



NORTH
AMERICAN
DRÄGER

OPERATOR'S INSTRUCTION MANUAL

**NARKOMED 3
ANESTHESIA SYSTEM**

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**NARKOMED 3
OPERATOR'S INSTRUCTION MANUAL**

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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 variety of different means depending on the institutional procedures, the preference of the operator, 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 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, 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. North American Dräger disclaims any liability arising from a degraded system due to an improperly designed or malfunctioning third party interfaced product.

WARRANTY

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

1. Defects caused by misuse, mishandling, tampering, 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. Respiratory volume sensors, fuel-cell oxygen sensors, and the MINUTE VOLUMETER have a six-month limited warranty. Fuel-cell oxygen sensor capsules have an eight-month limited warranty from the date of delivery.
4. Warranty for Durasensors® is limited to a period of six months from the 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.

Goods are subject to the terms of applicable warranty. Defective products will be accepted for return at North American Dräger's discretion, and only during the warranty period.

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 Warranty-Registration card and/or Periodic Manufacturer's Service record (if applicable) must be returned to North American Dräger 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.

TERMS AND CONDITIONS

All merchandise to be returned must have prior written authorization by North American Dräger, and a valid Return Material Authorization (RMA) Number shall appear on the shipping label, packing slip, purchase order and any other related documents.

When requesting authorization to return material, the following information should be provided:

1. Customer purchase order and date.
2. NAD order number, shipping date, and method of shipment (available from packing slip).
3. Invoice date and number.
4. Quantity, NAD product number, and description of merchandise to be returned.
5. Reason for return.

The following are accepted reasons for return of merchandise:

1. Material failure within the warranty period.
2. Repairs.
3. Customer order in error.
4. Sales/Service order entry error.
5. Shipping Errors.

Any shortages or errors in shipment of goods must be reported to North American Dräger within two (2) weeks of receipt.

Material is subject to the terms of any applicable warranty. Premature failure of products shall be accepted for return at North American Dräger's discretion, and only during the warranty period.

Material to be returned which is not under warranty should have been purchased within thirty days of request for return, and returned within thirty days after request. Material shall be returned unused, and in NAD shipping containers. Material shall be subject to a 20% restocking charge, with the exception of material failure within the warranty period or NAD error.

The following merchandise is not eligible for return, unless proven defective:

1. Sterile material, unless shipped in error by NAD.
2. Rubber and plastic components that have been used.
3. Specially ordered or produced items.
5. Material which has been altered or abused.

All items to be returned should be shipped to:

North American Dräger
 Technical Service Department
 24 Commerce Drive
 Telford, PA 18969
 Attn: Customer Service Department
 (Include RMA Number)

REPAIR AND SERVICE

Repair of this equipment must be performed by an authorized North American Dräger Technical Service Representative.

North American Dräger products/material in need of factory repair shall be sent to:

North American Dräger
Technical Service Department
24 Commerce Drive
Telford, PA 18969
(Include RMA Number)

North American Dräger recommends that anesthesia machines be serviced at three month intervals.

Periodic Manufacturer's Service Contracts are available for products manufactured by North American Dräger. These agreements are available from the NAD Inc. Technical Service Department or our Factory Authorized Technical Service Centers.

RESTRICTION

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

GENERAL DESCRIPTION

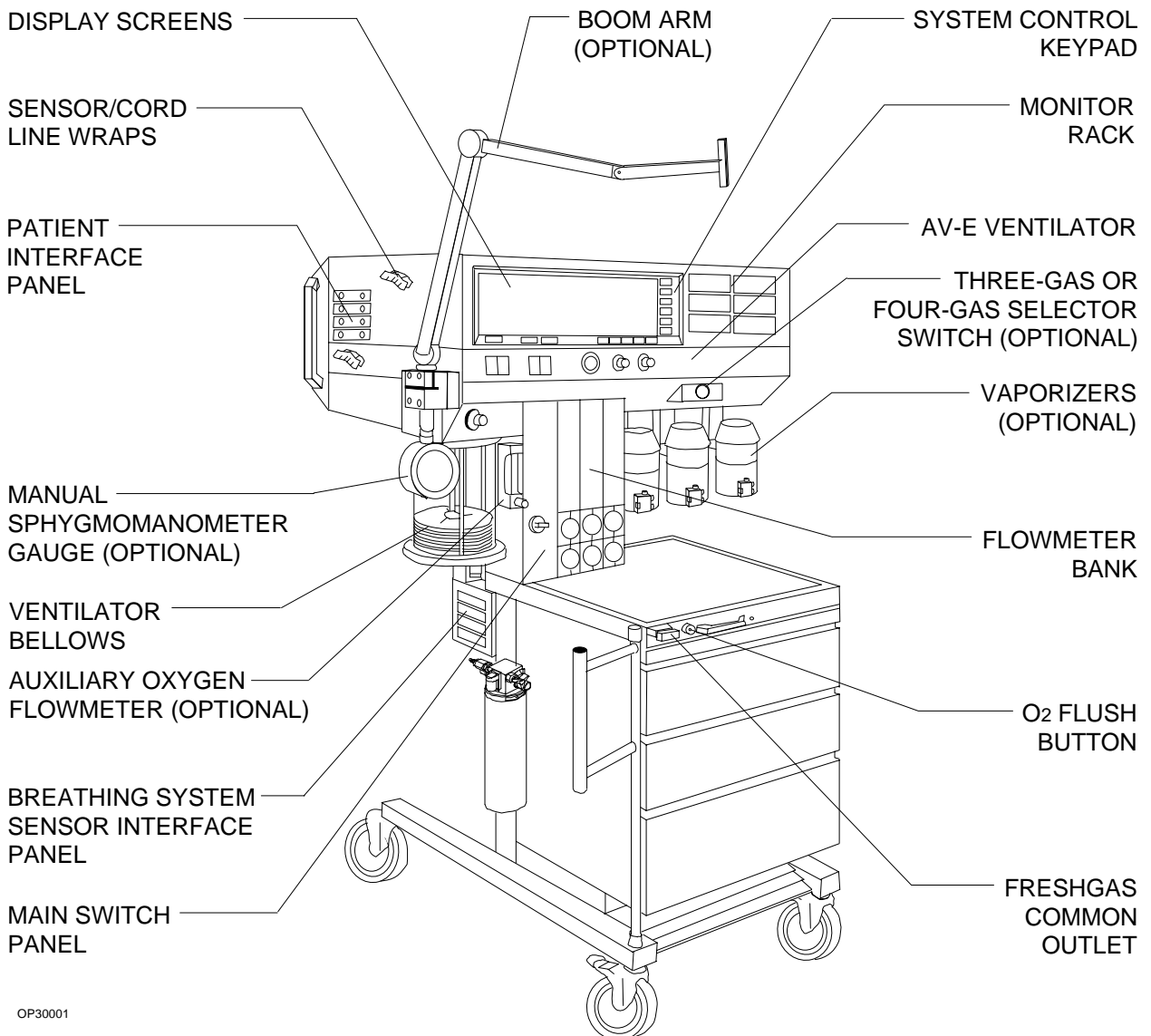
The NARKOMED® 3 is a continuous flow anesthesia system. All NARKOMED 3 machines are equipped with pneumatic circuitry, for mixing gases and liquid agent vapor, and a comprehensive monitoring system.

The pneumatic system is capable of delivering up to four gases simultaneously and one liquid anesthetic agent from a selection of up to three. Oxygen (O₂) and nitrous oxide (N₂O) are standard on all NARKOMED 3 machines. Optional gases are air, carbon dioxide (CO₂), and Oxygen-Helium (O₂-He).

Up to three optional vaporizers may be mounted on the vaporizer exclusion system. The optional vaporizers are Halothane, Enflurane and Isoflurane.

The vaporizers are mechanically interlocked so that only one vaporizer may be used at a time.

The anesthesia machine's monitoring system integrates the functions of the electronic monitors and organizes information from these monitors on two screens.



OP30001

Figure 1 NARKOMED 3 Anesthesia System, Front View

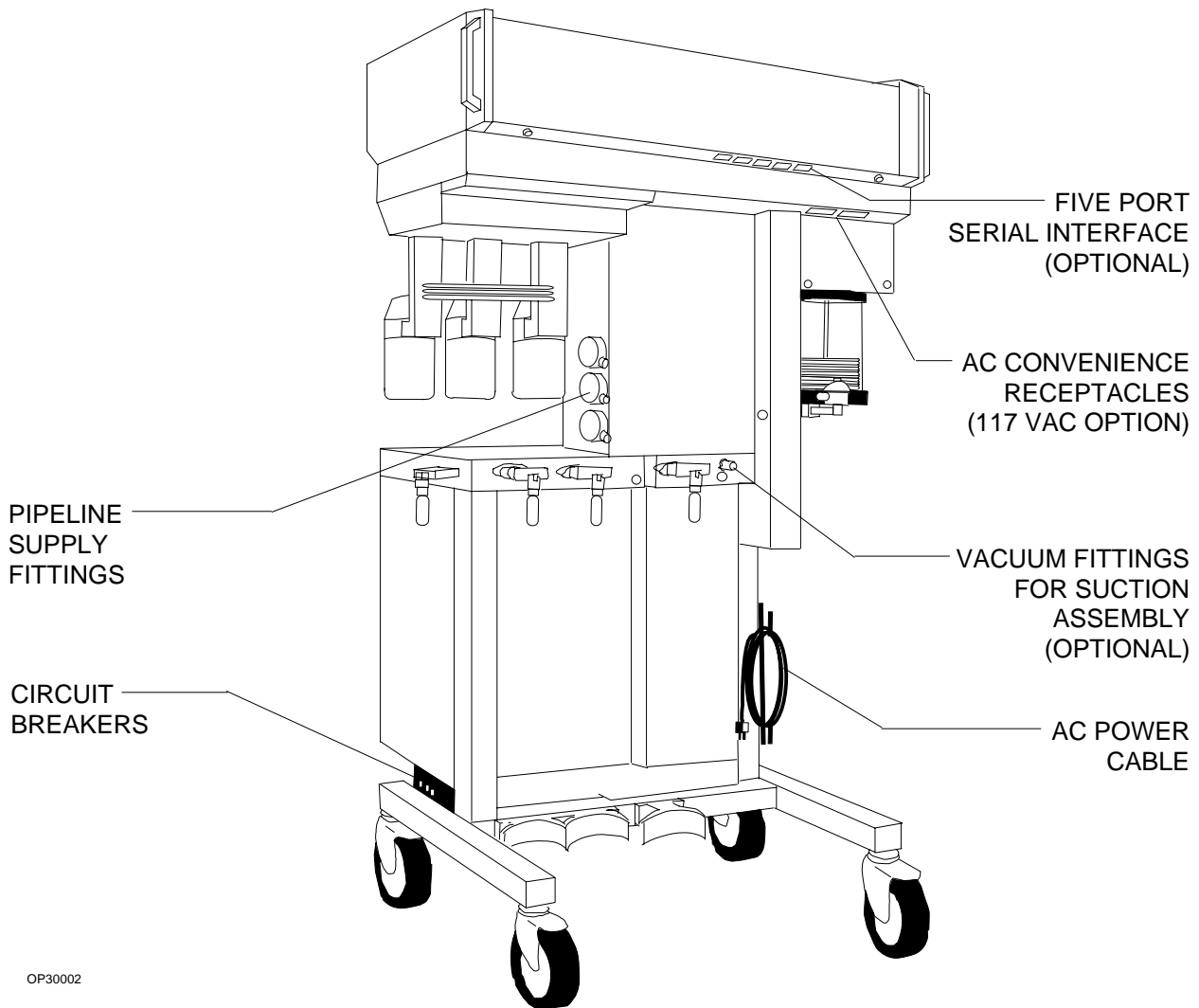
GENERAL DESCRIPTION (continued)

The monitoring package includes an oxygen analyzer, breathing pressure monitor, respiratory volume monitor, respiratory gas analyzer, pulse oximeter, and noninvasive blood pressure monitor. In addition, the anesthesia machine monitors all key anesthesia system functions (e.g., oxygen supply pressure, O₂/N₂O flow ratio, backup battery status).

The monitoring system organizes alarm messages into Warnings, Cautions, and Advisories, presenting them on the central alarm display.

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, trend, bargraph and data displays.

The NARKOMED 3 can be optionally equipped with an absorber system and/or a Bain circuit adapter. Two different scavenger systems are available, permitting the best match with the hospital's waste gas disposal system. An adjustable Positive End Expiratory Pressure (PEEP) valve is available on the ventilator or absorber assembly.



OP30002

Figure 2 NARKOMED 3 Anesthesia System, Back View

MOVING THE NARKOMED 3

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

Remove the Absorber System, along with any external monitors or equipment, before moving the anesthesia machine.

Retract the boom arm, before moving the anesthesia machine.

The NARKOMED 3 is equipped with two locking casters on the front 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 the casters are locked.

Exercise caution when moving the anesthesia machine on ramps, or over thresholds.

It is recommended that two people be used when moving the machine.

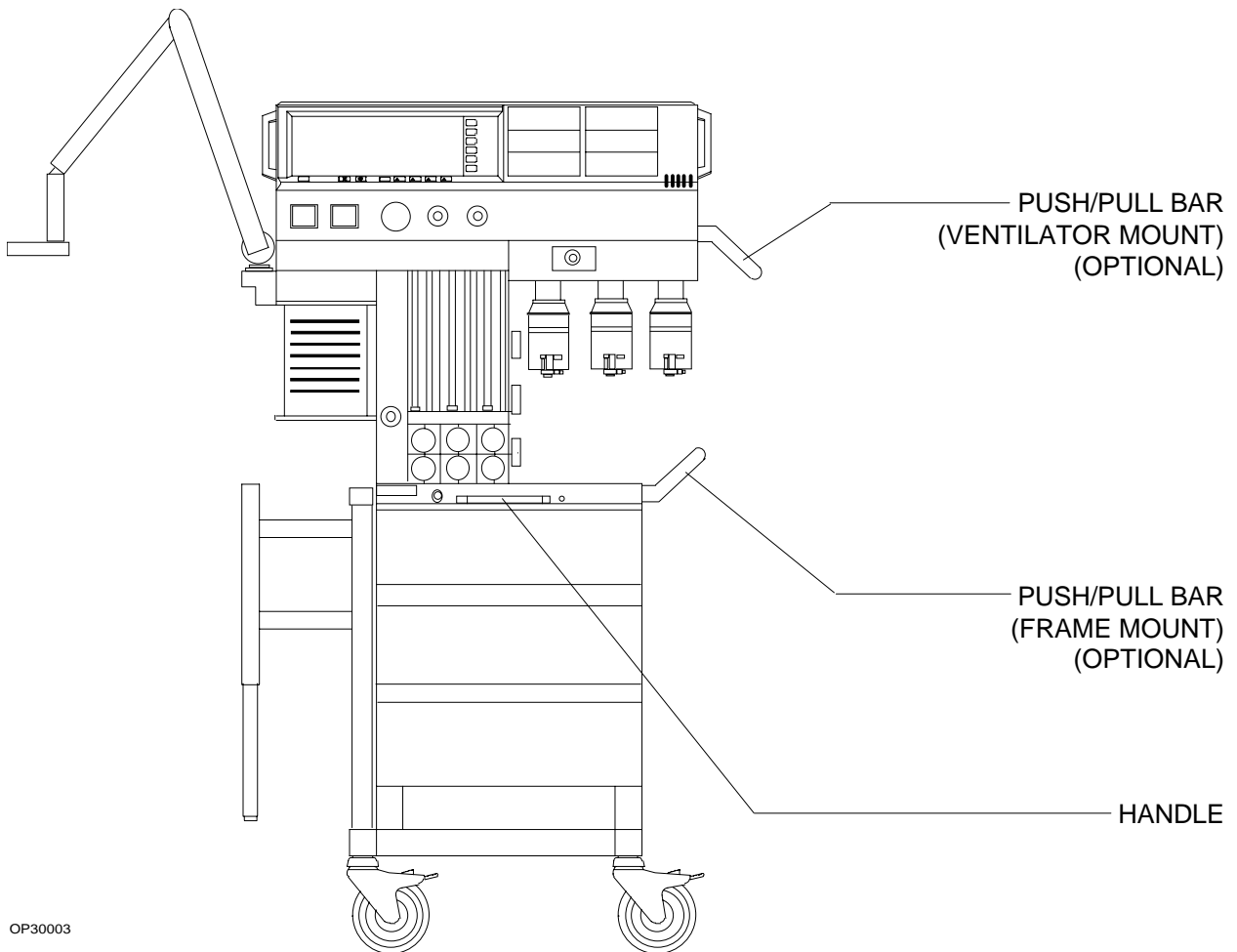


Figure 3 Acceptable Handles for Transportation

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 attachment of gas cylinders.

Optional Gases

In addition to oxygen and nitrous oxide, the NARKOMED 3 may be equipped with up to two additional gases. The additional gases may be air, oxygen-helium (O₂-He) mixture (25% O₂, 75% He) or carbon dioxide (CO₂). The additional gas is supplied to the anesthesia system by means of pin-indexed cylinders and yokes, diameter-indexed safety system (DISS) pipeline connections, or both (if so selected).

Color Coding

Each connection, valve, gauge, and flowmeter is labeled and color coded for the appropriate gas, as shown in the table below.

Pipeline Connections

The DISS gas fittings for oxygen, nitrous oxide, and an optional third gas are located on the right side of the flowmeter housing. The DISS fittings prevent improper connection of supply hoses. The inlets include check valves to prevent back 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 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	MARKING	COLOR CODE	
		U.S.	CANADA (CSA)
Air	AIR	Yellow	Black/White checkered
Carbon Dioxide	CO ₂	Gray	Gray
Oxygen-Helium	O ₂ -He	Green/Brown Diag. Stripes	White/Brown Diag. Stripes
Nitrous Oxide	N ₂ O	Blue	Blue
Oxygen	O ₂	Green	White

Gas Cylinder Yokes

The NARKOMED 3 can be equipped with a maximum of two oxygen and two nitrous oxide cylinder hanger yokes (Figure 4). An additional yoke for an optional third gas is also available. The cylinder is the primary supply for carbon dioxide and oxygen-helium.

To prevent a cylinder from being improperly connected, the yokes are labeled, color-coded, and keyed for gas-specific cylinders using the Pin Index Safety System.

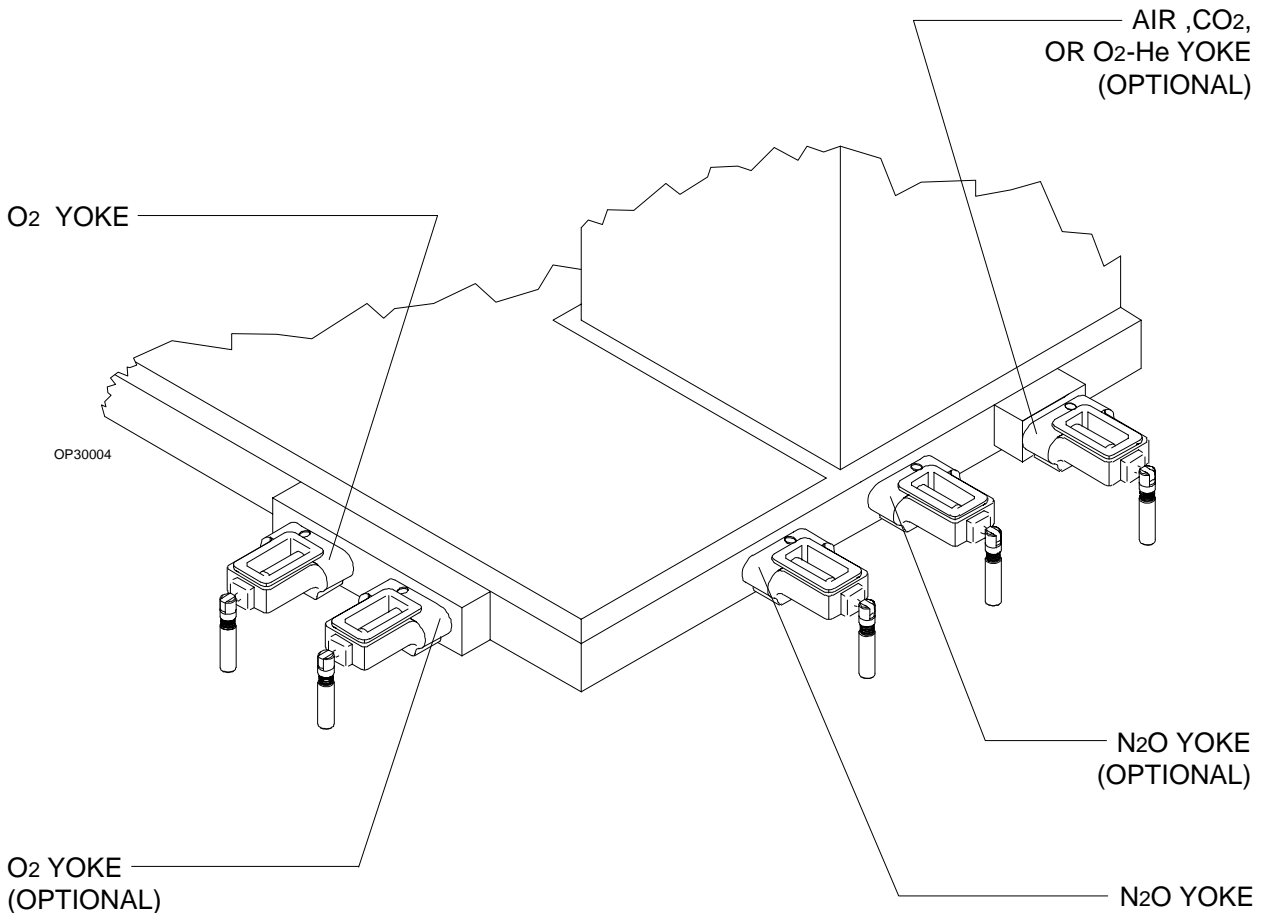


Figure 4 Gas Cylinder Yokes (Right, Rear View)

GAS DELIVERY SYSTEM (continued)

A sintered bronze filter within each yoke prevents foreign material from entering the internal gas piping of the NARKOMED 3. A check valve in each yoke prevents back flow into the cylinder or leakage into the atmosphere if the cylinder is not mounted on the yoke.

When the machine is configured with two yokes for the same gas, the check valve prevents migration of gas from one cylinder to another. If a cylinder is not mounted to a yoke, the attached yoke plug should be placed between the yoke handle's threaded bolt and the yoke's gas inlet.

When attaching a cylinder, ensure only one washer is installed between the cylinder and the yoke gas inlet. The use of multiple washers may compromise the Pin Index Safety System. The integrity of both index pins must be verified whenever a new cylinder is installed. Cylinders attached to the hanger yokes must contain gas at the recommended pressures outlined in the table below.

**RECOMMENDED RESERVE CYLINDER
MAXIMUM PRESSURES**

GAS	MAX PSI
Air	2200
Carbon Dioxide	830
Oxygen-Helium	2400
Nitrous Oxide	745
Oxygen	2200

Pressure Regulators

Each cylinder gas circuit incorporates a pressure regulator that reduces the gas pressure. These regulators are preset below the commonly used hospital pipeline pressure of 50-55 psi to ensure that gas will be supplied from the pipeline and not the cylinder if both sources of supply are open. Pressure relief valves, integral to the regulator, prevent excessive pressure in case of regulator failure or excessive pipeline pressure.

NOTE: Canadian machines are equipped with an additional pipeline overpressure relief valve that is set to open at 75 psi (520 kPa).

Cylinder Pressure Gauges

Each cylinder gas circuit on the NARKOMED 3 is provided with a cylinder pressure gauge, located at the bottom of the flowmeter panel on the front of the machine (Figures 5, 6, & 7). Each gauge is labeled and color-coded for its respective gas.

When a cylinder's valve is open, its pressure gauge indicates the gas pressure in the cylinder. The dial is marked with concentric scales in psi and kPa.

