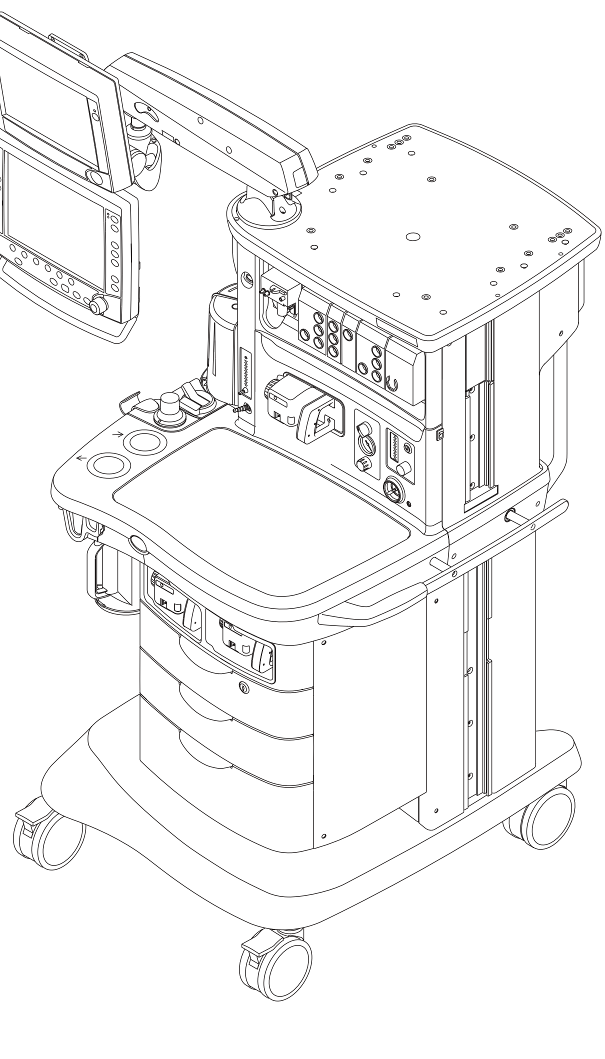
Aisys Anesthesia Machine
Technical Reference Manual



Datex-Ohmeda products have unit serial numbers with coded logic which indicates a product group code, the year of manufacture, and a sequential unit number for identification. The serial number can be in one of two formats.

AAA**X**11111	AAA**XX**111111AA
The **X** represents an alpha character indicating the year the product was manufactured; **H** = 2004, **J** = 2005, etc. **I** and **O** are not used.	The **XX** represents a number indicating the year the product was manufactured; **04** = 2004, **05** = 2005, etc.

Aisys Anesthesia Machine

Important

The information contained in this Technical Reference manual pertains only to those models of products which are marketed by Datex-Ohmeda as of the effective date of this manual or the latest revision thereof. This Technical Reference manual was prepared for exclusive use by Datex-Ohmeda service personnel in light of their training and experience as well as the availability to them of parts, proper tools and test equipment. Consequently, Datex-Ohmeda provides this Technical Reference manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that customer has received such information from Datex-Ohmeda does not imply in anyway that Datex-Ohmeda deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or device is referred to within, or that abnormal or unusual circumstances, may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review, update and revision. Customers are cautioned to obtain and consult the latest revision before undertaking any service of the equipment. Comments and suggestions on this manual are invited from our customers. Send your comments and suggestions to the Manager of Technical Communications, Datex-Ohmeda, Ohmeda Drive, PO Box 7550, Madison, Wisconsin 53707.

⚠ **CAUTION** Servicing of this product in accordance with this Technical Reference manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision to this service manual which is clearly and thoroughly understood.

Technical Competence

The procedures described in this Technical Reference manual should be performed by trained and authorized personnel only. Maintenance should only be undertaken by competent individuals who have a general knowledge of and experience with devices of this nature. No repairs should ever be undertaken or attempted by anyone not having such qualifications.

Datex-Ohmeda strongly recommends using only genuine replacement parts, manufactured or sold by Datex-Ohmeda for all repair parts replacements.

Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

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1 Introduction

In this section

This section provides a general overview of the Aisys anesthesia machine.

1.1 What this manual includes

This manual covers the service information for the S/5 Aisys line of anesthesia machines. It covers the following components:

- Display Unit
- Integral electronics
- Gas delivery components
- Breathing system components
- Frame component
- Optional suction regulator
- Optional auxiliary O_2 flowmeter

Other equipment Other equipment may be attached to the system on a display mount, the top shelf, or on the side dovetail rails. Consult separate documentation relative to these items for details.

1.2 User's Reference manuals

Some sections of this manual refer you to the User's Reference manual for the S/5 Aisys. To expedite repairs, you must have, and be familiar with, the User's Reference manuals for this product.

Refer to the S/5 Aisys User's Reference manual if you need further information about the operation of the system.

1.3 What is an Aisys Carestation?

The Aisys Carestation for anesthesia is a scalable, flexible, and functionally integrated system, featuring advanced design ventilation, respiratory monitoring, and breathing system.

Module bays allow for the integration of Datex-Ohmeda patient monitors. Optionally, the open architecture design supports mounting of non-Datex Ohmeda patient monitors, record keeping, and connections to the hospital information system.

Aisys uses SmartVent ventilation technology offering Volume Control Ventilation with tidal volume compensation, Pressure Control Ventilation and electronic PEEP. It features optional Pressure Support Ventilation with an Apnea Backup (PSVPro) that is used for spontaneously breathing patients and Synchronized Intermittent Mandatory Ventilation (SIMV).

The Aisys is not suitable for use in a MRI environment.

Note Configurations available for this product depend on local market and standards requirements. Illustrations in this manual may not represent all configurations of the product.

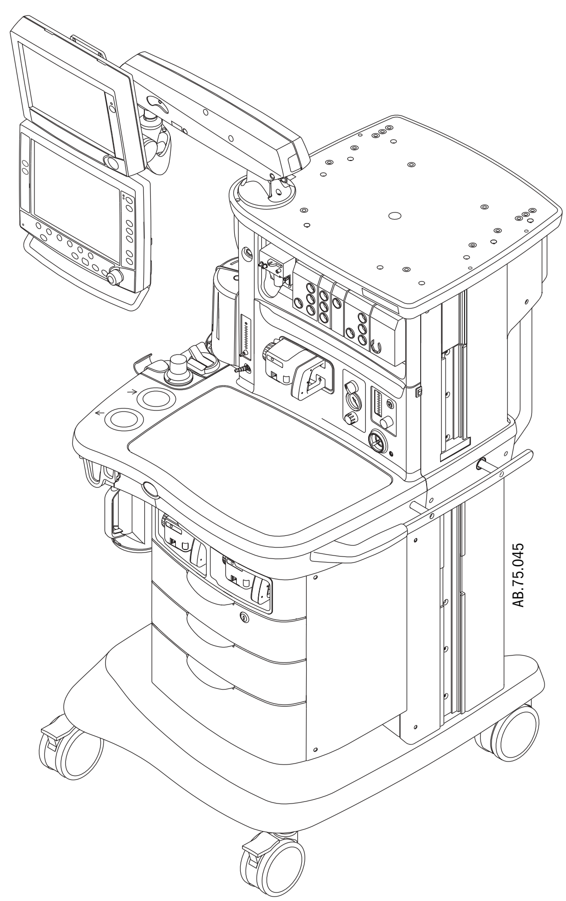
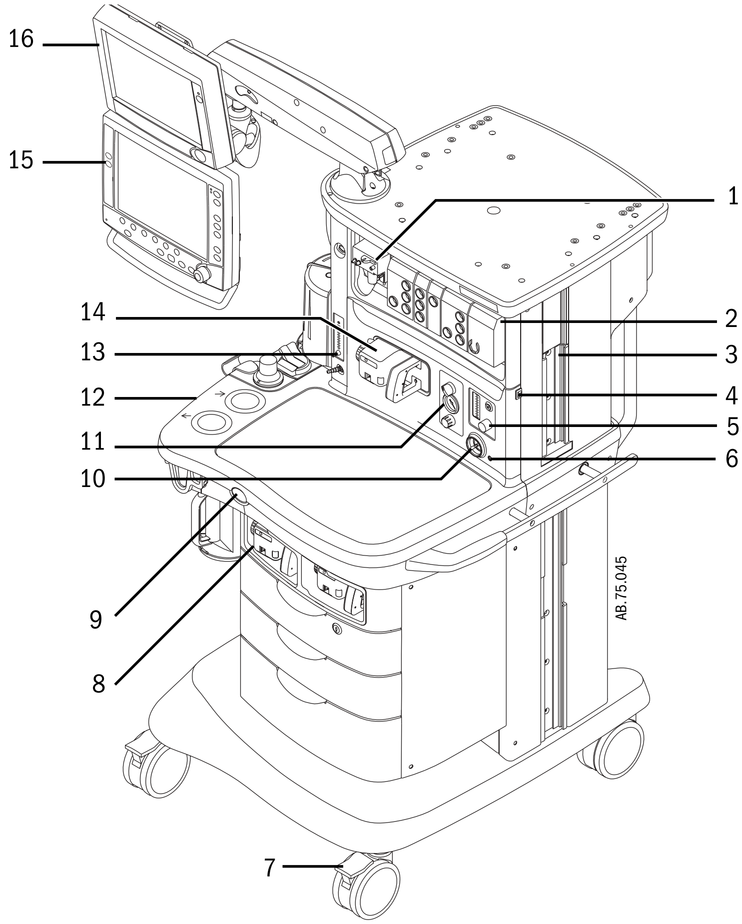


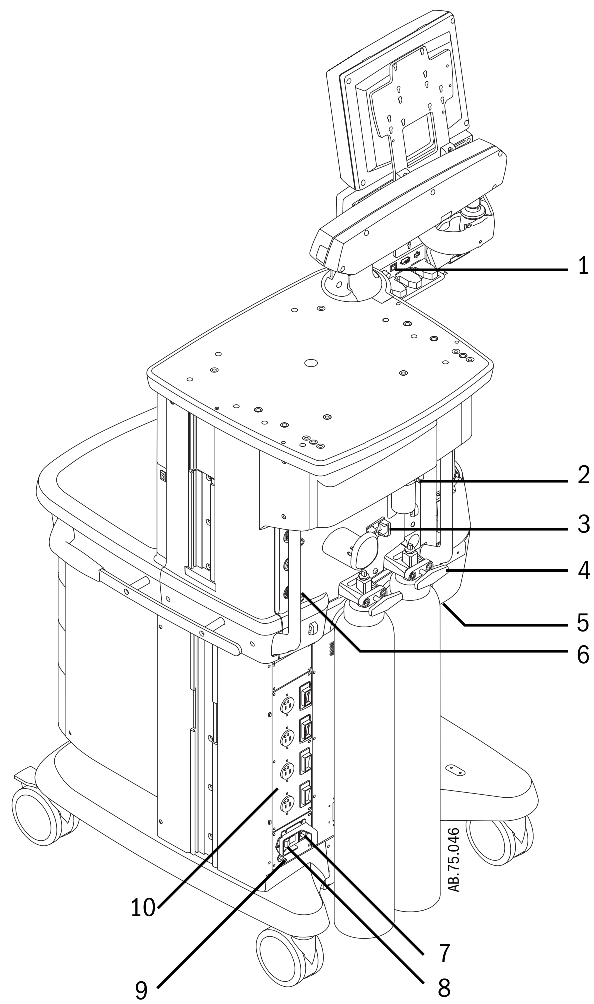
Figure 1-1 • Aisys Carestation

1.4 Anesthesia system components



1. Airway module (optional)
2. Datex-Ohmeda patient monitoring modules (optional)
3. Dovetail rails
4. Light switch
5. Alternate O_2 control
6. Mains indicator
7. Brake
8. Aladin cassette storage bay
9. O_2 flush button
10. System switch
11. Integrated suction (optional)
12. Advanced breathing system
13. Auxiliary O_2 flow control (optional)
14. Aladin cassette and bay
15. Anesthesia display
16. Datex-Ohmeda patient monitoring display (optional)

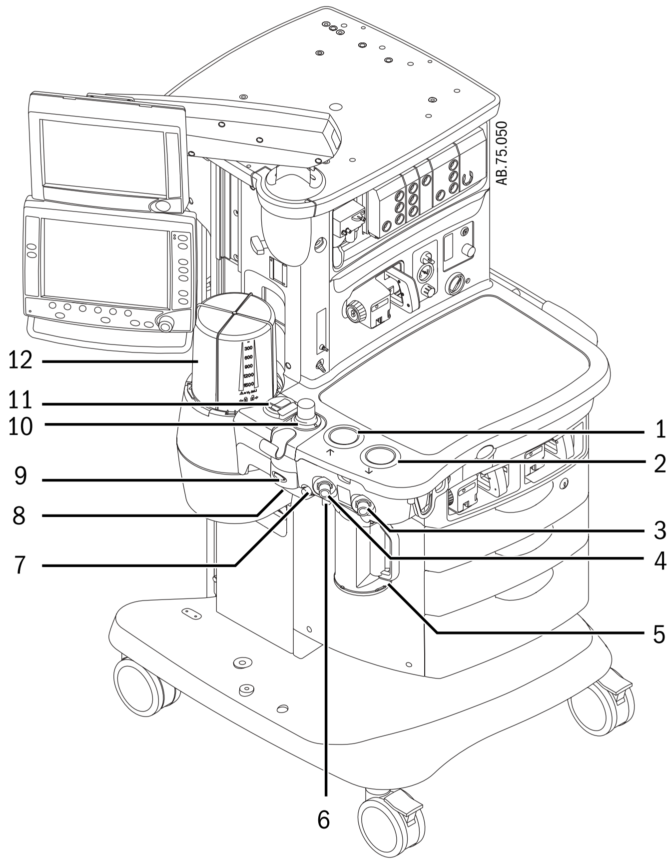
Figure 1-2 • Front view



1. Serial port
2. Collection bottle connection (optional)
3. Cylinder wrench (key) storage
4. Cylinder yoke
5. AGSS (Anesthesia Gas Scavenging System)
6. Pipeline connections
7. Mains inlet
8. System circuit breaker
9. Equipotential stud
10. Isolated electrical outlet

Figure 1-3 • Rear view

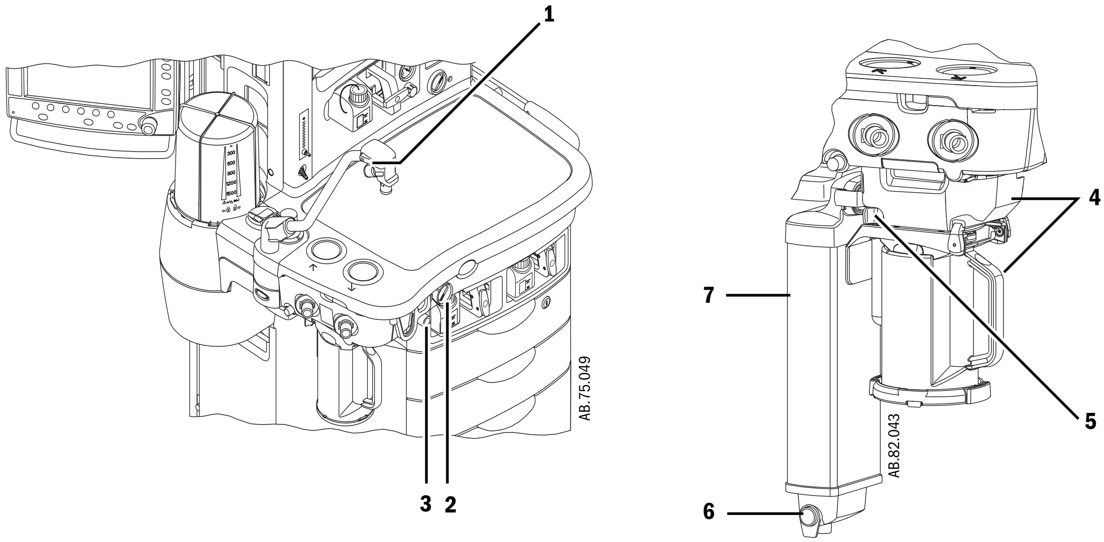
1.5 Breathing system components



1. **Expiratory check valve**
2. **Inspiratory check valve**
3. **Inspiratory flow sensor**
4. **Expiratory flow sensor**
5. **Absorber canister**
6. **Absorber canister release**
7. **Leak test plug**
8. **Manual bag port**
9. **Breathing system release**
10. **Adjustable pressure-limiting (APL) valve**
11. **Bag/Vent switch**
12. **Bellows assembly**

Figure 1-4 • Advanced breathing system

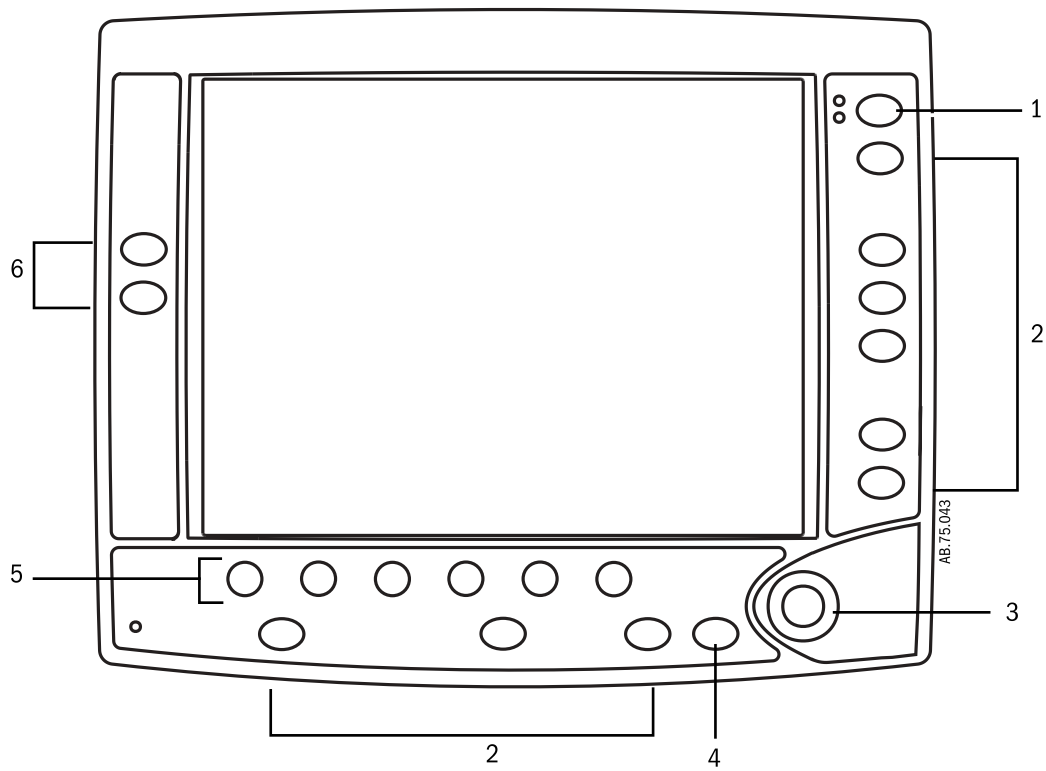
1.5.1 Optional ABS components



1. **Bag support arm**
2. **Auxiliary Common Gas Outlet (ACGO) switch**
3. **ACGO port**
4. **EZchange Canister system (CO_2 bypass)**
5. **EZchange Canister release**
6. **Condenser drain button**
7. **Condenser**

Figure 1-5 • Breathing system options

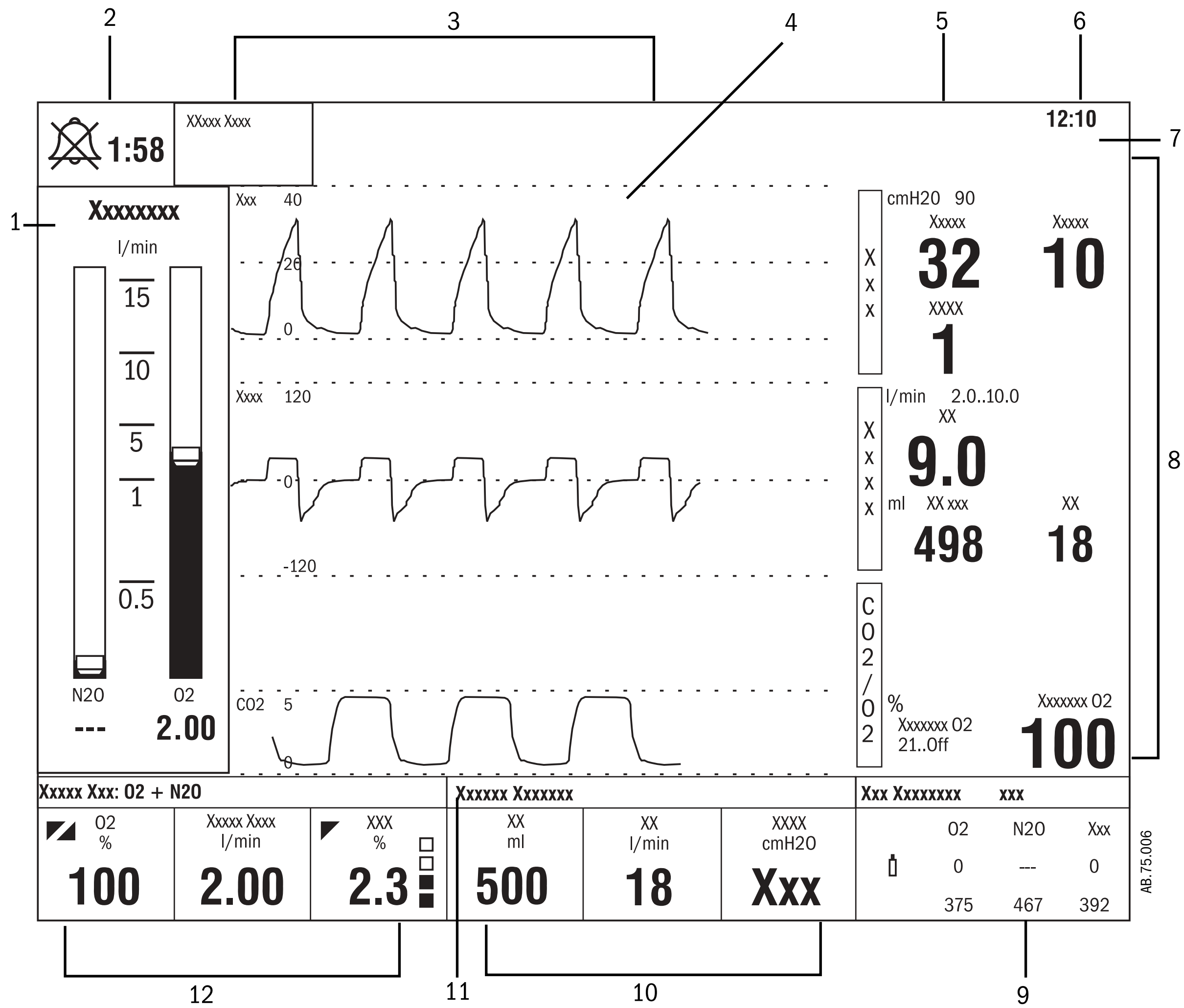
1.6 Display controls



1.	Alarm Silence key	Push to silence any active, silenceable high and medium priority alarms or to suspend/acknowledge any non-active medium or high priority alarms. Alarm is silenced for 120 seconds or alarm is suspended for 90 seconds.
2.	Menu keys	Push to show corresponding menu.
3.	ComWheel	Push to select a menu item or confirm a setting. Turn clockwise or counterclockwise to scroll menu items or change settings.
4.	Normal Screen key	Push to remove all menus from the screen.
5.	Quick keys	Push to change corresponding gas setting or ventilator setting. Turn the ComWheel to make a change. Push the ComWheel to activate the change.
6.	Timer keys	Push to start or stop the timer. Push to reset the timer back to zero.

Figure 1-6 • Display controls

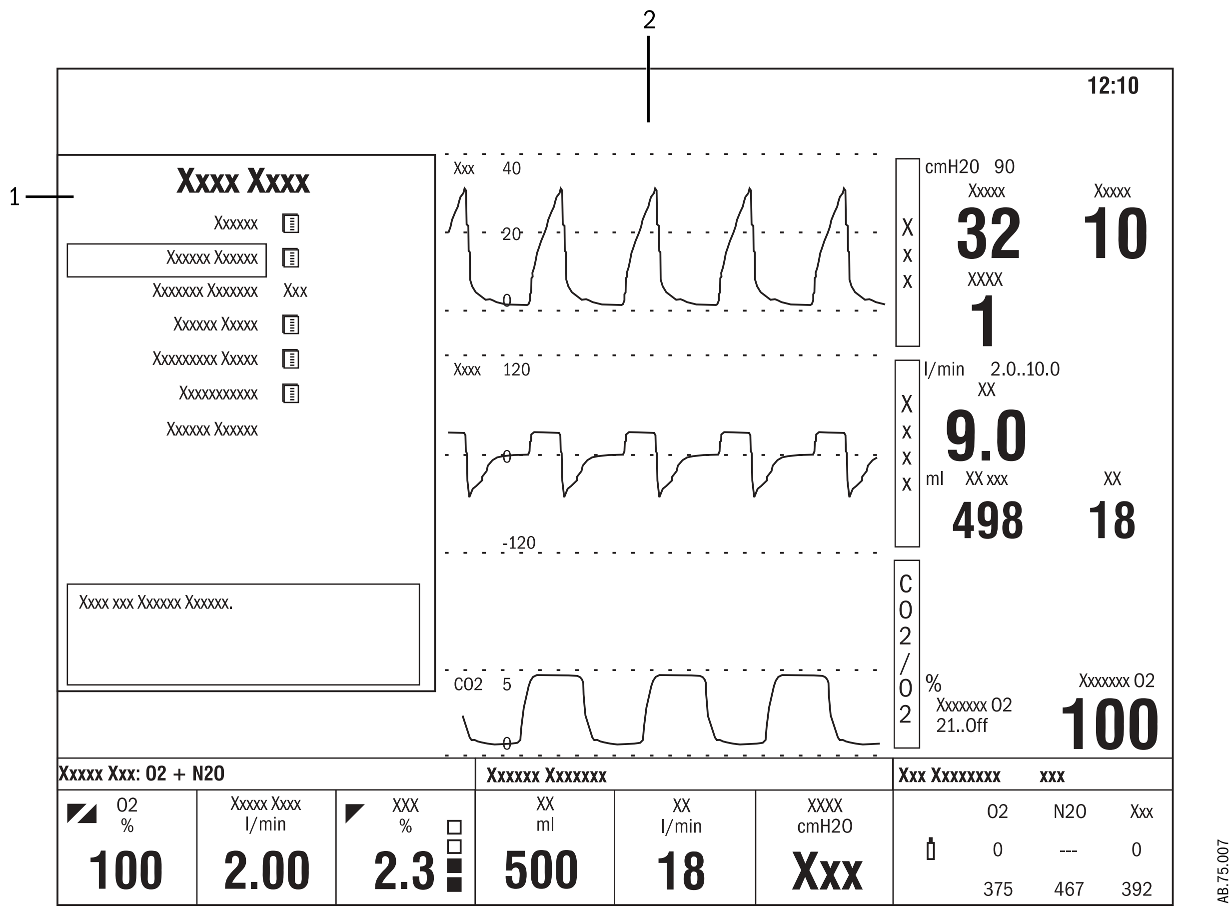
1.7 Anesthesia system display



1. Electronic gas flow indicators
2. Alarm silence countdown
3. Alarm message fields
4. Waveform fields
5. General message field or timer field
6. Clock
7. Battery indicator field
8. Measured values field
9. Pipeline and cylinder supply or respiratory data
10. Ventilator settings
11. Ventilation mode
12. Gas and agent settings

Figure 1-7 • Normal view

When a menu key is selected, the menu field overlays the gas flow tubes and the waveform fields start at the right edge of the menu.

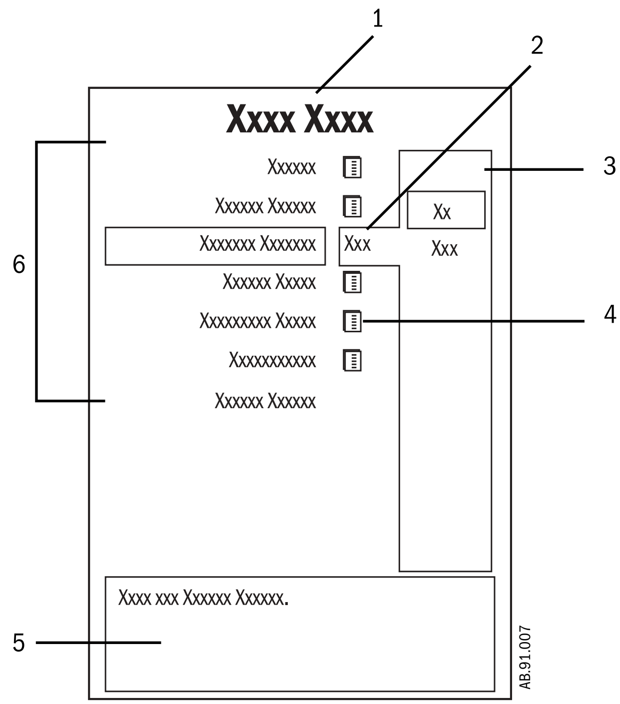


1. Menu
2. Waveform fields

Figure 1-8 • Menu view

1.7.1 Using menus

Push a menu key to display the corresponding menu. Use the ComWheel to navigate through the menu.



1. Menu title
2. Present selection
3. Adjustment window
4. Indicates submenu
5. Short instructions
6. Menu selections

Figure 1-9 • Example menu

1. Push the menu key to display the corresponding menu.
2. Turn the ComWheel counterclockwise to highlight the next menu item. (Turn the ComWheel clockwise to highlight the previous menu item.)
3. Push the ComWheel to enter the adjustment window or a submenu.
4. Turn the ComWheel clockwise or counterclockwise to highlight the desired selection.
5. Push the ComWheel to confirm the selection.
6. Select ***Normal Screen*** or push the **Normal Screen** key to exit the menu and return to the normal monitoring display. (Select ***Previous Menu*** to return to the last displayed menu, if available.)

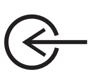
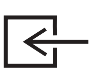
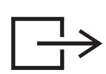
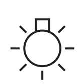
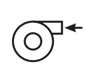
1.8 Symbols used in the manual or on the equipment

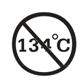
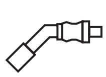
Symbols replace words on the equipment, on the display, or in Datex-Ohmeda manuals.

Warnings and Cautions tell you about dangerous conditions that can occur if you do not follow all instructions in this manual.

Warnings tell about a condition that can cause injury to the operator or the patient.

Cautions tell about a condition that can cause damage to the equipment. Read and follow all warnings and cautions.

I	On (power)	O	Off (power)
	Standby	O_2+	O_2 Flush button
	Type BF equipment		Type B equipment
	Dangerous voltage		Alternating current
	Caution, ISO 7000-0434		Attention, refer to product instructions, IEC 60601-1
	Electrical input		Electrical output
	Pneumatic inlet		Pneumatic outlet
SN	Serial number	REF	Stock number
	Equipotential		Lamp, lighting, illumination
	Variability		Variability in steps
	Suction bottle outlet		Vacuum inlet

MAX	Maximum	**VACUUM**	Vacuum
+	Plus, positive polarity	-	Minus, negative polarity
	Bag position/manual ventilation		Mechanical ventilation
$\swarrow$	Inspiratory flow	$\nearrow$	Expiratory flow
$\longrightarrow$	Movement in one direction	$\longleftrightarrow$	Movement in two directions
	Lock		Unlock
	Isolation transformer		Low pressure leak test
134°C	Autoclavable		Not autoclavable
	This way up	**O_2%**	O_2 cell connection
	No battery/battery failure		Battery in use. Bar indicates amount of battery power remaining.
⚠ ≈ **cmH_2O**	APL settings are approximate	**AGSS**	Anesthetic Gas Scavenging System
	Alarm silence		Submenu
℞ ONLY	Caution: federal law prohibits dispensing without prescription.		Pinch hazard
	Pipeline		Cylinder
	Read to center of float		EZchange Canister (CO_2 bypass)

CE xxxx	Systems with this mark agree with the European Council Directive (93/42/EEC) for Medical Devices when they are used as specified in their User's Reference manuals. The xxxx is the certification number of the Notified Body used by Datex-Ohmeda's Quality Systems.	EC REP	Authorized representative in the European Community
	Manufacturer		

2 Theory of Operation

In this section

2.1 Electrical system

The electrical system consists of two main computing units: the Display Unit and the Anesthesia Control board. Additional subsystems interact with these computing hosts to perform various gas delivery, ventilation, and monitoring functions.

The Display Unit handles the main user interface functions and connections to external devices. The Display Unit software runs on the Windows CE operating system.

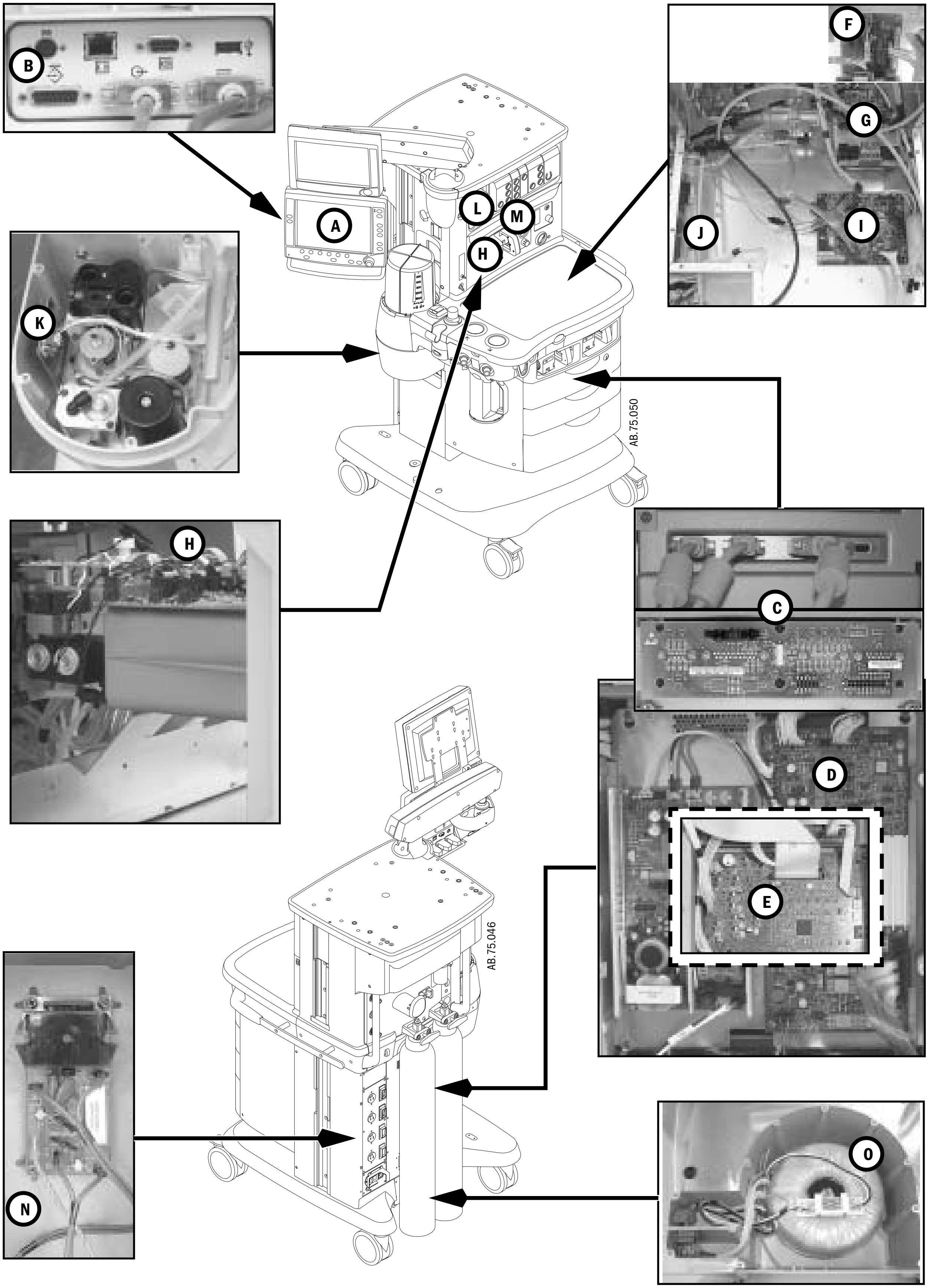
Therapy functions are handled by the Anesthesia Control board. The Anesthesia Control board is based on the Motorola Coldfire processor with a Nucleus operating system.

Embedded controllers are used to perform specific machine functions on subsystems like the Power Controller board and the Mixer board.

The processors communicate through serial bus channels.

The various functions of the electrical system are accomplished on the following:

- Display Unit CPU (**A**)
- Display Unit System Interconnect assembly (**B**)
- Display Connector board (**C**)
- Power Controller board (**D**)
- Anesthesia Control board (**E**)
- Pan Connector board (**F**)
- Electronic Mixer board (**G**)
- Agent Delivery (**H**)
- Ventilator Interface board (**I**)
- ABS Filter board (**J**)
- Vent Engine Connector board (**K**)
- MGAS Power Supply board (**L**)
- Light Strip board (**M**)
- Inrush board (**N**)
- Toroid (**O**)


B
F
G
L
M
A
J
I
H
K
AB.75.050
H
C
D
E
AB.75.046
O
N

2.2 Power subsystem

Mains power enters the system through the AC Inlet module (**A**), which includes a line filter and the system circuit breaker. Mains power is routed through the Inrush (**B**) circuit board to the isolation transformer (**C**).

The isolated secondary output of the transformer is routed through fuses (**D**) to the universal power supply (**E**). The DC output of the power supply feeds into the Power Controller board (**F**). The transformer also supplies isolated power to the electrical outlets through individual circuit breakers.

The Power Controller board interfaces with the system through:

- the Anesthesia Control board connector (**G**),
- the Display Connector board connector (**H**),
- the battery connector (**I**) and fan connectors (**J**).

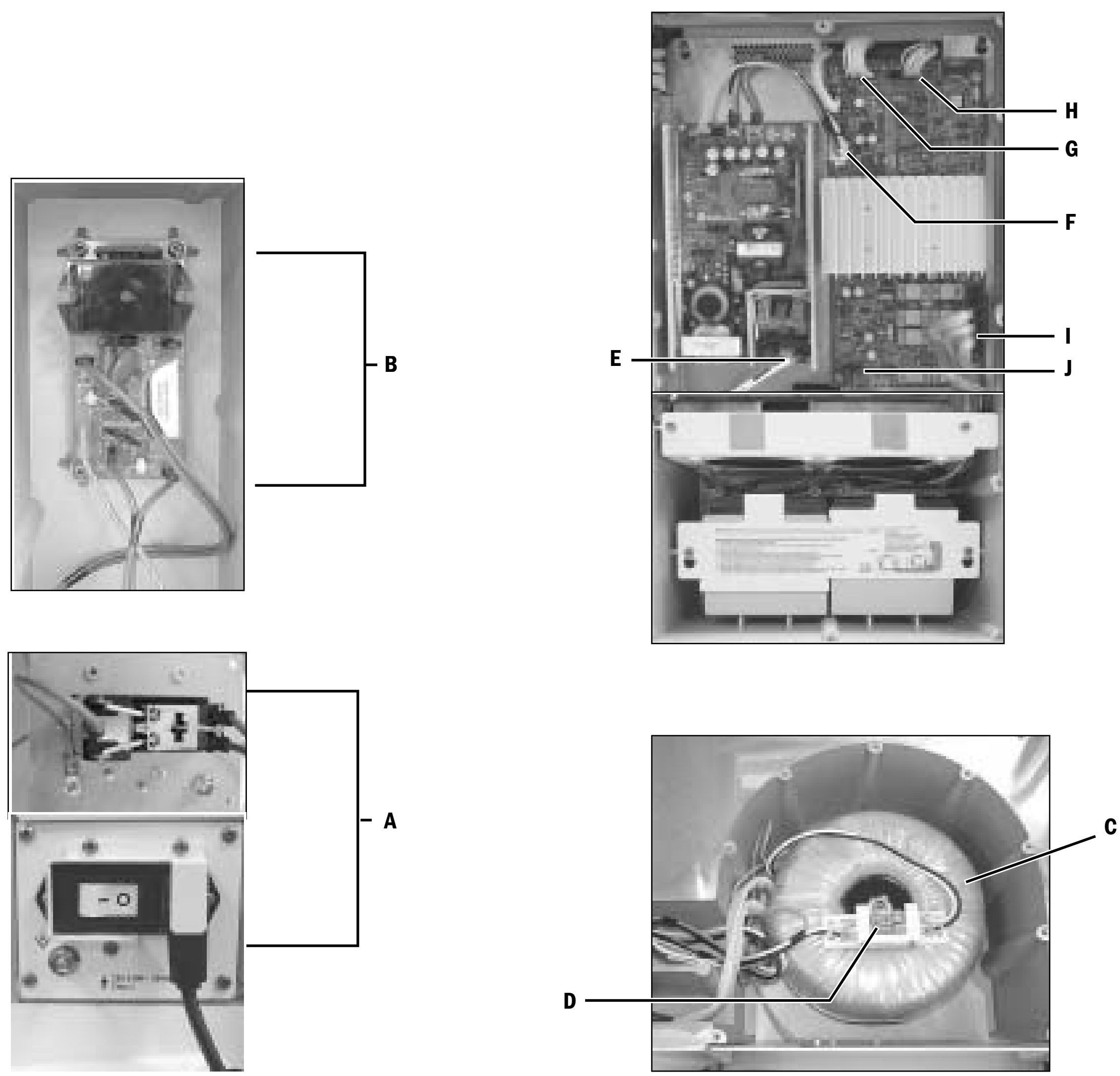


Figure 2-10 • Power subsystem

2.2.1 Power Controller board

The system uses a distributed power bus. The Power Controller board contains:

- a DC/DC converter that converts the input from the universal power supply to the 12.5 VDC system bus voltage.

The Power Controller contains supervisory circuitry that performs:

- battery charge control (battery switch circuits provide a minimum of 30 minutes of system power in the event of AC power failure).
- current, voltage, and temperature monitoring.
- AC sensing.
- fan control.

Two 12-volt batteries, wired in series, provide the back-up power.

The Power Controller communicates with the Display Unit through a RS-422, 9.6 kB channel. It receives the On/Standby signal from the system switch through the Anesthesia Control board.

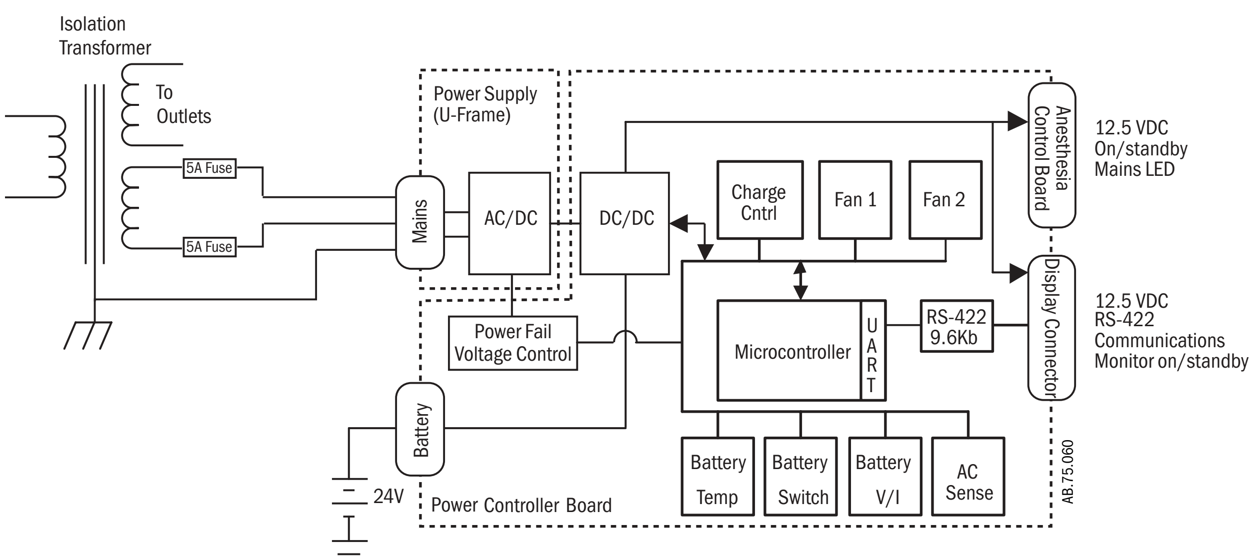


Figure 2-11 • Power subsystem

2.2.2 Power distribution

The Power Controller board provides outputs to the Anesthesia Control board and the Display Connector board. These boards provide distribution of power supplies required by the system.

The Anesthesia Control board interfaces with the Mixer board, the Ventilator Interface board, and the Agent Delivery board through the Pan Connector board.

The Display Connector board interfaces with the Display Unit and the Module assembly.

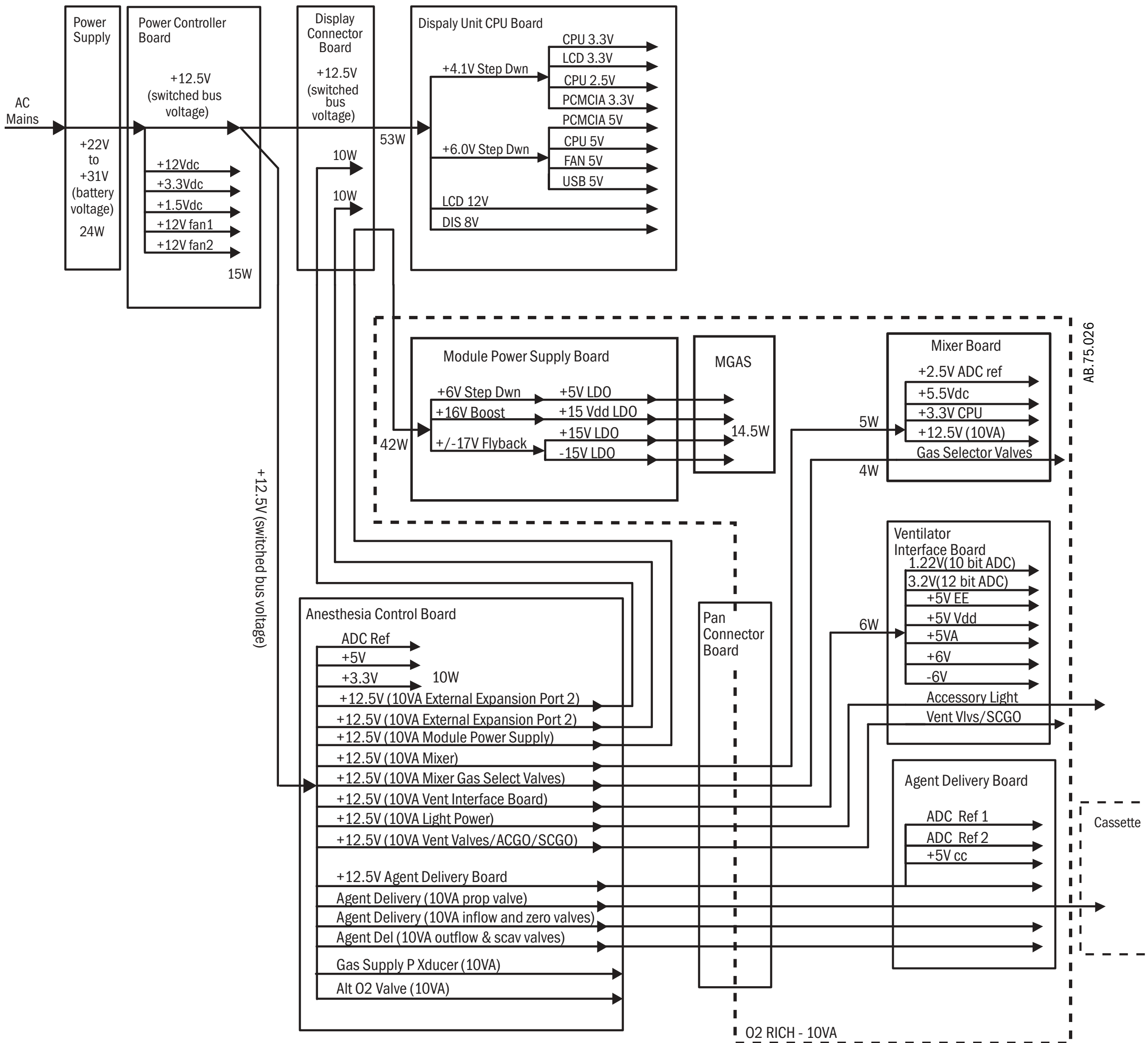


Figure 2-12 • Power distribution

2.3 Display Unit

The Display Unit handles most of the machine's user interface functions through the front panel controls and the LCD screen. It is the primary interface to external peripherals.

The main components of the Display Unit include:

- An active matrix thin film transistor liquid crystal display (**A**)
- The CPU board (**B**)
- The System Interconnect assembly (**C**)

The CPU board includes a host processor and three coprocessors to handle display, front panel, and monitoring interfaces.

The Display Unit includes a PCMCIA interface (**D**) to handle software upgrades and to load the diagnostics Service Application.

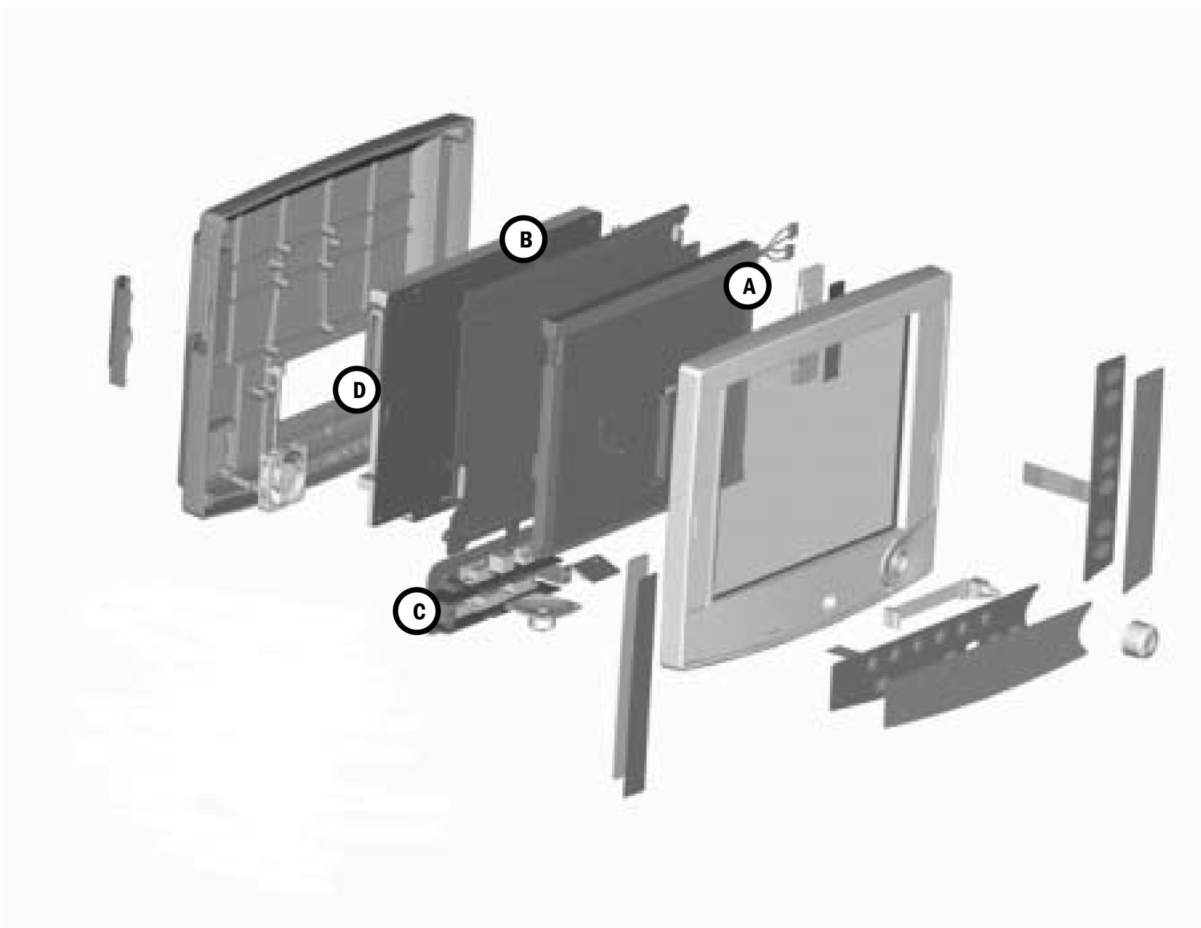


Figure 2-13 • Display Unit

2.4 System communications

RS-422 serial communication is used between the two main processors — Display Unit and Anesthesia Computer — and the subsystem processors. Various baud rates accommodate data requirements between subsystem and host. External communication uses the standard RS-232 interface.

