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OPERATOR'S INSTRUCTION MANUAL

NARKOMED 3 ANESTHESIA SYSTEM

NARKOMED 3

OPERATOR'S INSTRUCTION MANUAL

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FOREWORD

OPERATOR'S RESPONSIBILITY FOR PATIENT SAFETY

North American Dräger anesthesia products are designed to provide the greatest degree of patient safety that is practically and technologically feasible. The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, to the specifics of the North American Dräger design. This publication excludes references to hazards which are obvious to a medical professional, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. North American Dräger disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of North American Dräger products with products supplied by other manufacturers if such a combination is not endorsed by North American Dräger.

The operator of the anesthesia system must recognize that the means of monitoring and discovering

hazardous conditions are specific to the composition of the system and the various components of the system. It is the operator, and not the various manufacturers or suppliers of components, who has control over the final composition and arrangement of the anesthesia system used in the operating room. Therefore, the responsibility for choosing the appropriate safety monitoring devices rests with the operator and user of the equipment.

Patient safety may be achieved through a wide variety of means depending on the institutional procedures, the preference of the operators, and the application of the system. These means range from electronic surveillance of equipment performance and patient condition to simple, direct contact between operator and patient (direct observation of clinical signs). The responsibility for the selection of the best level of patient monitoring belongs solely to the equipment operator. To this extent, the manufacturer, North American Dräger, disclaims responsibility for the adequacy of the monitoring package selected for use with the anesthesia system. However, North American Dräger is available for consultation to discuss safety monitoring options for different applications.

LIMITATION OF LIABILITY

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

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

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

WARRANTY

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

1. The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, or by modifications not authorized by North American Dräger or its representatives are not covered.
2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.
3. SPIROMED sensors, oxygen sensors, and the MINUTE VOLUMETER have a six-month limited warranty. O₂MED sensor capsules have an eight-month limited warranty from the date of delivery.
4. Warranty for Durasensors® is limited to a period of 6 months from date of delivery. Oxisensors™ are warranted to be free of defects at time of delivery.

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

Application of this warranty is subject to the following conditions:

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

In order to assure complete protection under this warranty, the Preventive Maintenance Form (if applicable) must be completed and returned to the North American Dräger Quality Assurance Department within ten (10) days of receipt of the equipment.

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

REPAIR & SERVICE

In case of malfunction of this device, contact your local North American Dräger authorized technical service center.

North American Dräger recommends that anesthesia machines be serviced at three month intervals. Yearly Preventive Maintenance contracts are available for most North American Dräger products. These agree-

ments are available from the North American Dräger Technical Service Department or from a North American Dräger Authorized Technical Service Center.

Repair of the NARKOMED 3 shall be performed only by a North American Dräger authorized technical service representative.

RESTRICTION

CAUTION: Federal law restricts this device to sale by or on the order of a physician.

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GENERAL DESCRIPTION

The NARKOMED 3 is a continuous flow anesthesia system capable of delivering up to four gases and three liquid anesthetic agents. The anesthesia machine includes an integral *time-cycled, volume preset* ventilator with *ascending* bellows.

The anesthesia machine's monitoring system integrates the functions of all electronic monitors and organizes information from these monitors on two display screens. The standard monitoring package includes an oxygen analyzer and breathing pressure monitor. Optional integral monitors are available for breathing volumes, carbon dioxide, noninvasive blood pressure, and oxygen saturation. In addition, the anesthesia machine itself monitors all key anesthesia system functions, i.e., oxygen supply pressure, O₂/N₂O flow ratio, backup battery status.

The monitoring system categorizes visual alarm messages into Warnings, Cautions, and Advisories, and presents them on a display screen. Audible alarms are organized into three distinct sound patterns and are delivered by a central audio annunciator. A second display screen can present real-time trace, bargraph, data, and trend displays.

The customer can choose an absorber system and/or a Bain circuit adapter. Three different scavenger systems are available, allowing the best match with the hospital's waste gas disposal system. An adjustable PEEP valve is available on the ventilator or in the breathing system (mounted on the absorber assembly).

GENERAL DESCRIPTION (continued)

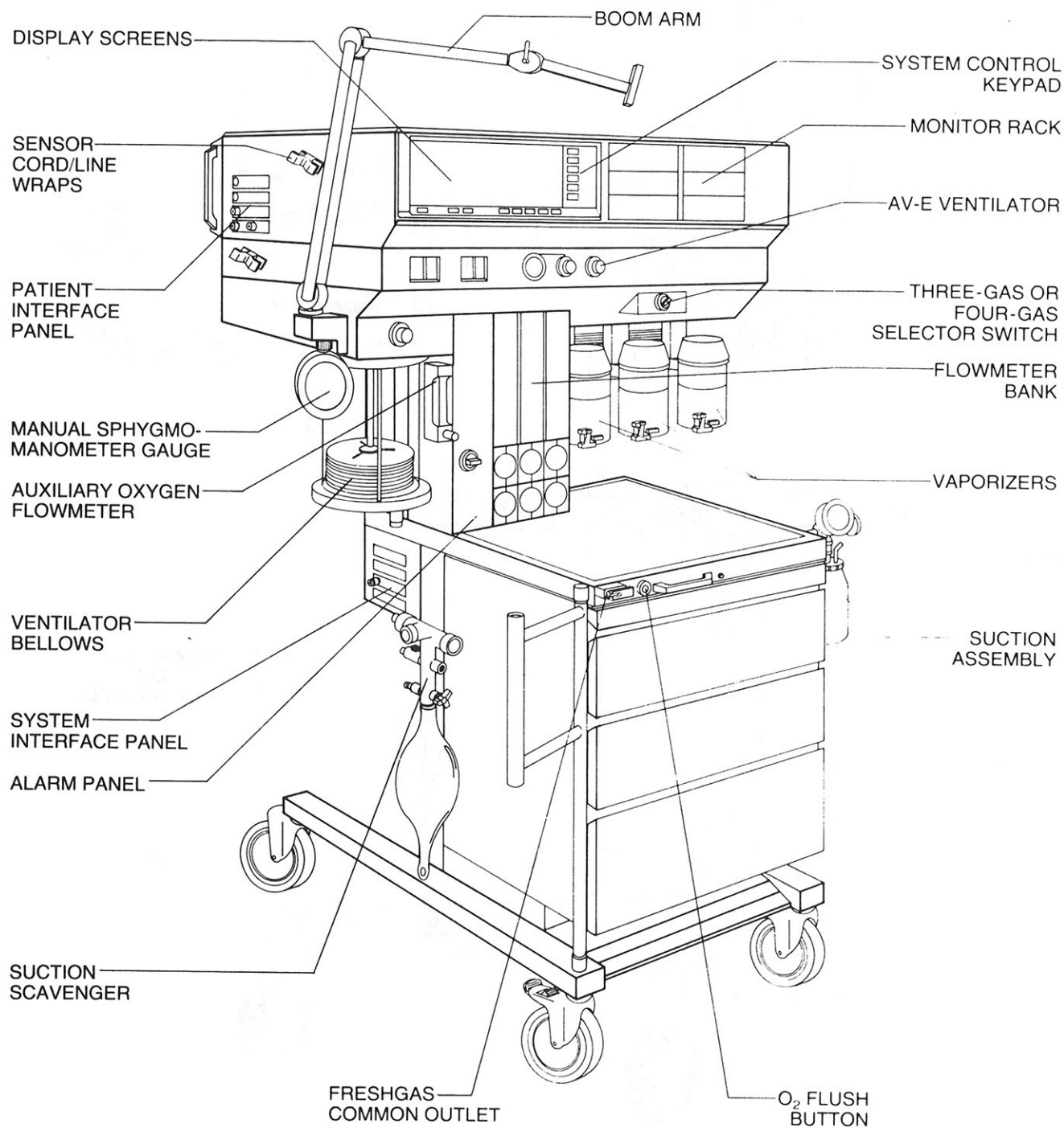


FIGURE 1: NARKOMED 3 WITH COMMON OPTIONS (FRONT VIEW)

GENERAL DESCRIPTION (continued)

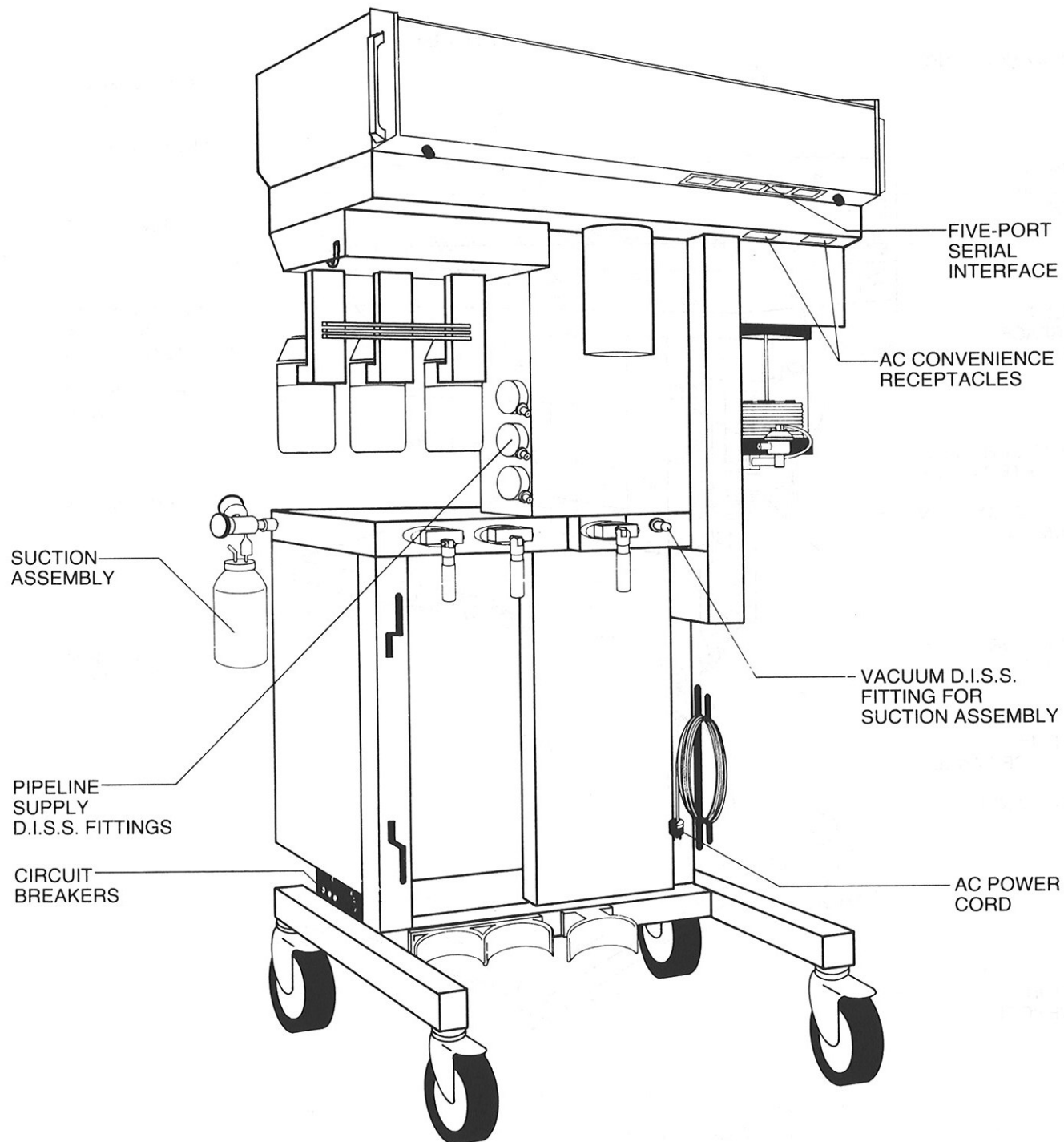


FIGURE 2: NARKOMED 3 WITH COMMON OPTIONS (REAR VIEW)

MOVING THE NARKOMED 3

When moving the NARKOMED 3, use only the handles shown in Figure 3. DO NOT pull the anesthesia machine by the Absorber System, Vaporizers, Ventilator Bellows, or Boom Arm.

The NARKOMED 3 is equipped with two locking casters on the front side of the machine. These casters may be unlocked by stepping on the lock mechanism on top of the caster. DO NOT attempt to move the anesthesia machine

while either of the casters are locked.

Take care when moving the anesthesia machine up or down ramps or over thresholds.

Remove any monitors or other equipment from the top shelf before moving the anesthesia machine.

Remove the Absorber System before moving the anesthesia machine.

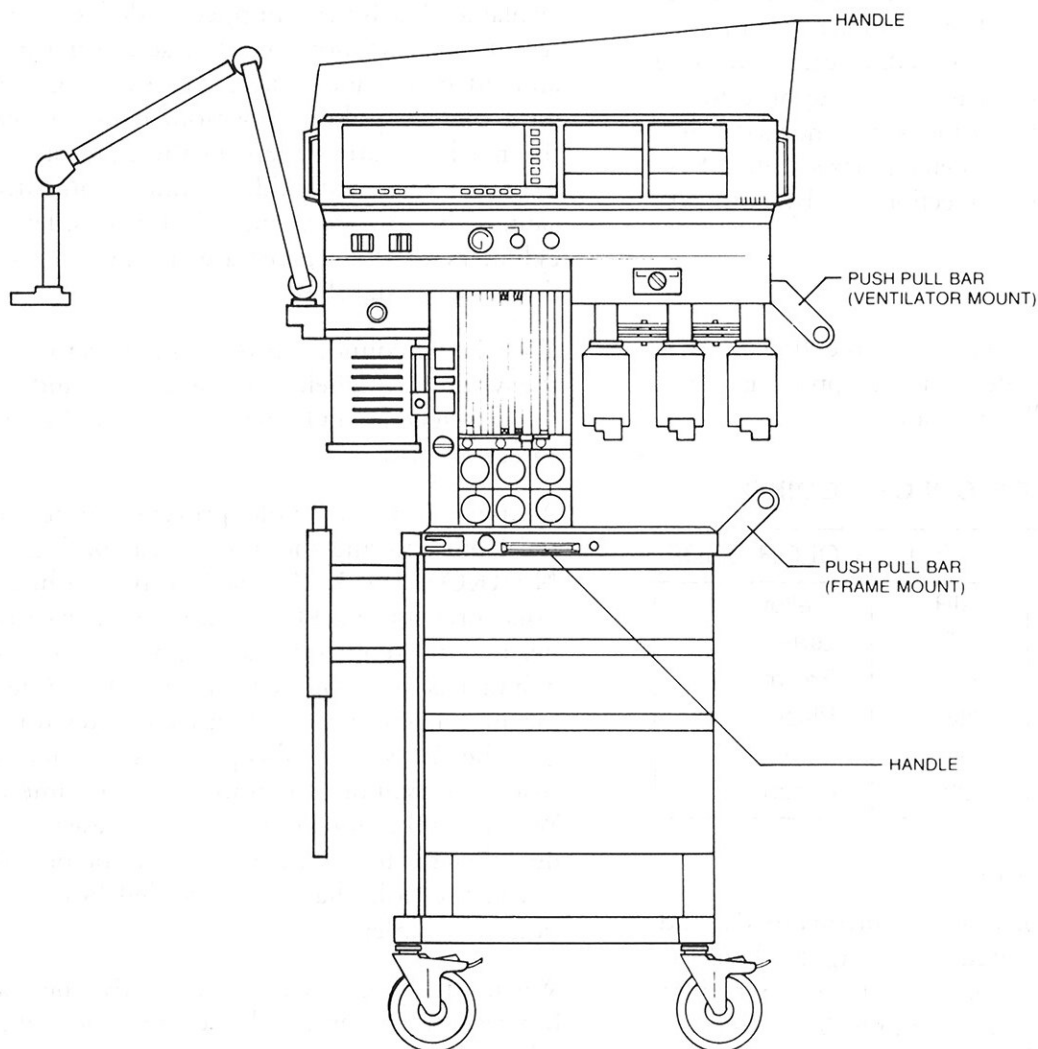


FIGURE 3: ACCEPTABLE HANDLES FOR TRANSPORT

GAS DELIVERY SYSTEM

Standard Gases

The NARKOMED 3 is equipped with pneumatic circuitry for the delivery of oxygen (O₂) and nitrous oxide (N₂O). It has at least one oxygen and one nitrous oxide yoke for reserve gas cylinders with flush-type valves. The Pin Index Safety System prevents connection of a cylinder of the incorrect type.

Optional Gases

In addition to oxygen and nitrous oxide, the NARKOMED 3 may be equipped with up to two additional gases. The additional gas may be air, helium (He), nitrogen (N₂), or carbon dioxide (CO₂). The additional gas may be supplied to the anesthesia system by means of pin-indexed cylinders and yokes, by Diameter Indexed Safety System (DISS) pipeline connections, or by both systems, if so selected.

Color Coding

Each connection, valve, gauge, and flowmeter is labeled and color-coded for the appropriate gas, as shown in the following table:

GAS SYSTEM COLOR CODING

GAS	LABEL	COLOR CODE
Air	AIR	Yellow
Carbon Dioxide	CO2	Gray
Helium	He	Brown
Nitrogen	N2	Black
Nitrous Oxide	N2O	Blue
Oxygen	O2	Green

Pipeline Connections

DISS gas fittings for oxygen, nitrous oxide, and air (optional) are located on the right side of the flowmeter housing (Fig. 2). The DISS fittings prevent misconnection of supply hoses and are of the male type. The inlets include check valves to prevent reverse flow leakage into the atmosphere when supply hoses are not connected, or

into the attached supply hoses when reserve cylinders are in use. Each pipeline connection is equipped with a replaceable filter to prevent foreign material from entering the internal gas piping of the NARKOMED 3. Pipeline gases should be supplied at 50–55 psi.

Gas Cylinder Yokes

The NARKOMED 3 can be equipped with a maximum of two oxygen and two nitrous oxide reserve cylinder hanger yokes (Fig. 4). An additional yoke for a third, optional gas is also available. Machines equipped to deliver four different gases do not have the additional oxygen and nitrous oxide yokes, and the single, standard oxygen yoke is positioned on the rear of the machine rather than on the right side (Fig. 5). Since carbon dioxide, helium, and nitrogen cannot be ordered with D.I.S.S. inlets, the cylinders of these gases are the primary rather than reserve supplies.

To prevent connection of an incorrect cylinder, the yokes are labeled, color-coded, and keyed for gas-specific cylinders using the Pin Index Safety System.

A filter within each yoke prevents foreign material from entering the internal gas piping of the NARKOMED 3. A check valve within each yoke prevents backflow into the reserve cylinder or leakage into the atmosphere if the reserve cylinder is not mounted on the yoke. When the machine is configured with two yokes for same gas, the check valve also prevents transfer of gas from one cylinder to another of the same type. When a yoke does not contain a reserve cylinder, the attached yoke plug should be placed between the yoke handle's threaded bolt and the yoke's gas inlet.

When attaching a cylinder, use only one washer between the reserve cylinder and the yoke gas inlet. The use of multiple washers may compromise the safety of the Pin Index Safety System. The integrity of both index pins should be

GAS DELIVERY SYSTEM (continued)

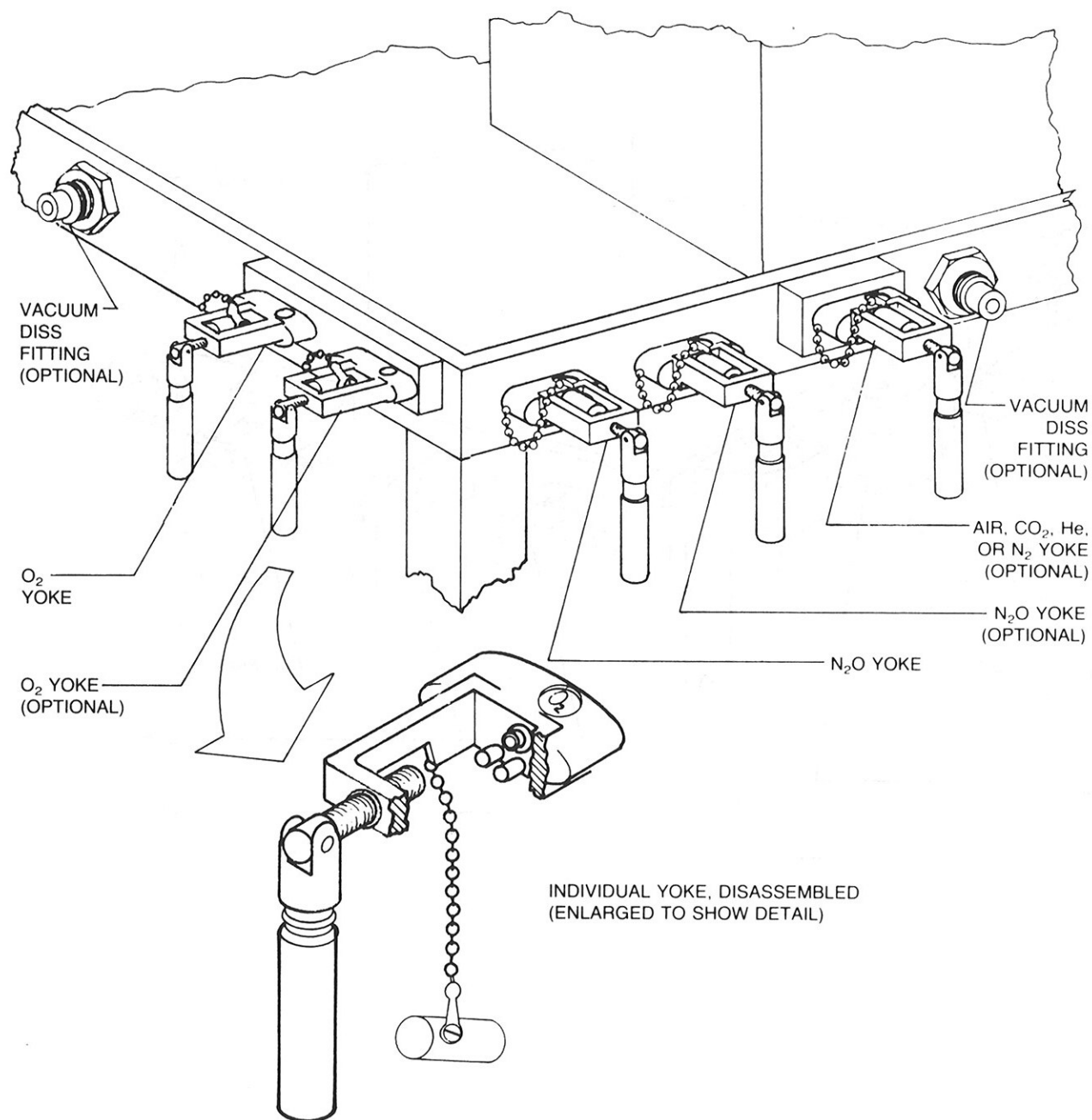


FIGURE 4: RESERVE GAS CYLINDER YOKES, THREE-GAS ARRANGEMENT (RIGHT, REAR VIEW)

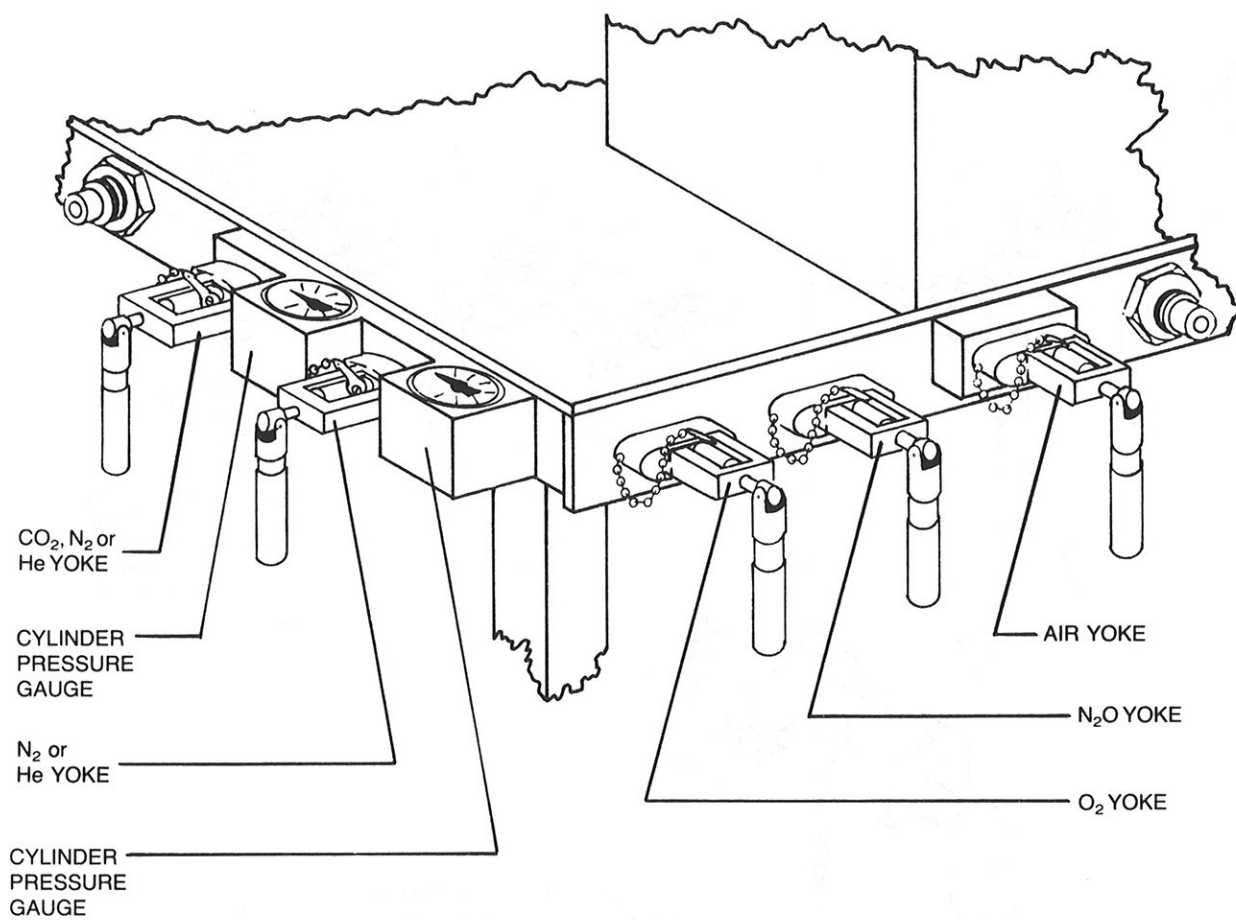


FIGURE 5: GAS CYLINDER YOKES, FOUR-GAS ARRANGEMENT (RIGHT, REAR VIEW)

GAS DELIVERY SYSTEM (continued)

verified whenever a new cylinder is installed. Reserve cylinders attached to the hanger yokes shall contain gas at the recommended pressures outlined below:

RECOMMENDED RESERVE CYLINDER MAXIMUM PRESSURES

GAS	MAX PSI
Air	2200
Carbon Dioxide	830
Helium	1650
Nitrogen	2200
Nitrous Oxide	745
Oxygen	2200

Pressure Regulators

Each reserve cylinder gas circuit incorporates a pressure regulator that controls the pressure at which gas can flow from the *reserve cylinders* rather than the *pipeline supply*. These regulators are adjusted to a delivery pressure of 47 ± 2 psi. (CO₂ regulators are adjusted lower to limit the maximum gas flow.) This pre-set delivery pressure of each regulator is purposely below the commonly used hospital pipeline pressure of 50 – 55 psi. Such settings ensure that gas will be supplied from the *pipeline* and not the cylinder *if both sources of supply are open*. Over-pressure relief valves, integral to the regulator, prevent excessive pressures in case of pressure regulator failure or excessive pipeline pressure.