GAS DELIVERY SYSTEM (continued)

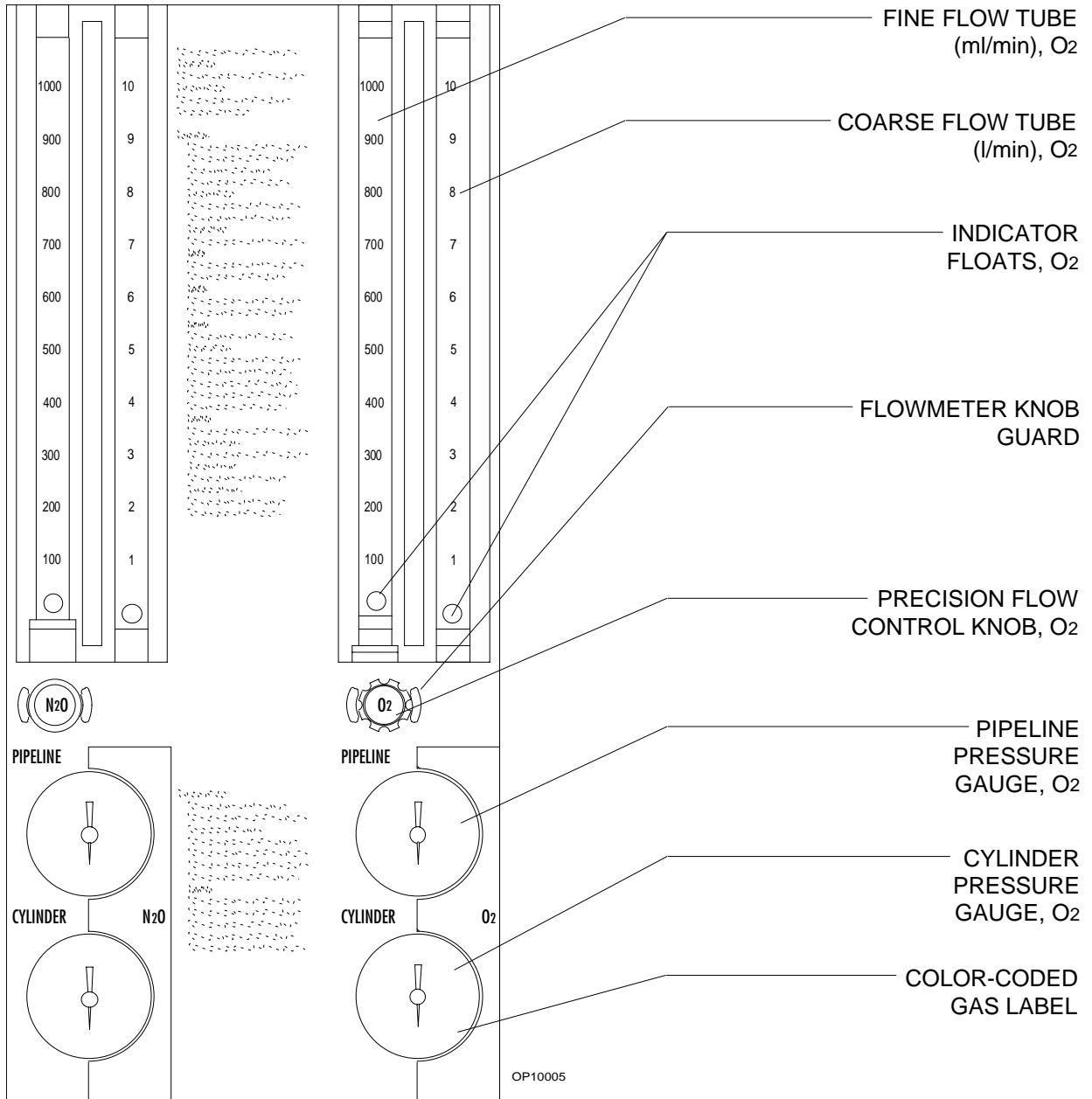


Figure 5 Standard Flowmeter Bank

GAS DELIVERY SYSTEM (continued)

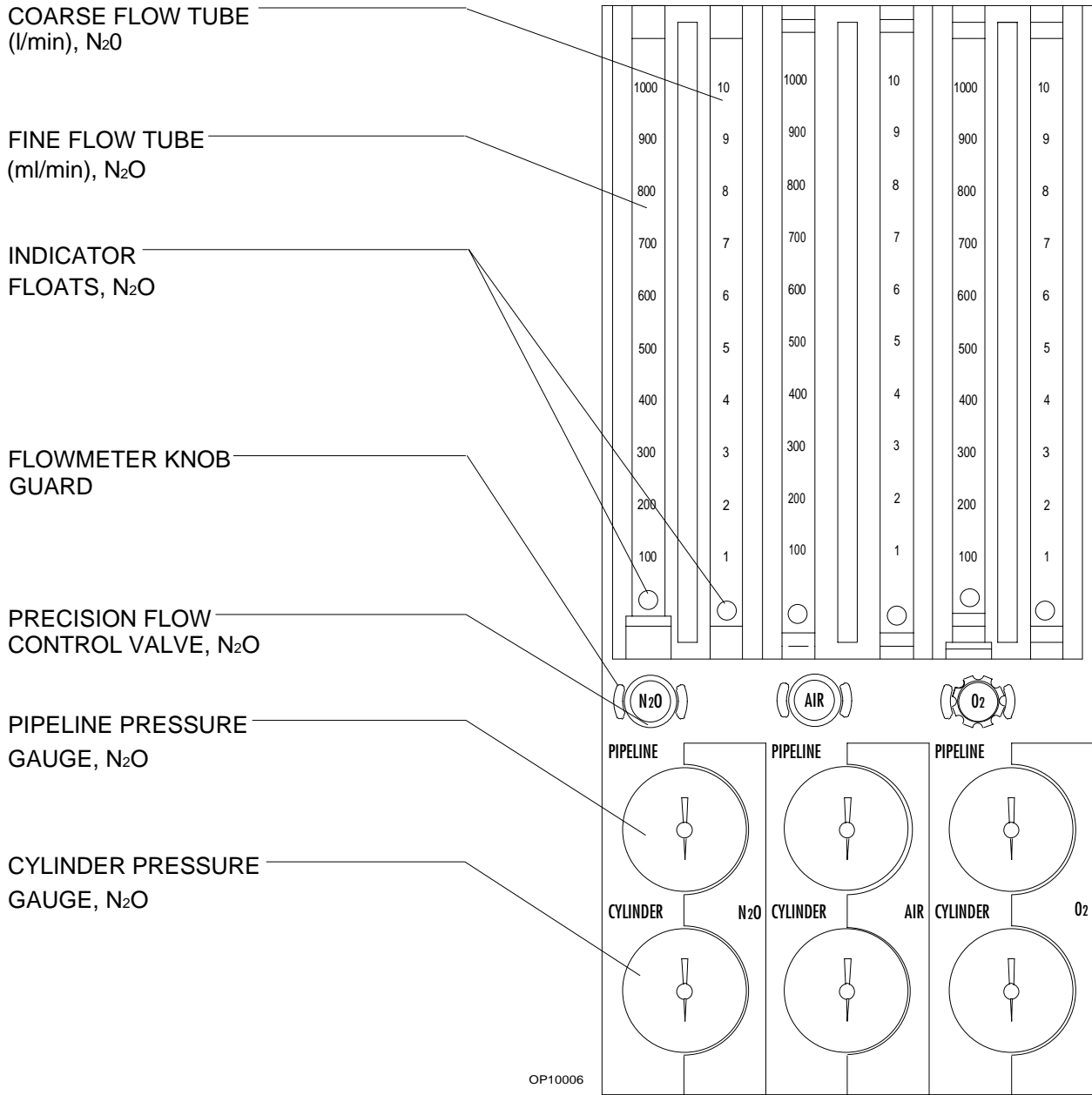


Figure 6 Three-Gas Flowmeter Bank (Air Option)

GAS DELIVERY SYSTEM (continued)

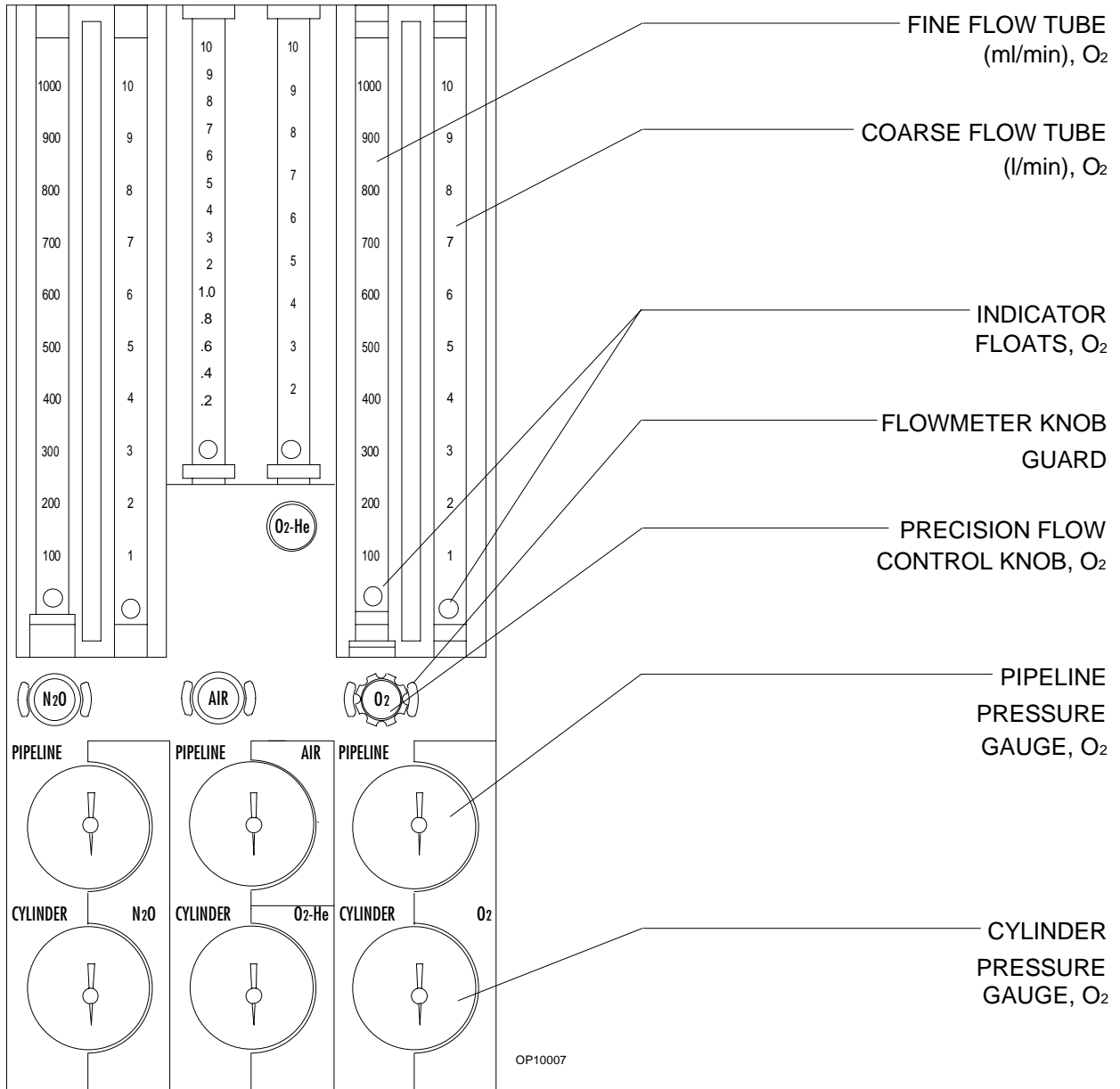


Figure 7 Four-Gas Flowmeter Bank (Air & Oxygen-Helium Option)

GAS DELIVERY SYSTEM (continued)

For non-liquefied gases (O₂, Air, O₂-He) the indicated pressure is proportional to the gas content of the cylinder. For liquefied gases (N₂O, CO₂) the gauge indicates the vapor pressure of the liquefied gas in the cylinder. This pressure remains constant until all of the liquid in the cylinder has vaporized. When the liquid has vaporized, the cylinder pressure decreases proportionally with further removal of gas from the cylinder.

NOTE: If 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 (Figures 5, 6, & 7). If the anesthesia machine is equipped with 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. 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. An excessively low pipeline pressure may activate the corresponding reserve cylinder and deplete its contents (if the reserve cylinder valve was left in the open position).

Carbon dioxide and oxygen-helium mixture supplies for NARKOMED 3 machines are provided exclusively from cylinders. Thus, these gases do not require pipeline pressure gauges.

Oxygen Supply Pressure Failure Protection Device (OFPD)

The oxygen failure protection device (OFPD) is a pneumatically operated valve located in the anesthesia machine's internal supply lines for all machine gas circuits except oxygen. The OFPD valve is controlled by the gas pressure in the oxygen supply line. Proper oxygen pressure keeps the valve open. A failure or reduction of pressure in the oxygen supply line will proportionally reduce and eventually shut off the supply of all other gases.

When the OFPD is activated, the flowmeters indicate a reduced gas flow, proportional to the reduction of oxygen supply pressure. When the oxygen supply pressure (from either pipeline or reserve cylinders) drops below approximately 37 psi, an "LO O₂ SUPPLY" alarm message appears on the central alarm display. The red "O₂ SUPPLY PRESSURE" indicator light on the main switch panel lights, and an intermittent audible alarm sounds.

If only one source 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 OFPD and "LO O₂ SUPPLY" alarm will not activate.

Flow Control Valves

A needle valve is located below the fine flowmeter tube for each specific gas. This valve is used to adjust the flow of gas (Figures 5, 6, & 7). Counterclockwise rotation of the valve knob increases flow, while clockwise rotation decreases flow.

A zero stop prevents damage to the flow control valve seats. 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. Also, the oxygen flow control valve is touch-coded with a deeply fluted knob.

Unless the anesthesia machine has been specifically modified to eliminate the minimum oxygen flow feature (see "Minimum Oxygen Flow"), the flow of oxygen cannot be totally shut off. 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 valve seat.

GAS DELIVERY SYSTEM (continued)**Flowmeters**

Flowmeters, located immediately above their corresponding flow control valves (Figures 5, 6 & 7), display the flow rate of each gas delivered for the fresh gas 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 other gases when supplied.

Oxygen, nitrous oxide, and air flowmeters are certified to be within $\pm 2.5\%$ of full scale at 20°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 table below.

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 flow rate. All flowmeters are labeled and color-coded at each end of the flowtube.

FLOWTUBE RANGES & ACCURACIES			
GAS	TUBE	RANGE (l/min)	ACCURACY (%FS)
Oxygen	Fine	0 - 1	± 2.5
Oxygen	Coarse	0 - 10	± 2.5
Nitrous Oxide	Fine	0 - 1	± 2.5
Nitrous Oxide	Coarse	0 - 10	± 2.5
Air	Fine	0 - 1	± 2.5
Air	Course	0 -10	± 2.5
Air	Dual Tapered	0 - 1	± 50 cc of range
		0 - 10	± 5
Oxygen-Helium	Single	0 - 10	± 5
Carbon Dioxide	Single	0- 1.0	± 5

GAS DELIVERY SYSTEM (continued)**Low-Flow Flowmeters (Optional)**

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 for low-flow anesthesia. They are calibrated as shown in the table below.

Auxiliary Oxygen Flowmeter (Optional)

For the delivery of a metered flow of pure oxygen (such as for the delivery of oxygen through a nasal cannula), an optional auxiliary oxygen flowmeter can be mounted on the left side of the flowmeter bank. It is calibrated from 0 to 10 l/min at an accuracy of $\pm 5\%$ of full scale. This flowmeter can be used with the machine turned off.

NOTE: The flow control valve for the auxiliary oxygen flowmeter does not include a zero stop. Do not over tighten.

Minimum Oxygen Flow

The oxygen dispensing system incorporates a calibrated bypass flow of 150 ± 50 ml/min (at 50 psi pipeline pressure), to ensure the delivery of some oxygen even if the flow control valve is 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 indicates that the anesthesia machine has been modified to eliminate minimum oxygen flow.

If air is an additional gas, when the gas selector switch is set to the "ALL GASES" position, the minimum oxygen flow is automatically disabled.

LOW-FLOW FLOWTUBE RANGES & ACCURACIES

GAS	TUBE	RANGE	ACCURACY
Oxygen	Fine	0 - 500 ml/min	$\pm 2.5\%$ (FS)
Oxygen	Coarse	0 - 10 l/min	$\pm 2.5\%$ (> 1 l/min) $\pm 15\%$ Rate (< 1 l/min)
Nitrous Oxide	Fine	0 - 500 ml/min	$\pm 2.5\%$ (FS)
Nitrous Oxide	Coarse	0 - 10 l/min	$\pm 2.5\%$ (> 1 l/min) $\pm 15\%$ Rate (< 1 l/min)

GAS DELIVERY SYSTEM (continued)**Oxygen Ratio Monitor/Controller (ORMC)**

The ORMC is a pneumatic O₂/N₂O interlock system designed to maintain a fresh gas oxygen concentration of at least 25 ±4 %. It permits independent control of the oxygen and nitrous oxide flows, but by proportionally limiting the nitrous oxide flow, the ORMC prevents a flow ratio that could result in a hypoxic fresh gas mixture.

The ORMC works by limiting the nitrous oxide flow whenever the operator selects oxygen and nitrous oxide flow control valve settings that would otherwise result in a hypoxic fresh gas 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 oxygen flow.

Due to rebreathing of previously exhaled gas in a circle system, lower fresh gas flows require a higher oxygen concentration to maintain a sufficient inspiratory oxygen concentration. For that reason, the ORMC is designed to maintain higher levels of oxygen in the fresh gas at lower flow rates. Figure 8 illustrates the ORMC's response curve.

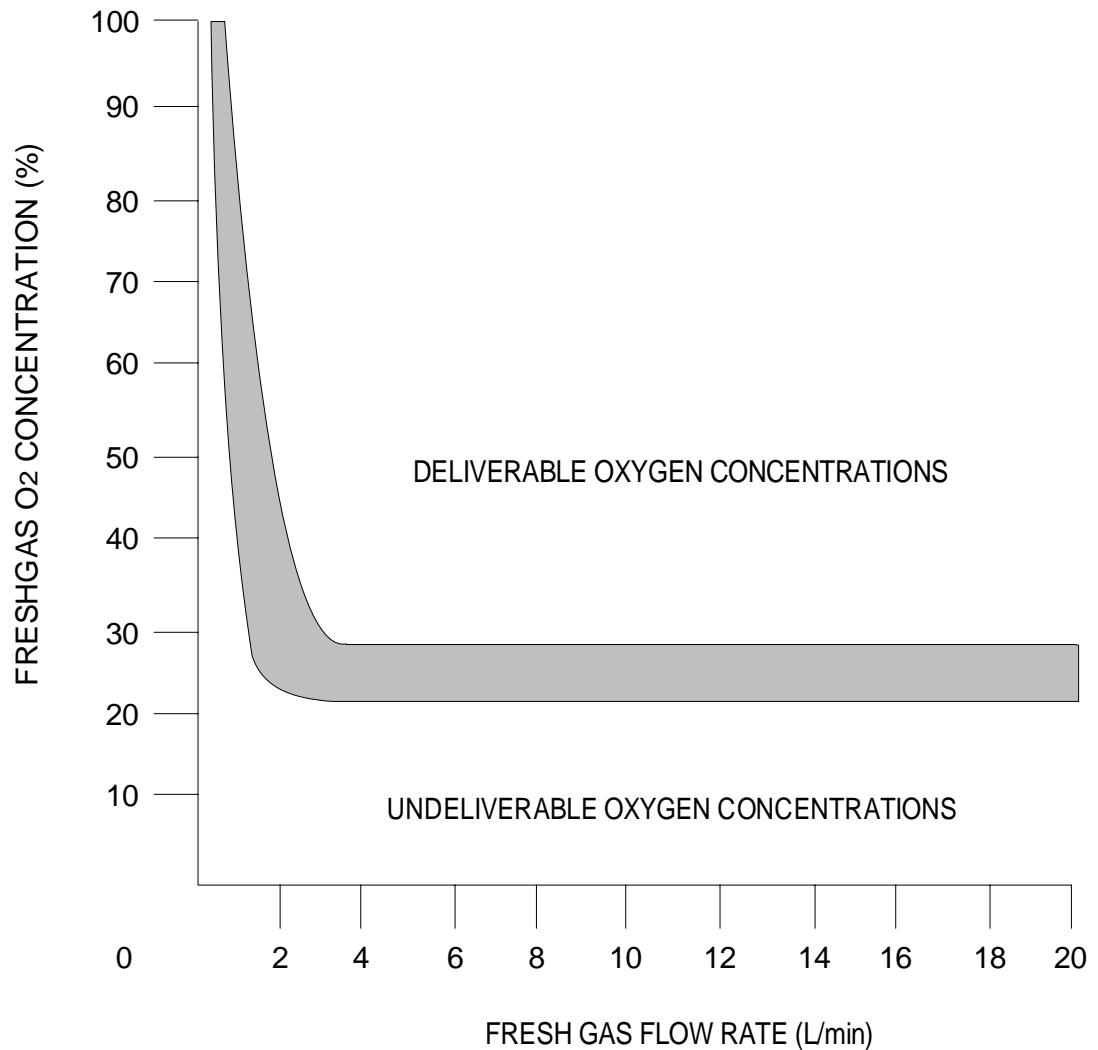
NOTE: At lower fresh gas flow rates, the ORMC maintains fresh gas oxygen concentrations well above 25% of the combined oxygen and nitrous oxide flow.

The ORMC interlocks only the flows of oxygen and nitrous oxide. Hypoxic fresh gas concentrations are possible if an additional gas other than air is used.

Gas Selector Switch (Optional)

Setting the gas selector switch to the "O₂ & N₂O" position permits oxygen and nitrous oxide flows to the appropriate flowmeter controls. This position also enables the minimum oxygen flow.

The "ALL GASES" position of the gas selector switch permits the additional gases to flow to their respective flowmeter controls, allowing a mixture of all gases. However, setting the switch to the "ALL GASES" position automatically disables the minimum O₂ flow.



OP10008

Figure 8 ORMC Response

GAS DELIVERY SYSTEM (continued)**Vaporizers (Optional)**

The NARKOMED 3 can be equipped with up to three Vapor 19.1 vaporizers for the administration of liquid anesthetics. The vaporizers (Figures 9 & 10) are located to the right of the flowmeters.

Vaporizers may be equipped with either an open-funnel filler or a pin-indexed filler. (Only pin-indexed fillers are permitted in Canada).

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.