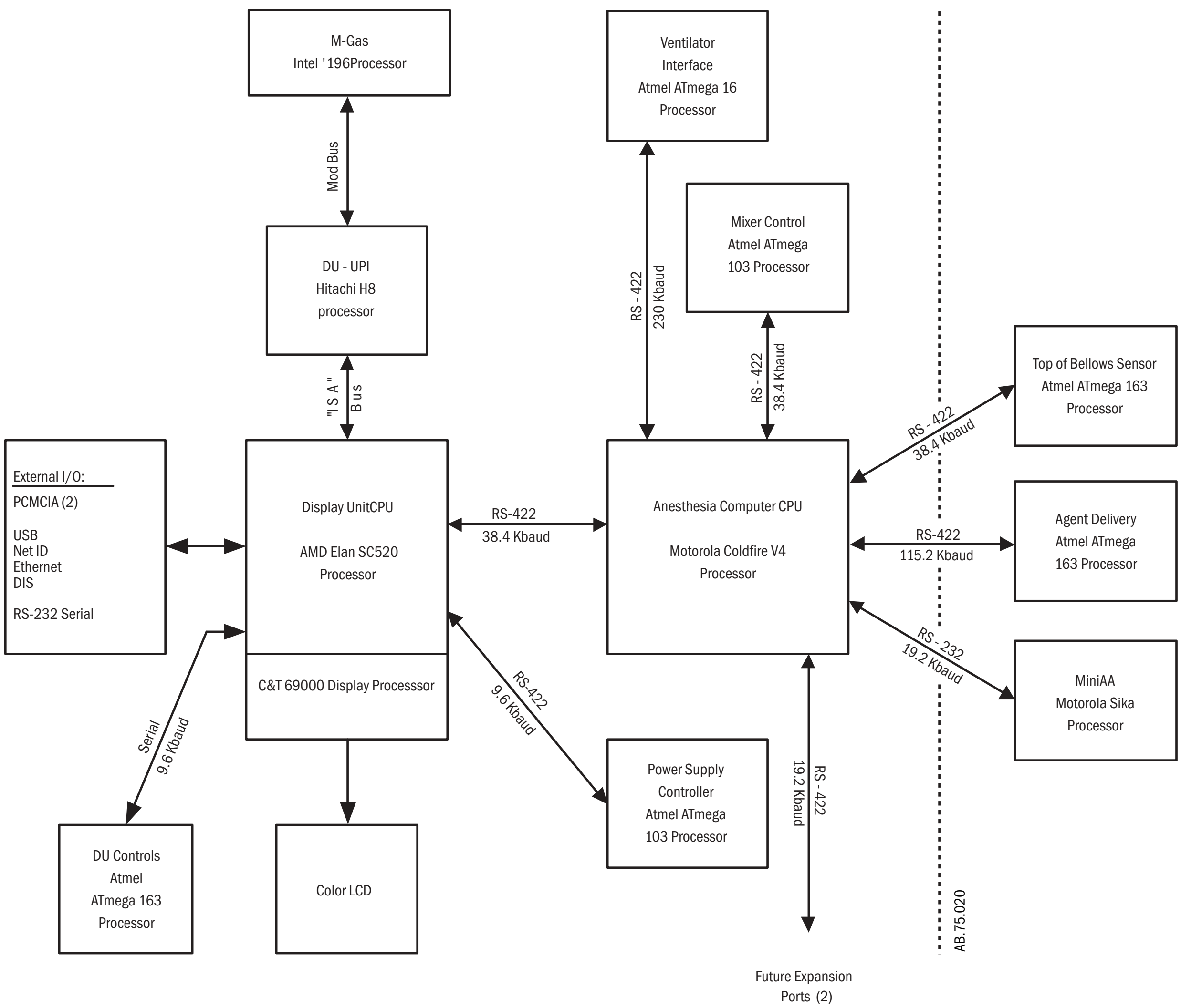


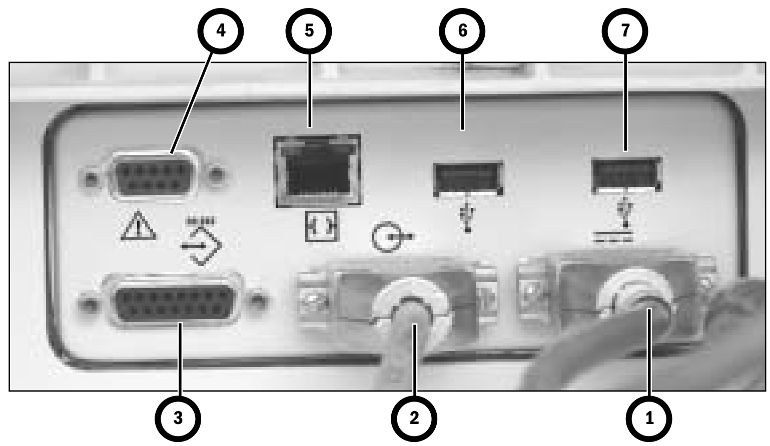
Figure 2-14 • System communications

2.5 System connections

2.5.1 Display Unit

The Display Unit accommodates the following connections:

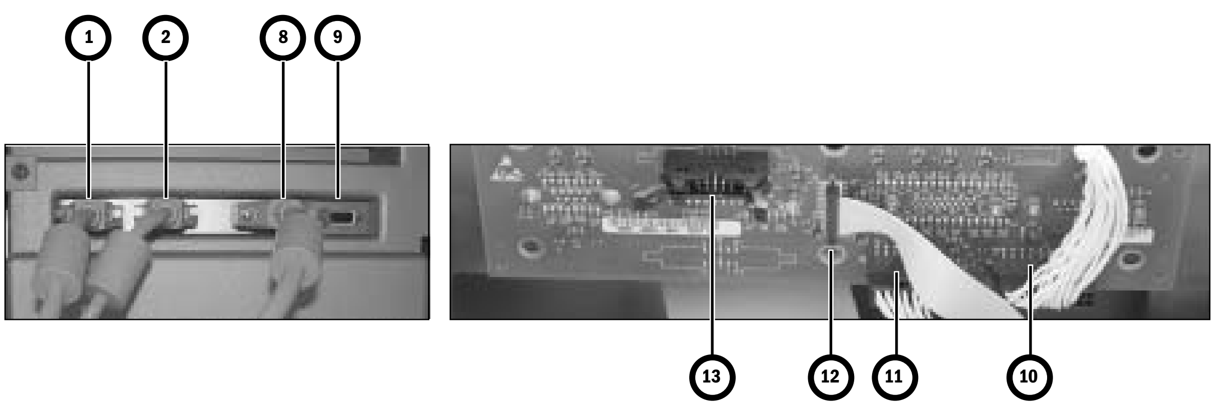
- System Power Interface (**1**).
- System Signal Interface (**2**).
- Serial Port — standard interface for external communication (**3**).
- Remote monitor On/Standby (**4**).
- Network connection — Standard Ethernet port for network connectivity (**5**).
- USB port — standard USB 2.0 interface (**6**).
- USB port — standard USB 2.0 interface (**7**).



2.5.2 Display Connector board

The front side of the Display Connector board accepts the following cables:

- System Power Interface to Display Unit (**1**).
- System Signal Interface to Display Unit (**2**).
- Airway Module (M-Gas) Power Supply board (**8**).
- Not used (**9**).
- The back side of the Display Connector board accepts the following cables:
- Power Controller board (**10**).
- Anesthesia Control board (MGAS power) connector (**11**).
- Anesthesia Control board (signal) connector (**12**).
- I/O to Auxiliary Connector board (**13**).



2.6 Power Controller and Anesthesia Control board connections

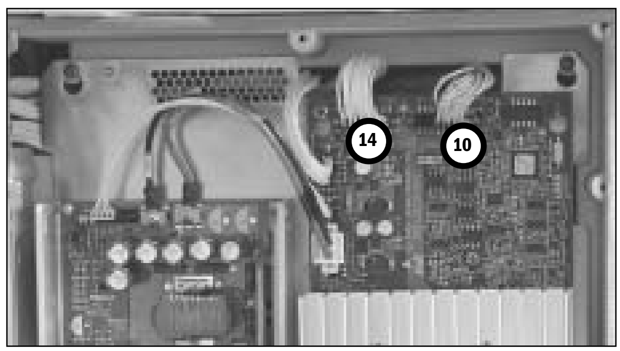
The Power Controller:

- Distributes 12.5 VDC power and communicates with the Display Unit (by way of the Display Connector board) through the connector (**10**).
- Distributes 12.5 VDC power to the Anesthesia Control board through connector (**14**).

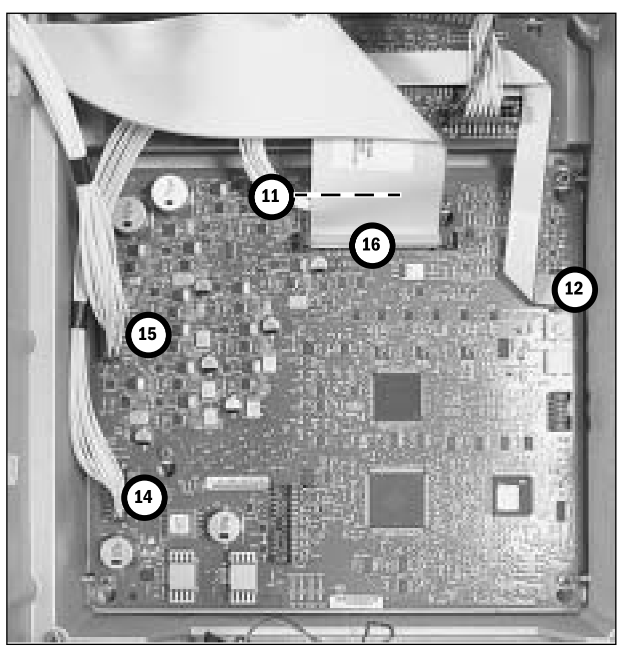
The Anesthesia Control board:

- Receives power from the Power Controller board through connector (**14**).
- Distributes 10VA power supplies to the Pan Connector board through connector (**15**).
- Communicates with Pan assemblies through connector (**16**).
- Communicates with Display Unit through connector (**12**).
- Distributes 10VA power supplies to the Display Unit through connector (**11**).

Power Controller board



Anesthesia Control board



2.7 Anesthesia Control board

The Anesthesia Control board (**A**) uses a Motorola MCF5407 Coldfire microcontroller with 4M Flash and 16M error correcting DRAM. The Anesthesia Control board includes 6 UARTs with a 64 byte FIFO and RS-422 communications to interface with the Display Unit, an accessory port, and anesthesia delivery subsystems located in the pan electronic enclosure. These include the Gas Mixer, Electronic Vaporizer, and the Ventilator Interface board.

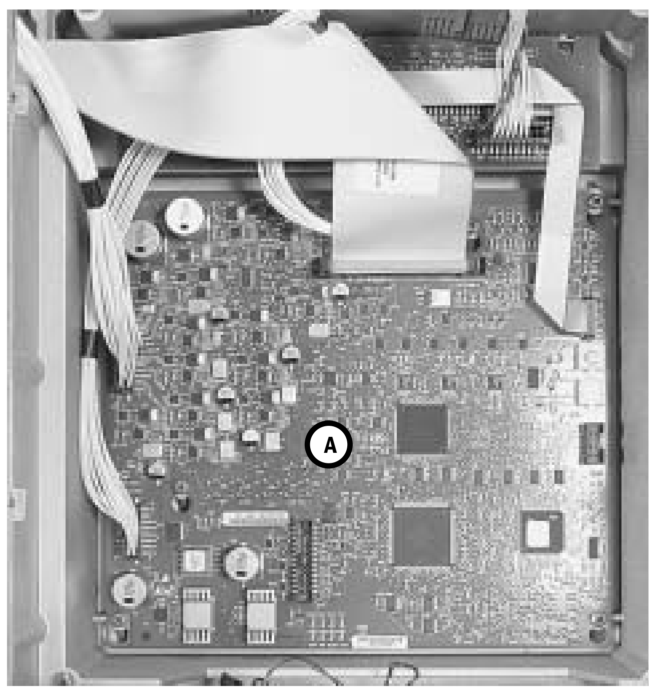


Figure 2-15 • Anesthesia Control board

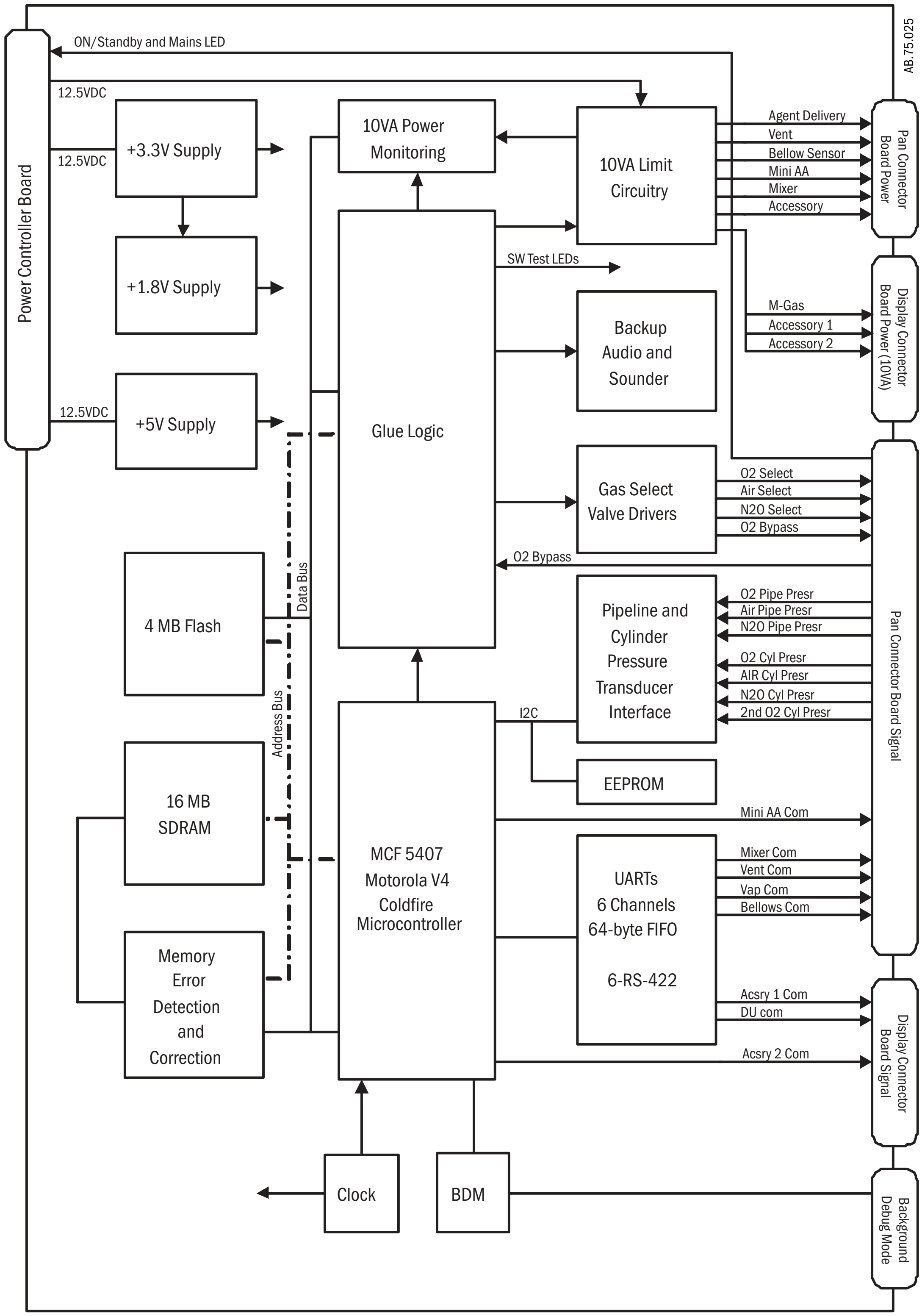


Figure 2-16 • Anesthesia Control board block diagram

2.8 Ventilator Interface board

The Ventilator Interface board (**A**) provides the electrical and/or pneumatic interface to the following:

- Inspiratory (**B**) and expiratory (**C**) flow sensors (transducers)
- Patient airway (**D**) and manifold (**E**) pressures (transducers)
- Oxygen sensor (in breathing system)
- ABS On switch
- ACGO position switch (if ACGO installed)
- SCGO solenoid, SCGO/CGO position switches (if SCGO installed)
- Bag/Vent switch
- O_2 Flush switch
- Gas Inlet Valve
- Inspiratory Flow Valve
- Accessory Power (for task lights)

The Ventilator Interface board functions are managed locally by a microcontroller. The microcontroller communicates data values to the controlling CPU via an RS-422 serial interface.

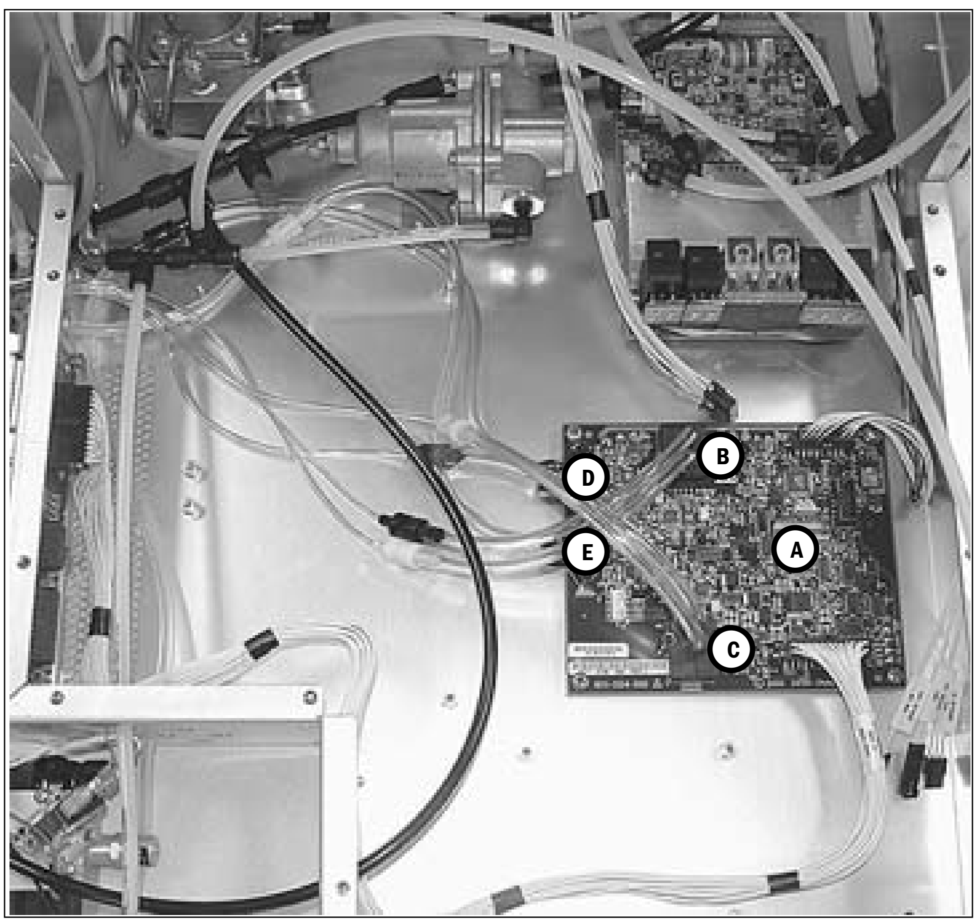


Figure 2-17 • Ventilator Interface board

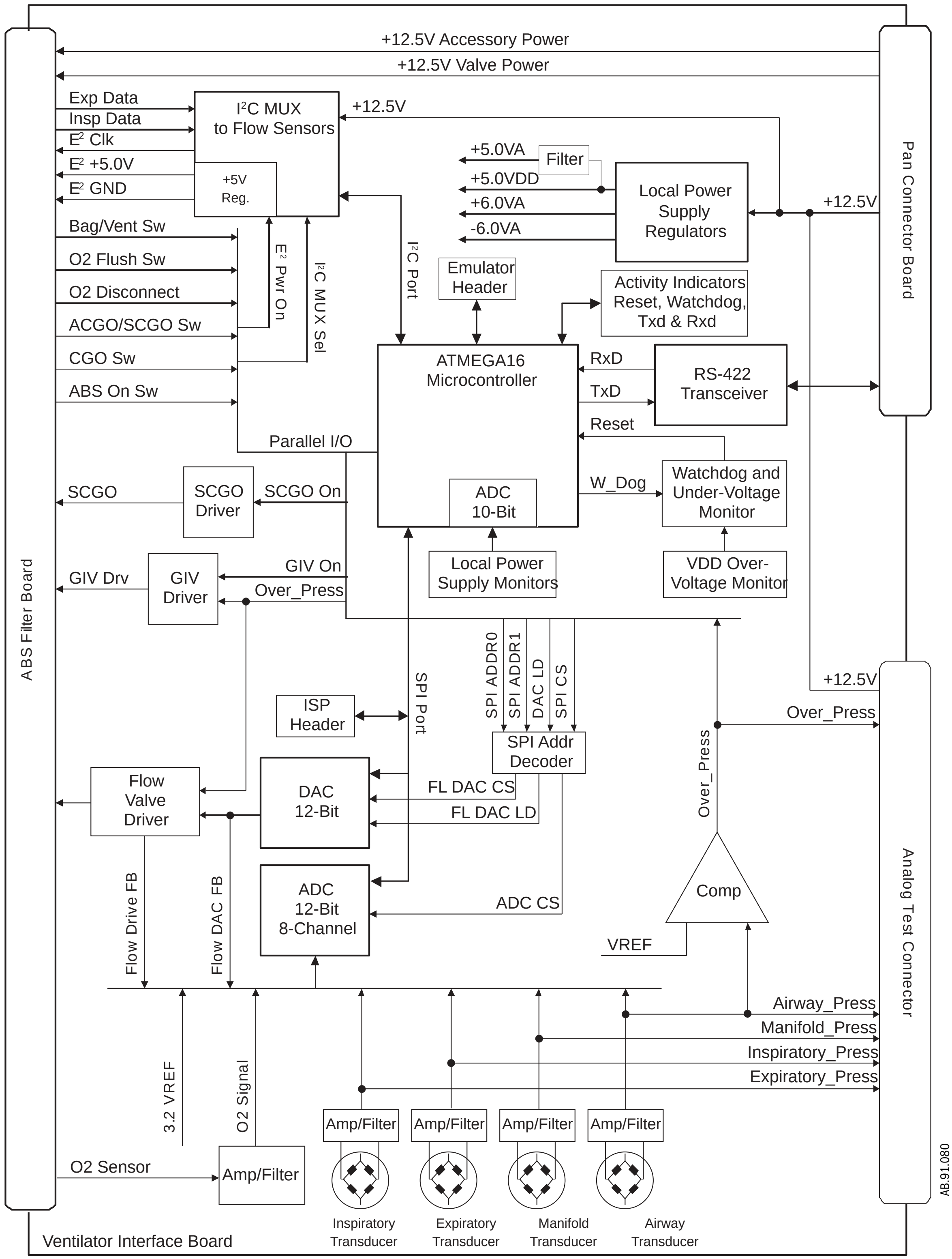


Figure 2-18 • Ventilator Interface board block diagram

2.9 Electronic Gas Mixer

The Gas Mixer receives its pneumatic inputs from the pipeline and cylinder supplies and sends mixed gas to the vaporizer manifold. The Gas Mixer interfaces to the Anesthesia Control board for power and communications.

The Gas Mixer consists of the following subassemblies and main components:

- Gas Mixer board (**A**)
- Control Manifold (**B**) — manifold, selector valves, proportional valves
- Flow sensor assembly (**C**)
- Mixed gas manifold and exit check valve (**D**)

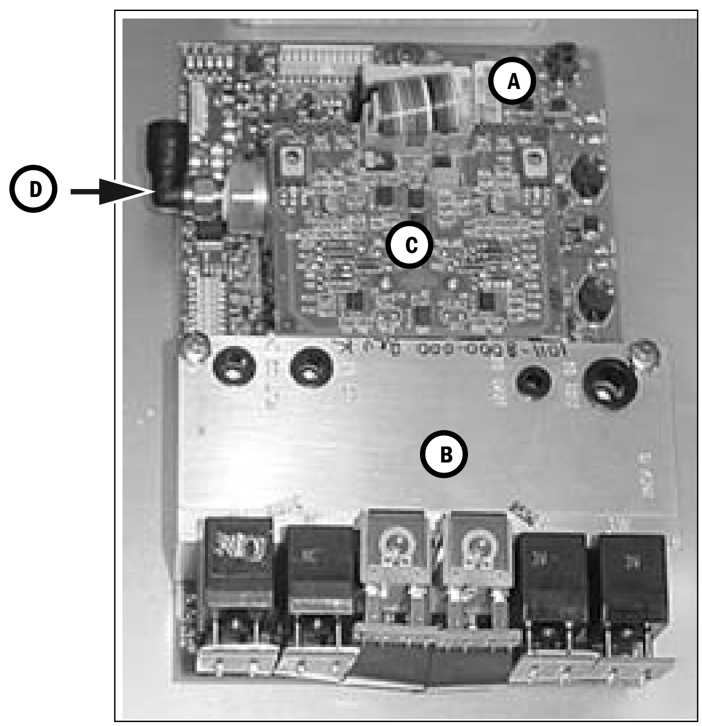


Figure 2-19 • Electronic Gas Mixer

Desired gas flows are sent from the Anesthesia Control board to the Gas Mixer.

Gas Mixer operation is controlled through a microcontroller which:

- Sends requests for the Anesthesia Control board to open and close selector valves for O_2, N_2O and Air.
- Regulates flow control valves for O_2 and balance gas (N_2O or Air).

Closed-loop flow control is accomplished through a hot-wire anemometer in concert with the flow control valves. Gas flow, based on a calibration table, is on target when the reference measurement equals the flow measurement.

Pressure measurements across each of the flow sensor channels are used as checks on the flow measurement for hazard mitigation, ambient pressure compensation, and compensation for back pressure downstream of the Mixer.

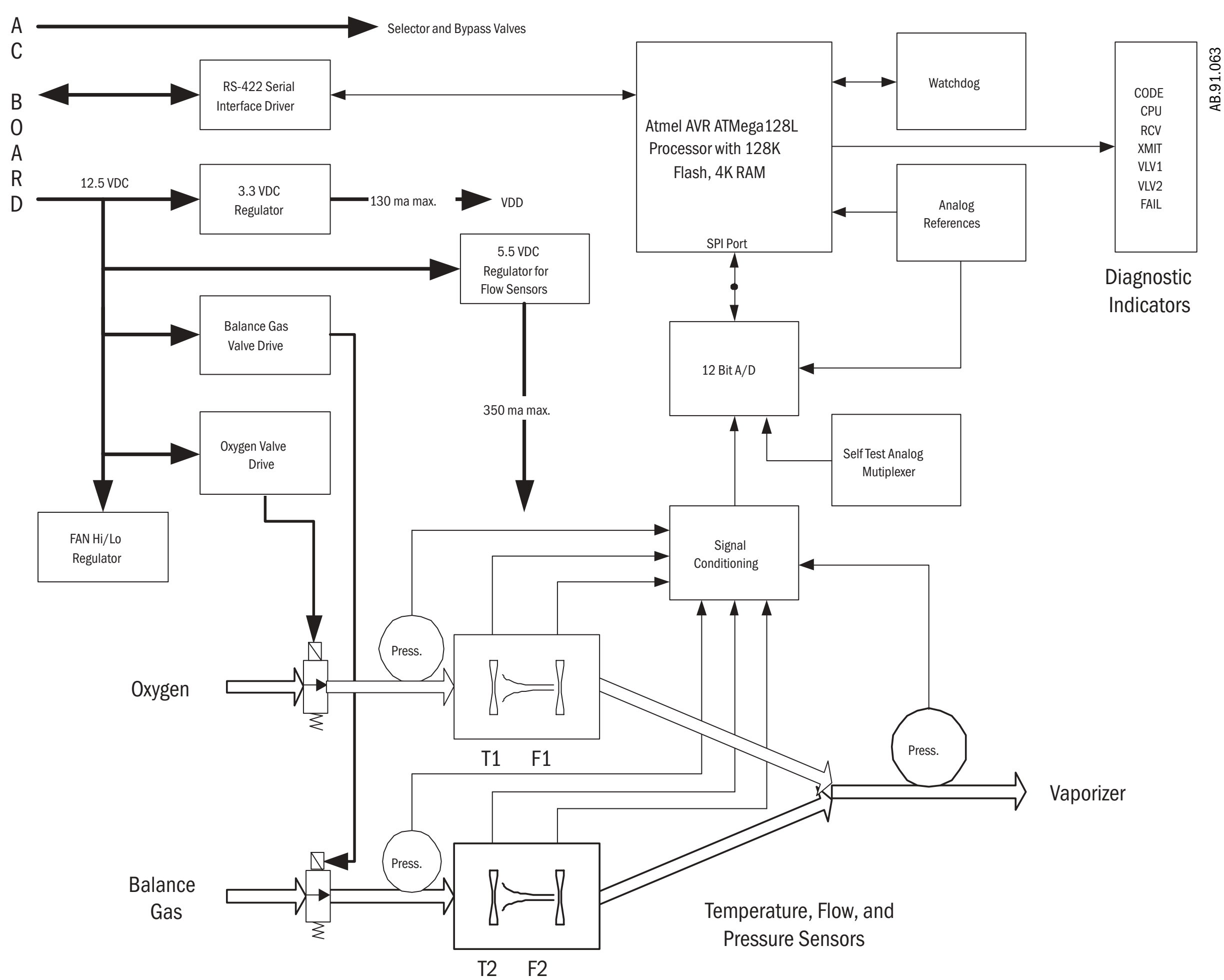


Figure 2-20 • Electronic Gas Mixer block diagram

2.10 Electronic Vaporizer

The Aisys system uses an integrated, electronic vaporization subsystem to add agent to the fresh gas flow. The main function of the Electronic Vaporizer subsystem is to mix the requested amount of anesthetic agent into the fresh gas stream.

Additional functions facilitated by the Electronic Vaporizer subsystem include cassette type detection, agent level detection, cassette overfill/overpressure handling, and safety features. Vaporization control algorithms depend on external reported parameters: user interface (agent setting, fresh gas composition), Mixer measured flow, and patient airway pressure information.

Agent is delivered from the subsystem in one of two configurations depending on whether cassette pressure is below or above Mixer output pressure. If cassette pressure is above Mixer output pressure, all fresh gas is routed through the Backpressure Regulator and agent is metered out of the pressurized cassette. If cassette pressure is below Mixer output pressure, some fresh gas is routed through the cassette, where it picks up agent vapor. The remaining fresh gas passes through the Backpressure Regulator. The mixed fresh gas and agent vapor from the subsystem is sent to the CGO.

To meet the requested agent concentration, outflow from the cassette (or flow through the cassette) is controlled with a proportional valve. This means the main subsystem control loop is on cassette flow, not agent concentration directly. If all fresh gas flow is through the Backpressure Regulator, the control loop depends strongly on Mixer reported flow and the cassette flow reading. It depends weakly on reported fresh gas composition, manifold temperature reading, and reported patient airway pressure. If fresh gas flow is split between the cassette and the Backpressure Regulator, the control loop depends strongly on Mixer reported flow, cassette flow reading, cassette pressure reading, and cassette temperature reading. It depends weakly on reported fresh gas composition, manifold temperature reading, and reported patient airway pressure.

Electrically, the subsystem interfaces to the Anesthesia Control board via the Pan Connector board for power (10VA limited) and communications (RS422). Power and communications to the Aladin cassette is supplied by the subsystem. While the subsystem contains a microcontroller, the vaporization control algorithms and safety functions run on the Anesthesia Control board. The subsystem microcontroller and other electronics simply handle the low-level tasks of sensor data gathering and command outputs to the actuators.

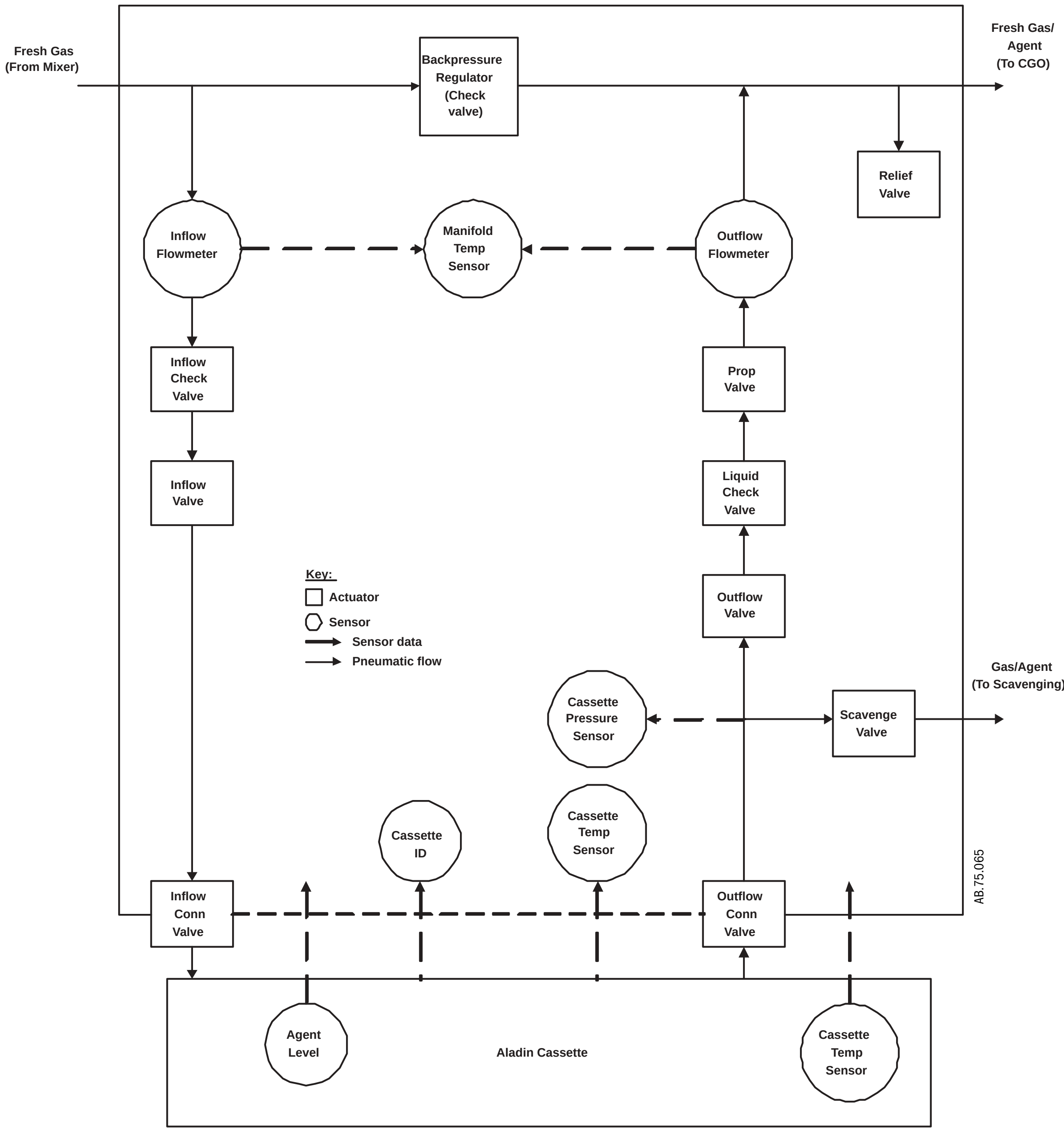


Figure 2-21 • Electronic Vaporizer electrical block diagram

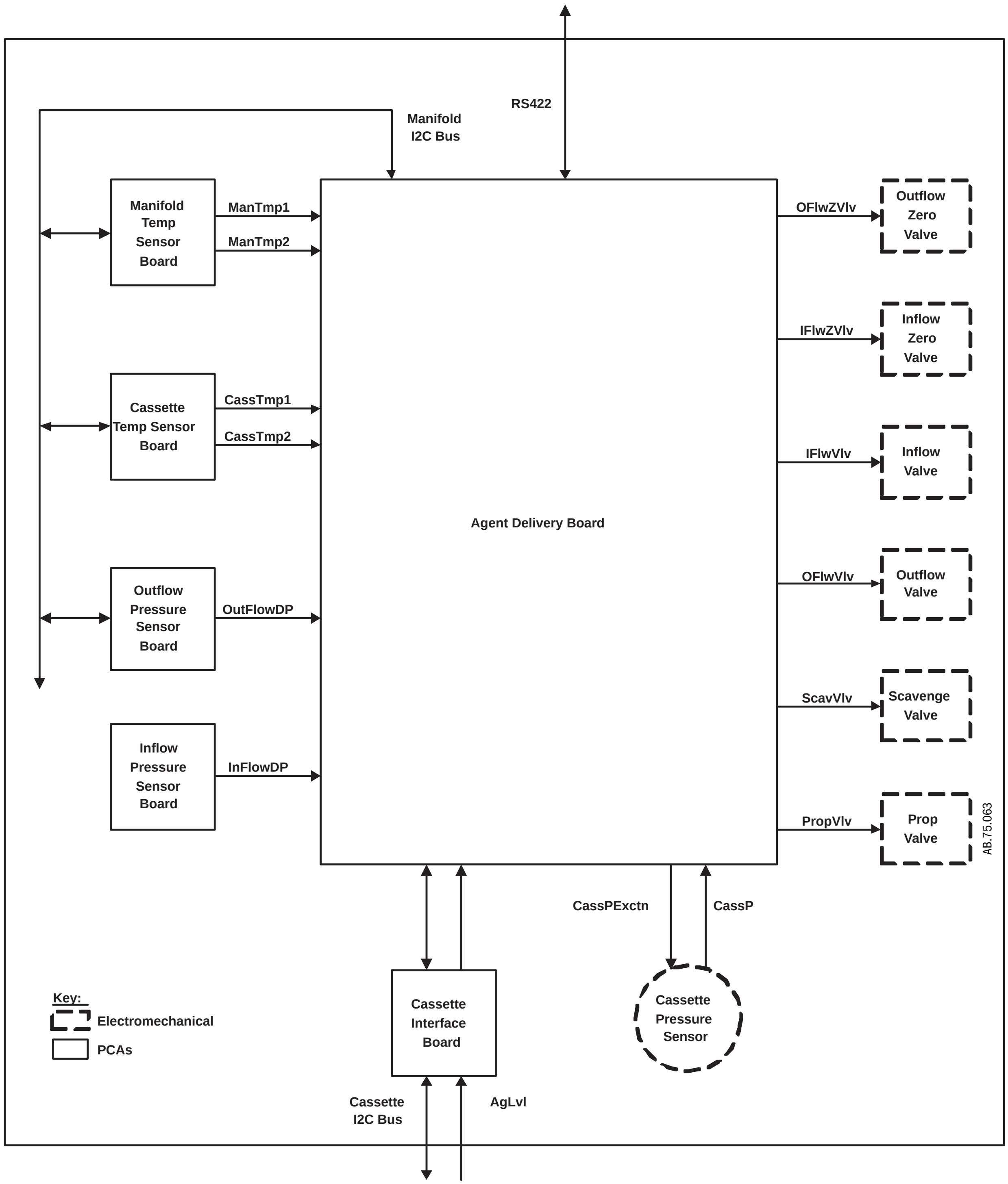


Figure 2-22 • Electronic Vaporizer electrical block diagram

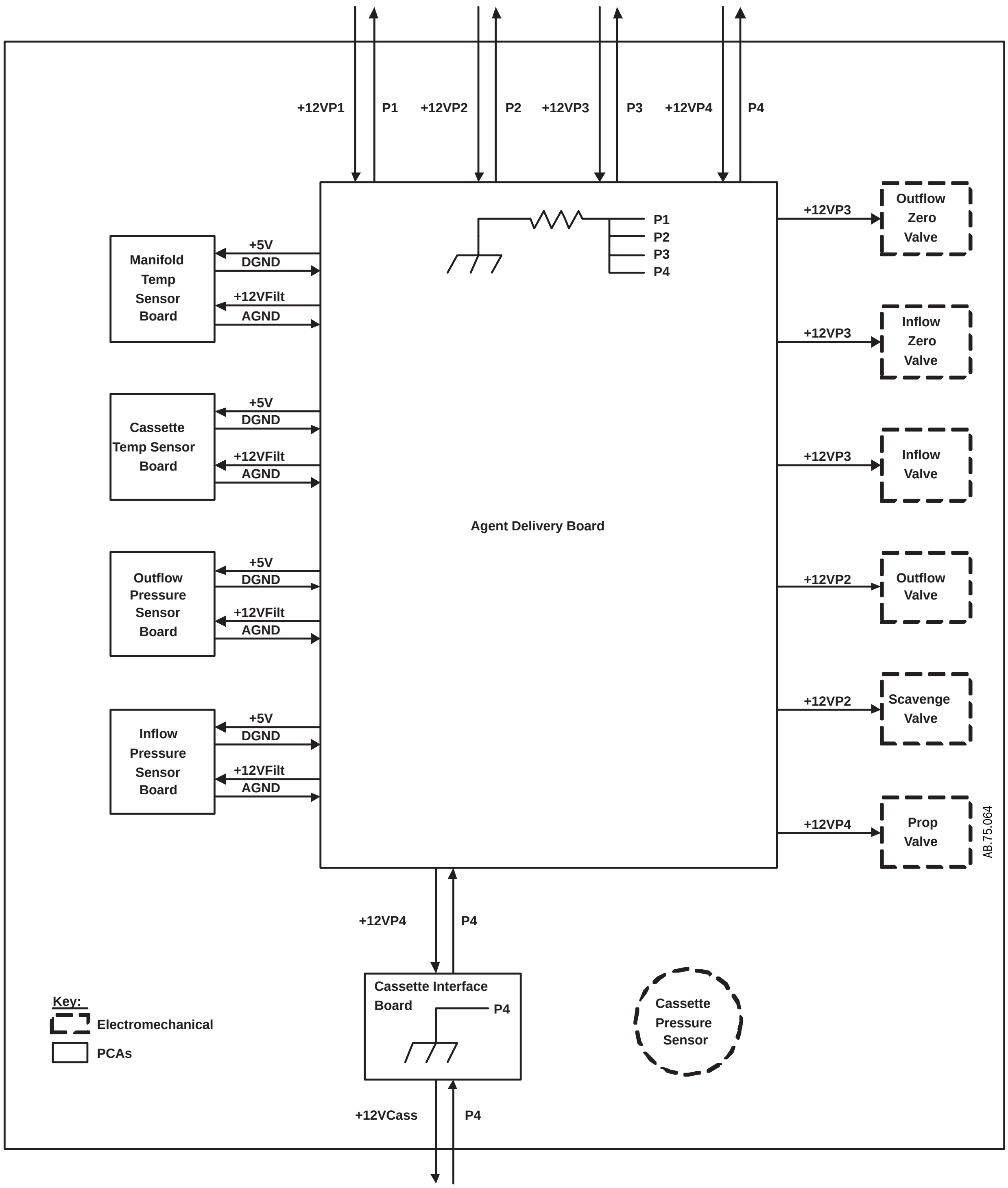


Figure 2-23 • Electronic Vaporizer power and grounding diagram

2.10.1 Agent Delivery board LED indicators

LED indicators are provided on the Agent Delivery Board to convey information about subsystem operation. Refer to the following table and to Figure 2-24.

Item	Marking	Indicates	Color
1	WDO	Blinks if microcontroller active	Yellow
2	TXD	Blinks if subsystem sending to Anesthesia Control Board	Yellow
3	RXD	Blinks if subsystem receiving from Anesthesia Control Board	Yellow
4	SCV	Lit if Scavenge Valve open	Yellow
5	OFV	Lit if Outflow Valve open	Yellow
6	OFZ	Lit if Outflow Zero Valve open	Yellow
7	IFZ	Lit if Inflow Zero Valve open	Yellow
8	IFV	Lit if Inflow Valve open	Yellow
9	CPWR	Lit if Cassette powered	Green
10	P1	Lit if voltage present on +12VP1 power rail	Green
11	P2	Lit if voltage present on +12VP2 power rail	Green
12	P3	Lit if voltage present on +12VP3 power rail	Green
13	P4	Lit if voltage present on +12VP4 power rail	Green
14		All segments lit immediately after reset. Segments flicker during subsystem POST. Segments extinguished upon communications established with ACB.	Red

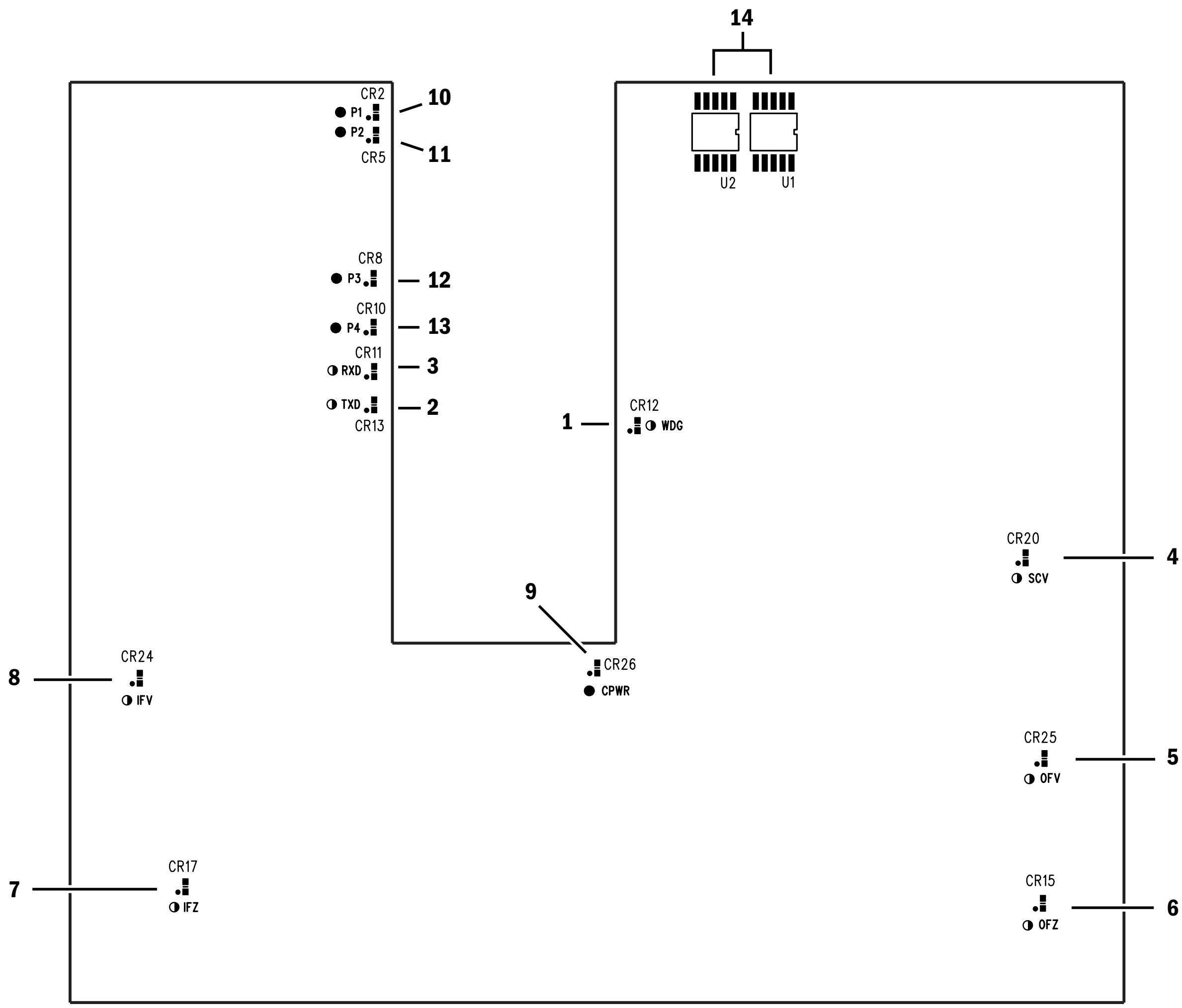


Figure 2-24 • Agent Delivery board LED indicators

2.11 Gas flow through the anesthesia machine

2.11.1 Overview

Refer to Figure 2-25 and Figure 2-26.

Gas supplies

Gas comes into the system through a pipeline (**1**) or cylinder (**6**) connection. All connections have indexed fittings, filters, and check valves (one-way valves). Pressure transducers monitor the pipeline (**2**) and cylinder (**7**) pressures.

The O_2 supply failure alarm is derived from the O_2 pipeline and the O_2 cylinder pressure transducer inputs.

A primary regulator (**8**) decreases the cylinder pressures to approximately pipeline levels. A pressure relief valve (**3**) helps protect the system from high pressures.

To help prevent problems with the gas supplies:

- Install yoke plugs on all empty cylinder connections.
- When a pipeline supply is adequate, keep the cylinder valve closed.

Gas flow

Pipeline or regulated cylinder pressure supplies O_2 or Air directly to the ventilator engine (**4a** or **4b**) and as pilot pressure (**4**) for the SCGO assembly (**E**). Connection points are also available for venturi suction (**5a** or **5b**) drive gas supply. An additional O_2 regulator (**18**) decreases the pressure for the O_2 Flush valve (**19**) and the auxiliary O_2 flowmeter (**24**).

The O_2 Flush valve supplies high flows of O_2 to the fresh gas outlet (**22** or **23**) through the SCGO/ACGO assembly (**E/F**). The flush pressure switch (**20**) monitors activation of the flush valve.

Gas mixing

Under normal conditions, with the system switch (**10**) in the On position, the Alternate O_2 Disable valve (**13**) is energized to block alternate O2 flow. Normal gas flows are enabled through their respective selector valves (**11**). The system controls gas flow through the flow control valves (**12**) and derives the individual flow rates through the hot-wire anemometers (**14**).