Cylinder Pressure Gauges

Oxygen, nitrous oxide, and air circuits are each provided with a cylinder pressure gauge, located at the bottom of the flowmeter panel on the front of the machine (Figs. 6, 7, & 8). Each of these gauges is labeled and color-coded for its respective gas. Cylinder pressure gauges for the carbon dioxide, helium, and nitrogen supplies in the four-gas machines are mounted on the right side of the NARKOMED 3 (Fig. 5).

When a cylinder valve is open, the respective cylinder pressure gauge indicates the gas pressure in the cylinder. The dial is labeled with concentric scales in psi and kPa. (Only the outer psi scale is shown in Figures 6, 7, & 8.) For non-liquified gases (O₂, air, N₂, He) the indicated pressure is proportional to the gas content of the cylinder. For liquified gases (N₂O, CO₂) the gauge indicates the vapor pressure of the liquified gas in the cylinder. This pressure remains constant until all of the liquid in the cylinder has vaporized. At this stage, the cylinder pressure decreases proportionally with further removal of gas from the cylinder.

When two reserve cylinders of the same gas are open at the same time, the cylinder pressure gauge will indicate the pressure in the cylinder having the higher pressure.

Pipeline Pressure Gauges

Pipeline pressure gauges for oxygen and nitrous oxide are standard (Figs. 6, 7, & 8). If the anesthesia machine is equipped with a D.I.S.S. inlet for air, a pipeline pressure gauge for air is also included.

These gauges are located directly below their corresponding flowmeters and flow control valves, and are labeled and color-coded for their respective gases. Concentric scales in psi and kPa indicate the delivered pipeline supply pressure. (Only the outer psi scale is shown in Figures 6, 7, & 8.) When the machine is connected to a functioning pipeline supply, each gauge should indicate 50 – 55 psi. A deviation from within this range indicates an improperly adjusted pipeline gas supply system and may adversely affect the operation of the NARKOMED 3. A fluctuating pipeline supply pressure, for example, would cause a corresponding fluctuation of the delivered flow of that gas. Also, an excessively low pipeline pressure may activate the corresponding reserve cylinder and deplete its contents (if the reserve cylinder valve is left in the open position).

GAS DELIVERY SYSTEM (continued)

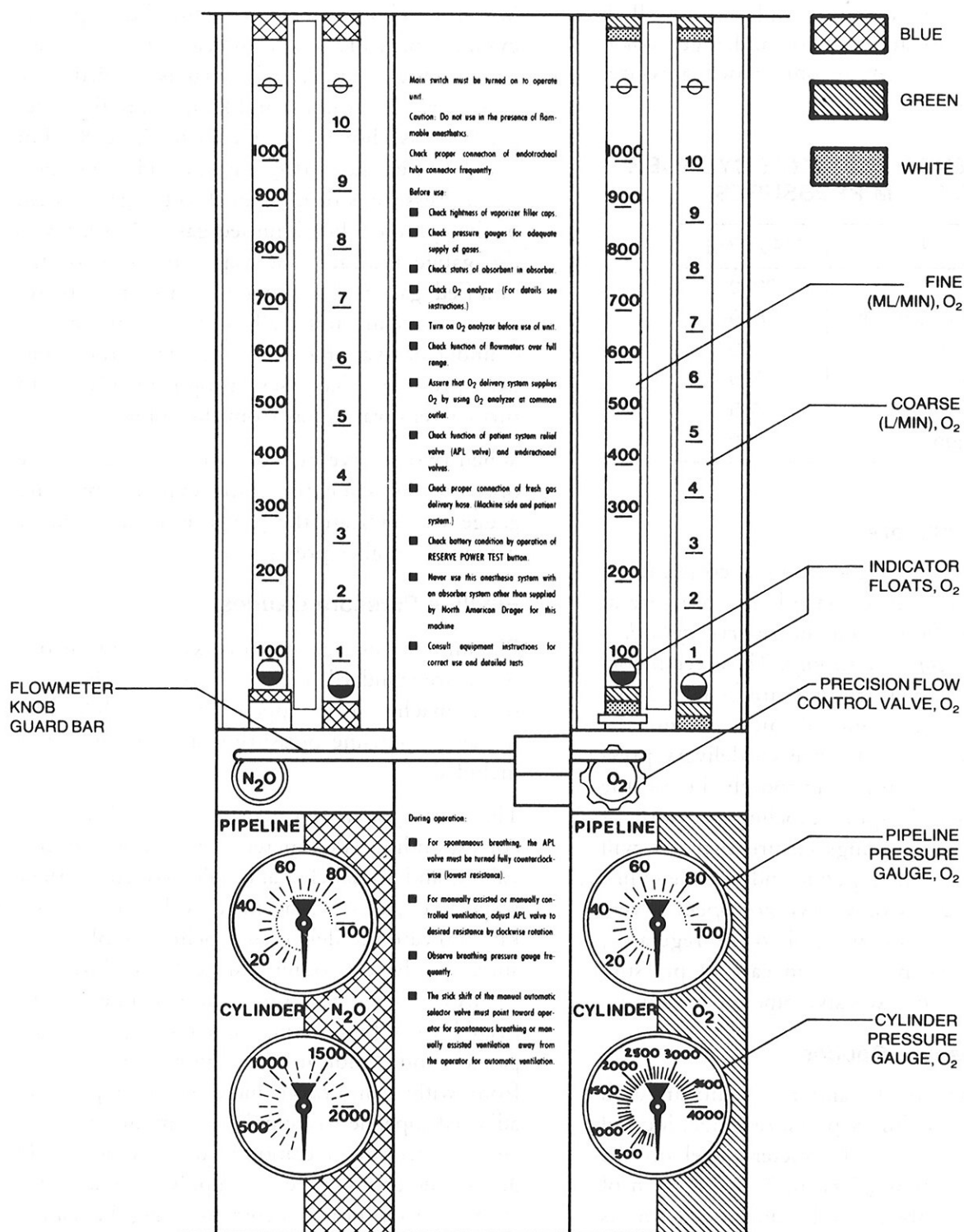
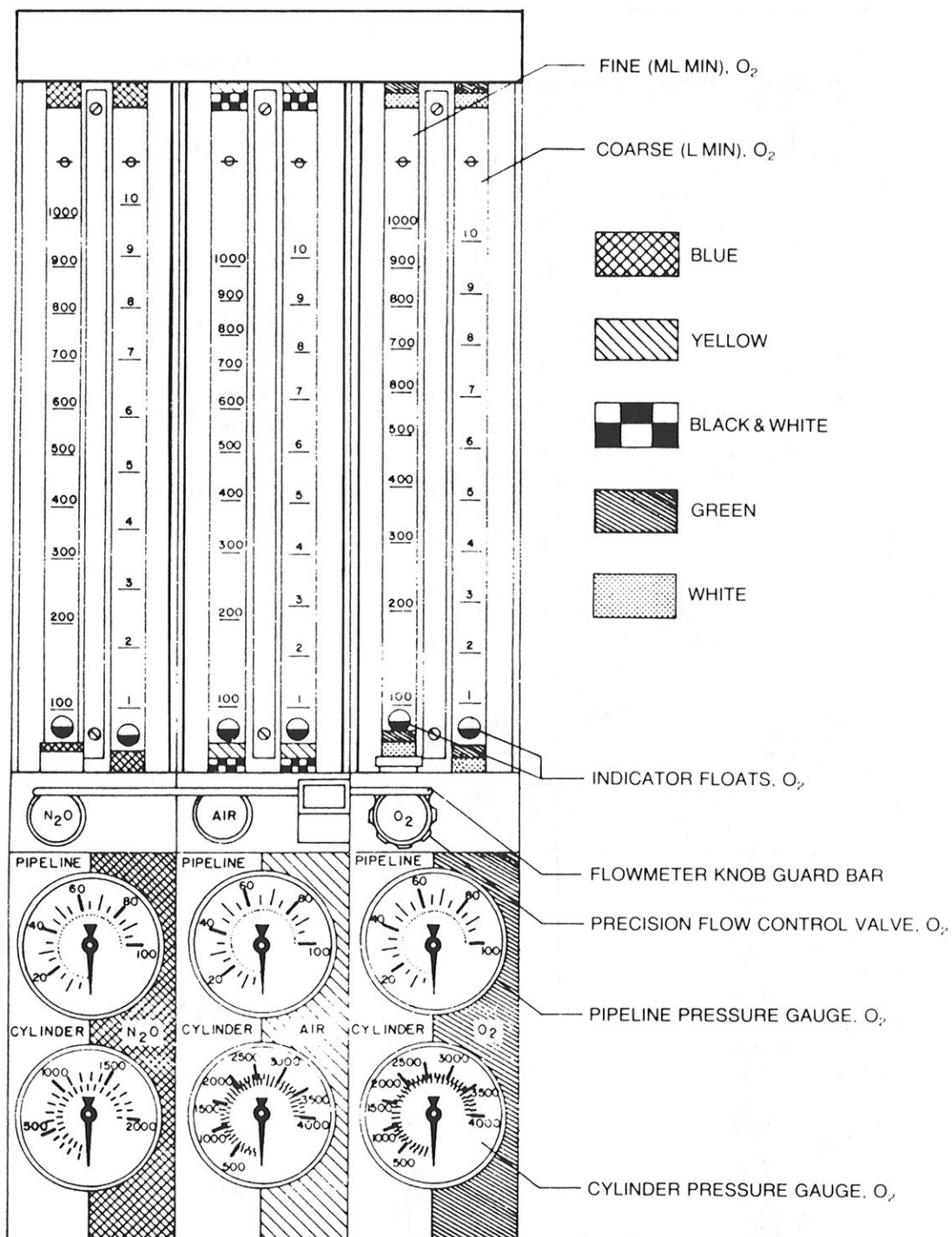


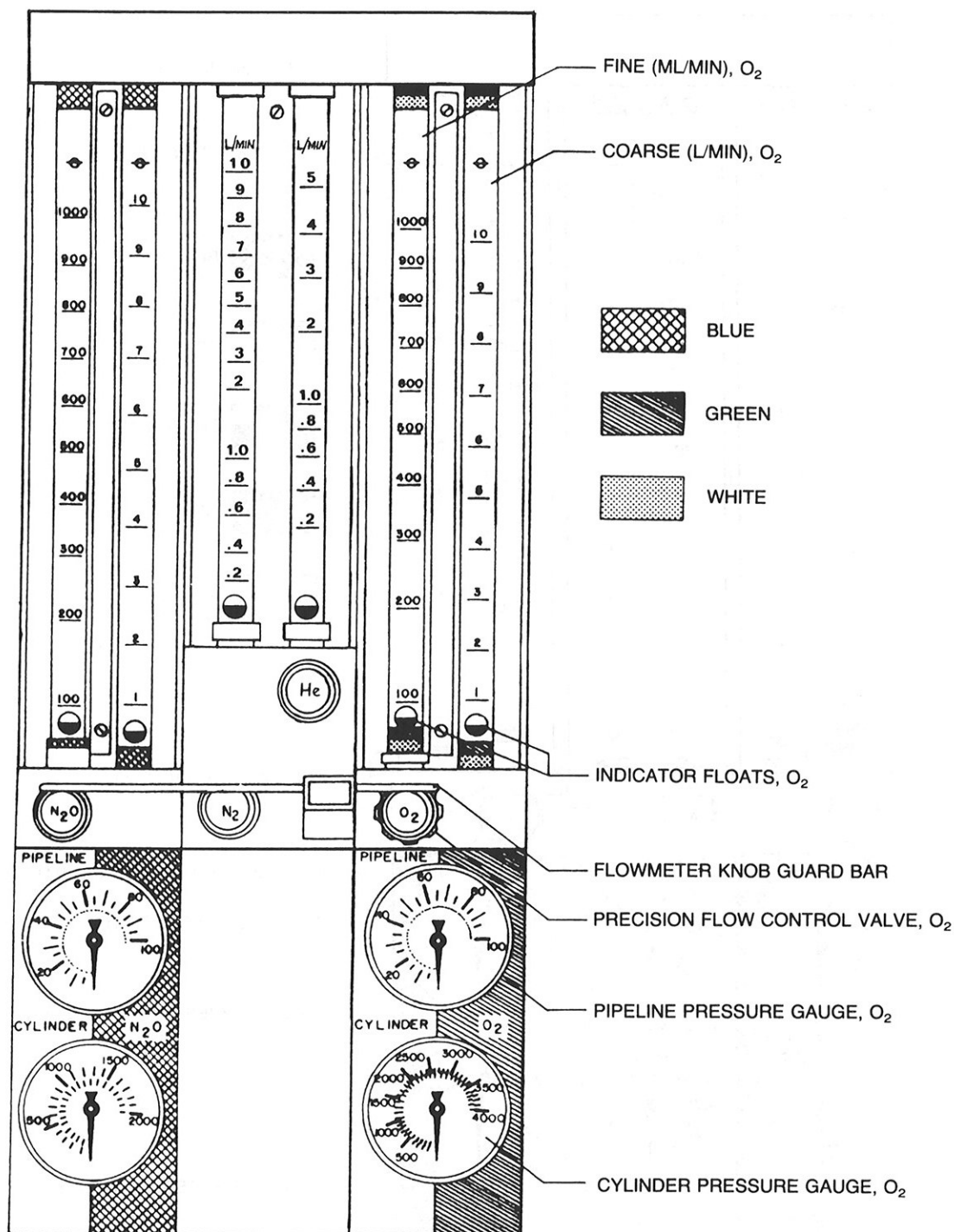
FIGURE 6: STANDARD FLOWMETER BANK

GAS DELIVERY SYSTEM (continued)



**FIGURE 7: THREE-GAS FLOWMETER BANK
(AIR OPTION)**

GAS DELIVERY SYSTEM (continued)



**FIGURE 8: FOUR-GAS FLOWMETER BANK
(NITROGEN & HELIUM OPTION)**

GAS DELIVERY SYSTEM (continued)

Since carbon dioxide, helium, and nitrogen can only be supplied from reserve cylinders on the NARKOMED 3, these gases do not require pipeline pressure gauges.

Oxygen Supply Pressure Failure Protection Device (OFPD)

To minimize hazards to the patient during oxygen supply pressure failure, all NARKOMED 3 gas circuits, with the exception of oxygen, are provided with an oxygen pressure failure protection device (OFPD). The OFPD consists of pneumatically operated valves located in the anesthesia machine's internal supply lines for each gas except oxygen. These valves are controlled by the pressure of gas in the oxygen supply line. Proper oxygen pressure keeps the valves open but a failure or reduction of pressure in the oxygen supply line will proportionally reduce and eventually shut off the supply of all other gases.

As an indication of the OFPD actuation, the floats in the flowmeters will indicate a reduced flow and eventually drop to zero. When the oxygen supply pressure (supplied from both pipeline and reserve cylinders) drops below 30 psi, a "LO O2 SUPPLY" alarm message appears on the central alarm display, the "O2 SUPPLY PRESSURE" indicator on the alarm panel lights continuously red, and an intermittent audible alarm sounds.

Flow Control Valves

The flow of each gas can be adjusted with a precision needle valve. These valves are located below the low range flowmeter tube for the specific gas that it controls (Figs. 6, 7, & 8). Counterclockwise rotation of the valve knob *increases* flow and clockwise rotation of the valve knob *decreases* flow. The flow control valves are capable of adjusting the gas flow within the *full* range of its flowmeter (or flowmeters) *only* when the supply pressures are within specified limits.

Unless specifically modified to eliminate the minimum oxygen flow feature (see "Minimum Oxygen Flow" below), the flow of oxygen cannot be totally shut off with its flow control valve. DO NOT force the oxygen flow control knob over its end stop in an effort to shut off the flow. Forcing the knob could damage the delicate valve seat.

To prevent damage to the flow control valve seats, the valves incorporate a zero stop. If necessary, an authorized service representative of North American Dräger can readjust the stop.

Each flow control knob is identified by its color code and chemical symbol. In addition, the oxygen flow control valve is touch-coded with a deeply fluted knob.

GAS DELIVERY SYSTEM (continued)

Flowmeters

Rotameter type flowmeters, located immediately above their corresponding flow control valves (Figs. 6, 7, & 8), display the flowrate of each gas delivered to the freshgas mixture. Dual (fine and coarse) flowmeter tubes are used in tandem for oxygen, nitrous oxide, and air (if provided). Single flowmeter tubes are used for any other gas.

Each flowtube has its scale etched and printed directly on the glass tubing. Oxygen, nitrous oxide, and air flowmeters are certified to be within $\pm 3\%$ of full scale at 20 degrees C and 760 mm HG. Single flowtubes are certified to be within $\pm 5\%$ of full scale. Flowmeter ranges and accuracies are outlined in the following table:

STANDARD FLOWMETERS

GAS	TUBE	RANGE (L/min)	ACCURACY (%Full Scale)
O ₂	Fine	0 – 1	± 3
O ₂	Coarse	1 – 10	± 3
N ₂ O	Fine	0 – 1	± 3
N ₂ O	Coarse	1 – 10	± 3
Air	Fine	0 – 1	± 3
Air	Coarse	1 – 10	± 3
N ₂	--	0 – 10	± 5
He	--	0 – 5	± 5
CO ₂	--	0 – 0.5	± 5

Oxygen, nitrous oxide and air flowmeters are equipped with floats, half chrome-plated and half colored red, to indicate free movement through rotation. Single tube flowmeters are equipped with stainless steel or black glass floats.

Regardless of the float type, the position of the center of the ball along the flowmeter scale should be used as an indication of the flowrate. All flowmeters are labeled and color coded with colored bands at each end of the flowtube.

Optional Low-Flow Flowmeters

For low-flow anesthesia, the NARKOMED 3 can be configured with low-flow, dual-tube flowmeters for oxygen and nitrous oxide. These flowmeters function in the same manner as the standard dual-tube flowmeters but are calibrated to provide greater resolution at the flows typically used for low-flow anesthesia. Ranges and accuracies for low-flow flowmeters are outlined in the following table:

LOW-FLOW FLOWMETERS

GAS	TUBE	RANGE (L/min)	ACCURACY (%Full Scale)
O ₂	Fine	0 – 500 mL/min	± 2.5
O ₂	Coarse	0.6 – 10 L/min	$\pm 2.5 @ > 1$ L/min $\pm 15 @ < 1$ L/min
N ₂ O	Fine	0 – 500 mL/min	± 2.5
N ₂ O	Coarse	0.6 – 10 L/min	$\pm 2.5 @ > 1$ L/min $\pm 15 @ < 1$ L/min

Optional Dual-Taper Flowmeters

For users who prefer to meter the flow of oxygen and nitrous oxide with only one flowtube, the NARKOMED 3 is available with single ("dual-taper") flowtubes for oxygen and nitrous oxide. These single-tube flowmeters are calibrated from 0 to 10 L/min at an accuracy of $\pm 5\%$ of full scale.

Optional Auxiliary Oxygen Flowmeter

For the delivery of a metered flow of pure oxygen (such as for the delivery of oxygen through a nasal cannula), the optional Auxiliary Oxygen Flowmeter can be mounted on the left-hand side of the flowmeter bank. It is calibrated from 0 to 10 L/min at an accuracy of $\pm 5\%$ of full scale. If adequate oxygen supply pressure is available (from either pipeline or reserve cylinders), oxygen is available at this flowmeter's flow control valve, regardless of the NARKOMED 3 System Power switch position.

NOTE: Since, the flow control valve for the Auxiliary Oxygen Flowmeter does not incorporate a zero stop, take care not to overtighten the valve control knob.

Minimum Oxygen Flow

The oxygen dispensing system incorporates a calibrated bypass flow of 150 ± 25 mL/min (at 50 psi pipeline pressure), thereby ensuring the delivery of some oxygen whenever the oxygen flow control valve might be fully closed.

If required for low-flow anesthesia, the NARKOMED 3 can be optionally modified to eliminate the minimum oxygen flow feature. A label above the oxygen flowmeter tells the operator that the anesthesia machine incorporates this feature. Also, this option slightly changes the performance of the Oxygen Ratio Monitor/Controller (see below).

On machines equipped to deliver air to the freshgas, the minimum oxygen flow is automat-

ically disabled (through the additional gas selector switch) whenever air is selected as an additional gas.

Oxygen Ratio Monitor/Controller (ORMC)

The ORMC is a pneumatic O_2/N_2O interlock system designed to maintain a freshgas oxygen concentration of at least $25 \pm 3\%$. It permits independent control of the oxygen and nitrous oxide flows but, by proportionally limiting the nitrous oxide flow, prevents a flow ratio that could result in a hypoxic freshgas mixture.

The ORMC works by limiting the nitrous oxide flow whenever the operator selects oxygen and nitrous oxide flow control valve settings that would result in a hypoxic freshgas mixture. For example, if the operator opens the nitrous oxide flow control valve excessively without making a corresponding increase in the oxygen flow control valve setting, the flow of nitrous oxide will not increase, *even though its flow control valve setting has been greatly increased*. Similarly, if the operator decreases the oxygen flow without also decreasing the nitrous oxide flow, the nitrous oxide flow will automatically drop in proportion to the drop in oxygen flow.

Whenever the ORMC is actively limiting the nitrous oxide flow to prevent a hypoxic freshgas mixture, an "O2/N2O LOW" alarm message appears on the central alarm display, the "O2/N2O FLOW RATIO" LED indicator on the alarm panel lights continuously yellow, and a single tone audible alarm sounds. Therefore, this alarm means that the nitrous oxide flow is being automatically limited due to incorrect oxygen and nitrous oxide flow control valve settings. It *does not* mean that the O_2/N_2O flow ratio has caused a hypoxic mixture.

Due to rebreathing of previously exhaled gas in a circle system, lower freshgas flows require a higher oxygen concentration to maintain a sufficient inspiratory oxygen concentration. To address this problem, the ORMC has been designed to maintain higher levels of

GAS DELIVERY SYSTEM (continued)

oxygen in the freshgas at lower flow rates. Figure 9 illustrates the ORMC's response curve. Note that, at lower freshgas flow rates, the ORMC maintains freshgas oxygen concentrations *well above* 25% of the combined oxygen and nitrous oxide flow.

It should be noted that the ORMC interlocks only the flows of oxygen and nitrous oxide. Hypoxic freshgas concentrations are possible if an additional gas other than air is used.

In the following instances, the anesthesia machine automatically disables ORMC audible and visual alarms (as indicated by the Advisory message "ORM ALRM OFF" on the central alarm display):

If the NARKOMED 3 is equipped with an additional gas circuit controlled by the additional gas selector switch (i.e., all additional gas options except carbon dioxide as a third gas) and the selector switch is placed in the "ALL GASES" position, the ORMC audible and visual alarms are automatically disabled.

The ORMC audible and visual alarms are automatically disabled at nitrous oxide flows below 150 ± 50 mL/min.

NOTES:

Although ORMC audible and visual alarms are automatically disabled in the above two instances, the ORMC continues to control the ratio of oxygen to nitrous oxide flow, *regardless of the alarm status*.

If the anesthesia machine has been optionally configured to eliminate the minimum oxygen flow feature, ORMC audible and visual alarms are automatically disabled at nitrous oxide flows below 750 ± 75 mL/min rather than the 150 ± 50 mL/min limit used for standard machines.

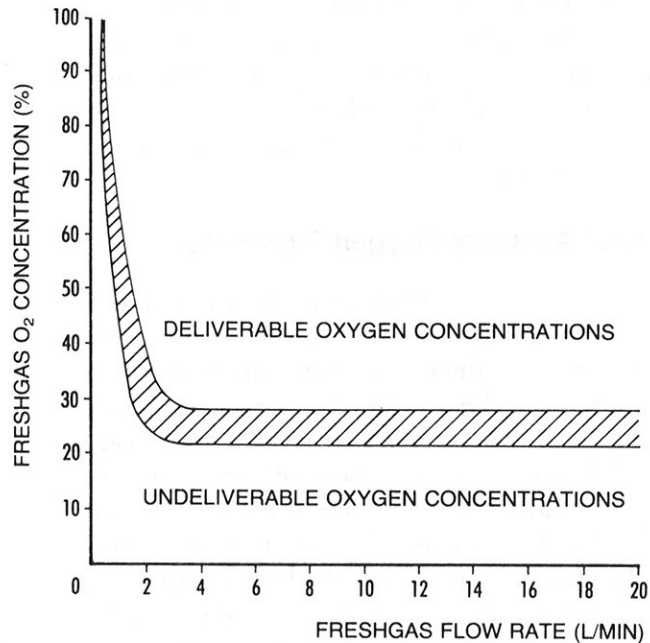


FIGURE 9: ORMC RESPONSE

Gas Selector Switch — Three-gas Feature (Optional)

The N₂O/third-gas selector switch is a valve mechanism allowing the operator to select either a freshgas mixture of *nitrous oxide and oxygen* or a freshgas mixture of *oxygen, nitrous oxide, and an additional gas (air, helium, nitrogen)*.

Carbon dioxide is also available as an optional third gas, but the third-gas selector switch does not control carbon dioxide. Rather, machines equipped with carbon dioxide as an optional third gas have no selector switch and carbon dioxide is always available at its flow control valve.

GAS DELIVERY SYSTEM (continued)

Setting the third-gas selector switch in the "ALL GASES" (right) position automatically disables the ORMC audible and visual alarms. In machines equipped to deliver air as a third gas, the right-hand position also disables the minimum O₂ flow. In machines equipped to deliver helium or nitrogen as a third gas, selection of the right-hand position disables the ORMC audible and visual alarms, but leaves the minimum O₂ flow functional. Moving the third-gas selector switch to the "O₂ & N₂O" (left) position restores the ORMC alarms and the minimum O₂ flow.

Gas Selector Switch — Four-gas Feature (Optional)

In NARKOMED 3 machines equipped to deliver four gases, the "O₂ & N₂O" (left) position of the gas selector switch permits oxygen and nitrous oxide flows to the appropriate flowmeter controls. This position also enables the ORMC audible and visual alarms and (in machines equipped to deliver air) enables the minimum oxygen flow.

The "ALL GASES" (right) position of the gas selector switch in four-gas machines permits two additional gases to flow to their respective flowmeter controls, thus allowing a mixture of all four gases. The following combinations for the two additional gases are available:

- Air & Carbon Dioxide
- Air & Helium
- Helium & Carbon Dioxide
- Carbon Dioxide & Nitrogen
- Nitrogen & Helium

Positioning the gas selector switch to the right permits flow of all gases to the flowmeters, disables the ORMC audible and visual alarms, and, in machines equipped to deliver air, shuts off the minimum O₂ flow feature.

NOTE: Carbon dioxide availability in four-gas machines is controlled by the four-gas selector switch.

Vaporizers (Optional)

The NARKOMED 3 can be equipped with up to three Vapor 19.1 vaporizers for the administration of liquid anesthetics. The vaporizers (Figs. 10 & 11) are located to the right of the flowmeter bank.

Vaporizers may be equipped with either an open-funnel filler or a pin-indexed filler.

A calibrated concentration of vaporized anesthetic is produced by adjusting the top-mounted handwheel of the selected vaporizer to the desired concentration indicated on the dial. Clockwise rotation *decreases* the anesthetic concentration and counterclockwise rotation *increases* the concentration. A cam and lever exclusion system, incorporated into the vaporizer bank, prevents more than one vaporizer from being activated and requires all unused vaporizers to be locked in their zero positions.