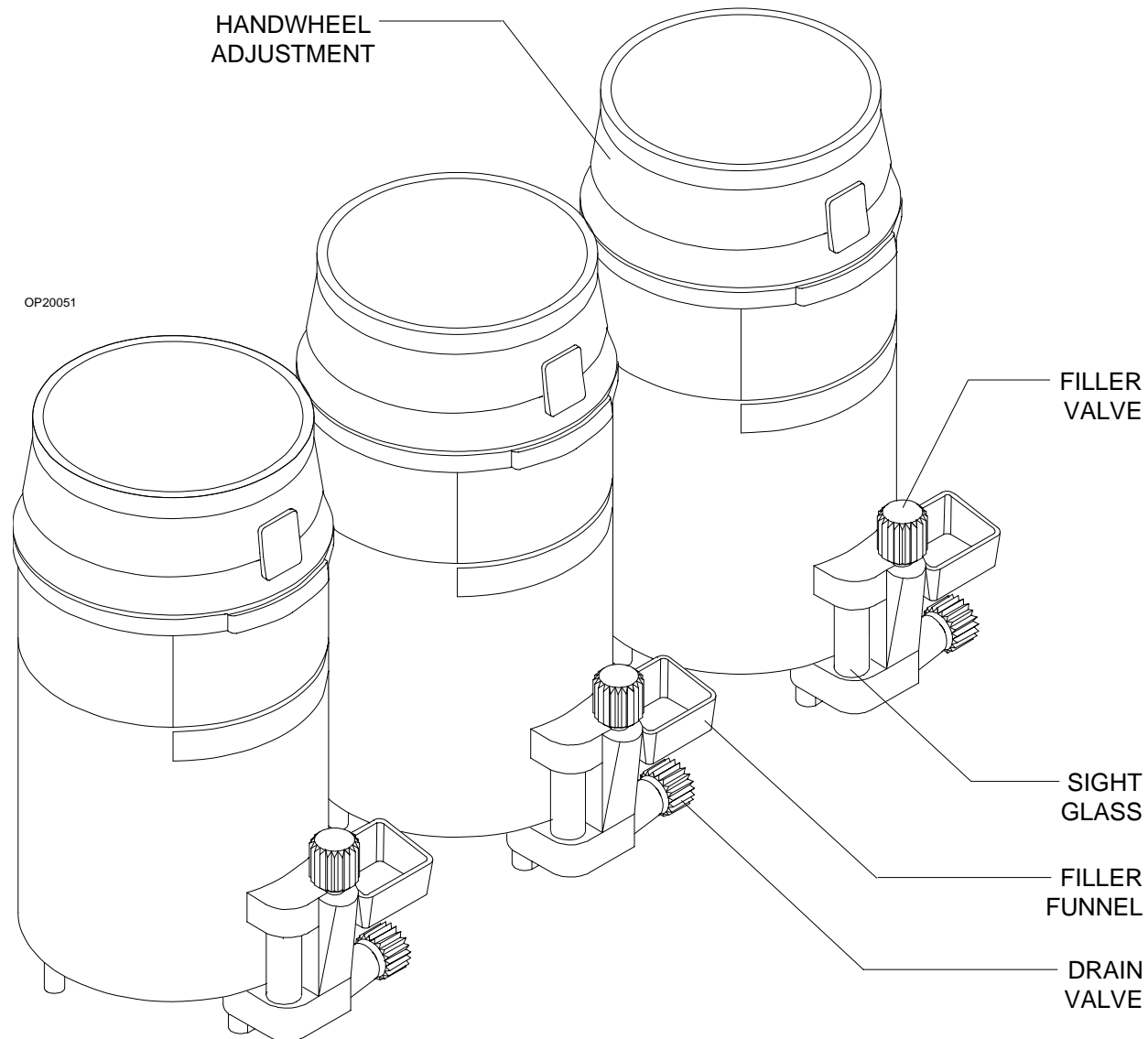


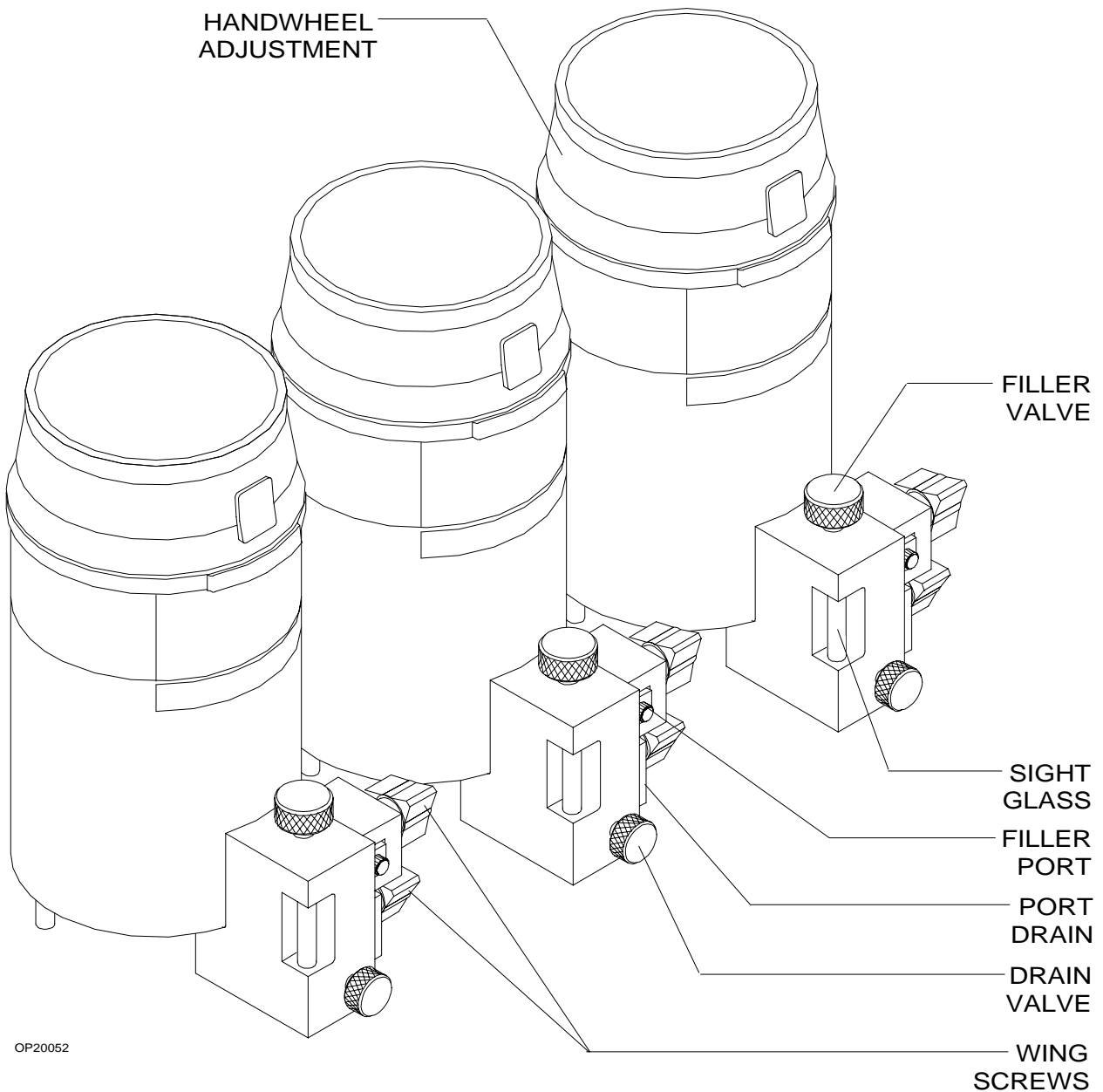
Figure 9 Vaporizers (with Standard Filler/Drain Mechanisms)

GAS DELIVERY SYSTEM (continued)

A cam and lever interlock 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 volume percent positions.

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

Detailed operating instructions for the vaporizers are in a separate manual supplied with the vaporizer.



OP20052

Figure 10 Vaporizers (with Optional Pin-Indexed Filler/Drain Mechanisms)

GAS DELIVERY SYSTEM (continued)**Oxygen Flush**

A manually operated, self-closing, oxygen flush valve (Figure 11) is located on the left front corner of the machine's frame. A bezel is mounted around the push button in order to prevent accidental engagement. The valve, when actuated, delivers an unmetered oxygen flow of approximately 55 l/min directly to the NARKOMED 3's fresh gas common outlet. The oxygen flush may be used without the SYSTEM POWER switch being in the "ON" position.

Fresh Gas Common Outlet

The fresh gas common outlet (Figure 11) delivers the fresh gas 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 oxygen 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 absorber fresh gas hose. The male fitting slides into a retaining slot in the spring-loaded safety locking bar (Figure 11) to prevent inadvertent disconnection of the fresh gas hose.

The 15 mm male fitting on the fresh gas hose is unique to North American Dräger design and cannot be replaced by that of any other manufacturer.

Fresh Gas Adapter (Optional)

The optional fresh gas adapter allows the NARKOMED 3 to monitor the fresh gas oxygen concentration when using a non-rebreathing circuit. The fresh gas adapter is designed to fit securely into the fresh gas common outlet of the anesthesia machine. A detailed description and operating instructions can be found in the Fresh Gas Adapter Operator's Instruction Manual.

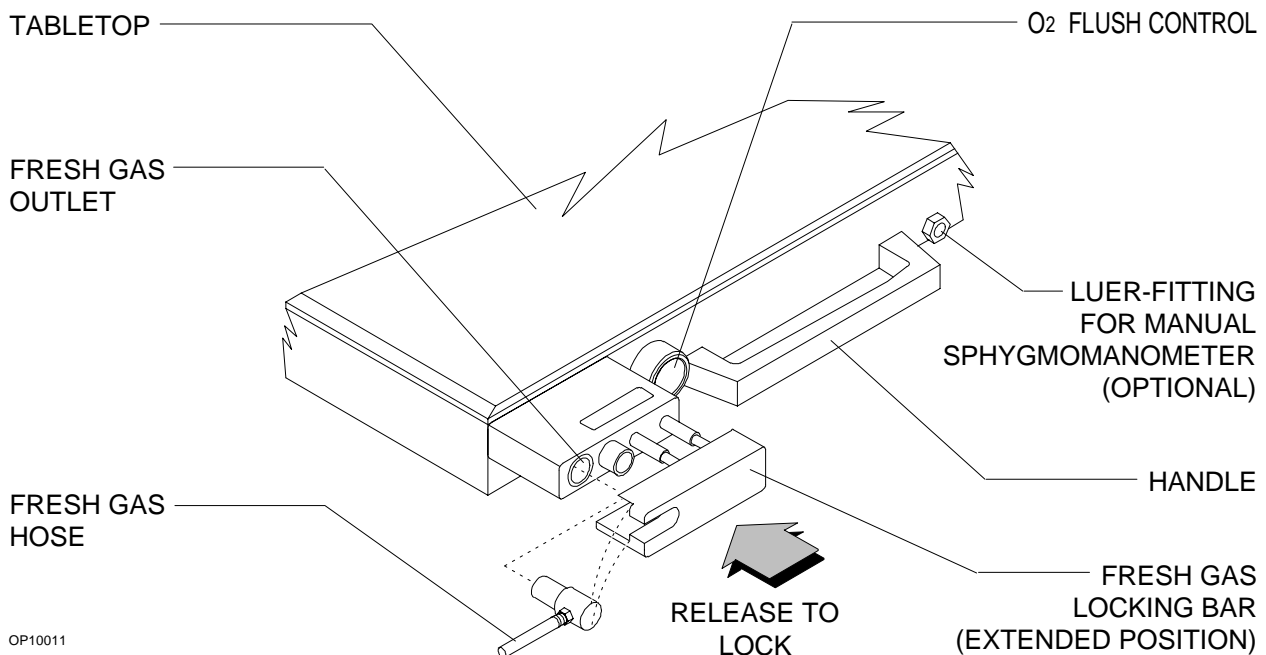


Figure 11 Oxygen Flush Control & Freshgas Common Outlet

Fresh Gas Common Outlet (Canada)

The fresh gas common outlet (Figure 12) delivers the fresh gas 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 oxygen flush button on the front of the anesthesia machine. The outlet incorporates a dual fitting that allows use of either a 15 mm male fresh gas hose fitting (such as supplied with North American Dräger Absorbers and Bain Circuit Adapters) or a 22 mm female fitting with a load-bearing threaded mount (such as for Magill circuits meant to be threaded onto the fresh gas common outlet).

When using the 15 mm male and female fittings, make sure that the spring-loaded locking bar fits over the male fresh gas hose fitting, securing it in the female fitting.

When using the Magill circuit fitting, swing the spring-loaded locking bar to the side to gain access to the threaded load bearing fitting.

Suction System (Optional)

The NARKOMED 3 can be configured with internal vacuum piping for a suction drainage assembly. A DISS vacuum fitting on the rear of the machine connects, via a hose, 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 overflow. Consult the operating instructions supplied with this device before use.

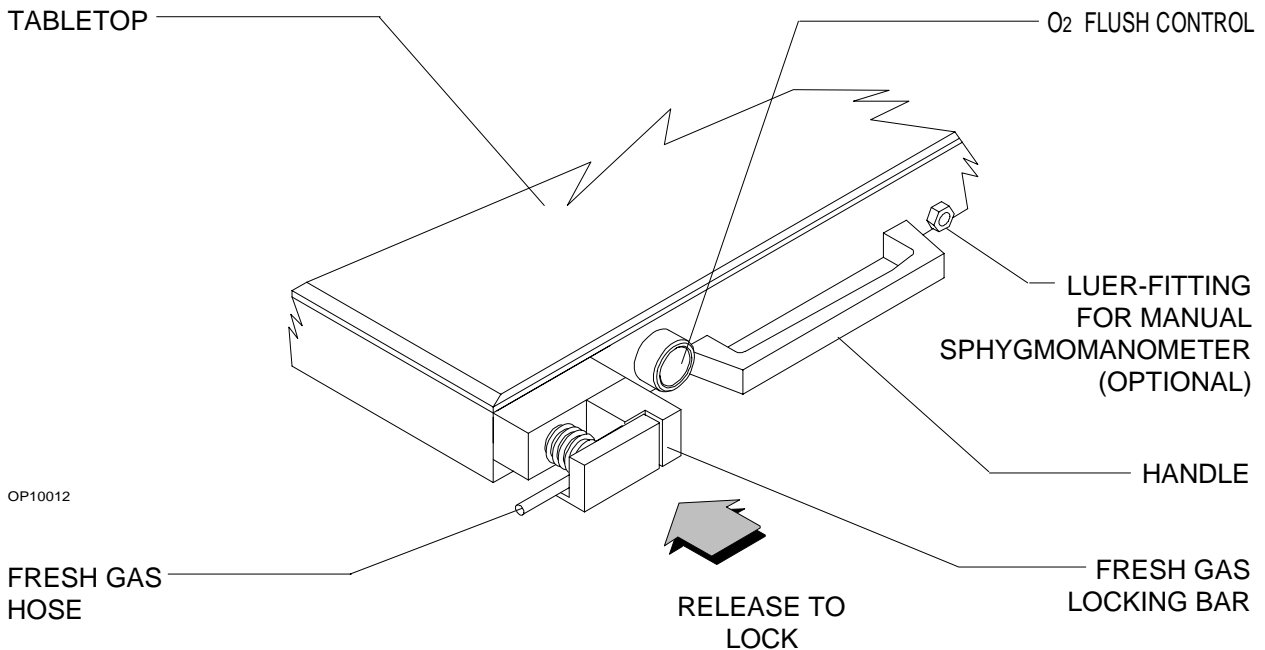


Figure 12 Oxygen Flush Control & Freshgas Common Outlet for Canada

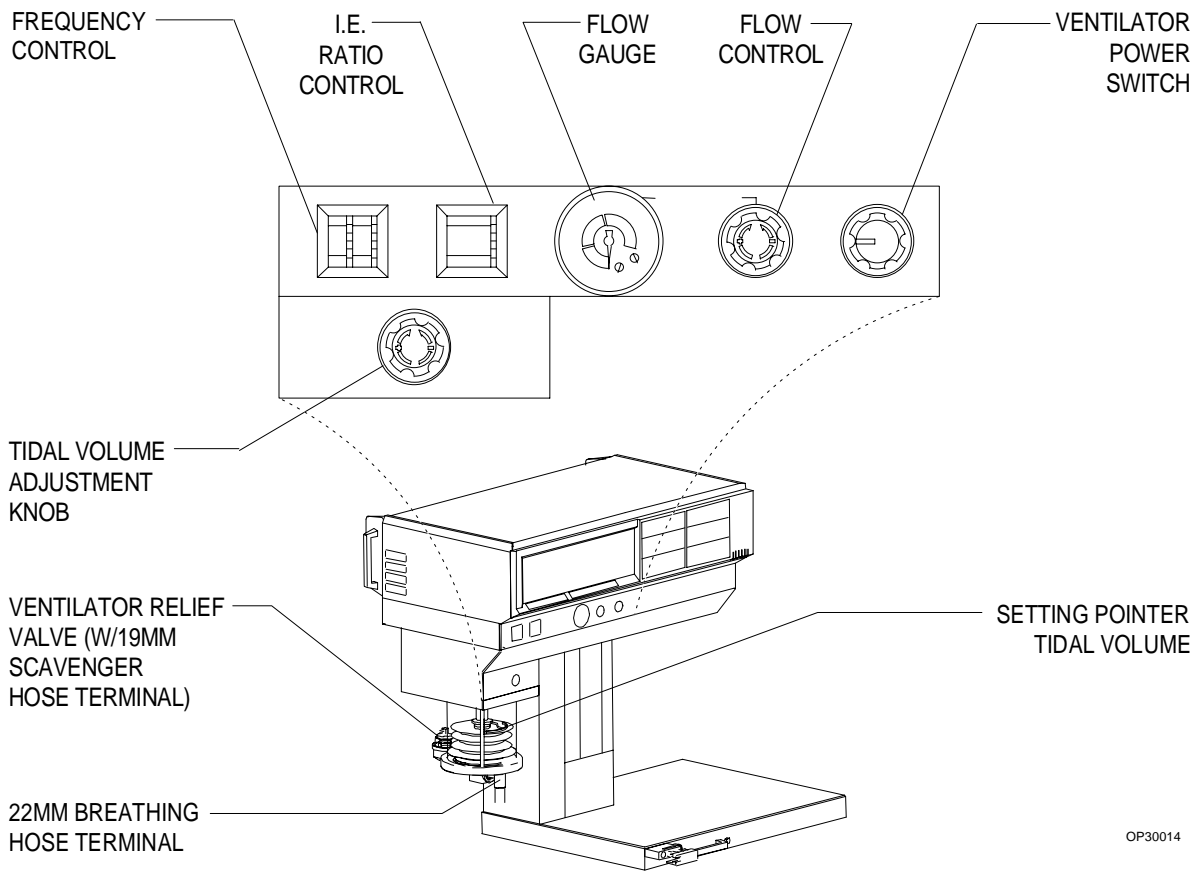
AV-E ANESTHESIA VENTILATOR

The anesthesia ventilator (Figure 13) is volume-preset and time-cycled. It has a solid-state timer and independent controls.

The pneumatic power to the ventilator may be supplied through the pipeline supply or, if the pipeline supply either fails or is disconnected, through cylinders. The pressure of the supply gas must be

between 40 and 60 psi. The ventilator will not function if this pressure drops below 32 psi.

The monitoring system's breathing pressure and expiratory flow waveform displays can be used as an aid in adjusting the ventilator. For further details, see the MONITORING SYSTEM section of this manual.



OP30014

Figure 13 AV-E Ventilator

NOTE: The anesthesia ventilator is designed for use with an NAD absorber system, which incorporates a Manual/Automatic selector valve. This valve allows the operator to bring into the breathing system either the breathing bag and pop-off valve for manual ventilation, or the ventilator bellows for automatic ventilation. Breathing system hose connections to this valve are described in the SETUP & INSTALLATION section of this manual.

Ventilator Power Switch

The ventilator power switch controls both pneumatic and electrical power to the ventilator. In the "OFF" position the ventilator is not operable, and the Advisory message "VENT OFF" appears on the anesthesia machine's central alarm display. In the "ON" position the ventilator is activated and cycles according to the settings of the other controls.

The ventilator power switch also automatically enables the monitoring system's volume-related alarms and apnea pressure alarm.

Tidal Volume Adjustment

The tidal volume may be adjusted between 50 and 1500 ml. A self-locking knob, located above the bellows assembly (Figure 13), adjusts a bellows stop within the canister. To adjust the tidal volume, depress the self-locking knob to allow rotation. Set the tidal volume, as indicated by the pointer on the bellows chamber scale (marked 200 to 1400 ml), to the desired set point.

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 calibration. As in any volume-preset anesthesia ventilator, the actual tidal volume delivered to the patient's lungs may differ from the preset volume at the bellows due to the compliance of the breathing system and fresh gas flow. To accurately set the tidal volume, the operator should refer to tidal and minute volume measurements.

The position of the tidal volume indicator can be calibrated by an NAD authorized service representative for a specific combination of fresh gas flow and equipment compliance.

Frequency Control

The respiratory frequency can be set between 1 and 99 BPM (in 1 BPM increments) using the two-digit thumb wheel switch labeled "FREQUENCY" (Figure 13). A setting of "00" will cause the ventilator to remain in the expiratory phase indefinitely.

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 are marked on the I:E controller-indicator thumb wheel in 0.5 increments. The thumb-wheel is located to the right of the frequency thumb wheel and is labeled "I:E RATIO" (Figure 13).

AV-E ANESTHESIA VENTILATOR (continued)**Inspiratory Flow Control**

The rotary knob marked "INSPIRATORY FLOW" controls the flow rate of gas into the bellows chamber, and 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" (Figure 13).

The flow setting is to be adjusted so that the bellows is fully compressed at the end of the inspiratory phase. In order to deliver the desired, preset tidal volume, adjust the inspiratory flow control so that the bellows corrugations make contact with each other but are not deformed at the end of the inspiratory phase.

The inspiratory flow control can be used to create an inspiratory plateau at the end of the inspiratory cycle. It 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 and waveform when adjusting the inspiratory flow control.

Ventilator Relief Valve

During automatic ventilation, the manual/automatic selector valve isolates the absorber's APL (adjustable pressure limiting) valve from the breathing system. To compensate for the continuous introduction of fresh gas into the breathing system, the ventilator incorporates a relief valve mounted behind the bellows chamber.

The ventilator relief valve remains closed until the end of expiration so that the ascending bellows can expand upward and refill. When the bellows is completely filled, any excess gas in the system is released by the ventilator relief valve to the scavenging system. 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 15 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 breathing pressure monitor indicate the amount of PEEP at the end of exhalation. For details, see the Bellows PEEP Valve Instruction Manual.

Power Supply

The NARKOMED 3 is equipped with a central power supply for the ventilator, alarm system, and monitoring system. The power of each monitor is individually regulated to prevent voltage fluctuations in one monitor from influencing the performance of the other monitors.

The NARKOMED 3 must be plugged into an AC outlet when in use.

Power Cord

A fifteen foot cord with a 3-prong hospital grade plug is supplied with the NARKOMED 3. The allowable input voltage range is from 90 to 130 VAC at 50 or 60 Hz. Excess cable is to be stored on the cord wrap at the rear of the NARKOMED 3. When unplugging the power cord be sure to pull the plug, not the cord.

Hospital Grade Convenience Receptacles

The NARKOMED 3 is equipped with four convenience receptacles. The receptacles are "active" whenever the NARKOMED 3 is plugged into an outlet, regardless if the machine is turned on. They are mounted on the upper rear of the anesthesia machine (see Figure 2). The total current for devices plugged into the receptacles must not exceed 5 amps. A 5 amp circuit breaker protects the convenience receptacle circuit. This circuit also incorporates an EMI filter, which minimizes interference to the anesthesia machine from devices plugged into the convenience receptacles.

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

240 Volt Power Supply (Optional)

The NARKOMED 3 can be equipped with an optional 240 VAC power supply. A 4.5 meter cable supplies the AC power. The allowable input voltage range is from 200 to 260 VAC at 50 or 60 Hz. The 240 VAC power supply does not include convenience receptacles. A pilot light replaces the circuit breaker for the convenience receptacles; it illuminates when AC power is supplied to the NARKOMED 3.

Backup Battery System

The backup battery system consists of a rechargeable 12 volt battery (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 may be encountered before generator power comes on line. The backup battery system automatically provides power during the interim between line power failure and the activation of the hospital's emergency generator. The backup battery would also provide power if the anesthesia machine's power cord is accidentally unplugged during a case.

When the hospital's emergency generator comes on line (or when a disconnected power cord is reconnected), the NARKOMED 3 automatically switches back to AC power and recharges its battery. The battery charging system will charge the battery any time that the power cord is connected to an active AC power source. The charger can recharge a fully discharged battery in approximately 16 hours.

POWER SUPPLY (continued)

Backup Battery Operating Instructions

To prevent premature battery failure, backup battery power must be used only during interruption of primary AC power. No anesthetic procedure shall be started using an anesthesia machine if the yellow "AC POWER FAIL" indicator light or the yellow "BATTERY LOW" indicator light is illuminated.

The operator must test the backup battery system daily. To test the battery ensure that the SYSTEM POWER switch on the main switch panel is in the "ON" position. Then press and hold the "BATTERY TEST" button on the main switch panel (Figure 14). A green BATTERY TEST light indicates that power is available to operate the electrical components of the anesthesia machine, but it does not indicate how long this power will be provided. This depends on the duration of previous battery use and recharging.

Machine Functions While on Backup Battery Power

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 the MULTISPEC. The operator is alerted to this condition with the following:
 - The yellow "AC POWER FAIL" indicator on the anesthesia machine's alarm panel illuminates.
 - The alarm message "AC PWR FAIL" appears in the central alarm display.
 - A single-tone audible alarm sounds.
 - The Error Code "E07" appears in the MULTISPEC front panel display window.

2. In the second stage, to preserve the battery for vital machine functions, power to the display screens and SPHYGMOMED is discontinued, and power is supplied only to the following machine functions: O₂MED, BAROMED, O₂SATMED, SPIROMED, the main switch 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" main switch 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 battery power has been cut off, the AV-E ventilator is inoperative, and manual ventilation by bag squeezing must be performed. In this final stage, the anesthesia machine cannot provide monitoring or alarm functions until it is reconnected to an active AC power source.

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

Circuit Breakers

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

The circuit breakers are located on the lower right side of the machine. When the plunger of a circuit breaker is flush with the surface of its base, the circuit breaker is in its normal, closed position. A circuit breaker is open (tripped) when its plunger extends beyond its base. The cause of an open breaker must be investigated and the appropriate corrective action must be taken before the anesthesia system is returned to service.