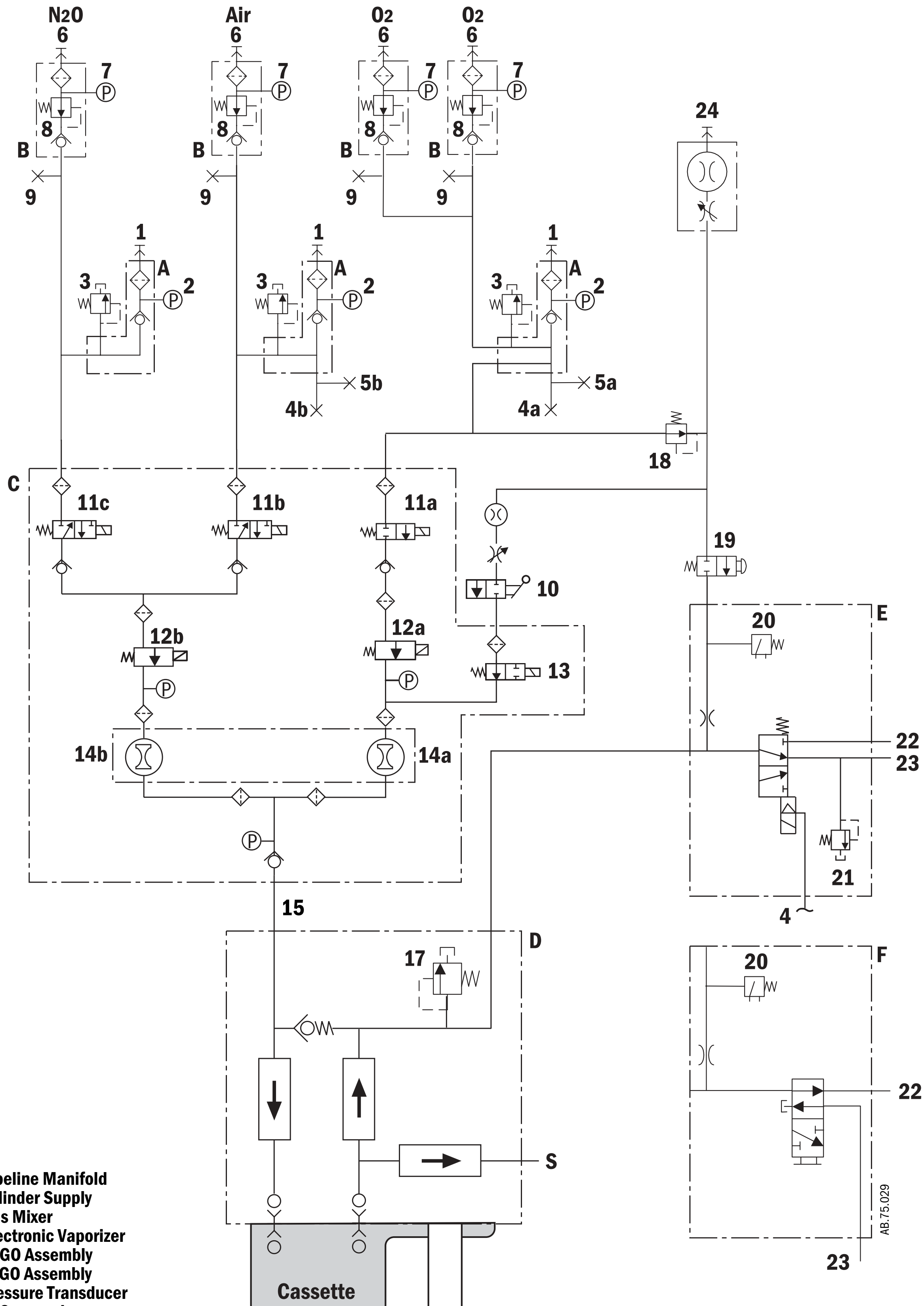
Under system failure conditions (or if Alt O_2 is selected), the normally-open Alternate O_2 Disable valve (**13**) allows delivery of O_2 through the Alternate O_2 Flowmeter when the system switch is in the On position.

Mixed gas

The mixed gas (**15**) flows through the electronic vaporizer (**D**) to the SCGO/ACGO assembly (**E/F**). A pressure relief valve (**17**) on the electronic vaporizer limits the maximum outlet pressure.

The SCGO assembly (**E**) directs the mixed gas to the selected circuit: **22** (ABS-circle) or **23** (to Inspiratory port of ABS). On SCGO assemblies, a relief valve (**21**) limits pressure in the breathing system to approximately 150 cmH_2O.

The ACGO assembly (**F**) directs the mixed gas to the selected circuit: **22** (ABS-circle) or **23** (external ACGO port).



A - Pipeline Manifold
B - Cylinder Supply
C - Gas Mixer
D - Electronic Vaporizer
E - SCGO Assembly
F - ACGO Assembly
P - Pressure Transducer
S - To Scavenging

Figure 2-25 • Pneumatic circuit

2.11.2 Electronic vaporizer

Agent is delivered from the subsystem in one of two configurations depending on whether cassette pressure is below or above Mixer output pressure. If cassette pressure is above Mixer output pressure, all fresh gas is routed through the Backpressure Regulator and agent is metered out of the pressurized cassette. If cassette pressure is below Mixer output pressure, some fresh gas is routed through the cassette, where it picks up agent vapor. The remaining fresh gas passes through the Backpressure Regulator. The mixed fresh gas and agent vapor from the subsystem is sent to the CGO.

A Backpressure Regulator (**25**) builds a pressure at the input to the vaporizer to drive gas through the cassette, if necessary. It is not needed to check flow in the reverse direction. A pressure relief valve (**17**) limits the maximum outlet pressure.

The Inflow and Outflow Flowmeters (**26**, **27**) measure flow by developing a pressure drop across a flow restrictor. The Outflow Flowmeter is used for control, while the Inflow Flowmeter is used for safety. Each Flowmeter includes a zeroing valve that temporarily shorts a pressure transducer’s ports together for an accurate zero measurement. The zeroing valves may be energized during Standby to heat the Flowmeter Manifold to prevent agent condensation.

An Inflow Check Valve (**28**) prevents unmetered agent vapor from flowing backwards and entering the fresh gas stream.

Inflow and Outflow Valves (**29**, **30**) direct flow in the subsystem, opening for agent delivery and closing for other system states, including safety conditions. The Outflow Valve must open for agent delivery, while the Inflow Valve opens if cassette pressure is lower than Mixer output pressure.

The Scavenge Valve (**31**) opens to vent built up pressure in cassettes to scavenging when the user commands the vaporizer off. It also is opened periodically when a cassette is not installed to automatically sample ambient pressure.

A liquid prevention valve (**32**) blocks liquid from entering the subsystem in the event that an overfilled cassette is present. This valve can also become temporarily blocked if cassette temperature exceeds Flowmeter Manifold temperature significantly, causing agent condensation. Clearing the blockage depends on the rate of agent evaporation.

Variable control of flow from the cassette is accomplished with a Proportional Valve (**33**) under software direction.

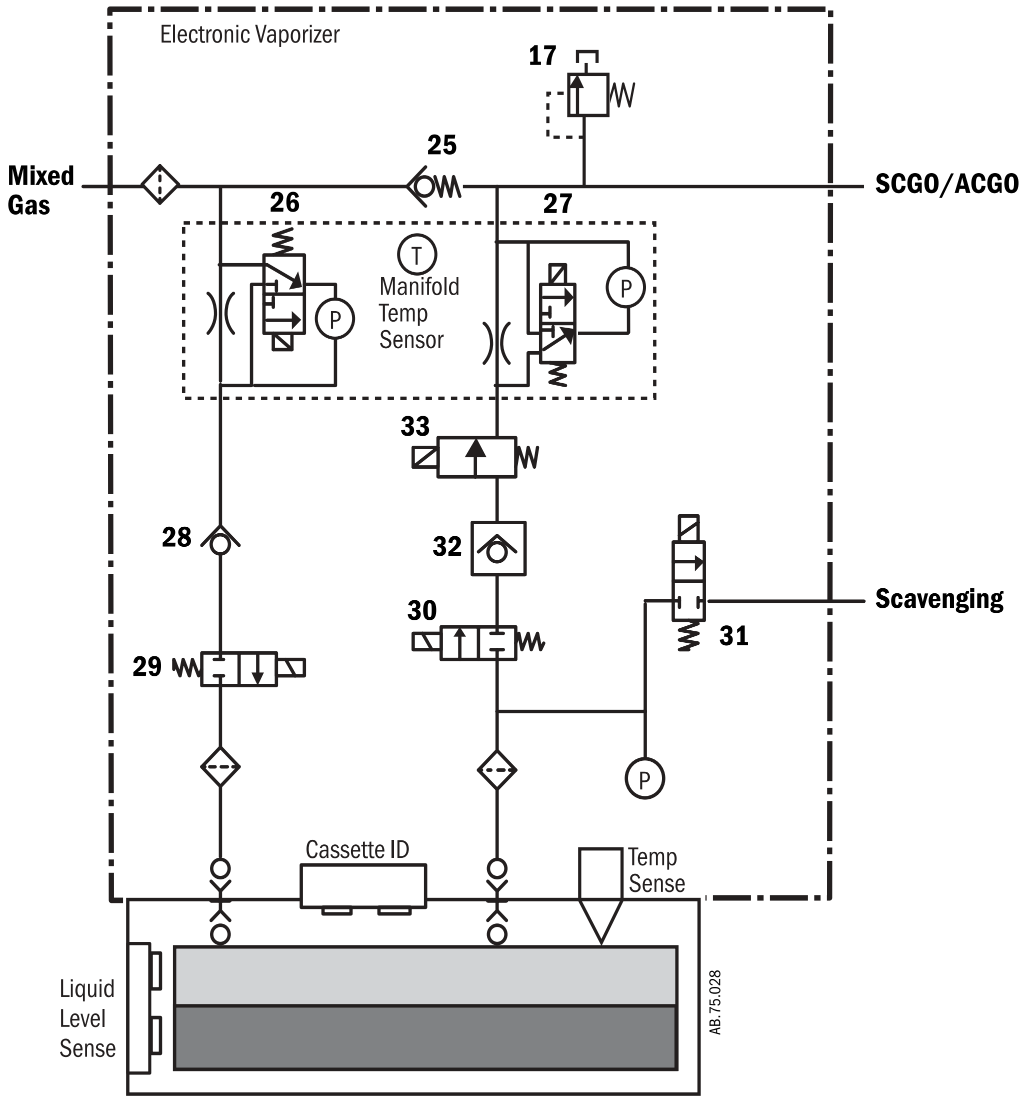
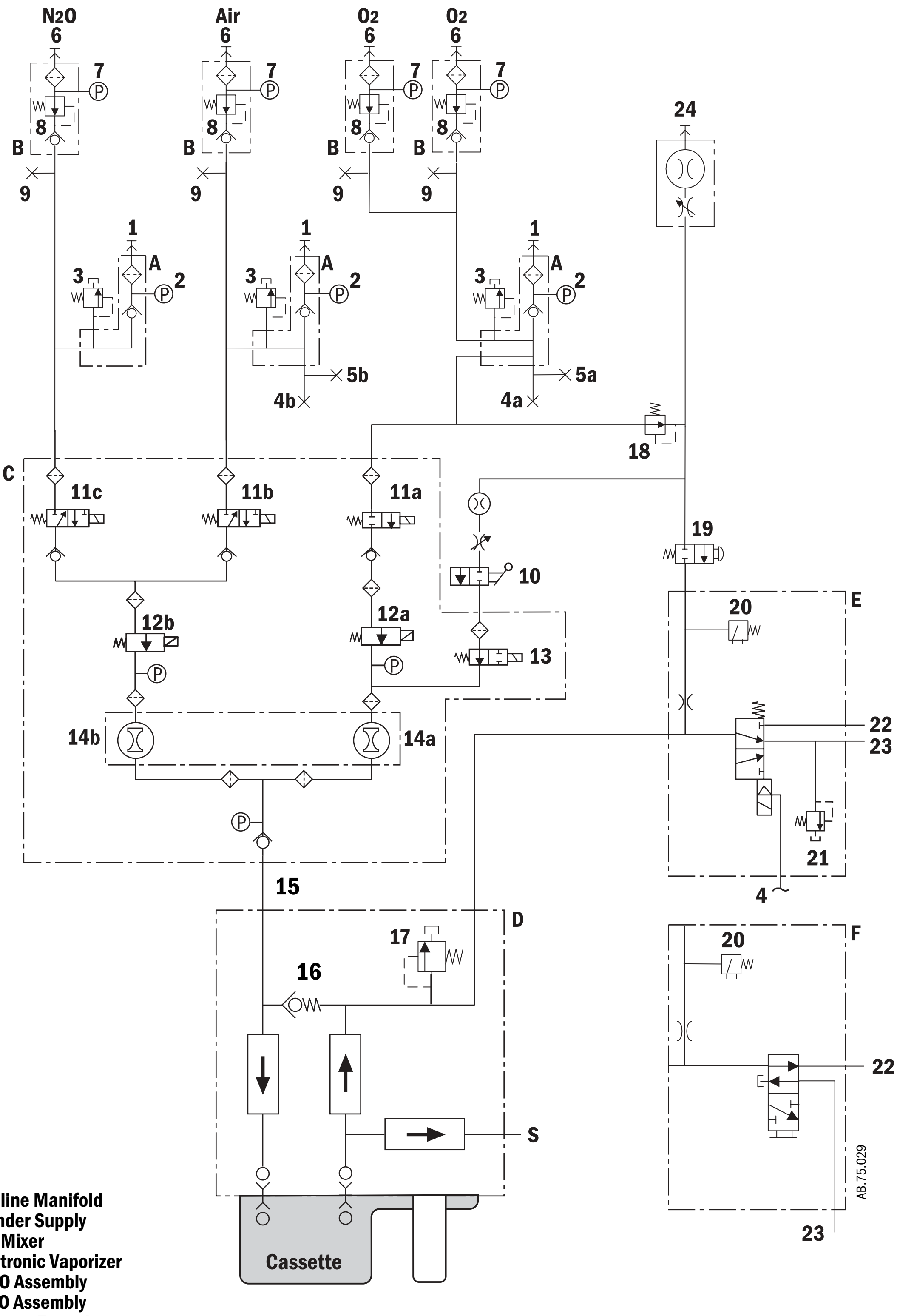


Figure 2-26 • Electronic vaporizer circuit



A - Pipeline Manifold
B - Cylinder Supply
C - Gas Mixer
D - Electronic Vaporizer
E - SCGO Assembly
F - ACGO Assembly
P - Pressure Transducer
S - To Scavenging

Figure 2-27 • Pneumatic circuit

Refer to Figure 2-27.

Key to Numbered Components

1. Pipeline inlet
2. Pipeline pressure transducer
3. High-pressure relief valve (758 kPa / 110 psi)*
4. Supply connections for the ventilator and pilot pressure for SCGO
   a. O_2 drive gas
   b. Air drive gas
5. Venturi suction supply connection
   a. O_2 drive gas
   b. Air drive gas
6. Cylinder inlet
7. Cylinder pressure transducer
8. Primary regulator (cylinder pressure)
9. Test port (primary regulator)
10. System switch
11. Selector valve
    a = O_2; b = Air; c = N_2O
12. Flow controller
    a = O_2; b = balance gas
13. Alternate O_2 disable valve
14. Hot-wire anemometer
    a = O_2 flow sensor channel; b = balance gas flow sensor channel
15. Mixed gas
16. Vaporizer bypass flow
17. Low-pressure relief valve (38 kPa / 5.5 psi)*
18. O_2 flush and auxiliary flowmeter regulator (241 kPa / 35 psi)*
19. O_2 Flush valve
20. Pressure switch (used with the ventilator)
21. Breathing system pressure relief valve (SCGO only — 150 cmH_2O)*
22. To Port 3 of ABS interface (circle)
23. For SCGO, to Port 2 of ABS interface (non-circle Inspiratory port)
    For ACGO, to external 22-mm ACGO connector
24. Auxiliary O_2 flowmeter (optional)

* Approximate values

Key to Symbols

 Pneumatic Connection

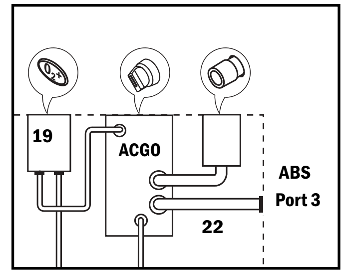
 Filter

 Direction of Flow

 Check Valve

2.11.3 Physical connections (O_2 supply)

Figure 2-28 shows the physical path that the O_2 gas supply takes. The item numbers are described in Figure 2-27.



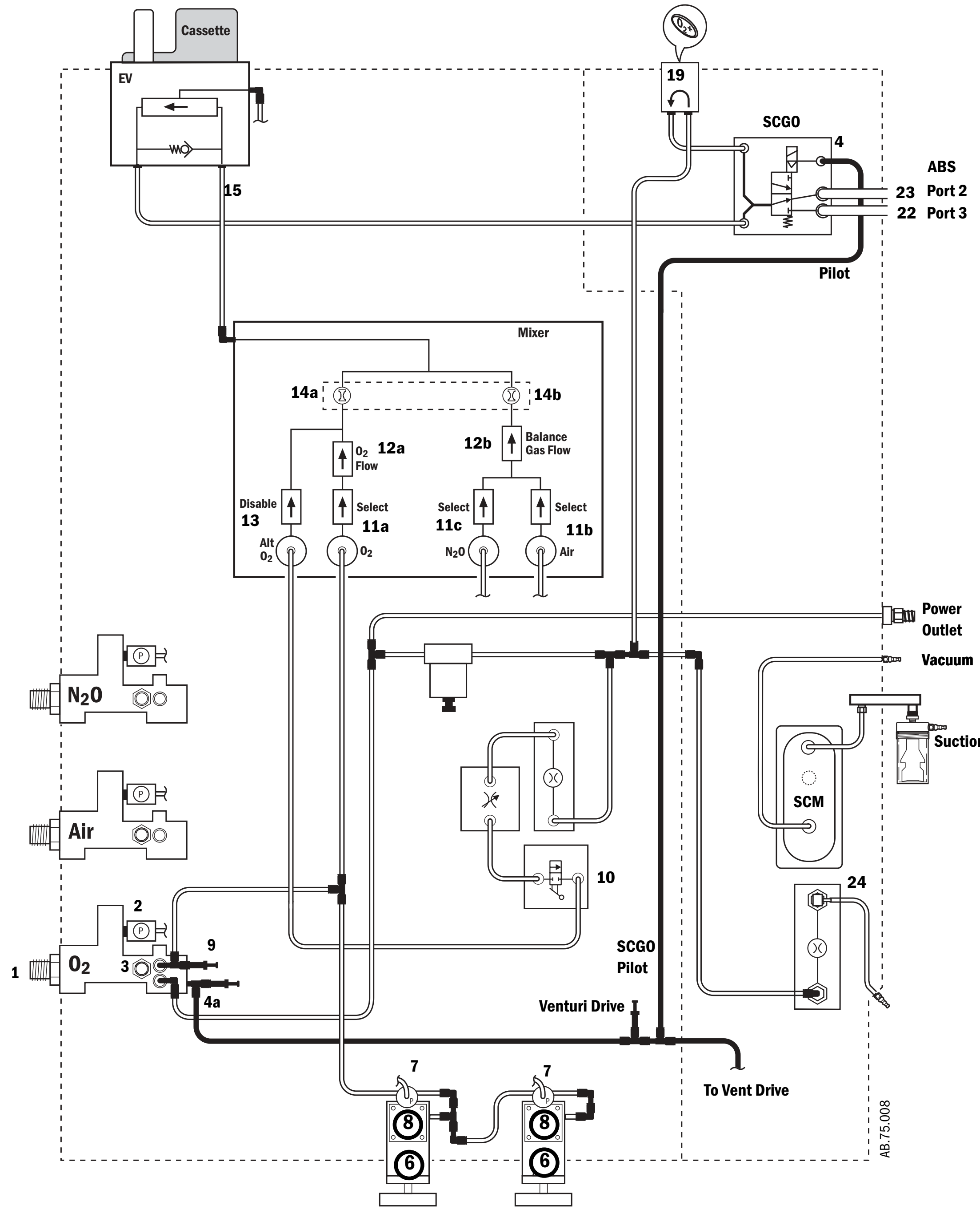
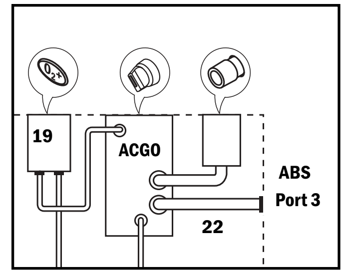


Figure 2-28 • Typical (O_2) tubing connections - pictorial

2.11.4 Physical connections (N2O and Air supplies)

Figure 2-29 shows the physical path that the N_2O and Air gas supplies take. The item numbers are described in Figure 2-27.



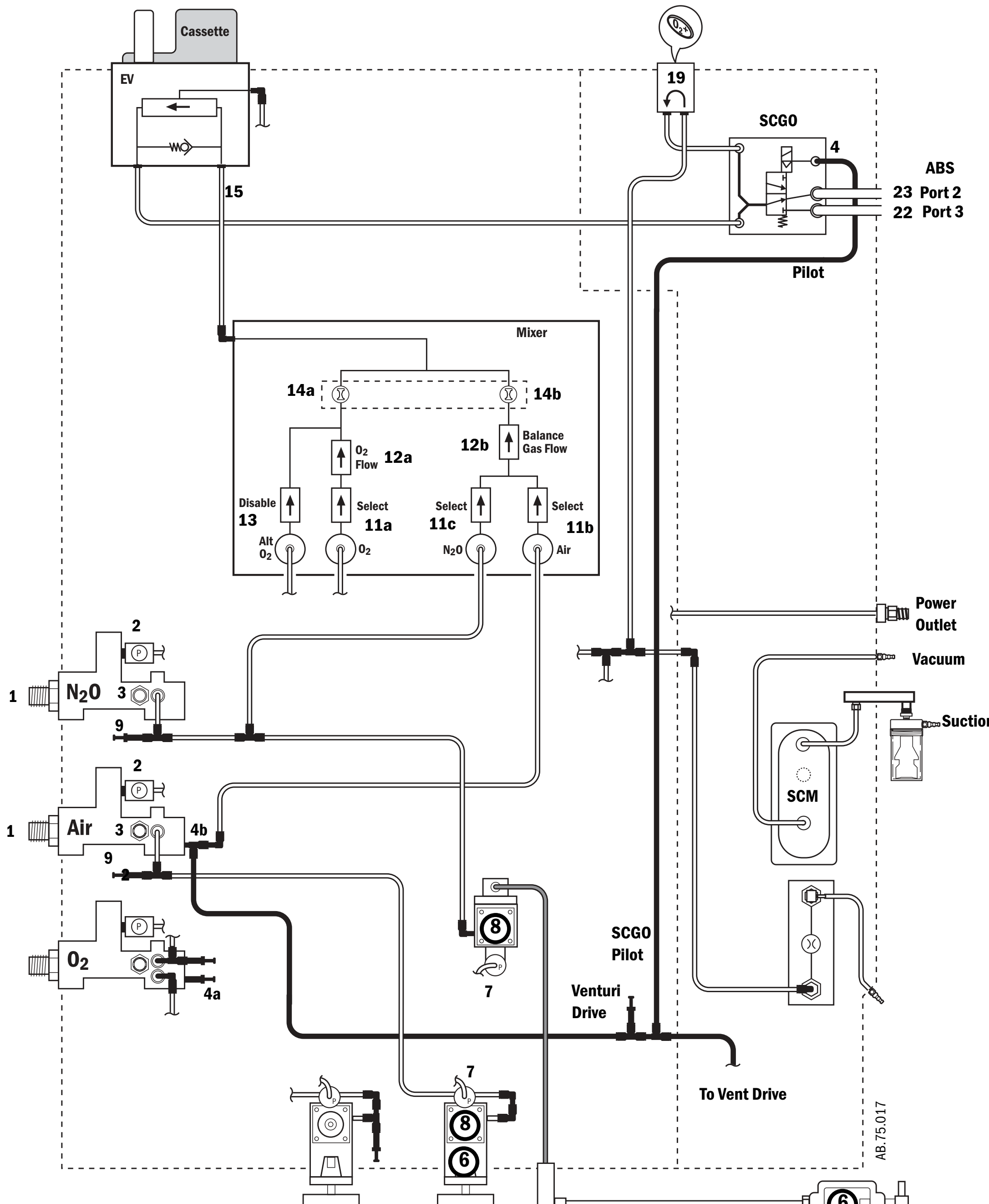


Figure 2-29 • Typical (N_2O and Air) tubing connections - pictorial

2.11.5 Suction regulators

Pipeline vacuum

The suction regulator (shown in Figure 2-28) uses an external vacuum source.

Venturi Drive vacuum

The suction regulator (shown in Figure 2-30) uses an internal, venturi derived vacuum source.

Drive gas (internally plumbed **Air** or **O_2**) enters the Venturi Module (**VM**) at the drive port (**A**). As the drive gas passes through the venturi module, a vacuum is created at port **B**. The drive gas exits the venturi module at port **C** and is exhausted outside the machine through the muffler (**D**).

The control port (**E**) on the venturi module responds to pneumatic signals from the front panel switch on the Suction Control Module (**SCM**) to turn the venturi vacuum drive gas on or off. The check valve (**CV**) helps prevent pressurization of the suction circuitry if the exhaust is occluded or the venturi unit fails.

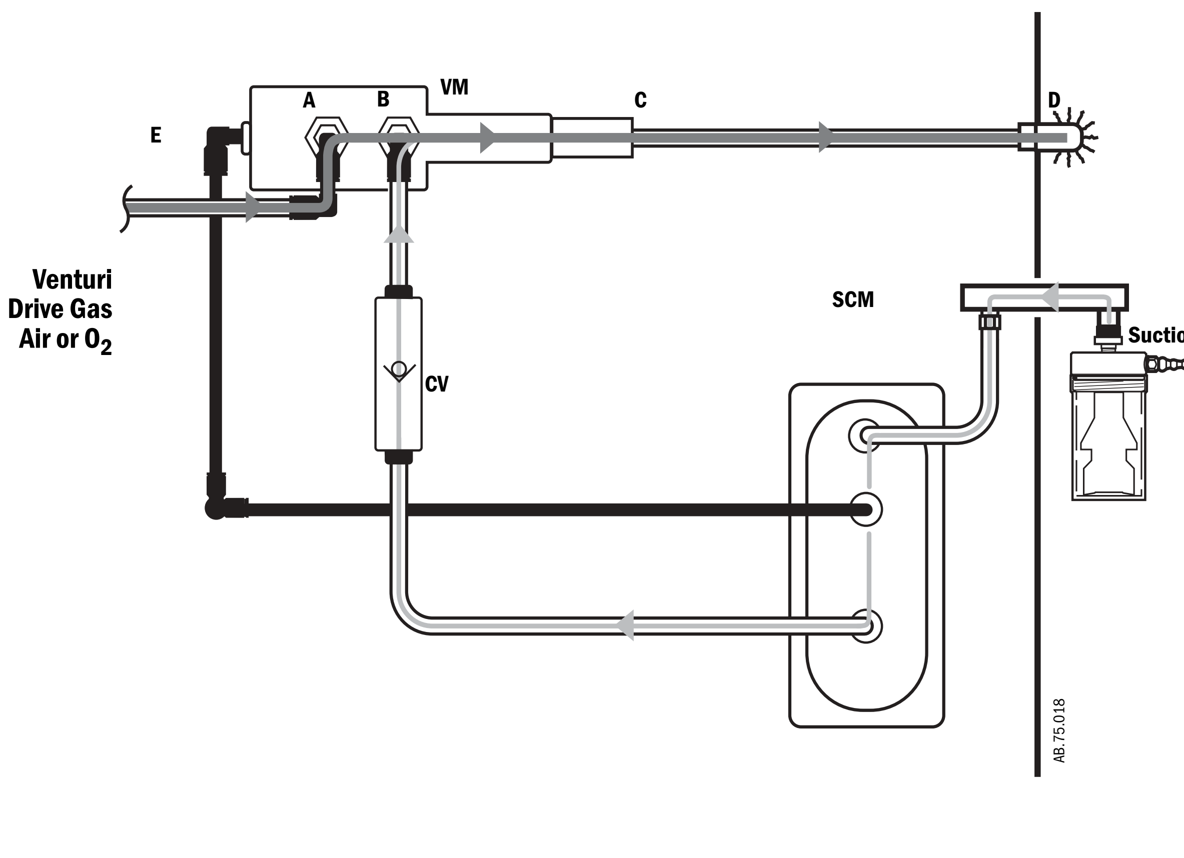


Figure 2-30 • Venturi suction

2.12 Flow through the breathing system

2.12.1 Overview of flow paths

This section looks at three types of flow paths.

- **Ventilation paths:** How gas flows from the drive source (bag or bellows) to and from the patient.
- **Fresh gas paths:** Fresh gas can flow from the machine interface directly to the patient through the inspiratory check valve, or through the absorber into the expiratory flow, or directly to an external circuit through the optional auxiliary common gas outlet.
- **Scavenged gas paths:** APL or Pop-off.

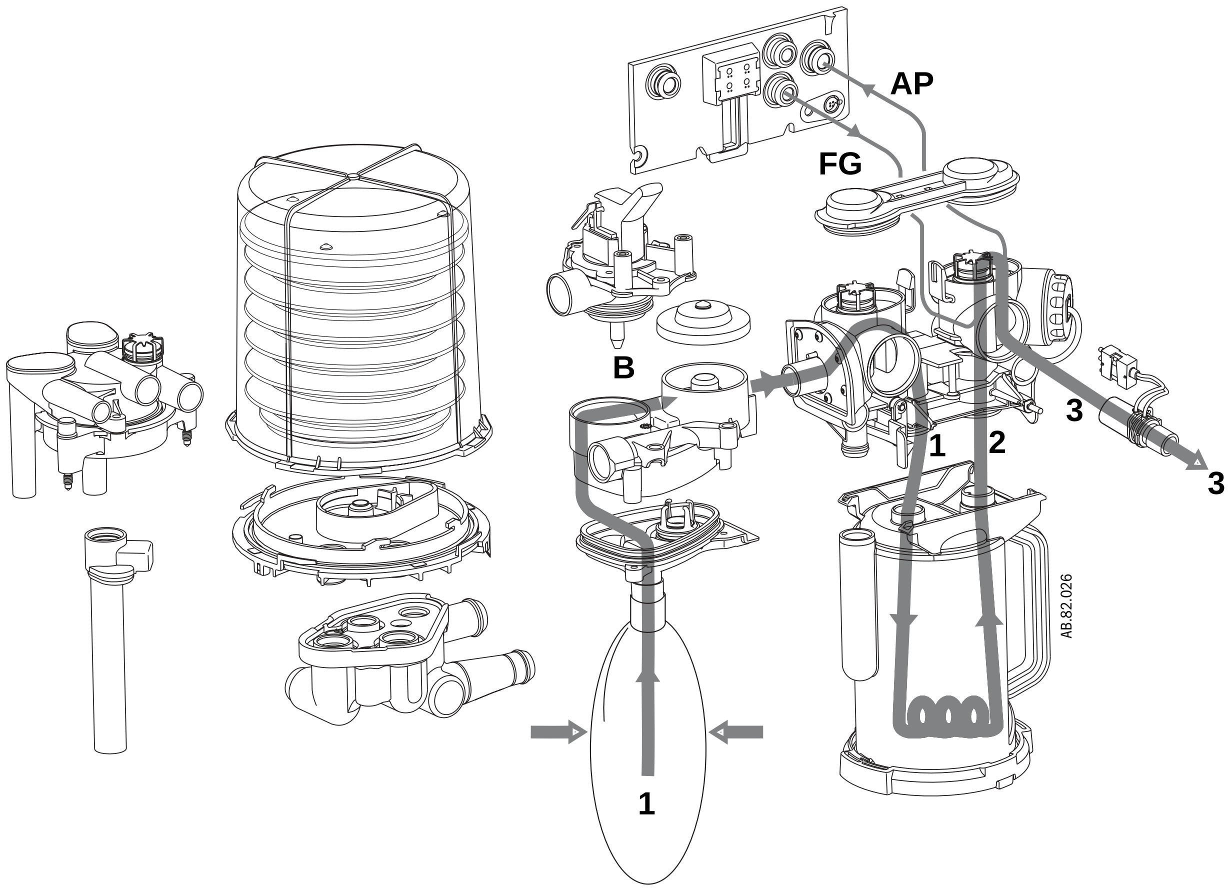
2.12.2 Manual ventilation

Manual inspiration
(Figure 2-31)

The Bag/Vent switch closes the ventilator path (**B**).

Gas flows from the bag (**1**), through the absorber (**2**), into the breathing circuit module, and through a unidirectional valve (inspiratory check valve) to the patient (**3**).

During inspiration, fresh gas (**FG**) flows from the machine into the inspiratory limb, upstream of the inspiratory check valve.



AP	Airway Pressure
B	Bag/Vent switch to Bag
FG	Fresh Gas
1	Flow to absorber
2	Flow from absorber
3	Inspiratory flow

Figure 2-31 • Gas flow during manual inspiration

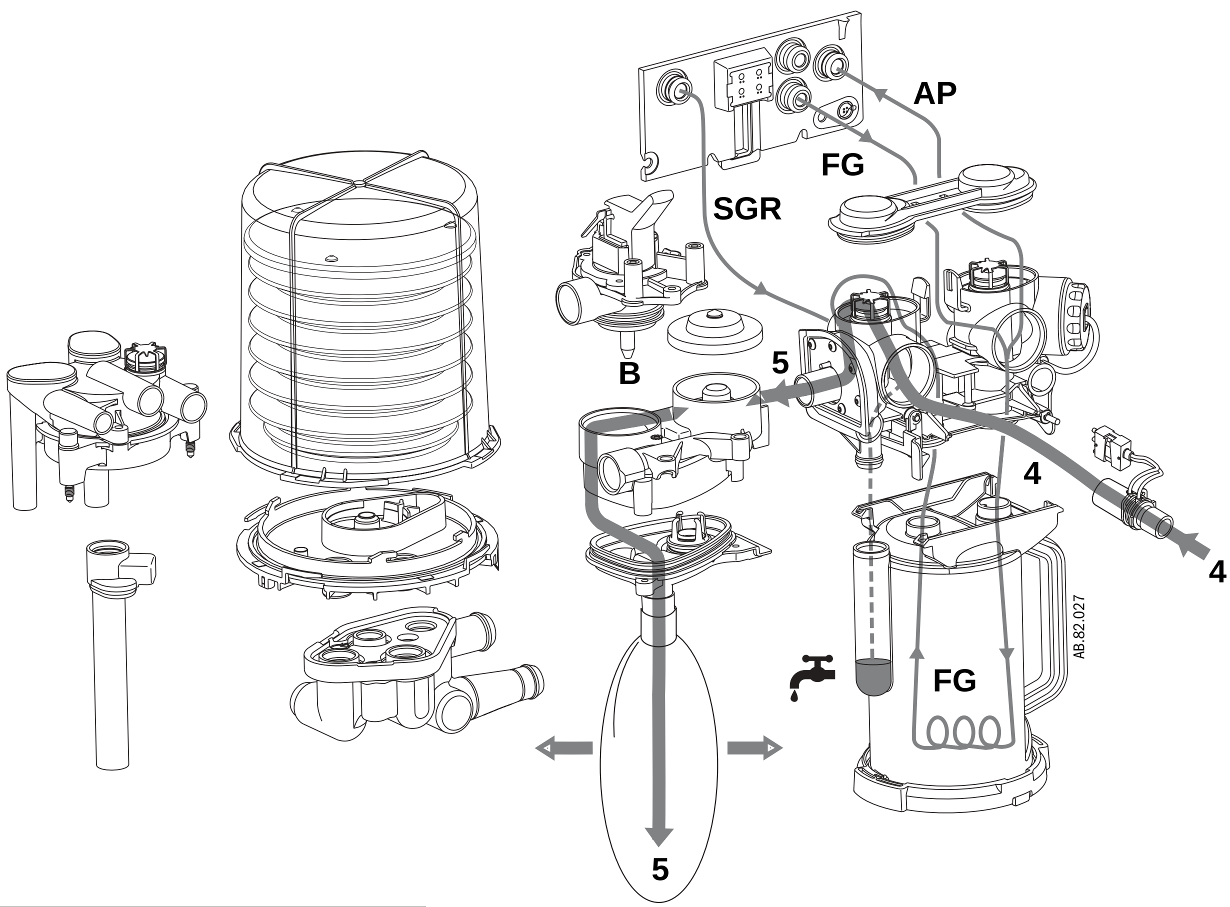
Manual expiration
(Figure 2-32)

The Bag/Vent switch keeps the ventilator path closed (**B**).

Gas flows from the patient (**4**), through a unidirectional valve (expiratory check valve), and into the bag (**5**).

During exhalation, fresh gas flows backwards through the absorber (**FG**) into the expiratory limb, downstream of the expiratory check valve.

For machines that are plumbed to return sample gas to the breathing system, the returned gas (**SGR**) enters the breathing system after the expiratory check valve (Refer to section 9.21).



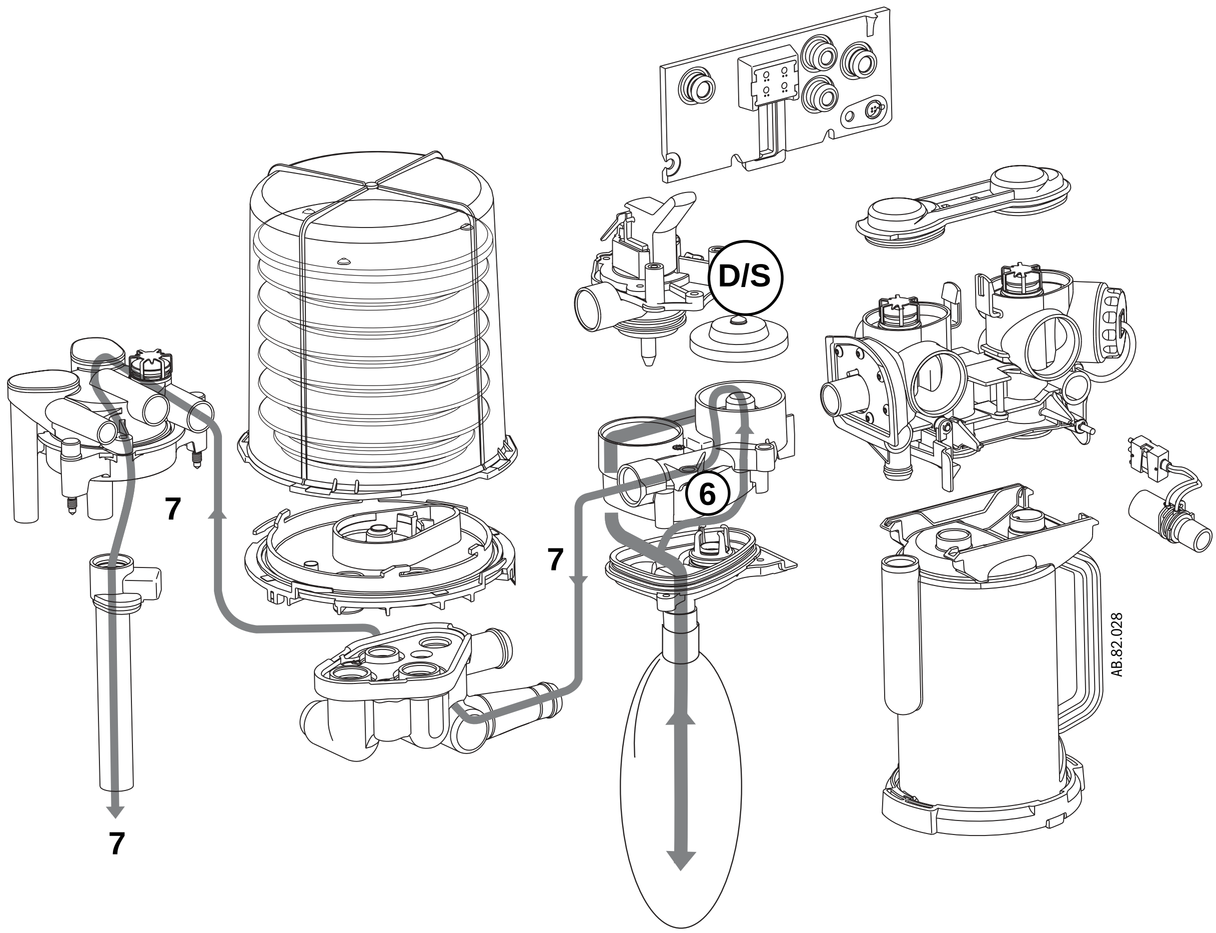
AP Airway Pressure
B Bag/Vent switch to Bag
FG Fresh Gas
SGR Sample Gas Return
4 Expiratory flow
5 Flow to bag

Figure 2-32 • Flow during manual expiration

APL Valve
(Figure 2-33)

The APL valve sets a pressure limit for manual ventilation.

As you turn the APL knob, it puts more or less force on the APL disc and seat (**D/S**). If the circuit pressure is too high (**6**), the disc and seat inside the diaphragm opens and vents gas to the scavenging system (**7**).



D/S APL disc and seat
6 APL flow
7 To scavenging

Figure 2-33 • Flow through the APL Valve

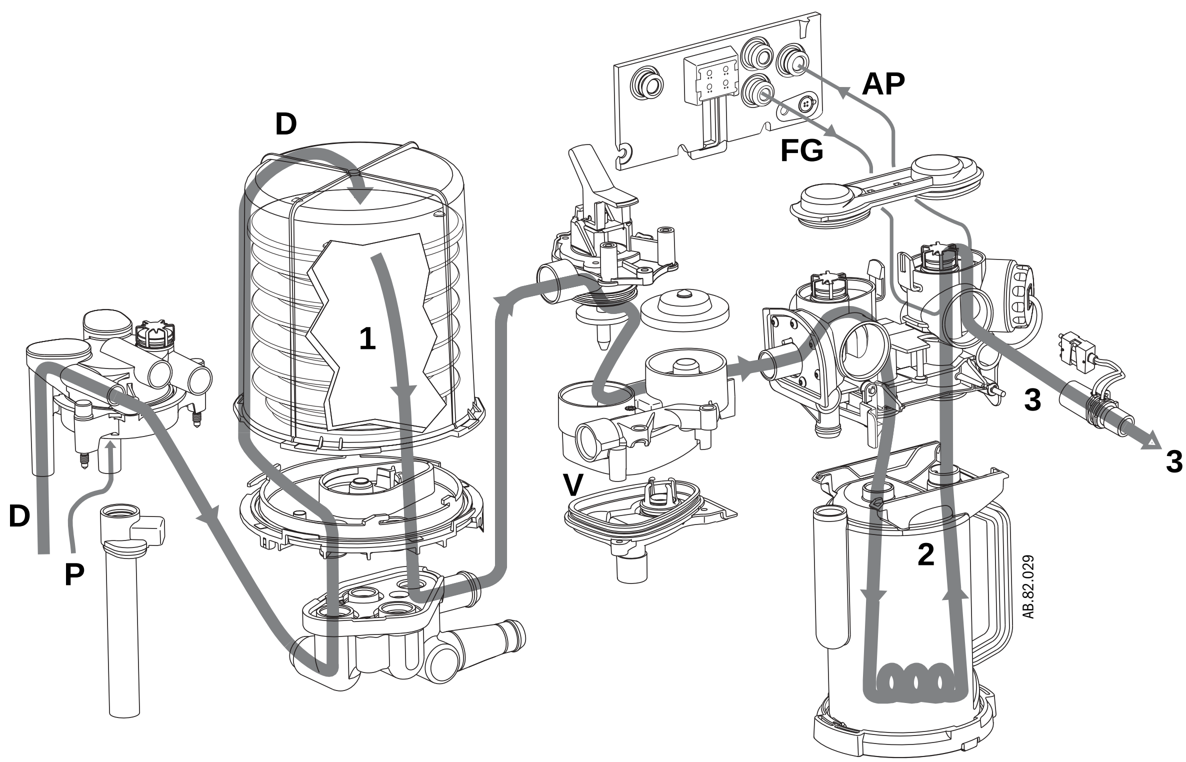
2.12.3 Mechanical ventilation

Mechanical inspiration
(Figure 2-34)

The Bag/Vent switch closes the manual path (**V**). Pilot pressure (**P**) closes the exhalation valve.

Drive gas (**D**) pushes down on the bellows. Gas flows from the bellows (**1**), through the absorber (**2**), and through a unidirectional valve (inspiratory check valve) to the patient (**3**).

During inspiration, fresh gas flows into the inspiratory limb, upstream of the inspiratory check valve.



AP Airway Pressure
D Drive gas
FG Fresh Gas
P Pilot pressure
V Bag/Vent switch to Vent
1 Flow to absorber
2 Flow from absorber
3 Inspiratory flow

Figure 2-34 • Mechanical inspiration

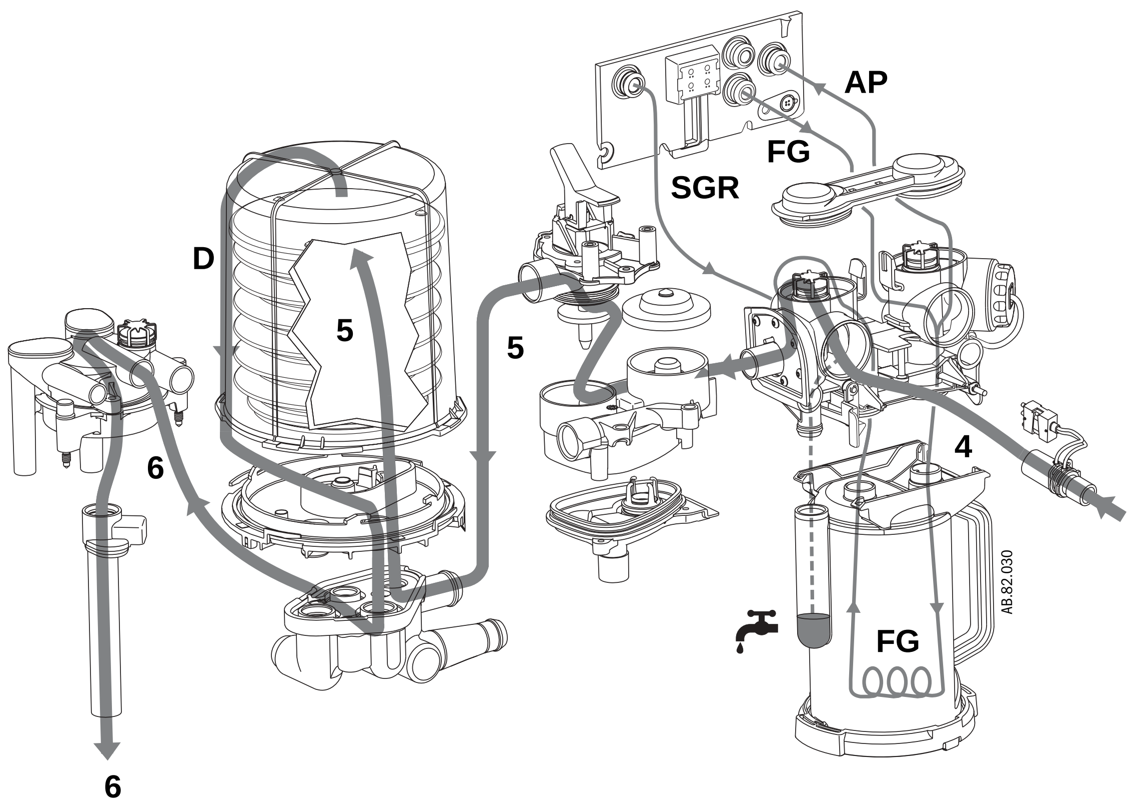
Mechanical expiration
(Figure 2-35)

Drive-gas flow stops and the exhalation valve opens. Exhaled gas flows from the patient (**4**), through a unidirectional valve (expiratory check valve) and into the bellows (**5**). Residual drive gas (**D**) flows out of the bellows to the scavenging system (**6**).

If PEEP is selected, static pressure on the pilot port of the exhalation valve sets the PEEP level.

During exhalation, fresh gas flows backwards through the absorber (**FG**) into the expiratory limb, downstream of the expiratory check valve.

For machines that are plumbed to return sample gas to the breathing system, the returned gas (**SGR**) enters the breathing system after the expiratory check valve (Refer to section 9.21).



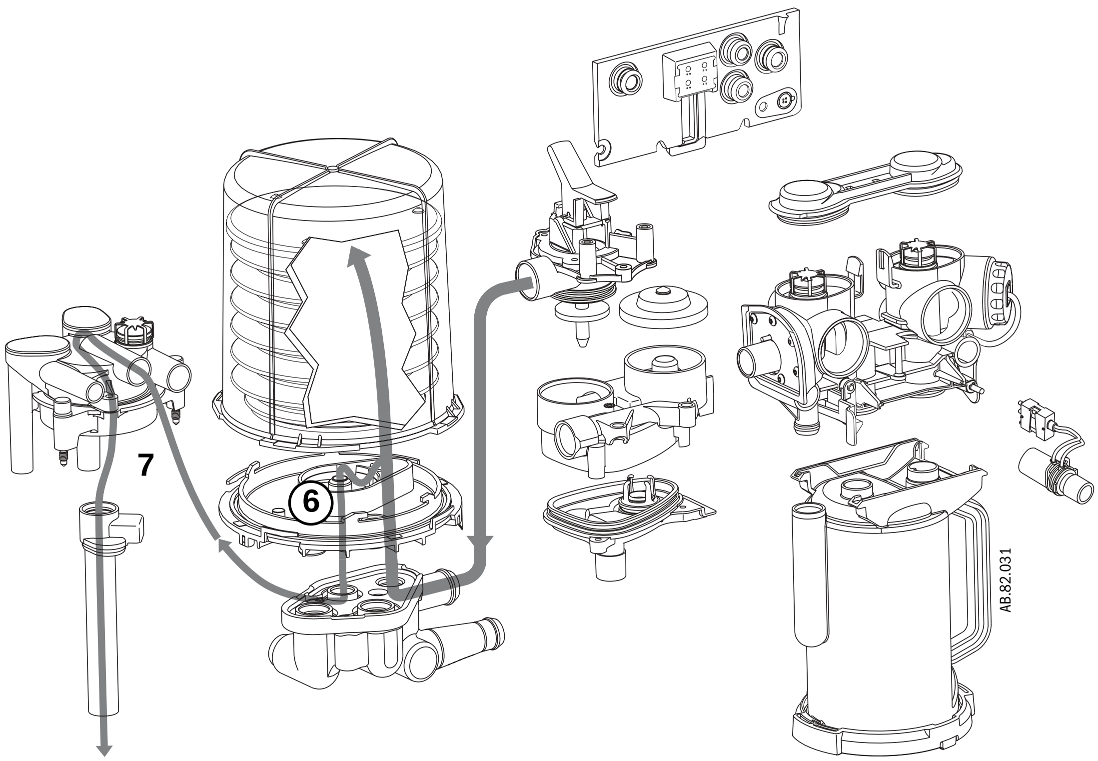
AP Airway Pressure
D Drive gas
FG Fresh Gas
SGR Sample Gas Return
4 Expiratory flow
5 Flow to bellows
6 To scavenging

Figure 2-35 • Flow through the APL Valve

Pop-off valve
(Figure 2-36)

The pop-off valve limits the pressure inside the bellows to 2.5 cm H_2O above the drive gas pressure. This normally occurs when the bellows reaches the top of the housing at the end of exhalation.

Excess gas (**6**) vents to the scavenging system (**7**) through the pop-off valve and the exhalation valve.



6 Pop-off flow
7 To scavenging

Figure 2-36 • Flow through the pop-off valve

2.12.4 Fresh gas and O_2 flush flow (with SCGO)

To ABS (Circle) breathing system (Figure 2-37)

Fresh gas (**1**) flows from the electronic vaporizer (**EV**) to the SCGO assembly.

With the Circle system selected, fresh gas flow is channeled to Port 3 of the breathing system (before the inspiratory check valve).

The output of the O_2 Flush regulator (**2**) is channeled to the O_2 Flush valve. When activate, O_2 flush flow joins the fresh gas flow in the SCGO assembly.