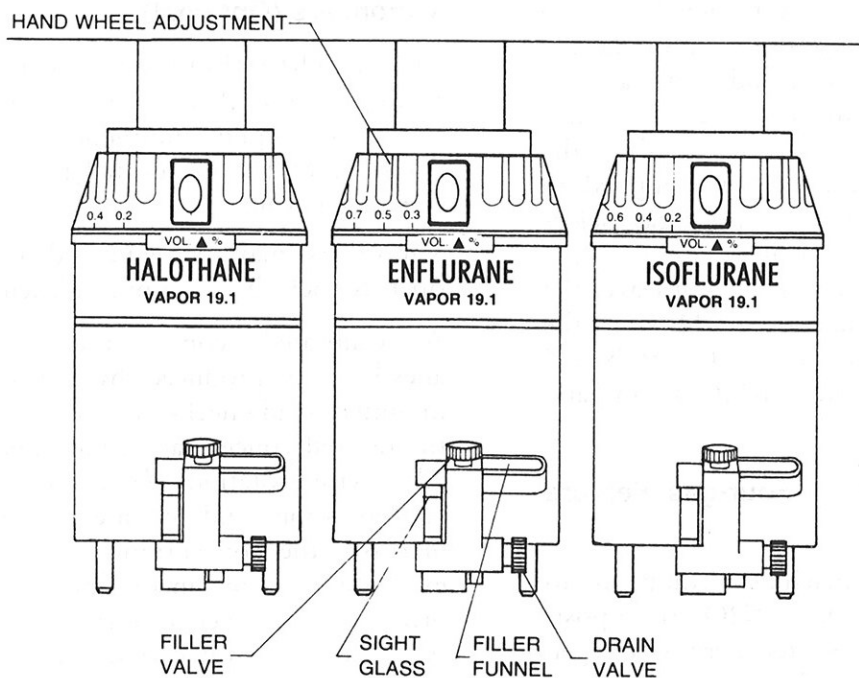
Detailed operating instructions for the vaporizers can be found in a separate manual supplied with the vaporizer.

NOTE: Only one vaporizer shall be activated at a time. If the exclusion system permits simultaneous activation of more than one vaporizer, **DO NOT** use the anesthesia machine and contact an authorized NAD service representative for repairs.

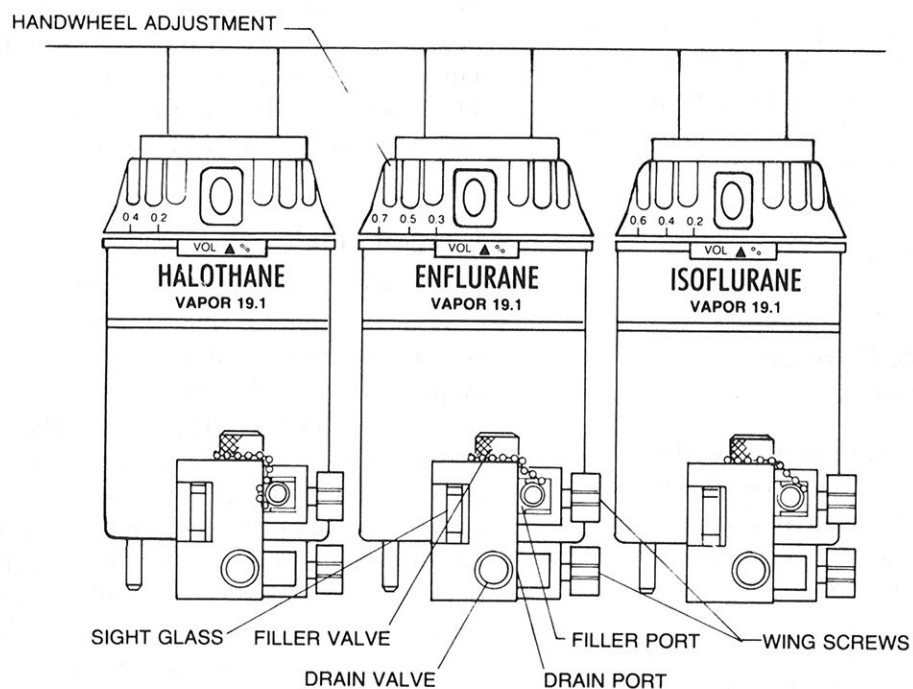
Oxygen Flush

A manually operated oxygen flush valve (Figs. 1 & 12) of self-closing construction is located on the left front corner of the machine's frame. A protective bezel surrounds the pushbutton to minimize accidental engagement. The valve, if actuated, delivers an unmetered oxygen flow of approximately 55 L/min directly to the freshgas common outlet of the machine. The internal connection of the freshgas line and oxygen flush line is designed to prevent the build-up of excessive pressure (within certain limits of downstream resistance) when flush is actuated. The oxygen flush may be operated *without* the System Power switch being in the "ON" position.

GAS DELIVERY SYSTEM (continued)



**FIGURE 10: VAPORIZERS
(WITH STANDARD FILLER/DRAIN MECHANISMS)**



**FIGURE 11: VAPORIZERS
(WITH OPTIONAL PIN-INDEXED FILLER/DRAIN MECHANISMS)**

GAS DELIVERY SYSTEM (continued)

Freshgas Common Outlet

The freshgas common outlet (Figs. 1 & 12) delivers the freshgas mixture (consisting of oxygen, nitrous oxide, optional gases, and vapors of a liquid anesthetic) to the patient breathing system. It is located to the left of the O₂ flush button on the front of the anesthesia machine. The outlet's 15 mm cylindrical female fitting is designed to accept a 15 mm male fitting on the freshgas hose, which is permanently attached to the absorber inspiratory pipe. A spring-loaded safety locking device (Fig. 12) prevents inadvertent disconnection of the freshgas hose. The 15 mm male fitting on the freshgas hose is of a specific North American Dräger design and shall not be replaced by that of any other manufacturer.

Vacuum (Optional)

The NARKOMED 3 can be configured with internal vacuum piping for a suction drainage assembly (Fig. 2). A DISS vacuum fitting on the rear of the machine (Fig. 4) connects to a wall vacuum outlet. The suction drainage assembly mounts on a DISS fitting on the machine's right front corner.

The suction drainage assembly consists of a 700 cc clear glass bottle, vacuum on/off valve, vacuum control knob, and vacuum gauge. A ball float at the top of the bottle's inlet pipe automatically prevents overfill. Consult the operating instructions supplied with this device before use.

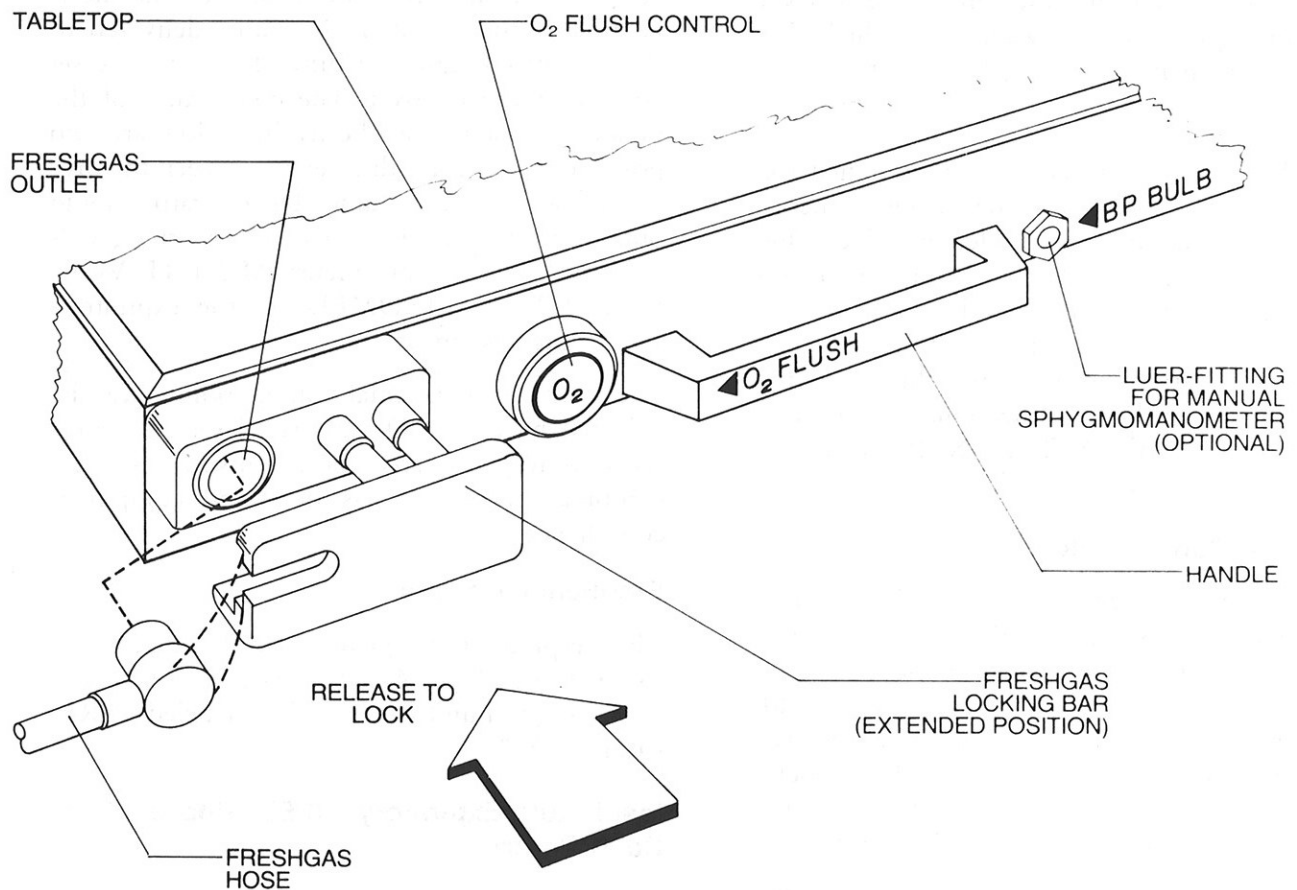


FIGURE 12: O₂ FLUSH CONTROL & FRESHGAS COMMON OUTLET

AV-E ANESTHESIA VENTILATOR

The Drager AV-E Anesthesia Ventilator (Fig. 13) is a *volume pre-set, time-cycled* ventilator that features solid state timing, pneumatic circuitry, and independent controls.

The pneumatic power to drive the ventilator may be supplied through the pipeline supply or, if the pipeline supply fails or is disconnected, through reserve cylinders. The pressure of the driving gas must be between 40 and 60 psi. The ventilator will cease to function if this pressure drops below 28 psi.

The AV-E ventilator can be used in conjunction with the standard BAROMED breathing pressure monitor. The BAROMED's real-time breathing pressure waveform proves especially useful for adjusting AV-E settings. The optional SPIROMED electronic respirometer provides a real-time expiratory flow waveform, which also aids in adjustment of the AV-E ventilator.

NOTE:

The AV-E anesthesia ventilator is designed for use with NAD absorber systems, which incorporate a manual/automatic selector valve. This valve allows the operator to bring either the breathing bag and pop-off valve, for manual ventilation, or the ventilator bellows, for automatic ventilation, into the breathing system. Breathing system hose connections to this valve are described in the SET-UP & INSTALLATION section of this manual.

Ventilator Power Switch

The ventilator power switch controls electrical and pneumatic power to the AV-E. In the "OFF" (i.e., 9 o'clock) position the ventilator is not operable and the Advisory message "VENT OFF" appears on the anesthesia machine's central alarm display. In the "ON" (i.e., 12 o'clock) position, the ventilator is activated and cycles according to the settings of the other controls.

The ventilator power switch also automatically enables the SPIROMED respiratory volume monitor's volume-related alarms and the

BAROMED breathing pressure monitor's apnea pressure alarm. For further details, consult the operator's instruction manual for these monitors.

Tidal Volume Adjustment

The tidal volume may be adjusted between 50 and 1500 mL with a self locking knob (push to turn) located above the bellows assembly. A pointer attached to the bellows stop indicates the tidal volume on a scale (labeled 200 to 1400 mL) on the bellows chamber.

Smaller tidal volumes can be adjusted by setting the pointer below the 200 mL marking on the bellows chamber. Larger tidal volumes can be selected by choosing settings above the 1400 mL marking. As in any volume pre-set anesthesia ventilator, the actual tidal volume delivered to the patient's lungs may differ from the pre-set volume at the bellows. The compliance of the breathing system and the freshgas flow are two possible causes for a difference between the pre-set and actual tidal volume. The operator should obtain an exact measurement of breathing volume by using a respirometer (MINUTE VOLUMETER or SPIROMED) in the expiratory side of the system.

The position of the tidal volume pointer can be adjusted by an NAD authorized service representative to give correct indications for a specific combination of freshgas flow and equipment compliance.

Frequency Control

The respiratory frequency can be preset between 1 and 99 BPM in 1 BPM increments with a two-digit thumbwheel switch labeled "FREQUENCY."

Inspiratory/Expiratory (I:E) Phase Time Ratio Control

The operator can vary the inspiratory/expiratory phase time ratio in calibrated steps from 1:1 through 1:4.5. Calibrations at each 0.5

AV-E ANESTHESIA VENTILATOR (continued)

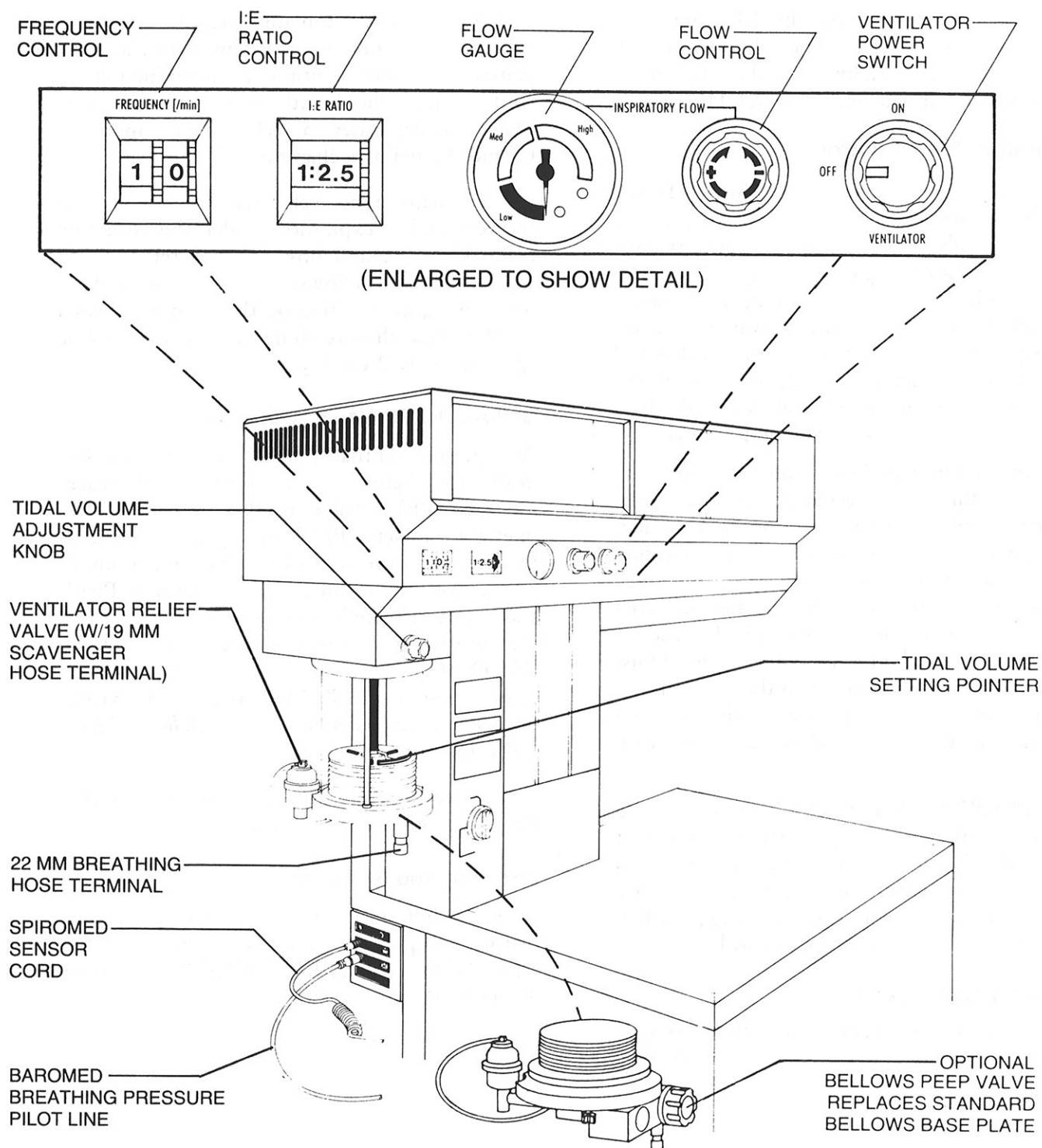


FIGURE 13: AV-E VENTILATOR

increment are marked on the I:E controller-indicator thumbwheel. The thumbwheel is located to the right of the frequency thumbwheel and is labeled "I:E RATIO."

Inspiratory Flow Control

The rotary knob labeled "INSPIRATORY FLOW" controls the flow rate of gas into the bellows chamber, and thus the inspiratory flow rate of gas into the patient's lungs. However, due to such variables as total lung compliance, equipment compliance, and airway resistance, the inspiratory flow control cannot be calibrated with numerical values. Instead, the gauge to the left of the control knob is labeled with three zones, "LOW," "MEDIUM," and "HIGH."

The flow setting should be adjusted so that the bellows is fully compressed at the end of the inspiratory phase. However, too high a flow setting will collapse the already compressed bellows at the end of the inspiratory phase. Such bellows deformation can increase the delivered tidal volume by as much as 100 mL. In order to deliver the desired preset tidal volume, adjust the inspiratory flow control so that the bellows corrugations make contact with each other and do not deform at the end of the inspiratory phase.

The "INSPIRATORY FLOW" control setting also affects the peak inspiratory pressure that can be developed within the patient breathing system. **Always** check the pressure indicated by the breathing system pressure gauge when adjusting the inspiratory flow control.

Ventilator Relief Valve

During automatic ventilation, the manual/automatic selector valve isolates the absorber

system's APL (automatic pressure limiting) valve from the breathing system. Thus, to compensate for the continuous introduction of freshgas into the breathing system, the ventilator incorporates a relief valve mounted behind the bellows chamber.

The ventilator relief valve remains closed until the very end of expiration so that the ascending bellows can expand upwards and refill. As in any ascending bellows, the force needed to overcome gravity acting on the bellows causes a PEEP within the breathing system, in this case approximately 2 cm H₂O.

Bellows PEEP Valve (Optional)

An optional ventilator PEEP valve mounts beneath the bellows. (An optional absorber-mounted PEEP valve is also available.) The operator can set a PEEP of approximately 2 to 18 cm H₂O with the PEEP valve control knob. Clockwise rotation of the knob *increases* PEEP and counterclockwise rotation *decreases* PEEP. The breathing system pressure gauge and the BAROMED breathing pressure monitor indicate the amount of PEEP at the end of exhalation. For further details, see the *Bellows PEEP Valve Instruction Manual*.

Before use, perform Step 29-B of this manual's Pre-Use Checkout Procedure.

Cleaning and Sterilization

Cleaning and sterilization instructions for ventilator components can be found in the CLEANING & STERILIZATION section of this manual.

POWER SUPPLY SYSTEM

Power Supply

The NARKOMED 3 is equipped with a central power supply for the ventilator, alarm system, and integrated monitors. The power supply takes the wall outlet's 117 volt AC (60 Hz) current and transforms it to direct current for output to various machine functions. The power of each monitor is individually regulated to prevent voltage fluctuations in one monitor from influencing the performance of the other monitors.

NOTE:

The NARKOMED 3 shall always be plugged into an active 117 volt AC outlet when in use.

Line Cord

A fifteen foot cable with a standard 3-prong hospital-grade plug supplies the 117 VAC power required by the NARKOMED 3. The allowable input voltage is $117 \pm 10\%$ VAC at 60 Hz. Excess cable length may be stored on the cord wrap on the rear of the NARKOMED 3. When unplugging the line cord, pull by the plug, never the cord.

Hospital Grade Convenience Receptacles

The NARKOMED 3 includes four 117 volt AC (60 Hz) convenience receptacles supplied with unswitched power. These hospital-grade receptacles are mounted on the upper, rear of the anesthesia machine (see Fig. 2). The total current drawn by devices plugged into the receptacles shall not exceed 5 amps. A 5-amp circuit breaker protects the convenience receptacle circuit. This circuit also incorporates an EMI filter, which minimizes interference with the anesthesia machine from devices plugged into the receptacles.

NOTE: Devices plugged into the convenience receptacles contribute to the anesthesia system's total leakage current. This total leakage current shall not exceed 100 microamps.

Battery Backup

The backup battery system consists of a rechargeable 12 volt battery pack (13 amp-hour, sealed lead-acid) and a built-in battery charging system. The battery and charging system are not user-serviceable and are located in the bottom of the machine's frame.

Although most hospitals have emergency generators to provide AC power when line power fails, delays are frequently encountered before generator power comes on line. The battery backup system automatically provides power during the interim between line power failure and the activation of the hospital's emergency generator. The battery backup system also performs the important function of powering the machine whenever the anesthesia machine's line cord is accidentally unplugged during a case.

When the hospital's emergency generator comes on line (or when a disconnected line cord is reconnected), the NARKOMED 3 automatically switches back to AC power and recharges the backup battery. The charger will take approximately 16 hours to recharge a fully discharged battery.

Backup Battery Operating Instructions

To prevent premature battery failure, backup battery power shall be used *only* during interruption of the primary AC power. No anesthetic procedure shall be started if the yellow "AC POWER FAIL" indicator or yellow "BATTERY LOW" indicator are illuminated.

The operator must test the backup battery system daily by pressing the "BATTERY TEST" button on the alarm panel (see Figure 14). Before pressing the test button, make sure that the "SYSTEM POWER" switch is in the on position. A green test indicator indicates that backup battery power for the anesthesia machine's electrical components is available, but does not indicate the period of time for which this power will be provided. This period of time depends on the duration of previous battery use and recharging.

POWER SUPPLY SYSTEM (continued)

If the hospital's primary AC power fails, the backup battery system works in three stages:

- ①. For approximately the first five minutes of battery activation, the battery powers all machine functions (including the two display screens), except the AC convenience receptacles, and optional CAPNOMED. To alert the operator of this condition:

The yellow "AC POWER FAIL" indicator on the anesthesia machine's alarm panel illuminates.

The alarm message "AC PWR FAIL" appears on the central alarm display.

A single-tone audible alarm sounds.

The Error Code "E07" appears in the CAPNOMED front-panel display window.

- ②. In the second stage, to preserve the battery for vital machine functions, power to the display screens and optional SPHYGMOMED is discontinued and power is supplied only to the following machine functions: O₂MED, BAROMED, optional O₂SATMED, optional SPIROMED, alarm panel, and the AV-E ventilator. The battery will power the machine in this state for at least 10 additional minutes. The "AC POWER FAIL" alarm panel indicator continues to alert the operator of the AC failure condition, but (since power to the display screens has been discontinued) no alarm messages can be displayed. At the beginning of the second stage, the yellow "BATTERY LOW" alarm panel indicator illuminates, and remains illuminated until the third stage. Also, the Error Code "E07" appears in the SPHYGMOMED front panel display window.

- ③. In the third stage (when the battery voltage drops to 10 volts), all electrical power to the anesthesia machine is automatically cut off to prevent deep discharge of the battery. (Deep discharge damages lead-acid batteries.) At this point, all gas supply systems remain operative. However, since the AV-E ventilator is inoperative when battery power has been cut off, manual ventilation by bag squeezing must be performed. In this final stage, the machine can not provide monitoring or alarm functions until it is reconnected to an AC power source.

NOTE: If the NARKOMED 3 is left with its line cord not plugged into an active AC wall outlet for a period of 7 days or more, the backup battery may become depleted. In this instance, the line cord must be plugged into an active AC outlet and the battery must be allowed to charge for at least 16 hours.

Circuit Breakers

The NARKOMED 3 electrical system includes three magnetic circuit breakers to protect the various machine functions (primary AC power input, convenience receptacles, backup battery power).

The circuit breakers are located on the lower right side of the machine (see Fig. 2). When the white plunger of a circuit breaker is flush with the surface of its black base, the circuit breaker is in its normal, closed position. A circuit breaker is open (tripped) when its white plunger extends beyond its black base. The cause of an open breaker must be investigated. Equipment that has caused the breaker to open shall be repaired or replaced before the anesthesia system is returned to service.

POWER SUPPLY SYSTEM (continued)

EMI Filtering

All power for the NARKOMED 3 is filtered for conducted electro-magnetic interference by a low pass filter in the primary AC line. This filter also minimizes the amount of noise generated within the NARKOMED 3 that can leave the device through the AC line.

System Power Switch Failure Alarm

A steady, high pitched (2.8 kHz) audible alarm activates if the NARKOMED 3 pneumatic circuitry is pressurized by the System Power switch and a malfunction in the switch prevents activation of the monitoring system. There is no visual indicator associated with the System Power switch failure alarm.

ALARM PANEL

The alarm panel is located between the ventilator bellows and flowmeter bank and incorporates alarms pertaining to the status of the system as a whole. Alarm panel alarms are annunciated and simultaneously displayed by the central alarm display.

Figure 14 illustrates the indicators and controls on the alarm panel.

O₂/N₂O Flow Ratio (ORMC)

The oxygen flow ratio alarm indicator (labeled "O₂/N₂O FLOW RATIO") activates whenever the ORMC limits the nitrous oxide flow in order to maintain a freshgas oxygen concentration of at least $25 \pm 3\%$ of the combined oxygen and nitrous oxide flow. Therefore, this alarm means that the oxygen and/or nitrous flow control valves have been incorrectly set and the ORMC has responded by limiting nitrous oxide flow. This alarm *does not* mean that the freshgas mixture itself has become hypoxic.

Whenever the ORMC is actively limiting the nitrous oxide flow to prevent a hypoxic freshgas mixture, an "O₂/N₂O LOW" alarm message appears on the central alarm display, the "O₂/N₂O FLOW RATIO" LED indicator on the alarm panel lights continuously yellow, and a single tone audible alarm sounds.

Due to rebreathing of previously exhaled gas in a circle system, lower freshgas flows require a higher oxygen concentration to maintain a sufficient inspiratory oxygen concentration. To

address this problem, the ORMC has been designed to maintain higher levels of oxygen in the freshgas at lower flow rates (see Fig. 9). Thus, especially at low freshgas flow rates, the ORMC alarm may activate at freshgas oxygen concentrations *well above* 25% of the combined oxygen and nitrous oxide flow.

It should be noted that the ORMC interlocks only the flows of oxygen and nitrous oxide. Hypoxic freshgas concentrations are possible if an additional gas other than air is used.

In the following instances, ORMC audible and visual alarms are automatically disabled (as indicated by the Advisory message "ORM ALRM OFF" on the central alarm display):

If the NARKOMED 3 is equipped with an additional gas circuit, controlled by the additional gas selector switch (i.e., all additional gas options except carbon dioxide as a third gas) and the selector switch is placed in the "ALL GASES" position, the ORMC audible and visual alarms are automatically disabled.

The ORMC audible and visual alarms are automatically disabled at nitrous oxide flows below 150 ± 50 mL/min.

Although ORMC audible and visual alarms are automatically disabled in the above two instances, the ORMC continues to control the ratio of oxygen to nitrous oxide flow *regardless of the alarm status*.