EMI Filtering

All power for the NARKOMED 3 is filtered for conducted electromagnetic interference by a low pass filter in the primary AC line. This filter also prevents noise generated within the NARKOMED 3 from leaving the device through the AC line.

MAIN SWITCH PANEL

The main switch panel, located between the ventilator bellows and flowmeter bank, incorporates alarms to communicate the status of the gas delivery and power supply systems.

These alarms are annunciated and simultaneously displayed on the central alarm display. Refer to Figure 14 for the location of the indicators and controls on the main switch panel.

Oxygen Supply Pressure Alarm

The oxygen supply pressure alarm activates if the oxygen supply pressure (from both the pipeline supply and reserve cylinders) in the system decreases below approximately 37 psi. The LED indicator marked "O₂ SUPPLY PRESSURE" lights continuously red, the alarm message "LO O₂ SUPPLY" appears on the central alarm display, and an intermittent audible alarm sounds.

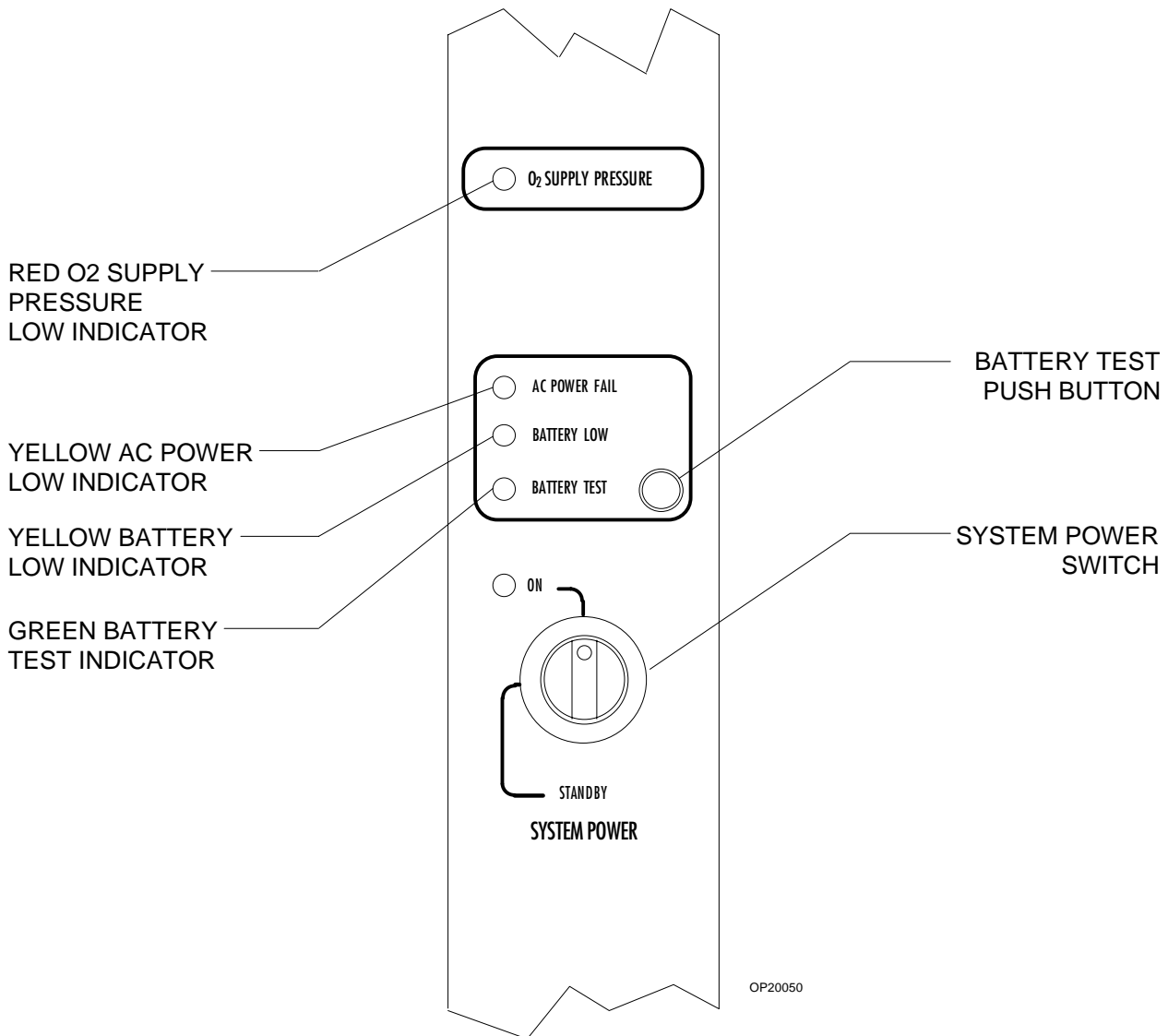


Figure 14 Main Switch Panel

NOTE: If only one source of oxygen supply pressure (either 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. To test the battery ensure that the SYSTEM POWER switch on the main switch panel is in the "ON" position. Then press and hold the "BATTERY TEST" button on the main switch panel. If the battery has been charged to normal operating potential, the green indicator light comes on when the BATTERY TEST button is pressed. Any time that the battery potential drops below the normal operating threshold, the yellow "BATTERY LOW" indicator comes on, 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 becomes completely depleted and the machine does not have AC power, the "BATTERY LOW" indicator will have no source of power and will not function. Therefore, always remember to perform the daily battery test.

AC Power Failure Indicator

The yellow "AC POWER FAIL" LED signals AC power disruption. The LED illuminates whenever the battery supplies power to the monitoring system and the electronic ventilator. A single tone also sounds when AC power is first disrupted. If the anesthesia machine's backup battery is completely discharged, the AC power failure indicator will not be supplied with the power and will not function.

System Power Switch

The SYSTEM POWER switch of the NARKOMED 3 has two positions: "STANDBY" and "ON". In the "ON" position, the SYSTEM POWER switch actuates all gas and electric power. In the "STANDBY" position, the switch shuts down the alarm system and the gas supplies.

The SYSTEM POWER switch must be depressed when turning to prevent inadvertent disengagement. A green LED indicator adjacent to the switch remains lit when the switch is in "ON" position and supplying power to the machine. Also, a single brief tone sounds when the switch is turned to the "ON" position.

Regardless of the switch setting, the battery charging circuit and convenience receptacles are activated whenever the power cable is attached to an active wall receptacle. To prevent drainage of the backup battery and waste or depletion of the oxygen supply through the minimum oxygen flow, the SYSTEM POWER switch must be turned to the "STANDBY" position whenever the machine is not in use.

System Power Switch Failure Alarm

A steady, high-pitched audible alarm activates if the NARKOMED 3 pneumatic circuitry is pressurized by the SYSTEM POWER switch, but a malfunction in the switch prevents activation of the monitoring system. The alarm is produced by a speaker located on the power supply controller. There is no visual indicator associated with the SYSTEM POWER switch failure alarm.

Flowmeter Lights

The SYSTEM POWER switch controls the lights for the flowmeter panel. When the switch is turned to the "ON" position, the flowmeter lights come on.

MONITORING SYSTEM

GENERAL DESCRIPTION

The NARKOMED 3 incorporates six standard, integral monitors:

- BAROMED breathing pressure monitor
- O₂MED oxygen analyzer
- O₂SATMED pulse oximeter
- SPIROMED respiratory volume monitor
- MULTISPEC respiratory gas analyzer
- SPHYGMOMED noninvasive blood pressure monitor

Figure 15 illustrates the front panels of the monitors. Each monitor consists of a modular chassis that mounts in a monitoring rack to the right of the monitoring system display screens.

O₂MED Oxygen Analyzer

The O₂MED uses a dual redundant galvanic cell sensor to monitor and digitally display the oxygen concentration in the patient breathing system. The operator can set low and high oxygen concentration alarm limits, calibrate the monitor to 21% oxygen with a single keystroke, and view oxygen concentration data on a trend graph display. 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

The BAROMED monitors breathing system pressure at either the absorber or the Y-piece. The unit can display 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, subatmospheric (< -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.

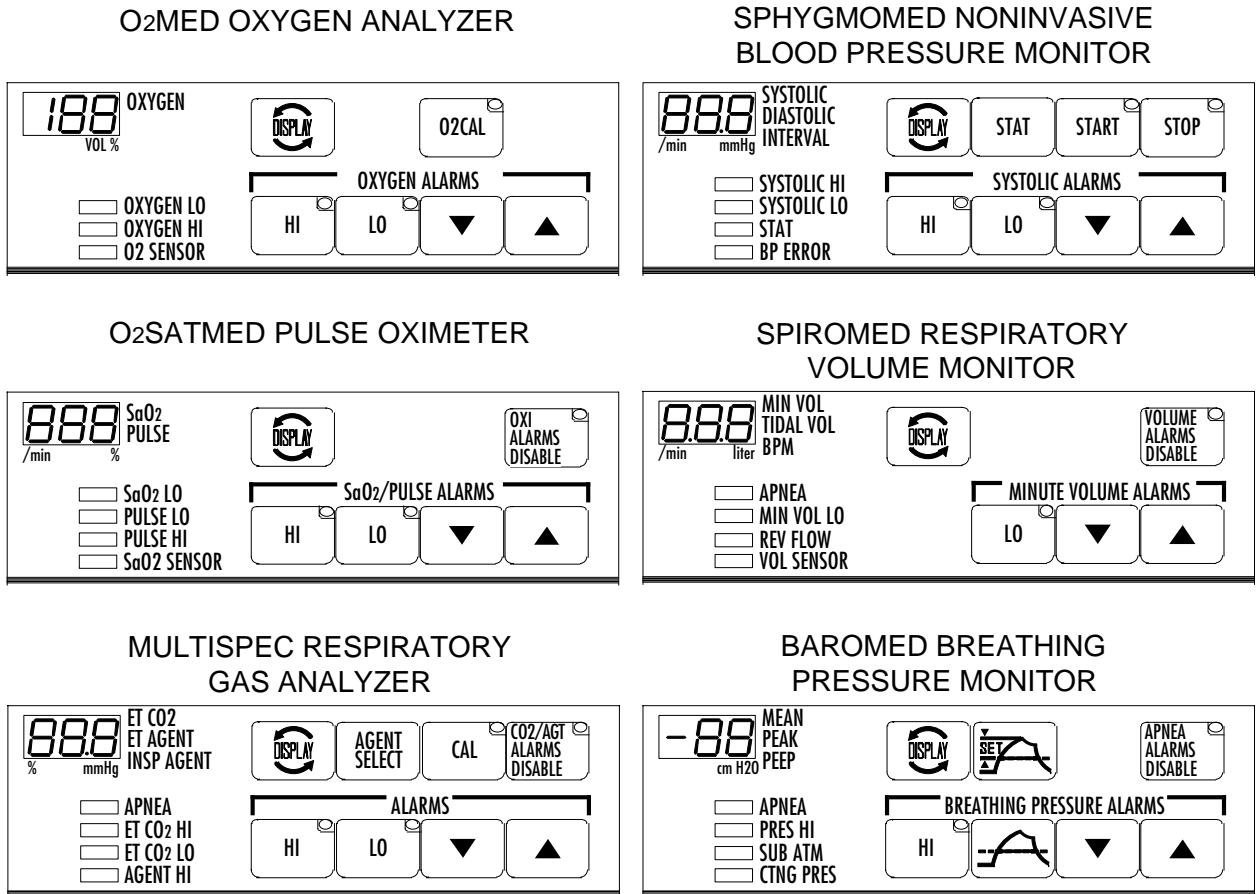
SPIROMED Respiratory Volume Monitor

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.

MULTISPEC Respiratory Gas Analyzer

The MULTISPEC uses a non-dispersive infrared analyzer to monitor carbon dioxide, N₂O and anesthetic concentration in a sample withdrawn from the patient breathing system at the Y-piece. The unit displays end-tidal CO₂ (in mm Hg), as well as inspiratory and expiratory anesthetic concentrations (in %). Using front panel adjustment keys, the operator can set both high and low alarm limits for end-tidal CO₂ and anesthetic concentration.

Apnea alarms are generated if the monitor does not sense a CO₂ fluctuation for 15 and 30 seconds. An inspiratory CO₂ high alarm is generated if the inspiratory CO₂ partial pressure exceeds 5 mm Hg. Alarms are also provided for sample-line blockage and internal electronic failure. Zero calibration can be performed with a single soft-touch key. The unit also performs zero calibrations automatically. A detailed description and operating instructions can be found in the MULTISPEC Operator's Instruction Manual.



OP30016

Figure 15 NARKOMED 3 Monitors

MONITORING SYSTEM**O₂SATMED Pulse Oximeter**

The O₂SATMED pulse oximeter uses a spectrophotometric infrared transmission sensor to noninvasively measure arterial hemoglobin oxygen saturation. The unit displays either percent SpO₂ or pulse rate. The operator can set both high and low alarm limits for SpO₂ 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

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 set-up, 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 (see Figure 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, attach the fitting on the free end of the gauge hose to the fitting labeled "BP GAUGE" on the upper left side of the anesthesia machine.

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, attach the free end of the extension hose to the fitting labeled "BP CUFF" 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") to the right of the O₂ flush button on the front of the anesthesia machine.

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 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.

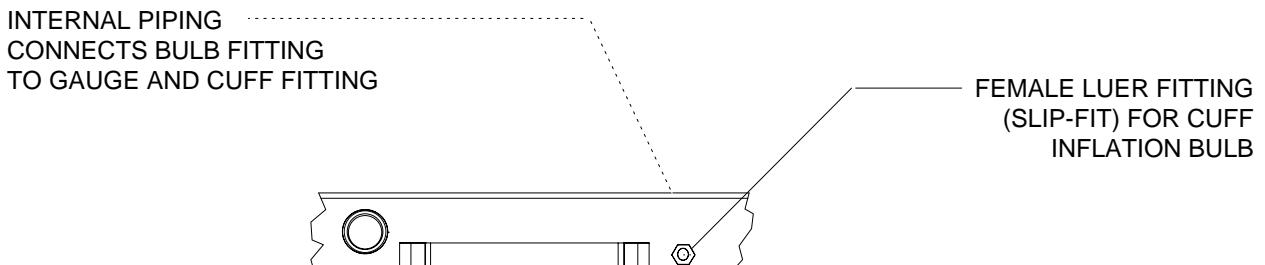
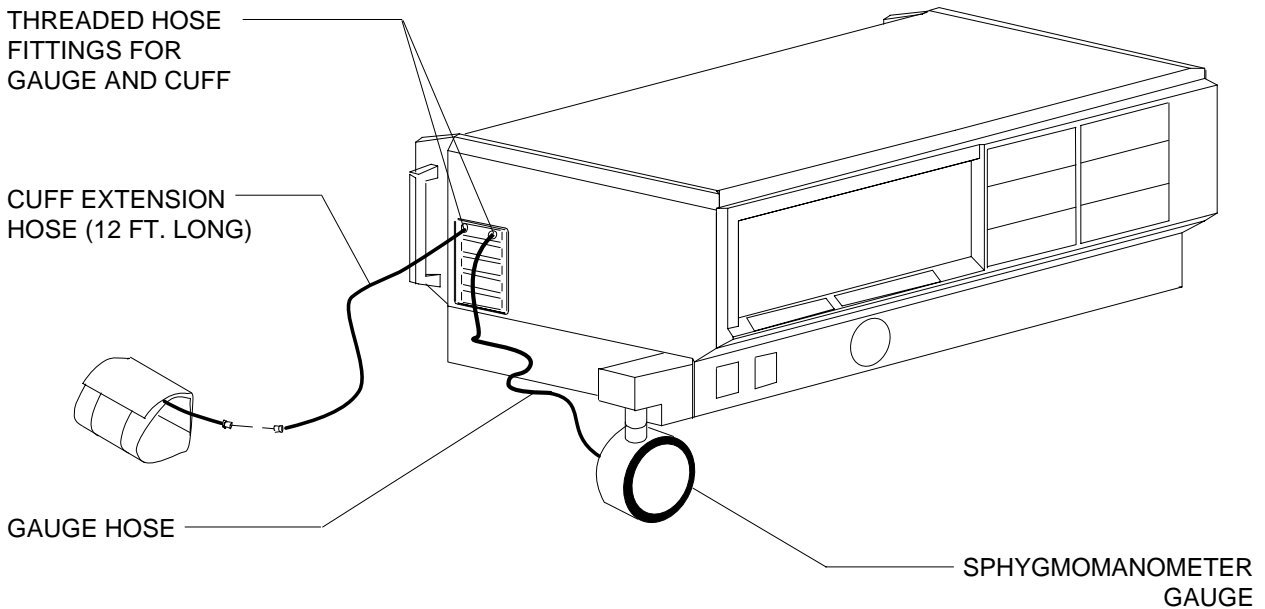
To check the manual sphygmomanometer for leaks, place the blood pressure cuff around a rigid cylindrical object of approximately the same diameter as a human arm. Inflate the cuff to a pressure of 250 mm Hg, as indicated on the sphygmomanometer gauge.

MONITORING SYSTEM (continued)

Then, watch the gauge reading for 10 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 hose after inflating the cuff to 250 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 250 mm Hg.



OP30017

Figure 16 Manual Sphygmomanometer

MONITORING SYSTEM (continued)**Breathing System Sensor Interface Panel**

A panel of four sensor connections is provided on the lower left side of the NARKOMED 3 (Figure 17). These connections pertain to the patient breathing system and thus are mounted close to the absorber assembly. The O₂MED sensor cord leads from the O₂MED sensor (mounted in the inspiratory valve) and plugs into a pin-type connector on the panel. The 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 SPIROMED sensor cord leads from the SPIROMED sensor on the absorber top dome to a pin-type connector on the panel. The MULTISPEC exhaust line leads from a hose barb fitting on the panel to an adapter on the scavenger system.

Patient Sensor Interface Panel

A panel of four sensor connections is provided on the upper left side of the NARKOMED 3 monitoring bank (Figure 17). The O₂SATMED incorporates an interface cable/preamplifier assembly that mounts on the boom arm and plugs into a pin-type connector on the panel.

The MULTISPEC 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 sample line 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 the 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.

MONITORING SYSTEM (continued)

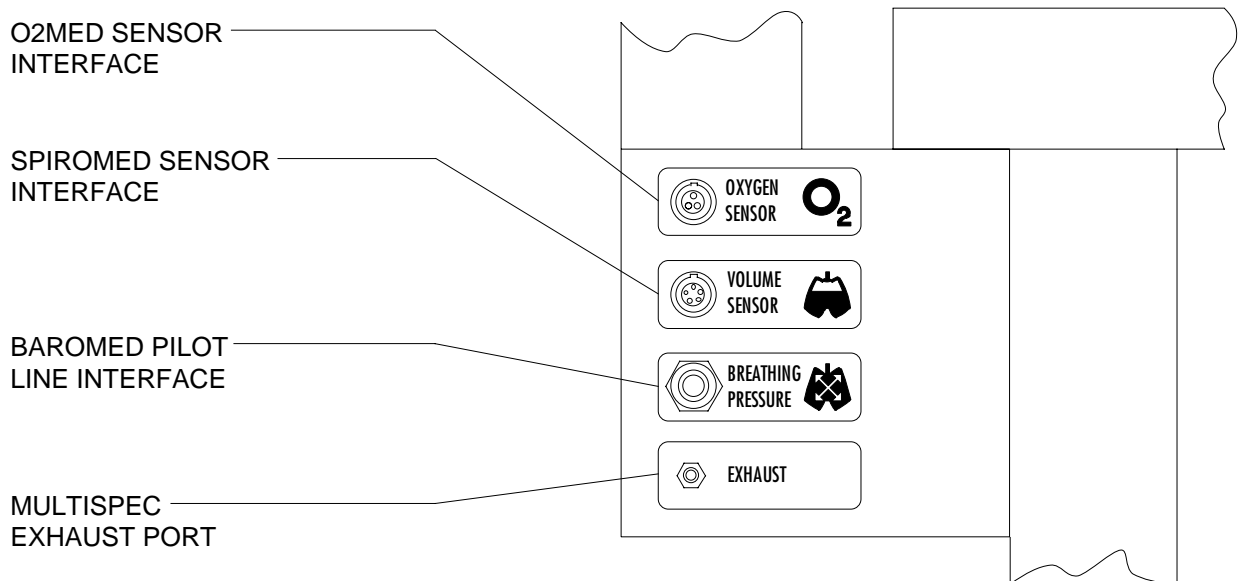
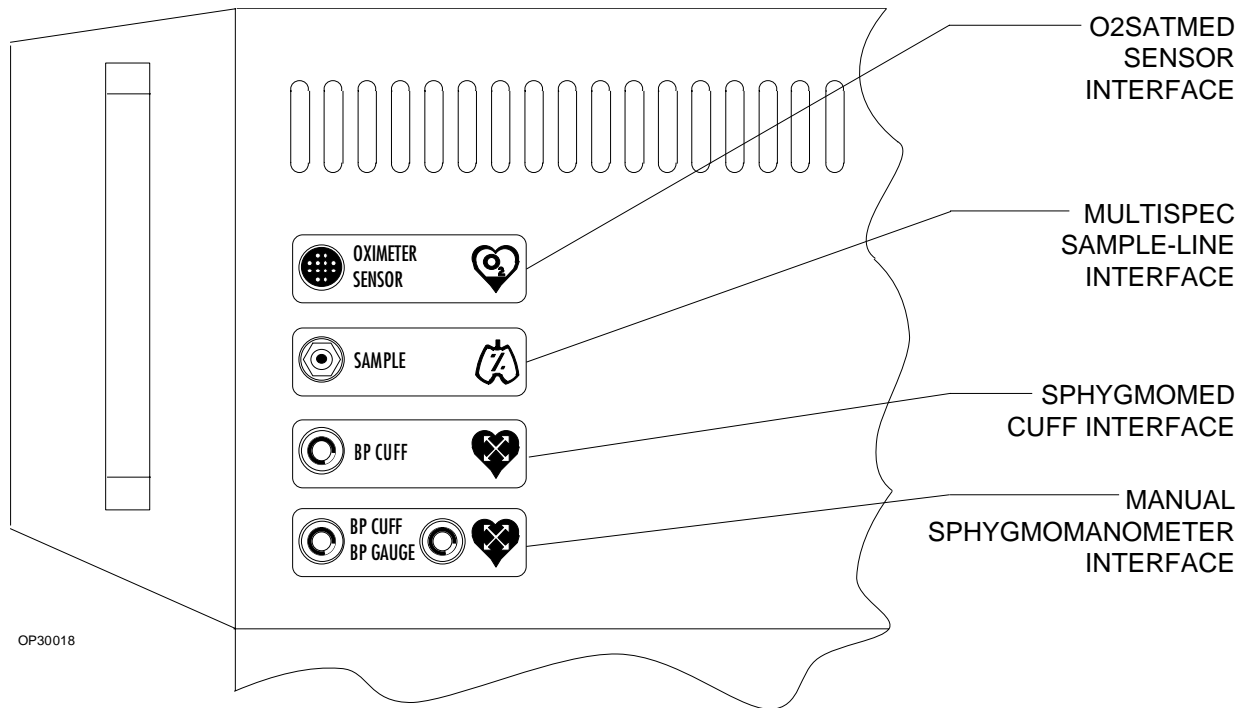


Figure 17 Patient and Breathing System Sensor Interface Panels

MONITORING SYSTEM (continued)

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 display screen. This combination of audio interlock and visual centralization facilitates the recognition of alarm conditions, and drastically reduces the response time for corrective action.

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 two different communication protocols: VITALINK and printer. Ports A-D can be configured for VITALINK 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, CO₂ waveform, and certain control functions between two medical monitoring devices. Refer to the VITALINK Technical Reference Manual for VITALINK programming details.