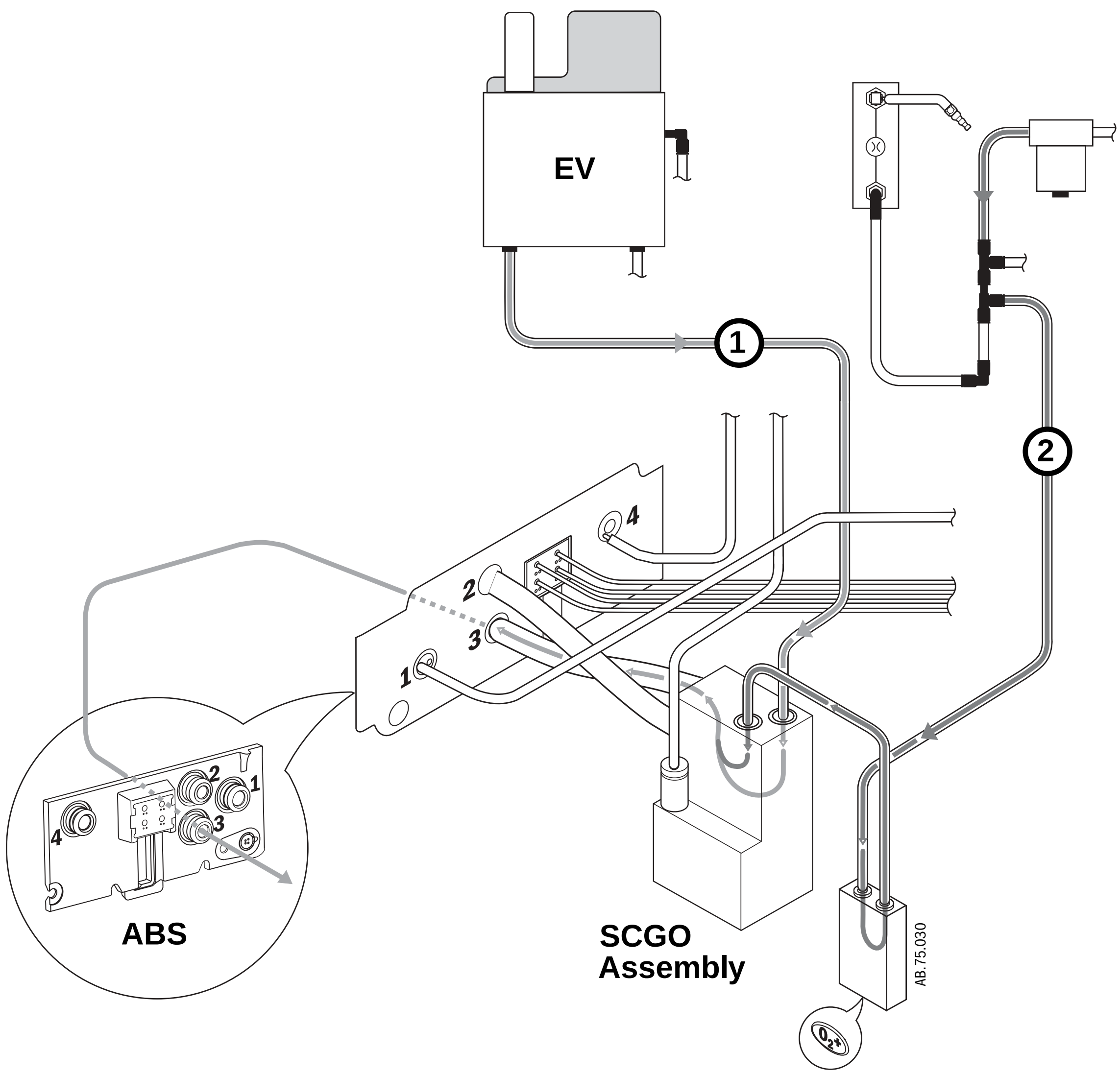


Figure 2-37 • Fresh gas and O_2 flush flow (to ABS)

Switched (Non-circle) Common Gas Outlet
(Figure 2-38)

Fresh gas (**1**) flows from the electronic vaporizer (**EV**) to the SCGO assembly.

With the Non-Circle system selected, fresh gas flow is channeled to Port 2 of the breathing system (after the inspiratory check valve - to an external patient circuit through the Inspiratory port).

The output of the O_2 Flush regulator (**2**) is channeled to the O_2 Flush valve. When activated, O_2 flush flow joins the fresh gas flow in the SCGO assembly.

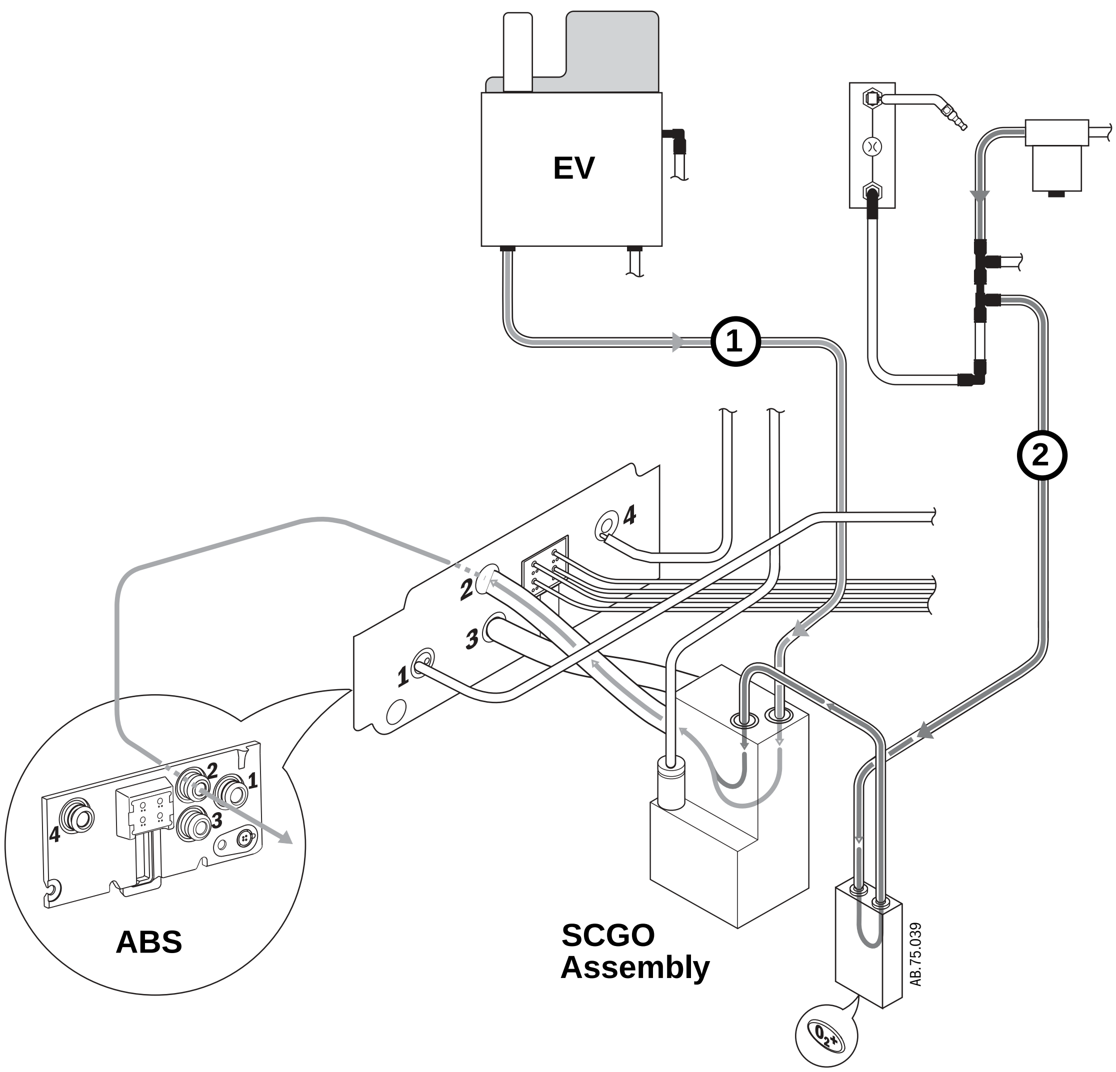


Figure 2-38 • Fresh gas and O_2 flush flow (to Insp port)

2.12.5 Fresh gas and O_2 flush flow (with ACGO)

To ABS (Circle) breathing system (Figure 2-39)

Fresh gas (**1**) flows from the electronic vaporizer (**EV**) to the ACGO Selector Switch.

With the ACGO Selector Switch in the ABS position, fresh gas flow is channeled to the breathing system.

The output of the O_2 Flush regulator (**2**) is channeled to the O_2 Flush valve.
When activate, O_2 flush flow joins the fresh gas flow in the ACGO Selector Switch.

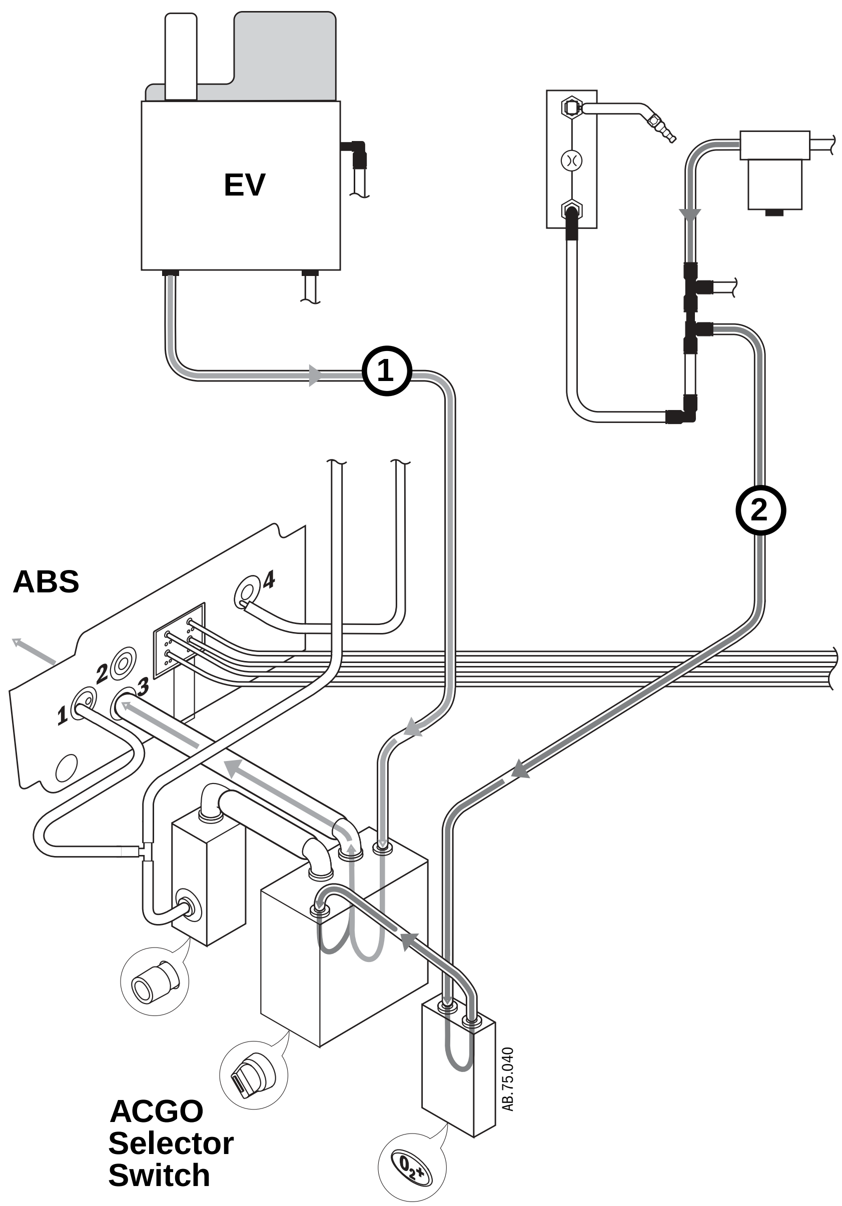


Figure 2-39 • Fresh gas and O_2 flush flow (to ABS)

Auxiliary (Non-circle) Common Gas Outlet (Figure 2-40)

Fresh gas (**1**) flows from the electronic vaporizer (**EV**) to the ACGO Selector Switch.

With the ACGO Selector Switch in the ACGO position, fresh gas flow is channeled to the ACGO outlet.

At the ACGO outlet, a small sample is diverted to the O_2 Cell in the ABS for O_2 monitoring.

The output of the O_2 Flush regulator (**2**) is channeled to the O_2 Flush valve. When activated, O_2 flush flow joins the fresh gas flow in the ACGO Selector Switch.

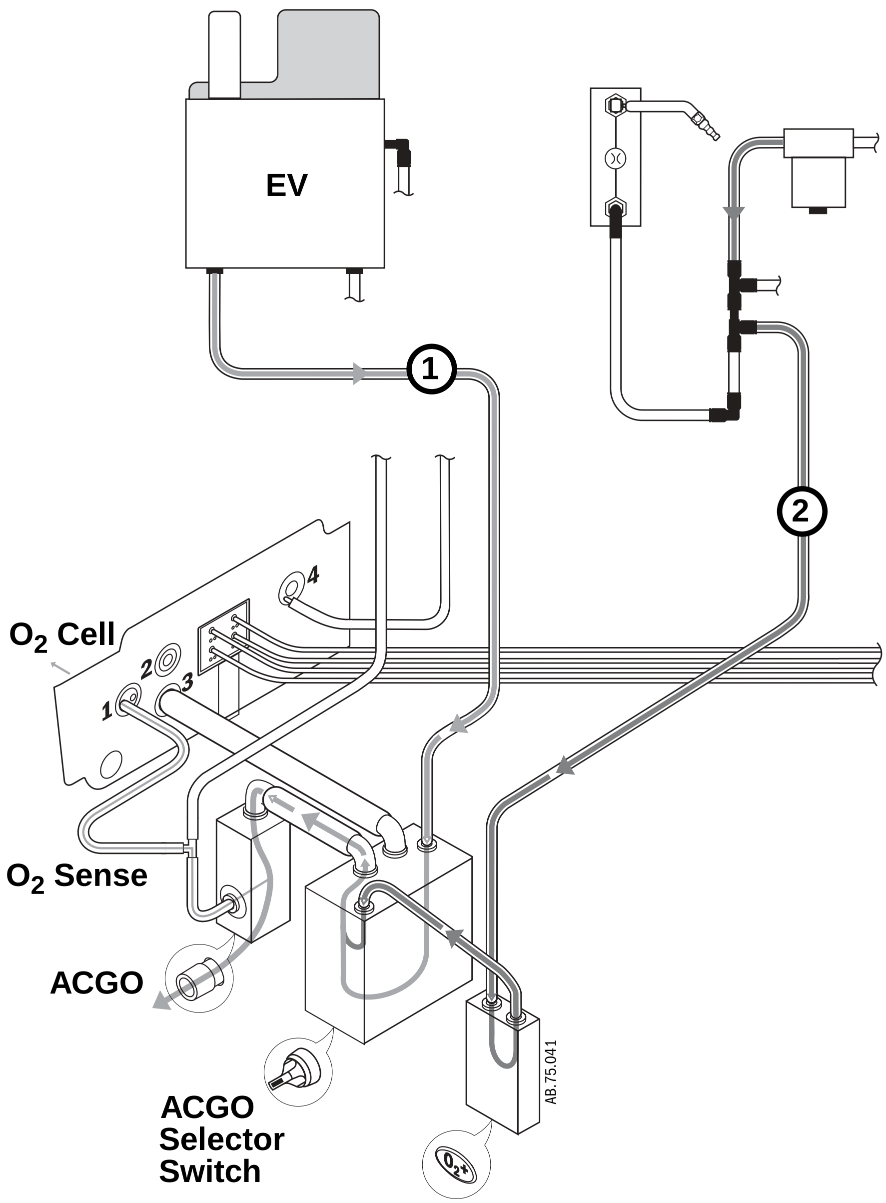


Figure 2-40 • Fresh gas and O_2 flush flow (to ACGO)

2.13 Ventilator mechanical subsystems

Refer to Figure 11-1, "*System circuit diagram*" in Section11, for the complete pneumatic/mechanical subsystem diagram.

The mechanical subsystems for the ventilator include:

Pneumatic Vent Engine

- Drive gas inlet filter
- Gas inlet valve
- Supply gas pressure regulator
- Flow control valve
- Drive gas check valve
- Mechanical Overpressure Valve (MOPV)
- Bleed resistor
- Free breathing valve

Exhalation valve

Bellows assembly

Breathing circuit flow sensors

2.13.1 Drive gas filter and Gas Inlet Valve

Drive gas (can be selected from O_2 or Air) enters the Vent Engine (**1**) at a pressure of 241 to 690 kPa (35 to 100 psi) through a 2-micron filter (**2**) that is located under the Gas Inlet Valve (**3**).

During normal operation the Gas Inlet Valve (GIV) is open to let supply gas flow. The GIV shuts off supply gas to the ventilator under failure conditions detected by the CPU or over-pressure switch. The output from the GIV stays at the filtered supply gas pressure.

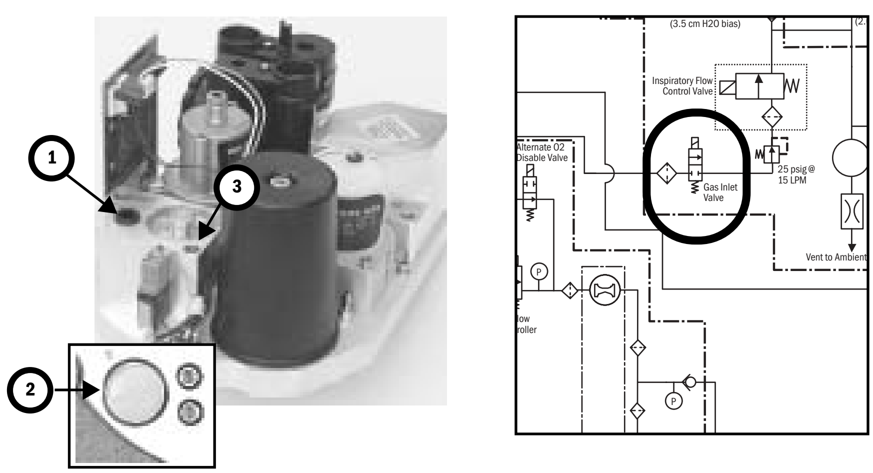


Figure 2-41 • Inlet filter and Gas Inlet Valve (GIV)

2.13.2 Pressure regulator

The pressure regulator (**4**) is a non-relieving pressure regulator that regulates high pressure filtered supply gas down to 172 kPa (25 psi).

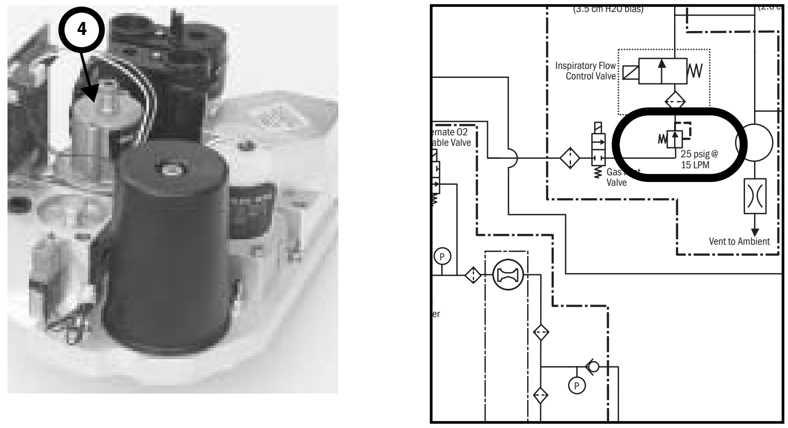


Figure 2-42 ▪ Pressure regulator

2.13.3 Flow control valve

The flow control valve (**5**) is controlled by the CPU. Signals are sent to the flow control valve of the necessary flow determined by ventilator settings and sensor signals. The flow control valve modulates the incoming 172 kPa (25 psi) drive gases to an output from 0 to 120 liters per minute at pressures ranging from 0 to 100 cm H_2O.

Figure 2-43 ▪ Flow control valve

2.13.4 Drive Gas Check Valve (DGCV)

The Drive Gas Check Valve (**6**) is used downstream of the flow control valve to create the pilot pressure for closing the exhalation valve during inspiratory phases. The DGCV valve is biased shut by an integral weight that supplies approximately 3.5 cm H_2O of bias pressure before permitting flow downstream to the breathing circuit. When the ventilator is exhausting flow from the breathing circuit, the DGCV permits the exhalation valve pilot pressure to be de-coupled from the circuit pressure. This permits the exhalation valve to open and lets gas flow to the exhaust and the gas scavenging system.

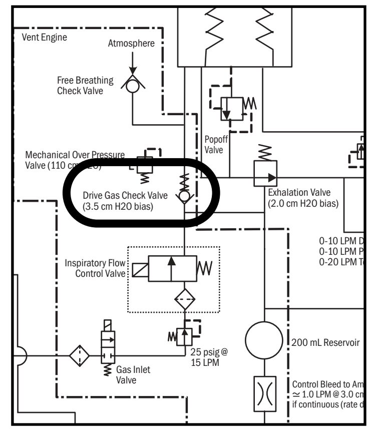


Figure 2-44 ▪ Drive Gas Check Valve

2.13.5 Bellows Pressure Relief Valve

The Bellows assembly is the interface between drive gas and patient gas in the breathing system. The pressure relief valve (or pop-off valve) in the bellows assembly (**7**) controls the pressure in the breathing circuit and exhausts excess patient gas through the exhalation valve.

The pressure relief valve is normally closed, maintaining approximately 1.5 cm H_2O in the breathing circuit in a no-flow condition, enough to keep the bellows inflated. It is piloted closed during inspiration and remains closed until the bellows is refilled during exhalation. It will exhaust ≤ 4 L/min excess fresh gas flow at ≤ 4 cm H_2O.

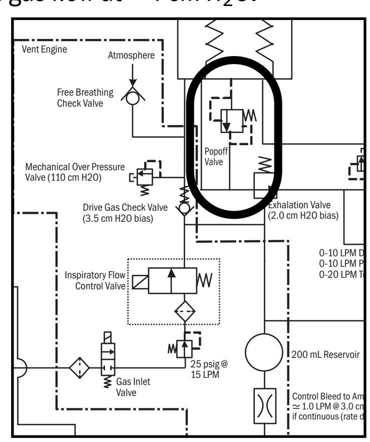


Figure 2-45 ▪ Bellows pressure relief valve

2.13.6 Exhalation valve

The exhalation valve contains an elastomeric diaphragm that is used along with the flow valve to control the pressures in the breathing circuit. The exhalation valve includes two male ports on the bottom for:

- Bellows drive gas (**8**)
- Exhalation valve pilot (**9**) - (manifold pressure)

The exhalation valve includes three ports on top that connect to the bellows base manifold:

- Drive gas pass through (**10**)
- Drive gas return and pop-off valve flow (**11**)
- APL exhaust flow to scavenging (**12**)

A port at the back of the exhalation valve (**13**) connects to the down tube that directs all the exhaust flows to the scavenging receiver.

The exhalation valve is normally open. Approximately 2 cm H_2O of pilot pressure is necessary to close the valve. When the exhalation port is open, gas flows from the bellows housing to the scavenging port.

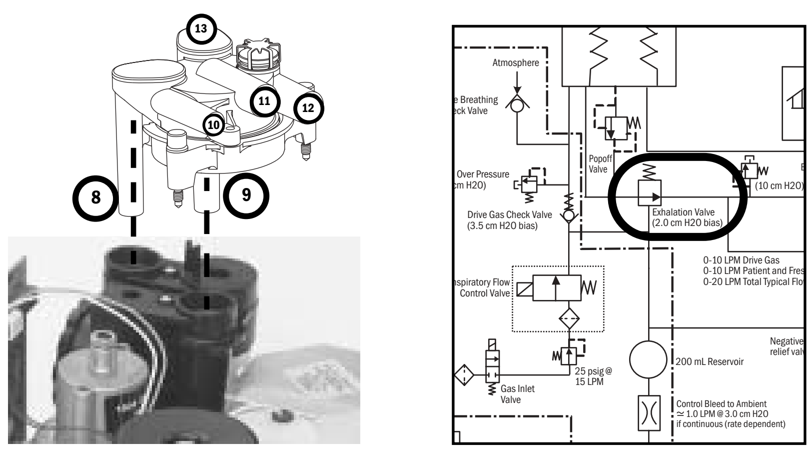


Figure 2-46 • Exhalation valve

2.13.7 Mechanical Overpressure Valve

The Mechanical Overpressure Valve (MOPV) is a mechanical valve (**14**) that operates regardless of electrical power. It functions as a third level of redundancy to the ventilator's pressure limit control functions, supplying pressure relief at approximately 110 cm H_2O.

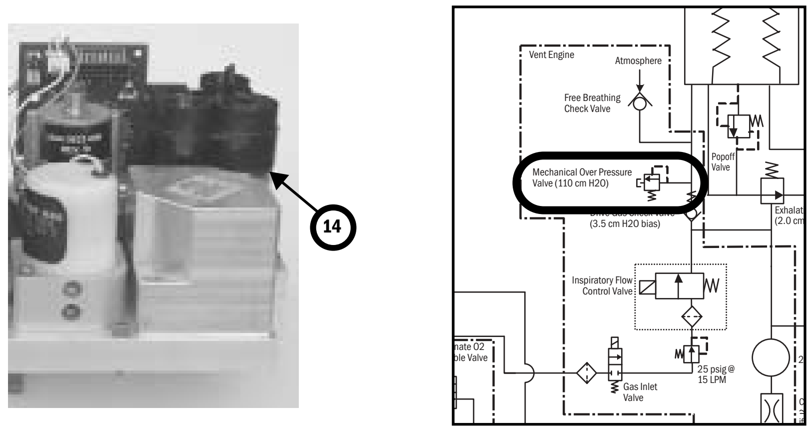


Figure 2-47 • Mechanical overpressure valve

2.13.8 Reservoir and bleed resistor

The reservoir (**15**) is a 200 ml chamber that dampens the manifold (pilot) pressure pulses to the exhalation valve.

The bleed resistor (**16**) is a “controlled leak” from 0 to 12 l/min in response to circuit pressures from 0 to 100 cm H_2O. The small quantity of pneumatic flow exhausting through the bleed resistor permits control of the exhalation valve's pilot pressure by modulation of the valve output. The bleed resistor exhausts only clean drive gas and must not be connected to a waste gas scavenging circuit. The output is routed away from the electrical components to make sure that systems using oxygen drive gas meet the 10VA limitation requirement for oxygen enrichment.

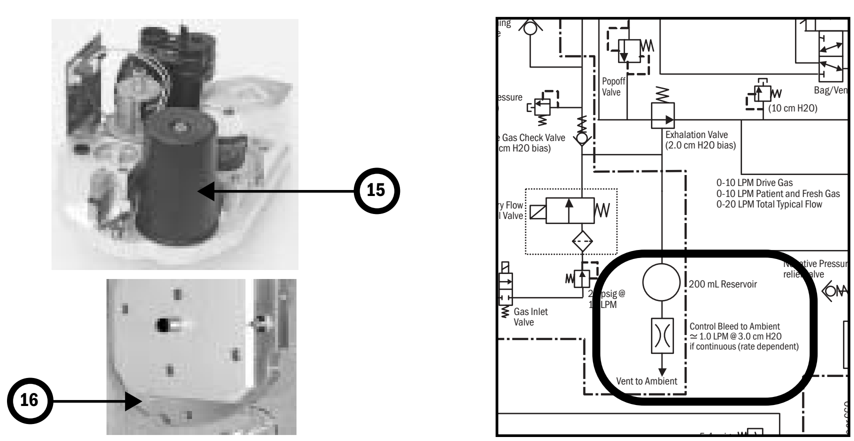


Figure 2-48 • Reservoir and bleed resistor

2.13.9 Free breathing valve

The free breathing valve (**17**) helps assure the patient can spontaneously breathe. The ventilator is programmed to supply a specified number of breaths per minute to the patient. If, in between one of these programmed cycles, the patient needs a breath (spontaneous), the free breathing valve permits the patient to inhale. The free breathing valve is closed on mechanical inspiration.

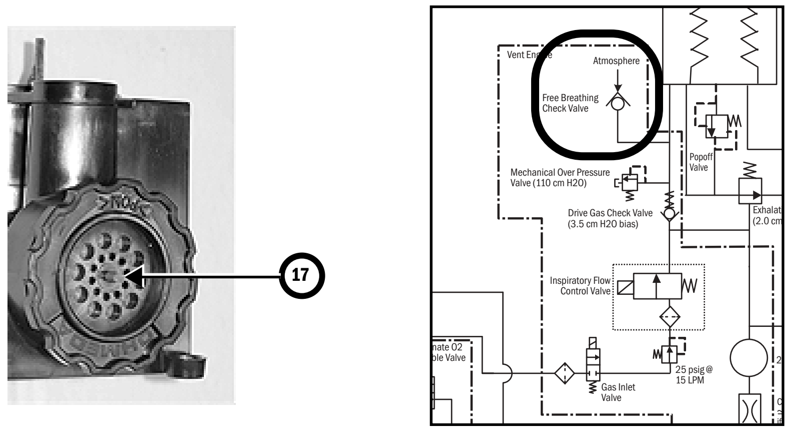


Figure 2-49 • Free breathing valve

2.13.10 Breathing circuit flow sensors

Two flow sensors are used to monitor inspiratory and expiratory gas flow. The inspiratory flow sensor is downstream of the gas system inspiratory check valve. Feedback from the inspiratory transducer is used to supply tidal volumes that make allowances for the effects of fresh gas flow and circuit compressibility. The expiratory flow sensor is located at the input to the gas system expiratory check valve. Feedback from the expiratory flow sensor is used to supply signals for expiratory tidal volume monitoring and the breath rate.

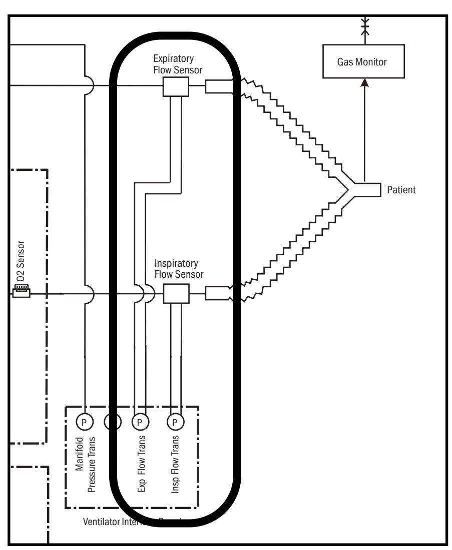


Figure 2-50 • Flow sensors

Notes

3 Checkout Procedure

In this section

⚠ WARNINGS

After any repair or service of the Aisys system, complete all tests in this section.

Before you do the tests in this section:

- Complete all necessary calibrations and subassembly tests. Refer to the individual procedures for a list of necessary calibrations.
- Completely reassemble the system.

If a test failure occurs, make appropriate repairs and test for correct operation.

3.1 Inspect the system

⚠ **CAUTION** The upper shelf weight limit is 45 kg (100 lb).

⚠ **WARNING** Do not leave gas cylinder valves open if the pipeline supply is in use. Cylinder supplies could be depleted, leaving an insufficient reserve supply in case of pipeline failure.

Before testing the system, ensure that:

- The equipment is not damaged.
- Components are correctly attached.
- The breathing circuit is correctly connected, not damaged.
- Pipeline gas supplies are connected.
- Cylinder valves are closed.
- Models with cylinder supplies have a cylinder wrench attached to the system.
- Models with cylinder supplies have a reserve supply of O_2 connected to the machine during system checkout.
- The casters are not loose and the brakes are set and prevent movement.
- The power cord is connected to a wall outlet. The mains indicator comes on when AC Power is connected.

3.2 System checkout

3.2.1 Leak < 250 ml

The ***Leak < 250 ml*** setting is used during the circuit leak check portion of the checkout procedures. This check tests for leaks in the machine, breathing circuit, patient circuit, and manual bag. The default setting is ***No***.

Note Extraction of gas by external gas monitors may cause failure of the leak checks during tests.

When No is selected, the leak test will pass for leaks below 250 ml at 3 kPa (30 cmH_2O) pressure with no user interaction required. For leaks between 250 ml and 750 ml, the user can fix the leak and rerun the test or accept the leak and continue. For leaks above 750 ml, the test will fail and the user must fix the leak and rerun the test.

Set to ***Yes*** to measure small leaks above 100 ml during the checkout procedures. Selecting ***Yes*** will display the measured leak at 3 kPa (30 cmH_2O) pressure and result in the test taking somewhat longer.

3.2.2 Machine Check

The machine check runs automatically and beeps to indicate when it is finished or if interaction is required.

The ***Machine Check*** does a ***Machine Check - System*** check, ***Machine Check- Circuit*** check, and a ***Machine Check - Circuit O2*** cell check (if circuit O_2 cell is present). When one of the checks is completed, the next check begins.

1. Turn the System switch to On.
2. Select ***Machine Check*** and follow the instructions.
3. If a check fails, follow the instructions to perform a recheck or accept the results.

3.2.3 Machine Check - System

The ***Machine Check-System*** checks the Bag/Vent switch, proper gas supply pressures, ventilator operation and leak, battery and electrical power, circuit compliance, flow control operation, and vaporizer operation. This is a two-step check.

Note The ***Machine Check-System*** can be run with a test cassette to invoke extended diagnostics (Agent Delivery test will take several minutes longer).

1. Set the Bag/Vent switch to Vent.
2. Open the patient Y.
3. (ACGO option only.) Set the ACGO switch to Circle.
4. Select ***Start***. The display shows the checks being run.
   - The system beeps when this portion of the check is done.
   - The results are shown on the display.
5. Make sure the bellows is fully collapsed.
6. Occlude the patient Y.
7. Select ***Continue***. The display shows the checks being run.
8. When the check passes, the system will transition to the next step.

3.2.4 Machine Check - Circuit

The ***Machine Check-Circuit*** checks the Bag/Vent switch, proper gas supply pressures, airway pressure measurement transducer, APL valve, and manual circuit leak.

1. Occlude patient Y.
2. Set Bag/Vent switch to Bag.
3. Set the APL valve halfway between 30 and 70.
4. (ACGO option only.) Set the ACGO switch to Circle.
5. Select ***Start***. The display shows the checks being run.
   - The system beeps when the check is done.
   - The results are shown on the display.
6. When the check passes, the system will transition to the next step.

3.2.5 Machine Check - Circuit O2

The ***Machine Check-Circuit O2*** check measures the O_2%.

1. Open the patient Y.
2. Set the Bag/Vent switch to Vent.
3. (ACGO option only.) Set the ACGO switch to Circle.
4. The display will show the O_2%. Do not select ***Done*** when 21 is first displayed. Allow the reading to stabilize, then select ***Done***. Calibrate the O_2 cell if necessary.

3.3 Individual Checks

Individual checks allow you to perform any combination of single checks. These checks are helpful if there is a specific problem/alarm and you want to test only that portion of the system.

The checks do not automatically move on to the next check. After completing a check, do another check or start a case. All of the checks must be performed at least once within every 24-hour period. If a check fails, follow the instructions to perform a recheck or accept the results.

3.3.1 System

The ***System*** check checks the Bag/Vent switch, proper gas supply pressures, ventilator operation and leak, battery and electrical power, circuit compliance, flow control operation, and vaporizer operation. This is a two-step check.

1. Set the Bag/Vent switch to Vent.
2. Open the patient Y.
3. (ACGO option only.) Set the ACGO switch to Circle.
4. Select ***Start***. The display shows the checks being run.
   - The system beeps when this portion of the check is done.
   - The results are shown on the display.
5. Make sure the bellows is fully collapsed.
6. Occlude the patient Y.
7. Select ***Continue***. The display shows the checks being run.
8. When the check passes, select ***Back***.
9. Select another check or select ***Start Case*** to go to the ***Start Case*** menu.

3.3.2 Circuit

The ***Circuit*** check checks the Bag/Vent switch, proper gas supply pressures, airway pressure measurement transducer, APL valve, and manual circuit leak.

1. Occlude patient Y.
2. Set Bag/Vent switch to Bag.
3. Set the APL valve halfway between 30 and 70.
4. (ACGO option only.) Set the ACGO switch to Circle.
5. Select ***Start***. The display shows the checks being run.
6. When the check passes, select ***Back***.
7. Select another check or select ***Start Case*** to go to the ***Start Case*** menu.

3.3.3 Circuit O2 Cell

The ***Circuit O2 cell*** check measures the O_2%.

1. Open the patient Y.
2. Set the Bag/Vent switch to Vent.
3. (ACGO option only.) Set the ACGO switch to Circle.
4. The display will show the O_2%. Do not select ***Done*** when 21 is first displayed. Allow the reading to stabilize, then select ***Done***. Calibrate the O_2 cell if necessary.
5. Select another check or select ***Start Case*** to go to the ***Start Case*** menu.

3.3.4 Low P Leak

The positive pressure ***Low P Leak*** check measures machine leaks before the breathing system and between the gas mixer and the common gas outlet. It measures low pressure pneumatic leaks with a pass/fail limit of 50 ml.

1. Occlude the inspiratory (right-hand) port.
2. Select ***Start***.
3. The display shows the checks being run. The system beeps when the check is done.
4. Open the inspiratory port and reconnect the breathing circuit.
5. Select another check or select ***Start Case*** to go to the ***Start Case*** menu.

3.3.5 Low P Leak (machines with ACGO)

The negative low P leak check measures machine leaks before the breathing system and between the gas mixer and the common gas outlet. It measures low pressure pneumatic leaks with a pass/fail limit of 50 ml.

1. Make sure the ACGO switch is set to ACGO.
2. Attach the squeeze bulb to the ACGO outlet.
3. Squeeze (collapse) the bulb.
4. If the bulb inflates in < 30 seconds, select ***Fail***.
5. If the bulb remains collapsed, select ***Pass***.
6. Remove the squeeze bulb from the ACGO outlet.

3.3.6 Agent Delivery

The Agent Delivery Check checks the Electronic Vaporization (EV) system.

1. Insert a test cassette, connect a patient circuit, and connect scavenging.
2. Set the Bag/Vent switch to Vent.
3. (ACGO option only.) Set the ACGO switch to Circle.
4. Occlude the patient Y.
5. Select ***Start***.
6. The display shows the checks being run. The system beeps when the check is done.
7. When the check passes, select ***Back***.
8. Select another check or select ***Start Case*** to go to the ***Start Case*** menu.

3.4 Backlight test

1. Push the **Main Menu** key.
2. Select ***Calibration***.
3. Select ***Backlight Test***.
4. Select ***Start Test***.
5. The display will show the test running on light 1 and then on light 2. If the display goes completely blank or flickers during the test, one of the lights has failed.

3.5 Pipeline and cylinder tests

1. Connect the pipeline supplies one at a time and ensure that the corresponding display indicates pipeline pressure.
2. Disconnect all pipeline supplies.
   a. Open each cylinder valve.
   b. Make sure that each cylinder has sufficient pressure. If not, close the applicable cylinder valve and install a full cylinder.
3. Test the cylinder supplies for a high pressure leak. Make sure that each cylinder has sufficient pressure:
   a. If equipped, turn the auxiliary O_2 flow control fully clockwise (no flow).
   b. If equipped, turn off venturi derived suction.
   c. Open each cylinder.
   d. Record the cylinder pressure.
   e. Close each cylinder valve.
   f. Record the cylinder pressure after one minute. If the pressure decreases more than indicated below, there is a leak.

      690 kPa (100 psig) for all gases.

      If a cylinder supply fails this test, install a new cylinder gasket and do this step again.
4. Close all cylinder valves.

⚠ **WARNING** Do not leave gas cylinder valves open if the pipeline supply is in use. Cylinder supplies could be depleted, leaving an insufficient reserve supply in case of pipeline failure.

3.5.1 O_2 supply alarm test

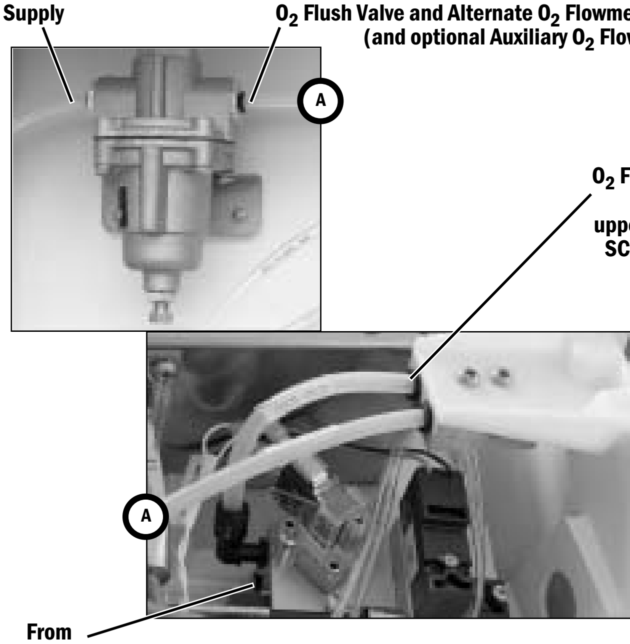
1. Establish O_2, Air, and (if equipped) N_2O gas supplies.
2. Set O_2 to 25% and (if equipped) N_2O as balance gas. For machines without N_2O, set Air as balance gas.
3. Set total flow to 3 L/min.
4. Stop the O_2 supply. (Disconnect the pipeline supply or close the cylinder valve.)
5. Make sure that:
   a. The low "O_2 supply pressure low" alarm occurs.
   b. The N_2O (if equipped) and O_2 flows stop.
   c. Air (if selected) flow continues or an Air selection prompt appears.

3.6 Flush Flow Test

1. With Bag/Vent switch in Bag, verify case has ended.
2. Set the Bag/Vent switch to Vent.
3. Attach a patient circuit and plug the patient port.
4. For ACGO equipped machines, set the ACGO selector switch to ABS (Circle).
5. Ensure that the bellows is completely collapsed.
6. Measure the amount of time it takes to fill the bellows when the O_2 Flush button is fully and continuously depressed.
7. Repeat the above measurement two more times (deflate bellows by removing the plug from the patient port).
   - The bellows should fill in 1.8 to 2.3 seconds.

Possible Causes of Failure

- Large leak (if long filling time).
- Flush regulator setting (Section 5.2).
- Flush regulator cross-connection (if long filling time).
- SCGO/ACGO selector valve inlet cross-connection (if short filling time).



3.7 Alarm tests

NOTE: If an Airway Gas Module is installed, ***FiO2*** readings are taken from the module instead of the O_2 sensor in the breathing circuit. When using an Airway Gas Module, a sample line must be connected to the patient circuit for testing the O_2 alarms.

1. Connect a test lung to the patient connection.
2. Start a case.
3. Set the Bag/Vent switch to Vent.
4. Set the O_2 concentration to 30%, and allow the O_2 reading to stabilize.
5. Test the O_2 alarms:
   - Set the ***FiO2 low*** alarm limit to 50%. Make sure an ***FiO2 low*** alarm occurs.
   - Set the ***FiO2 low*** alarm limit back to 21% and make sure that the ***FiO2 low*** alarm cancels.
   - Set the ***FiO2 high*** alarm limit to 50%.
   - Push and hold the O_2 flush button.
   - Make sure the ***FiO2 high*** alarm occurs.
   - Release the O_2 flush button.
   - Set the ***FiO2 high*** alarm limit back to 100%. Make sure that the ***FiO2 high*** alarm cancels.
6. Test the ***MVexp low*** alarm:
   - Go to the ***Alarm Setup*** menu.
   - Set the ***MV low*** alarm limit to greater than the measured minute volume.
   - Make sure that a ***MVexp low*** alarm occurs.
   - Set the ***MV low*** alarm limit to off.
7. Test the ***Ppeak high*** alarm:
   - Set the ***Pmax*** to less than the peak airway pressure.
   - Make sure that the ***Ppeak high*** alarm occurs.
   - Set the ***Pmax*** to the desired level.
8. Test the ***PEEP high. Blockage?*** alarm:
   - Close the APL valve.
   - Set the Bag/Vent switch to Bag. Mechanical ventilation stops.
   - Block the patient connection and push the O_2 flush button.
   - Make sure that the ***PEEP high. Blockage?*** alarm occurs after approximately 15 seconds.
9. Test the ***Apnea*** and ***Ppeak low. Leak?*** alarms:
   - Unblock the patient connection.
   - Set the Bag/Vent switch to Vent.
   - Set the tidal volume and total flow to minimum.
   - Other alarms such as ***MVexp low*** can occur.
   - Make sure that the ***Apnea*** and ***Ppeak low. Leak?*** alarms occur.
10. Set all alarm limits to approved clinical values.

3.8 Alternate O_2 flowmeter tests

1. Open the O_2 cylinder valve or connect an O_2 pipeline.
2. Rotate the Alt O_2 flow control fully clockwise to minimum flow.
3. Press the Alternate O_2 switch to turn on Alternate O_2 flow.
   The flowmeter should indicate 0.5 to 0.7 L/min.
4. Rotate the flow control counterclockwise (increase). The ball should rise immediately after rotation is begun. It should rise smoothly and steadily with continued counterclockwise rotation. When a desired flow is set, the ball should maintain in a steady position.
5. Rotate the flow control clockwise to minimum flow.
6. Press the Alternate O_2 switch to turn off Alternate O_2 flow; confirm yes.

3.9 Auxiliary O_2 flowmeter tests

1. Open the O_2 cylinder valve or connect an O_2 pipeline.
2. Rotate the flow control clockwise (decrease) to shut off the flow. The ball should rest at the bottom of the flow tube and not move.
3. Rotate the flow control counterclockwise (increase). The ball should rise immediately after rotation is begun. It should rise smoothly and steadily with continued counterclockwise rotation. When a desired flow is set, the ball should maintain in a steady position.
4. Occlude the auxiliary O_2 outlet. The ball should rest at the bottom of the flow tube and not move. A ball that does not rest at the bottom of the flow tube indicates a leak and requires service.
5. Rotate the flow control clockwise to shut off the flow.

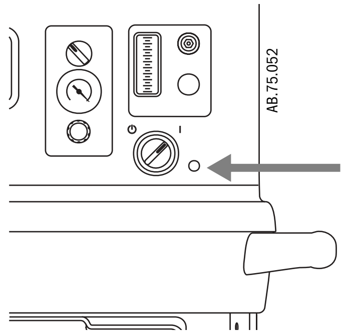
3.10 Integrated Suction Regulator tests

The gauge needle should come to rest within the zero range bracket when no suction is being supplied. Gauges which do not comply may be out of calibration.

1. Adjust the regulator setting to minimum.
2. Turn the mode selector to I (On).
3. Ensure the gauge remains less than 200 mmHg (26 kPa, 0.26 Bar).
4. Occlude the inlet.
5. Ensure the gauge remains less than 200 mmHg (26 kPa, 0.26 Bar).
6. Adjust the regulator in an increasing vacuum level.
7. The gauge should rise after rotation has begun. The gauge should rise with continued rotation of the regulator adjustment.
8. Adjust the regulator setting to minimum.
9. Turn the Mode selector to O (Off).

3.11 Power failure test

1. Connect the power cord to a wall outlet. The mains indicator on the front panel comes on when AC Power is connected.



2. Set the system switch to On and Start a case.
3. Unplug the power cord with the system turned on.
4. Make sure that the power failure alarm comes on.
5. Make sure the following message is displayed:
   - Plug in power cable. On battery
6. Connect the power cable again.
7. Make sure the alarm cancels.

3.12 Electrical safety tests

Make sure the system is completely assembled and all accessory devices are connected to electrical outlets.

1. Connect an approved test device (e.g. UL, CSA, or AAMI) and verify that the leakage current is less than:

Voltage	**Max. Leakage Current**
120/100 Vac	300 μAmps
220/240 Vac	500 μAmps

2. Make sure that the resistance to ground is less than 0.2Ω between an exposed metal surface and the ground pin on the power cord.

Notes

4 Install/Service Menus

In this section

4.1 Service and Installation menu structure

This section describes the Service level functions that are part of the main software installed in the anesthesia machine.

Section 8, "*Service Diagnostics and Software Download*," covers a separate service application that loads from a PCMCIA card and is used to download system software and run service diagnostics and other service tests.

Menu structure

The Service menu structure has three levels which are password protected:

- Install/Service (super-user)
- Installation
- Service

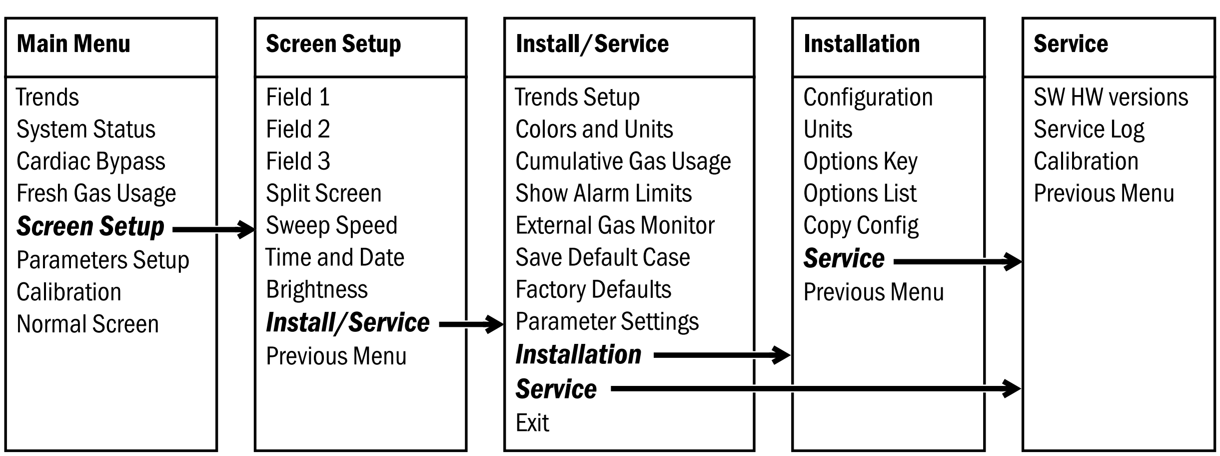
The **Install/Service** level (super-user password) supports standard hospital preferences: choosing units; setting ventilator, alarm, and gas delivery defaults.

The **Installation** level requires the service password and supports language, gas color codes, flow tube position, country, hardware flags for system components (acgo or scgo etc.), enabling software options, and cloning a system.

The **Service** level requires the service password and supports diagnostic tools and automated component tests.

Follow the menu structure to access the various service screens:

- on the **Main Menu**, select **Screen Setup**;
- on the **Screen Setup** menu, select **Install/Service** to access the Install/Service (with super-user password) menu;
- on the **Install/Service** menu, select **Installation** (with service password) to access the Installation menu.
- to access the Service menu, select **Service** (with service password) on the **Install/Service** menu; or, from the **Installation** menu, select **Service** to access the same Service menu without having to enter the service password.



4.2 Install/Service Menu (Super User)

Use the super-user password to access the Install/Service menu: "16-4-34."

Menu Item	Message text	Comments
Trends Setup	Configure graphical trend pages.	
Colors and Units	Set colors and units of parameters.	Refer to section 4.2.1
Cumulative Gas Usage	View total usage of fresh gases since last reset.	
Show Alarm Limits	Select yes to show alarm limits in digit fields.	Default is Yes.
External Gas Monitor	Yes disables O2 limit alarms, the "No O2 sensor alarm", and the "No CO2 or AA monitor" alarm.	Default is No. Select yes only if sys is using external monitor for O2, AA, and CO2.
Save Default Case	Save normal screen, air/ N2O, circuit type, ventilator, and alarm settings from the last case as defaults	Last used alarm settings (including hide/ show alarm limits, Auto MV Limit, alarm volume), screen layout (middle waveform selection, sweep speed), ventilator mode and setting, balance gas, and start case gas outlet selection are saved as facility defaults. **Note:** The Pmax alarm limit shall not be saved higher than 40 cmH2O. The low FiO2 alarm limit shall not be saved lower than 21%.
Factory Defaults	Return to default factory settings. After selecting Factory Defaults: "Reset machine for defaults to take effect."	Action: All facility defaults get replaced with factory defaults. Super User settings also get set to Factory Defaults. No Service level configuration settings are changed.
Parameter Settings	Set volume conditions and CO2 humidity compensation.	
Installation	Set language, gas colors, hardware, and install options.	Navigate with password to Installation menu. Password is "26-23-8"
Service	Show technical data for troubleshooting and calibration.	Navigate with password to Service menu. Password is "26-23-8"
Exit	Turn power off to exit the service and super user menus.	

4.2.1 Trends Setup

Menu Item	Message text	Values
Default Trend	Change default trend type: graphical, numerical, or settings.	Num (default), Graph, or Set
Graphical Trends	Configure graphical trend pages.	
Previous Menu	Return to previous menu.	