ALARM PANEL (continued)

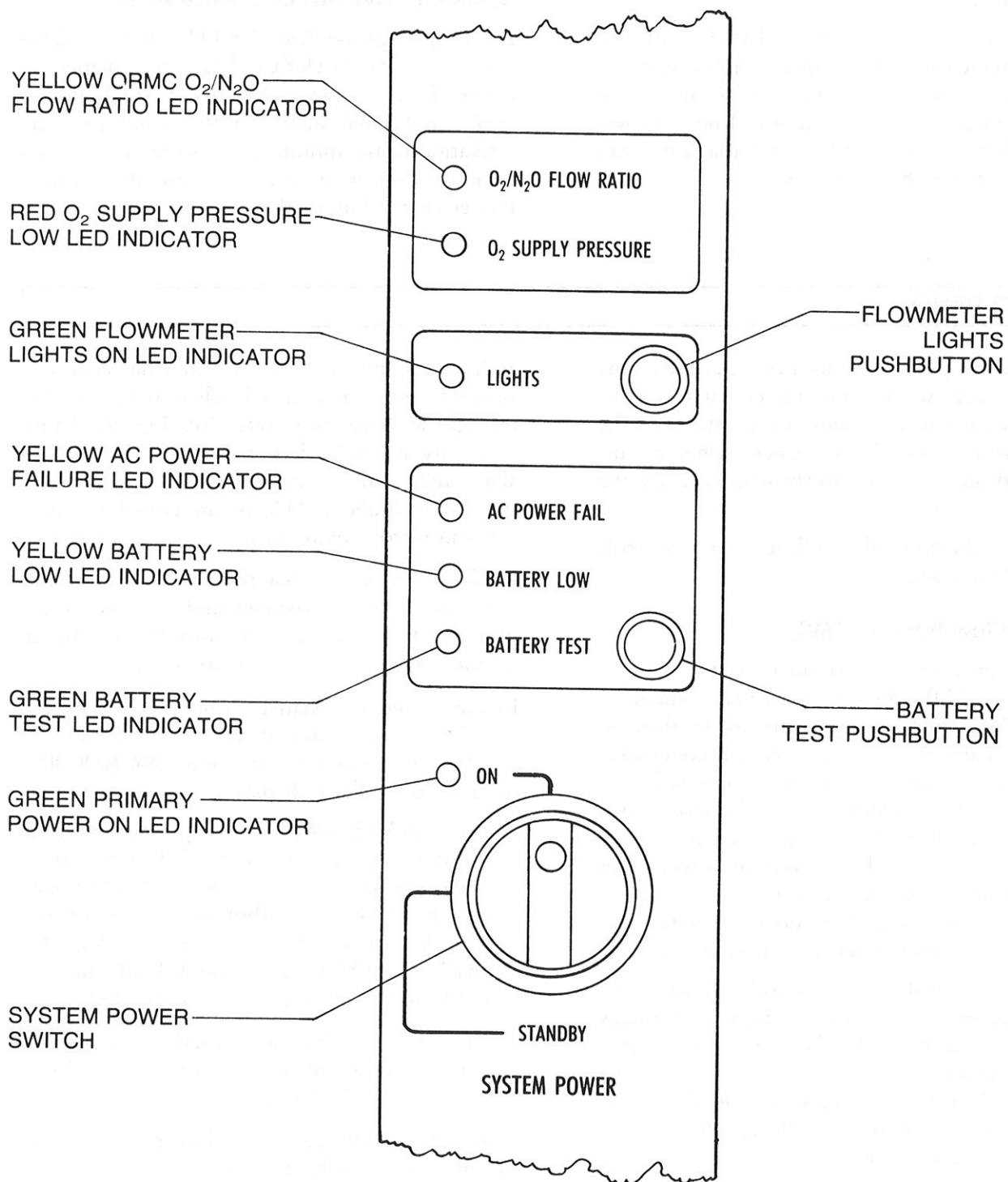


FIGURE 14: ALARM PANEL

ALARM PANEL (continued)

Oxygen Supply Pressure Alarm

The oxygen supply pressure alarm activates if the oxygen supply pressure (from either the pipeline supply or reserve cylinders) in the system decreases below 30 ± 3 psi. The LED indicator labeled "O₂ SUPPLY PRESSURE" lights continuously red, the alarm message "LO O₂ SUPPLY" appears on the central alarm display, and an intermittent audible alarm sounds.

If only one of the sources of oxygen supply pressure (either reserve cylinders or pipeline) fails while the other maintains proper supply pressure within the machine's oxygen supply lines, the oxygen supply pressure alarm will not activate.

Battery Test

The operator must test the backup battery system daily by pressing the "BATTERY TEST" pushbutton. Before pressing the pushbutton, make sure that the "SYSTEM POWER" switch is in the on position. The green test indicator illuminates when the pushbutton is pressed *if the battery has been charged to normal operating potential*. Any time that the battery potential drops below the normal operating threshold, the yellow "BATTERY LOW" LED lights, whether the "BATTERY TEST" button has been pressed or not.

NOTE: Do not rely *only* on the "BATTERY LOW" indicator for an assessment of battery capacity. If the backup battery became completely depleted and the machine did not have AC power, the "BATTERY LOW" indicator would have no source of power. Therefore, always remember to perform the daily battery test.

AC Power Failure Indicator

The yellow "AC POWER FAIL" LED signals AC power disruption. This LED illuminates when the battery is supplying power to the alarm circuit or the electronic ventilator. When AC power is first disrupted, a single-tone audible alarm sounds. However, if the anesthesia machine's backup battery is completely discharged, the AC power failure indicator will not be supplied with power.

System Power Switch

The System Power switch of the NARKOMED 3 has two functional positions: "STANDBY" (9 o'clock position) and "ON" (12 o'clock position). Set to the "ON" position, the System Power switch actuates all gas and electric power.

To prevent inadvertent disengagement of the switch, it must be depressed when turning it to a new position. A green LED indicator adjacent to the switch remains lit any time that the switch is "ON" and supplying power to the machine. A single, brief tone sounds when the switch is turned to the "ON" position.

Set in the "STANDBY" position, the System Power switch shuts down the alarm system and the gas supplies. The battery charging circuit and 117 VAC receptacles are powered whenever the power cord is attached to an active wall receptacle, regardless of the setting of the switch. To prevent drainage of the backup battery, and waste or depletion of the oxygen supply through the minimum oxygen flow, the System Power switch shall be turned to the "STANDBY" position whenever the machine is not in use.

Flowmeter Lights

A pushbutton on the alarm panel controls lights for the flowmeter panel.

MONITORING SYSTEM

The NARKOMED 3 supports a comprehensive system of integrated anesthesia monitoring. The NARKOMED 3 incorporates two standard integral monitors: the BAROMED breathing pressure monitor and the O₂MED oxygen concentration monitor. Optional monitors are:

- O₂SATMED pulse oximeter
- SPIROMED respiratory volume monitor
- CAPNOMED carbon dioxide monitor
- SPHYGMOMED noninvasive blood pressure monitor

Figure 15 illustrates the front panels of standard and optional monitors. Each monitor consists of a modular chassis that mounts in a monitoring rack to the right of the monitoring system display screens. A maximum of six monitors can fit into the rack (including the two standard monitors).

O₂MED Oxygen Analyzer (Standard)

The O₂MED uses a "dual-redundant" galvanic cell sensor to monitor and digitally display concentration of oxygen in the patient breathing system. Calibration is performed with a single keystroke. The operator can set both high and low oxygen concentration alarm limits with adjustment keys. An O₂ Sensor alarm warns of sensor cable disconnection, sensor malfunction, and sensor degradation. The unit can also (through alarm messages on the central alarm display) alert the operator that a calibration is due or that an internal electronics malfunction has occurred. A detailed description and operating instructions can be found in the *O₂MED Operator's Instruction Manual*.

BAROMED Breathing Pressure Monitor (Standard)

The BAROMED monitors breathing system pressure at either the absorber or the Y-piece. The unit can display either mean, peak, or positive end expiratory (PEEP) pressure in cm H₂O. The operator can set alarm limits for high pressure and threshold pressure with adjustment

keys. Alarms are provided for high pressure, pressure below threshold for 15 and 30 seconds, sub-atmospheric (≤ -10 cm H₂O) pressure, excessive PEEP, and continuing pressure above the set threshold for 15 seconds. Also, the unit can alert the operator of an improperly set threshold pressure with the alarm message "THRESHOLD LO" on the central alarm display. A detailed description and operating instructions can be found in the *BAROMED Operator's Instruction Manual*.

SPIROMED Respiratory Volume Monitor (Optional)

The SPIROMED uses a positive displacement, rotating lobe impeller sensor to monitor and display tidal volume, minute volume, and respiratory rate. The operator can set a low alarm limit for minute volume with adjustment keys. A fixed alarm warns of reverse flow through the sensor. An apnea alarm is generated if the sensor does not sense a breath for 15 and 30 seconds. A volume sensor alarm activates if the sensor cord is disconnected or damaged. A detailed description and operating instructions can be found in the *SPIROMED Operator's Instruction Manual*.

CAPNOMED Carbon Dioxide Monitor (Optional)

The CAPNOMED uses a non-dispersive infrared analyzer to monitor the CO₂ concentration in a sample withdrawn from the breathing circuit at the Y-piece. The unit displays both end-tidal and inspiratory carbon dioxide partial pressure in mm Hg. The operator can set both high and low alarm limits for end-tidal CO₂ with adjustment keys. An apnea alarm is generated if the unit does not sense a CO₂ fluctuation for 15 and 30 seconds. Self diagnostic alarms include a sample-line blockage alarm, a calibration gas depletion alarm, and an internal electronics malfunction alarm. Zero calibration can be performed with a single soft-touch key. The unit also automatically performs span and zero calib-

MONITORING SYSTEM (continued)

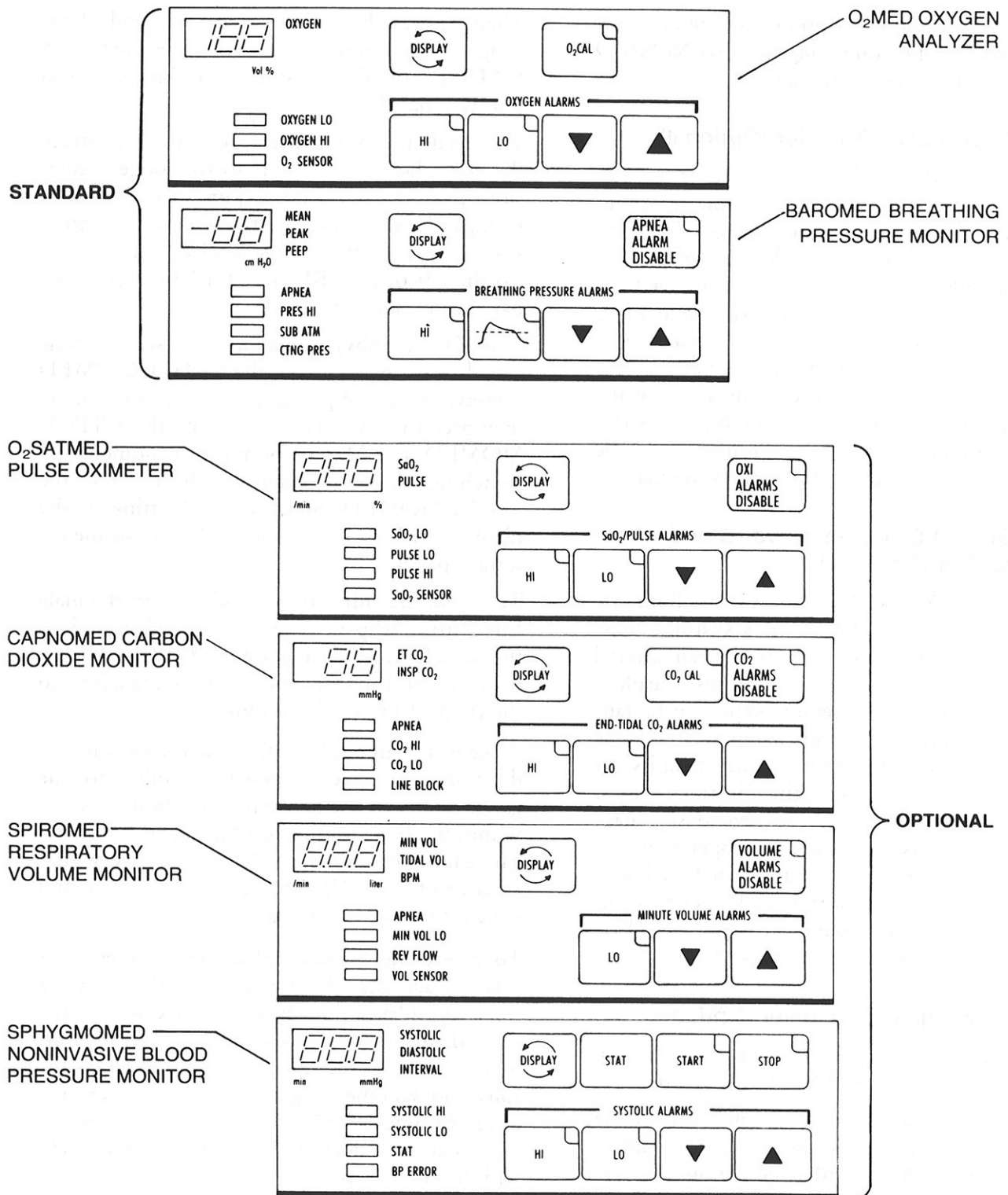


FIGURE 15: STANDARD AND OPTIONAL MONITORS

rations. A detailed description and operating instructions can be found in the *CAPNOMED Operator's Instruction Manual*.

O₂SATMED Pulse Oximeter (Optional)

The O₂SATMED pulse oximeter uses a spectrophotometric infrared transmission sensor to noninvasively measure arterial hemoglobin oxygen saturation. The unit displays either percent SaO₂ or pulse rate. The operator can set both high and low alarm limits for SaO₂ and pulse rate with adjustment keys. Alarms are also provided for an absence of pulse (no pulse at the sensor for 10 seconds) and disconnection of the sensor cable. A detailed description and operating instructions can be found in the *O₂SATMED Operator's Instruction Manual*.

SPHYGMOMED Noninvasive Blood Pressure Monitor (Optional)

The SPHYGMOMED employs oscillometric means to determine the patient's systolic, diastolic, and mean blood pressure (mean arterial pressure) and pulse rate. The unit also displays the interval between measurements, instantaneous cuff pressure, and sample age. The operator can set high and low alarm limits for systolic blood pressure with adjustment keys. Alarms are also provided for several self-diagnostic conditions, including improper cuff setup, cuff disconnection, and internal malfunction. A detailed description and operating instructions can be found in the *SPHYGMOMED Operator's Instruction Manual*.

Manual Sphygmomanometer (Optional)

An aneroid manual sphygmomanometer can be mounted on the NARKOMED 3 (Fig. 16).

The sphygmomanometer gauge mounts on the left-hand side of the anesthesia machine, above the ventilator bellows, either on a mount on the machine itself or on the underside of the optional Boom Arm. To install the gauge, tighten the gauge's threaded mounting ring in a clockwise direction over the gauge mount.

Then, thread the fitting on the free end of the gauge hose onto the fitting labeled "BP GAUGE" on the anesthesia machine's patient interface panel.

To install the blood pressure cuff, first attach the short hose on the cuff to the longer extension hose. The two hoses join with Luer lock fittings. Then, thread the free end of the extension hose over the fitting labeled "BP CUFF" (to the left of the "BP GAUGE" fitting) on the patient interface panel.

The Manual Sphygmomanometer uses the same blood pressure cuff as the SPHYGMOMED noninvasive blood pressure monitor. Some users may prefer to use one cuff for both the SPHYGMOMED and Manual Sphygmomanometer by switching the cuff extension hose from the SPHYGMOMED interface panel fitting to the identical "BP CUFF" fitting below it on the interface panel.

To install the cuff inflation bulb, insert the male Luer fitting (slip-fit type) on the bulb hose into the female Luer fitting (labeled "BP BULB") provided on the front of the anesthesia machine to the right of the O₂ flush button.

After installation, check the gauge's pressure indication. With zero pressure applied to the gauge and cuff, the gauge pointer should remain within the band marked on the gauge face plate. The gauge accuracy is $\pm 1\%$ of full scale within a range of 75 – 225 mm Hg, and $\pm 3\%$ of full scale outside of this range.

To check the manual sphygmomanometer for leaks, place the blood pressure cuff around a rigid cylindrical object of approximately the same diameter as a human arm. Inflate the cuff to a pressure of 200 mm Hg, as indicated on the sphygmomanometer gauge. Then, watch the gauge reading for 30 seconds; the gauge indication shall not decrease more than 10 mm Hg within this time period.

To isolate a specific source of leaks, eliminate components from the system and perform the test described above. For example, to exclude the cuff inflation bulb, pinch the cuff inflation

MONITORING SYSTEM (continued)

hose after inflating the cuff to 200 mm Hg. To exclude the cuff itself, remove the extension hose from the interface panel, occlude the "BP CUFF" fitting, and then pressurize the gauge to a reading of 200 mm Hg.

In typical usage, the Manual Sphygmomanometer will not require any further cleaning than wipe-down with a liquid disinfection agent. If required, the sphygmomanometer gauge assem-

bly, hoses and blood pressure cuff may be removed from the anesthesia machine and sterilized with ethylene oxide gas, followed by appropriate aeration as per the sterilizer manufacturer's instructions.

NOTE:

The gauge assembly cannot withstand the heat of autoclaving, and therefore must NOT be autoclaved.

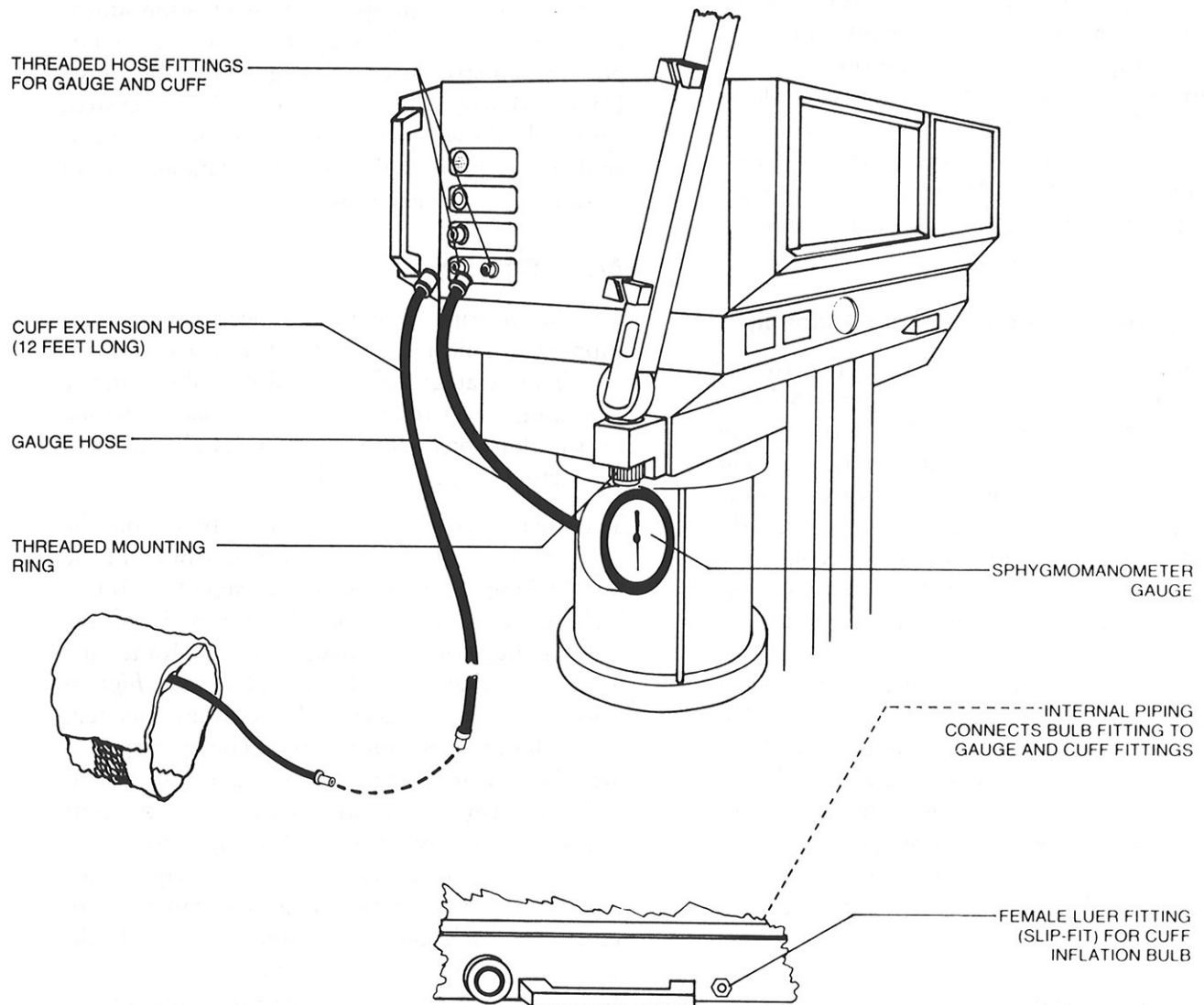


FIGURE 16: MANUAL SPHYGMOMANOMETER

System Sensor Interface Panel

A panel of four sensor connections is provided on the lower left side of the NARKOMED 3 (Fig. 17). These connections pertain to the patient breathing system and thus are mounted close to the absorber assembly. The standard O₂MED sensor cord leads from the O₂MED sensor (mounted in the inspiratory valve) and plugs into a pin-type connector on the panel. The standard BAROMED breathing pressure pilot line leads from either the absorber (shorter pilot line) or the Y-piece (longer pilot line) and plugs into a quick-connect fitting on the panel. The optional SPIROMED sensor cord leads from the SPIROMED sensor on the absorber top dome to a pin-type connector on the panel. The optional CAPNOMED exhaust line leads from a hose barb fitting on the panel to an adapter on the scavenger system.

Patient Sensor Interface Panel (Optional)

A panel of four sensor connections is provided on the upper left side of the NARKOMED 3 monitoring bank (Fig. 17). These connections pertain to optional patient monitors. The O₂SATMED incorporates an interface cable/pre-amplifier assembly that mounts on the Boom Arm and plugs into a pin-type connector on the panel. The CAPNOMED sample line leads from a 15 mm sample adapter at the Y-piece to a Luer-lock fitting on the semi-permeable tubing, which then connects to the water trap mounted on the interface panel. The SPHYGMOMED cuff extension hose leads from the blood pressure cuff to a threaded hose connection on the panel. The optional Manual Sphygmomanometer hose connections occupy the bottom slot on the interface panel and are intended for the gauge hose and the cuff extension hose.

Boom Arm (Optional)

An optional Boom Arm can be mounted on the left side of the monitoring bank. Patient sensor

lines (O₂SATMED interface cable, CO₂ sample line, SPHYGMOMED cuff extension hose) can be routed from the patient to anesthesia machine in an organized fashion with the Boom Arm. The arm can be adjusted to the desired position to retain the lines in the most convenient position.

System Communications

Although designed to operate independently, each monitor is equipped with data communications capabilities, allowing it to become a component of a structured and organized Anesthesia Data Management System. This system approach allows other devices in the system to analyze, display, and record the data and alarm conditions from any monitor.

Alarm Strategy

The Monitoring System has been designed to support a uniform and structured alarm strategy. This strategy solves a major problem in the operating room today – the confusion caused by simultaneous audible and visual alarms from a variety of independent devices.

The structured alarm strategy is based on the centralization of visual alarm indicators and the interlocking of audible alarm signals. “Interlocking” coordinates the alarm signals of the various monitors that make up the Monitoring System so that only the sound of the *highest priority, currently active* alarm is annunciated, while all others are suppressed. The corresponding visual alarm signal is displayed at a centralized alarm annunciation location – the central alarm display screen. Multiple alarm messages can be displayed simultaneously at the central alarm display. This combination of audio interlock and visual centralization facilitates the recognition of alarm conditions, and drastically reduces the response time for corrective action.

MONITORING SYSTEM (continued)

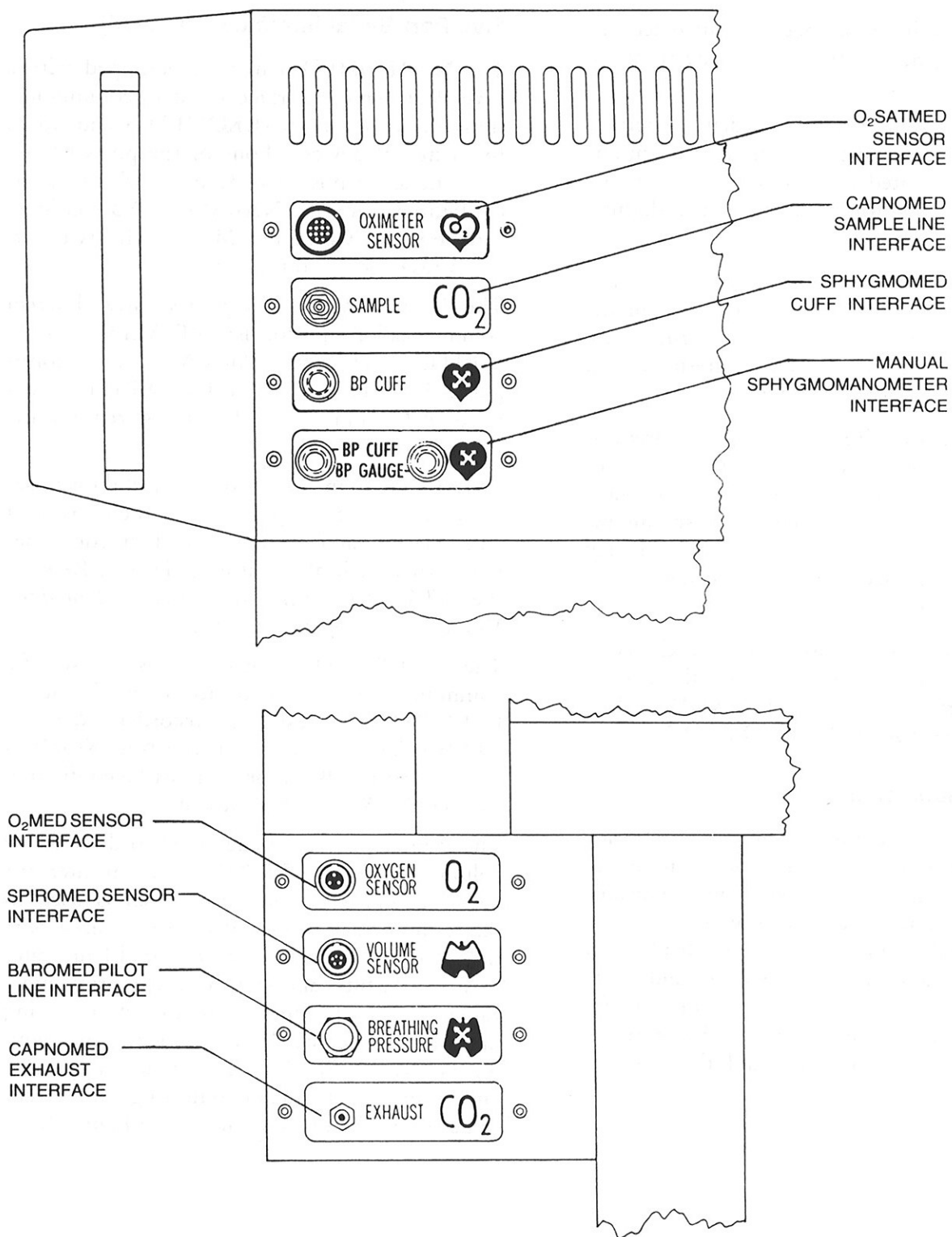


FIGURE 17: PATIENT INTERFACE PANEL AND SYSTEM INTERFACE PANEL

MONITORING SYSTEM (continued)

Each alarm condition has been classified according to the urgency of the appropriate response as follows:

WARNING: Requires immediate action. Warning conditions are annunciated by a continuously repeating tone pattern and a flashing red indicator.

CAUTION: Requires prompt action. Cautionary conditions are annunciated by an intermittently repeating tone pattern and a steady red indicator.

ADVISORY: Requires operator awareness, but not necessarily action. Advisory conditions are indicated by a continuously illuminated yellow indicator and may be accompanied by a single, brief tone.

Each alarm message consists of a 12-character alphanumeric phrase that describes the corresponding alarm condition. APPENDIX 2 lists alarm messages for the NARKOMED 3.