MONITORING SYSTEM (continued)

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 (Figure 18).

```

NAME      : ..... PROCEDURE : .....
DATE : 24-JUL-87
Page 1
-----
TIME      BLOOD PRESSURE PULSE   SaO2   O2     AGENT   CO2     RESP  MIN  TEMPERATURE
mmHg      mmHg          /min    %      %      %      mmHg   RATE  VOL  DEG C
SYS/DIAS  MEAN
-----
12:00     120/80    95     72     99     30    12.0/30.3  34/00   20  10.4  37.2  37.2
12:02     120/80    92     74     99     21    12.2/30.2  34/00   20  10.6  37.2  37.2
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  37.2
12:20     120/80    92     72     95     21    11.9/30.3  36/00   20  10.5  37.2  37.2
12:25     120/80    92     72     95     21    11.9/30.3  36/00   20  10.5  37.2  37.2
12:27     120/80    92     72     97     20    12.0/29.1  30/00   20  10.3  37.2  37.2
12:27     CAUTION:  APNEA - PRES
12:27     CAUTION:  APNEA - CO2
    
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OP30019

Figure 18 Printer Output

MONITORING SYSTEM (continued)

Central Monitoring Display

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 Figure 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 on 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, any occurrence of a new alarm will produce a non-repeating tone pattern appropriate for its priority).
- A three-minute disable period is invoked for the SPIROMED, MULTISPEC and O₂SATMED patient alarms, as indicated by the appropriate Advisory messages on the central alarm display and by illumination of the yellow indicators on the monitor's alarm disable/enable keys. These alarms will be automatically enabled after three minutes, and can be immediately enabled with each monitor's alarm 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.

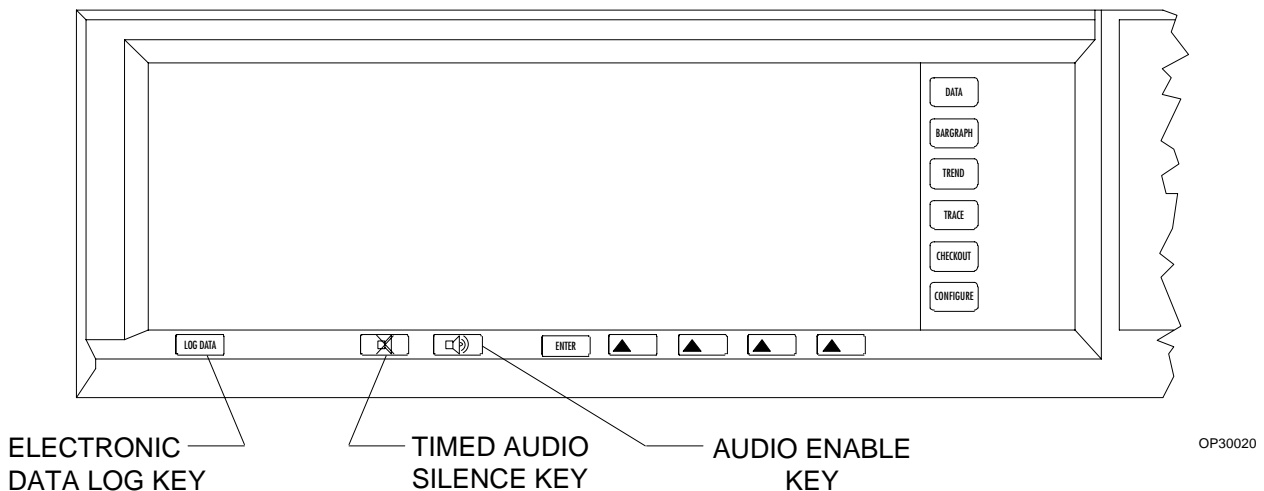


Figure 19 Display Screens and System Control Keypad

MONITORING SYSTEM (continued)

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 NAD service representative can change the monitoring system's power-up default configuration.

Monitor Alarm Disable Keys

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

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 MULTISPEC and O₂SATMED) for a quick check of patient condition (see Figures 20 & 21).

As alarm conditions occur, alarm messages (such as "% OXYGEN LO") are indicated on the central alarm display and organized into one of three categories: WARNING, CAUTION, and ADVISORY.

MONITOR	ALARMS DISABLED	ADVISORY MESSAGE
BAROMED	Apnea pressure (threshold pressure)	"APNEA-P OFF"
MULTISPEC	Apnea CO ₂ , high inspiratory CO ₂ , high & low ET-CO ₂	"CO2 ALRM OFF" "AGT ALRM OFF"
SPIROMED	Apnea volume, minute volume	"VOL ALRM OFF"
O ₂ SATMED	Absence of pulse, high & low SpO ₂ , high & low pulse	"OXI ALRM OFF"

MONITORING SYSTEM (continued)

Each type of alarm message produces a different sound pattern:

Warning: A continuously repeating tone pattern.

Caution: An intermittently repeating tone pattern.

Advisory: A single tone or none.

Alarm messages are listed in 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 occurs, an arrow appears to the left of the most recent alarm message on the screen (Figure 20). 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.

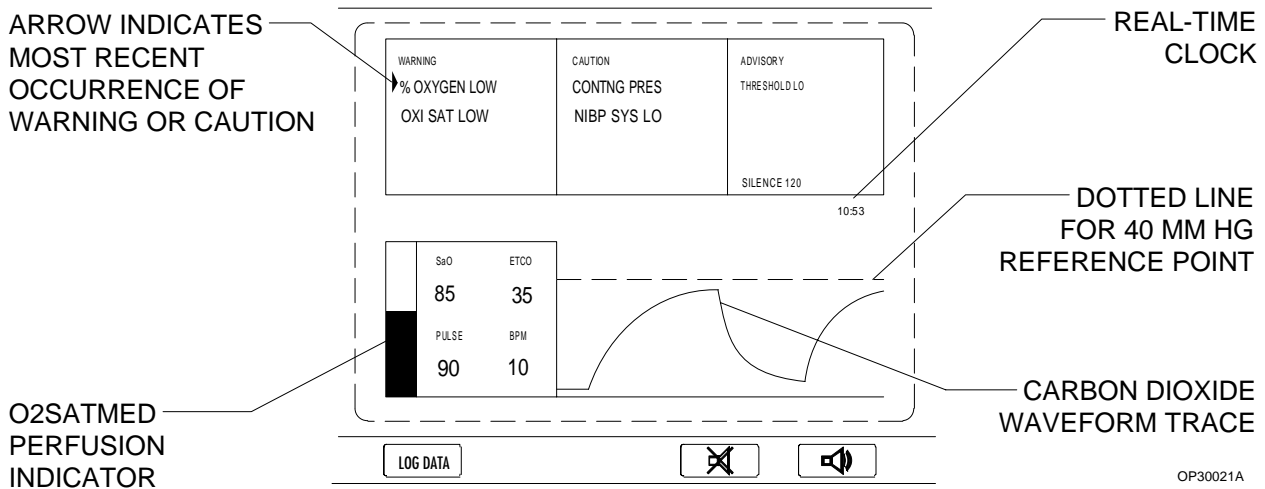
NOTE: If the number of alarm messages in any of the three categories exceeds the space provided on the display screen for that category, additional alarm messages will be held in the machine's memory until space is available (i.e., through the resolution of some of the displayed alarm conditions).

Real-Time Pulse Bargraph and Carbon Dioxide Trace

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 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.



OP30021A

Figure 20 Central Alarm 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 Figure 20) and shows the time in military time. The real-time clock may be set through the Configure Menu.

Audio Silence Control

Two keys beneath the central alarm display (Figure 21) can be used to temporarily silence and enable continuous audible alarms. Pressing the Audible Alarm Silence key (labeled with a crossed-out speaker) **once** silences existing alarms for a period of 60 seconds. Pressing the Audible Alarm Silence key **twice** silences existing alarms for a period of 120 seconds.

The occurrence of a new alarm during a silence period results in a non-repeating tone pattern corresponding to the alarm. 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 Audible Alarm Enable key (labeled with a speaker producing sound) located 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.

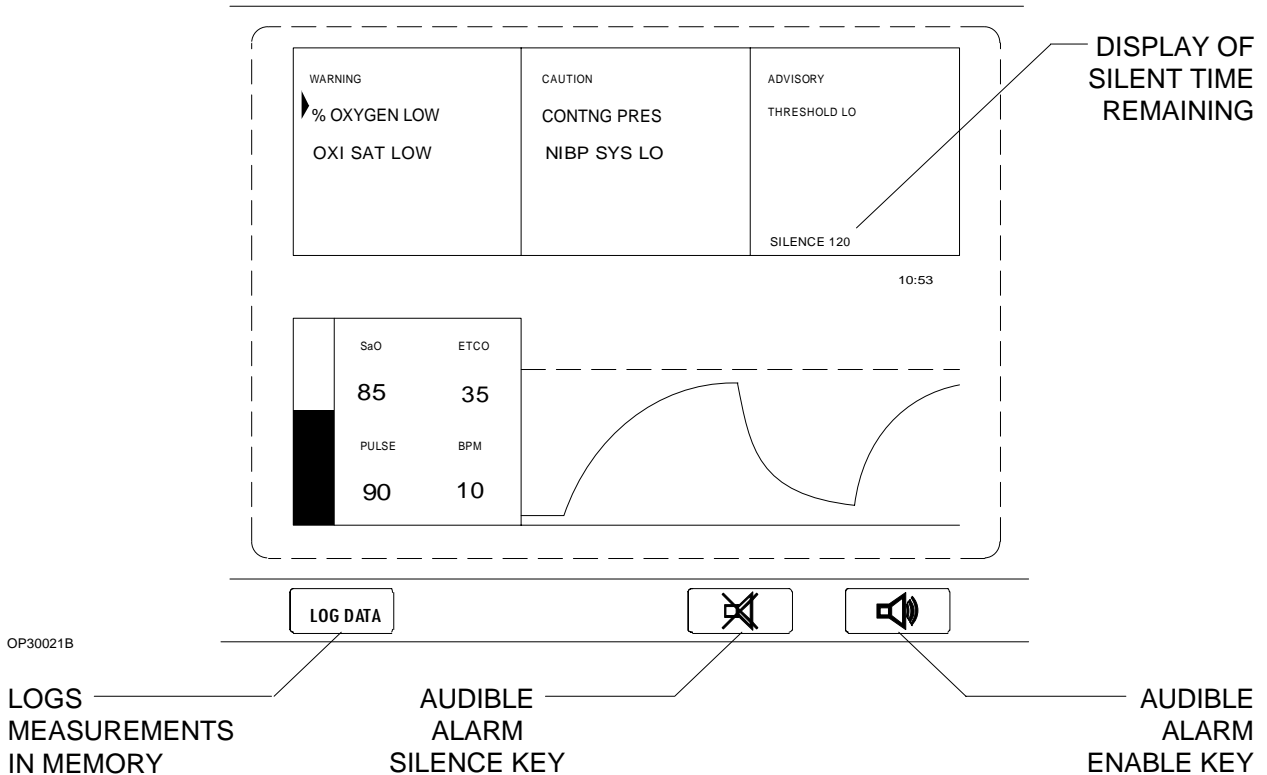
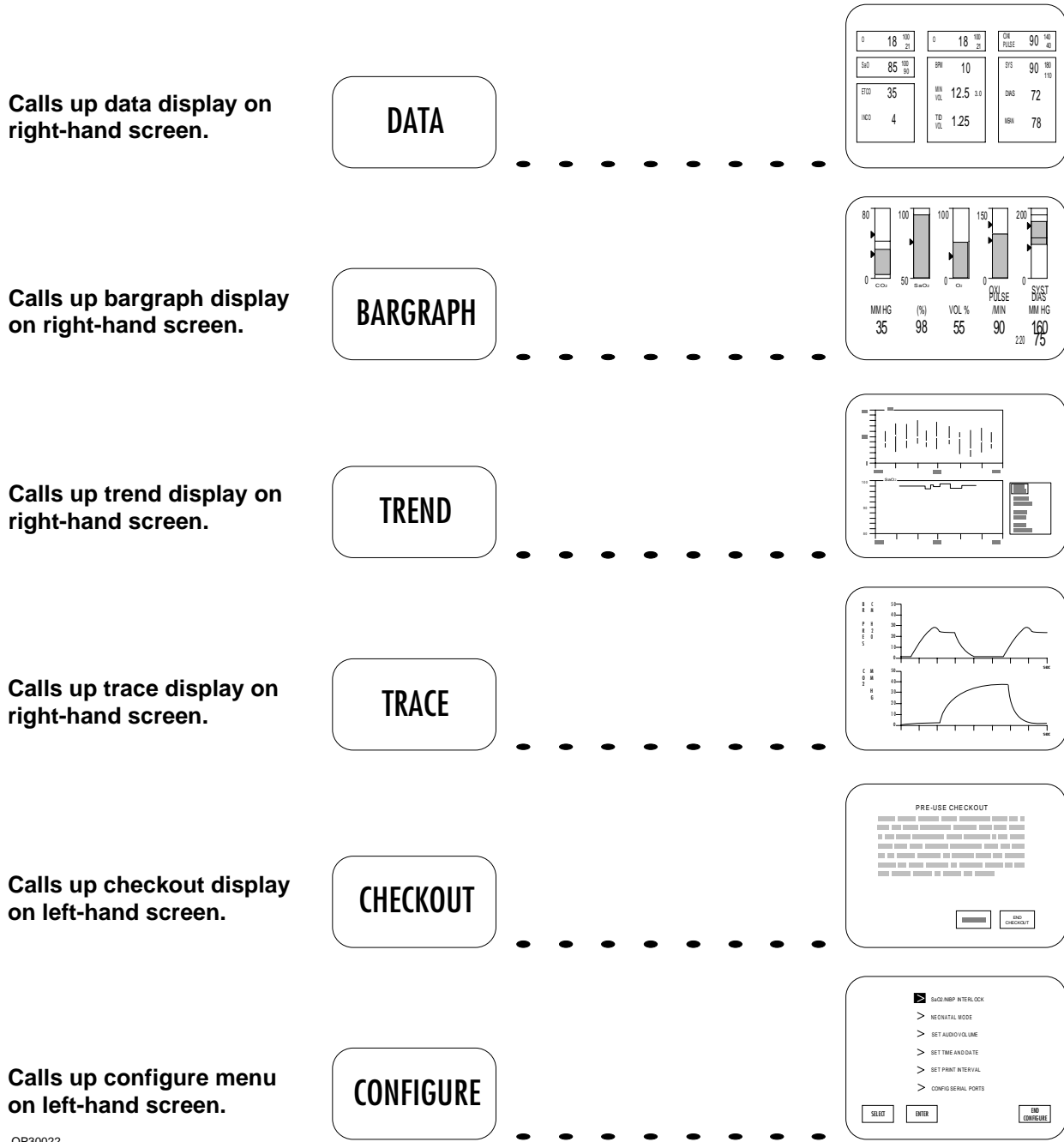


Figure 21 Central Alarm Display and Keys

MONITORING SYSTEM (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.



OP30022

Figure 22 System Control Keypad

Checkout Display (Refer to Figure 23)

Pressing the "CHECKOUT" key calls up the checkout display on the left-hand screen. This selection provides a text display of pre-use checkout 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 24)

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 "SpO₂/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 SpO₂/NIBP interlock when the anesthesia machine is next powered up.

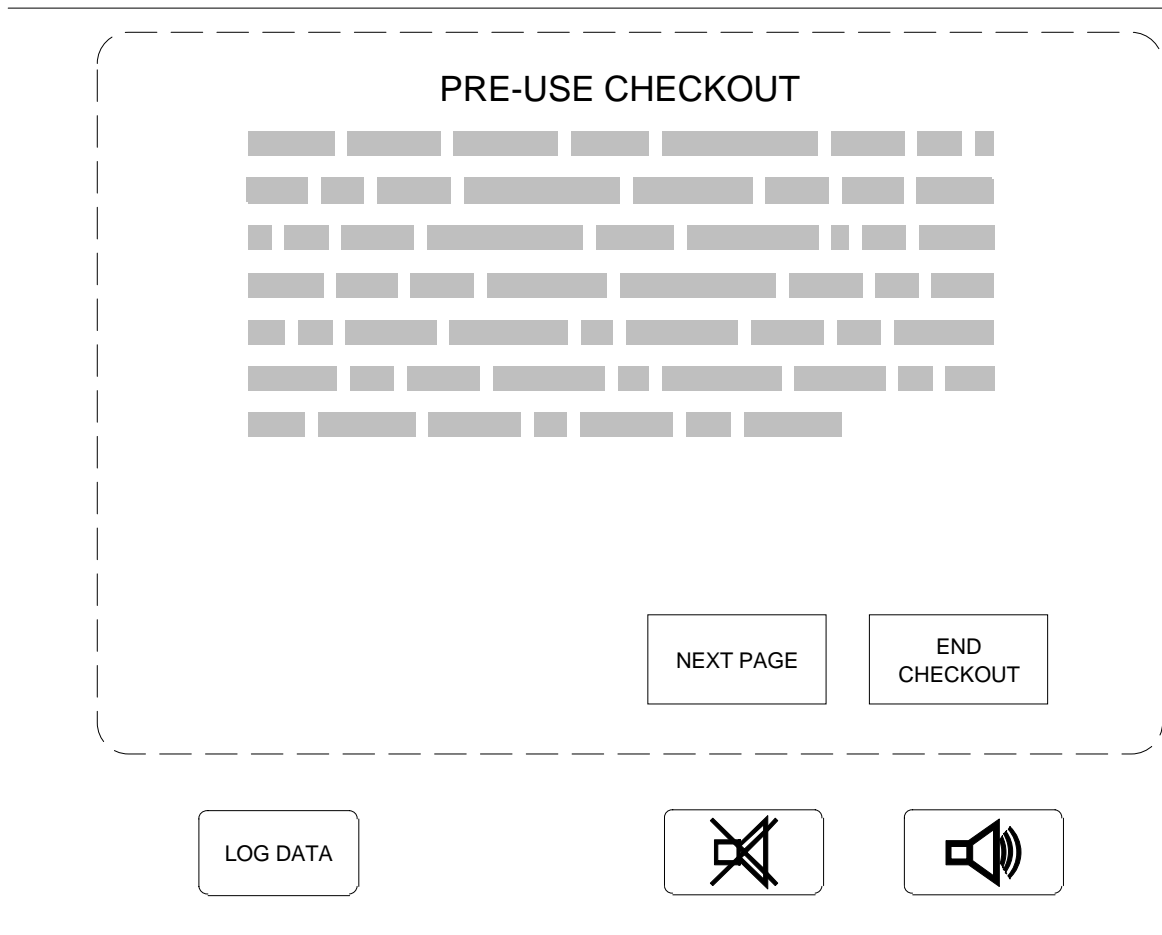


Figure 23 Checkout Display

MONITORING SYSTEM (continued)

Certain NAD monitors are capable of operating in a "NEONATAL MODE" (e.g., reduced NIBP cuff pressure). Selecting the "NEONATAL MODE" configuration option 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.

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 using the system control keypad.

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 "CONFIGURE SERIAL PORTS" 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 and "3" for VITALINK.

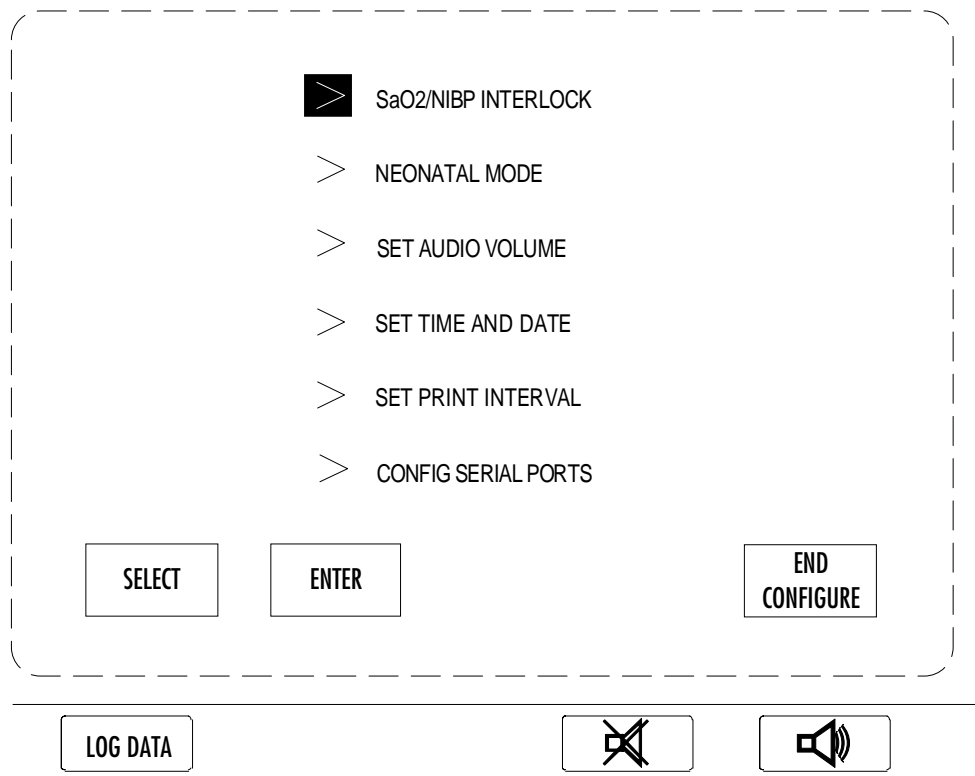


Figure 24 **Configure Menu**

OP30023

Data Display (Refer to Figure 25)

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 and the reading is 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.

OP30025

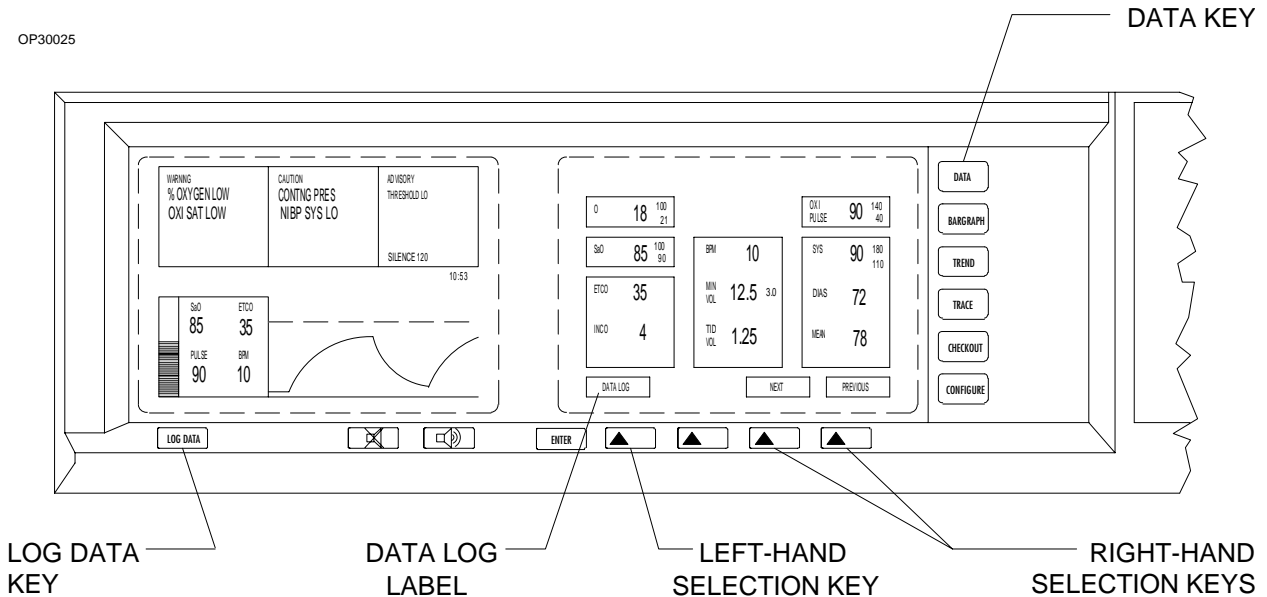


Figure 25 Data Display

MONITORING SYSTEM (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 on 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 26)

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 MULTISPEC 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 and is 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.

MONITORING SYSTEM (continued)

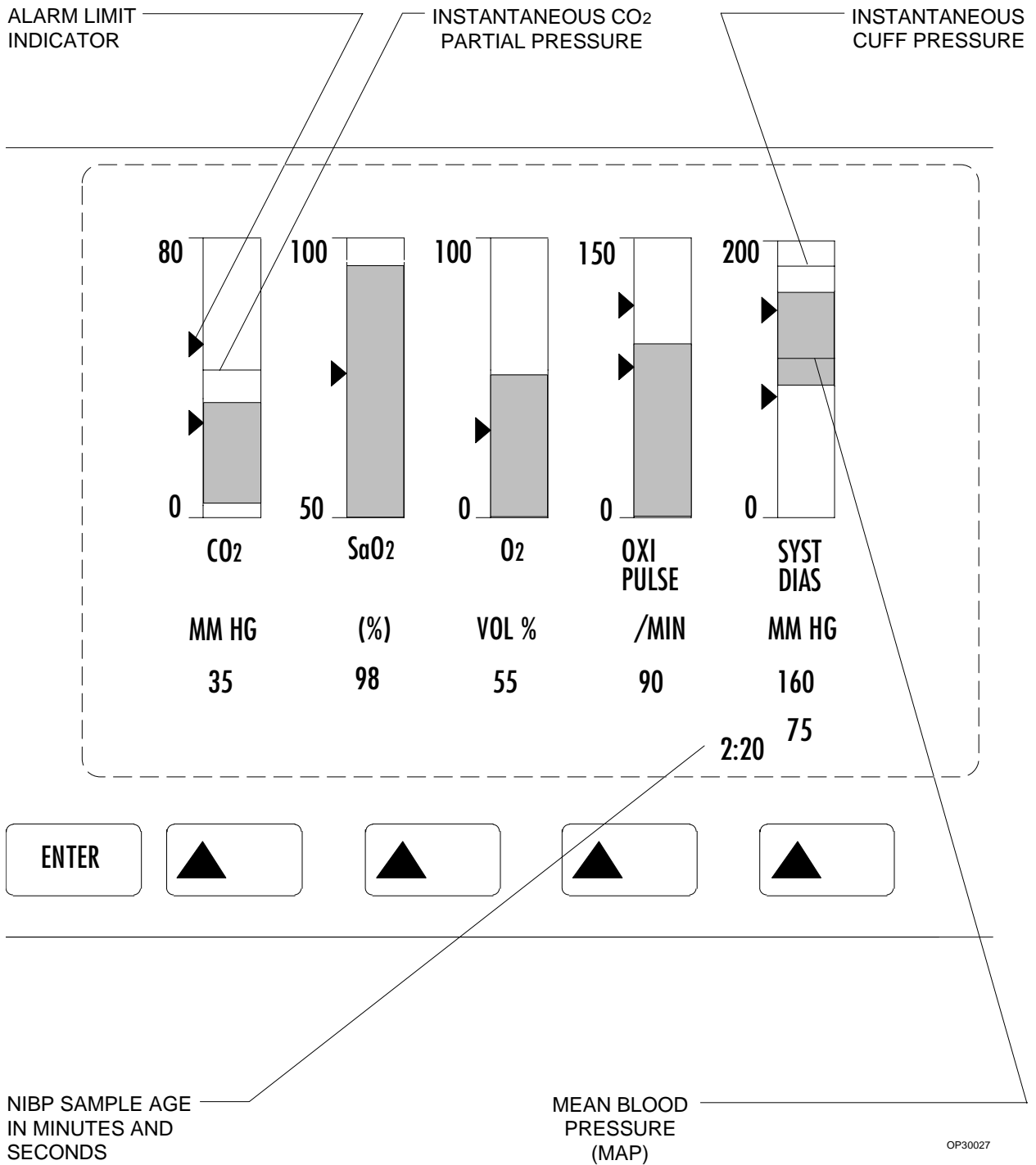


Figure 26 Bargraph Display

MONITORING SYSTEM (continued)**TREND MONITOR**

Pressing the "TREND" key invokes the Trend monitor's display screen (Figure 27). The Trend monitor is activated on power-up and provides up to 8 hours of trend history for up to 17 measurements, showing two trends at a time. The Trend monitor consists of five screens:

- Trend Display
- Set Up Trend
- Rapid Track
- Tabular Data Log
- Set Up Data Log.

A description of each screen follows:

Trend Display Screen

The Trend Display screen is invoked when the "TREND" key is pressed. Two trend graphs, each representing a specific measurement's trend history, are displayed simultaneously.

The label for the selected measurement appears at the top of the corresponding trend graph, next to the vertical axis. The horizontal axis is calibrated in military time. The vertical axis is calibrated in the appropriate units for the selected measurement. A line graph, representing the historical variations of the trended measurement, travels from left to right across the graph as new trend data accumulates.

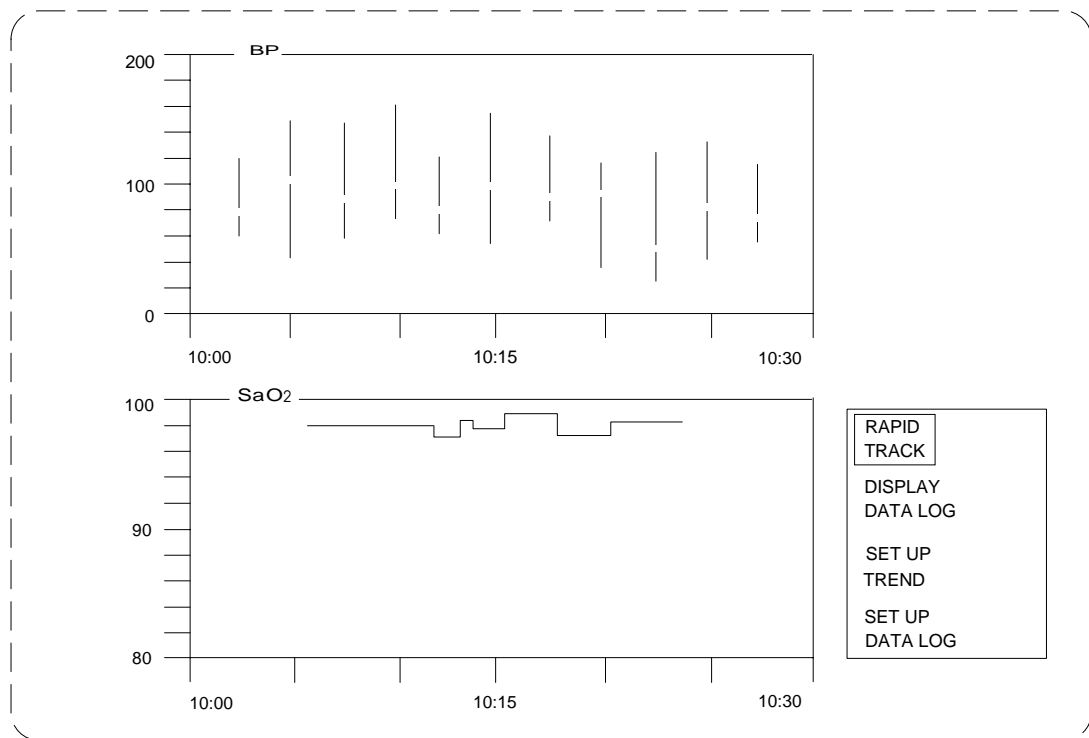


Figure 27 Trend Display Screen

OP30028

MONITORING SYSTEM (continued)

The box in the bottom right corner of the Trend display screen contains labels for the remaining four Trend Monitor screens. By using the soft key beneath the labels, the operator can select a specific screen. Pressing the "ENTER" key activates the selected screen.

The Trend Display screen can be configured by the operator using the Set Up Trend screen.

Set Up Trend Screen

The Set Up Trend screen (Figure 28) allows the operator to select measurements for the top and bottom trend graphs, the time scale interval, the Auto Scale feature, Data Erase function, and the Trend Grid display.

To select a specific configuration, the operator must:

1. Press the soft key beneath the corresponding column. The cursor will move to the top selection of the column.
2. Continue pressing the soft key until the cursor moves to the desired configuration.
3. Press the "ENTER" key to enable the selected configuration. The cursor will automatically return to the "EXIT" screen label.

The operator can press the "ENTER" key again to exit the Set Up Trend Screen, or else continue configuration via the soft keys.

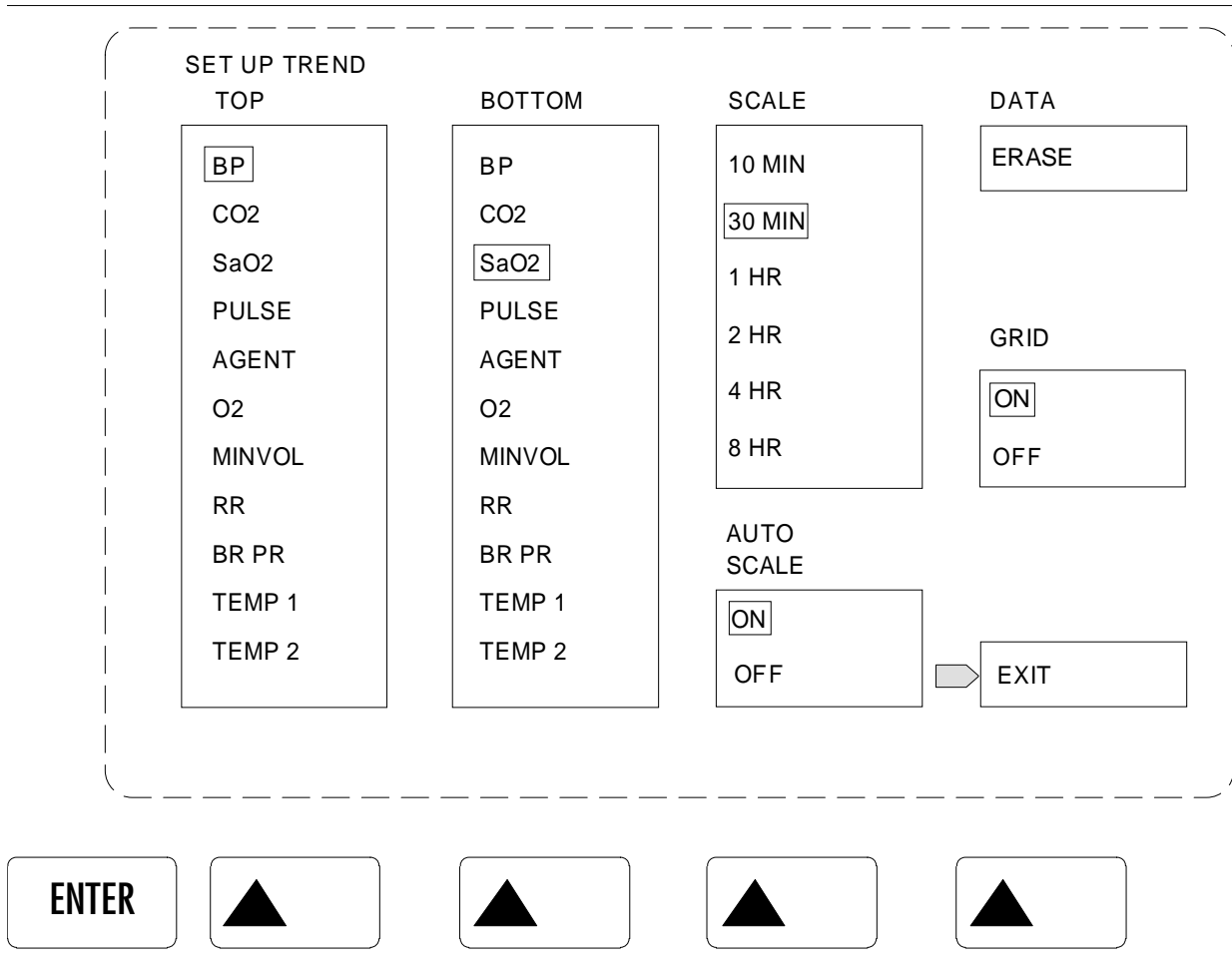


Figure 28 Set Up Trend Screen

MONITORING SYSTEM (continued)

Trend Graph Selection

Measurement display selections for the top and bottom trend graphs appear in the two left columns on the screen, labeled TOP and BOTTOM. Although the Set Up Trend screen allows the operator to select displayed parameters, all parameters are trended.

NOTE: The power-on default selections for the Trend graphs are blood pressure (BP) and oxygen saturation (SpO₂).

In general, trends appear on the display as a single line graph plotted against time. The following are five exceptions:

1. The noninvasive blood pressure trend is displayed as a vertical bar appearing at the point in time 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.
2. The invasive blood pressure trend appears as a shaded area on the screen showing the blood pressure envelope, with the top of the area representing systolic pressure, the bottom representing diastolic pressure, and the unshaded gap in the area representing the mean arterial pressure.
3. 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.
4. The anesthetic agent trend appears as a shaded area on the screen showing the agent envelope. During the induction phase of an operation, the top of the envelope area represents inspired agent and the bottom represents expired agent. For the maintenance phase of an operation, the inspired agent typically approaches the expired agent.

During the recovery phase of an operation, the top of the envelope area represents expired agent, while the bottom represents inspired agent.

5. 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 Scale Selection

The operator can select one of six time scales for the trend graphs: 10 minutes, 30 minutes, 1 hour, 2 hours, 4 hours or 8 hours. The selected scale is indicated on the horizontal axis of the trend graphs.

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.

When a trend graph is completely filled and the Auto Scale mode is disabled, the Trend Monitor automatically shifts the horizontal axis and data in order to keep a continuous display of trend information.

NOTE: The power-on default selection for the time scale is 30 minutes.

Automatic Scaling

Enabling Auto Scale allows the Trend Monitor to adjust a filled trend graph to the next time scale for a complete display of trend history.

NOTE: The power-on default selection for Auto Scale is ON.

Selectable Trend Grid

To aid in the interpretation of a trend graph, the Trend Monitor features a selectable trend grid.

NOTE: The power-on default selection for the trend grid is ON.

Data Erase Command

Activating the Data Erase command clears all existing trend data from the Trend Monitor. 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.

Rapid Track Screen

Selecting the Rapid Track screen trends the currently selected measurements on a 10-minute time scale, displaying the last five minutes of data. When the line graph fills the 10-minute time scale, the trend monitor

automatically shifts the data to provide a 5-minute history and space for the next 5 minutes of trend data. Rapid Track can be terminated any time by highlighting the "RESUME TREND" selection and pressing the "ENTER" key. If selected, Auto Scale is reactivated and the previously selected trend scale returns to the screen. Other ways to eliminate the Rapid Track function include changing the time scale from 10 minutes in the Set Up Trend screen or by turning Auto Scale "ON."

Tabular Data Log Screen