Graphical Trends

Menu Item	Message text	Values
Page 1 (Page 2 to Page 5)	Configure first graphical trend page (second, third, fourth, fifth)	
Previous Menu	Return to previous menu.	

Page Menus

<table>
<tr><th>Menu Item</th><th>Options</th><th>Page 1 Default</th><th>Page 2 Default</th><th>Page 3 Default</th><th>Page 4 Default</th><th>Page 5 Default</th></tr>
<tr><td>Field 1</td><td rowspan="4">Off—Select Off to clear trend field
rr+co2—respiration rate and CO2
Pres—Ppeak, Pplat, and PEEP
MVexp—expired minute volume
CO2—CO2
O2—oxygen
Bal—balance gas
AA1—current anesthetic
AA2—previous anesthetic agent if used
N2O—N2O
MAC—minimum alveolar concentration
TVexp—tidal volume and respiratory rate
Pmean—Pmean
Spont—spontaneous MVexp and respiration rate
Compl—compliance and Raw</td><td>Pres</td><td>O2</td><td>AA2</td><td>Bal</td><td>rr+CO2</td></tr>
<tr><td>Field 2</td><td>TVexp</td><td>N2O</td><td>N2O</td><td>MAC</td><td>Compl</td></tr>
<tr><td>Field 3</td><td>CO2</td><td>AA1</td><td>MAC</td><td>MVexp</td><td>Off</td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>Previous Menu</td><td>Return to previous menu.</td><td colspan="5"></td></tr>
</table>

4.2.2 Colors and Units Menu

The Units menu can be accessed here in the super-user level to change individual preferences, or if required during installation, in the service level Installation menu.

Menu Item	**Message text**	**Values**
Colors	Set colors of parameters.	
Weight	Change weight unit: kg or lb.	kg or lb
CO2	Change CO2 unit: %, kPa, or mmHg.	%, kPa, or mmHg;
Gas Supply Pressure	Change gas supply pressure unit: kPa, psi, or bar.	psi, kPa, or bar
Paw	Change Paw unit: kPa, hPa, cmH2O, mmHg, mbar.	kPa, hPa, cmH2O, mmHg, or mbar
Previous Menu	Return to previous menu.	

Colors Menu

Menu Item	Message text	Values
Paw	Change color of Paw waveform, digits and trend.	Yellow, White, Green, Red, or Blue
Flow	Change color of Flow waveform, Flow and Volume digits and trends.	Yellow, White, Green, Red, or Blue
Resp	Change color of respiration, digits and trend.	Yellow, White, Green, Red, or Blue
CO2	Change color of CO2 waveform, digits and trend.	Yellow, White, Green, Red, or Blue
Previous Menu	Return to previous menu.	

4.2.3 Cumulative Usage

Gas and agent cumulative usage data is store in non-volatile RAM.

Menu Item	Message text	Values
Reset Usage	Push ComWheel to set cumulative fresh gas totals to zero.	Date of last reset.
Desflurane		ml
Enflurane		ml
Halothane		ml
Isoflurane		ml
Sevoflurane		ml
O2 (*1000 l)		l
Air (*1000 l)		l
Previous Menu	Return to previous menu.	

4.2.4 Factory Defaults

The following table lists the factory defaults for parameters and alarm limits:

Parameter	Value
Vent Mode	VCV
TV (tidal volume)	500 ml
Pinsp	5 cmH_2O (5 hPa, 0.5 kPa, 5 mbar, 4.0 mmHg)
RR	12 /min
Mech RR	12 /min
Tinsp	1.70
I:E	1:2.0
Trig. Window	25%
Flow Trig.	2 l/min
End Breath	30%
Psupport	Off
PEEP	Off
Tpause	Off
Backup Time	30 s
O_2%	100%
Balance Gas	Air
Circuit	Circle
Gas Outlet installed	SCGO
Paw Color	Yellow
Flow Color	Green
Resp Color	White
CO_2 Color	White
Paw Units	cmH_2O
Weight Units	kg
Temperature Units	C
CO_2 Units	%
Altitude	300 m
Gas Supply Pressure Units	kPa
Decimal marker	. <dot>
Language	English
Gas Supply Colors	ISO (O_2 = white, N_2O = blue, Air = blk/wht)
O_2 flow tube	Right side
Vent drive gas	O_2
PSV Pro	Enabled
SIMV/PSV	Enabled
PCV	Enabled
SIMV-PC	Enabled
N_2O enabled	No
Spirometry Source	Vent
Patient/Sensor Type	Adult
Auto MV Limit	Off
Alarm Volume	3

Alarm Limit	Value
Pmax High	40 cmH_2O (40 hPa, 4 kPa, 40 mbar, 30 mmHg)
MV High	10 l/min
MV Low	2 l/min
TV High	1000 ml
TV Low	Off
RR High	Off
RR Low	Off
Et CO_2 High	8.0% (60 mmHg or 8.0 kPa)
Et CO_2 Low	3.0% (23 mmHg or 2.0 kPa)
Fi CO_2 High	Off
Fi O_2High	Off
Fi O_2 Low	21%
EtO_2 High	Off
EtO_2 Low	Off
Fi Iso High	5%
Fi Iso Low	Off
Et Iso High	Off
Et Iso Low	Off
Fi Sev High	8%
Fi Sev Low	Off
Et Sev High	Off
Et Sev Low	Off
Fi Des High	15%
Fi Des Low	Off
Et Des High	Off
Et Des Low	Off
Fi Enf High	5%
Fi Enf Low	Off
Et Enf High	Off
Et Enf Low	Off
Fi Hal High	5%
FI Hal Low	Off
Et Hal High	Off
Et Hal Low	Off

4.2.5 Parameter Settings

Menu Item	Message text	Values
TV Based on	Change volume calculation conditions: ATPD or BTPS.	ATPD - default (Ambient temperature and pressure, dry humidity condition) BTPS (Body temperature, ambient pressure, saturated humidity condition)
CO2 Numbers	Change humidity compensation type in CO2 partial pressure values.	Dry - default Wet
Previous Menu	Return to previous menu.	

4.3 Installation Menu

Use the service-level password to access the Installation menu: "26-23-8."

Whenever the installation menu is entered, "Enter Service dd-mmm-yyyy hh:mm:ss" is recorded in the Event log.

Menu Item	Message text
Configuration	Set language, gas color code, and O2 flowmeter position.
Units	Set units.
Options Key	Enable software options.
Options List	Display software options.
Copy Config	Normal Message "Save or install configuration and default settings using memory card." Blocked Message "Please insert memory card."
Service	Show error, event, and alarm logs. (Accessing the Service menu from the Installation menu does not require second use of service password.)
Previous Menu	Return to previous menu.

Configuration	**Configuration Units**	**Options Key**	**Options List**	**Copy Configuration**
Decimal Marker	Weight	Current Key	Available Options	Save to Card
Language	CO2	Entry 1	SIMV/PSV	Copy from Card
Gas supply Colors	Gas Supply Pressure	Entry 2	PCV	
O2 Flowtube	Paw	Entry 3	PSV Pro	
Ventilator Drive Gas		Entry 4		
Altitude		Entry 5		
Gas Outlet		Entry 6		
N2O Enabled		Entry 7		
		Save New Key		
		Control Board ID		

4.3.1 Configuration

Menu Item	Message text	Values	Comments
Decimal Marker	Select decimal delineator.	0.01, 0 01 or 0,01	
Language	Change language translation of screen texts.	Chinese (simplified) Czech Danish Dutch English Finnish French German Greek Hungarian Italian Japanese Norwegian Polish Portuguese Russian Spanish Swedish Turkish	Default: English
Gas supply Colors	Change color of O2, N2O, and Air.	ANSI, ISO, Neutral	ANSI: O2 green, Air yellow, N2O blue; ISO: O2 white, Air black/white, N2O blue; Neutral: All gases white.
O2 Flowtube	O2 on left or right-hand side.	Left, Right	
Ventilator Drive Gas	Change drive gas to match machine configuration.	Air, O2	
Altitude	Change altitude used for gas calculations.	–400 to 3000 m in 100-m increments	
Gas Outlet*	Change type of fresh gas outlet.	SCGO, ACGO	SCGO: Use insp port. ACGO: Use auxiliary port.
N2O Enabled	Change to match machine configuration.	Yes; No	

* For machines without a separate auxiliary common gas outlet and selector switch, set ***Gas Outlet*** to SCGO: Selectable Common Gas Outlet.

* For machines with an external auxiliary common gas outlet and selector switch, set ***Gas Outlet*** to ACGO: Auxiliary Common Gas Outlet

4.3.2 Configuration Units

This is the same menu that is accessible from the super-user Install/Service menu.

Menu Item	Message text	Values
Weight	Change weight unit: kg or lb.	kg or lb
CO2	Change CO2 unit: %, kPa, or mmHg.	%, kPa, or mmHg
Gas Supply Pressure	Change gas supply pressure unit: kPa, psi, or bar.	psi, kPa, bar
Paw	Change Paw unit: kPa, hPa, cmH2O, mmHg, mbar.	kPa, hPa, cmH2O, mmHg, or mbar

4.3.3 Options Key

The Options Key menu is used to configure the software to include the features that the customer has purchased. The included features are shown in the Options List menu.

Options Key menu

Menu Item	Message text	Values
Current Key	Enter key code to enable options.	XXXAXBC
Entry 1	Enter first entry of key-code.	0 to 9, A to Z, ~, !, @, #, $, %, ^, *, (,), ?
Entry 2	Enter second entry of key-code.	
Entry 3	Enter third entry of key-code.	
Entry 4	Enter fourth entry of key-code.	
Entry 5	Enter fifth entry of key-code.	
Entry 6	Enter sixth entry of key-code.	
Entry 7	Enter seventh entry of key-code.	
Save New Key	Confirm entries for key-code.	
Control Board ID	Control number used by key-code.	XXX

When options are added, “Add <option> dd-MMM-yyy hh:mm:ss” is written to the event log.

If more than one option is added, each option is be listed separately.

Options List menu The options list shows which options are enabled.

Menu Item	Message text	Values
Available Options		
SIMV/PSV	SIMV vent w/pressure support.	On, Off
PCV	Pressure controlled ventilation.	On, Off
PSV Pro	Pressure support ventilation w/backup.	On, Off

4.3.4 Copy Configuration

Copy Configuration menu

Menu Item	Message text	Values	Comments
Save to Card	Save Configuration and defaults to card.	<blank>, Fail, or OK. The field is blank until the data has either been written to the card (OK) or the system determines it cannot write to the card (Fail).	Saves all settings that are not hardware dependent, including facility defaults, colors, units, O2 flow tube position, decimal marker, and altitude.
Copy from Card	Copy Configuration and defaults from card. When completed: Copy from card complete. Please reboot system.	<blank>, Fail, or OK. The field is blank until the data has either been read from the card (OK) or the system determines it cannot read the card or the card does not have the required data (Fail).	

Systems cannot accept configuration files from a different product model.

The software version is stored with the saved configuration. A system will reject any configurations from other than the current version of software.

Selecting Save to Card overwrites any configuration on the card.

4.4 Service Menu

Use the service-level password to access the Service menu: "26-23-8."

Whenever service menu is entered, "Enter Service dd-mmm-yyyy hh:mm:ss" is recorded in the Event log.

Menu Item	Message text
SW HW versions	Scroll through system information.
Service Log	Show error, event, and alarm histories.
Calibration	Push ComWheel to perform service calibrations.
Previous Menu	Return to previous menu.

SW HW Versions
Total Time: Software Release: Model Code: Machine Serial Number: Option Package: Option Code: Anes Hardware . . . Disp Hardware . . . Mixer Hardware . . . Vent Hardware . . . Power Hardware . . . MGas Hardware . . . Electronic Vaporizer . . .

Service Log Menu
Scroll Recent Error History Event History Alarm History Copy Logs Reset Logs Previous Menu

Calibration
Instructions Spiro Cal User Calibration Manifold P Span Insp Flow Zero Insp Flow Valve Bleed Resistor Paw Span Zero Gas Xducer Cal Config Mixer P Zero Previous Menu

4.4.1 Software/ Hardware Ver Menu

Turn the ComWheel to scroll through the list box.

Push the ComWheel to return to the Service menu.

System Information menu

List box text with X=Number, A, B, C = letter
Total Time: XXXXX (Minutes)
Software Release: XX.XX
Model Code: XXX
Machine Serial Number: ABCDXXXXX
Option Package: XXX
Options Code: XXXXX
Anes Software Version: XX.XX
Anes Hardware Version: XXXX-XXXX-XXX REV A
Anes Board Serial Number: ABCXXXXX
Disp Software Version: XX.XX
Disp BIOS Ver: XX.XX
Disp Hardware Version: XXXX-XXXX-XXX REV A
Disp Hardware Serial Number: ABCXXXXX
Mixer Software Version: XX.XX
Mixer Hardware Version: XXXX-XXXX-XXX REV A
Mixer Board Serial Number: ABCXXXXX
Mixer O2 Flow Sensor Serial Number: XXXXXXXXX
Mixer Balance Gas Flow Sensor Serial Number: XXXXXXXXX
Vent Software Version: XX.XX
Vent Hardware Version: XXXX-XXXX-XXX REV A
Vent Intf Board Serial Number: ABCXXXXX
Power Software Version: XX.XX
Power Hardware Version: XXXX-XXXX-XXX REV A
Power Board Serial Number: ABCXXXXX
MGas Software Version: X.X
MGas Hardware Version: <module type>
MGas Hardware Serial Number: XXXXXXXX
Elec Vap Software Version: XX.XX
EVap Agt Dlv Hardware Version: XXXX-XXXX-XXX RR CCC
EVap Agt Dlv Board Serial Number: XXXXXXXX
EVap Flowmeter Hardware Version: XXXX-XXXX-XXX RR CCC
EVap Flowmeter Serial Number: XXXXXXXX
EVap Cas Tmp Sns Hardware Version: XXXX-XXXX-XXX RR CCC
EVap Cas Tmp Sns Serial Number: XXXXXXXX

The MGas information is only displayed when an Airway module is present.

4.4.2 Service Log Menu

The Service log menu is a organized listing of stored events.

Menu Item	Message text
Scroll Recent	Scroll through newest entries.
Error History	Show error history.
Event History	Show event history.
Alarm History	Show alarm history.
Copy Logs	Copy logs to PCMCIA card. Takes about 1 minute.
Reset Logs	Erase Error and Alarm log entries
Previous Menu	Return to previous menu.

Each history log shows at the top of the screen the total “Running Hours” and the date when the logs were last reset.

Whenever logs are reset, “Reset Logs dd-MMM-yyy hh:mm:ss” is recorded in the Event log.

If the logs are saved to a memory card, the machine’s serial number is saved along with the current contents of the logs and the date and time.

Error History ◂

The Error History log lists the last 200 errors logged since the last log reset, starting with the most recent. The system stores the last 1,000 errors logged since the last log reset.

Event History ◂

The Event History log records the service history of the device. This includes: service calibrations, entry into the service mode, options enabled, and software installation. In the event of a board replacement, it is understood that this log like all others could be lost.

The Event History menu lists the last 200 events logged starting with the most recent. The Event History log stores the last 1000 events.

The Event History log cannot be reset.

Alarm History ◂

The Alarm History log lists the last 200 medium and high priority parameter alarms since the last log reset starting with the most recent. The Alarm History log store the last 1000 entries.

Copy Logs

The Copy Logs function copies Error, Event, and Alarm logs along with the software/hardware configuration to a text file on a PCMCIA card. The copying takes about one minute.

4.5 Calibration

For step-by-step instruction, refer to Section 5.

Menu Item	Message text
Instructions	These values are used for calibration: Ventilator drive gas - Air or O2 Altitude - XXXX m Change these values on the Cal Config menu
Spiro Cal	Calibrate gas module spirometry. Blocking message: Insert gas module with spirometry
User Calibration	Show the normal user calibration menu.
Manifold P Span	Calibrate manifold pressure transducer.
Insp Flow Zero	Zero inspiratory flow valve.
Insp Flow Valve	Calibrate inspiratory flow valve.
Bleed Resistor	Calibrate bleed resister flow.
Paw Span	Calibrate the airway pressure transducer.
Zero Gas Xducers	Calibrate the gas supply transducers.
Cal Config	Set vent drive gas and altitude.
Mixer P Zero	Zero mixer pres transducer.
Previous Menu	Return to previous menu.

4.5.1 User Calibration menu

Menu Item	Message text
Flow and Pressure	Calibrate the flow and pressure sensors.
Circuit O2 Cell	Calibrate Circuit O2 Cell.
Airway Gas	Start Gas Calibration. Calibrate CO2, O2, N2O, and agent measurements.
Backlight Test	Push ComWheel to test back lights. Test every month.
Previous Menu	Return to the previous menu.

4.5.2 Manifold P Span

The Manifold P Span instructions appear when the focus is on Manifold P Span menu item.

Instructions

Read all steps before you start:

1. Remove the breathing system, the exhalation valve, and the metal plate.
2. Put #2 plugs in the manifold and the drive gas ports of the vent engine.
3. Connect a pressure gauge in line with the manifold pressure transducer.
4. Push the ComWheel to continue.
5. Select Start Manifold P Span.
6. Increase the Flow valve setting until the gauge shows 100 cmH2O.
7. When the gauge shows 100 cmH2O, select Save Calibration.

Manifold P Span menu

Menu Item	Message text	Values/ Comments
Insp Flow Valve (DAC)	Increase setting until test gauge shows 100 cmH2O (approx 1020 counts). Then save calibration.	0 to 4095 Disabled until user selects Start Manifold P Span.
Start Manifold P Span	Start Calibration. Increase flow valve setting until test gauge = 100 cmH2O (approximately 1020 counts). Then save calibration. Blocking message: “Connect a supply of the drive gas to continue.”	Blocked when the ventilator drive gas supply pressure would cause a gas supply failure alarm during normal operation.
Save calibration	Save Manifold P Span calibration.	
Previous Menu	Return to the previous menu. During calibration: “Calibration in progress. Push ComWheel to cancel.”	

4.5.3 Insp Flow Zero

The Insp Flow Zero instructions appear when the focus is on the Insp Flow Zero menu item.

Instructions

Read all steps before you start: 1. Push the ComWheel to start the zero check 2. No disassembly is required.

- If the outcome of the calibration is Pass, the new calibration data is saved.
- If the outcome is Fail, the old calibration data is retained.
- The result of the calibration is saved to the Event Log.

Selecting Previous Menu before the calibration is done aborts the calibration in progress and keeps the old calibration constants.

Insp Flow Zero menu

Menu Item	Message text	Values
Start	If the result is failed, do the insp flow valve calibration.	Pass or Fail
Previous Menu	Return to previous menu. During Calibration: “Calibration in progress. Push ComWheel to cancel.”	

4.5.4 Inspiratory Flow Valve

The Inspiratory Flow Valve instructions appear when the focus is on the Insp Flow Valve menu item.

Instructions

Read all steps before you start:
1. Complete the Manifold P Span calibration.
2. Put #2 plugs in the manifold and the drive gas ports of the vent engine.
3. Push the ComWheel to show the next menu.
4. Select Stage 1 calibration.
5. After Pass, replace the manifold port plug with the calibration orifice.
6. Select Stage 2 calibration.
7. You MUST do both stages for the calibration to be saved.

During calibration, a separate menu shows the counts and corresponding flow at each step.

- If the outcome of both stages of the calibration is Pass, the new calibration data is saved.
- If the outcome of either stage is Fail, the old calibration data is retained.
- The results of each stage of the calibration are saved to the Event Log.

Selecting Previous Menu before the calibration is done, aborts the calibration in progress and keep the old calibration constants.

Insp Flow Valve Menu

Menu Item	Message text	Comments
Stage 1	Calibrate the insp flow valve at low flows. Blocked text: “Connect a supply of the drive gas to continue.”	Blocked if the ventilator drive gas supply pressure would cause a gas supply alarm during normal operation.
Stage 2	Calibrate the insp flow valve at high flows. Blocked text: “Stage 1 calibration is required first.”	Blocked if Stage 1 has not been completed.
Insp Flow Valve Data	Show insp flow valve calibration table.	
Previous Menu	Return to previous menu. During Calibration: “Calibration in progress. Push ComWheel to cancel.”	

Insp Flow Valve Data menu

The Insp Flow Valve Data menu contains a table of 24 entries from the previous calibration. The table is erased at the start of Stage 1. The table is updated in real time during the calibration.

4.5.5 Bleed Resistor

The Bleed Resistor instructions appear when the focus is on the Bleed Resistor menu item.

Instructions

Read all steps before you start:
1. Complete the Insp Flow Valve calibration.
2. Put #2 plugs in the manifold and the drive gas ports of the vent engine.
3. Push the ComWheel to show the next menu.
4. Select Start.

The calibration fails if the flow required to reach 91 cmH2O is > 16 l/min.

- If the outcome of the calibration is Pass, the new calibration data is saved.
- If the outcome is Fail, the old calibration data is retained.
- The result of the calibration is saved to the Event Log.

Selecting Previous Menu before the calibration is done aborts the calibration in progress and keep the old calibration constants.

Bleed Resistor Menu

Menu Item	Message text	Comments
Start	Calibrate manifold pressure to bleed resistor flow. Blocked text: “Connect a supply of the drive gas to continue.”	Blocked if the ventilator drive gas supply pressure would cause a gas supply failure alarm during normal operation.
Bleed Resistor Data	Show bleed resistor calibration table.	
Previous Menu	Return to the previous menu. During Calibration: “Calibration in progress. Push ComWheel to cancel.”	

Bleed Resistor Data menu

The Bleed Resistor Data menu contains a table of 17 entries from a previous calibration. The table is erased at the start of the calibration. The table is updated in real time during the calibration.

4.5.6 Paw Span

The Airway P Span instructions appear when the focus is on Paw Span menu item.

Instructions

Read all steps before you start:
1. Complete the Bleed Resistor calibration.
2. Install the flow sensor and circuit module
3. Put a #2 plug in the drive gas port of the vent engine.
4. Put the calibrated orifice in the manifold port of the vent engine.
5. Connect the pressure tee to the insp port. Connect the tee to the calibrated orifice with a 22 mm tube.
6. Connect a pressure gauge to the pressure tee.
7. Select Start Paw Span.
8. Increase the flow valve setting until the gauge shows 100 cmH2O.
9. Select Save Calibration

Paw Span menu

Menu Item	Message text	Values/Comments
Insp Flow Valve (DAC)	Increase setting until test gauge shows 100 cmH2O (approximately 1020 counts). Then save calibration.	0 to 4095 (initially set to 800)
Start Paw Span	Start Calibration. Increase flow valve setting until test gauge = 100 cmH2O (approximately 1020 counts). Then save calibration. Blocked text: Connect a supply of the drive gas to continue.	Blocked if the ventilator drive gas supply pressure would cause a gas supply failure alarm during normal operation.
Save calibration	Save Paw Span calibration.	Saves new calibration data. Writes calibration result, date and time to the event log.
Previous Menu	Return to the previous menu. During Calibration: “Calibration in progress. Push ComWheel to cancel.”	

4.5.7 Zero Gas Xducer

The Zero Gas Xducer instructions appear when the focus is on the Zero Gas Xducer menu item.

Instructions

Read all steps before you start: 1. Remove all cylinders. 2. Disconnect all pipeline supplies. 3. Select Zero Gas Xducers. 4. Select Start Zero on the next menu. This page also shows: • Gas supply counts • Gas supply ID

A failed test is usually the result of a pipeline or cylinder still connected to the system.

- If the outcome of the calibration is Pass, the new calibration data is saved.
- If the outcome is Fail, the old calibration data is retained.
- The result of the calibration is saved to the Event Log.

Selecting Previous Menu before the calibration is done aborts the calibration in progress and keep the old calibration constants.

Zero Gas Xducers menu

The Zero Gas Xducers menu shows only transducers that are installed, If not installed, the menu row is blank.

Menu Item	Message text	Values
O2 Pipeline		0-4095 Counts
O2 Cylinder 1		0-4095 Counts
O2 Cylinder 2		0-4095 Counts
N2O Pipeline		0-4095 Counts
N2O Cylinder		0-4095 Counts
Air Pipeline		0-4095 Counts
Air Cylinder		0-4095 Counts
Start Zero	Disconnect all pipelines and remove cylinders. Then select Start Zero.	
Previous Menu	Return to the previous menu. During Calibration: “Calibration in progress. Push ComWheel to cancel.”	

4.5.8 Cal Config

Before calibration, you must verify that the Ventilator Drive Gas and the Altitude settings are set appropriately to match the current drive gas configuration and machine location.

If you change any of the settings in the Cal Config menu, you must restart the system.

Cal Config menu

Menu Item	Message text	Values
Ventilator Drive Gas	Change drive gas to match machine configuration.	Air, O2
Altitude	Change altitude used for gas calculations.	–400 to 3000 m (in 100-m increments)

4.5.9 Mixer P Zero

The Mixer P Zero instructions appear when the focus is on the Mixer P Zero menu item.

Instructions

Back	Default	Start

To go back to factory defaults, select Defaults (above).

To Zero Pres Sensors:

1. Disconnect pipeline gas supplies.
2. Close the gas cylinders.
3. Remove the flow sensors.
4. Insert a non-Des cassette.
5. Push the O2 Flush button for 3 seconds.
6. Let the system sit WITHOUT gas flow for > 5 min.
7. Select Start.

Do not disturb the system while waiting for results.

5 Calibration

⚠ **WARNING** After adjustments and calibration are completed, always perform the checkout procedure. Refer to Section 3 of this manual.

In this section

5.1 Primary Regulators

First, follow the procedure in Section 5.1.1 to gain access to the regulators.

Then, in Section 5.1.2, select the test that is appropriate for the regulator you are testing.

⚠ WARNING When testing/adjusting N_2O regulators, nitrous oxide flows through the system. Use a safe and approved procedure to collect and remove it.

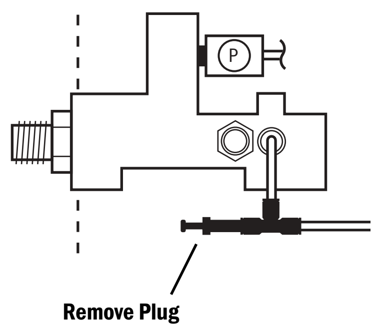
Note To test or calibrate the primary regulators, you must set the system to the Install/Service mode and use the PC based Service Application to control flow through the regulator.

5.1.1 Test setup

⚠ **WARNING** Wear safety glasses while test device is connected to the test port.

⚠ **CAUTION** Be careful not to plug the output of the primary regulator without having a pressure relief valve in the output circuit.

1. Set the system switch to Standby.
2. Disconnect all pipeline supplies.
3. Remove the upper cosmetic and rear panels (Section 9.2.1).
4. If equipped, turn the auxiliary O_2 flowmeter control fully clockwise (no flow).
5. Install a full cylinder in the cylinder supply to be tested. It is essential that the cylinder be within 10% of its full pressure.
6. Remove the plug from the test port at the pipeline inlet manifold and connect a test device capable of measuring 689 kPa (100 psi).



5.1.2 Testing Primary Regulators

There are two variations of the test procedure for the primary regulators:

- Test A — For primary regulators that supply drive gas to the ventilator.
- Test B — For all gases not used to supply drive gas to the ventilator.

Test A **For primary regulators that supply drive gas to the ventilator (O_2 or Air):**

Under low flow conditions, the output pressure of a properly adjusted/ functioning regulator should fall within specifications listed in step 5d.

Under high flow conditions, the output pressure should not drop below the specifications listed in step 6f.

1. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
2. If required,
   - set ***Gas Delivery Mode*** to ***Fresh Gas***.
   - set ***Balance Gas*** to ***Air***.
3. Adjust the ***O2 Concentration*** so that 100% of the gas flow will be through the regulator being tested (100% for O_2; 0% for Air).
4. Slowly open the cylinder valve for the regulator being tested and observe the pressure reading for the cylinder.
5. **Low Flow Test:**
   a. Set ***Total Flow*** of the tested gas to 0.5 l/min.
   b. Close the cylinder valve and allow the pressure to decay to 2068 kPa (300 psi) as indicated on the cylinder pressure display.
   c. At the time that the cylinder pressure reaches 2068 kPa (300 psi), set ***Total Flow*** to 0.00 l/min to turn off gas flow.
   d. Within one minute, the test device reading must stabilize between:

      (60) DIN 372–400 kPa (54–58 psi)

      (50) Pin Indexed 310–341 kPa (45.0–49.5 psi).

      - If the test device pressure does not stabilize within one minute, replace the cylinder supply.
      - If the test device stabilizes within one minute, but the readings are not within specifications, readjust the regulator (Section 5.1.3).

6. **High Flow Test:**
   a. Slowly open the cylinder valve.
   b. Remove the ABS breathing system from the machine to allow continuous Insp Valve flow through the exhalation valve.
   c. Access the Ventilation Schematic (Section 12.2.3) of the Service Application.
   d. Set ***Gas Inlet Valve*** to ***On***.
   e. Adjust the ***Insp Flow Valve*** counts until the inspiratory flow value on the schematic reads approximately 65 l/min.
   f. While watching the test device, toggle the Gas Inlet Valve several times (Off, On, Off):
      - The minimum test device reading observed must be greater than:
        (60) DIN 221 kPa (32 psi)
        (50) Pin Indexed 207 kPa (30 psi)
      - Repeat this step (6f) three times.

   If the test device reading under "high flow" conditions is less than specified, readjust the regulator per the procedure in Section 5.1.3; however, set the regulated pressure higher by the difference you noted in this step plus 7 kPa (1 psi). This adjusts the "low flow" regulated output to the high side of the specification so that the "high flow" regulated pressure can fall within the specification.

   If the regulator subsequently fails the "low flow" specification (step 5d) because the reading is too high, replace the cylinder supply.

7. Set the system switch to Standby.
8. Close the cylinder valve.
9. Bleed the system of all pressure.
10. Disconnect the test device and plug the test port (pull on the plug to ensure it is locked in the fitting).
11. Replace the ABS breathing system.
12. Replace the rear panel.
13. Perform the checkout procedure (Section 3).

Test B **For all gases not used to supply drive gas to the ventilator:**

Under low flow conditions, the output pressure of a properly adjusted/functioning regulator should fall within specifications listed in step 5d.

Under high flow conditions, the output pressure should not drop below the specifications in step 6a.

1. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
2. If required,
   - set ***Gas Delivery Mode*** to ***Fresh Gas***.
   - set ***Balance Gas*** to ***Air*** (for O_2 or Air) or ***N2O***.
3. Adjust the ***O2 Concentration*** so that 100% of the gas flow will be through the regulator being tested (100% for O_2; 0% for Air or N_2O).
4. Slowly open the cylinder valve for the regulator being tested and observe the pressure reading for the cylinder.
5. **Low Flow Test:**
   a. Set ***Total Flow*** of the tested gas to 0.5 l/min.
   b. Close the cylinder valve and allow the pressure to decay to 2068 kPa (300 psi) as indicated on the cylinder pressure display.
   c. At the time that the cylinder pressure reaches 2068 kPa (300 psi), set ***Total Flow*** to 0.00 l/min to turn off gas flow.
   d. Within one minute, the test device reading must stabilize between:

      (60) DIN 372–400 kPa (54–58 psi)

      (50) Pin Indexed 310–341 kPa (45.0–49.5 psi).

      - If the test device pressure does not stabilize within one minute, replace the cylinder supply.
      - If the test device stabilizes within one minute, but the readings are not within specifications, readjust the regulator (Section 5.1.3).

6. **High Flow Test:**
   a. Access the Gas Delivery Schematic.
   b. Set ***Total Flow*** of the tested gas to 10 l/min.

      The test device reading must be greater than:

      (60) DIN 221 kPa (32 psi)

      (50) Pin Indexed 221 kPa (32 psi)

      - If the test device reading under “high flow” conditions is less than specified, readjust the regulator per the procedure in Section 5.1.3; however, set the regulated pressure higher by the difference you noted in this step plus 7 kPa (1 psi). This adjusts the “low flow” regulated output to the high side of the specification so that the “high flow” regulated pressure can fall within the specification.
      - If the regulator subsequently fails the “low flow” specification (step 5d) because the reading is too high, replace the cylinder supply.
7. Set the system switch to Standby.
8. Close the cylinder valve.
9. Bleed the system of all pressure.
10. Disconnect the test device and plug the test port (pull on the plug to ensure it is locked in the fitting).
11. Replace the rear panel.
12. Perform the checkout procedure (Section 3).

5.1.3 Adjusting Primary Regulators

Important: Cylinder supplies in an Aisys machine must have all primary regulators set to the same pressure range:
(50) Pin Indexed or (60) DIN.

If a regulator is replaced, the replacement regulator must be set (as required) to the same specification as the one removed.

Important: Install a full cylinder in the cylinder supply to be adjusted. It is essential that the cylinder be within 10% of its full pressure.

To adjust the primary regulators, follow the procedure in Section 5.1.1 to gain access to the regulators.

Do not attempt to adjust without flow.

1. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
2. If required,
   - set ***Gas Delivery Mode*** to ***Fresh Gas***.
   - set ***Balance Gas*** to ***Air*** (for O_2 or Air) or ***N2O***.
3. Adjust the ***O2 Concentration*** so that 100% of the gas flow will be through the regulator being tested (100% for O_2; 0% for Air or N_2O).
4. Slowly open the cylinder valve for the regulator being tested and observe the pressure reading for the cylinder.
5. Set ***Total Flow*** of the tested gas to 0.5 l/min.
6. Close the cylinder valve and allow the pressure to decay to 2068 kPa (300 psi) as indicated on the cylinder pressure display.
7. When the cylinder gauge reaches 2068 kPa (300 psi), adjust the regulator output pressure to:

   (60) DIN 386–400 kPa (56–58 psi)

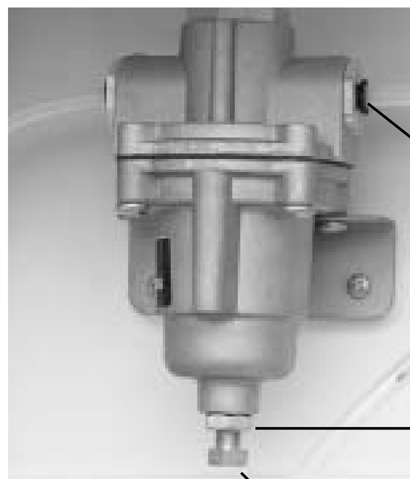
   (50) Pin Indexed 327–341 kPa (47.5–49.5 psi).

   Note: It may be necessary to open the cylinder valve and repeat steps 6 and 7 a number of times to achieve the above setting.
8. Test the regulator settings per the appropriate test in Section 5.1.2:
   - **Test A —** For primary regulators that supply drive gas to the ventilator.
   - **Test B —** For all gases not used to supply drive gas to the ventilator.

5.2 O_2 Flush Regulator

1. Bleed all gas pressure for the machine (Section 9.1).
2. Remove the tabletop (Section 9.3).
3. Remove the cover from the electronic enclosure.
4. Remove the O_2 Flush Regulator output tubing. Attach a 6-mm tee and a test device to the open port.

Upper (Pan) electronic enclosure



5. Connect an O_2 pipeline supply or slowly open the O_2 cylinder valve.
6. Push the flush button just enough to achieve a slight flow or open the auxiliary flowmeter if equipped with this option. Read the pressure shown on the test device.

   The pressure should be 241 ±7 kPa (35 ±1.0 psi).
7. If adjustment is required:
   a. Loosen the adjustment screw's jam nut.
   b. Adjust the regulator (in small steps) to the above specification.
   c. Tighten the jam nut.
   d. Verify the reading.
8. Disconnect the pipeline supply or close the cylinder valve.
9. Bleed gas pressure by pushing the flush button; then, disconnect the tee and test device.
10. Reattach the output tubing to the regulator.

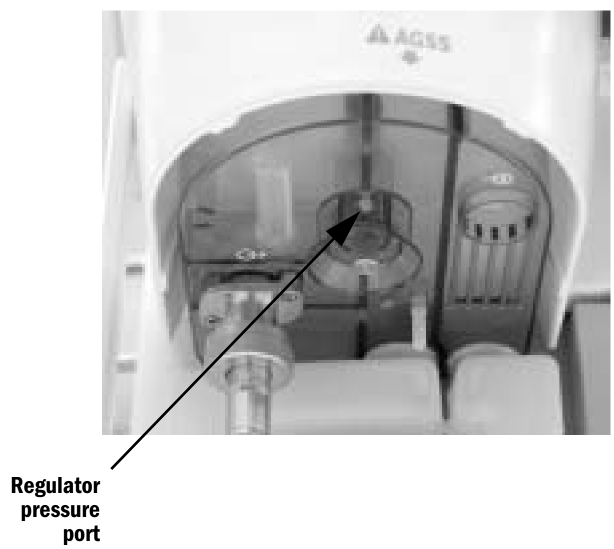
5.3 Adjust Drive Gas Regulator

The drive gas regulator must be adjusted while maintaining a flow of 15 l/min. To adjust the flow, you must set the system to the Install/Service mode and use the PC based Service Application to control flow through the regulator.

The drive gas regulator should provide a constant gas input pressure of 172 kPa (25 psi).

Calibration setup

1. Attach a pressure test device to the regulator pressure port (shown below)
   - Remove the 6.35-mm (1/4 inch) plug.
   - Attach test device to the open port.
2. Remove the ABS breathing system from the machine to allow continuous Insp Valve flow through the exhalation valve.



3. Access the Ventilation Schematic (Section 12.2.3) of the Service Application.
4. Set ***Gas Inlet Valve*** to ***On***.
5. Adjust the ***Insp Flow Valve*** counts until the inspiratory flow value on the schematic reads approximately 15 l/min.
6. If required, adjusting the regulator to 172 ±1.72 kPa (25 ±0.25 psi).

5.4 Ventilator Calibrations

Before performing the ventilator calibrations, verify that the drive gas regulator is adjusted to specifications (Section 5.3).

The Service menu structure is detailed in Section 4. To access the Ventilator Calibrations menu:

1. Turn on the system.
2. Navigate the menu selections to the **Calibration** menu.
   - On the **Checkout** menu, select **Bypass Checks**.
   - On the **Start Case** menu, press the **Main Menu** button.
   - On the **Main Menu**, select **Screen Setup**.
   - On the **Screen Setup** menu, select **Install/Service** (dial in 16 - 4 - 34).
   - On the **Install/Service** menu, select **Service** (dial in 26 - 23 - 8).
   - On the **Service** menu, select **Calibration**.

Unless otherwise specified, perform the ventilator calibrations in the order that they appear on the Calibration menu.

- User Calibration
- Manifold P Span
- Insp Flow Zero
- Insp Flow Valve
- Bleed Resistor
- Paw Span

The following calibrations should be perform as required:

- Zero Gas Xducer:
  - The pipeline and cylinder pressure transducer should be “zeroed” at least once a year.
  - Whenever a pipeline or cylinder pressure transducer is replaced.
- Cal Config:
  - Reset the ***Ventilator Drive Gas*** to match the machine configuration.
  - Reset the ***Altitude*** whenever the machine is moved to a new location that differs by more than 100 meters.

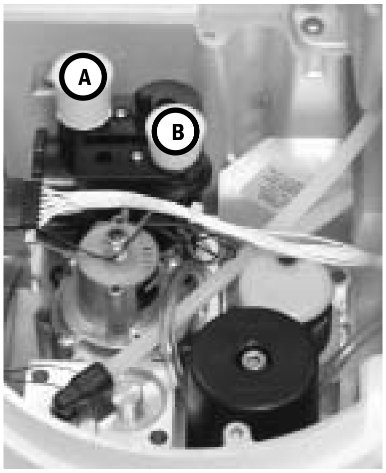
5.4.1 Cal Config

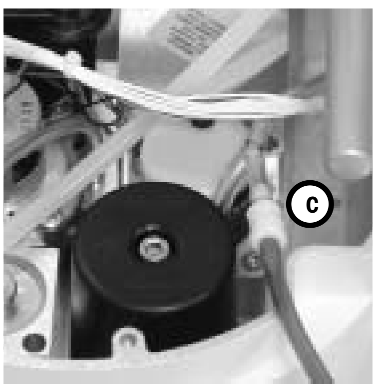
Before calibration, you must verify that the Ventilator Drive Gas and the Altitude settings are set appropriately to match the current drive gas configuration and machine location.

If you change any of the settings in the Cal Config menu, you must restart the system.

3. On the **Installation** menu, select **Configuration**.
4. On the **Configuration** menu, verify the **Ventilator Drive Gas** and the **Altitude** setting; adjust as necessary.
5. When done, reboot the system (System switch to Standby; then On).

5.4.2 Manifold P Span





Calibration setup:

1. Remove the ABS breathing system from the machine.
2. Remove the Exhalation Valve.
3. Remove the Vent Engine cover.
4. Plug the Drive Port (**A**) and the Manifold Port (**B**) on the Vent Engine interface valve.
5. Connect the manifold pressure tee adapter (**C**) – refer to Section 10.1.2 – to the Manifold Pressure Transducer tubing (white inline connectors).
6. Connect a manometer to the open port of the tee adapter.

Calibration procedure:

1. On the Calibration menu, select ***Manifold P Span***.
2. Select ***Start Manifold P Span***.
3. Adjust the Insp Flow Valve (DAC) setting until the manometer reading equals 100 cmH_2O:
   - start at approximately 950 counts (press the ComWheel to activate).
   - continue to increment the count until the manometer reading equals 100 cmH_2O.
4. Select ***Save Calibration***.
5. Select ***Previous Menu***.
6. Disconnect the manometer from the tee adapter.
7. Remove the tee adapter and reconnect the Manifold Pressure Transducer tubing.

5.4.3 Insp Flow Zero

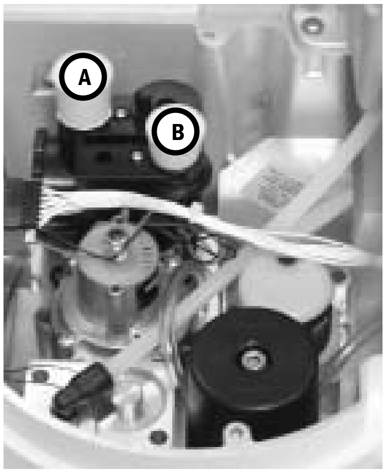
Calibration setup

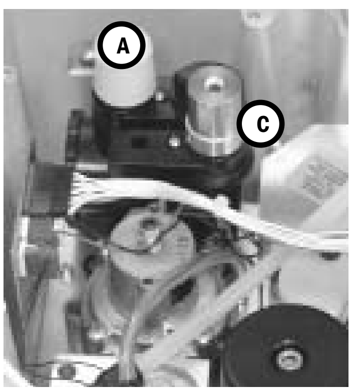
Leave the Drive Port (**A**) and the Manifold Port (**B**) on the interface valve plugged.

Calibration procedure:

1. On the Calibration menu, select ***Insp Flow Zero***.
2. Select ***Start***.
3. Select ***Previous Menu***.

5.4.4 Inspiratory Flow Valve Cal



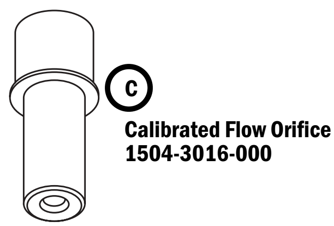


Calibration setup

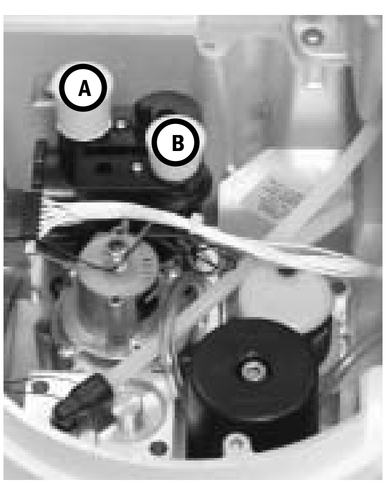
Leave the Drive Port (**A**) and the Manifold Port (**B**) on the interface valve plugged.

Calibration procedure:

1. On the Calibration menu, select ***Insp Flow Valve***.
2. Push the ComWheel to enable the ***Stage 1*** calibration.
3. When Stage 1 is completed, remove the plug from the Manifold port and insert the calibrated orifice (**C**)
4. Push the ComWheel to enable the **Stage 2** calibration.
   (May take two minutes before you see any effects of the test on the screen.)
5. When Stage 2 is completed, select ***Previous Menu***.



5.4.5 Bleed Resistor Cal



Calibration setup

1. Remove the Calibration Orifice from the Manifold port.
2. Plug the Manifold (**B**) port.
3. Leave the Drive Gas (**A**) port plugged.

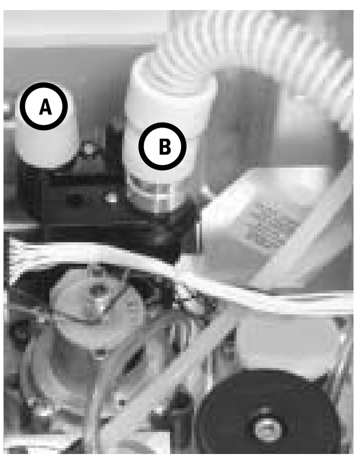
Calibration procedure

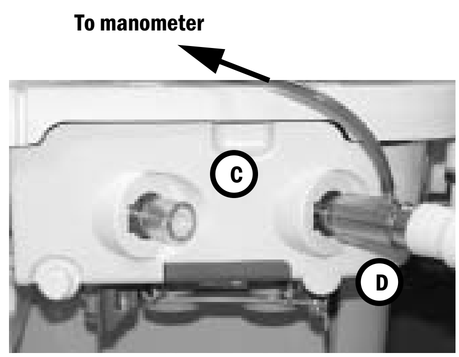
1. On the Calibration menu, select ***Bleed Resistor***.
2. Select ***Start***.
3. When the test is completed, select ***Previous Menu***.

5.4.6 Paw Span

Calibration setup

1. Leave the Drive port (**A**) port plugged.
2. Remove the plug from the Manifold port.
3. Attach a patient circuit tube to the Calibrated Flow Orifice.
4. Insert the Calibrated Flow Orifice into the Manifold port (**B**).
5. Separate the Circuit module from the ABS Bellows module.
6. Install only the Circuit module (**C**) on to the machine.
7. Connect a pressure sensing tee (**D**) to the inspiratory flow patient connection.
8. Connect the open end of the patient circuit tube to the flow port of the pressure sensing tee.
9. Connect a manometer to the pressure sensing port of the tee connector.





Calibration procedure

1. On the Calibration menu, select ***Paw Span***.
2. Select ***Start Paw Span***.
3. Adjust the Insp Flow Valve (DAC) setting until the manometer reading equals 100 cmH_2O:
   - start at approximately 950 counts (press the ComWheel to activate).
   - continue to increment the count until the manometer reading equals 100 cmH_2O.
4. Select ***Save Calibration***.
5. Select ***Previous Menu***.

6 Installation and Maintenance

In this section This section covers the regular maintenance procedures (minimum requirements) needed to make sure that the Aisys anesthesia machine operates to specifications.

⚠ WARNINGS Do not perform testing or maintenance on the Aisys anesthesia machine while it is being used on a patient. Possible injury can result.

Items can be contaminated due to infectious patients. Wear sterile rubber gloves. Contamination can spread to you and others.

Obey infection control and safety procedures. Used equipment may contain blood and body fluids.

6.1 Aisys Installation Checklist

Serial Number:	Date: (YY/MM/DD) / /
Hospital:	Performed by:

☐ 1. Unpack and assemble the Aisys System.

☐ 2. Reconfigure the sample gas return line as required (*TRM - Section 9.21*).

☐ 3. Access the Installation menu from the Install/Service menu and change the following as required:

☐ a. Configuration (*TRM - Section 4.3.1*)
- Decimal Marker
- Language
- Gas Supply Colors
- O_2 Flowtube
- Ventilator Drive Gas
- Altitude
- Gas Outlet
- N_2O Enabled

☐ b. Units Menu (*TRM - Section 4.3.2*)
- Weight
- CO_2
- Gas Supply Pressure
- Paw

☐ c. Options List (*TRM - Section 4.3.3*)
- Check that the factory installed ventilation options match the configuration purchased with the machine.

☐ d. Copy Configuration Menu (*TRM - Section 4.3.4*)
- Can be used to save a configuration to a PCMCIA card and then copy the configuration to additional machines.

☐ e. From the Service Menu select the Service Log Menu (*TRM - Section 4.4.2*)
- Review and reset the error and alarm log entries.

☐ f. From the Service Menu select Calibration and perform the following calibrations (*TRM - Section 4.5*):
- User Calibration
- Manifold P Span
- Insp Flow Zero
- Insp Flow Valve
- Bleed Resistor
- Paw Span
- Zero Gas Xducers

☐ 4. Verify the “Schedule Service Calibration” message is not present in the normal display.

☐ 5. Complete the System Checkout by performing the following steps:

   a. Inspect the system (*TRM - Section 3.1*)
   b. System checkout (*TRM - Section 3.2*)

      Note: You must insert a Test Cassette for the Machine Check - System Agent Delivery Test to run the extended diagnostic Vaporizer Test.

   c. Backlight test (*TRM - Section 3.4*)
   d. Pipeline and Cylinder tests (*TRM - Section 3.5*)
   e. Flush Flow test (*TRM - Section 3.6*)
   f. Alarm tests (*TRM - Section 3.7*)
   g. Alternate O_2 flowmeter tests (*TRM - Section 3.8*)
   h. Auxiliary O_2 flowmeter tests, if equipped with option (*TRM - Section 3.9*)
   i. Integrated suction regulator tests, if equipped with option (*TRM - Section 3.10*)
   j. Power failure test (*TRM - Section 3.11*)
   k. Electrical safety tests (*TRM - Section 3.12*)

6.2 Aisys Planned Maintenance

Serial Number:			Date: (YY/MM/DD) / /
Hospital:			Performed by:
☐ 12 months	☐ 24 month	☐ 48 month	☐ ______________

6.2.1 Every twelve (12) months

Perform the following steps every 12 months.
For details, refer to the sections listed.

- Sections marked URM are found in the User's Reference manuals for the Aisys anesthesia system.
- Sections marked TRM are found in this Technical Reference manual.

Checks and Tests

☐ 1. AGSS Maintenance (*URM - Part 2, Section 2*):
- Empty any condensate from the reservoir (disposable item).
- Inspect air brake for occlusion on active AGSS.
- Inspect, clean or replace filter on active AGSS.

☐ 2. Breathing System Maintenance (*URM - Part 2, Section 2*)
- Disassemble the breathing system modules and inspect components. Replace any parts that are physically damaged or worn.

☐ 3. Bellows Assembly Maintenance (*URM - Part 2, Section 2*)
- Disassemble the bellows assembly and inspect components. Replace any parts that are physically damaged or worn.

☐ 4. Bellows Assembly Tests (*URM - Part 2, Section 2*)

☐ 5. Perform the checkout procedures in Section 3.
- Inspect the system (*TRM - Section 3.1*)
- Pipeline and cylinder tests (*TRM - Section 3.5*)
- O_2 supply alarm test (*TRM - Section 3.5.1*)
- Flush Flow Test (*TRM - Section 3.6*)
- Alarm tests (*TRM - Section 3.7*)
- Power failure test (*TRM - Section 3.11*)

☐ 6. Mixer outlet check valve leak test (*TRM - Section 6.6.1*)

☐ 7. Mixer flow verification test (*TRM - Section 6.6.2*)

☐ 8. Alternate O_2 flowmeter tests (*TRM - Section 6.7*)

☐ 9. Auxiliary O_2 flowmeter tests (*TRM - Section 6.8*)

☐ 10. Integrated Suction Regulator tests (*TRM - Section 6.9*)

☐ 11. Perform the following diagnostics using the PCMCIA Special Functions.
- Display Diagnostics (*TRM - Section 8.3.1*).

☐ 12. Perform the following diagnostics using the PC Service Application.

- Vaporizer Test with a Test Cassette inserted (*TRM - Section 12.9.2*).
- MOPV pressure relief valve test (*TRM - Section 6.4*).
- Pressure Limit Circuit test (*TRM - Section 6.5*).
- Adjust Drive Gas Regulator (*TRM - Section 5.3*).