Data Communication

In addition to generating alarm messages, each monitor transmits the results of its measurements and calculations, as well as any applicable alarm limits. This capability provides the basis for the central monitoring system's displays. It also allows automatic recording and data documentation. Each data message consists of a 12-character identifying phrase, the numeric results of the measurement, and the units of measure.

Five Port Serial Interface (Optional)

The NARKOMED 3 may be equipped with a Five Port Serial Interface for data communications between the NARKOMED 3 and up to five external devices. Four of the ports (A–D) are general purpose RS-232 ports which can be configured using the NARKOMED 3 configure function (see Configure Menu). The last port (E) is reserved for future use.

The NARKOMED 3 supports three different communication protocols: VITALINK, CO·WRITER, and Printer. Ports A–D can be configured for VITALINK or CO·WRITER, and ports A, C, and D can be configured for the Printer protocol.

VITALINK is an asynchronous, full duplex, serial communications protocol for the transfer of data, alarms, and certain control functions between two medical monitoring devices. Refer to the *VITALINK Technical Reference Manual* for VITALINK programming details.

The CO·WRITER protocol is a specific communications protocol to be used with a CO·WRITER Anesthesia Recorder. When a CO·WRITER is interfaced to a NARKOMED 3, that port (A, B, C, or D) must be configured for the CO·WRITER protocol.

The Printer protocol is designed to drive an 80 column (or more) RS-232 ASCII printer for data logging. The configure screen is used to select the printer protocol for the desired port (A, C, or D), as well as the required baud rate, parity, data bits, and stop bits. The print interval (1, 2, 5, or 10 minutes) is also selected using the configure screen. When using a printer with the NARKOMED 3, a line of data is printed once every print interval reflecting the current values of all the measurements (see Figure 18).

MONITORING SYSTEM (continued)

NAME : _____ PROCEDURE : _____

DATE : 24-JUL-87

Page 1

TIME	BLOOD PRESSURE		PULSE /min	SaO2 %	O2 %	AGENT % EX/IN	CO2 mmHg ET/IN	RESP RATE /min	MIN VOL 1	TEMPERATURE DEG C	
	mmHg SYS/DIAS	MEAN								CH 1	CH 2
12:00	120/ 80	95	72	99	30	12.0/30.3	34/00	20	10.4	37.2	37.5
12.02	120/ 80	92	74	99	21	12.2/30.2	34/00	20	10.6	37.2	37.5
12:02	WARNING: % OXYGEN LOW										
12:02	CAUTION: NIBP SYS LO										
12:15	120/ 80	92	71	98	21	12.5/30.0	33/00	20	11.0	37.2	37.5
12:20	120/ 80	92	72	95	21	11.9/30.3	36/00	20	10.5	37.2	37.5
12:25	120/ 80	92	72	95	21	11.9/30.3	36/00	20	10.5	37.2	37.5
12:27	120/ 80	92	72	97	20	12.0/29.1	30/00	20	10.3	37.2	37.5
12:27	CAUTION: APNEA - PRES										
12:27	CAUTION: APNEA - CO2										

FIGURE 18: PRINTER OUTPUT

CENTRAL MONITORING DISPLAY

General Description

The central monitoring display organizes the presentation of measured variables and alarm conditions. The display's two screens make up the left portion of the upper housing of the anesthesia machine (see Fig. 19). The left-hand screen is reserved for the Central Alarm Display, Checkout Display, and Configure Menu. The right-hand screen can be used in one of four display modes: Bargraph, Data, Trend, and Trace. Soft-touch keys located along the bottom edge of the screens, and in a system control keypad to the right of the screens, control various display and system functions.

Power-On-Initialization

After the System Power switch is turned to the on position, the following occurs:

- All of the monitors perform a six-second self-diagnostic test and lamp test.
- The left-hand display screen shows the Central Alarm Display.
- The right-hand display screen shows the Data Display.
- All continuous audible alarms are silenced for a period of 120 seconds. (During this period,

Warnings and Cautions produce only single-tone audible alarms.)

- A three-minute disable period is invoked for the SPIROMED, CAPNOMED, and O₂SATMED patient alarms, as indicated by the appropriate Advisory messages on the central alarm display and illumination of the yellow indicators on the monitors' alarm disable/enable keys. These alarms will be automatically enabled after three minutes, and can be immediately enabled with each monitor's alarms disable/enable key.
- The BAROMED's apnea pressure alarm is automatically disabled on power-up to avoid a spurious apnea alarm with a spontaneously breathing patient. The apnea pressure alarm will remain disabled until manually enabled with the BAROMED's apnea alarm disable/enable key or the ventilator power switch.
- Each monitor automatically selects commonly used alarm limits and display selections. The operator can, at any time, override these default settings with each monitor's front panel controls. If desired, your authorized North American Dräger service representative can change the monitoring system's power-up default configuration.

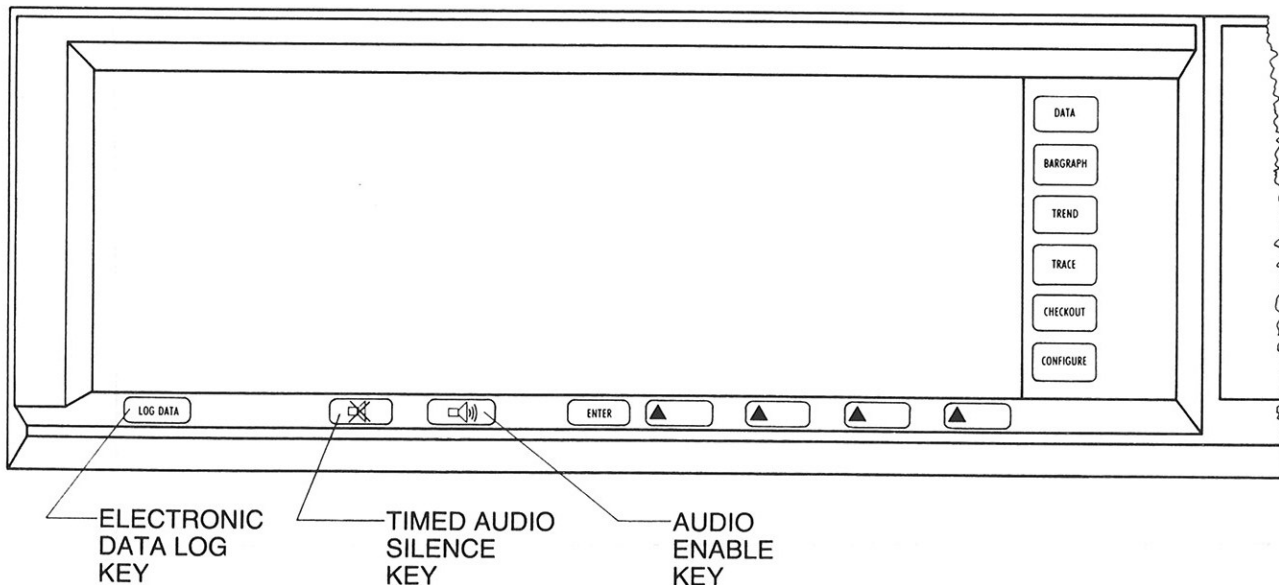


FIGURE 19: DISPLAY SCREENS AND SYSTEM CONTROL KEYPAD

CENTRAL MONITORING DISPLAY (continued)

Monitor "Alarm Disable" Keys

To prevent nuisance alarms during machine setup and during certain clinical situations, the BAROMED, SPIROMED, CAPNOMED, and O₂SATMED incorporate alarms disable keys. The following chart summarizes the functions of these keys:

MONITOR	ALARMS DISABLED	ADVISORY MESSAGE
BAROMED	Apnea pressure (threshold pressure)	"APNEA-P OFF"
CAPNOMED	Apnea CO ₂ , high inspiratory CO ₂ , high ET CO ₂ & low ET CO ₂	"CO ₂ ALRM OFF"
SPIROMED	Apnea volume, minute volume	"VOL ALRM OFF"
O ₂ SATMED	Absence of pulse, low SaO ₂ , high SaO ₂ , low pulse, high pulse	"OXI ALRM OFF"

Note these important points:

The BAROMED "APNEA ALARM DISABLE" key will not disable the apnea pressure (threshold pressure) alarm if the AV-E ventilator's power switch is in the "ON" position. This interlock ensures that the BAROMED apnea alarm will be used during automatic ventilation.

The ventilator power switch automatically enables the SPIROMED volume alarms and the BAROMED apnea pressure alarm.

If a monitor fault condition (such as a disconnected sensor) is corrected, a *formerly disabled* alarm will become *enabled* upon correction of the fault condition. For example, if the "OXI ALRMS DISABLE" key has been actuated in order to silence nuisance alarms during machine setup and then the O₂SATMED patient sensor becomes disconnected, subsequent *reconnection* of the patient sensor will immediately *re-enable* O₂SATMED alarms. This feature ensures that alarms will return from a fault condition in an *enabled* state.

Central Alarm Display

The central alarm display performs a dual function. In its upper half, it organizes system alarm messages into three display areas. In its lower half, it provides a display of key measurements (from the optional CAPNOMED and O₂SATMED) for a quick check of patient condition (see Figs. 20A & 20B).

The three areas on the upper half of the central alarm display are labeled Warning, Caution, and Advisory. Each type of alarm message produces a different sound pattern during an alarm condition.

Warnings produce two short 1.26 kHz tones followed by one short 1.0 kHz tone in a pattern repeating every 2.5 seconds.

Cautions produce two short 840 Hz tones followed by a short 1.0 kHz in a pattern repeating every 60 seconds.

Advisories produce one brief, non-repeating 1.0 kHz tone. (Some Advisories may not call for an audible alarm; see APPENDIX 2.)

Alarm messages are listed in the order of the time of occurrence, with the most recent alarm messages appearing at the bottom of the list. To alert the operator of the time at which a Warning or Caution occurred, an arrow appears to the left of the last alarm message that has appeared on the screen (Fig. 20A). If the alarm condition creating this message is then resolved, the arrow disappears and does not reappear until the occurrence of a new alarm condition.

NOTE: If the number of alarm messages in any of the three categories exceeds the space provided on the display screen for that category, the most recent alarm messages will be held in the machine's memory until space is available for them (i.e., through the resolution of some of the posted alarm conditions).

CENTRAL MONITORING DISPLAY (continued)

Real-Time Pulse Bargraph and Carbon Dioxide Trace

If the anesthesia machine features the optional CAPNOMED and optional O₂SATMED, the central alarm display incorporates two real-time displays for a quick, qualitative assessment of patient condition. In the lower left corner of the central alarm display, a real-time bargraph pulsates each time that a pulse is detected by the O₂SATMED sensor. The digital values for oxygen saturation and pulse rate (from the O₂SATMED) appear to the right of the bargraph. The lower right corner of the central alarm display incorporates a real-time carbon dioxide waveform. The horizontal dotted line represents a CO₂ partial pressure of 40 mm Hg. The digital value for end-tidal CO₂ appears to the left of the waveform.

By glancing at this display, the operator can check for a regular pulse (with the real-time pulse bargraph) and also check the patient's ventilation (with the real-time carbon dioxide waveform).

NOTE: If desired, a more detailed carbon dioxide waveform and a pulse oximeter waveform can be viewed on the Real-Time Trace Display.

Real-Time Clock

The central alarm display also includes a real-time clock. This unlabeled digital display is located beneath the Advisory display area (see Fig. 20A) and shows the time in *military* time. The real-time clock may be set through the Configure Menu.

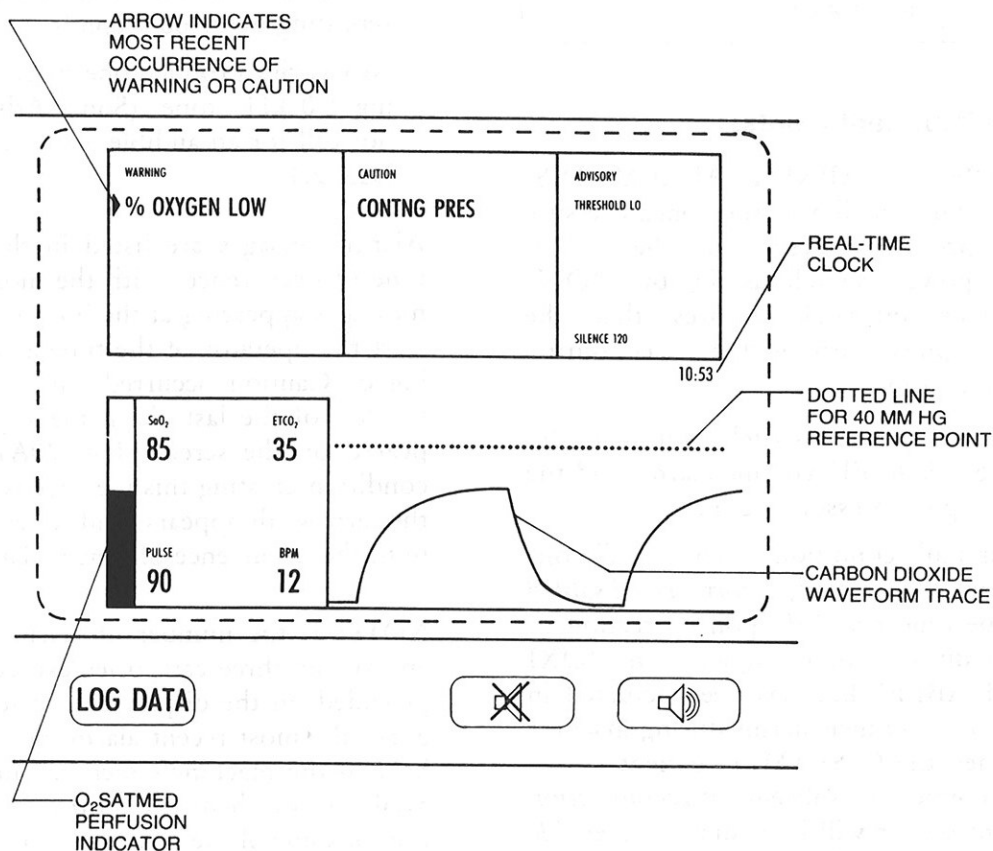


FIGURE 20A: CENTRAL ALARM DISPLAY

CENTRAL MONITORING DISPLAY (continued)

Audio Silence Control

Two keys beneath the central alarm display (see Fig. 20B) can be used to temporarily silence continuous audible alarms. Pressing the silence key (labeled with a speaker with an X through it) *once* will begin a 60 second period in which Warnings and Cautions produce single-tone audible alarms. Pressing the silence key again, during the silence period, will begin a 120 second silence period. The silence periods cannot add up; 120 seconds is the maximum. The audio silence condition and the silent time remaining are displayed at the bottom of the ADVISORY section of the central alarm display.

Audible alarms can be immediately enabled at any time by pressing the enable key (labeled with a speaker producing sound) to the right of the silence key.

LOG DATA Key

Pressing the "LOG DATA" key, on the lower left of the display screen, logs the current measurements into the system's memory for later reference. For details, see the "Electronic Data Log" section of this manual.

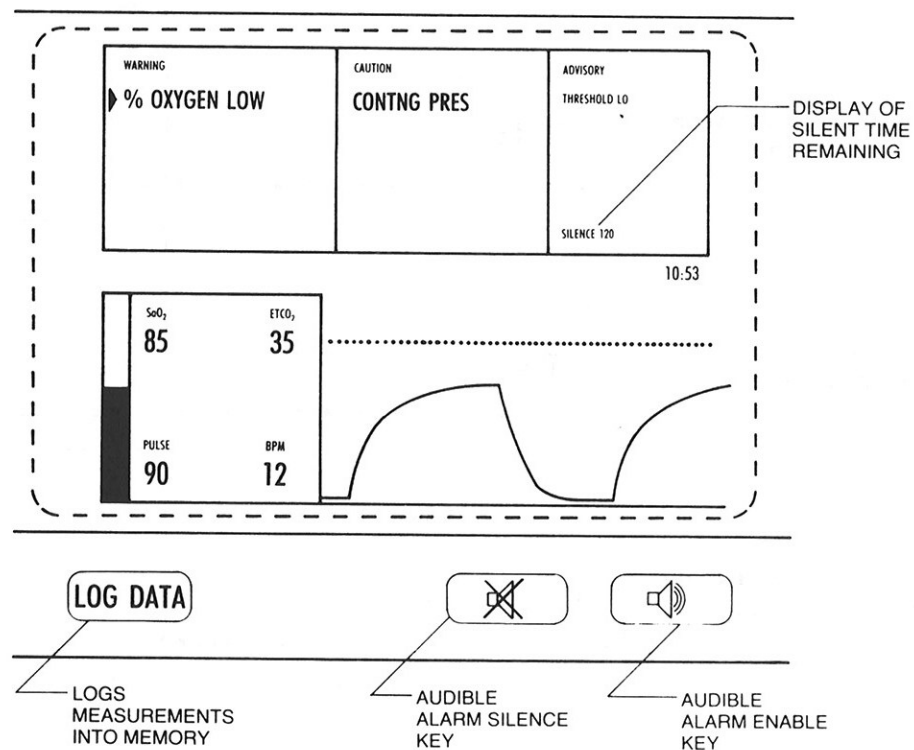


FIGURE 20B: CENTRAL ALARM DISPLAY

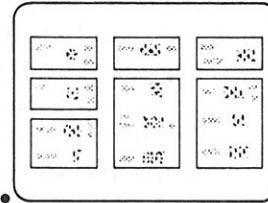
CENTRAL MONITORING DISPLAY (continued)

System Control Keypad

Oriented vertically and to the right of the display screens, the system control keypad calls up a series of displays and menus on the two display screens (see Fig. 21).

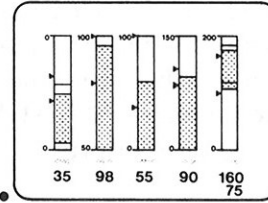
Calls up data display on right-hand screen.

DATA



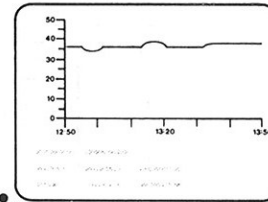
Calls up bargraph display on right-hand screen.

BARGRAPH



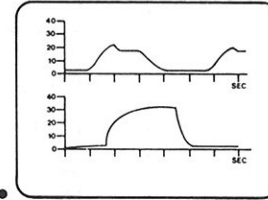
Calls up trend display on right-hand screen.

TREND



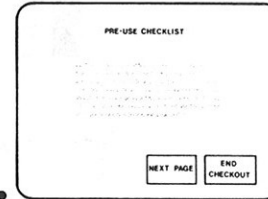
Calls up trace display on right-hand screen.

TRACE



Calls up checkout display on left-hand screen.

CHECKOUT



Calls up configure menu on left-hand screen.

CONFIGURE

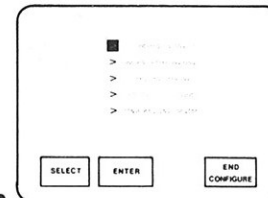


FIGURE 21: SYSTEM CONTROL KEYPAD

CENTRAL MONITORING DISPLAY (continued)

Checkout Display (Refer to Figure 22)

Pressing the "CHECKOUT" key calls up the checkout display on the left-hand screen. This selection provides a text display of pre-use check-out procedures to be performed by the operator in the room in which the anesthesia machine is to be used. The two right-hand keys beneath the checkout display can then be used to page the display forward and exit from the display.

Configure Menu (Refer to Figure 23)

Pressing the "CONFIGURE" key calls up a menu on the left-hand screen that allows the operator to change certain anesthesia system features.

Selecting the "SaO₂/NIBP INTERLOCK" item on the menu allows the operator to coordinate the O₂SATMED's alarms with the SPHYGMOMED's cuff inflation for those instances where the O₂SATMED finger sensor must be placed on the same arm as the SPHYGMOMED blood pressure cuff. When the interlock is enabled, the monitoring system automatically disables O₂SATMED alarms (as indicated by the Advisory message "OXI ALRM OFF" and illumination of the yellow indicator on the "OXI ALARMS DISABLE" key) during SPHYGMOMED cuff inflation and for a short period after cuff deflation. After this interlock is enabled, if the anesthesia machine's System Power switch is turned to the "STANDBY" position, the system will *disable* the SaO₂/NIBP interlock when the anesthesia machine is next powered up.

Certain NAD monitors are capable of operating in a "NEONATAL MODE" (e.g., reduced NIBP cuff pressure). If the NARKOMED 3 is equipped with such a monitor(s), then selecting the "NEONATAL MODE" configuration op-

tion allows the operator to invoke the neonatal operating mode of all such monitors in the system. Refer to the operator's manuals of the individual monitors for a detailed description of the neonatal operating mode. Switching the NARKOMED 3 to standby automatically *disables* the "NEONATAL MODE".

The "SET PRINT INTERVAL" selection allows the operator to adjust the interval at which an interfaced Printer will print out data for certain physiologic and system parameters. When entered, this selection offers the following choice of print intervals: 1, 2, 5, or 10 minutes. For example, a print interval of two minutes means that the Printer will print out a line of alphanumeric data every two minutes.

Selecting the "SET AUDIO VOLUME" item allows the operator to adjust the alarm annunciator volume for varying levels of background noise. The audio volume setting chosen through this menu becomes the power-up default that will be set whenever the System Power switch is turned on.

Selecting the "SET TIME AND DATE" item on the configure menu allows the operator to set the machine's real-time clock. Pressing the left-hand selection key pages through the day, month, year, hour, and minute settings. Then, two of the selection keys can be used to increase or decrease each setting.

The real-time clock setting is saved when the operator selects another display with the system control keypad.

Selecting the "CONFIGURE SERIAL INTERFACE" option on the Configure Menu allows the operator to select the baud rate, parity, data bits, stop bits, and protocol for ports A-D on the optional Five Port Serial Interface. When selecting the protocol, enter "1" for Printer, "2" for CO-WRITER, and "3" for VITALINK.

CENTRAL MONITORING DISPLAY (continued)

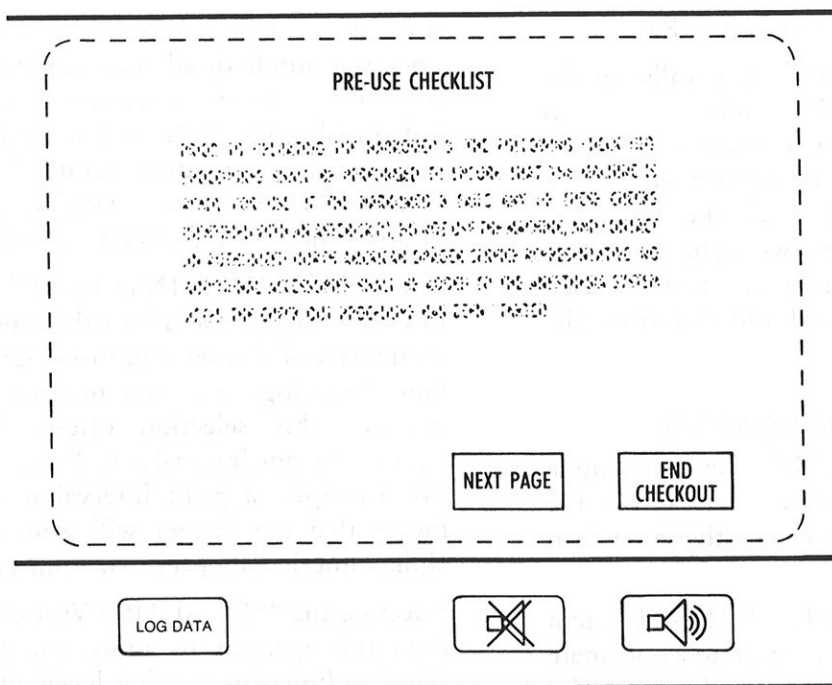


FIGURE 22: CHECKOUT DISPLAY

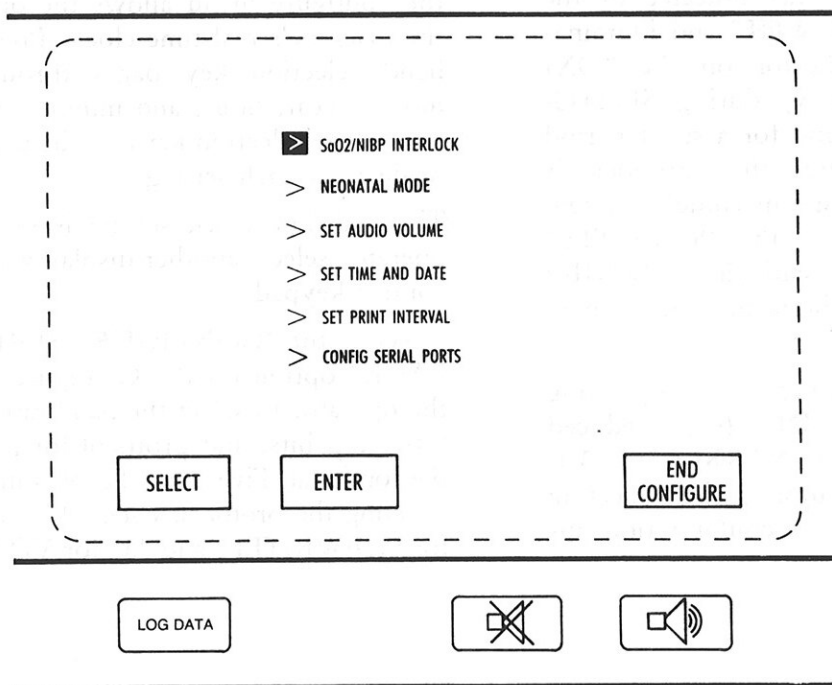


FIGURE 23: CONFIGURE MENU

DISPLAYS APPEARING ON THE RIGHT-HAND SCREEN:

Data Display (Refer to Figure 24)

Pressing the "DATA" key calls up a numerical display of key measurements and alarm limits, thus displaying numerical data in a central location to facilitate record keeping. Alarm limits appear to the right of measured variables and are smaller in size on the screen. The noninvasive blood pressure sample age is displayed in minutes and seconds.

The pulse rate for the Data Display is first supplied by the O₂SATMED pulse oximeter: the reading is then labeled "OXI PULSE." If a pulse rate measurement is not available from the O₂SATMED, the SPHYGMOMED noninvasive blood pressure monitor supplies the pulse rate measurement, which is then labeled "NIBP PULSE." The Data Display waits approximately one minute before switching to the SPHYGMOMED pulse rate measurement.

Electronic Data Log

When the operator must devote full attention to the patient, it can be difficult to record or note the measurements provided by the monitoring system. To address this need, the NARKOMED 3 allows the operator to log a set of measurements into memory by pressing a single key. Then, at a more convenient time, the operator can manually recall this logged data for reference or manual completion of the anesthesia record.

Pressing the "LOG DATA" key (located at the far left of the display screens) takes a "snapshot" of the data on the Data Display screen and stores it in the system's memory. At the first actuation of the "LOG DATA" key after the NARKOMED 3 has been turned on, a "DATA LOG" label appears above the left-hand selection key for the Data Display.