The Trend Monitor incorporates a tabular Data Log. This capability allows the operator to save a set of measurements (called an "event") for future reference. Selecting the Display Data Log screen (Figure 29) presents all previously logged data in a tabular form. The events are numbered sequentially as they are logged (up to 99).

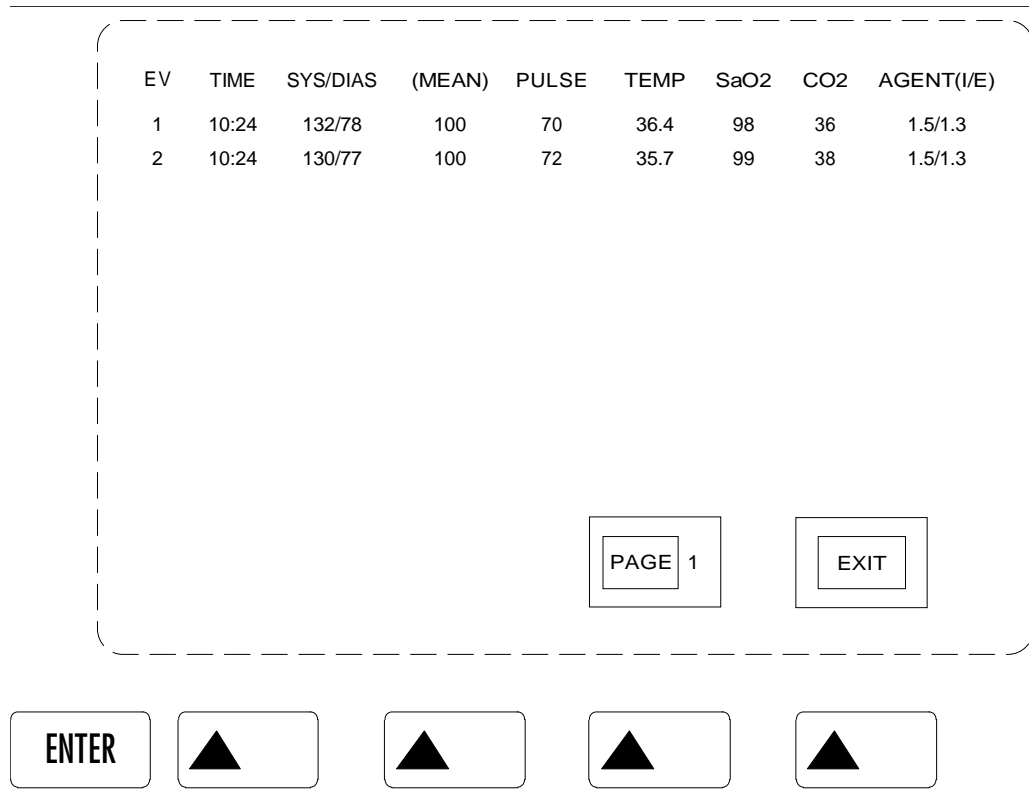


Figure 29 Display Data Log Screen

OP30030

MONITORING SYSTEM (continued)

The time of occurrence, as well as seven measurements, are displayed for each event. Pressing the highlighted "PAGE" soft key allows the operator to go through each page of logged data where 11 entries per page are displayed. In this mode, "PAGE" and "EXIT" soft keys will activate functions; pressing the "ENTER" key is not necessary.

An event can be manually logged by pressing the "LOG DATA" key, located at the far left of the display screens. The operator can also configure the Trend Monitor to automatically log data via the Auto Log function of the Set Up Data Log screen.

Set Up Data Log Screen

The Set Up Data Log screen (Figure 30) allows the operator to select the parameters for automatically saving a set of measurements.

Configuration selections for the Set Up Data Log screen are implemented in the same style as the Set Up Trend screen (see Set Up Trend section for more details).

Auto Log

When the Auto Log function is enabled, the Trend Monitor can be configured to record an event at 1, 2, 5 or 10 minute time intervals. An event can also be automatically recorded at each noninvasive blood pressure measurement.

NOTE: The power-on default selection for Auto Log is ON, with a time interval of 5 minutes and the NIBP criteria disabled.

Data Erase Command

Activating the Data Erase command clears all existing tabular log data from the Trend Monitor. It should be noted that this function does not work in conjunction with the electronic Data Log (see Electronic Data Log section for more details).

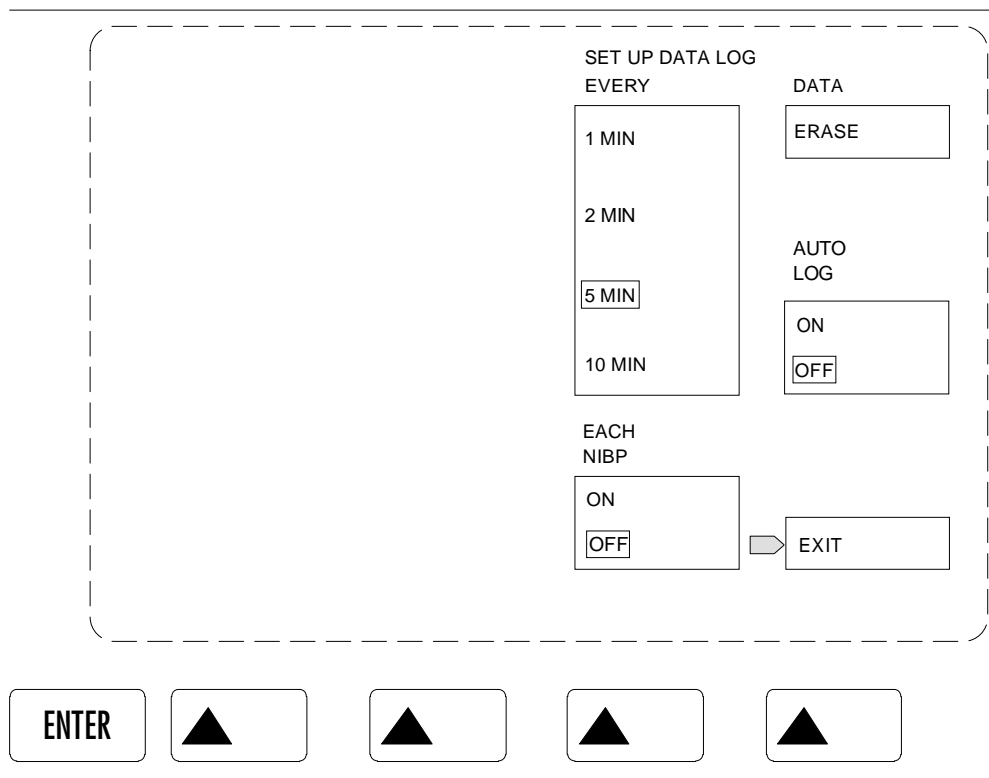


Figure 30 Set Up Data Log Screen

OP30031

REAL-TIME TRACE MONITOR

Pressing the "TRACE" key calls up a real-time trace display on the right-hand display screen (Figure 31). 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 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.

Successive 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.

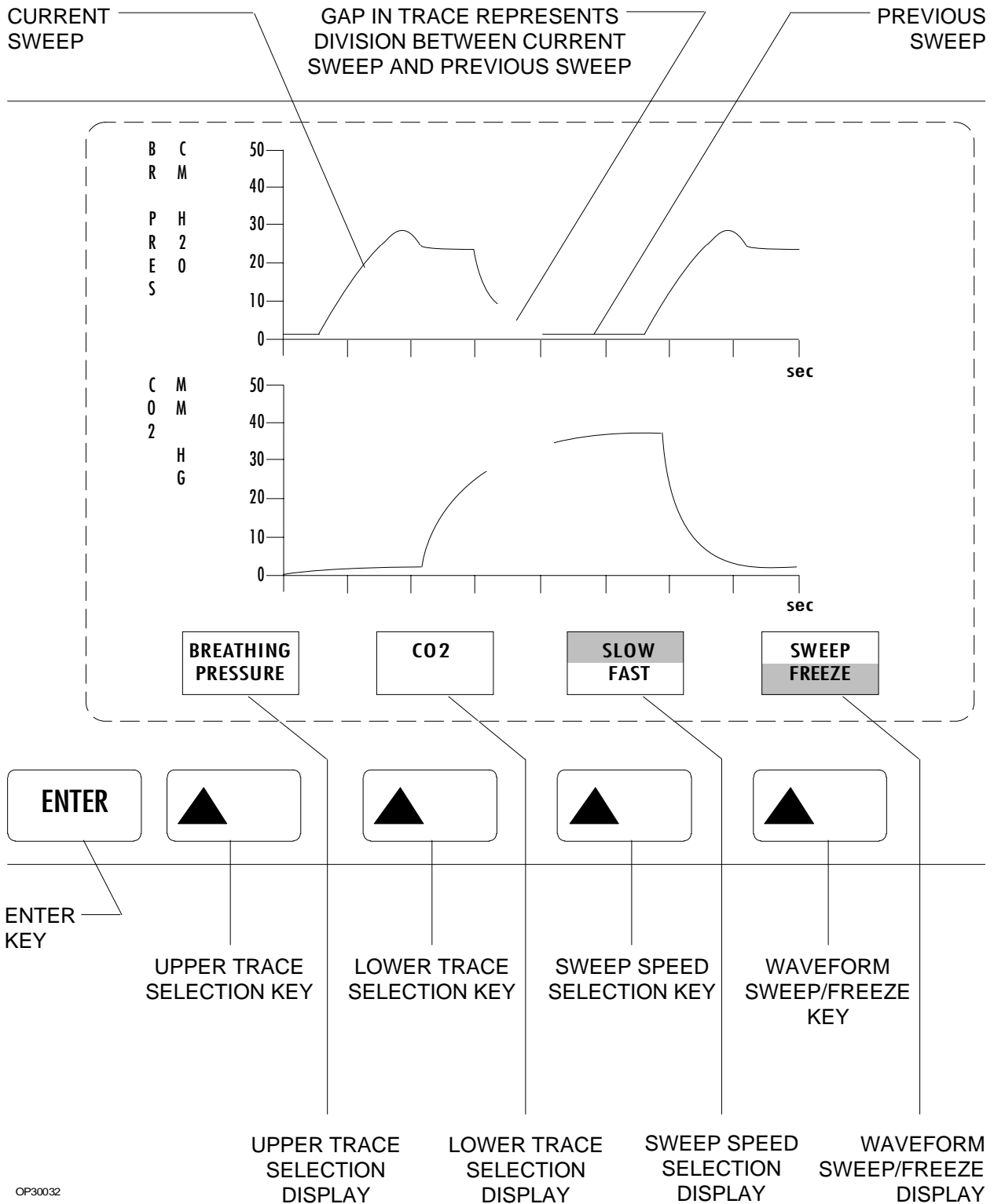
Waveform Sweep/Freeze Control

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.

MONITORING SYSTEM (continued)



OP30032

Figure 31 Real-Time Trace Display

Initial Setup

Initial setup of a NARKOMED 3 anesthesia machine shall be by or under the direct supervision of an authorized North American Dräger 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 fresh gas delivery system pressure test as described in Step 26 of this manual's Pre-Use Checkout Procedure.

Auxiliary and Optional Equipment

Instructions for the setup and installation 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 an optional third gas are located on the side of the flowmeter housing (Fig. 32). Standard Diameter Indexed Safety System (DISS) 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 reserve gas cylinders with the cylinder wrench tethered to the rear of the anesthesia machine.

2. Connect the gas fitting on the supply hose to the corresponding gas fitting on the side of the flowmeter housing (Fig. 32). Use a wrench to tighten the attached hex nut fitting.
3. Attach the other end of the supply hose(s) to the appropriate, functioning hospital pipeline supplies.
4. Check for sufficient pipeline pressure (50-55 psi) using 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 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 oxygen sensor mounted in the inspiratory valve dome, the Oxygen Analyzer display area should read 100 (±3) % oxygen.
8. Close the O₂ flow control valve and turn the NARKOMED 3 System Power switch to "STANDBY".

NARKOMED 3 SETUP & INSTALLATION (continued)

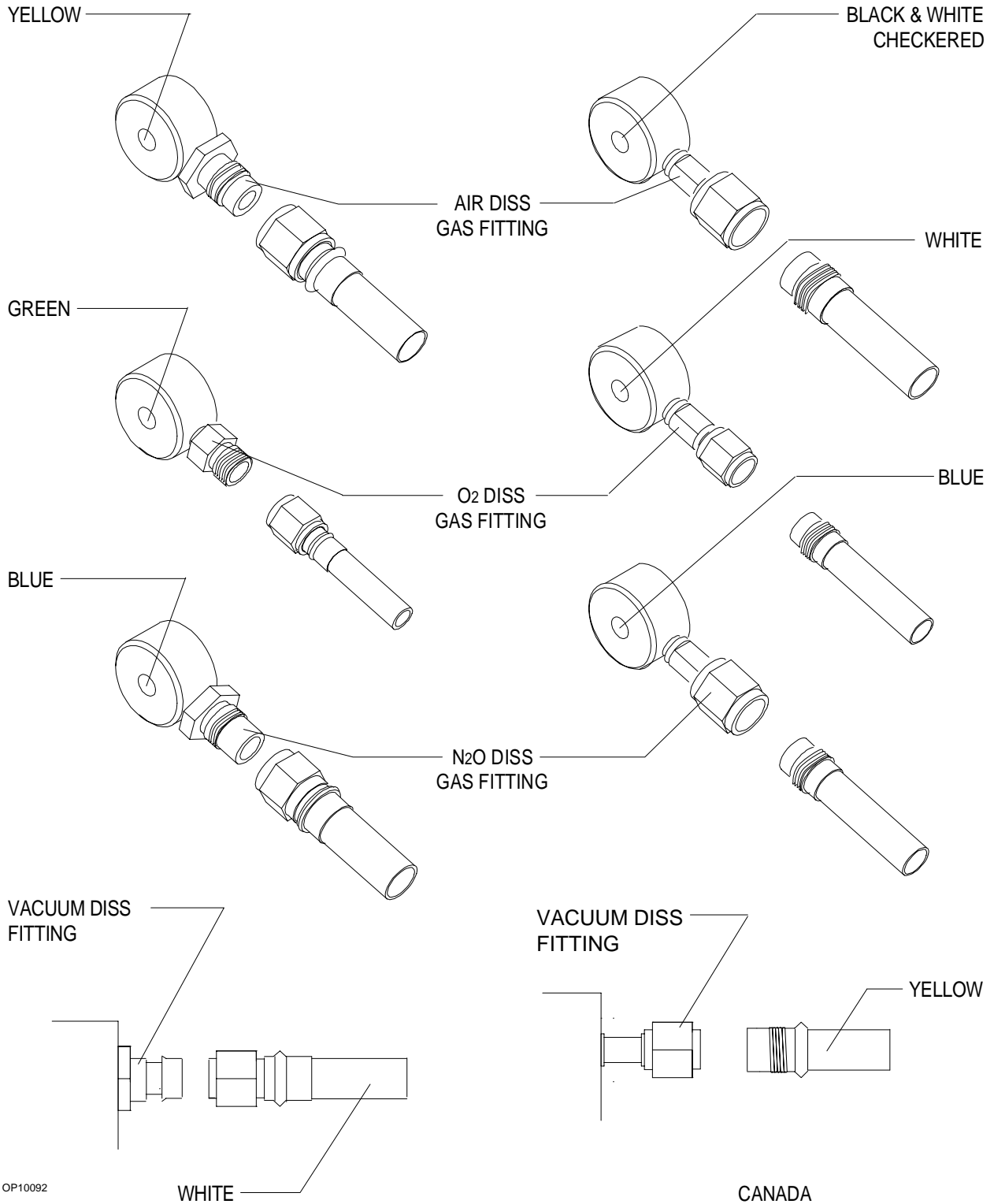


Figure 32 Supply Line DISS Gas Fittings And Supply Line Hose Connections (Air Option)

NARKOMED 3 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. 33):

1. Turn the System Power switch to "STANDBY" and disconnect the hospital pipeline supply hose.
2. Remove the old sealing washers 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 indexing 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.

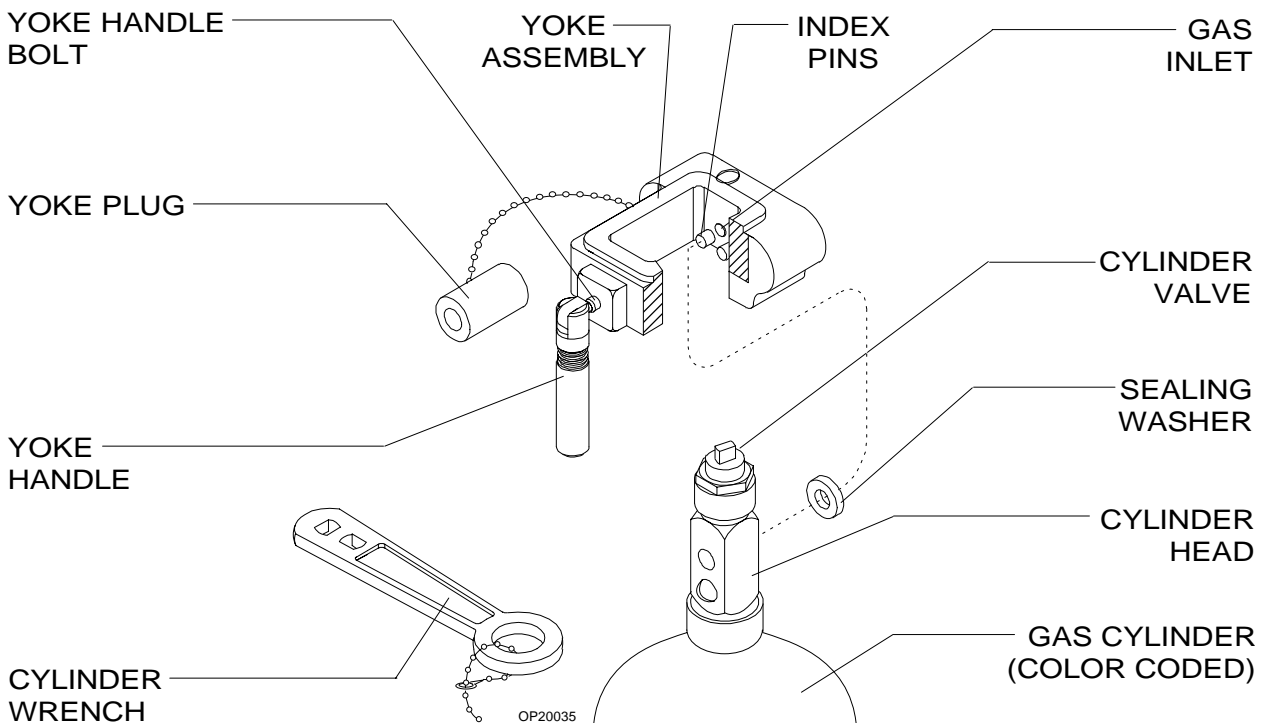


Figure 33 Reserve Gas Cylinder Installation

NARKOMED 3 SETUP & INSTALLATION (continued)

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| <ol style="list-style-type: none"> 8. Open the cylinder valve by turning the cylinder valve stem in a counter-clockwise direction, using the cylinder wrench tethered to the rear of 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 oxygen analyzer. 12. Close the flow control valve(s) and turn the System Power switch to the "STANDBY" position. | <ol style="list-style-type: none"> 1. Turn the NARKOMED 3 System Power switch to "STANDBY." 2. Unwrap sufficient length of power cord. 3. Plug the power cable into a 117 or 240 VAC hospital grade outlet (depending on the voltage requirement of the machine). 4. Turn the System Power switch of the NARKOMED 3 to "ON." The central monitoring display should now be active. 5. Verify that the battery-in-use ("AC POWER FAIL") indicator on the main switch 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 3 to "STANDBY." |
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Electrical Power Connection

The NARKOMED 3 is equipped with a power cable with a hospital grade plug for the 117 VAC primary electrical power or with a power cable with a hospital grade plug for the optional 240 VAC primary electrical power. Attach the NARKOMED 3 to electrical power as follows:

NARKOMED 3 SETUP & INSTALLATION (continued)

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: Devices plugged into the NARKOMED 3's convenience receptacles (117 VAC option) contribute to the anesthesia machine's total leakage current. This total leakage current should not exceed 100 μ amps.

2. Attach a data cable between the external device and one of the ports on the NARKOMED 3 as shown in the chart below:

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 cannot 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 section). When interfacing a printer, the print interval can also be selected through the configure screen.

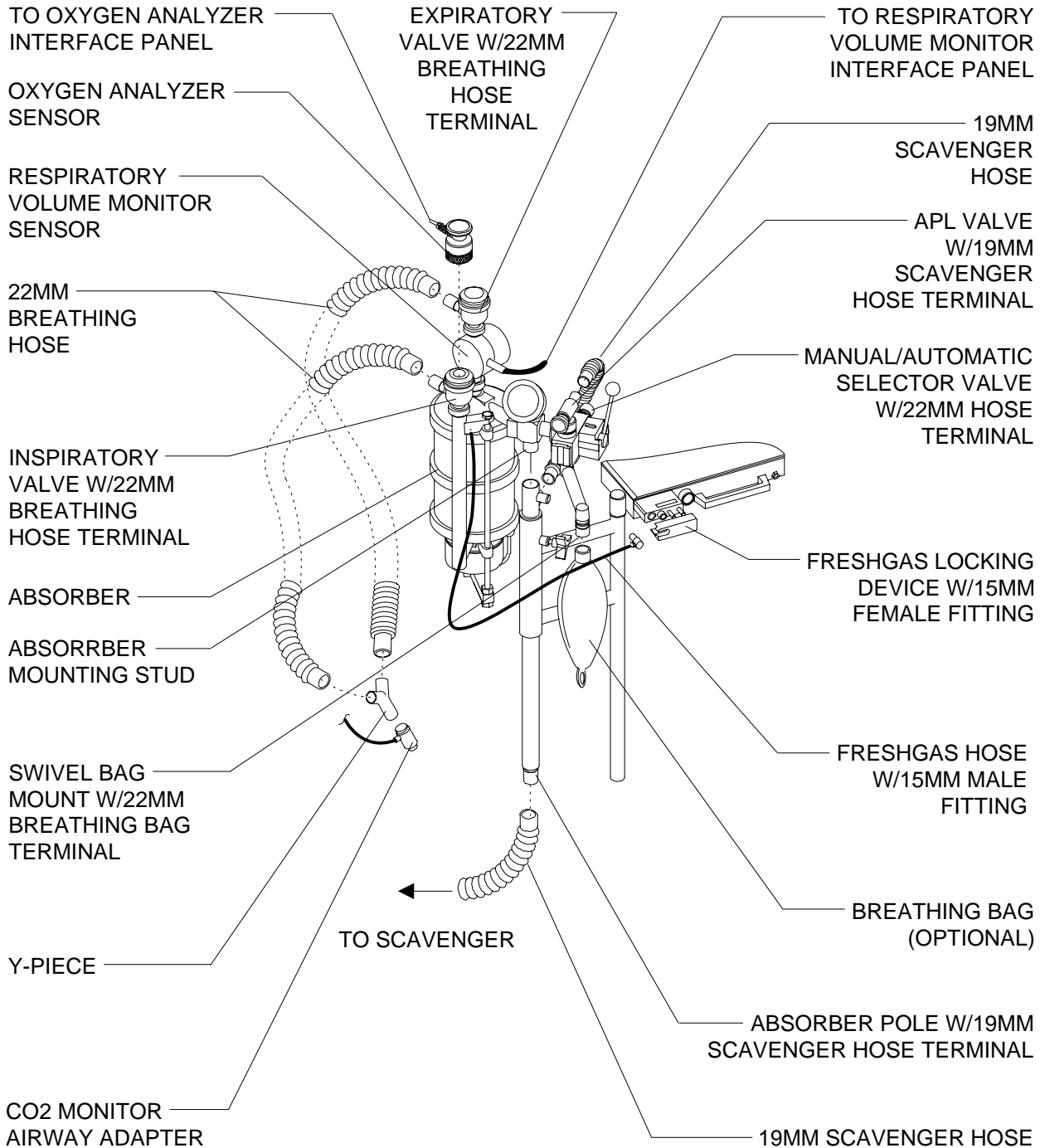
NARKOMED 3 SETUP & INSTALLATION (continued)

Absorber System and Monitor Sensors

Install the absorber system and monitor sensors as described below (Figs. 34 & 35). This installation presumes the use of an appropriate scavenger system with the absorber system. If using a Bain circuit adapter, consult the manual supplied with the adapter.

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 in place.
3. Pull the fresh gas locking bar, located on the front of the NARKOMED 3, out to its extended position (Figs. 11 & 34). Attach the fitting on the fresh gas hose to the 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. 35) between the ventilator bellows 22 mm terminal marked "VENTILATOR HOSE" and the 22 mm terminal on the rear of the manual/automatic selector valve, which is also marked "VENTILATOR HOSE."
5. Attach a 22 mm breathing hose (Fig. 34) between the 22 mm hose terminal on the inspiratory valve marked "INSPIRATION" and one side of the Y-piece.
6. Similarly, attach another 22 mm breathing hose (Fig. 34) between the other side of the Y-piece and the 22 mm hose terminal on the expiratory valve marked "EXPIRATION."
7. Attach the breathing bag to the swivel bag mount 22 mm terminal marked "BREATHING BAG" (Fig. 34).
8. Connect the 19 mm scavenger hose between the 19 mm terminal (marked "SCAVENGER HOSE") on the bottom of the absorber pole (Fig. 34) and the 19 mm terminal (marked "SCAVENGER HOSE") on the scavenger (Fig. 35).
9. Attach the breathing pressure pilot line to the connector on the system interface panel marked "BREATHING PRESSURE" (Fig. 35). 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 Oxygen Analyzer sensor cord to the connector on the interface panel marked "OXYGEN SENSOR" (Fig. 35). Make sure that the oxygen sensor assembly is properly mounted in the inspiratory valve dome.
11. Connect the 19 mm scavenger hose between the 19 mm terminal (marked "SCAVENGER HOSE") on the rear of the APL valve and the 19 mm terminal (marked "SCAVENGER HOSE") on the rear of the absorber pole (Fig. 34).
12. Install the Respiratory Volume Monitor sensor between the expiratory valve and the absorber. Plug the sensor cord into the connector on the interface panel marked "VOLUME SENSOR" (Fig. 35).

NARKOMED 3 SETUP & INSTALLATION (continued)



OP20036

Figure 34 Absorber Installation (Front View)

NARKOMED 3 SETUP & INSTALLATION (continued)

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| <p>13. Connect the respiratory gas analyzer sample tubing to the patient breathing system.</p> <p>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.</p> <p>15. Verify the delivery of oxygen by providing oxygen to the breathing circuit. The measured oxygen concentration should rise towards 100%.</p> <p>16. Perform a complete Pre-Use Checkout Procedure as described in this manual.</p> | <p>3. Connect one end of a 19 mm scavenger hose to the 19 mm hose terminal on the bottom of the absorber pole (Fig. 35) and connect the other end to the 19 mm hose terminal labeled "Scavenger Hose" on the right-hand side of the scavenger body.</p> <p>4. Attach the 19 mm scavenger hose between the 19 mm terminal (marked "SCAVENGER HOSE") on the ventilator relief valve (Fig. 35) and the 19 mm terminal (marked "SCAVENGER HOSE") on the left-hand side of the scavenger.</p> <p>5. Attach the 19 mm scavenger hose between the 19 mm terminal (marked "SCAVENGER HOSE") on the rear of the APL valve (Fig. 34) and the 19 mm terminal (marked "SCAVENGER HOSE") on the rear of the absorber pole.</p> |
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Scavenger System

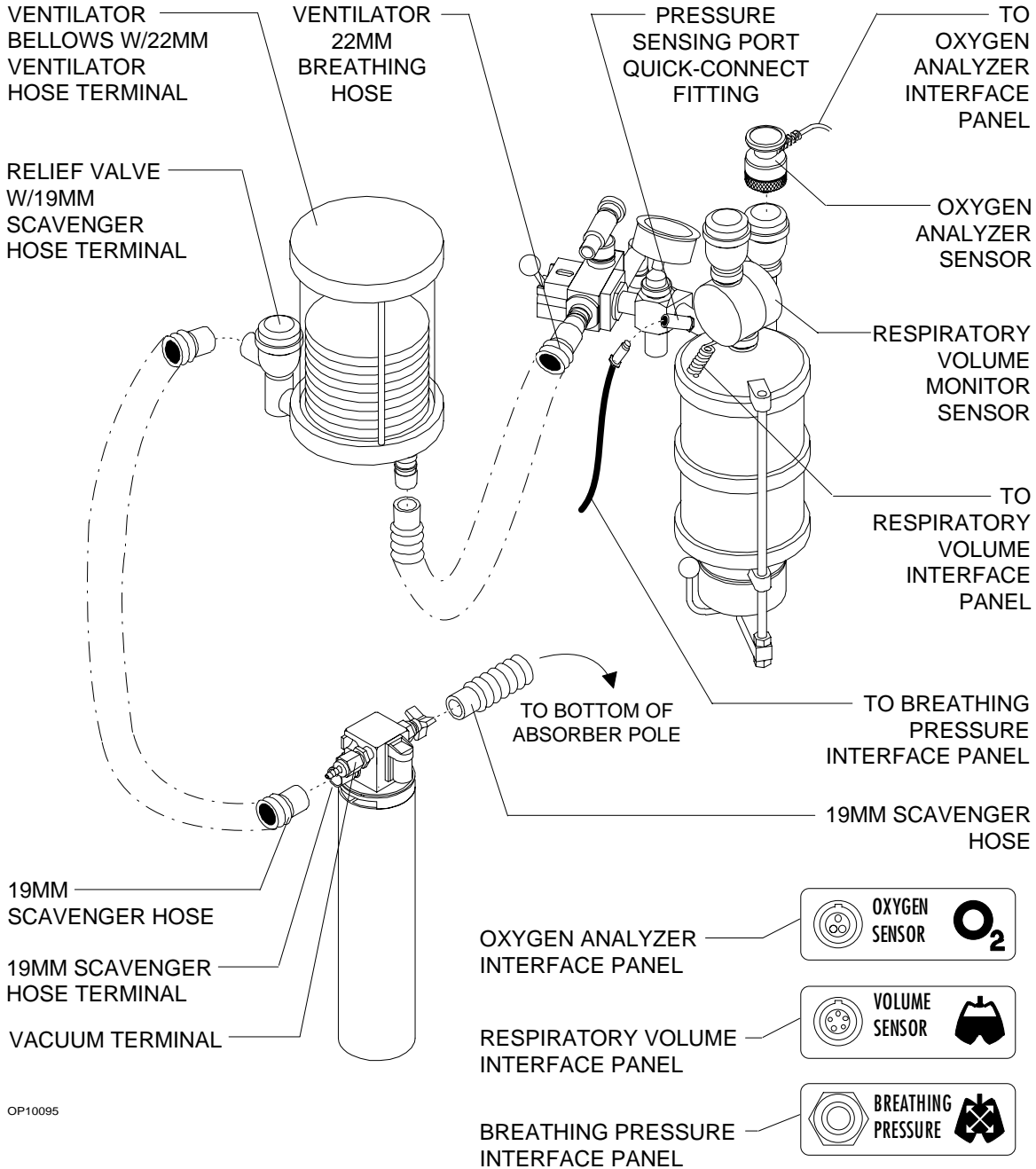
Installation of an open reservoir scavenger system (Fig. 35) on the NARKOMED 3 is as follows:

NOTE: Two different types of scavenger systems are available for the NARKOMED 3. The following installation procedure applies only to the open reservoir scavenger system. For details on the air conditioning scavenger, consult its instruction manual.

1. Using the mounting bracket, install the scavenger on the side of the anesthesia unit as shown in Figure 35.
2. Attach a wall suction hose between the wall suction outlet and the suction terminal (DISS or hose barb w/adaptor) on the scavenger.

6. Verify the proper functioning of the scavenger system. Check for excessive PEEP or NEEP during ventilation.

NARKOMED 3 SETUP & INSTALLATION (continued)



OP10095

Figure 35 Absorber (Rear View) and Scavenger Installations

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 the 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 cable to a live 117 VAC or 240 VAC receptacle that will accept and properly ground the anesthesia unit's line power cable. 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 Oxygen Analyzer section of this 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. Verify the existence of 2 index pins in the yoke, and mount cylinder(s).
 - B. Disconnect the oxygen 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 pipeline and cylinder pressure gauges indicate zero pressure.
 - 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 with a pressure less than 600 psi. At least one cylinder should be nearly full. Adjust flow over the full range of the flowmeter and verify that maximum flow can be achieved. Close the flow control valve.

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

PRE-USE CHECKOUT PROCEDURE (continued)

D. If equipped with dual oxygen reserve cylinder yokes, press the flush button again to empty the piping. Then, repeat the above steps for the second reserve cylinder.

- *11. Check the nitrous oxide cylinder supplies:

A. Verify the existence of 2 index pins in the yoke, and mount cylinder(s).

B. Disconnect the nitrous oxide 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.

C. Open the cylinder (or one of the cylinders if equipped with dual N₂O 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 with a pressure less than 600 psi. At least one cylinder should be nearly full. Adjust flow over the full range of the flowmeter and verify that maximum flow can be achieved. Close the flow control valve.