☐ 13. From the Service Calibration menu (*TRM - Section 4.5*), perform the following (refer to *TRM - Section 5.4* for details):

- User Calibration
- Manifold P Span
- Inspiratory flow zero
- Inspiratory flow valve
- Bleed resistor
- Paw Span
- Zero Gas Transducers
- Mixer P Zero

☐ 14. From the Service Log menu (*TRM - Section 4.4.2*), perform the following:

- Access the Error History log. If any error codes have been logged, follow the appropriate troubleshooting procedures. Clear the error log.

☐ 15. Perform the system "Checkout" (*TRM - Section 3.2*).

☐ 16. Electrical safety tests (*TRM - Section 3.12*).

6.2.2 Every twenty-four (24) months

In addition to the 12-month requirements, replace the following parts every 24 months. All parts should be replaced before performing the checks, tests, and calibrations.

Parts Replacement

Refer to *TRM - Section 6.3***.**

Perform the following step:

☐ 1. Replace the free breathing flapper valve (Stock Number 0211-1454-100).

☐ 2. Replace the free breathing valve o-ring (Stock Number 1503-3208-000).

6.2.3 Every forty-eight (48) months

In addition to the 24-month requirements, replace the following parts every 48 months. All parts should be replaced before performing the checks, tests, and calibrations.

Parts Replacement

Refer to *TRM - Section 9.10.2*; perform the following step:

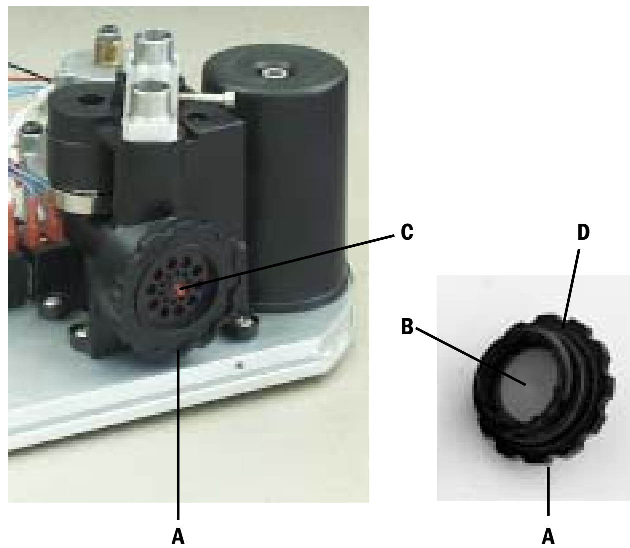
☐ Replace the Display Unit battery (Stock Number 1009-5800-000).

Refer to *TRM - Section 9.11.4*; perform the following step:

☐ Replace the system batteries* (Stock Number 1009-5682-000).

*__Note__: Refer to the "*Battery capacity test*" in *TRM - Section 6.10*.

6.3 Free breathing valve maintenance



1. Unscrew the valve seat (**A**) from the side of the interface manifold.
2. Inspect the flapper (**B**) and valve seat for nicks, debris and cleanliness.

To replace the flapper valve

3. If necessary, clean the new flapper valve with alcohol.
4. Pull the tail (**C**) of the new free breathing valve flapper through the center of the valve seat until it locks in place.
5. Trim the tail flush with outside surface of the valve seat (refer to the removed flapper).
6. Replace the O-ring (**D**). Lubricate with a thin film of Krytox.
7. Hand screw the assembly into the interface manifold.
8. Reassemble the system.
9. Perform the Preoperative Checkout Procedure (refer to the User's Reference manual).

6.4 MOPV pressure relief valve test

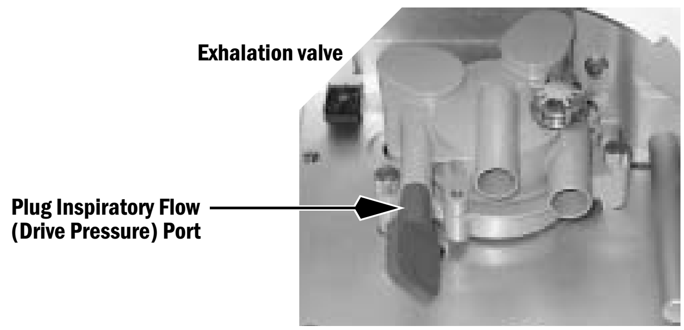
⚠ **WARNING** Objects in the breathing system can stop gas flow to the patient. This can cause injury or death:

- Do not use a test plug that is small enough to fall into the breathing system.
- Make sure that there are no test plugs or other objects caught in the breathing system.

6.4.1 Test setup

1. Remove the ABS breathing system.

2. Plug the inspiratory flow (drive pressure) port of the exhalation valve with a stopper.



6.4.2 Test procedure

To test the pressure relief valve, you must establish a flow (blocked by setup above) of 30 l/min through the Inspiratory Flow Control valve.

3. Access the Ventilation Schematic (*TRM - Section 12.2.3*) of the Service Application.
4. Set ***Gas Inlet Valve*** to ***On***.
5. Adjust the ***Insp Flow Valve*** counts until the inspiratory flow value on the schematic reads approximately 30 l/min.

3. Carefully listen for the MOPV relief weight to be relieving and "popping off" from its seat (a purring sound). This indicates the valve is functioning correctly.

4. Set the system switch to Standby.

5. Remove the stopper from the inspiratory flow port.

6. Reassemble the system.

7. Perform the Preoperative Checkout Procedure
(refer to the User's Reference manual).

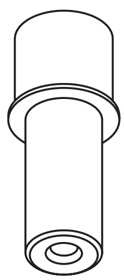
6.5 Pressure Limit Circuit test

To perform the test:

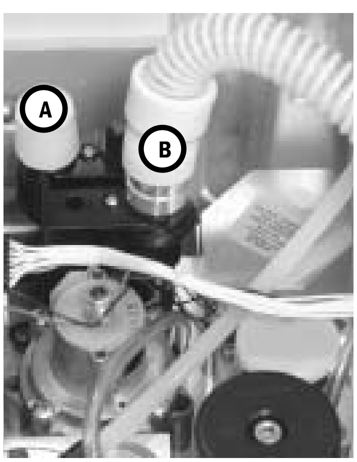
- establish a closed patient airway circuit.
- increment the pressure in the airway circuit.
- observe the output of the airway pressure transducer.
- note that the “pressure limit circuit” trips at approximately 109 cmH_2O.

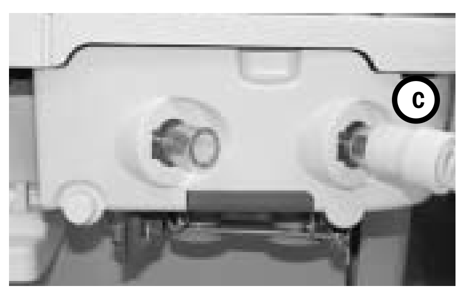
Test setup

1. Remove the ABS breathing system from the machine.
2. Remove the Exhalation Valve.
3. Remove the Vent Engine cover.
4. Separate the Circuit Module from the ABS Bellows Module.
5. Install the Circuit Module only.
6. Plug the Drive Port (**A**) on the Vent Engine interface valve.
7. Attach a patient circuit tube to the Calibrated Flow Orifice test tool.
8. Insert the Calibrated Flow Orifice into the Manifold (pilot) Port (**B**).
9. Connect the open end of the patient circuit tube to the inspiratory flow patient connection (**C**).



Calibrated Flow Orifice
1504-3016-000





Test Procedure

10. Access the Ventilation Schematic (*TRM - Section 12.2.3*) of the Service Application.
11. Select ***Vent Status*** and verify that ***Over Pressure Circuit*** reads ***OK***.
12. Select ***Gas Inlet Valve*** to ***ON***.
13. Adjust the ***Insp Flow Valve*** counts to approximately 1000 counts and observe the ***Airway Pressure*** reading on the Ventilator Schematic.
14. Increase the flow count slowly until the ***Airway Pressure*** reading reaches approximately 109 cmH_2O.
15. Continue to increase the flow by one count and observe the airway pressure until gas flow stops.
16. On the Status page, verify that:
    - ***Over Pressure Circuit*** reads ***High Pressure***.
    - ***Gas Inlet Valve Feedback*** reads ***Closed***.

8. Reassemble the system.
9. Perform the Preoperative Checkout Procedure (refer to the User's Reference manual).

6.6 Mixer test

To perform the mixer tests, you must gain access to the mixer outlet tubing which is connected to the inlet of the electronic vaporizer.

1. To access the electronic vaporizer, refer to Section 9.6
2. Disconnect the mixer outlet tube at the inlet to the electronic vaporizer.

6.6.1 Mixer outlet check valve leak test

To test the mixer outlet check valve you must apply back pressure to the check valve through the mixer outlet tubing and time the leak down rate of the pressure.

1. Tee in a pressure gauge and a syringe to the mixer outlet tube.
2. Slowly pressurize the mixer outlet check valve to 200 mmHg.
3. The pressure shown on the test gauge should not decrease by more than 10 mmHg in 30 seconds.

6.6.2 Mixer flow verification

To perform the flow verification test, you must attach a flowmeter to the mixer outlet tubing and access the Gas Delivery Schematic (Section 12.2.2) on the Service Application.

1. Connect a flowmeter to mixer outlet tubing.
2. On the Gas Delivery Schematic, establish the following flows and verify the readings on the test flowmeter.

	Verify Flowmeter Reading	
Select	**Lower Limit l/min**	**Upper Limit l/min**
100% O2 at 10 l/min	9.0	11.0
100% O2 at 0.5 l/min	0.45	0.55
Air at 10 l/min	9.0	11.0
Air at 0.5 l/min	0.45	0.55
100% N2O at 10 l/min	9.0	11.0
100% N2O at 0.5 l/min	0.45	0.55

Note If you will be testing the Auxiliary O_2 flowmeter (*TRM - Section 6.7*), you can proceed to the Alternate O_2 "*Flow Accuracy Test*" at this point without reassembling the machine.

3. Remove the test device.
4. Connect the mixer outlet tubing to the electronic vaporizer.
5. Reassemble the machine.
10. Perform the Preoperative Checkout Procedure (refer to the User's Reference manual).

6.7 Alternate O_2 flowmeter tests

1. Open the O_2 cylinder valve or connect an O_2 pipeline.
2. Rotate the Alt O_2 flow control fully clockwise to minimum flow.
3. Press the Alternate O_2 switch to turn on Alternate O_2 flow.
   The flowmeter should indicate 0.5 to 0.7 L/min.
4. Rotate the flow control counterclockwise (increase). The ball should rise immediately after rotation is begun. It should rise smoothly and steadily with continued counterclockwise rotation. When a desired flow is set, the ball should maintain in a steady position.
5. Rotate the flow control clockwise to minimum flow.
6. Press the Alternate O_2 switch to turn off Alternate O_2 flow; confirm yes.

Flow Accuracy Test

Note: To check flow accuracy, be sure that the flow test device is capable of measuring 0–15 l/min with an accuracy of ±2% of reading.

To perform the test, you must gain access to the mixer outlet tubing which is connected to the inlet of the electronic vaporizer.

1. To access the electronic vaporizer, refer to Section 9.6
2. Disconnect the mixer outlet tube at the inlet to the electronic vaporizer.
3. Connect a flowmeter to the mixer outlet tubing.
4. Press the Alternate O_2 switch to turn on Alternate O_2 flow.
5. Adjust the flowmeter so the **center** of the ball aligns with the selected test point (observe that the ball maintains a steady position for 10 seconds).
6. The test device reading should be between the limits shown for each of the selected settings in the table below.

	Flow Tester Reading	
Flowmeter Setting L/min	**Lower Limit l/min**	**Upper Limit l/min**
minimum (valve fully closed)	0.50	0.70
1	0.52	1.48
3	2.56	3.44
5	4.60	5.40
10	9.70	10.30
maximum (valve fully open)	10.00	13.00

7. Rotate the flow control clockwise to minimum flow.
8. Close the O_2 cylinder valve or disconnect the O_2 pipeline.
9. Remove the test device.
10. Connect the mixer outlet tubing to the electronic vaporizer.
11. Reassemble the machine.

11\. Perform the Preoperative Checkout Procedure
(refer to the User's Reference manual).

6.8 Auxiliary O_2 flowmeter tests

1. Open the O_2 cylinder valve or connect an O_2 pipeline.
2. Rotate the flow control clockwise (decrease) to shut off the flow. The ball should rest at the bottom of the flow tube and not move.
3. Rotate the flow control counterclockwise (increase). The ball should rise immediately after rotation is begun. It should rise smoothly and steadily with continued counterclockwise rotation. When a desired flow is set, the ball should maintain in a steady position.
4. Rotate the flow control clockwise to shut off the flow.

Flow Accuracy Test

Note: To check flow accuracy, be sure that the flow test device is capable of measuring 0 to 15 L/min with an accuracy of ±2% of reading.

1. Connect the flowmeter outlet to the flow test device.
2. Adjust the flowmeter so the **center** of the ball aligns with the selected test point (observe that the ball maintains a steady position for 10 seconds).
3. The test device reading should be between the limits shown for each of the selected settings in the table below.

	Flow Tester Reading	
Flowmeter Setting L/min	**Lower Limit L/min**	**Upper Limit L/min**
1	0.52	1.48
3	2.56	3.44
5	4.60	5.40
10	9.70	10.30
maximum (valve fully open)	12.00	-------

4. Rotate the flow control clockwise to shut off the flow.
5. Close the O_2 cylinder valve or disconnect the O_2 pipeline.

6.9 Integrated Suction Regulator tests

Note There are two types of integrated suction systems for the Avance anesthesia machine:

- Continuous Vacuum Regulator, Three-Mode, Pipeline Vacuum
- Continuous Vacuum Regulator, Three-Mode, Venturi Derived Vacuum

For Pipeline Vacuum systems,
a vacuum source of at least 500 mm Hg (67 kPa or 20 in Hg) is required for testing. The supply open flow must be a minimum of 50 L/min.

For Venturi Derived Vacuum systems,
an O_2 or Air source of at least 282 kPa (41 psi) is required for testing.

Gauge Accuracy The gauge needle should come to rest within the zero range bracket when no suction is being supplied. Gauges which do not comply may be out of tolerance.

Note To check gauge accuracy, be sure that the test gauge is capable of measuring 0 to 550 mm Hg with an accuracy of ±1% of reading.

1. Connect the suction patient port to the test gauge.
2. Turn the mode selector switch to I (ON).
3. Ensure that the vacuum test gauge is in agreement with the suction vacuum gauge ± 38 mm Hg/5 kPa at the following test points.

Test points

Suction vacuum gauge	**Test gauge tolerance**
100 mm Hg (13.3 kPa)	62–138 mm Hg (8.3–18.4 kPa)
300 mm Hg (40 kPa)	262–338 mm Hg (35–45 kPa)
500 mm Hg (66.7 kPa)	462-538 mm Hg (61.6–71.7) kPa)

Flow Test **Note:** To check flow accuracy, be sure that the flow test device is capable of measuring 0–30 L/min.

1. Connect the patient port of the suction regulator to the flow test device.
2. Rotate the suction control knob fully clockwise (increase).
3. Turn the mode selector switch to I (ON) and verify that the flow rate is:
   - at least 20 L/min.
4. Disconnect the test flowmeter.

(Tests continue on next page.)

Regulation Test

1. Turn the mode selector switch to I (ON).
2. Occlude the patient port of the suction regulator.
3. Set the vacuum regulator gauge to 100 mm Hg/13 kPa.
4. Open and close the patient port several times.
5. With the patient port occluded, the gauge should return to 100 mm Hg/13 kPa within a tolerance of ± 10 mm Hg/1.3 kPa.

Vacuum Bleed Test

1. Occlude the patient port of the suction regulator.
2. Set the vacuum regulator gauge to 100 mm Hg/13 kPa.
3. Turn the mode selector switch to O (OFF) and observe the gauge needle. It must return to the zero range bracket or stop pin within 10 seconds.

Vacuum Leak Test

1. Turn the mode selector switch to O (OFF).
2. Rotate the suction control knob a minimum of two full turns in the clockwise direction (increase suction) to ensure its setting is not at the off position.
3. Occlude the patient port of the suction regulator.
4. Observe the suction gauge, the needle should not move.
5. Rotate the suction control knob fully counterclockwise to ensure its setting is at the fully off position.
6. Turn the mode selector switch to I (ON).
7. Observe the suction gauge, the needle should not move.

6.10 Battery capacity test

Although replacement of the backup batteries is recommended at the end of 4 years, batteries that pass the capacity test can be considered viable for battery backup of the system for up to 6 years at the discretion of the hospital.

Before testing the batteries, ensure that they are fully charged.

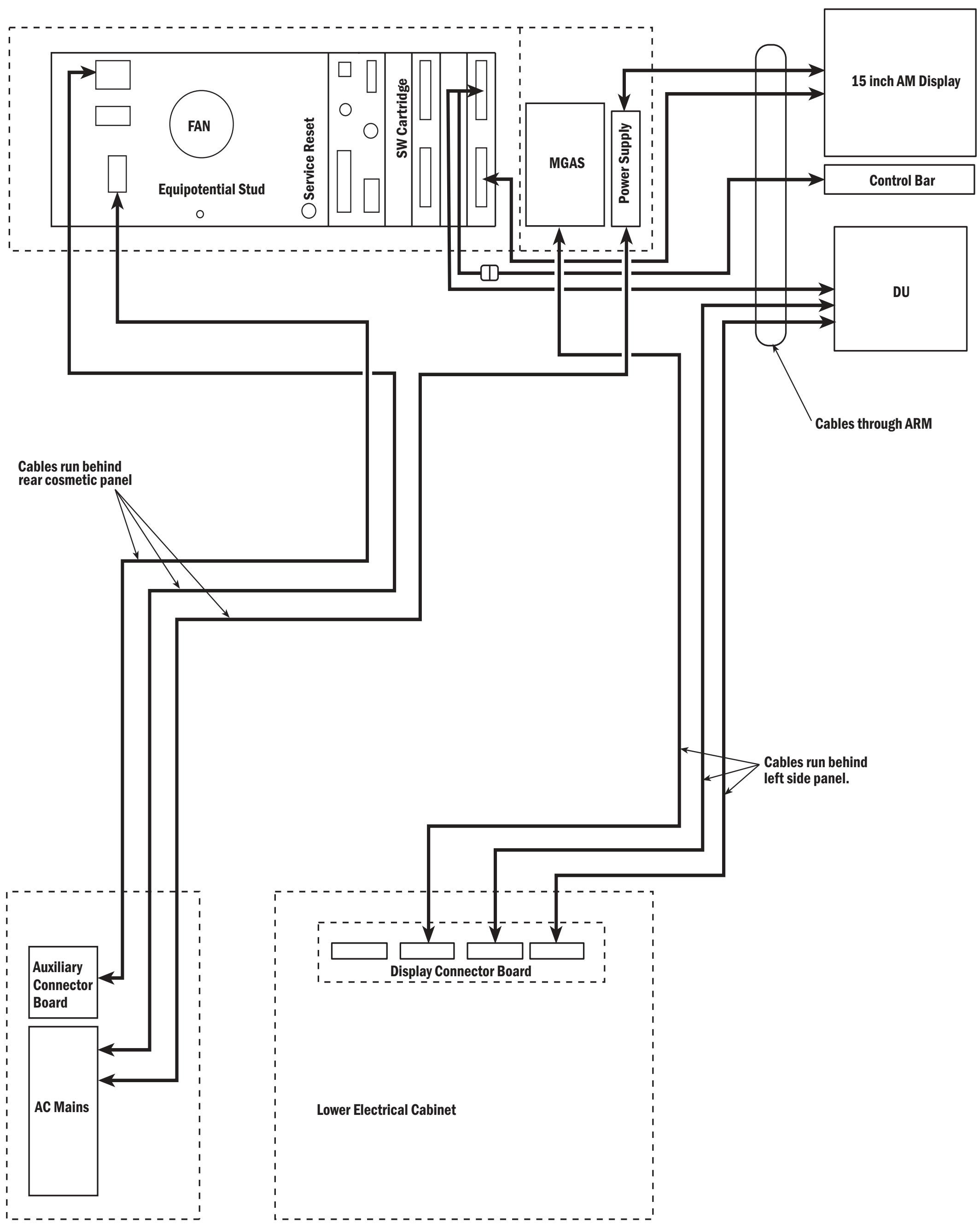
Test procedure

1. Turn the system on and start a case (simulated).
2. Turn off the mains system breaker on the AC Inlet.
3. Allow the system to run on battery until it does an orderly shutdown and powers off (can be in excess of 90 minutes).
4. Set the system switch to Standby and turn on the mains system breaker.
5. Launch the Service Application.
6. On the Power Diagnostics menu (Section 12.6) select ***Power Board***.
7. The Power Board window (Section 12.6.1) shows the ***Date battery Tested*** (the last full battery discharge) and the ***Last Full Discharge*** time.
   - If the ***Last Full Discharge*** time is greater than 45 minutes, the batteries can be left in service for one more year.
   - If the ***Last Full Discharge*** time is less than 45 minutes, both batteries should be replaced.

6.11 Cable routing, upper module rack

The following diagram shows typical cable connections for Aisys machines with an upper module rack. Refer to the individual sections showing proper routing of the cables through the machine.

Note In general, route the cables through the machine as shown in the following sections. Connect each end to the intended connector. Ensure that the cable is properly restrained and positioned so that it does not interfere when replacing covers or with the motion of the Display arm. Store excess cable length within the machine.



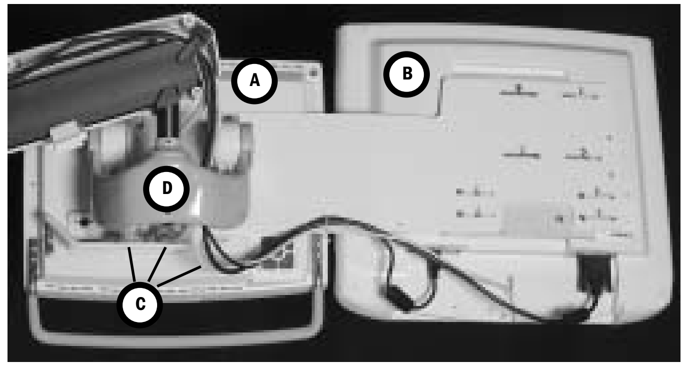
6.11.1 Display Unit and Anesthesia Monitor

Attach the respective cables to the Display Unit (**A**) and, if present, to the monitor (**B**).

Leave enough cable length outside the arm to allow positioning of the displays throughout the full range without straining the cables.

Use cable ties to keep the monitor cable attached neatly behind the assembly.

Ensure that each cable has a slight loop (**C**) at the wrist casting (**D**).

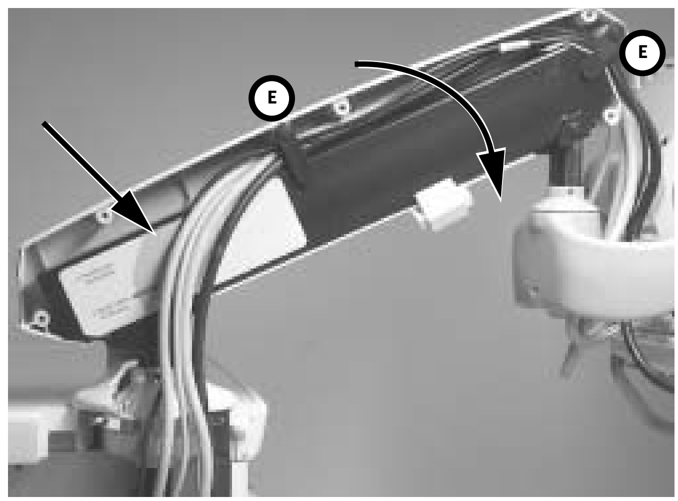


6.11.2 Display arm

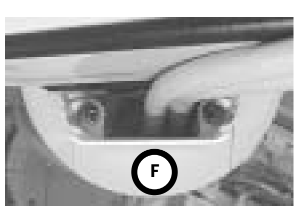
Route the cables through the Display Arm retaining clips (**E**) and the wrist casting as shown.

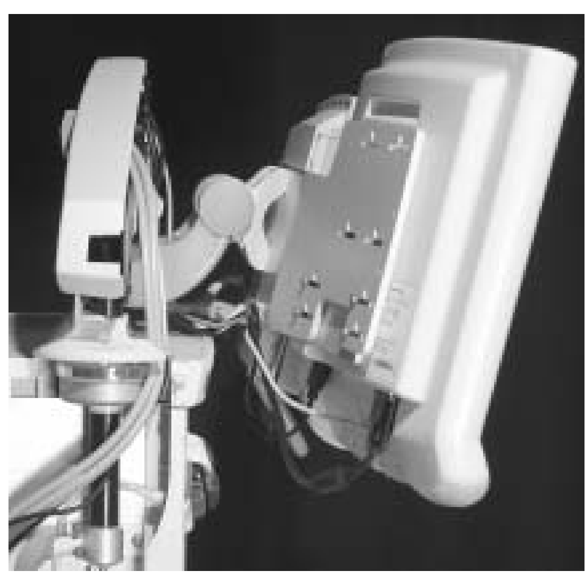
To ensure adequate cable length for the full range of arm and display motion:

1. Move the arm down to a horizontal position. Arrange the cables so that they fall within the shaded area on the label.



2. Swing the arm to its extreme counterclockwise position and place the display up against the arm.
3. Replace the base cover with adhered gasket (**F**) to hold the cables in place.



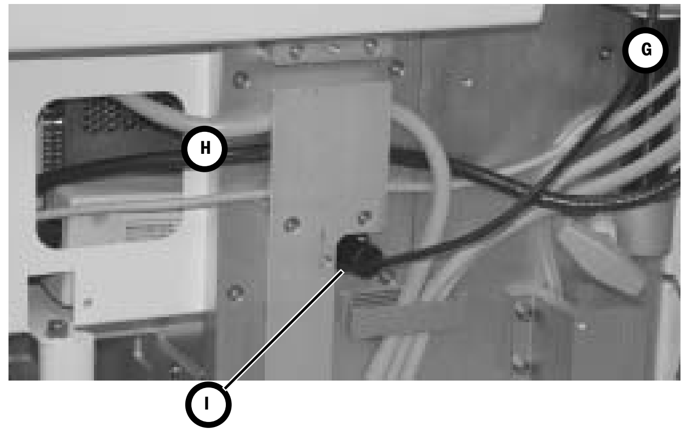


6.11.3 Left-side cable route

To access the left-side cable route, remove the following:

- the breathing system.
- the upper left-side cosmetic panel.
- the lower left-side cosmetic panel.
- the AGSS reservoir.

Route the cables through the cable clamps shown (**arrows**).

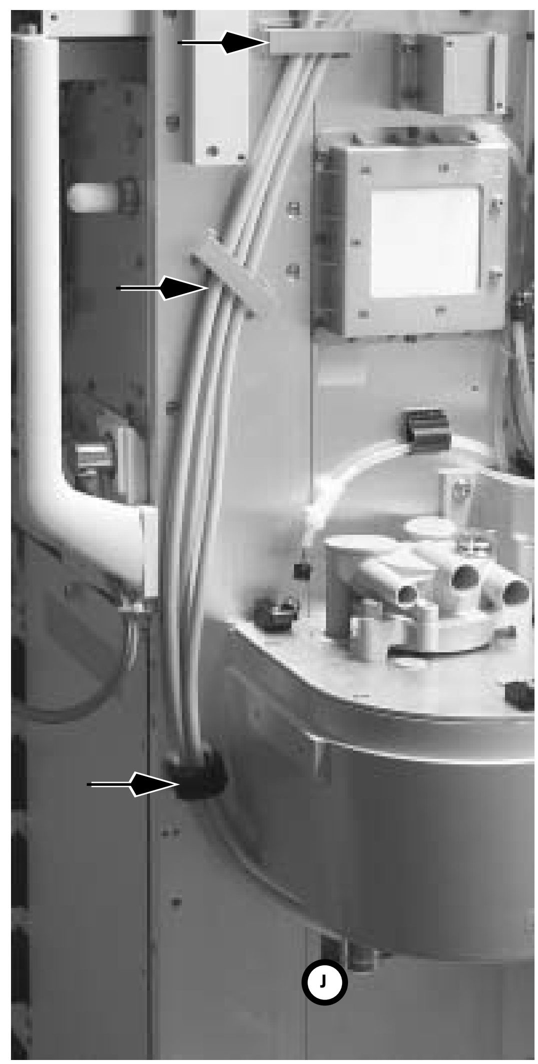


6.11.4 Upper left-side cable route

The upper left-side is a transition route for cabling.

- to the display arm (**G**).
- to the M-Gas chassis and the upper module rack (**H**).

The extrusion includes an opening that accommodates the ferrite bead (**I**) on the power supply cable for the 15-inch Anesthesia Monitor display.



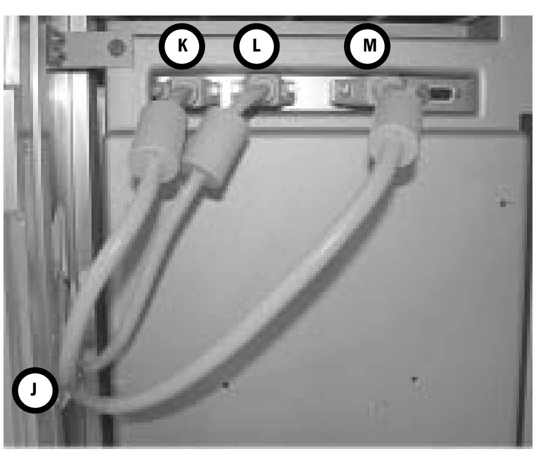
6.11.5 Front side of Display Connector Board

Cables from the front side of the Display Connector Board route through an opening in the left-side frame extrusion (**J**).

- System Power Interface to Display Unit (**K**).
- System Signal Interface to Display Unit (**L**).
- Airway Module (M-Gas) Power Supply Board (**M**).

To access the cable connectors, you need to remove one of the following components depending on machine configuration:

- a drawer.
- the cassette storage bay assembly.

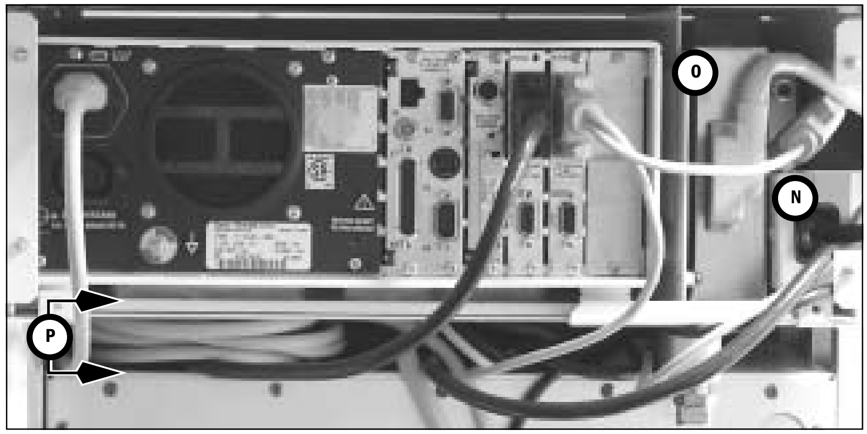


6.11.6 Upper module rack

To access the upper module rack, remove the upper rear cosmetic cover.

Store the power supply "brick" (**N**) for the 15-inch Anesthesia Monitor display in the open area to the right of the M-Gas power supply (**O**).

Coil the excess length of each cable and store it in the open area below the module rack (**P**).

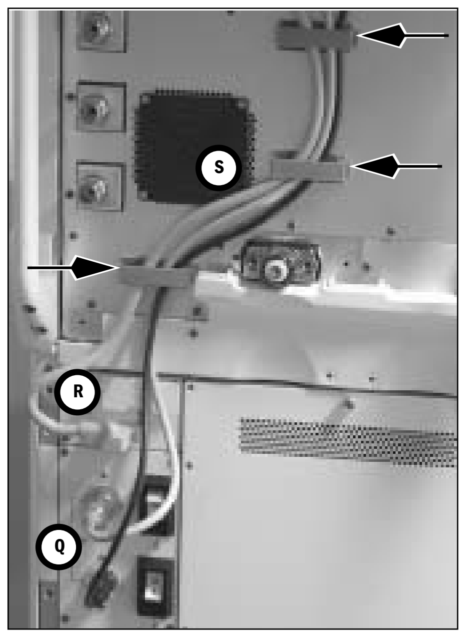


6.11.7 Rear cosmetic panel

To access the rear cable route, remove the rear pneumatic cosmetic panel.

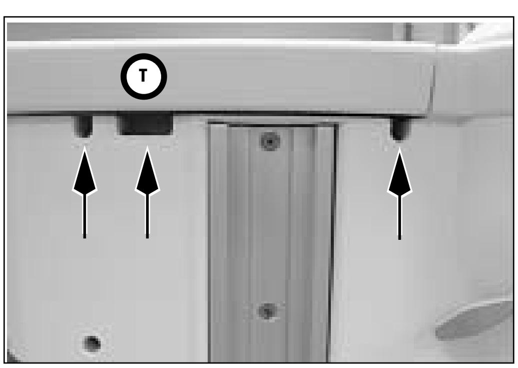
Route the AC power cables (**Q**) and the Auxiliary Connector Board cables (**R**) through the cable clamps shown (**arrows**).

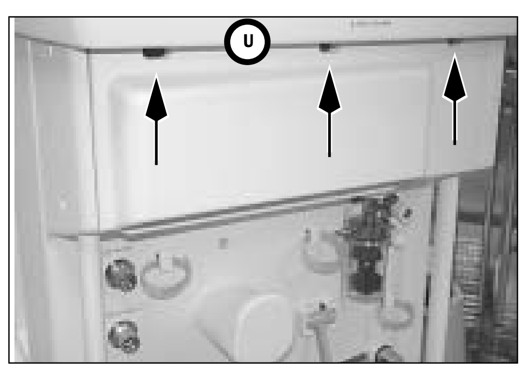
Arrange the cable so that they do not impede air flow through the rear panel fan (**S**).



6.11.8 Additional cable access points to upper chassis

Additional cables can be routed into upper chassis area through openings along the edge of the top shelf in the left-side (**T**) and upper rear (**U**) cosmetic panels.

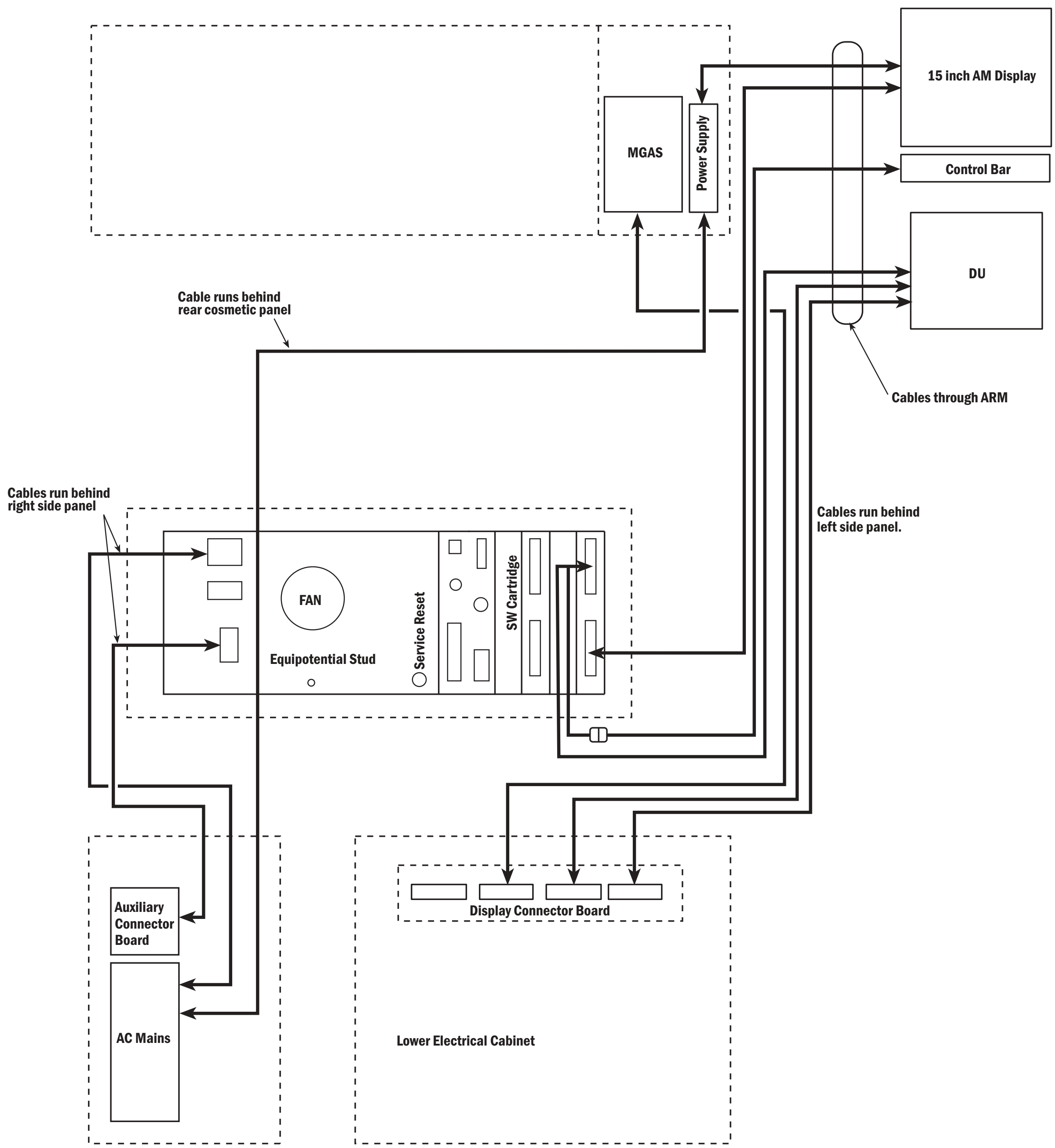




6.12 Cable routing, lower module rack

The following diagram shows typical cable connections for Aisys machines with an lower module rack. Refer to the individual sections showing proper routing of the cables through the machine.

Note In general, route the cables through the machine as shown in the following sections. Connect each end to the intended connector. Ensure that the cable is properly restrained and positioned so that it does not interfere when replacing covers or with the motion of the Display arm. Store excess cable length within the machine.



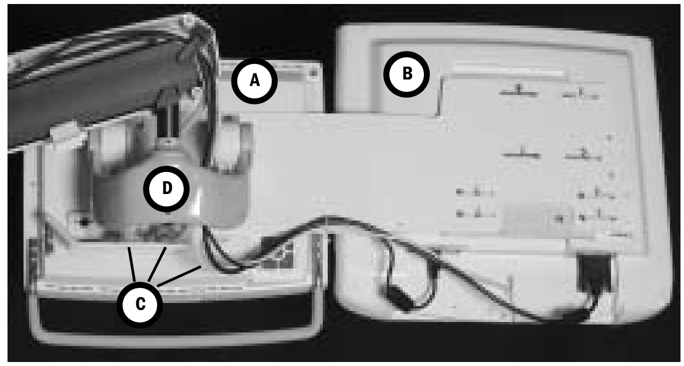
6.12.1 Display Unit and Anesthesia Monitor

Attach the respective cables to the Display Unit (**A**) and, if present, to the monitor (**B**).

Leave enough cable length outside the arm to allow positioning of the displays throughout the full range without straining the cables.

Use cable ties to keep the monitor cable attached neatly behind the assembly.

Ensure that each cable has a slight loop (**C**) at the wrist casting (**D**).

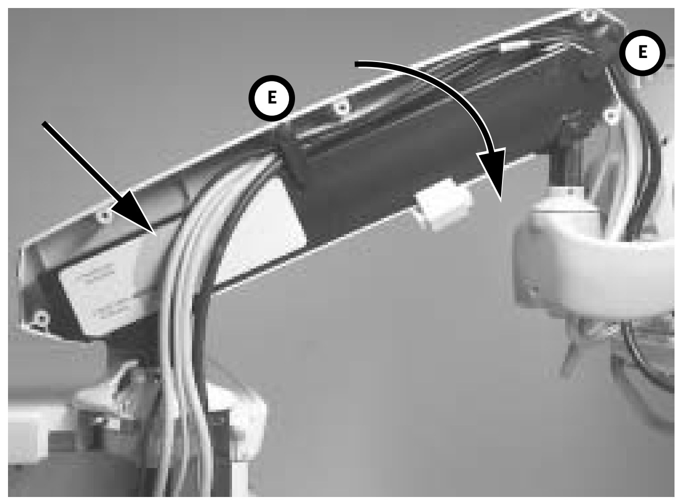


6.12.2 Display arm

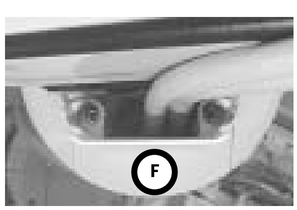
Route the cables through the Display Arm retaining clips (**E**) and the wrist casting as shown.

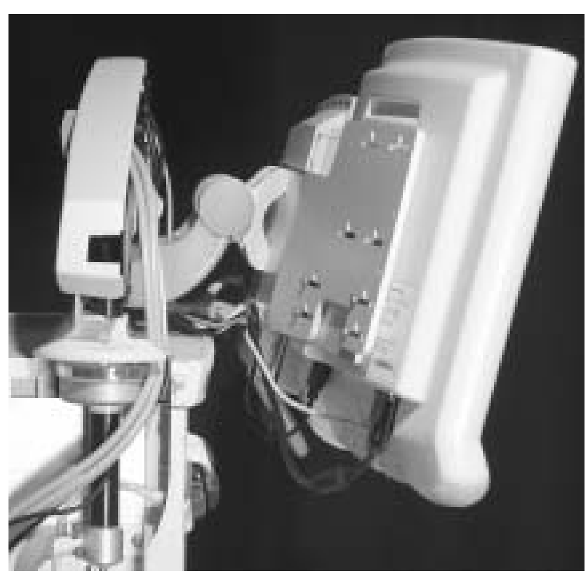
To ensure adequate cable length for the full range of arm and display motion:

1. Move the arm down to a horizontal position. Arrange the cables so that they fall within the shaded area on the label.



2. Swing the arm to its extreme counterclockwise position and place the display up against the arm.
3. Replace the base cover with adhered gasket (**F**) to hold the cables in place.





6.12.3 Left-side cable route

To access the left-side cable route, remove the following:

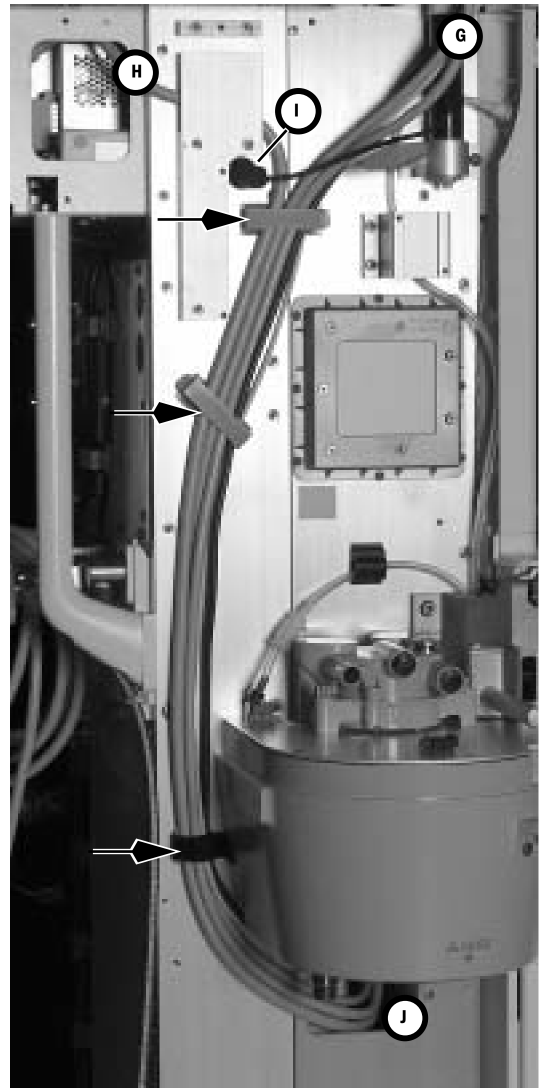
- the breathing system.
- the upper left-side cosmetic panel.
- the lower left-side cosmetic panel.
- the AGSS reservoir.

Route the cables through the cable clamps shown (**arrows**).

The upper left-side is a transition route for cabling:

- to the display arm (**G**).
- to the M-Gas chassis (**H**).

The extrusion includes an opening that accommodates the ferrite bead (**I**) on power supply cable for the 15-inch Anesthesia Monitor display.



6.12.4 Front side of Display Connector Board and lower module rack.

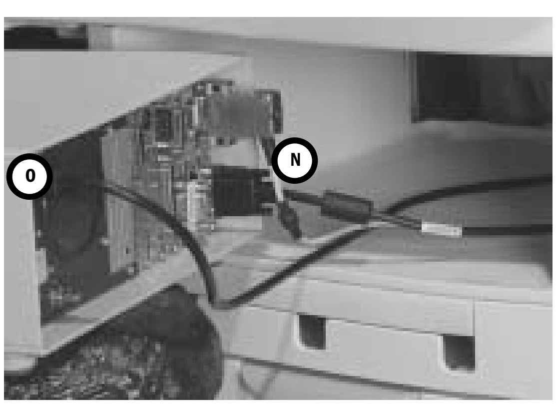
Cables from the front side of the Display Connector Board and the signal cable from the module rack route through an opening in the left-side frame extrusion (**J**).

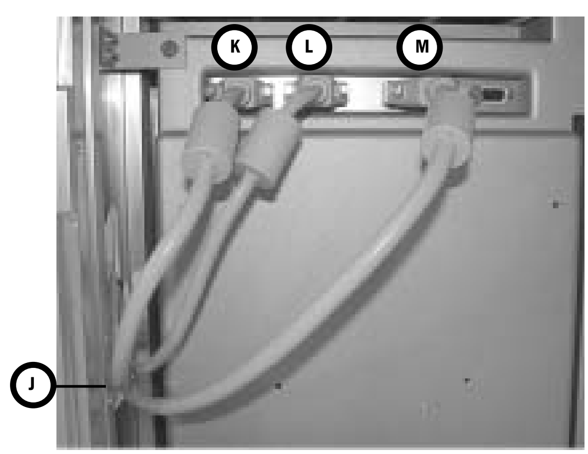
- System Power Interface to Display Unit (**K**).
- System Signal Interface to Display Unit (**L**).
- Airway Module (M-Gas) Power Supply Board (**M**).
- Signal cables to module rack (**N**).

To access the cable connectors, move the lower rack out of the bay onto a suitable stand.

The power cable (**O**) to the module rack is routed from the right side of the machine (*TRM - Section 6.12.6*).

Note: When replacing the module rack, ensure that the excess cable length fall behind the rear drawer brace — away from the drawers.





6.12.5 Rear cable route

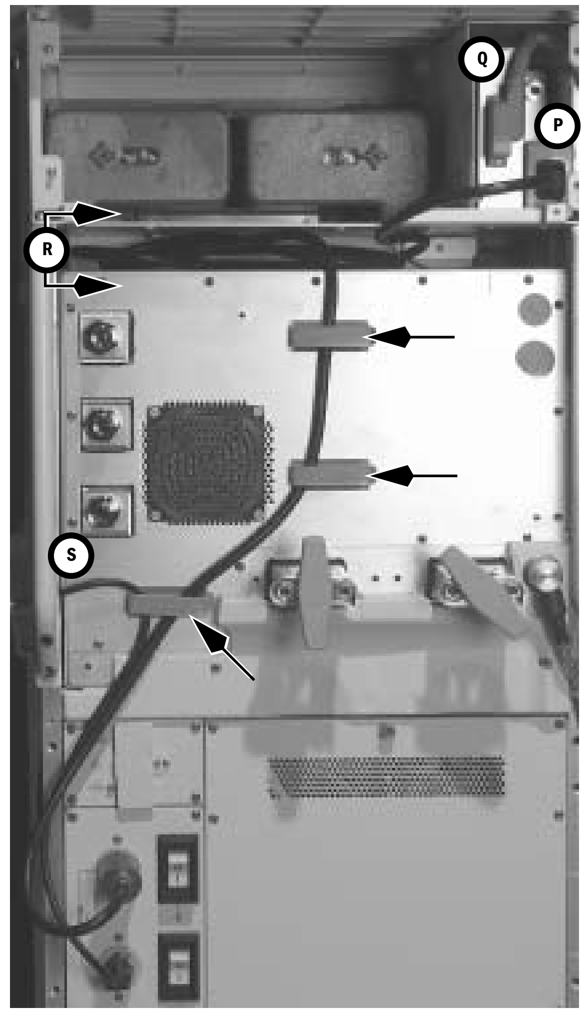
To access the rear cable route, remove the rear pneumatics cosmetic panel and the upper rear cosmetic cover.

Route the cables through the cable clamps shown (**arrows**).

Store the power supply "brick" (**P**) for the 15-inch Anesthesia Monitor display in the open area to the right of the M-Gas power supply (**Q**).

Coil the excess length of each cable and store it in the open area below the module rack (**R**).

The power cord (**S**) for the lower module rack (and if present, the battery backup cable for the Anesthesia Monitor) wraps to the right-side of the machine.



6.12.6 Right-side cable route

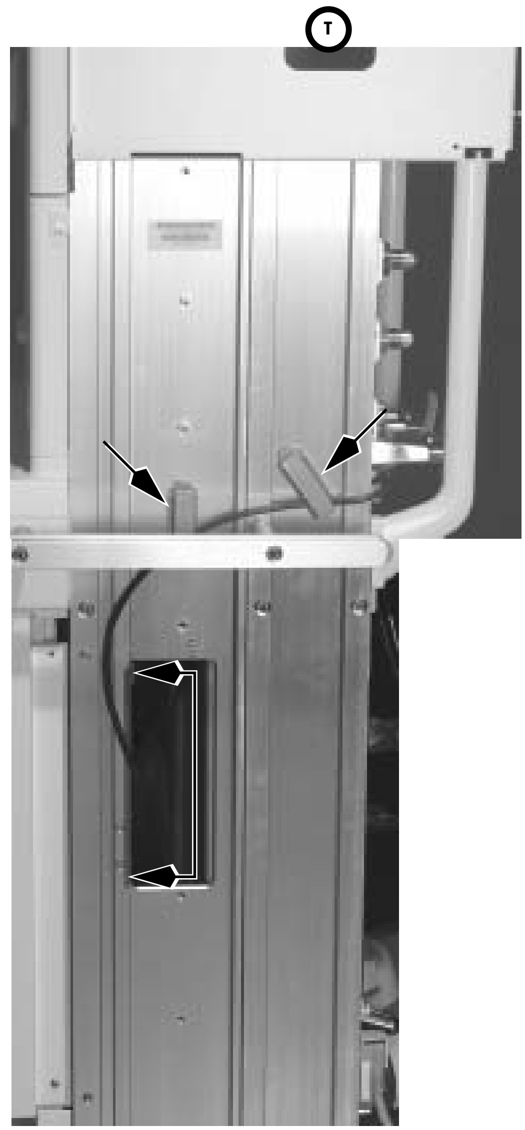
To access the cable route on the right side of the machine, remove the lower and upper right-side cosmetic panels.

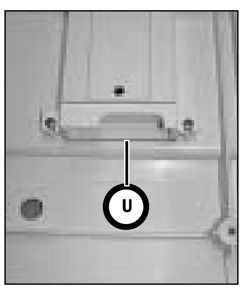
Route the cables through the cable clamps shown (**arrows**).

Note: When replacing the lower cosmetic panel, position the cables within the beveled edge of the extrusion to allow a flush mount of the panel without pinching the cables

Cable from the upper chassis can be routed in this area through the cutout (**T**) in the chassis.

Additional cables can be routed into this area through the upper cosmetic panel. First, remove the plug (**U**); then, route the cable through the upper panel. Flip the plug over before replacing it onto the cosmetic panel.