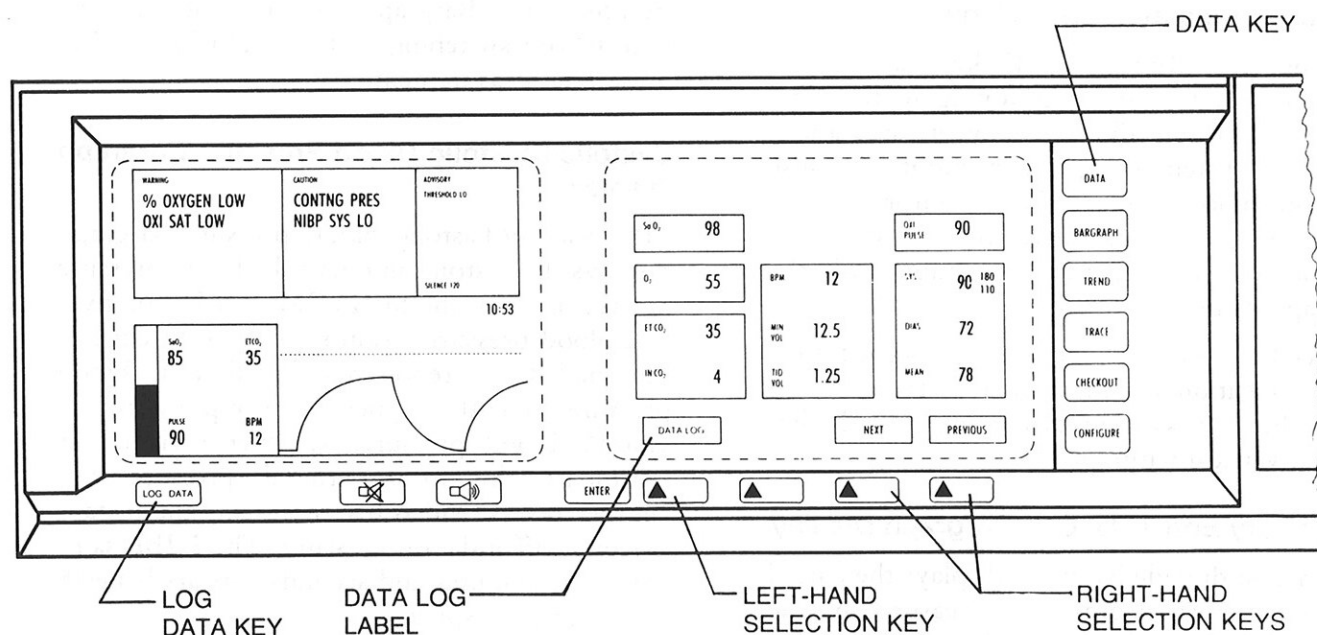


FIGURE 24: DATA DISPLAY

CENTRAL MONITORING DISPLAY (continued)

Pressing this selection key then displays the previously logged data as it appeared at the actuation of the "LOG DATA" key. Each "logged" screen is labeled with an Event number (up to Event 99) and the time at which it had been logged into memory. The ten most recently logged Events can be reviewed by using the right-hand selection keys to view either the "PREVIOUS" or "NEXT" Event. For example, if 13 Events have been stored, pressing the "PREVIOUS" selection key will page the display backwards through the stored screens until reaching Event 4, the tenth screen back from Event 13.

The Event display screen automatically returns to the Data Display after 30 seconds. To return to the Data Display immediately, press the "DATA" key within the System Control Keypad.

Note that turning the anesthesia machine's System Power switch to the "STANDBY" position will erase all of the logged Events and start the event numbering from Event 1 again.

Bargraph Display (Refer to Figure 25)

Pressing the "BARGRAPH" key calls up an array of vertical bargraphs for up to five vital variables: carbon dioxide, oxygen saturation, breathing system oxygen concentration, pulse rate, and blood pressure. The operator can, at a glance, obtain a qualitative assessment of the anesthesia machine/patient condition with the bargraph display.

A specific measured variable is assigned to a unique location on the display screen. Alarm limits show up as triangular pointers to the left of each vertical bargraph.

Inspiratory/End-Tidal CO₂ Bargraph Display

The carbon dioxide bargraph displays the partial pressure of carbon dioxide as measured by the CAPNOMED carbon dioxide monitor. The

lower edge of the shaded bar corresponds to the instantaneous CO₂ value.

O₂ Saturation Bargraph Display

The oxygen saturation bargraph displays the percent arterial hemoglobin saturation as measured by the O₂SATMED.

% Oxygen Bargraph Display

The oxygen concentration bargraph displays the breathing system oxygen concentration (usually inspiratory) measured by the O₂MED oxygen concentration monitor.

Pulse Rate Bargraph Display

The pulse rate for the Bargraph Display is first supplied by the O₂SATMED pulse oximeter; the reading is then labeled "OXI PULSE." If a pulse rate measurement is not available from the O₂SATMED, the SPHYGMOMED noninvasive blood pressure monitor supplies the pulse rate measurement, which is then labeled "NIBP PULSE." The Bargraph Display waits one minute before switching to the SPHYGMOMED pulse rate measurement.

Systolic/Diastolic Blood Pressure Bargraph Display

The systolic/diastolic blood pressure bargraph displays the systolic and diastolic blood pressure as measured by the SPHYGMOMED noninvasive blood pressure monitor. The lower edge of the shaded bar represents the diastolic blood pressure and the upper edge represents the systolic blood pressure. A reverse video bar represents the mean arterial pressure and another reverse video bar represents the instantaneous cuff inflation pressure. The NIBP sample age in minutes and seconds appears beneath the bargraph display.

CENTRAL MONITORING DISPLAY (continued)

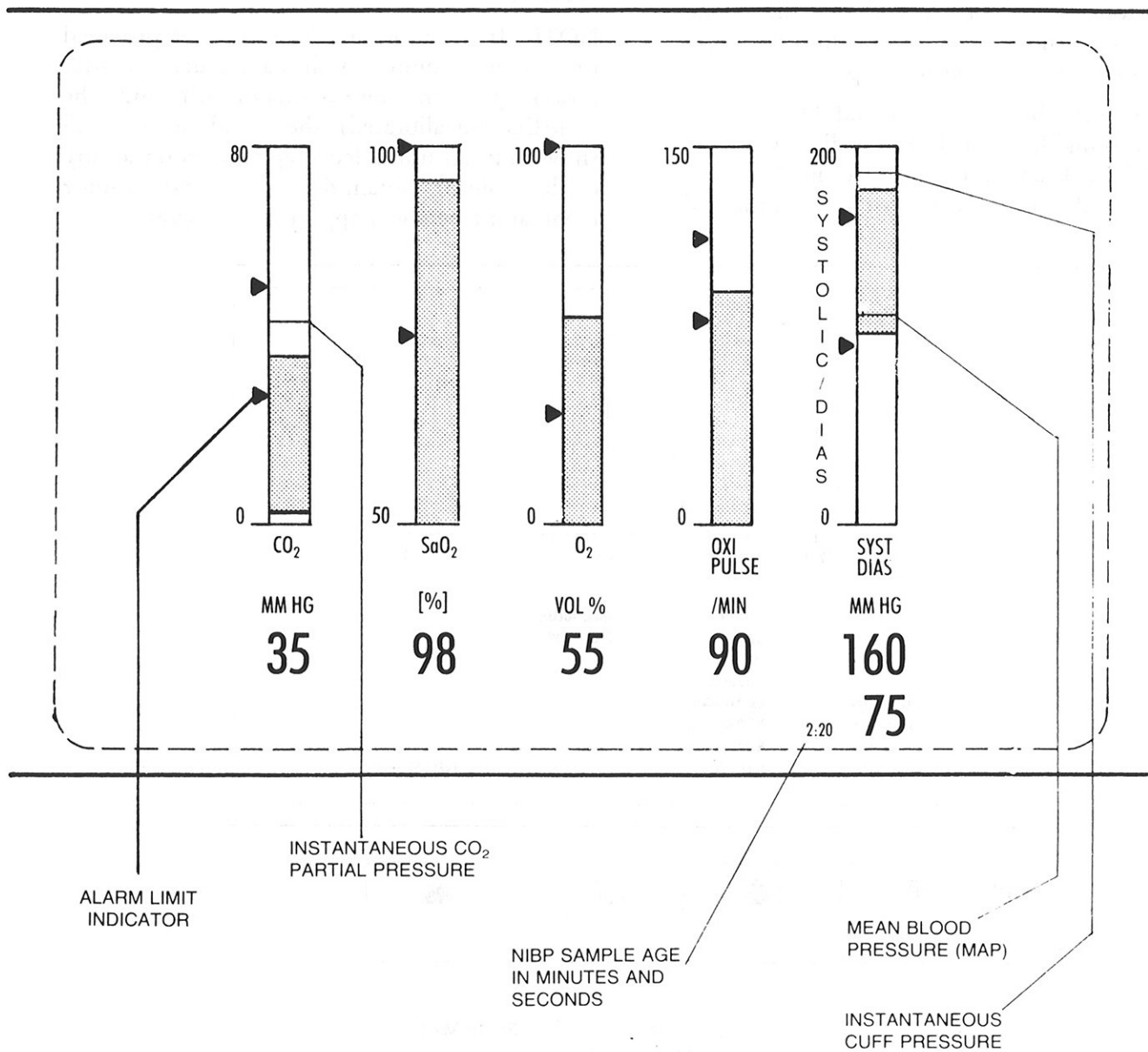


FIGURE 25: BARGRAPH DISPLAY

CENTRAL MONITORING DISPLAY (continued)

TREND MONITOR

Pressing the "TREND" key calls up the trend display (Fig. 26). As many as 16 measurements are automatically maintained in the trend monitor's memory; any of the measurements can be manually selected for display.

Selection keys beneath the Trend Monitor can be used to highlight labels on the display screen. A highlighted label must then be invoked with the "ENTER" key. Note that the highlighted

selection *does not* correspond to the current selection but rather to the selection that will be invoked when the "ENTER" key is next pressed.

NOTE: If the monitors have not yet provided the Trend Monitor with data (such as after power-up with the ventilator off and the O₂MED uncalibrated) the trend screen will show only an unlabeled graph. As soon as any of the monitors obtain data, the Trend Monitor menu and labels will appear on the screen.

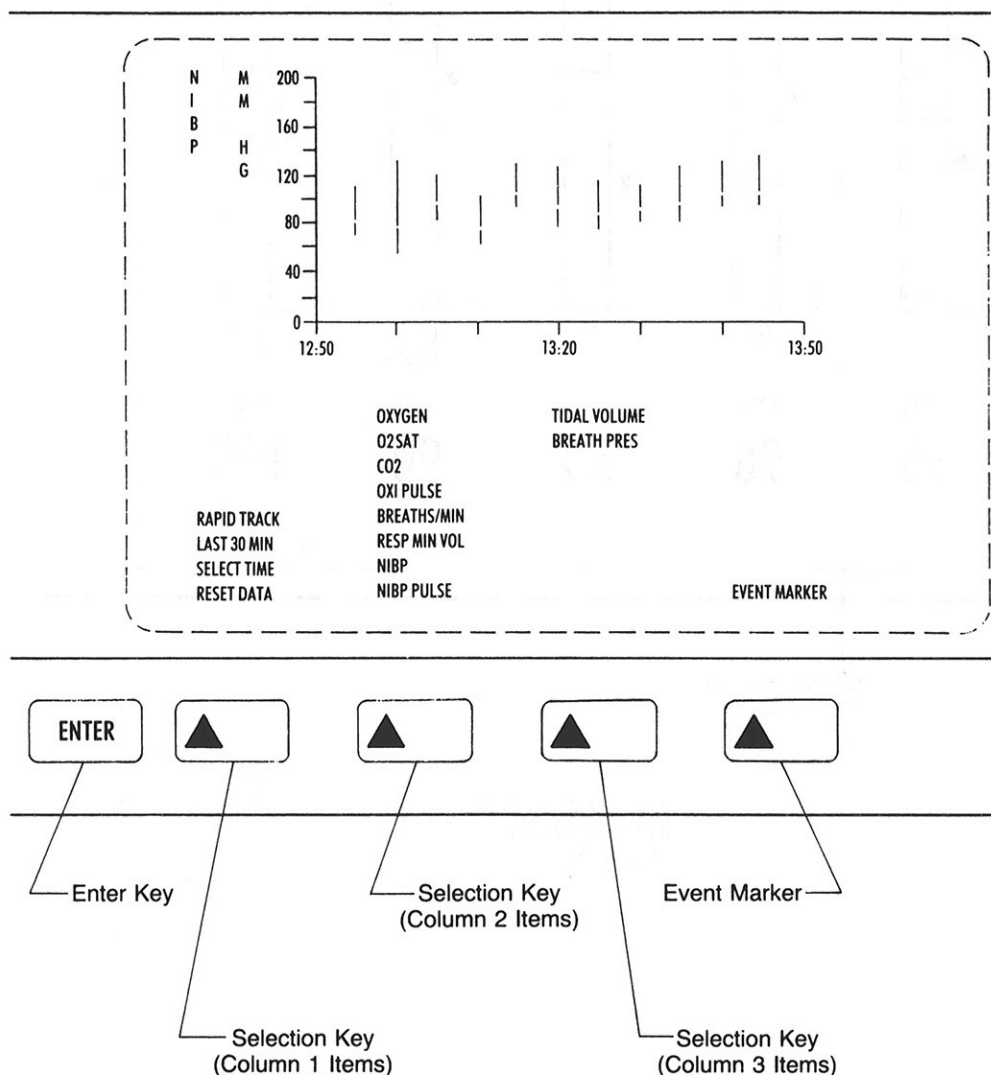


FIGURE 26: TREND MONITOR

Trend Graph Display

The variable selected for trending is displayed beside the trend graph's vertical axis and the horizontal axis is calibrated in *military time*. The vertical axis is calibrated in the appropriate units for the selected display variable. A line graph, representing the historical variations of the trended measurement, travels from left to right across the graph as new trend data accumulates. The Trend Monitor automatically adjusts the vertical axis scaling to accommodate the largest recorded measurement.

Trend Variable Selection

Trends for the 16 most significant measurements made by the Monitoring System are automatically maintained in the Trend Monitor. These variables are displayed in a two column table at the bottom of the display. To select a variable for display, use the selection key beneath the desired column to highlight a table entry, and then press the "ENTER" key.

In general, trends appear on the display as a single trace plotted against time. Following are three exceptions:

The NIBP trend appears as a vertical bar appearing at the point in time at which the sample was taken. The top and bottom of the bar represent systolic and diastolic pressure, respectively, and the gap in the bar represents the mean arterial pressure.

The CO₂ trend appears as a shaded area on the screen showing the CO₂ envelope, with the top of the area representing end-tidal CO₂ and the bottom representing inspiratory CO₂.

The Breathing Pressure trend appears as a shaded area on the screen showing the breathing pressure envelope, with the top of the area representing peak breathing pressure, the bottom representing PEEP, and the unshaded gap in the area representing the mean breathing pressure.

Trend Time Selection

To change the horizontal axis time scaling, use the key below the left-most column to highlight the "SELECT TIME" entry and then press the "ENTER" key. Pressing the same key beneath the left-most column will then sequentially display a series of time scale choices: 1 HR, 2 HR, 3 HR, 4 HR, 6 HR, or AUTO (automatic scaling). Pressing the "ENTER" key puts the selected time scale choice into effect.

The Trend Monitor rounds out the time scale labeling for ease of reading. As a result, the trend graph will sometimes show a gap on the left-hand portion of the display. This gap does not represent a loss of data but rather shows that data for that gap has not been trended.

The Trend Monitor prevents selection of a smaller time scale than the currently selected time scale. To select a smaller time scale, first enter the "SELECT TIME" feature and select the "AUTO" time scale choice. Then, enter the "RESET DATA" selection. This sequence of keystrokes will clear the Trend Monitor's memory (thus erasing all accumulated trend data) and allow selection of a smaller time scale.

Automatic Scaling

Pressing the "ENTER" key while the "AUTO" selection is displayed in the time scale window places the monitor into an automatic time scaling mode. Selecting this mode of operation does not change the currently displayed scale, but it automatically expands the time scale to the next time scale after the current trend line graph has filled the entire display. This time scaling mode is the power-on default selection.

Rapid Track

To invoke the rapid track mode of operation, highlight the "RAPID TRACK" entry in the left-most column and press the "ENTER" key. Rapid track trends the currently selected measurement on a six-minute time scale that begins

CENTRAL MONITORING DISPLAY (continued)

with the time of selection of rapid track. When the line graph reaches the right-hand side of the time scale, six minutes will have elapsed and the Trend Monitor will automatically return to normal trending.

This feature provides the operator with a detailed view of the response of a measurement to a specific set of conditions (i.e., O₂ flush).

Rapid track can be terminated at any time by pressing the "ENTER" key (since "TREND" is already highlighted in the left-hand column). The display then returns to the previously selected time scale selection.

Last 30 Minutes Command

To view the last 30 minutes of trend data in greater detail, the display can be *temporarily* reconfigured to show the trend during the previous 30 minutes. Highlighting the "LAST 30 MIN" entry in the left-most column and pressing the "ENTER" key invokes this display mode. One minute after the selection of this display mode, normal trend display is automatically resumed with the previously selected time scale. The "LAST 30 MIN" display can be exited at any time by pressing the "ENTER" selection key, which returns the display to normal trending.

NOTE: The "LAST 30 MIN" display provides a "snap-shot" view of trend data; the Trend Monitor does not add new data to this display.

Event Marker

To place a visible marker on the Trend Monitor's time scale, the display features an event marker. Pressing the selection key beneath the "EVENT MARKER" label on the screen displays an arrow beneath the time scale (on all of the trend screen selections) at the point in time that the key was pressed. The Trend Monitor provides for only one event marker at a time. Thus, pressing the "EVENT MARKER" key a second time erases the previous marker and inserts a new one at the present time on the display's time scale.

Reset Data Command

Trending of all variables can be restarted by highlighting the "RESET DATA" entry in the left-most column and pressing the "ENTER" key. At this point, any existing trend data is erased and trending is started again. This feature is particularly useful for erasing the unwanted trend data that accumulates during the setup and checkout of the machine prior to actual use with the patient.

REAL TIME TRACE MONITOR

Pressing the "TRACE" key calls up a real-time trace display on the right-hand display screen (Fig. 27). The display is capable of presenting two simultaneous traces from a choice of up to eight signals. Depending on monitor options, the choices may be: CO₂, N₂O, Halothane, Enflurane, Isoflurane, expiratory flow rate, breathing pressure, and pulse oximeter waveform.

Selection Keys

The three left-most keys are used to select which signals are to be displayed in the upper and lower traces. The key immediately to the right of the "ENTER" key corresponds to the upper trace of the display, and the second key to the right of the "ENTER" key corresponds to the lower trace. A selection is made by stepping through the available choices displayed sequentially directly above the key. Pressing the "ENTER" key while the selected choice is displayed will put the selection into effect and alter the display accordingly. If the "ENTER" key is not pressed within a short time, the display window above the key will be relabeled with the current trace.

Sweep Speed Control

The second key from the right controls the sweep speed for both waveform displays. Suc-

cessive keystrokes will toggle the sweep speed selection between "SLOW" (16 seconds) and "FAST" (8 seconds). The currently selected sweep speed selection is displayed against an illuminated background in the window directly above the sweep speed selection key. The unselected sweep speed is displayed against a dark background.

Waveform Sweep/Freeze Control

The right-most key freezes the display after the completion of the current sweep. Successive keystrokes will alternately freeze and unfreeze the display. The current display sweep/freeze state is identified against an illuminated background in the window directly above the sweep/freeze control key. The unselected sweep/freeze selection is displayed against a dark background. When in the sweep mode, a gap in the trace represents the division between the previous sweep and the current sweep.

Automatic Scaling

The Real-Time Trace Display calculates the average peak measurement and then automatically selects the appropriate vertical axis scaling. This feature ensures maximum use of the display's full resolution and reduces the amount of over-range displays.

CENTRAL MONITORING DISPLAY (continued)

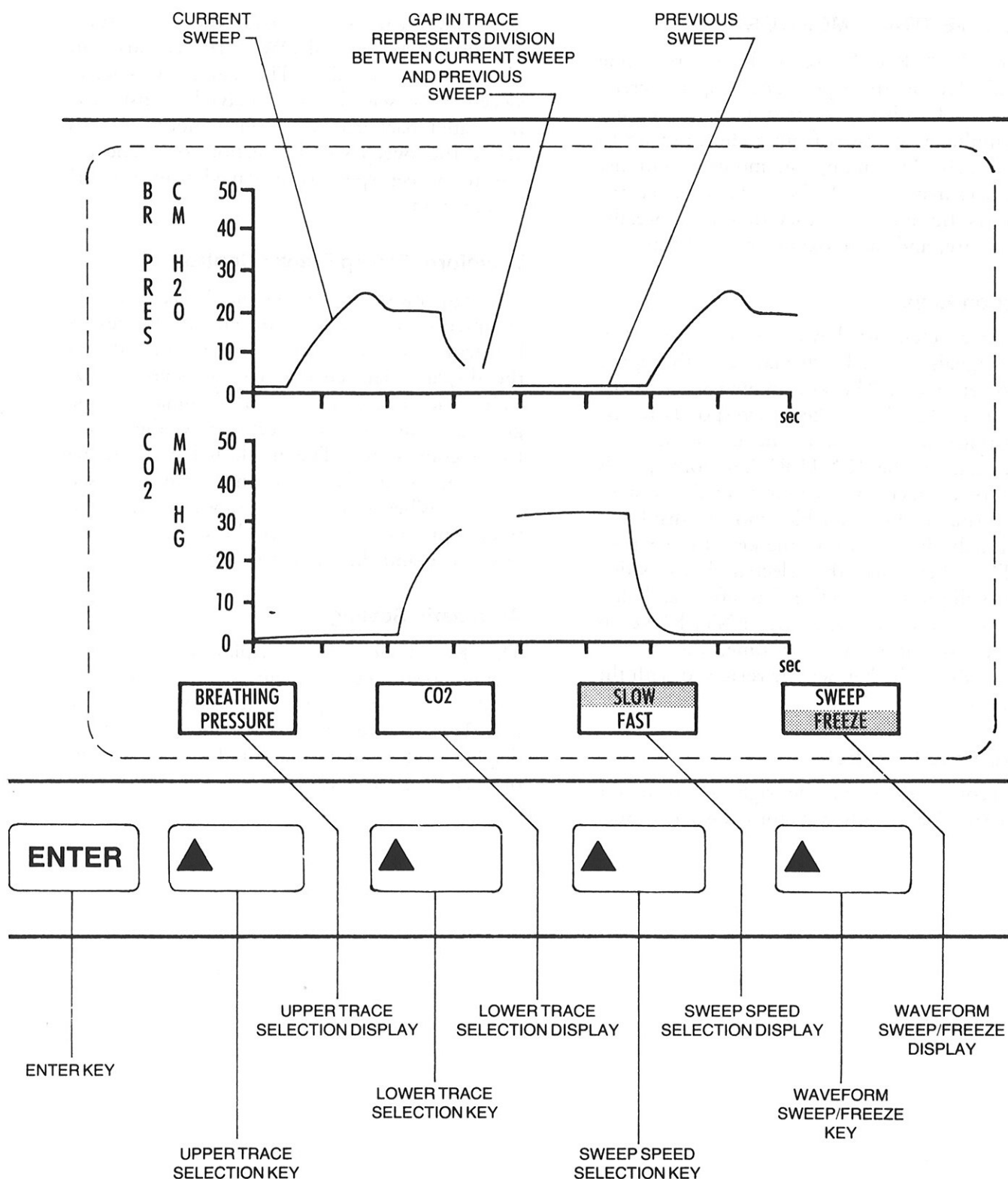


FIGURE 27: REAL TIME TRACE DISPLAY

SETUP & INSTALLATION

Initial Setup

Initial setup of a NARKOMED 3 Anesthesia Machine shall be by or under the direct supervision of an authorized North American Dräger service representative.

Vaporizers

Vaporizers shall be installed during the initial setup performed by an authorized North American Dräger service representative. After initial setup, if a vaporizer bypass block must be replaced with a vaporizer, this procedure must be performed by an authorized North American Dräger service representative. In addition, any such replacement must be followed by a *breathing and freshgas delivery system pressure test* as described in Step 26 of this manual's Pre-Use Checkout Procedure.

Auxiliary and Optional Equipment

Instructions for the installation and setup of auxiliary and optional equipment are included within the operator's manual supplied with each device.

Pipeline Connections

Pipeline connections for oxygen, nitrous oxide, and air (optional) are located on the side of the flowmeter housing (Fig. 28). Standard Diameter Indexed Safety System (DISS) male gas fittings are used for each gas.

Attach pipeline supply hoses as follows:

1. Turn the NARKOMED 3 System Power switch to "STANDBY" and close the re-

serve gas cylinders with the cylinder wrench tethered to the anesthesia machine.

2. Axially insert the stem in the center of the gas fitting on the supply hose into the corresponding stationary gas fitting on the side of the flowmeter housing and screw the supply hose nut onto the external thread of the stationary gas fitting in a clockwise direction (Fig. 28). If the hose fitting is equipped with a wing nut, a snug hand-tight fit is adequate. If a hex nut is provided, it should be tightened with a wrench.
3. Attach the other end of the supply hoses to the appropriate, functioning hospital pipeline supplies.
4. Check for sufficient pipeline pressure (50–55 psi) on the pressure gauge on the front of the NARKOMED 3.
5. Turn the NARKOMED 3 System Power switch to "ON".
6. Turn on the oxygen flow to 10 L/min and turn off all other gases.
7. Verify the delivery of pure oxygen to the patient breathing system by using the O₂MED oxygen analyzer. First, flush the patient breathing system repeatedly by pressing the O₂ flush button. Then, open the O₂ flow control valve to a flow of 8 L/min. With the O₂MED sensor mounted in the inspiratory valve dome, the monitor display window should read 100 ± 3% oxygen.
8. Close the O₂ flow control valve and turn the NARKOMED 3 System Power switch to "STANDBY."