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 steps.

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

A. Verify the existence of 2 index pins in the yoke, and mount cylinder.

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

C. Open the cylinder and check the cylinder pressure gauge. Replace the cylinder if its contents are insufficient for the intended procedure. Adjust flow over the full range of the flowmeter and verify that maximum flow can be achieved. Close the flow control valve.

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

- *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 fresh gas.

- *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.

PRE-USE CHECKOUT PROCEDURE (continued)

- *16. Check the function of the flowmeters: Attach pipeline supplies (if disconnected). 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 4 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.
- When the oxygen supply pressure (from either pipeline or reserve cylinders) drops below approximately 37 psi, the electronic oxygen supply pressure Caution alarm shall sound continually, a "LO O₂ SUPPLY" alarm message shall appear on the central alarm display, and the red "O₂ SUPPLY PRESSURE" indicator on the main switch panel shall illuminate.
- If only one source 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 OFPD and "LO O₂ SUPPLY" alarm shall not activate.
- *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 fresh gas oxygen/nitrous oxide flow ratio of at least 25 (±4)%. At low flows the ORMC will maintain a fresh gas oxygen concentration higher than 25%.
- *19. Test the oxygen flush: Pressing the oxygen flush button shall 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 oxygen analyzer sensor mounted in the inspiratory valve dome, the oxygen analyzer display area should read 100 (±3) % oxygen concentration.
- *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 fresh gas common outlet. There should be no noticeable odor.
- *22. Check the reserve battery power: Pressing the "BATTERY TEST" button on the anesthesia machine's main switch 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 34 & 35 in the SETUP & INSTALLATION section of this manual):

PRE-USE CHECKOUT PROCEDURE (continued)

A. The fresh gas hose of the breathing system **intended for use** shall be connected to the fresh gas 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. The gas analyzer 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.

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.

K. 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.

- *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 fresh gas delivery system pressure test. This test detects leaks from the patient breathing system and fresh gas delivery system.

PRE-USE CHECKOUT PROCEDURE (continued)

To perform the test:

A. First close all flow control valves on the anesthesia machine.

B. Turn the System Power switch of the NARKOMED to the "STANDBY" position.

C. Turn the vaporizers to 0 concentration. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm breathing hose.

D. Set manual/automatic selector valve to "BAG."

E. Close the APL valve by turning the knob fully clockwise to its stop position.

F. Attach the supplied test terminal to the breathing bag mount.

G. Connect a sphygmomanometer squeeze bulb (available from North American Dräger) to the hose barb on the test terminal.

H. 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).

I. Observe the pressure drop at the breathing system pressure gauge. Thirty 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:

A. First set the manual/automatic selector valve to the "BAG" position.

B. Remove the bag from the swivel arm bag mount.

C. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm hose.

D. Completely open the APL valve by turning the control knob fully counterclockwise to its stop position.

E. Open the oxygen flow control valve to a flow of 8 l/min.

F. 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 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 absorber manual/automatic selector valve to the "BAG" position. Completely open the APL valve by turning the control knob fully counterclockwise to its stop position.

PRE-USE CHECKOUT PROCEDURE (continued)

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 is 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 completely 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.

E. The flow of oxygen shall now exit through the scavenger's positive pressure relief ports. 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, 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 power switch to their "ON" positions. 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. (If testing the Pediatric Bellows, adjust the tidal volume to 200 ml.)

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 an 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.

PRE-USE CHECKOUT PROCEDURE (continued)

- 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 counter-clockwise to its lowest setting after the test has been completed.
30. Check the alarm limit settings: The NARKOMED 3 automatically sets monitor alarm limits 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 of, or during, a procedure. Also, make sure that external monitors (if present) are connected properly and annunciate alarms through the anesthesia machine's central audio annunciator.
- *31. Test the alarm functions of all monitors: simulate alarm conditions and check for appropriate alarm signals.
32. After the above checkout 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 power 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 that system in the appropriate manual.

Perform cleaning and sterilization according to hospital-established policies and procedures as well as the following additional specifications:

Accessory Equipment

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

Surfaces

Clean painted, plated, and plastic surfaces of the NARKOMED 3 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 Assembly

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 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, clean the bellows assembly and all its parts 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 sterilize them in ethylene oxide gas (cold cycle), 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 ring nut. Replace the ventilator bellows, followed by 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.

CLEANING & STERILIZATION (continued)**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 (cold cycle), properly aerate rubber goods.

Inspiratory and Expiratory Valves

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

Manual Sphygmomanometer

In typical usage, the Manual Sphygmomanometer will not require any further cleaning than a wipe down with a liquid disinfection agent. However, if further disinfection is required, remove the sphygmomanometer gauge assembly, hoses, and blood pressure cuff from the anesthesia machine and sterilize them with ethylene oxide gas (cold cycle), 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.

WARNINGS

Anesthesia Machine:

Any person involved with the setup, 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).

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. Since 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 reserve cylinders, cylinder valves, gauges, fittings, etc., which conduct oxygen or nitrous oxide within the machine. For further information regarding safety precautions in the use of medical gases, consult Compressed Gas Association Pamphlets 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 check valves 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.

The ORMC maintains a nominal O₂/N₂O fresh gas flow ratio of at least 25 (±4) %. Hypoxic fresh gas mixtures may be delivered if CO₂ is used as an additional gas.

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 a wall or ceiling outlet to ensure that both ends of the hose are indexed for the same gas.

PRECAUTIONS (MAINTENANCE & USE) (continued)

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

The oxygen flow control valve is set to deliver a minimum O₂ flow of 150 (±50) ml/min (unless 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.

Patient Breathing System:

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

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

CAUTIONS**Anesthesia Machine:**

Due to the weight of the NARKOMED 3, the anesthesia machine should only be moved by people who are physically capable of the task. It is recommended that two people move the anesthesia machine to aid in maneuverability on inclines, around corners, and over raised thresholds (i.e., elevators).

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.

Refer any servicing to qualified service personnel.

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 µA.

Unless the unit is specifically modified to eliminate the minimum oxygen flow, the flow of oxygen cannot be totally shut off using 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 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, the vaporizer filler valves (Figs. 9 & 10) should be tightened (turned fully clockwise). Vaporizer drain valves should also be tightened fully clockwise.

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.

PRECAUTIONS (MAINTENANCE & USE) (continued)

Communications may be temporarily affected by electromagnetic interference due to the use of certain electrosurgical equipment.

Regardless of the indications of any alarm or monitoring device, patient chest movement shall be the primary indication of a securely connected, properly ventilated patient.

Patient Breathing System

To prevent leaks and misdirection of gas pathways, all hoses should be correctly and tightly fitted, as shown in Figures 34 & 35. Special care must be taken to assure 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 CO₂ 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 developing 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 H₂O at an 8 l/min flow.

To ensure proper direction of gas flow during inspiratory and expiratory phases, the following must occur: (1) the inspiratory valve must provide free gas passage from the breathing system to the patient 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 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 shall be positioned away from the operator. The word "AUTO" will 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.

SPARE & REPLACEMENT PARTS

DESCRIPTION	PART NUMBER
Breathing Hose (22 mm x 23" LG)	9995123
(22 mm x 32" LG)	9995132
(22 mm x 40" LG)	9995140
Scavenging Hose (19 mm x 10" LG)	9995210
(19 mm x 20" LG)	9995220
(19 mm x 30" LG)	9995230
Breathing Bags (1.0 l)	9995310
(2.0 l)	9995320
(3.0 l)	9995330
(4.0 l)	9995340
(5.0 l)	9995350
Kuhn w/ vent (0.5 l)	2114638
Adult Bellows (replacement bellows)	4106930
Data Cable (DB9/DB25/2.5 ft.) for 9 to 25 pin adapter	4109882
Data Cable (DB9/DB9/2.5 ft.) for use with Vitalink	4110328
Data Cable (DB9/DB25/10 ft.) for link to printer	4110568
Narkomed 3 Operator's Instruction Manual	4108980
Vitalink Technical Reference Manual	4110117
Pulse Oximeter Accessories	
Interface cable w/pre-amp	4108982
Interface cable extension	4110686
DURASENSOR	4108983
OXISENSORS	
D-25 (Adult, adhesive, flexible)	4108984
D-20 (Older children & small adults, adhesive, flexible)	4108985
R-15 (Mounts on bridge of nose--ind. for severe vasoconstriction, adhesive, flexible)	4108986
N-25 (Neonates up to 3 kg, adhesive, flexible)	4108987
I-20 (Infants between 3 & 15 kg, adhesive, flexible)	4108988

SPARE & REPLACEMENT PARTS (continued)

Description	Part Number
Oxygen Analyzer Accessories	
O ₂ Sensor Capsule	6803290
Sensor Housing & Cable Assembly	4106363
Inspiratory Valve Dome	4108329
Inspiratory Valve Dome Plug	4106387
Noninvasive Blood Pressure Monitor Accessories	
Newborn cuff	4109596
Infant cuff	4109595
Pediatric cuff	4109094
Adult cuff	4109095
Large adult cuff	4109096
Thigh cuff	4109597
Extension hose	4108971
Breathing Pressure Monitor Accessories	
Breathing Pressure Pilot Line (to absorber)	4109368
Breathing Pressure Pilot Line (w/Luer to Y-piece)	4108528
Respiratory Volume Monitor Accessories	
Volume Monitor Sensor Assembly	4106362
Volume Sensor Lubrication Kit (supplied w/Sensor Assembly)	2218180
Gasket (exp. valve mount & sensor inlet)	1101690
Respiratory Gas Analyzer Accessories	