7 Troubleshooting

In this section

7.1 Troubleshooting Guidelines

Review system error logs using the Special Functions feature of the Software Download card (Section 8.3) or download the logs to PC files using the PC Service Application (Section 12.5.3). Review the logs to identify issues and follow the appropriate subsystem troubleshooting procedures.

⚠ **WARNING** Objects in the breathing system can stop gas flow to the patient. This can cause injury or death:

- Do not use a test plug that is small enough to fall into the breathing system.
- Make sure that there are no test plugs or other objects caught in the breathing system.

7.2 Troubleshooting high pressure and low pressure leaks

Problem	Possible Cause	Action
High Pressure Leak	Pipeline leak	Use a leak detector or Snoop to check for source of leak. Repair or replace defective parts.
	O_2 flush valve	Use a leak detector or Snoop to check for source of leak. Make sure tubing connections are tight. Replace valve if defective.
	System switch	Use a leak detector or Snoop to check for source of leak. Make sure tubing connections are tight. Replace switch if defective.
	Cylinder not installed properly	Make sure cylinder is correctly aligned. Verify that tee handles are tight.
	Cylinder transducer	Use a leak detector or Snoop to check for source of leak. Tighten/replace transducer if defective.
	Cylinder gaskets	Use a leak detector or Snoop to check for source of leak. Replace gasket if defective.
	Relief valves	Use a leak detector or Snoop to check for source of leak. Replace valve if defective.
Low Pressure Leak	Leak in mixer	If vaporizer manifold passed previous tests: Remove tubing from inlet port of vaporizer manifold (mixer outlet tube) and perform leak test of mixer.
	Leaking flush valve	Attach pressure measuring device on CGO. Replace valve if device shows increased pressure.
	Leaking system switch	Attach pressure measuring device on CGO. Replace switch if device shows increased pressure.
Bellows leak	Pop-off valve diaphragm not sealing properly	Disassemble pop-off valve; inspect and clean seats; reseat; reassemble.
	Bellows mounting rim loose	Remove rim and pop-off valve diaphragm; reseat diaphragm; snap rim (2) into place.
	Bellows improperly mounted or has a hole or tear	Check that only the last bellows convolute is mounted to the rim and that the ring roll is in the groove under the rim. Inspect the bellows for damage; replace.
Breathing System Leak	Absorber canister open or missing	Install canister properly.
	Soda lime dust on canister seals	Clean seals and mating surfaces.
Breathing System Leak (Intermittent)	ACGO O_2 sense check valve	Replace.
Unable to begin mechanical ventilation	ABS not fully engaged	Remount ABS.
	No O_2 supply	Check O_2 supply.
	Defective Bag/Vent switch	Check Bag/Vent switch.

7.3 Breathing System Leak Test Guide

Note Always do the ***System "Checkout"*** (Section 3.2) on the machine before proceeding with these breathing system leak tests.

Follow the troubleshooting flowcharts in Section 7.3.2 to determine the best sequence of tests for locating a breathing system leak.

The procedures in Section 7.3.3 test specific components of the breathing system for leaks.

⚠ WARNING Objects in the breathing system can stop gas flow to the patient. This can cause injury or death:

- Do not use a test plug that is small enough to fall into the breathing system.
- Make sure that there are no test plugs or other objects caught in the breathing system.

7.3.1 Check Valves

Make sure that the check valves on the breathing circuit module work correctly: The Inspiratory check valve rises during inspiration and falls at the start of expiration. The Expiratory check valve rises during expiration and falls at the start of inspiration. A leak across one of the check valves may be great enough to cause a “reverse flow” alarm.

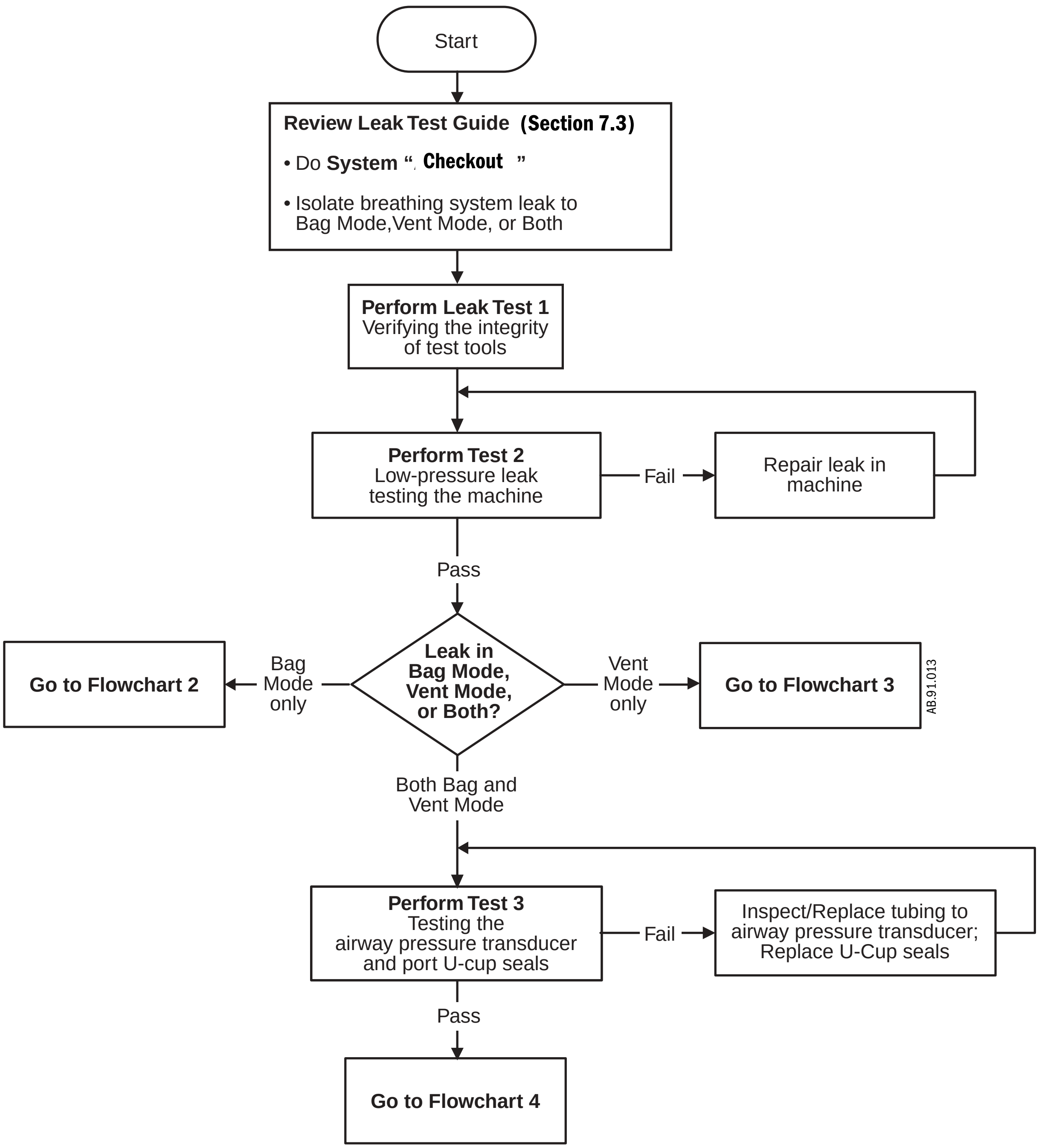
Inspiratory check valve

1. Set the system switch to On.
2. Set fresh gas flow to minimum.
3. If equipped with an ACGO, connect a tube between the ACGO outlet and the Inspiratory port.
   - Set the ACGO switch to the ACGO position.
   - Verify that the Airway Pressure reading increases to 10 cm H_2O in 30 seconds.
4. If not equipped with an ACGO, select End Case and connect a tube to the Inspiratory port.
   - Stretch the tube approximately 5 cm.
   - Occlude the open end of the tube.
   - Release the tension on the tube.
   - Ensure that the Airway Pressure reading increases to between 20 and 40 cm H_2O. If not, repeat the above steps, but stretch the tube a little further.
   - Verify that the Airway Pressure reading does not drop by more than 10 cm H_2O in 30 seconds.

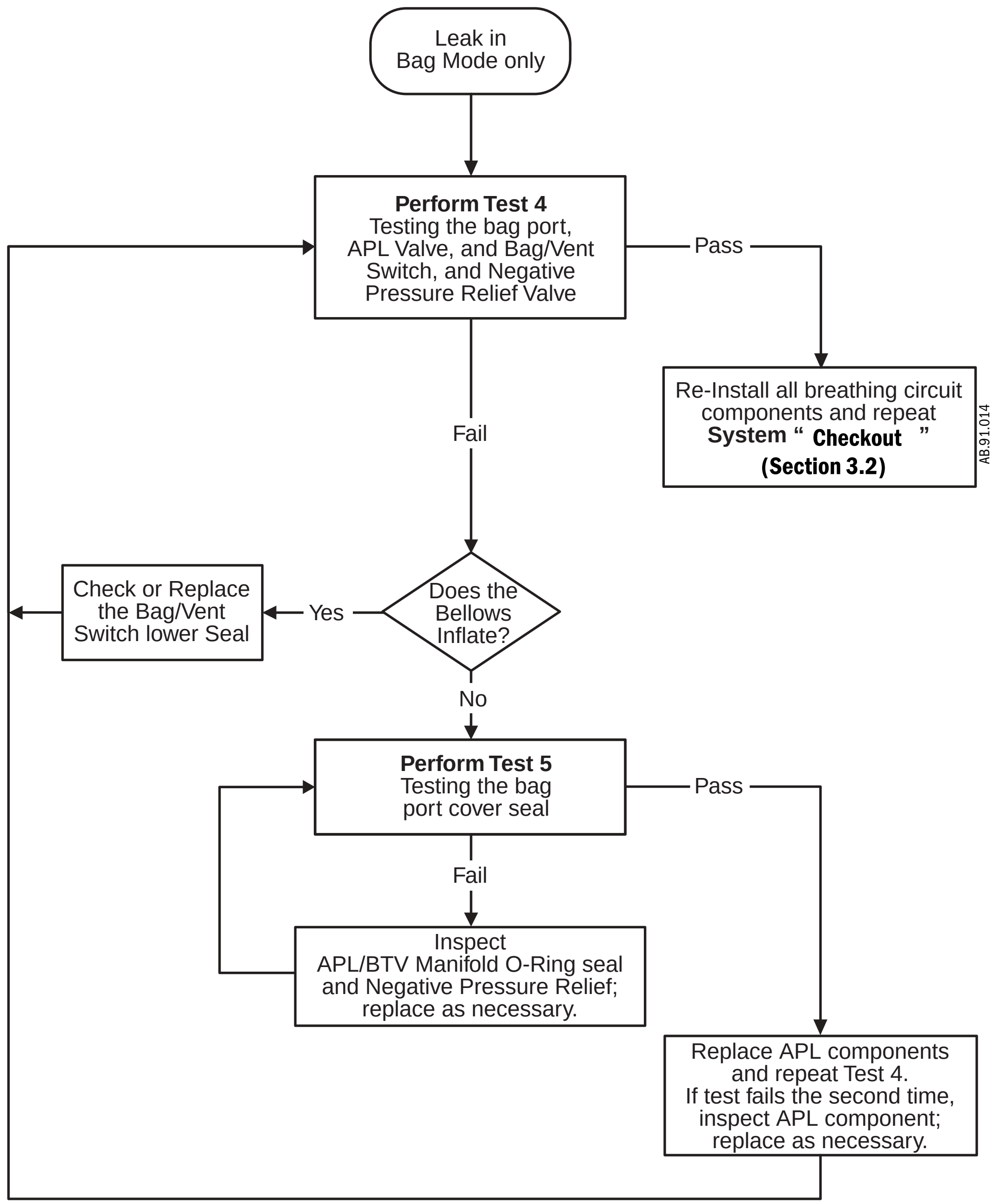
Expiratory check valve

1. Set all gas flows to minimum.
2. Set the Bag/Vent switch to Bag.
3. Fully close the APL valve (70 cm H_2O).
4. Connect a tube between the Inspiratory port and the Bag port.
5. Slowly increase the O_2 flow to achieve 30 cm H_2O.
   - The leak rate is equal to the flow needed to maintain 30 cm H_2O.
   - The leak rate should be less than 500 mL/min.

7.3.2 Breathing System Troubleshooting Flowcharts

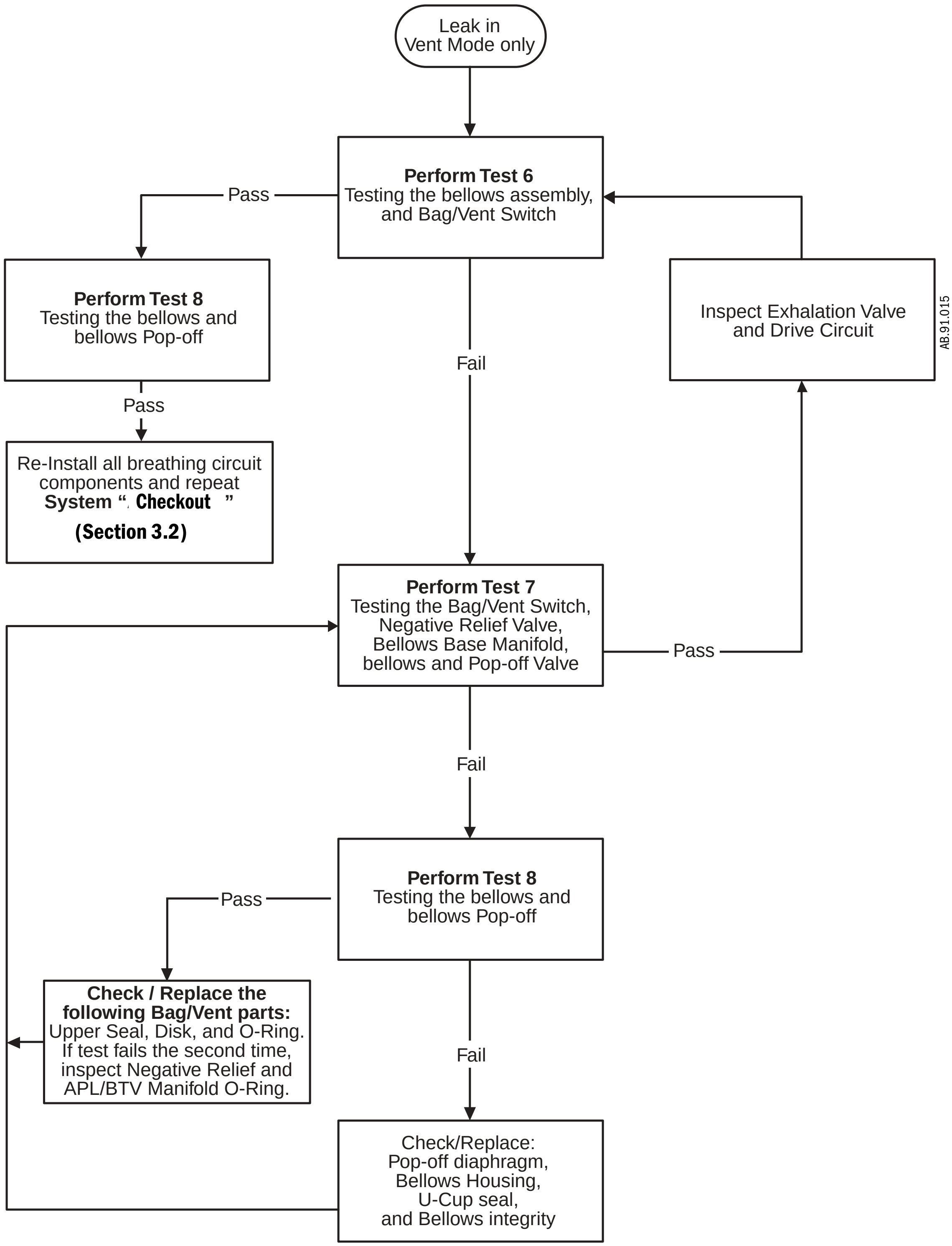


Flowchart **1**

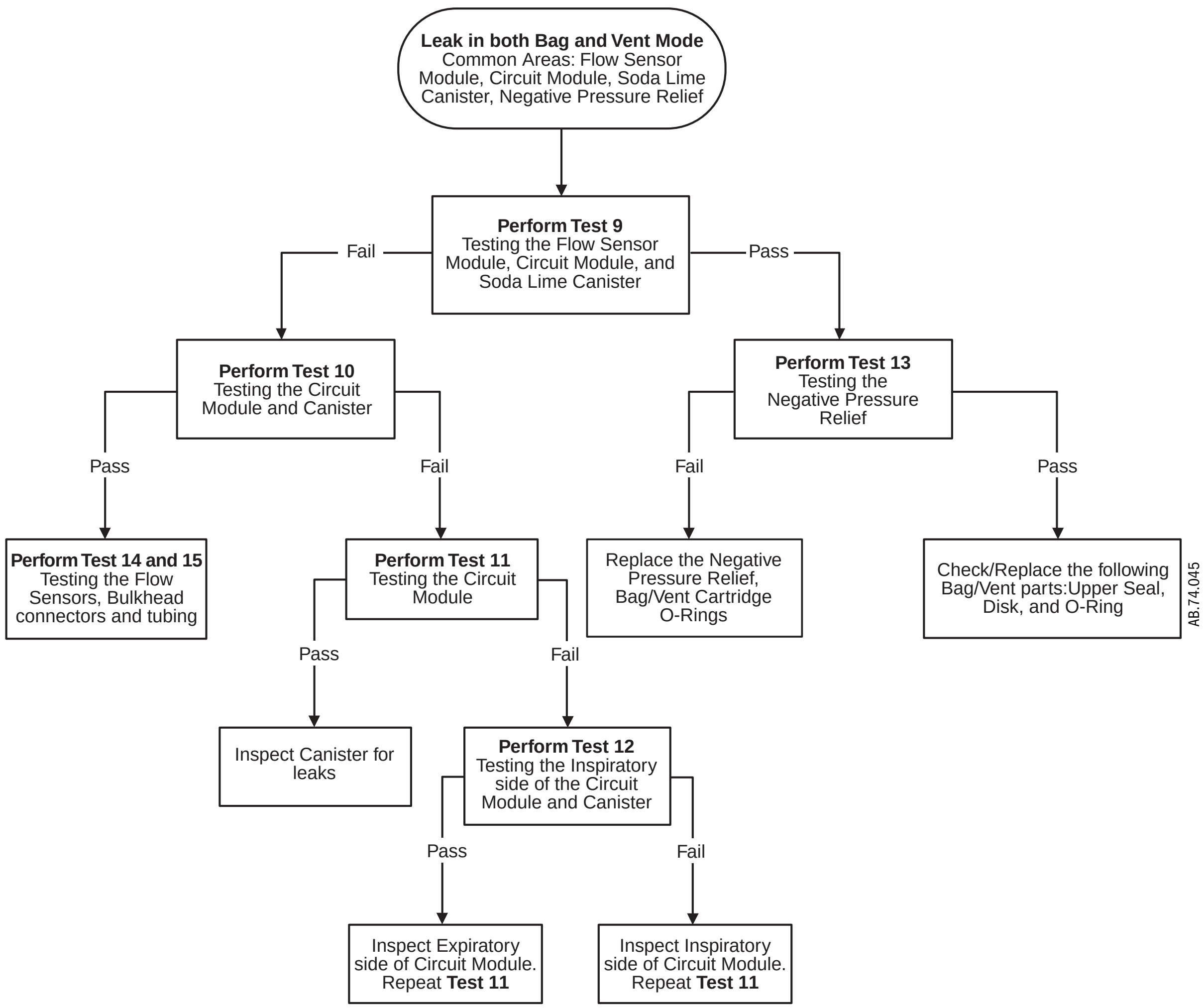


Leak in Bag Mode only
Perform Test 4 Testing the bag port, APL Valve, and Bag/Vent Switch, and Negative Pressure Relief Valve
Pass
Re-Install all breathing circuit components and repeat System "Checkout" (Section 3.2)
AB.91.014
Fail
Does the Bellows Inflate?
Yes
Check or Replace the Bag/Vent Switch lower Seal
No
Perform Test 5 Testing the bag port cover seal
Pass
Fail
Inspect APL/BTV Manifold O-Ring seal and Negative Pressure Relief; replace as necessary.
Replace APL components and repeat Test 4. If test fails the second time, inspect APL component; replace as necessary.

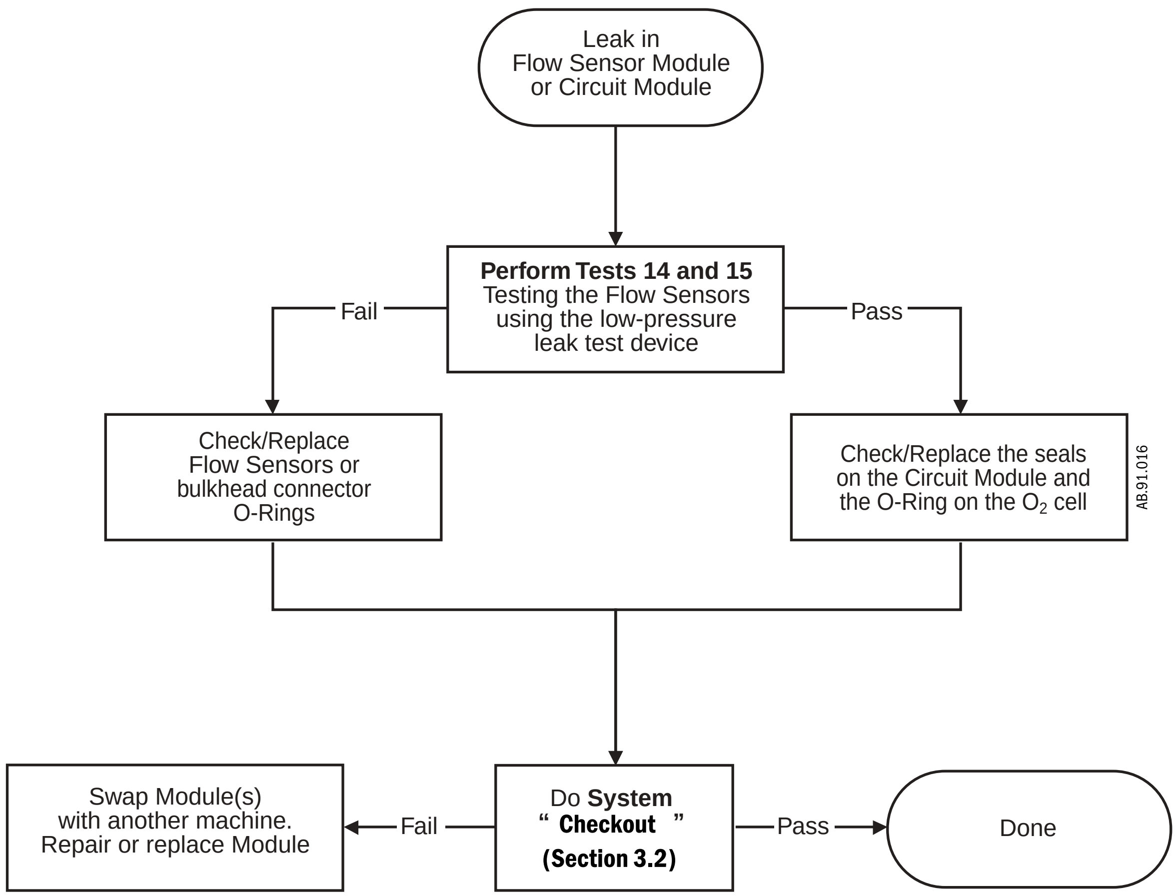
Flowchart 2


Leak in
Vent Mode only
Perform Test 6
Testing the bellows assembly, and Bag/Vent Switch
Pass
Perform Test 8
Testing the bellows and bellows Pop-off
Pass
Re-Install all breathing circuit components and repeat
System “ Checkout ”
(Section 3.2)
Fail
Inspect Exhalation Valve and Drive Circuit
AB.91.015
Perform Test 7
Testing the Bag/Vent Switch, Negative Relief Valve, Bellows Base Manifold, bellows and Pop-off Valve
Pass
Fail
Perform Test 8
Testing the bellows and bellows Pop-off
Pass
Check / Replace the following Bag/Vent parts:
Upper Seal, Disk, and O-Ring. If test fails the second time, inspect Negative Relief and APL/BTV Manifold O-Ring.
Fail
Check/Replace:
Pop-off diaphragm, Bellows Housing, U-Cup seal, and Bellows integrity

Flowchart 3


Leak in both Bag and Vent Mode
Common Areas: Flow Sensor Module, Circuit Module, Soda Lime Canister, Negative Pressure Relief
Perform Test 9
Testing the Flow Sensor Module, Circuit Module, and Soda Lime Canister
Fail
Pass
Perform Test 10
Testing the Circuit Module and Canister
Perform Test 13
Testing the Negative Pressure Relief
Pass
Fail
Fail
Pass
Perform Test 14 and 15
Testing the Flow Sensors, Bulkhead connectors and tubing
Perform Test 11
Testing the Circuit Module
Replace the Negative Pressure Relief, Bag/Vent Cartridge O-Rings
Check/Replace the following Bag/Vent parts:Upper Seal, Disk, and O-Ring
AB.74.045
Pass
Fail
Inspect Canister for leaks
Perform Test 12
Testing the Inspiratory side of the Circuit Module and Canister
Pass
Fail
Inspect Expiratory side of Circuit Module. Repeat Test 11
Inspect Inspiratory side of Circuit Module. Repeat Test 11

Flowchart 4


Leak in
Flow Sensor Module
or Circuit Module
Perform Tests 14 and 15
Testing the Flow Sensors
using the low-pressure
leak test device
Fail
Pass
Check/Replace
Flow Sensors or
bulkhead connector
O-Rings
Check/Replace the seals
on the Circuit Module and
the O-Ring on the O2 cell
AB.91.016
Swap Module(s)
with another machine.
Repair or replace Module
Fail
Do System
" Checkout "
(Section 3.2)
Pass
Done

Flowchart **5**

7.3.3 Leak Isolation Tests

The previous flowcharts refer you to the following tests.

These tests require the use of the Low Pressure Leak Test Device and the Leak Test Tool Kit (refer to Section 10.1, "Service tools").

The Leak Test Tool Kit includes:
- the Machine Test Tool
- the Circuit Test Tool
- and various Test Plugs

When performing these tests on machines with an ACGO outlet, ensure that the ACGO selector switch is set to the ABS (Circle circuit) position.

Note To perform most of these tests, you must boot the system with the PC Service Application and access the diagnostics functions as described in the test.

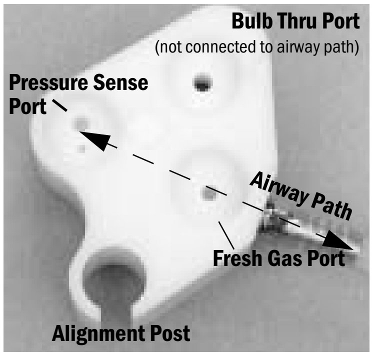
⚠ WARNING Objects in the breathing system can stop gas flow to the patient. This can cause injury or death:

- Do not use a test plug that is small enough to fall into the breathing system.
- Make sure that there are no test plugs or other objects caught in the breathing system.

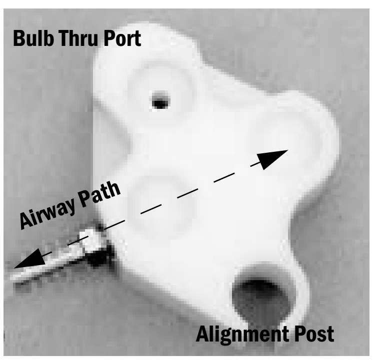
⚠ CAUTION Do not use O_2 Flush for leak isolation tests. Do not leave pressurized systems unattended. High pressure and equipment damage may result.

Test 1 Verifying the integrity of the test tools

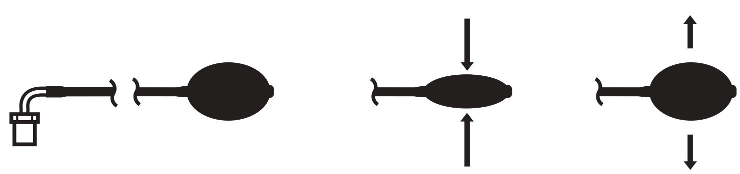
Machine Test Tool
Front View



Back View



1. Verify integrity of low-pressure leak test device.
   - Put your hand on the inlet of the leak test device. Push hard for a good seal.
   - Squeeze the bulb to remove all air from the bulb.
   - If the bulb completely inflates in less than 60 seconds, replace the leak test device.



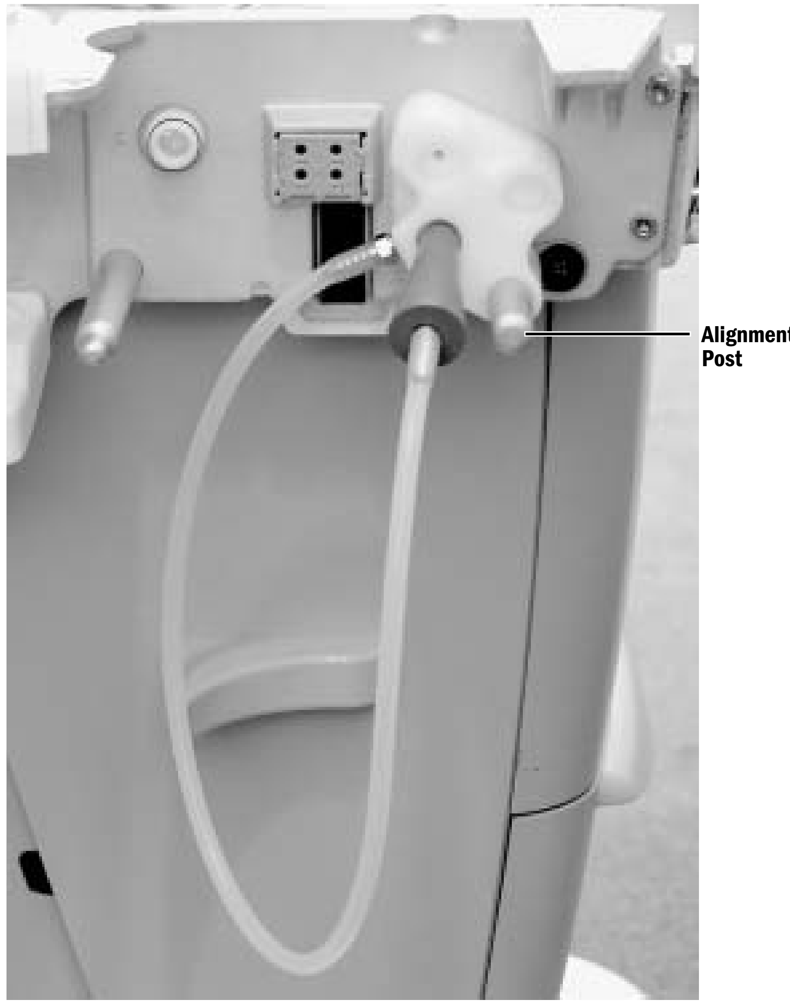
2. Attach the low-pressure leak test device to the Machine Test Tool.
3. Plug the two pressure orifices.
4. Repeatedly squeeze and release the hand bulb until it remains collapsed.
5. If the bulb inflates in less than 30 seconds, locate and correct the leak.

Test 2 Low-pressure leak testing the machine

1. Remove the breathing system from the machine.
2. Attach the Machine Test Tool (using only the Thru Port) and the low-pressure leak test device to **Port 3** of the breathing system interface as shown above.

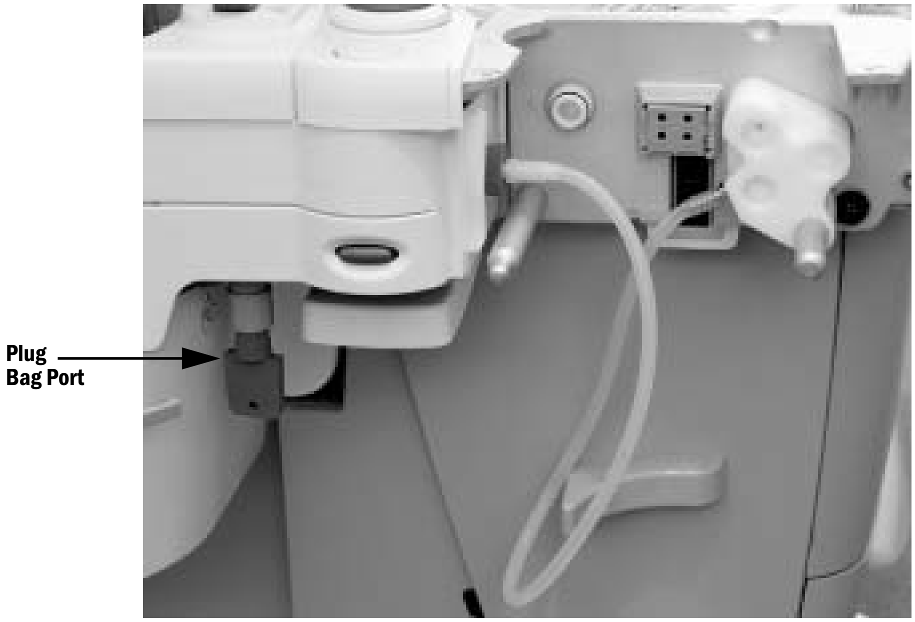
   Note: To prevent damage to the airway pressure transducer, ensure that the gauge port (**Port 1**) is not connected to the Test Tool.
3. Access the Ventilation Schematic (Section 12.2.3) of the Service Application.
4. Ensure that the ***Circuit Setting*** shows is set to Circle.
   - For machines with an ACGO outlet, ensure that the ACGO selector switch is set to the ABS (circle breathing circuit).
5. Compress and release the bulb until it is empty.
6. If the bulb completely inflates in 30 seconds or less, there is a leak in the low-pressure circuit.

Test 3 Testing the airway pressure transducer, and Port 1 and Port 3 u-cup seals



1. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
2. Set O_2 Flow to **0.2 l/min**.
3. Attach the Machine Test Tool to the breathing system interface ports (using the alignment post) as shown above.
4. Occlude the tapered plug.
   - the Airway Pressure reading should increase.
   - If not, there is a leak in the tested circuit.
5. Set O_2 Flow to 0.00 l/min.

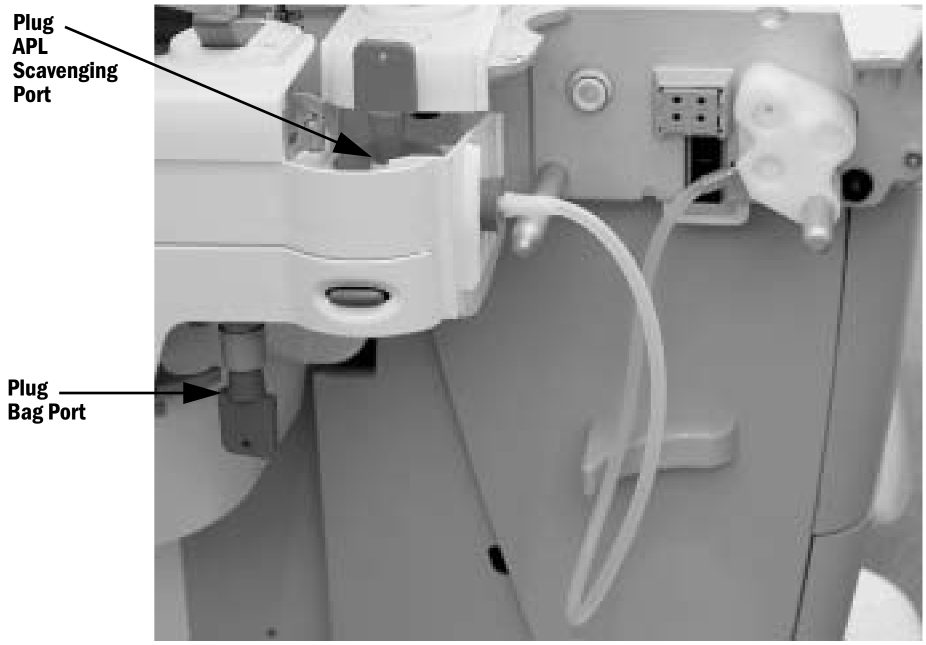
Test 4 Testing the bag port cover, the APL valve, the Bag/Vent switch, and the negative pressure relief valve



1. Separate the Bellows Module from the Circuit Module and re-install the Bellows Module.
2. Occlude the Bag Port connector.
3. Connect the Machine Test Tool to the interface ports as shown above.
4. Set the Bag /Vent switch to Bag and close the APL Valve (70 cm H_2O).
5. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
6. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.

   Note: If the bellows rises, it indicates a leak in the Bag /Vent Switch.
7. Set O_2 Flow to 0.00 l/min.

Test 5 Testing the APL diaphram

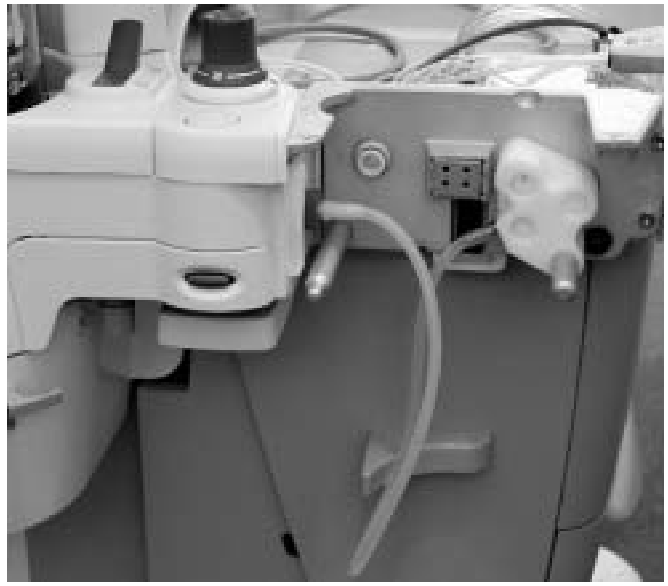


Note If required, set up the Machine Test Tool and breathing system as shown in Test 4.

1. Slide the Bellows Module away from the machine.
2. Remove the APL ramp and diaphragm.
3. Insert a Test Plug into the APL scavenging port, as shown above.
4. Slide the Bellows Module partially back onto the machine casting.
5. Ensure that the Bag Port is plugged and that the Bag/Vent switch is set to Bag.
6. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
7. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.

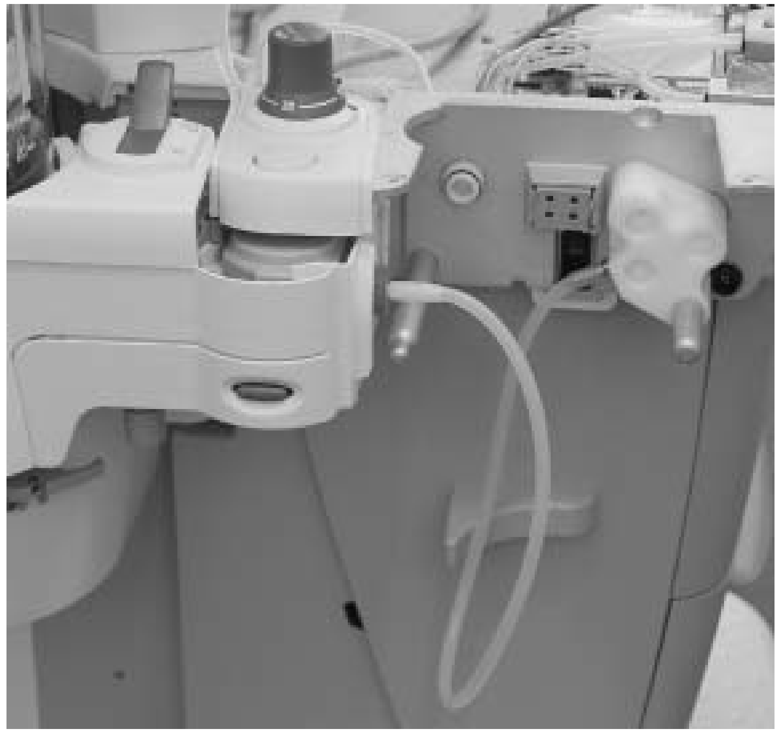
   Note: If the bellows rises, it indicates a leak in the Bag /Vent Switch.
8. Set O_2 Flow to 0.00 l/min.

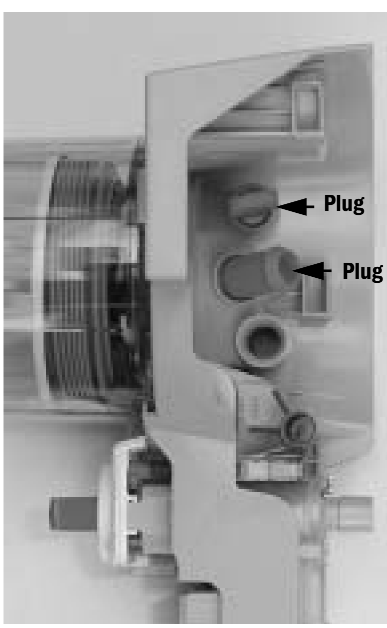
Test 6 Testing the bellows module and the Bag/Vent switch



1. Separate the Bellows Module from the Circuit Module and re-install the Bellows Module.
2. Connect the Machine Test Tool to the interface ports as shown above.
3. Set the Bag/Vent switch to the Vent position.
4. Access the Ventilator Schematic (Section 12.2.3) of the Service Application.
5. Set ***Gas Inlet Valve*** to ***On***.
6. Set ***Insp Flow Valve*** to approximately 900 to 950 counts to achieve a Manifold Pressure of 60 cm H_2O.
7. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
8. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.
9. Set O_2 Flow to 0.00 l/min.
10. Set ***Gas Inlet Valve*** to ***Off***.

Test 7 Testing the bellows, the bellows pop-off valve, the bellows base manifold, and the Bag/Vent switch



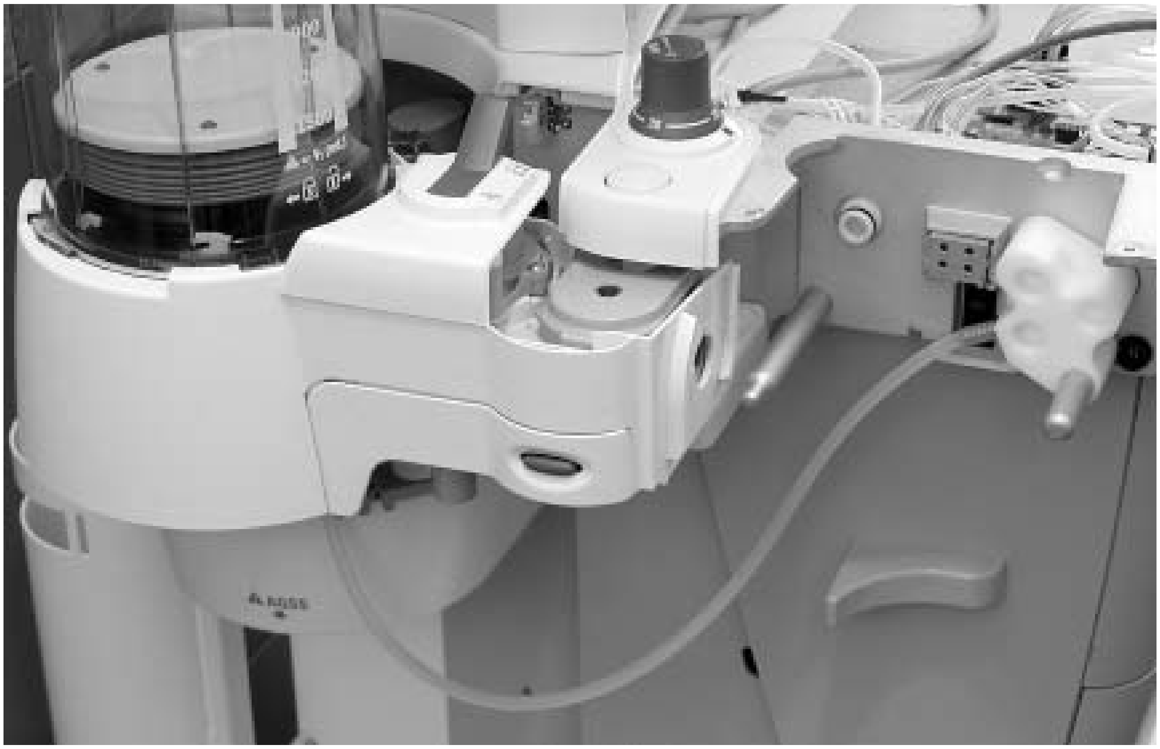


1. Separate the Bellows Module from the Circuit Module.
2. Insert appropriate test plugs into the bellows base manifold as shown to the left.

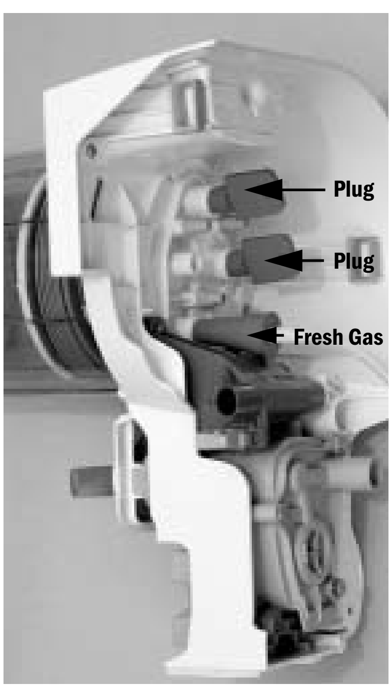
   Note: Position the bellows assembly so that the bellows remain collapsed as you plug the ports.
3. Set Bag/Vent switch to Vent.
4. Position the bellows upright with the bellows collapsed.
5. Connect the Machine Test Tool to the interface ports as shown above.
6. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
7. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.

   Note: If the bellows rises, it indicates a leak in the Bag /Vent Switch.
8. Set O_2 Flow to 0.00 l/min.

Test 8 Testing the bellows assembly



Note If required, set up the Machine Test Tool and breathing system as shown in Test 7.



1. Remove the bellows base manifold from the Bellows Module.
2. Insert appropriate test plugs into the bellows base manifold as shown to the left.

   Note: Position the bellows assembly so that the bellows remain collapsed as you plug the ports.
3. Connect the tapered plug of the Machine Test Tool to the bellows base inlet as shown to the left.
4. Position the bellows upright with the bellows collapsed.
5. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
6. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.

   Note: If the bellows rises, it indicates a leak in the Bag /Vent Switch.
7. Set O_2 Flow to 0.00 l/min.

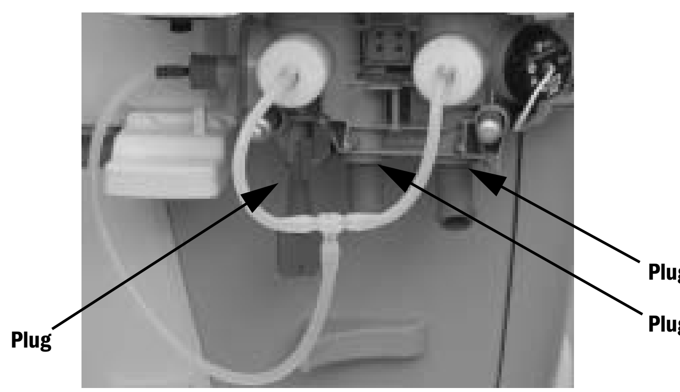
Test 9 Testing the flow sensor module, the circuit module, and the soda lime canister

1. Separate the Bellows Module from the Circuit Module and re-install the Circuit/Flow Sensor Module.
2. Connect short tubing between the inhalation and exhalation ports of the breathing system.
3. Insert an appropriate test plug in the outlet port of the Circuit Module.
4. Access the Gas Delivery Schematic (Section 12.2.2) of the Service Application.
5. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.
6. Set O_2 Flow to 0.00 l/min.
7. Remove the plug to release pressure.

Test 10 Testing the circuit module and the canister

1. Remove the Flow Sensor module.
2. Connect the Circuit Test Tool to the Circuit Module as shown above.
3. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.
4. Set O_2 Flow to 0.00 l/min.

Test 11 Testing the circuit module

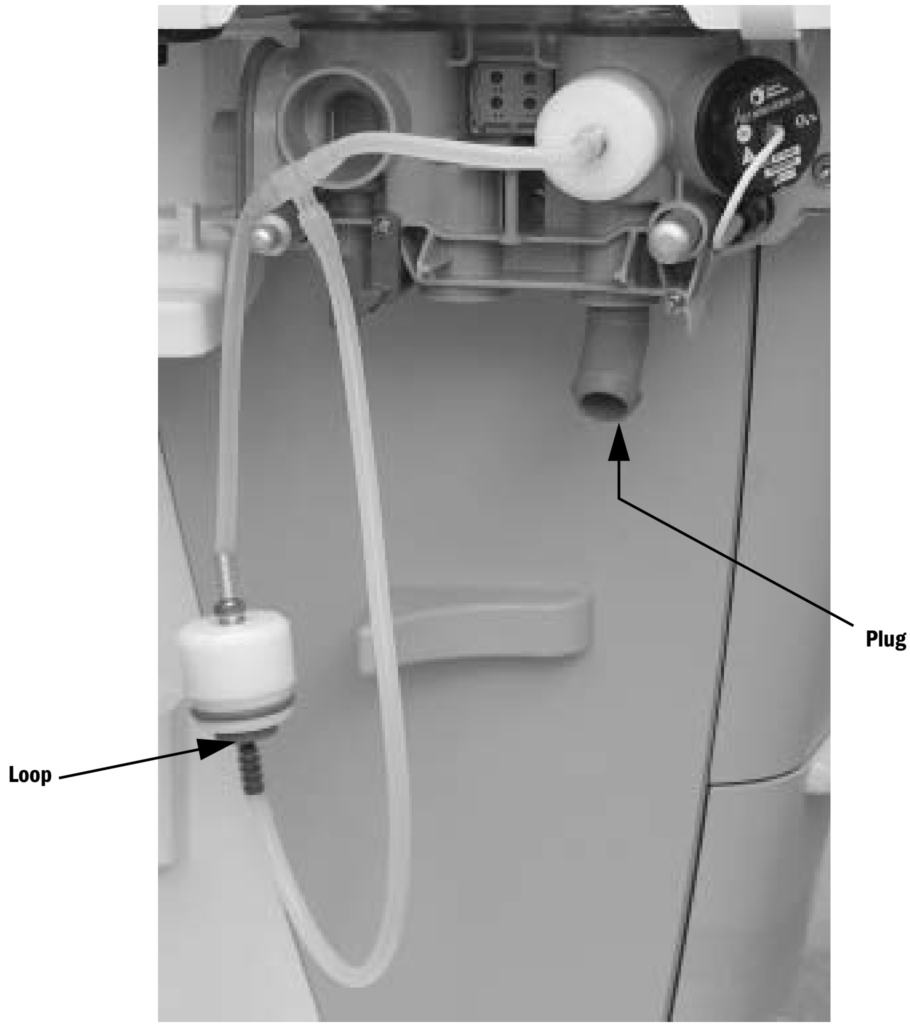


Note: If required, set up the machine as in Test 10.

1. Remove the Soda Lime Canister.
2. Using appropriate Test Plugs, plug the three canister ports in the Circuit Module as shown above.
3. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.

   Note: If the bellows rises, it indicates a leak in the Bag /Vent Switch.
4. Set O_2 Flow to 0.00 l/min.