SETUP & INSTALLATION (continued)

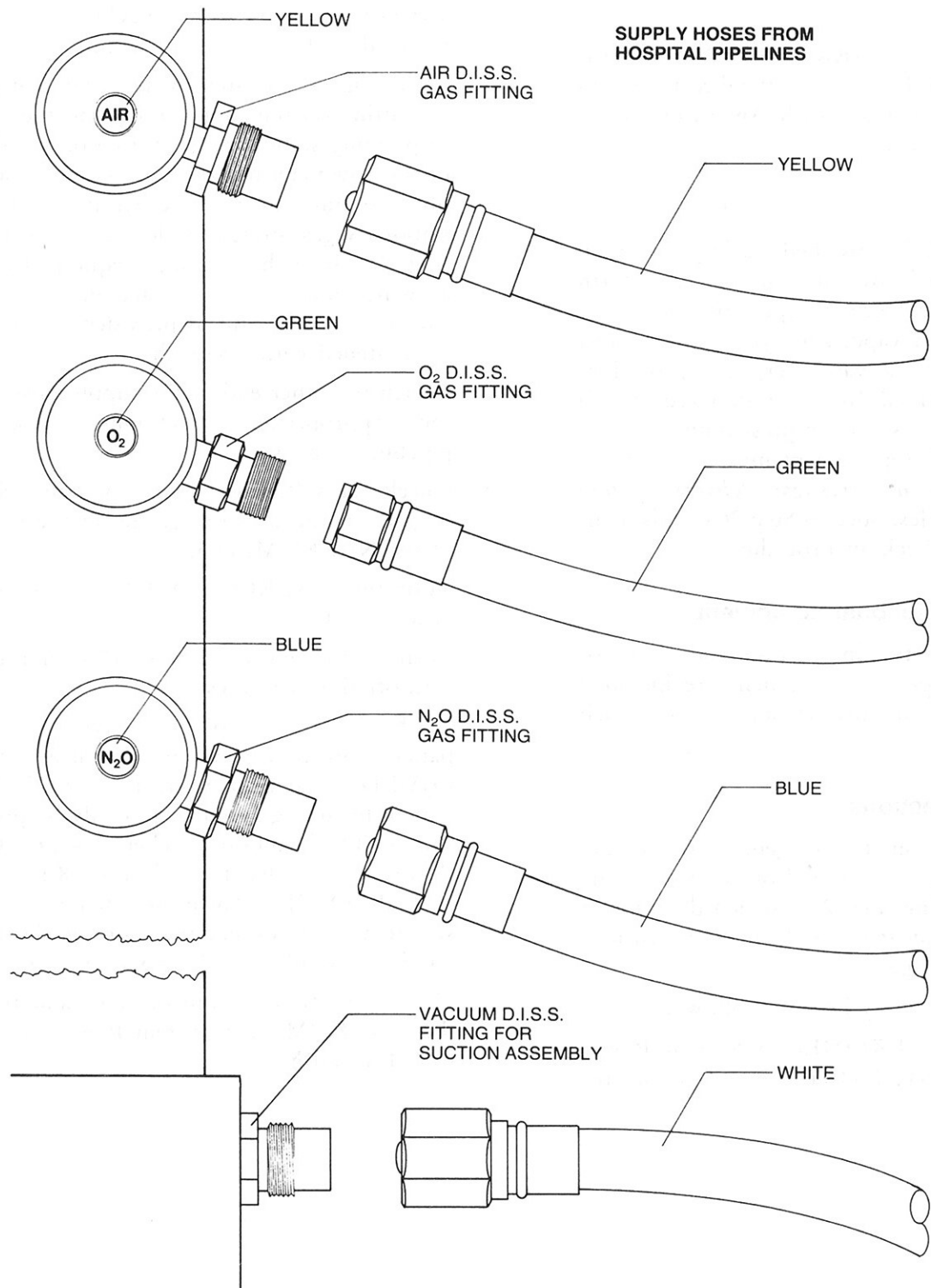


FIGURE 28: PIPELINE SUPPLY DISS FITTINGS AND SUPPLY HOSE CONNECTIONS (AIR OPTION)

SETUP & INSTALLATION (continued)

Cylinder Connections

The NARKOMED 3 is equipped with ANSI standard pin-indexed hanger yokes for E-size reserve gas cylinders. Reserve cylinders are attached as follows (see Fig. 29):

1. Turn the System Power switch to "STANDBY" and disconnect the hospital pipeline supply hose.
2. Remove the old sealing washer from the seat of the gas inlet in the yoke.
3. Insert a new washer onto the seat of the yoke gas inlet connection.
4. Verify the presence and integrity of the two index pins below the gas inlet.
5. Insert the head of a gas cylinder with matching gas color code into the yoke from below, such that the gas outlet and indexing holes on the cylinder head are facing the gas inlet and index pins on the yoke assembly.
6. Engage the indexing holes with the index pins and screw the yoke handle clockwise against the cylinder head, such that the point of the yoke handle bolt is aligned with the countersunk recess on the back of the cylinder head.
7. Verify that the sealing washer is in place, that the index pins are engaged, and that the cylinder hangs vertically. Tighten securely.
8. Open the cylinder valve by turning the cylinder valve stem in a counterclockwise direction, using the cylinder wrench tethered to the NARKOMED 3.
9. Check for adequate cylinder pressure on the pressure gauge on the anesthesia machine.
10. Turn the System Power switch to "ON" and verify the gas flow from the exchanged cylinder by opening the corresponding flow control valve and observing its flowmeter.
11. If the oxygen cylinder was exchanged, verify the delivery of pure oxygen to the patient breathing system by using the O₂MED oxygen analyzer.
12. Close the flow control valve(s) and turn the System Power switch to the "STANDBY" position.

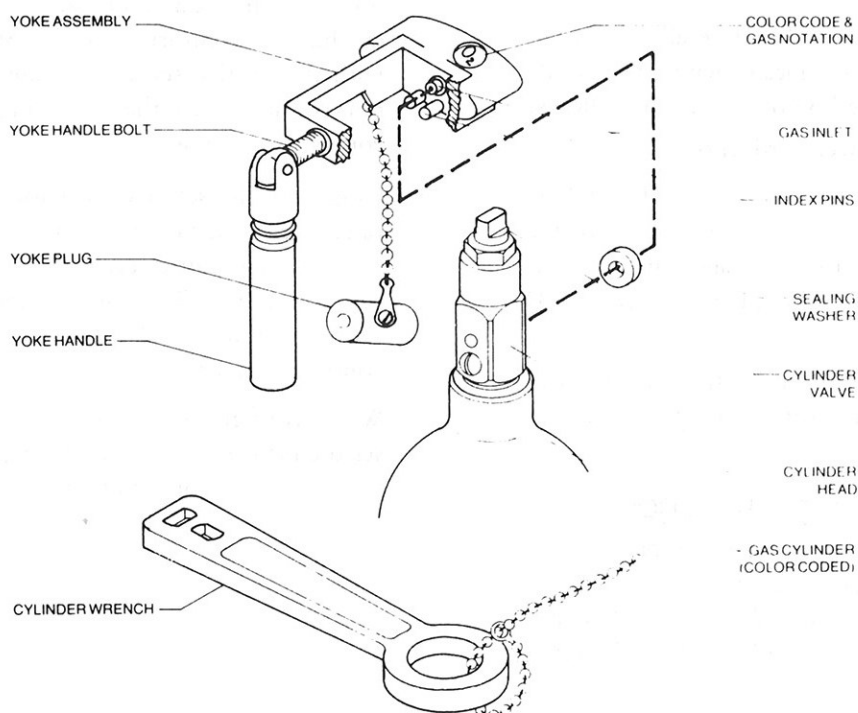


FIGURE 29: RESERVE GAS CYLINDER INSTALLATION

SETUP & INSTALLATION (continued)

Electrical Power Connection

The NARKOMED 3 is equipped with a 15A power cord and a hospital grade plug for 117 VAC primary electrical power. Attach the NARKOMED 3 to electrical power as follows:

1. Turn the NARKOMED 3 System Power switch to "STANDBY."
2. Unwrap sufficient length of power cord.
3. Plug the power cord into a 117 VAC hospital grade outlet.
4. Turn the System Power switch of the NARKOMED 3 to "ON." All monitors should now be activated.
5. Verify that the battery-in-use ("AC POWER FAIL") indicator on the alarm panel remains extinguished.
6. Verify that all circuit breakers, located on the lower right side of the frame, remain reset (i.e., pushed in).
7. Turn the System Power switch of the NARKOMED to "STANDBY."

Five Port Serial Interface (Optional)

An optional Five Port Serial Interface allows various external devices to communicate with the NARKOMED 3. A typical method of connection follows:

1. Plug the device's power cord into an AC outlet.

NOTE: Device's plugged into the NARKOMED 3's convenience receptacles contribute to the anesthesia machine's total leakage current. This total leakage current should not exceed 100 microamps.

2. Attach a data cable between the external device and one of the following ports on the NARKOMED 3:

PORT	DEVICE PROTOCOL
A	VITALINK or CO·WRITER or Printer
B	VITALINK or CO·WRITER
C	VITALINK or CO·WRITER or Printer
D	VITALINK or CO·WRITER or Printer
E	Reserved

The NARKOMED 3 uses a 9 pin connector (see Appendix 1 for pinout) with a DTE configuration for each serial port. Thus, when interfacing the NARKOMED 3 with a device that also has a DTE configuration, a straight-through cable can not be used. Instead, employ one of the following connections:

- a. Use the type of cable that interfaces an IBM PC AT (or compatible) with a user supplied device.

Attach the 9 pin connector to the appropriate port on the rear underside of the anesthesia machine's monitoring bank. Secure the cable with the captive screws provided. Attach the 25 pin connector to the serial port on the user supplied device.

- b. If not equipped with the type of cable mentioned above, the 30" DB9-DB25 (RS-232C) adapter cable supplied with the Five Port Serial Interface may be required to translate pin connections.

Attach the 9 pin connector to the appropriate port on the rear underside of the anesthesia machine's monitoring bank. Secure the cable with the captive screws provided. Attach the 25 pin connector to the user supplied cable that connects to the device.

3. Configure the selected port for the proper baud rate, parity, data bits, stop bits, and protocol using the configure serial interface function. (see configuration). When interfacing a printer, the print interval can also be selected through the configure screen.

When configuring a port for the CO·WRITER set the baud rate to 1200, the parity to even, data bits to 8, and stop bits to 1.

Absorber System

Install the absorber system (Figs. 30 & 31) as described below. This installation presumes the use of an appropriate scavenger system with the absorber system.

1. Slip the absorber mounting stud into the absorber pole on the swivel arm.
2. Tighten the set screw on the absorber pole to lock the absorber pole in place.
3. Pull the freshgas locking bar, located on the front of the NARKOMED 3, out to its extended position (Figs. 12 & 30). Insert the 15 mm male fitting on the freshgas hose axially into the 15 mm female terminal. Release the spring-loaded locking bar over the fitting, allowing it to "lock" the fitting into place.
4. Attach a 22 mm breathing hose (Fig. 31) between the ventilator bellows 22 mm terminal labeled "VENTILATOR HOSE" and the 22 mm terminal on the rear of the manual/automatic selector valve, which is also labeled "VENTILATOR HOSE."
5. Attach a 22 mm breathing hose (Fig. 30) between the 22 mm hose terminal on the inspiratory valve labeled "INSPIRATION" and one side of the Y-piece.
6. Similarly, attach another 22 mm breathing hose (Fig. 30) between the other side of the Y-piece and the 22 mm hose terminal on the expiratory valve labeled "EXPIRATION."
7. Attach the breathing bag to the swivel bag mount 22 mm terminal labeled "BREATHING BAG" (Fig. 30).
8. Connect the 19 mm scavenger hose between the 19 mm terminal (labeled "SCAVENGER HOSE") on the bottom of the absorber pole (Fig. 30) and the 19 mm terminal (labeled "SCAVENGER HOSE") on the scavenger (Fig. 31).
9. Attach the breathing pressure pilot line to the connector on the system interface panel labeled "BREATHING PRESSURE" (Fig. 31). If the shorter pilot line is used, it reads the pressure at the absorber top dome gas pipe by means of a quick-connect fitting. If the longer pilot line is used, it reads the pressure at or near the patient Y-piece, at either a 15 mm adapter with the appropriate Luer fitting or a Y-piece with the appropriate Luer fitting.
10. Connect the O₂MED sensor cord to the connector on the system interface panel labeled "OXYGEN SENSOR" (Fig. 31). Make sure that the O₂MED sensor assembly is properly mounted in the inspiratory valve dome.
11. Connect the 19 mm scavenger hose between the 19 mm terminal (labeled "SCAVENGER HOSE") on the rear of the APL valve and the 19 mm terminal (labeled "SCAVENGER HOSE") on the rear of the absorber pole (Fig. 30).
12. If a SPIROMED respiratory monitor is provided, install the volume sensor between the expiratory valve and the absorber (Fig. 30). Plug the sensor cord into the SPIROMED sensor connector on the system interface panel labeled "VOLUME SENSOR" (Fig. 31).
13. If a CAPNOMED CO₂ monitor is provided, install the sampling adapter on the 15 mm side of the Y-piece. Connect one end of the sampling line to the adapter and the other end to the Semi-Permeable Tube, which in turn connects to the Water Trap on the Patient Interface Panel (Fig. 31).
14. Verify the functional integrity of the breathing system by obstructing the patient side of the Y-piece and ventilating the breathing circuit. There should be a cyclic increase and decrease in the breathing pressure.
15. Verify the delivery of oxygen by delivering oxygen to the breathing circuit. The measured oxygen concentration should rise towards 100%.
16. Perform a complete Pre-Use Checkout Procedure as described in this manual.

SETUP & INSTALLATION (continued)

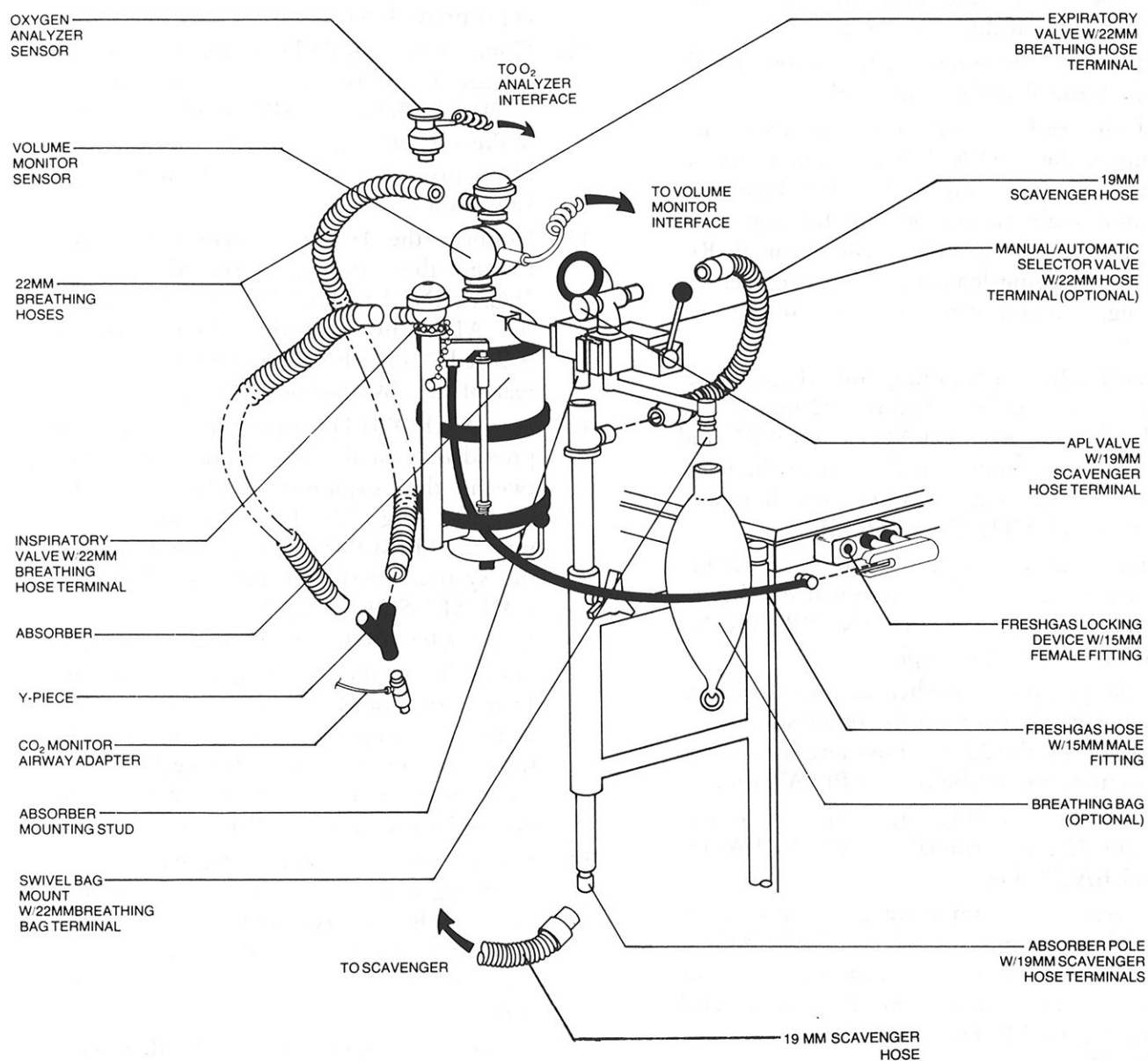


FIGURE 30: ABSORBER INSTALLATION (FRONT VIEW)

SETUP & INSTALLATION (continued)

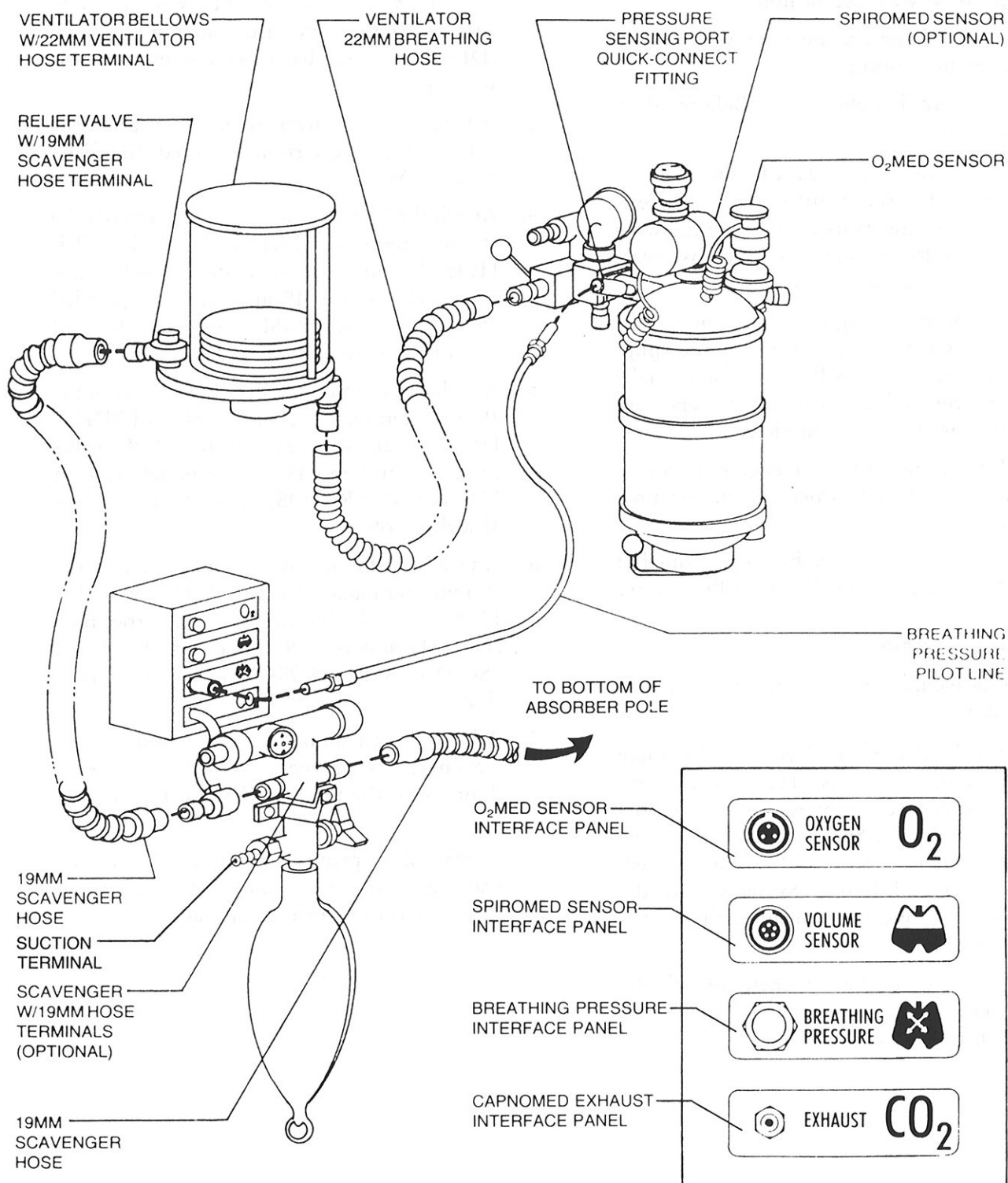


FIGURE 31: ABSORBER (REAR VIEW) AND SCAVENGER INSTALLATIONS

Ventilator Bellows Assemblies

The AV-E ventilator can be used with several bellows assembly options.

To install the Adult Bellows and Bellows Peep Valve Assembly:

1. Hold the assembly beneath the bellows canister so that the ventilator relief valve is on the rear of the canister. Line up the wing nuts on the lower surface of the base plate with the two canister rods.
2. Tighten the two wing nuts until the assembly engages with the canister rods and snugs up tight against the bellows canister. Make sure that the seal between canister and bellows base is even and complete.
3. Install breathing and scavenging hoses as described in the Absorber installation procedure.
4. Before use, test the assembly as described in Step 29 of the Pre-Use Checkout Procedure.

Scavenging System

Install the Scavenger Interface for Suction Systems as follows.

NOTE: North American Dräger sells three different scavenger systems. The following installation procedure applies only to the Scavenger Interface for Suction Systems. For installation instructions for the Scavenger Interface for Air Conditioning Systems and the Open Reservoir Scavenger, consult each device's instruction manual.

1. Using the mounting bracket, install the scavenger on the side of the anesthesia unit as shown in Figure 31.
2. Attach a wall suction hose between the wall suction outlet and the suction terminal (DISS or hose barb w/adapter) on the scavenger.
3. Attach the scavenger reservoir bag to the scavenger at the terminal labeled "RESERVOIR BAG."
4. Attach the 19 mm scavenger hose between the 19 mm terminal (labeled "SCAVENGER HOSE") on the ventilator relief valve (Fig. 31) and the 19 mm terminal (labeled "SCAVENGER HOSE") on the left-hand side of the scavenger (Fig. 31).
5. Attach the 19 mm scavenger hose between the 19 mm terminal (labeled "SCAVENGER HOSE") on the rear of the APL valve (Fig. 30) and the 19 mm terminal (labeled "SCAVENGER HOSE") on the rear of the absorber pole.
6. Attach the 19 mm scavenger hose between the 19 mm terminal (labeled "SCAVENGER HOSE") on the bottom of the absorber pole (Fig. 31) and the 19 mm terminal (labeled "SCAVENGER HOSE") on the right-hand side of the scavenger (Fig. 31).
7. Adjust the vacuum valve wing nut on the scavenger to prevent overfilling or overdraining of the reservoir bag during ventilation.
8. Verify the proper functioning of the scavenger system. Check for excessive PEEP or NEEP during ventilation.

PRE-USE CHECKOUT PROCEDURE

Prior to operating the NARKOMED 3, the following checkout procedures shall be performed to ensure that the machine is ready for use. If the anesthesia machine fails any of these procedures identified by an asterisk (*), do not use the machine, and contact an authorized North American Dräger Service Representative.

NOTE: Do not insert any additional components into the anesthesia system after the checkout procedure has been started.

1. Enter the anesthesia machine serial number, located on the right rear leg, into the anesthesia record.
2. Verify the presence of a valid inspection sticker on the rear of the NARKOMED 3, indicating that the anesthesia machine has been serviced and inspected by an authorized North American Dräger service representative.
3. Verify the presence of a reserve cylinder wrench, tethered to the rear of the anesthesia machine, adjacent to one of the reserve cylinders.
4. Connect the electrical power cord to a live 117 VAC receptacle that will accept and properly ground the anesthesia machine's line power cord. DO NOT use "cheater" plugs.
5. Connect the hospital pipeline supply hoses from the anesthesia machine's DISS fittings to the appropriate wall outlet DISS fittings.
- *6. Calibrate the oxygen sensor: Expose the oxygen sensor to ambient air and perform a calibration. (See the *O₂MED Operator's Instruction Manual* for details.)
- *7. Verify that the correct gases are supplied to the anesthesia machine inlets.
- *8. Inspect the supply hoses for cracks or wear.
- *9. Check for sufficient pipeline pressure: The pressure for each gas, indicated on the pipeline pressure gauge below the flow control valves, should be 50–55 psi. Open the flow control valve for each gas to a

moderate value; the pressure indicated at the pipeline pressure gauge shall not decrease more than 5 psi.

- *10. Check the oxygen cylinder supplies:
 - a.) Disconnect the pipeline supply (if connected). With the reserve oxygen cylinder(s) closed, actuate the oxygen flush button on the front of the anesthesia machine. Hold the button in until the pipeline and cylinder pressure gauges indicate zero pressure.
 - b.) Verify the existence of 2 index pins in the yoke.
 - c.) Open the oxygen cylinder (or one of the cylinders if equipped with dual yokes) and check the cylinder pressure gauge. A full oxygen cylinder should indicate a pressure of about 2200 psi. Replace any cylinder less full than 600 psi. At least one cylinder should be nearly full.
Then, to check for a high pressure leak, close the cylinder and observe the cylinder pressure gauge for a decrease of the pressure indication.
 - d.) If equipped with dual oxygen reserve cylinder yokes, actuate the flush button again to empty the piping. Then repeat the above two steps for the second reserve cylinder.
- *11. Check the nitrous oxide cylinder supplies:
 - a.) Disconnect the pipeline supply (if connected). With the reserve cylinder(s) closed, open the nitrous oxide flow control valve until the nitrous oxide pipeline and cylinder pressure gauges indicate zero pressure.
 - b.) Verify the existence of 2 index pins in the yoke.
 - c.) Open the cylinder (or one of the cylinders if equipped with dual yokes) and check the cylinder pressure gauge. A full nitrous oxide cylinder should show a pressure gauge indication of about 745 psi. Replace any cylinder less full than 600 psi. At least one cylinder should be nearly full.

PRE-USE CHECKOUT PROCEDURE (continued)

Then, to check for a high pressure leak, close the cylinder and observe the cylinder pressure gauge for a decrease of the pressure indication.

d.) If equipped with dual nitrous oxide reserve cylinder yokes, flush the nitrous oxide piping again with the nitrous oxide flow control valve. Then repeat the above two steps for the second reserve cylinder.

- *12. Check additional gas cylinder supplies (optional):

a.) Disconnect the pipeline supply (applicable to air only). With the reserve cylinder closed, open the flow control valve until the cylinder and pipeline pressure gauges (air only) indicate zero pressure.

b.) Verify the existence of two index pins in the yoke.

c.) Open the cylinder and check the cylinder pressure gauge. Replace the cylinder if its contents are insufficient for the intended procedure. After checking the cylinder's pressure, close the cylinder and observe the cylinder pressure gauge for evidence of a high pressure leak.

- *13. Check for sufficient supply of liquid anesthetic in the vaporizer(s): The liquid level, as indicated by the vaporizer sight glass, must be between the minimum and maximum markings.

- *14. Check for tightness of the vaporizer fill and drain valves: The vaporizer fill and drain valves must be completely closed to prevent leakage of liquid anesthetic and freshgas.

- *15. Check the vaporizer exclusion device, which prevents more than one vaporizer from being activated simultaneously. Make sure that when each vaporizer handwheel is turned to a setting greater than "0", the others remain locked in their "0" positions. Then turn all vaporizers to the "0" position.

- *16. Check the function of the flowmeters: Adjust the flow control knob for each gas and verify the proper operation of the

corresponding flowmeters. The float shall move freely over the full range of each flowmeter.

- *17. Check the oxygen failure protection device: With all gases available on the machine set to a flow of about 1 L/min, discontinue the oxygen flow by disconnecting the oxygen pipeline supply hose and closing the oxygen reserve cylinder(s). The flow of all other gases, as indicated by their flowmeters, shall decrease in proportion to the decrease in oxygen flow and eventually shut off.

- *18. Check the function of the ORMC: If the anesthesia machine includes an additional gas selector switch, set the switch to the "O₂ + N₂O" position. With the nitrous oxide flow control valve open to a flow of 10 L/min, vary the oxygen flow with the oxygen flow control valve. The nitrous oxide flow, as indicated on the nitrous oxide flowmeter, shall automatically vary in response to the adjustment of the oxygen flow control valve.

The ORMC shall maintain a freshgas oxygen/nitrous oxide flow ratio of at least $25 \pm 3\%$. The ORMC will maintain a freshgas oxygen concentration higher than 25% at low flows. The O₂/N₂O flow ratio alarm shall be activated while the ORMC is limiting the nitrous oxide flow.

- *19. Test the oxygen flush: Pressing the oxygen flush button must result in an audible gas flow sound, accompanied by a marked increase in oxygen concentration in the breathing system.

- *20. Verify the delivered oxygen concentration: Repeatedly flush the patient breathing system by pressing the O₂ flush button. Open the oxygen flow control valve to a flow of 8 L/min and close the other flow control valves. With the O₂MED sensor mounted in the inspiratory valve dome, the O₂MED display window should read $100 \pm 3\%$ oxygen concentration.