15 mm Adapter/Filter	4108104
Sample Line (96 in)	4108103
Semi-permeable Tube (6 in)	4109447
Auxiliary Water Trap	4110615
Water Trap Reservoir	4110616
Scavenger Adapter	4108114
Gas Analyzer Calibration Kit	4110683

APPENDIX 1: NARKOMED 3 SPECIFICATIONS (continued)

ELECTRICAL (cont.)**Circuit Breakers**

Primary AC power input (machine)	5.0 amps AC
Convenience receptacles (117 VAC power supply only)	5.0 amps AC
Reserve battery power	15.0 amps DC

Backup Battery

Type	Sealed lead-acid, maintenance-free
Charging time	≤ 16 hours
Reserve power time	≥ 15 minutes

MISCELLANEOUS

Conductive caster resistance	≤ 250 kohms
------------------------------------	-------------

GAS DELIVERY SYSTEM

Pipeline inlet connections	DISS, male Nut with nipple (Canada)
Pipeline inlet pressure	50 - 55 psi (O ₂ , N ₂ O, Air) (345 - 380 kPa)
Cylinder connections	Pin indexed hanger yokes
Overpressure Relief Valve (Canada)	75 psi (520 kPa)
Regulator safety relief valve	95 psi (655 kPa)

APPENDIX 1: NARKOMED 3 SPECIFICATIONS (continued)

GAS DELIVERY SYSTEM (cont.)

Cylinder pressures	Recommended maximum pressures
O ₂ , Air	2200 psi (15,150 kPa)
N ₂ O	745 psi (5,130 kPa)
CO ₂	830 psi (5,700 kPa)
He - O ₂	2400 psi (16,550 kPa)
Fresh gas common outlet	15 mm female 15 mm female/22 mm male (Canada)
O ₂ flush flowrate	55 (± 10) l/min (unmetered)

Flowmeter Accuracy

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

O ₂ , N ₂ O, Air (Fine)	100-1000 ml/min ±2.5% FS
O ₂ , N ₂ O, Air (Coarse)	1-10 l/min ±2.5% FS
Air (dual-tapered)	0.2-1 l/min ± 50 cc of range 2-10 l/min ±5% FS
CO ₂	0.05-1.0 l/min ±5% FS
O ₂ - He	2-10 l/min ±5% FS
O ₂ , N ₂ O (Optional, Low-Flow) (Fine)	20 - 500 ml/min ± 2.5% FS
O ₂ , N ₂ O (Optional, Low-Flow) (Coarse)	0.6 - 10 l/min ± 2.5% FS @ (>1 l/min) ± 15% Rate @ (<1 l/min)
O ₂ (Optional, Auxiliary)	0 - 10 l/min ±5% FS

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 > 6.0 and < 15 l/min and handwheel settings > 5.0 vol%, accuracy is between -30% and +20% of setting.)

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

Isoflurane:

Adjustment range	0.2 - 5 vol%
Accuracy	± 0.15 vol% or $\pm 15\%$ of setting, whichever is greater

VENTILATOR

Frequency	1-99, ± 1 BPM (in 1 BPM steps)
I:E Ratio	1:1 - 1:4.5, ± 0.1 (in 0.5 steps)
Inspiratory flow	10 - 33 l/min (uncalibrated)
Tidal Volume	50 - 1500 ml, ± 100 ml
PEEP (Optional)	2-15 cm H ₂ O (continuously adjustable)

ENVIRONMENTAL

Storage:

Temperature	-20 C° to 60 C°
Humidity	10% - 90% relative humidity (noncondensing)

Operating:

Temperature	10 C° to 40 C°
Humidity	30% - 75% relative humidity (noncondensing)

OXYGEN ANALYZER

Range	0 - 100% O ₂
Resolution	1% O ₂
Accuracy	$\leq \pm 3\%$ O ₂
Response Time	25 sec (T90)
Service Life	1 yr @ 50% O ₂ , 50% RH, 25 C° or 5000% hour CO ₂
Zero Drift	$\leq 0.1\%$ O ₂ /month
Span Drift	$\leq 1\%$ O ₂ /8 hours
Temperature Error	$\leq \pm 3\%$ of reading (15 to 40 C°)
Cross Sensitivity	$\leq 1\%$ O ₂ (70% N ₂ O, and 5% CO ₂ , and 4% Halothane, 5% Enflurane or 5% Isoflurane)

BREATHING PRESSURE MONITOR

Range	-10 to 125 cm H ₂ O
Resolution	1 cm H ₂ O
Accuracy	$\leq \pm 3$ cm H ₂ O or $\pm 10\%$

APPENDIX 1: NARKOMED 3 SPECIFICATIONS (continued)**SPIROMETER**

Minute Volume:

Range	0.1 to 99.9 l
Resolution	0.1 l
Accuracy	$\leq \pm 10\%$ or 0.1 l, whichever is greater

Tidal Volume:

Range	0.05 to 9.99 l
Resolution	0.01 l
Accuracy	$\leq \pm 10\%$ or 0.1 l, whichever is greater
Minimum detectable volume	0.05 l

Respiratory Rate:

Range	2 to 99 BPM
Resolution	1 BPM
Accuracy	$\leq \pm 10\%$ or 1 BPM, whichever is greater

Sensor Flow Range 5.0 to 100 l/min

MULTISPEC**CO₂ Measurement**

Range	0 to 80 mm Hg
Resolution	1 mm Hg
Accuracy (full accuracy mode)	± 2.0 mm Hg (00-40) ± 2.5 mm Hg (41-60) ± 4.0 mm Hg (61-80)
Accuracy (warm-up period)	± 5 mm Hg (00-60)
Response	200 mS
Noise	0.5 mm Hg (00-40) 2.0 mm Hg (41-60) 3.0 mm Hg (61-80)

N₂O Measurement

Range	0 to 100 volume % N ₂ O
Resolution	1 volume % N ₂ O
Accuracy (full accuracy mode)	± 7.5 volume % N ₂ O
Accuracy (warm-up period)	± 10 volume % N ₂ O
Response*	400 mS
Noise	3 volume % N ₂ O

*10 to 90% @ 200 ml/min

APPENDIX 1: NARKOMED 3 SPECIFICATIONS (continued)

MULTISPEC (continued)**Halothane Measurement**

Range	0 to 8.5 volume % Halothane
Resolution	0.1 volume % Halothane
Accuracy (full accuracy mode)	± 0.2 volume % or $\pm 10\%$ of reading **
Accuracy (warm-up period)	± 0.5 volume % Halothane or 10% of reading **
Response*	400 mS
Noise	0.2 vol % Halothane

Enflurane Measurement

Range	0 to 8.5 volume % Enflurane
Resolution	0.1 volume % Enflurane
Accuracy (full accuracy mode)	± 0.2 volume % Enflurane or 10% of reading **
Accuracy (warm-up period)	± 0.5 volume % Enflurane or 10% of reading **
Response*	400 mS
Noise	0.1 volume % Enflurane

Isoflurane Measurement

Range	0 to 8.5 volume % Isoflurane
Resolution	0.1 volume % Isoflurane
Accuracy (full accuracy mode)	± 0.2 volume % Isoflurane or 10% of reading **
Accuracy (warm-up period)	± 0.5 volume % Isoflurane or 10% of reading **
Response*	400 mS
Noise	0.1 volume % Isoflurane

Influence by other gases

Within accuracy specified above.

Sample Flowrate	200 ml/min (Adult) 100 ml/min (Neonatal)
------------------------------	---------------------------------------------

* 10 to 90% @ 200 ml/min

** whichever is greater

APPENDIX 1: NARKOMED 3 SPECIFICATIONS (continued)**O₂SATMED****Monitor**

SpO ₂ display range	0 to 100%
Resolution	1%
Accuracy	Adult 70 to 100% ± 2% full scale 50 to 70% ± 3% full scale Neonatal 70 to 95% ± 3% full scale
Pulse display range	20 to 250 BPM
Resolution	1 BPM

Sensor

Power dissipation	<50 milli-watts (typically <1 C° temp rise)
Measurement wavelengths	Red -- 660 nM
Operating temperature	Infrared -- 925 nM

SPHYGMOMED**Monitor**

Systolic blood pressure range	60-260 mm Hg (Adult) 40-160 mm Hg (Neonatal)
Diastolic blood pressure range	25-200 mm Hg (Adult) 15-120 mm Hg (Neonatal)
Mean blood pressure (MAP*) range	35-240 mm Hg (Adult) 25-140 mm Hg (Neonatal)
Resolution	1 mm Hg
Pulse display range*	40 to 180 BPM (Adult & Neonatal)
Resolution	1 BPM

Default Alarm Limits

Low systolic blood pressure	80 mm Hg
High systolic blood pressure	180 mm Hg

Cuff Inflation

Maximum cuff inflation pressure	325 mm Hg (Adult) 220 mm Hg (Neonatal)
Maximum cuff inflated time	2.5 min
Maximum cuff deflated interval between measurements	3 sec
Automatic mode sample duration	25-30 sec (Adult) 20 sec (Neonatal)
Stat mode sample duration	12-20 sec (Adult) 20 sec (Neonatal)

(*) Pulse rate (from SPHYGMOMED) and mean arterial pressure appear only on the central alarm display.

APPENDIX 2: NARKOMED 3 ALARM MESSAGES

CLASS	ALARM MESSAGE	CONDITION	AUDIO
W	% OXYGEN LOW	% O ₂ < low limit setting	CONT
W	APNEA - PRES	Apnea for 30 seconds	CONT
W	APNEA - VOL	Apnea for 30 seconds	CONT
W	APNEA - CO2	Apnea for 30 seconds	CONT
W	VENT PRES HI	Pressure > high limit	CONT
W	SUB ATM PRES	Pressure < -10 cm H ₂ O	CONT
W	NO OXI PULSE	No pulse for 10 seconds	CONT
W	OXI PULSE LO	Pulse < low limit	CONT
W	OXI SAT LOW	Saturation < low limit	CONT
W	% HAL HIGH	Halothane % > high limit	CONT
W	% ENF HIGH	Enflurane % > high limit	CONT
W	% ISO HIGH	Isoflurane % > high limit	CONT
C	LO O ₂ SUPPLY	O ₂ supply pressure < 37 psi	INTERMIT
C	APNEA - PRES	Apnea for 15 seconds	INTERMIT

APPENDIX 2: NARKOMED 3 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO
C	APNEA - VOL	Apnea for 15 seconds	INTERMIT
C	APNEA - CO2	Apnea for 15 seconds	INTERMIT
C	CONTNG PRES	Pressure > threshold limit for 15 seconds	INTERMIT
C	PEEP > 25	PEEP \geq 26 cm H ₂ O	INTERMIT
C	MIN VOL LOW	Minimum volume < low limit	INTERMIT
C	AC/BATT FAIL	Narkomed 3 not receiving line power and battery < 11 VDC	INTERMIT
C	OXI PULSE HI	Pulse > high limit	INTERMIT
C	OXI SAT HIGH	Saturation > high limit	INTERMIT
C	NIBP SYS LOW	Systolic < low limit	INTERMIT
C	NIBP SYS HI	Systolic > high limit	INTERMIT
C	ET CO2 HIGH	End-tidal CO ₂ > high limit	INTERMIT
C	ET CO2 LOW	End-tidal CO ₂ < low limit	INTERMIT
C	% HAL LOW	Halothane % < low limit	INTERMIT

APPENDIX 2: NARKOMED 3 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO
C	% ENF LOW	Enflurane % < low limit	INTERMIT
C	% ISO LOW	Isoflurane % < low limit	INTERMIT
C	AGT DETECTED	Gas monitor agent detected, none selected	INTERMIT
A	O2 SENS DISC	Sensor cord disconnected	SINGLE TONE
A	OXI SEN DISC	Sensor cord disconnected	SINGLE TONE
A	INS CO2 HIGH	Inspiratory CO ₂ > 5 mm Hg	SINGLE TONE
A	% OXYGEN HI	% O ₂ > high limit	SINGLE TONE
A	AC PWR FAIL	NM3 not receiving line power	SINGLE TONE
A	REVERSE FLOW	Reverse flow > 20 ml	SINGLE TONE
A	VOL SEN DISC	Sensor cord disconnected	NONE
A	O2 CAL DUE	18 hrs since last O ₂ analyzer calibration	NONE
A	O2 NOT CAL	O ₂ analyzer not calibrated	NONE
A	O2 SENS ERR	O ₂ analyzer sensor error	NONE

APPENDIX 2: NARKOMED 3 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO
A	O ₂ CAL ERR	Bad calibration data	NONE
A	THRESHOLD LO	Threshold pressure alarm limit set > 6 or > 8 cm H ₂ O from sensed peak	NONE
A	PEEP > 4	PEEP ≥ 5 cm H ₂ O	NONE
A	BATTERY LOW	NM3 battery < 11 VDC	NONE
A	SPEAKER FAIL	NM3 primary speaker failure	NONE
A	SILENCE XXX	Temporary alarm silence in effect	NONE
A	VENT OFF	AV-E ventilator power switch in OFF position	NONE
A	APNEA-P OFF	Apnea pressure threshold alarm disabled	NONE
A	O ₂ ALRM OFF	O ₂ analyzer patient alarms disabled	NONE
A	VOL ALRM OFF	Volume alarms disabled	NONE
A	CO ₂ WARMUP	Gas monitor in reduced accuracy mode	NONE
A	AGT WARMUP	Gas monitor in reduced accuracy mode	NONE

APPENDIX 2: NARKOMED 3 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO
A	CO2 LINE BLK	Gas monitor sample line blocked	NONE
A	CO2/AGT ERR	Gas monitor internal failure	NONE
A	AGT NOT SEL	Gas monitor agent not selected	NONE
A	TIDAL VOL LO	Tidal volume < 70 ml	NONE
A	BP CUFF DISC	SPHYGMOMED cuff disconnected	NONE
A	BP CUFF ERROR	SPHYGMOMED cuff error	NONE
A	CO2 ALRM OFF	CO ₂ patient alarms disabled	NONE
A	AGT ALRM OFF	Anesthetic agent alarms disabled	NONE
A	OXI ALRM OFF	O ₂ SATMED patient alarms disabled	NONE
A	NIBP STBY	SPHYGMOMED in standby mode	NONE
A	NIBP STAT	SPHYGMOMED in max. rate mode	NONE
A	COMM ERR	NM3 self-diagnostic	NONE
A	BAROMED ERR	Self-diagnostic	NONE
A	O2MED ERR	Self-diagnostic	NONE

APPENDIX 2: NARKOMED 3 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO
A	OXIMETER ERR	Self-diagnostic	NONE
A	SPHYGMOM ERR	Self-diagnostic	NONE
A	SPIROMED ERR	Self-diagnostic	NONE
A	EXT COMM ERR	Self-diagnostic	NONE
A	PORT A ERR	Communications error	NONE
A	PORT B ERR	Communications error	NONE
A	PORT C ERR	Communications error	NONE
A	PORT D ERR	Communications error	NONE
A	PORT E ERR	Communications error	NONE
A	REM SILENCE	NM3 audio remotely silenced	NONE









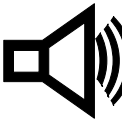



APPENDIX 3: NARKOMED 3 TROUBLESHOOTING GUIDE

NARKOMED 3 ANESTHESIA SYSTEM		
PROBLEM	POSSIBLE CAUSE	REMEDY
Excessive PEEP	Improperly adjusted vent 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 stop during expiration	Frequency too high for selected tidal volume	Decrease frequency
		Increase expiratory phase time
	Improperly adjusted vent relief valve	Contact NAD service
Ventilator won't cycle	Frequency set to 00	Select correct frequency
	Low O ₂ supply pressure	Provide sufficient O ₂ supply pressure
Bellows won't compress during inspiration	Absorber manual/automatic selector valve in "BAG" position	Place manual/automatic selector valve in "AUTO" position
	Inspiratory flow control setting on ventilator too low	Increase inspiratory flow control setting
	Frequency too high	Decrease frequency

For troubleshooting assistance for the monitors included in the NARKOMED 3, see the Troubleshooting sections of the Operator's Manuals for the individual monitors.

APPENDIX 4: VISUAL SYMBOLS

Visual symbols are used on N.A.D. products to provide quick and easy recognition of the product's function. A list of symbols and their descriptions is given below.

	Oxygen Concentration
	Carbon Dioxide Concentration
	Gas Concentration
	Breathing Pressure
	Breathing Volume
	Blood Pressure
	Arterial Oxygen Saturation
	Audible Alarm Disable
	Audible Alarm Enable
	Threshold Pressure Alarm Limit
	Automatic Threshold Set
	Display Select

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NORTH
AMERICAN
DRÄGER

148B Quarry Road
Telford, Pennsylvania 18969
Telephone: (215) 721-5400
Telefax: (215) 721-9561 (SALES)
(215) 723-5935 (SERVICE)

Part Numbers: 4108980 (NARKOMED 3 Operator's Instruction Manual)
4108836 (NARKOMED 3 Anesthesia System)
4109500 (NARKOMED 3 Anesthesia System - Canada)

Rev: S
Date: May 22, 1992
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