PRE-USE CHECKOUT PROCEDURE (continued)

- *21. Open the oxygen flow control valve to an 8 L/min flow and close all other flow control valves. Sniff the gas coming from the freshgas common outlet. There should be no noticeable odor.
- *22. Check the backup battery: Pressing the "BATTERY TEST" button on the anesthesia machine's alarm panel shall result in the illumination of the green LED indicator directly to the left of the test button. The yellow "BATTERY LOW" LED indicator shall remain extinguished.
- *23. Check the hose connections in the breathing system (refer to Figures 30 & 31 in the SETUP & INSTALLATION section of this manual):
 - a.) The freshgas hose of the breathing system *intended for use* must be connected to the freshgas common outlet of the anesthesia machine.
 - b.) A 22 mm breathing hose shall be connected between the inspiratory valve on the absorber and the Y-piece.
 - c.) A 22 mm breathing hose shall be connected between the expiratory valve on the absorber and the Y-piece.
 - d.) A 22 mm breathing hose shall be connected between the ventilator breathing hose terminal and the manual/automatic selector valve breathing hose terminal.
 - e.) A breathing bag of sufficient capacity and appropriate construction shall be connected to the breathing bag terminal of the breathing system.
 - f.) If CO₂ monitoring is provided, the sample line shall be connected to the 15 mm patient side of the Y-piece.
 - g.) The breathing pressure pilot line shall be properly connected between the system sensor interface panel and either the absorber quick-connect fitting or the appropriate fitting at or near the patient Y-piece.
 - h.) A 19 mm scavenger hose shall be connected between the ventilator relief valve and the scavenger interface.
 - i.) A 19 mm scavenger hose shall be connected between the APL valve on the absorber and the 19 mm hose terminal on the rear of the absorber pole.
 - j.) A 19 mm scavenger hose shall be connected between the bottom of the absorber pole and the scavenger interface.
 - k.) Adjust the vacuum (for suction system scavengers) for the scavenging system as required.
 - l.) Check for water accumulation in the breathing and scavenger hoses, and in the absorber dust cup. Remove any water found.
- *24. Check the status of the absorbent in the absorber system: Ensure an adequate supply of CO₂ absorbent in the absorber system. Consult the absorbent manufacturer's literature and replace the absorbent when signs of exhausted absorbent are evident. Make sure that the color change represents the absorbent's true state of depletion and is not due to regeneration after a rest period.

Remove accumulated absorbent dust and water from the absorber dust cup. Absorbent is caustic and is a strong irritant to the eyes, skin, and respiratory tract. When emptying the absorber dust cup, take care not to spill its caustic contents.

PRE-USE CHECKOUT PROCEDURE (continued)

- *25. Check for free gas passage in the patient breathing system: With a surgical mask over your mouth, inhale and exhale through the breathing system (each limb individually if possible). Verify the unidirectional flow in each limb and then reconnect the tubing.

- *26. Perform a breathing and freshgas delivery system pressure test: This test detects leaks from the patient breathing system and freshgas delivery system.

To perform the test, first close all flow control valves on the anesthesia machine. Turn the System Power switch of the NARKOMED 3 to the "STANDBY" position. Turn the vaporizers to "0" concentration. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm breathing hose. Set the manual/automatic selector valve to "BAG." Close the APL valve by turning the knob fully clockwise to its stop position. Attach the supplied test terminal to the breathing bag mount. Connect a sphygmomanometer squeeze bulb (available from North American Dräger) to the hose barb on the test terminal. Pump the squeeze bulb by hand until the breathing system pressure gauge indicates pressure of at least 50 cm H₂O (not to exceed 80 cm H₂O). Observe the pressure drop at the breathing system pressure gauge. 30 seconds or longer shall be required for a pressure drop from 50 to 30 cm H₂O.

- *27. Check the function of the patient system relief valve (adjustable pressure limiting or "APL" valve): The APL valve must be capable of relieving excess gas from the breathing system into the scavenger system.

To check the APL valve's flow resistance, first set the manual/automatic selector valve to the "BAG" position. (This step is not necessary if you have the APL valve and bag mount without the manual/automatic selector valve.) Then remove the bag from the swivel arm bag mount.

Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm hose. Fully open the APL valve by turning the control knob fully counterclockwise to its stop position. Open the oxygen flow control valve to a flow of 8 L/min. Occlude the bag mount opening, and watch for a pressure increase on the breathing system pressure gauge. This pressure increase, a reflection of the valve's flow resistance, shall not exceed 2 cm H₂O.

- *28. Verify the safe performance of the suction scavenging system. With the scavenging system properly set up and operating, test for positive and negative pressure relief.

To test for negative pressure relief:

a.) Short circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose. Set the manual/automatic selector valve to the "BAG" position. Turn the APL valve fully counterclockwise.

b.) With the scavenger needle valve open enough to allow flow through the scavenger and all flow control valves on the anesthesia machine closed, occlude the absorber breathing bag mount. At this point, the absorber breathing pressure gauge shall indicate only a negligible negative pressure (no lower than -1.0 cm H₂O).

To test for positive pressure relief:

a.) Perform step A above.

b.) If the absorber system or ventilator bellows are equipped with a PEEP valve, turn the PEEP valve control knob fully counterclockwise to its lowest setting.

c.) Adjust the scavenger needle valve to a fully closed position by turning it fully clockwise.

d.) Open the oxygen flow control valve to a flow of 10 L/min and occlude the absorber breathing bag terminal. Push the O₂ flush button to inflate the scavenger reservoir bag.

PRE-USE CHECKOUT PROCEDURE (continued)

e.) The flow of oxygen shall now exit through the scavenger's positive pressure relief valve. At this point, the absorber system's breathing pressure gauge shall indicate a pressure less than 10.0 cm H₂O.

NOTE: To test the Scavenger Interface for Air Conditioning Systems and the Open Reservoir Scavenger refer to each device's instruction manual.

***29. Test the ventilator:**

a.) Check for proper pressure and flow at the Y-piece during the inspiratory and expiratory phases. Turn the anesthesia unit System Power switch and ventilator to the on position. Place the manual/automatic selector valve in the "AUTO" position. Adjust the oxygen flow control valve to a 3 L/min flow. Set the ventilator frequency to 3 BPM, the I:E ratio to 1:2, and the tidal volume to approximately one liter. Adjust the ventilator flow control to the maximum of the "low" zone on the flow gauge. Occlude the patient side of the Y-piece. Fill the ventilator bellows by pressing the O₂ flush button. Observe the breathing system pressure gauge as the ventilator cycles. The pressure gauge shall indicate a pressure in excess of 30 cm H₂O when the bellows has completed its downward travel. At the end of the expiratory phase when the bellows has completed its upward travel, the pressure should be about 2 cm H₂O.

b.) If the ventilator or absorber is equipped with a PEEP valve, verify the PEEP valve's performance. Attach a breathing bag to the patient Y-piece with an appropriate adapter such as a NAD combination mask elbow with a 22 mm male

fitting for the breathing bag and 15 mm male fitting for the Y-piece. With the manual/automatic selector valve in the "AUTO" position, set the ventilator to the desired frequency. Then adjust the PEEP valve to different values and observe the breathing system pressure gauge to verify performance. Turn the PEEP valve control knob fully counterclockwise to its lowest setting after the test has been completed.

***30.** Check the alarm limit settings: The NARKOMED 3 automatically sets monitor alarm limits (as well as other monitor parameters) to a default configuration when the System Power switch is turned on. Check these settings and adjust if necessary. Alarm limits may be adjusted at the beginning or during a procedure.

***31.** Test the alarm functions of all monitors: Simulate alarm conditions and check for appropriate alarm signals. Consult each monitor's operator's manual for details.

***32.** After the above check-out procedure has been performed, verify that the pipeline gas supply hoses are connected. Check the final positions of all controls, specifically the flow control valves, vaporizer controls, manual/automatic selector valve, PEEP valve control knob, APL valve control knob, ventilator on/off switch, and the System Power switch of the NARKOMED 3.

***33.** Flush the system with 100% oxygen by pressing the O₂ flush button.

NOTE: If a breathing system other than an absorber system is used, consult the checkout procedure for such a system in the appropriate manual.

CLEANING & STERILIZATION

Cleaning and sterilization should be performed according to hospital-established policies and procedures and according to the following additional specifications:

Accessory Equipment

For specific details of cleaning monitor sensors and the absorber system, refer to each device's operator's manual.

Surfaces

Painted, plated, and plastic surfaces of the NARKOMED 3 may be cleaned with a soft cloth moistened with an aqueous germicidal cleanser.

Mix the germicidal cleanser in accordance with instructions provided by the manufacturer. Use a moist wiping cloth only. Do not allow liquid to enter the interior of the NARKOMED 3.

DO NOT use solvent cleaners or abrasive cleaning agents on any surfaces of the NARKOMED 3.

DO NOT use anesthetic agents for cleaning purposes.

Ventilator Bellows

NOTE: The ventilator bellows assembly with an integral PEEP valve (Bellows PEEP Valve option) requires special cleaning/sterilization procedures. Consult the *Bellows PEEP Valve Instruction Manual* for specific instructions.

The bellows assembly and the ventilator relief valve are the only ventilator components in contact with the patient's breath. Follow these step-by-step cleaning and sterilization procedures:

1. Remove the ventilator bellows assembly by loosening the two wing nuts at the bottom of the ventilator bellows canister.
2. Unscrew the knurled ring nut around the ventilator relief valve and pull the relief valve dome and pilot line away from the

relief valve body. Remove the ventilator bellows from the assembly by unscrewing it in a counterclockwise direction. Then the bellows assembly and all parts can be cleaned with a mild detergent solution followed by a distilled water rinse.

NOTE: Special care must be taken not to change the position of the adjustment lock ring on the ventilator relief valve dome. DO NOT attempt to loosen the knurled relief valve ring nut by twisting the pilot line hose barb.

3. Drip dry the assembly and all parts. If necessary the assembly and all parts can be sterilized in ethylene oxide gas, followed by shelf aeration for 24 hours or 8 hours aeration in an appropriate aeration cabinet.
4. After aeration, fit the relief valve dome onto the relief valve body, and tighten the knurled relief valve ring nut. Replace the ventilator bellows and then replace the entire bellows assembly into the bellows canister. Ensure that the ventilator relief valve pilot line is completely dry. If necessary, dry the line with compressed air or oxygen.
5. After reassembly, test automatic ventilation cycling as described in step 29 of the Pre-Use Checkout Procedure.

Rubber Goods

Follow hospital procedures and sterilizer manufacturer's instructions for the sterilization of hoses, breathing bags, and other components of the breathing system.

After sterilization with ethylene oxide, rubber goods should be allowed to properly aerate.

Inspiratory and Expiratory Valves

Refer to the detailed instructions in the *Absorber Systems Operator's Instruction Manual*.

PRECAUTIONS (MAINTENANCE & USE)

Warnings

Any person involved with the set-up, operation, or maintenance of the NARKOMED 3 anesthesia machine must be thoroughly familiar with this instruction manual.

This anesthesia system will not respond automatically to certain changes in patient condition, operator error, or failure of components. The system is designed to be operated under the constant surveillance and control of a qualified operator.

The "PRE-USE CHECKOUT PROCEDURE" of this manual must be performed prior to each case and must be performed in the room in which the anesthesia machine is to be used.

No third-party components shall be attached to the NARKOMED 3 anesthesia machine, ventilator, or breathing system (except for certain approved exceptions).

The NARKOMED 3 breathing system shall not be used in conjunction with any additional components that establish a flow direction.

Service of this machine shall be by an authorized representative of North American Dräger.

The NARKOMED 3 is designed for use with non-flammable anesthetic agents. Flammable anesthetic agents shall not be used with this equipment. As this machine is not suitable for use with flammable anesthetic agents such as ether and cyclopropane the use of antistatic breathing tubes and face masks is not necessary. The use of antistatic or electrically conductive breathing tubes when utilizing high frequency electric surgery equipment, may cause burns and is therefore not recommended in any application of this machine.

Oil and grease may combine explosively with oxygen or nitrous oxide. For this reason, oil and grease shall never be allowed to come in contact with cylinders, cylinder valves, gauges, fittings, etc., which conduct oxygen or nitrous oxide in the machine. For further information regarding safety precautions in the use of medi-

cal gases, consult the Compressed Gas Association Pamphlet P-2 and the appropriate sections of NFPA Standard 99.

Check reserve cylinder yokes for the presence of two index pins each time a cylinder is attached to the machine.

Use only one reserve cylinder gasket per yoke. The use of more than one gasket could cause leakage of the cylinder gas, and could compromise the pin indexing system.

Yoke checkvalves may not always provide a leak-free seal. Always place a yoke plug in each unused yoke to prevent leakage.

Vaporizers used with this machine must have an adjustment knob with a safety interlock cam.

Only one vaporizer shall be activated at a time. If the exclusion system permits simultaneous activation of more than one vaporizer, DO NOT use the anesthesia machine and contact an authorized NAD service representative for repairs.

The ORMC maintains a nominal O_2/N_2O freshgas flow ratio of at least $25 \pm 3\%$. Hypoxic freshgas mixtures may be delivered if an additional gas other than air is used.

Delivery hoses used between wall outlets and anesthesia machines have been the cause of accidents when, during assembly, an oxygen fitting has been placed on one end of the hose and a nitrous oxide fitting on the other end. Hoses must be carefully checked each time a machine is connected to wall or ceiling outlet to ensure that both ends of the hose are indexed for the same gas.

DO NOT pinch or kink the freshgas hose leading from the common freshgas outlet to the absorber.

Ensure that the locking device of the freshgas outlet is in its fully retracted position, thus properly securing the freshgas hose fitting.

The oxygen flow control valve is set to deliver a minimum O_2 flow of 150 ± 25 mL/min (unless the machine is optionally configured to elimi-

PRECAUTIONS (MAINTENANCE & USE) (continued)

nate the minimum O_2 flow or an additional air gas circuit is selected). Thus, to prevent waste or depletion of the oxygen supply, ensure that the System Power switch is in the "STANDBY" position when the machine is not in use.

The NARKOMED 3 shall only be used in conjunction with a functioning oxygen analyzer and breathing pressure monitor. In addition, an appropriate respirometer is highly recommended.

Cautions

When moving the NARKOMED 3, remove all monitors and equipment from the top shelf, remove the absorber system, and use only the handles provided. Take care when crossing thresholds and moving up or down ramps.

Devices plugged into the anesthesia machine's convenience receptacles contribute to the anesthesia system's total leakage current. This total leakage current shall not exceed 100 microamps.

Because of the risk of electric shock, do not remove any machine panels. Refer any servicing to qualified service personnel.

Unless the unit has been specifically modified to eliminate the minimum oxygen flow, the flow of oxygen cannot be totally shut off with the oxygen flow control valve. Do not force the oxygen flow control knob over the end stop of the valve. Forcing the knob could damage the delicate valve seat.

To ensure that gas supplies are at adequate pressure, pipeline pressure gauges should indicate steady pressures of at least 50–55 psi.

To ensure that the backup battery is in a continuously ready state, a successful Battery Test (i.e., "BATTERY TEST" green indicator illuminates) should be performed prior to each anesthesia procedure.

To test for erroneous flow indications due to a lodged flowmeter float, the individual flow control valves should be opened and closed in a manner sufficient to demonstrate the free movement of each float up and down the full range of its respective flowmeter tube.

To avoid leakage of anesthetic vapors into the operating room atmosphere from the vaporizer fillers, the vaporizer filler valves (Figs. 10 & 11) should be fully tightened (turned fully clockwise). Vaporizer drain valves also should be tightened fully clockwise.

To prevent leaks and misdirection of gas pathways, all hoses should be correctly and tightly fitted, as shown in Figures 30 & 31. Special care must be taken to ensure that all 19 mm hoses are attached to the proper 19 mm connectors. Possible machine malfunction and harm to the patient could occur if the scavenger hoses were attached to any 22 mm connection.

To ensure proper absorption of carbon dioxide, the CO_2 absorbent should be checked prior to use. To aid in this assessment, an absorbent should be used which contains an indicator that changes color as the absorbent becomes saturated with carbon dioxide. Absorbent showing a significant color change should not be used to begin a procedure. Make sure that the color change represents the absorbent's true state of depletion, and is not due to regeneration after a rest period.

To prevent excessive pressure from accumulating within the breathing circuit during spontaneous or manually assisted ventilation, the resistance of the fully-opened adjustable pressure limiting (APL) valve must not exceed 2 cm H_2O at an 8 L/min flow.

To ensure proper direction of gas flow during inspiratory and expiratory phases, (1) the inspiratory valve must provide free gas passage from the patient into the breathing system, and not allow backflow from the patient into the breathing system, (2) the expiratory valve must provide free gas passage exclusively from the patient to the breathing system, and (3) the disks in both valves should move freely without sticking.

To ensure that either the ventilator or breathing bag is properly engaged in the breathing circuit, the stick shift lever of the manual/automatic selector valve must be positioned properly. This

PRECAUTIONS (MAINTENANCE & USE) (continued)

lever must be positioned toward the operator for spontaneous breathing or manually assisted, bag ventilation. The word "BAG" shall be visible in the selector valve window. For automatic (ventilator-controlled) ventilation, the stick shift lever of the manual/automatic selector valve must be positioned away from the operator. The word "AUTO" shall be visible in the selector valve window. The manual/automatic selector valve shall not be used in an intermediate position, indicated by the color red visible in the valve window.

To minimize mechanical resistance to the patient's exhalation during spontaneous breathing, the control knob of the APL valve must be turned fully counterclockwise. For manually assisted or manually controlled ventilation, APL valve resistance must be increased, as desired, by clockwise rotation of the APL valve control knob.

Although designed to minimize the effects of ambient radio-frequency interference, the functioning of the NARKOMED 3 may be adversely affected by the operation of electrosurgical equipment or short wave or microwave diathermy equipment in the vicinity.

SPARE & REPLACEMENT PARTS

Part or Assembly	Description	Part Number
Breathing hose	22 mm x 23" LG	9995123 P
	22 mm x 40" LG	9995140 P
Scavenging hose	19 mm x 10" LG	9995210 P
	19 mm x 20" LG	9995220 P
	19 mm x 30" LG	9995230 P
Breathing bags	1.0 L	9995310 P
	2.0 L	9995320 P
	3.0 L	9995330 P
	4.0 L	9995340 P
	5.0 L	9995350 P
	Kuhn w/vent, 0.5 L	2114638 A
Suction scavenger reservoir bag	Blue, 5.0 L	9991885 P
Adult bellows	Replacement bellows	4106930 A
NARKOMED 3 Operator's Manual	Replacement Manual	4108980 P

APPENDIX 1: NARKOMED 3 SPECIFICATIONS

GENERAL

Maximum Dimensions	40 × 68 × 28 inches	(L × H × W)
Weight	450 lbs	(approximate)

ELECTRICAL

Primary input voltage	117 ± 10% @ 60 Hz or 100 ± 10% @ 50/60 Hz	(power supply – Japan)
Primary input current	≤ 10 amps ≤ 5 amps ≤ 5 amps	(RMS total) (machine) (receptacles)
Primary input power	≤ 1200 Watts	
Leakage current	≤ 100 μamps	
Ground impedance	≤ 0.1 ohm	(60 Hz source)
Dielectric withstand	≥ 1250 VAC	(per UL544)
Chassis resistance	≤ 0.1 ohm	(between any metallic point and ground pin on power cord)
Conductive caster resistance	≤ 250 Mohms	
Circuit breakers:		
Primary AC power input (machine)	5.0 amps AC	
Convenience receptacles	5.0 amps AC	
Reserve battery power	15.0 amps DC	
Back-up battery:		
Type	Sealed lead-acid, maintenance-free	
Charging time	≤ 16 hours	
Reserve power time	≥ 15 minutes	(AV-E ventilator, O ₂ MED, BAROMED, O ₂ SATMED and SPIROMED displays)

GAS DELIVERY SYSTEM

Pipeline inlet connections	DISS, male	(ANSI B57.1–1977)
Pipeline inlet pressure	50–55 psi	(O ₂ , N ₂ O, Air)
Cylinder connections	Pin-indexed hanger yokes	(ANSI B57.1–1977)

APPENDIX 1: NARKOMED 3 SPECIFICATIONS (continued)**GAS DELIVERY SYSTEM** (continued)

Cylinder pressures	(recommended maximum pressures)
O ₂ , Air, N ₂	2200 psi
N ₂ O	745 psi
CO ₂	830 psi
He	1650 psi

Common freshgas outlet 15mm, female

Flowmeter ranges & accuracies for standard flowmeters:

(ambient conditions of 20 degrees C and 760 mm Hg)

O ₂ , N ₂ O, AIR (Fine)	100–1000 mL/min	±3% FS
O ₂ , N ₂ O, AIR (Coarse)	1–10 L/min	±3% FS
CO ₂	0.05–0.9 L/min	±5% FS
He	0.2–5 L/min	±5% FS
N ₂	0.2–5 L/min	±5% FS
Auxiliary O ₂	0–10 L/min	±5% FS
O ₂ flush flowrate	55±10 L/min	(unmetered)

Vaporizers (Vapor 19.1)

Halothane

Adjustment range	0.2–5 vol%
Accuracy	±0.15 vol% or ±15% of setting whichever is greater

Enflurane

Adjustment range	0.3–7 vol%
Accuracy	±0.2 vol% or ±20% of setting, whichever is greater; for flow settings > 6 and < 15 L/min and handwheel settings > 5.0 vol%, accuracy is between –30% and +20% of setting

Isoflurane

Adjustment range	0.2–5 vol%
Accuracy	±0.15 vol% or ±15% of setting, whichever is greater

VENTILATOR

Frequency	1–99, BPM	(in 1 BPM steps)
I:E ratio	1:1–1:4.5	(in 0.5 steps)
Inspiratory flow	10–33 L/min	(uncalibrated)
Tidal volume	50–1500, ±100 mL	
PEEP (optional)	2–18 cm H ₂ O	(minimum, continuously adjustable)

APPENDIX 1: NARKOMED 3 SPECIFICATIONS (continued)**SERIAL INTERFACE** (optional)

Type: RS-232C, Five Ports, DTE

Pinout:

PIN#	PORT A	PORT B	PORT C	PORT D	PORT E
1	NC	NC	NC	NC	DCD
2	RxD	RxD	RxD	RxD	RxD
3	TxD	TxD	TxD	TxD	TxD
4	DTR	DTR	DTR	DTR	DTR
5	GND	GND	GND	GND	GND
6	NC	NC	NC	NC	NC
7	RTS	NC	NC	RTS	NC
8	CTS	NC	CTS	CTS	NC
9	NC	NC	NC	NC	NC
SHIELD	NC	NC	NC	NC	NC

Baud Rate: 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, or 19.2 K

Parity: Odd, Even, or None

Data Bits: 7 or 8

Stop Bits: 1 or 2

Protocol: Printer (01), CO-WRITER (02), VITALINK (03)

APPENDIX 2: NARKOMED 3 ALARM MESSAGES

NOTE: The following chart lists all alarm messages transmitted by the NARKOMED 3 and all monitors available at the time of printing.

CLASS	ALARM MESSAGE	CONDITION	AUDIO
WARNING	% OXYGEN LOW APNEA – VOL APNEA – CO2 APNEA – PRES SUB ATM PRES VENT PRES HI NO OXI PULSE OXI PULSE LO OXI SAT LOW	% O ₂ < low limit Apnea for 30 seconds Apnea for 30 seconds Apnea for 30 seconds Pressure < –10 cm H ₂ O Pressure > high limit No pulse for 10 seconds Pulse < low limit Saturation < low limit	CONTINUOUS
CAUTION	APNEA - VOL APNEA - CO2 APNEA - PRES CONTNG PRES PEEP > 25 LO O2 SUPPLY MIN VOL LOW OXI PULSE HI OXI SAT HIGH NIBP SYS LOW NIBP SYS HI ET CO2 HIGH ET CO2 LOW	Apnea for 15 seconds Apnea for 15 seconds Apnea for 15 seconds Pressure > threshold for 15 seconds PEEP ≥ 26 cm H ₂ O O ₂ supply pressure < 30 psi Minute volume < low limit Pulse > high limit Saturation > high limit Systolic < low limit Systolic > high limit End-tidal CO ₂ > high limit End-tidal CO ₂ < low limit	INTERMITTENT
ADVISORY	INSP CO2 HIGH CO2 CAL ERR O2/N2O LOW % OXYGEN HI O2 SENS DISC REVERSE FLOW AC PWR FAIL	Inspiratory CO ₂ > 5 mm Hg Bad CAPNOMED calibration data ORMC active % O ₂ > high limit Sensor cord disconnected Reverse flow > 20 mL NM3 not receiving line power	SINGLE TONE

APPENDIX 2: NARKOMED 3 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO
ADVISORY	CO2 WARMUP	CAPNOMED in reduced accuracy mode	NONE
	CO2 LINE BLK	CAPNOMED sample line blocked	
	CO2 NOT CAL	CAPNOMED not calibrated	
	CAL GAS OUT	No CAPNOMED calibration gas	
	THRESHOLD LO	BAROMED threshold set > 6 cm H ₂ O or > 8 cm H ₂ O from sensed peak	
	PEEP > 4	PEEP ≥ 5 cm H ₂ O	
	O2 NOT CAL	O ₂ MED not calibrated	
	O2 CAL DUE	> 18 hours since last O ₂ MED calibration	
	O2 CAL ERR	Bad O ₂ MED calibration data	
	O2 SENS ERR	O ₂ MED sensor error	
	TIDAL VOL LO	Tidal volume < 70 mL	
	VOL SEN DISC	Sensor cord disconnected	
	OXI SEN DISC	Sensor cord disconnected	
	BP CUFF DISC	SPHYGMOMED cuff disconnected	
	BP CUFF ERROR	SPHYGMOMED cuff error	
	BATTERY LOW	NM3 battery < 11 VDC	
	SPEAKER FAIL	NM3 primary speaker failure	
	COMM ERR	NM3 self-diagnostic	
	SILENCE XXX	Temporary NM3 audible alarm silence in effect	
	VENT OFF	AV-E ventilator power switch in off position	
	ORM ALRM OFF	ORMC alarm disabled	
	APNEA-P OFF	Apnea pressure (threshold) alarm disabled	
	CO2 ALRM OFF	CAPNOMED patient alarms disabled	
	O2 ALRM OFF	O ₂ MED patient alarms disabled	
	OXI ALRM OFF	O ₂ SATMED patient alarms disabled	
	VOL ALRM OFF	SPIROMED volume alarms disabled	
	NIBP STBY	SPHYGMOMED in Standby mode	

APPENDIX 2: NARKOMED 3 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO
ADVISORY	NIBP STAT	SPHYGMOMED in Maximum Rate mode	NONE
	BAROMED ERR	Self-diagnostic	
	CAPNOMED ERR	Self-diagnostic	
	O2MED ERR	Self-diagnostic	
	O2SATMED ERR	Self-diagnostic	
	SPHYGMOM ERR	Self-diagnostic	
	SPIROMED ERR	Self-diagnostic	
	EXT COMM ERR	Self-diagnostic	
	PORT A ERR	Communications Error	
	PORT B ERR	Communications Error	
	PORT C ERR	Communications Error	
	PORT D ERR	Communications Error	
	PORT E ERR	Communications Error	

APPENDIX 3: NARKOMED 3 TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	REMEDY
Excessive PEEP	Improperly adjusted ventilator relief valve	Contact NAD service
	Insufficient suction scavenger flow	Increase suction scavenger flow valve setting
	PEEP valve active	Decrease PEEP valve setting
Excessive NEEP	Excessive suction scavenger flow	Reduce suction scavenger flowrate
Bellows won't reach tidal volume setting stop during expiration	Frequency too high for selected tidal volume	Decrease frequency
		Increase expiratory phase time
	Improperly adjusted ventilator relief valve	Contact NAD service
Ventilator won't cycle	Frequency set to 00	Select correct frequency
	Low O ₂ supply pressure	Provide sufficient oxygen supply pressure
Bellows won't compress during inspiration	Manual/Automatic selector valve on absorber in "BAG" position	Place Manual/Automatic selector valve in "AUTO" position
	Inspiratory flow control setting on ventilator too low	Increase inspiratory flow
	Frequency too high	Decrease frequency

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NOTES



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4108836 A (NARKOMED 3 Anesthesia System)

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