Test 12 Testing the inspiratory side of the circuit module



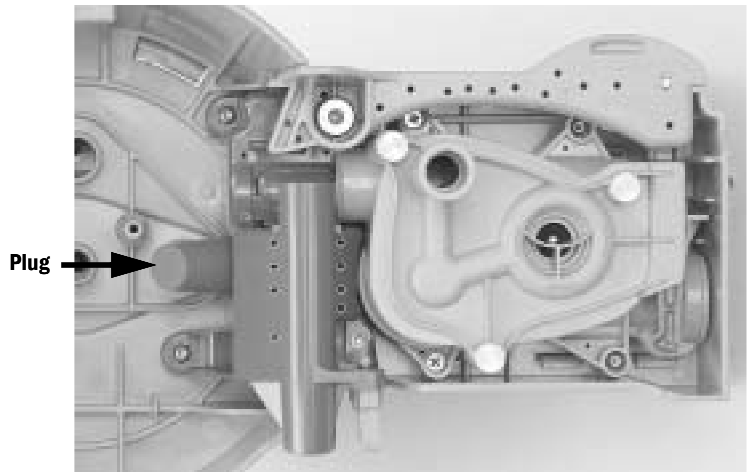
Note: If required, set up the machine as in Test 10 and 11.

1. Connect the Circuit Test Tool to the Circuit Module as shown above.
2. Insert an appropriate test plug in the inspiratory outlet to the canister as shown above.
3. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.

   Note: If the bellows rises, it indicates a leak in the Bag /Vent Switch.
4. Set O_2 Flow to 0.00 l/min.

Test 13 Testing the negative pressure relief valve

1. Separate the Bellows Module from the Circuit Module.
2. Remove the Bellows Interface Manifold.
3. Insert test plug (recessed end) into the rear Bag/Vent switch port as shown.

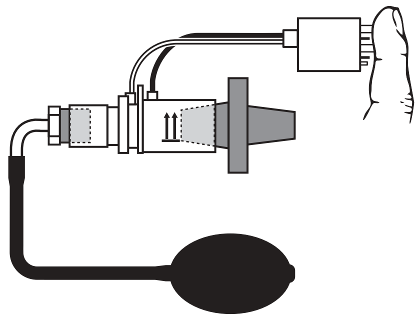


4. Install the Bellows Module.
5. Connect the Machine Test Tool to the interface ports and the Bellows Module as shown above.

6. Set the Bag/Vent Switch to Vent.
7. Set O_2 Flow to **0.2 l/min**.
   - Ensure that the Airway Pressure rises to ≥ 30 cm H_2O.

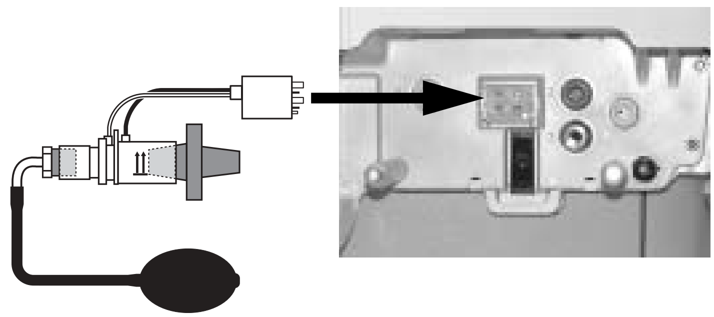
   Note: If the bellows rises, it indicates a leak in the Bag /Vent Switch.
8. Set O_2 Flow to 0.00 l/min.

Test 14 Testing the flow sensors only



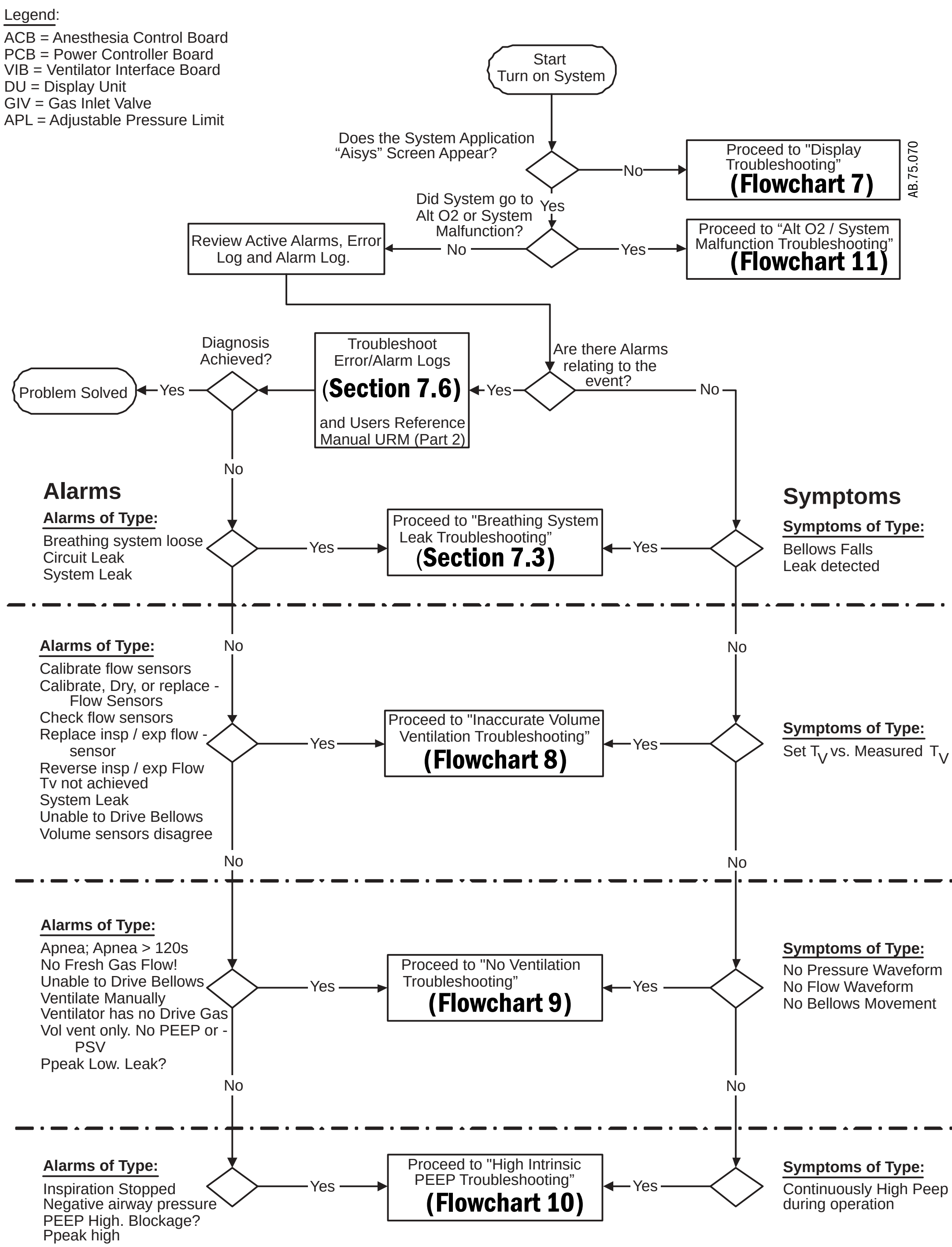
1. Remove the Flow Sensor Module.
2. Plug each Flow Sensor as shown above.
3. Connect the low-pressure leak test device to the open end of the Flow Sensor.
4. Block the connector end of the Flow Sensor with your hand.
5. Compress and release the bulb until it is empty.
6. If the bulb inflates in 30 seconds or less, there is a leak in the flow sensor.
7. If there are no leaks in the flow sensors, go to Test 15.

Test 15 Testing a flow sensor including the Ventilator Monitoring Assembly and interfacing components



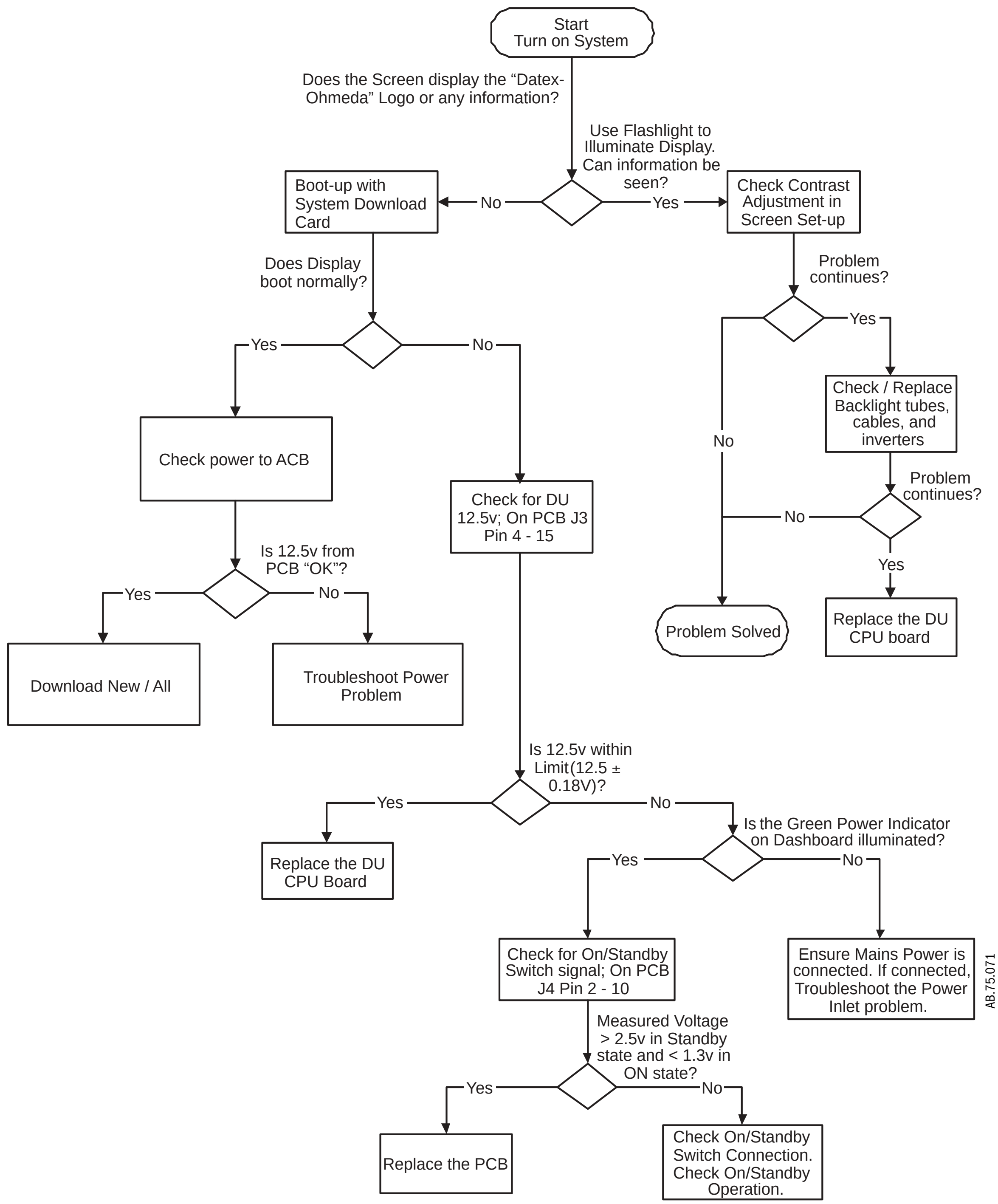
1. Remove Flow Sensors from the Flow Sensor Module.
2. Attach the Flow Sensor to the bulkhead connector.
3. Plug each Flow Sensor as shown.
4. Connect the low-pressure leak test device to the open end of the Flow Sensor.
5. Compress and release the bulb until it is empty.
6. If the bulb inflates in 30 seconds or less, there is a leak. The leak may be through the connector o-rings, in the internal tubbing, or in the Transducer on the VIB.

7.4 System Troubleshooting Flowcharts



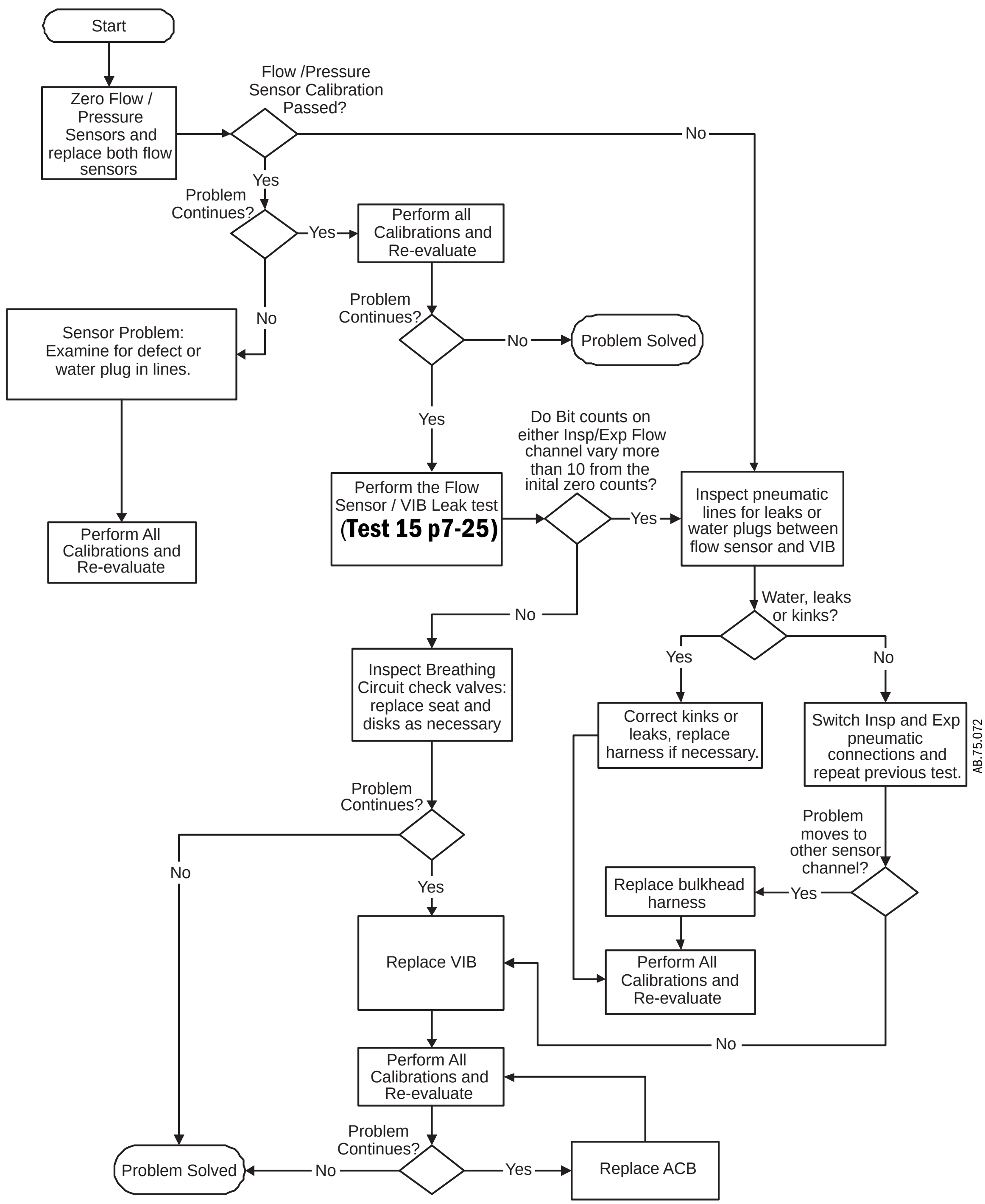
Flowchart ***6***

Display Troubleshooting



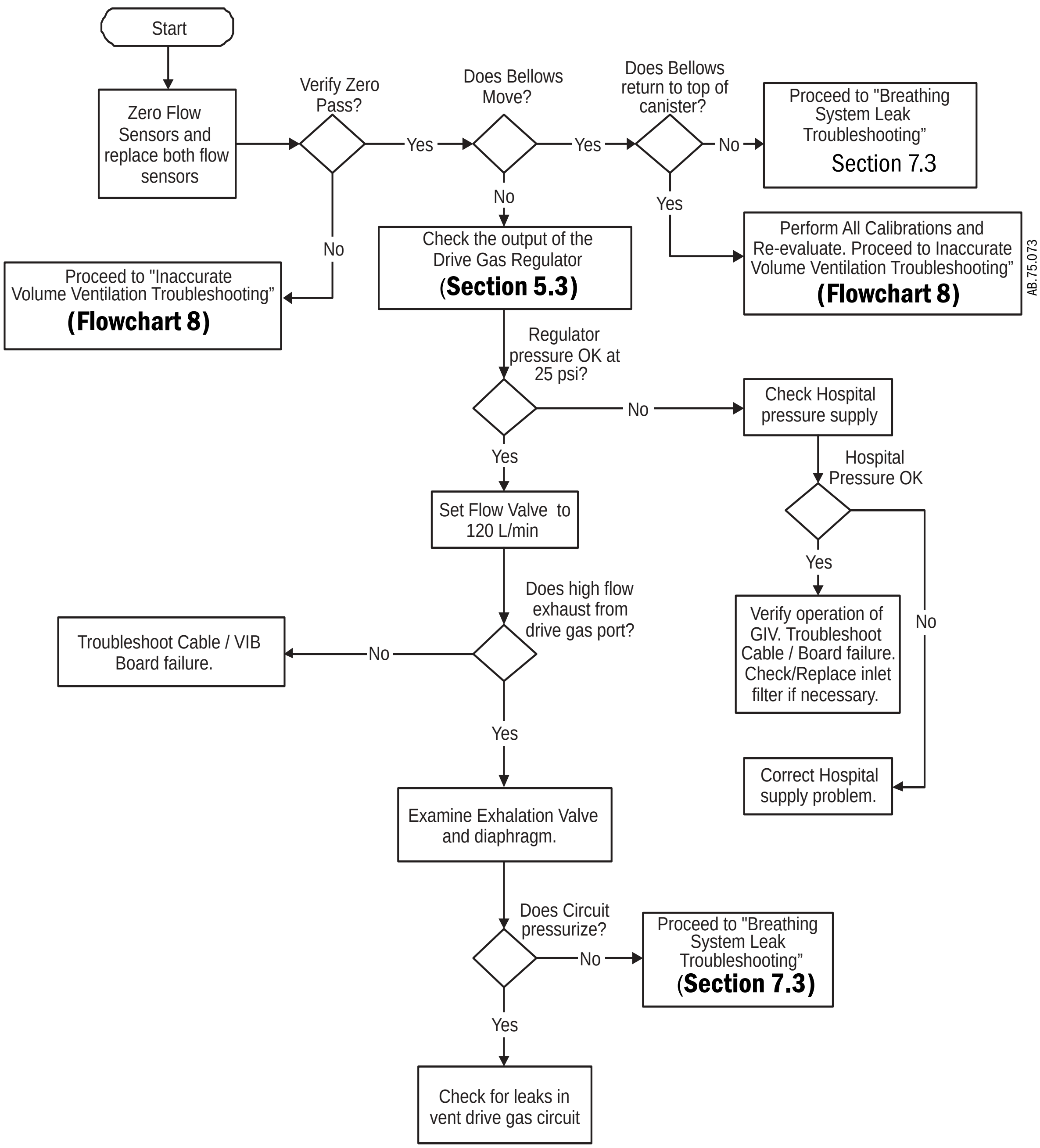
Flowchart ***7***

Inaccurate Volume Ventilation Troubleshooting



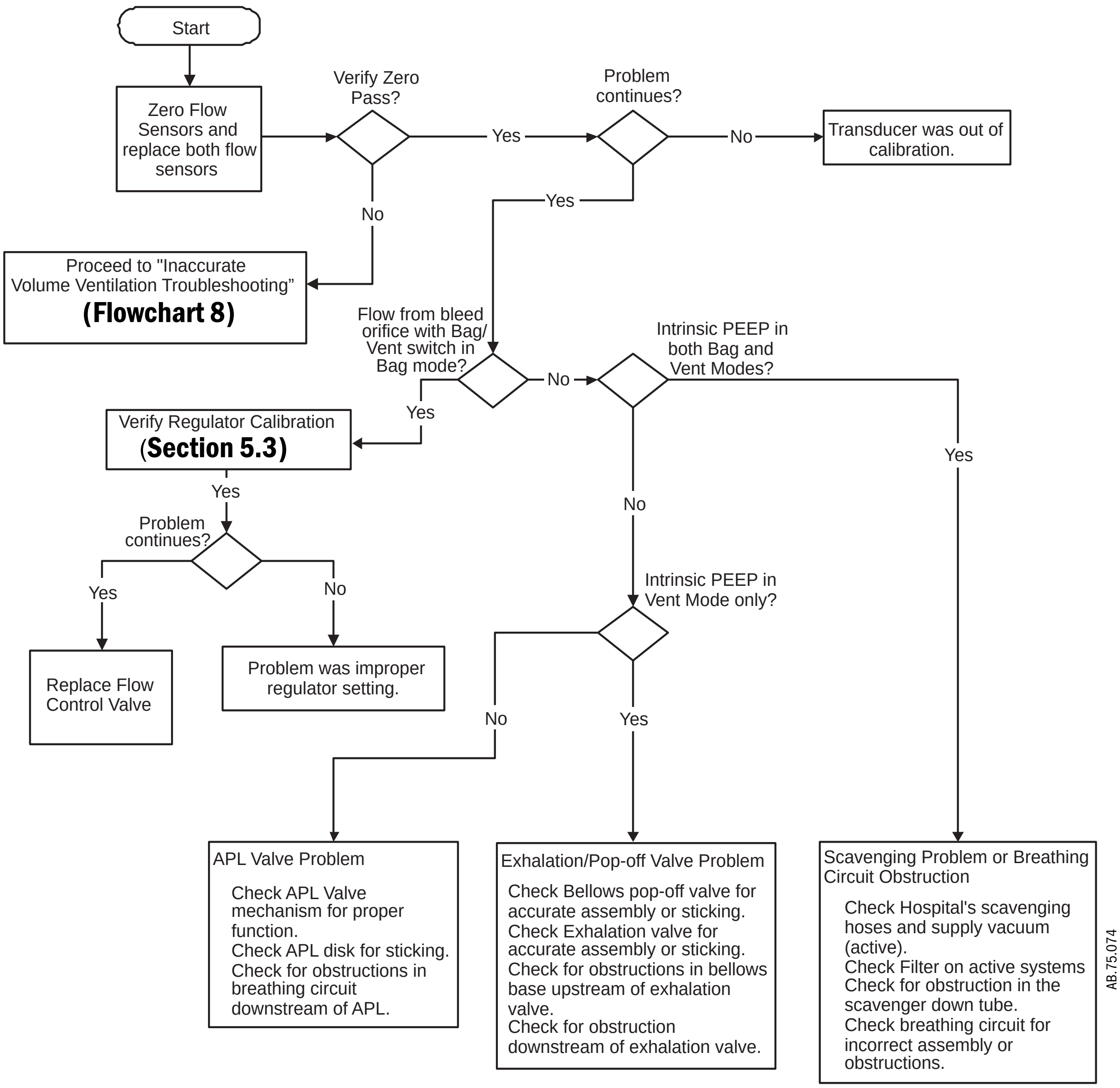
Flowchart **8**

No Ventilation Troubleshooting



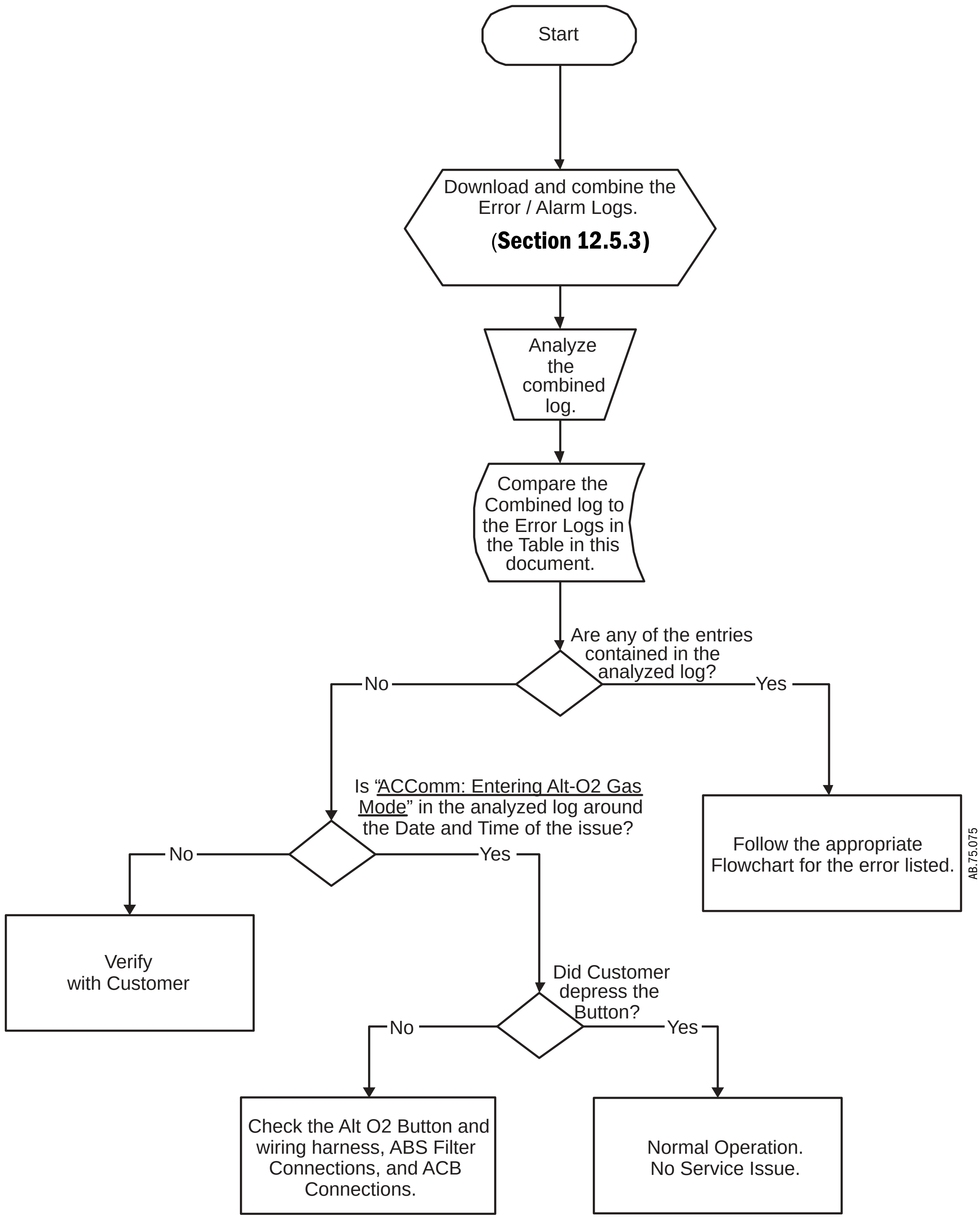
Flowchart **9**

High Intrinsic PEEP Troubleshooting



Flowchart ***10***

Alternate O_2 / System Malfunction Screen Troubleshooting

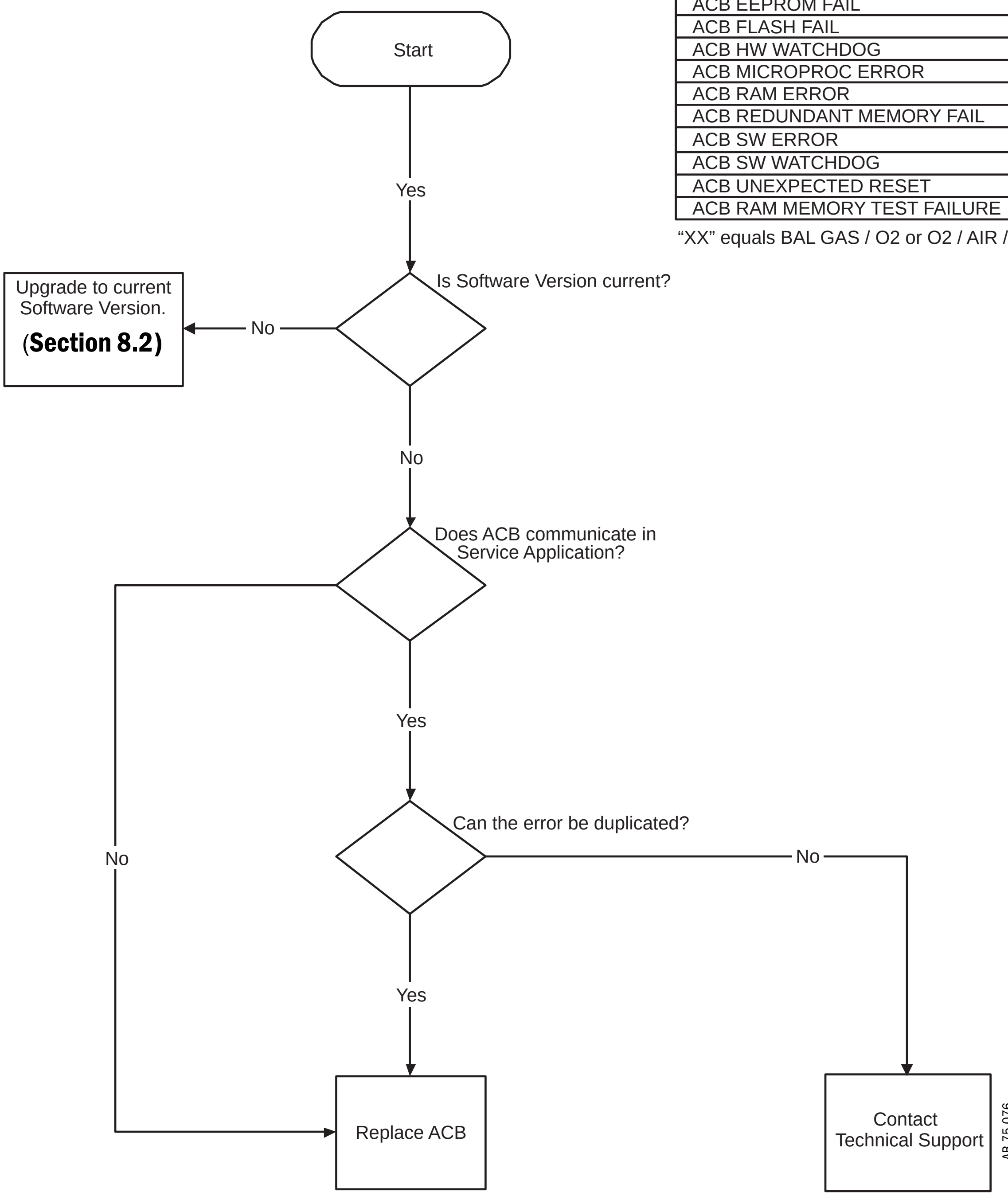


Flowchart **11**

Anesthesia Control Board Troubleshooting

Error Entry
ACB CLOCK SPEED
ACB CPU TEST FAIL
ACB EEPROM FAIL
ACB FLASH FAIL
ACB HW WATCHDOG
ACB MICROPROC ERROR
ACB RAM ERROR
ACB REDUNDANT MEMORY FAIL
ACB SW ERROR
ACB SW WATCHDOG
ACB UNEXPECTED RESET
ACB RAM MEMORY TEST FAILURE

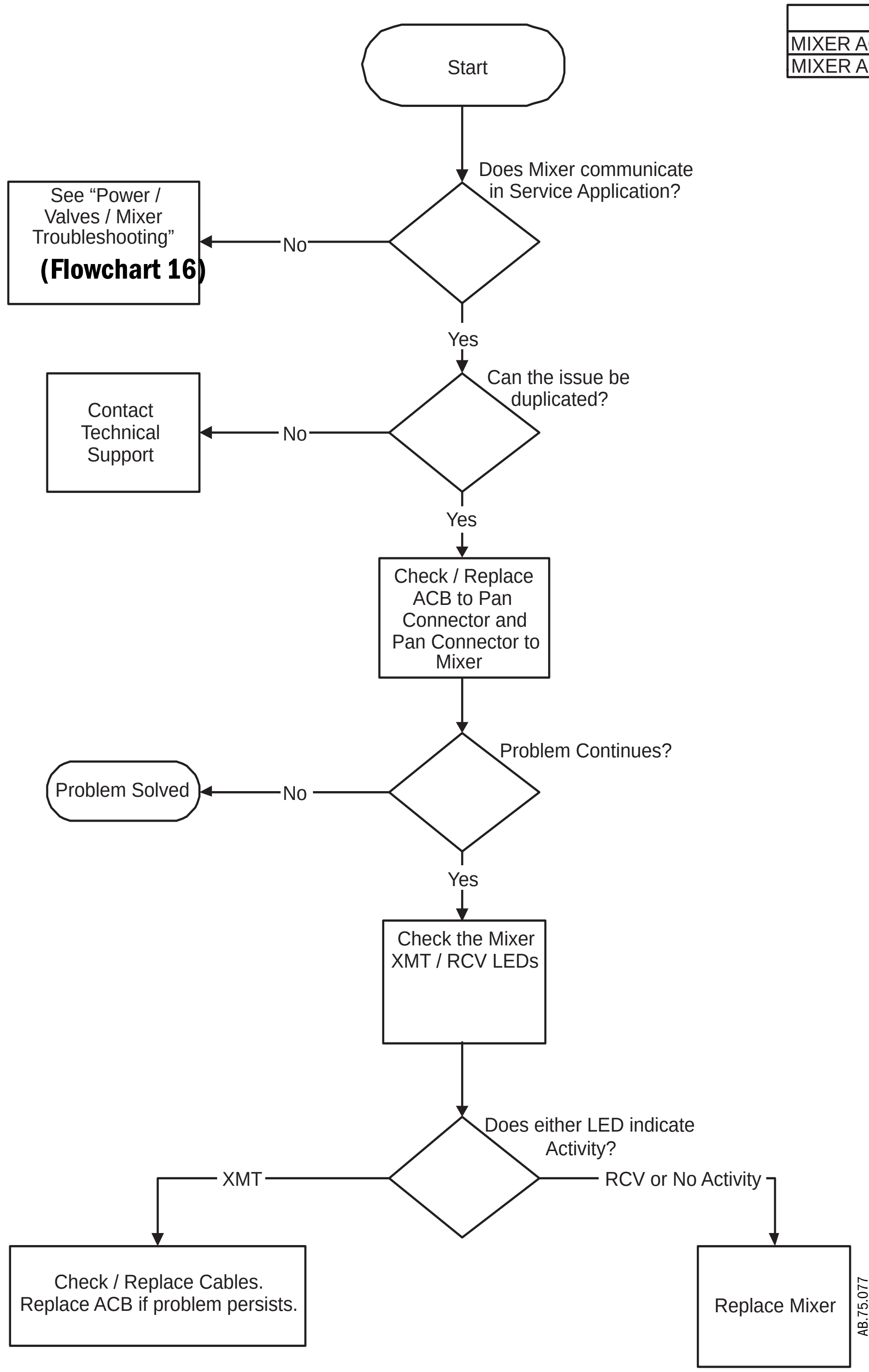
"XX" equals BAL GAS / O2 or O2 / AIR / N2O



Flowchart **12**

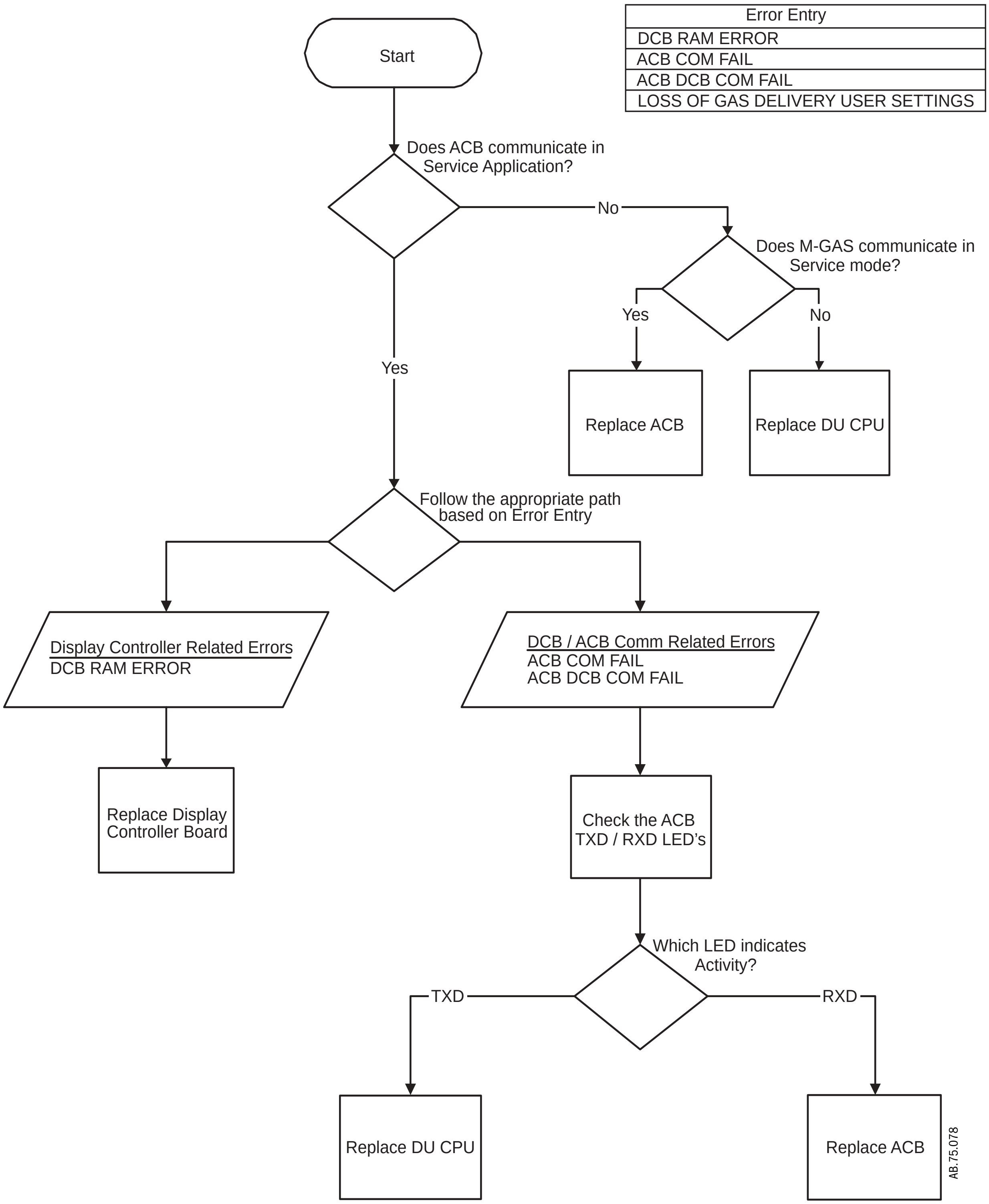
ACB - Mixer Troubleshooting

Error Entry
MIXER ACB COM FAIL
MIXER ACB COM FAILLOST CMD



Flowchart ***13***

DU - ACB Communication Troubleshooting

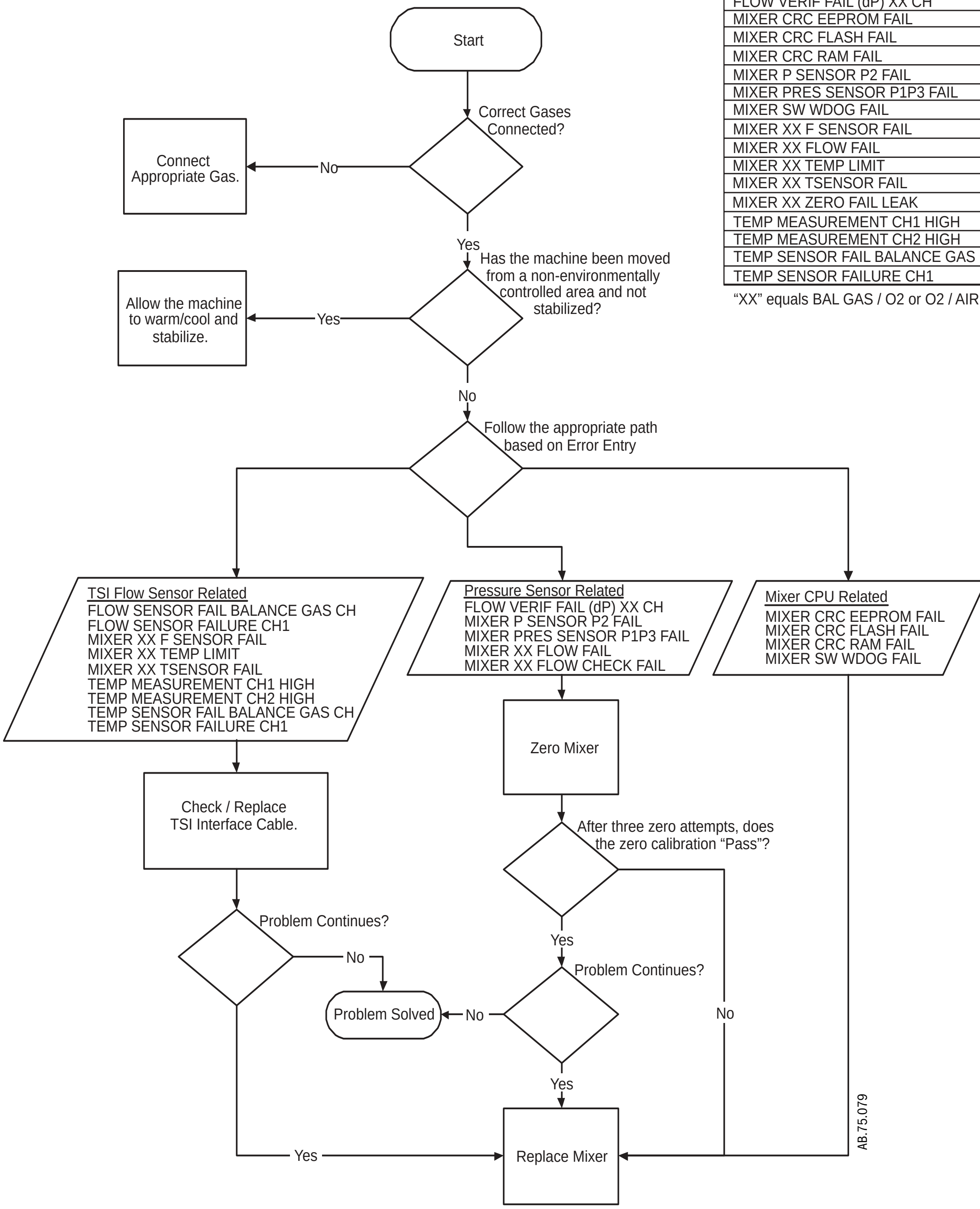


Flowchart ***14***

Mixer Specific Troubleshooting

Error Entry
FLOW SENSOR FAIL BALANCE GAS CH
FLOW SENSOR FAILURE CH1
FLOW VERIF FAIL (dP) XX CH
MIXER CRC EEPROM FAIL
MIXER CRC FLASH FAIL
MIXER CRC RAM FAIL
MIXER P SENSOR P2 FAIL
MIXER PRES SENSOR P1P3 FAIL
MIXER SW WDOG FAIL
MIXER XX F SENSOR FAIL
MIXER XX FLOW FAIL
MIXER XX TEMP LIMIT
MIXER XX TSENSOR FAIL
MIXER XX ZERO FAIL LEAK
TEMP MEASUREMENT CH1 HIGH
TEMP MEASUREMENT CH2 HIGH
TEMP SENSOR FAIL BALANCE GAS CH
TEMP SENSOR FAILURE CH1

“XX” equals BAL GAS / O2 or O2 / AIR / N2O

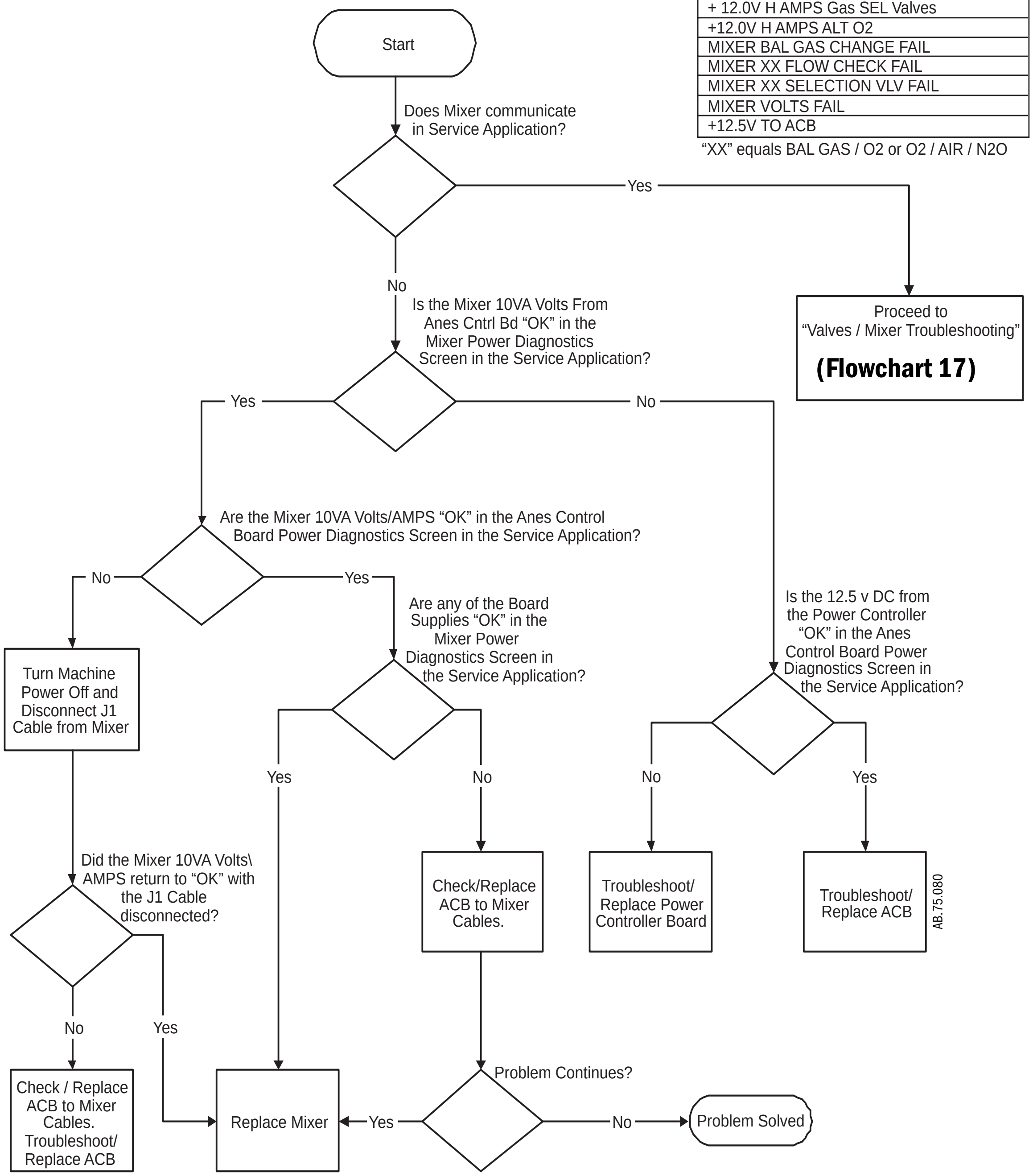


Flowchart 15

Power - Valves - Mixer Troubleshooting

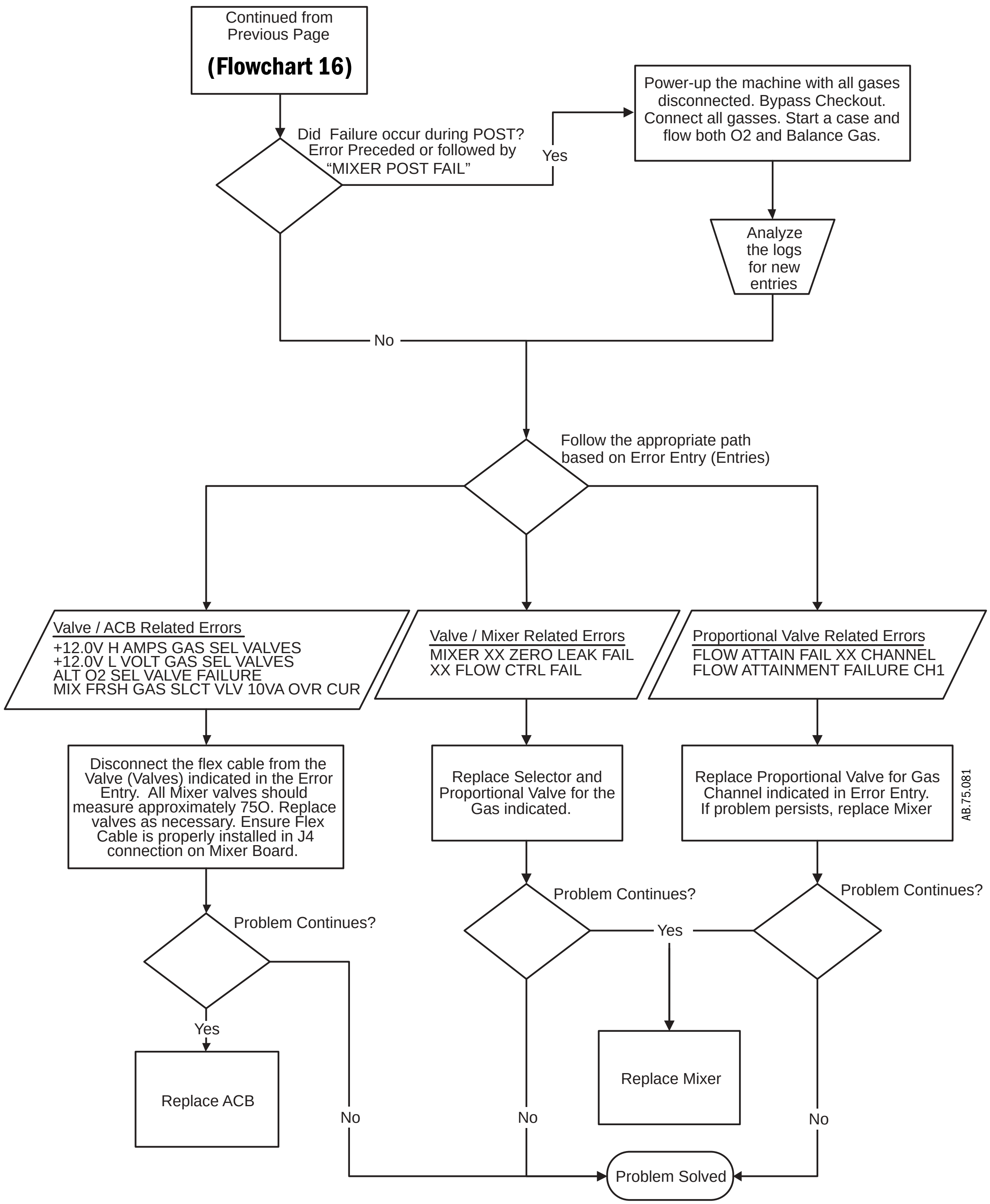
Error Entry
XX FLOW CTRL FAIL
XX PROP VALVE FAIL
FLOW ATTAIN FAIL BAL GAS CHANNEL
FLOW ATTAINMENT FAILURE CH1
+12.0V H AMPS MIXER
+ 12.0V H AMPS Gas SEL Valves
+12.0V H AMPS ALT O2
MIXER BAL GAS CHANGE FAIL
MIXER XX FLOW CHECK FAIL
MIXER XX SELECTION VLV FAIL
MIXER VOLTS FAIL
+12.5V TO ACB

"XX" equals BAL GAS / O2 or O2 / AIR / N2O



Flowchart **16**

Valves - Mixer Troubleshooting



Flowchart ***17***

7.5 Electronic Vaporizer Troubleshooting

As a general rule, proceed with electronic vaporizer fault isolation as follows:

1. Review the system error logs for vaporizer specific entries.
   - Refer to Section 7.6 for procedures related to the system error log entries.
2. Within the PC service application, perform the Vaporizer Test (Section 12.9.2).
   - Follow procedures below as directed by the vaporizer test results.
3. After servicing the vaporizer, rerun the Vaporizer Test to confirm any repairs made were successful.

7.5.1 Vaporizer Test Results

The Vaporizer Test will display extended diagnostic information upon completion.

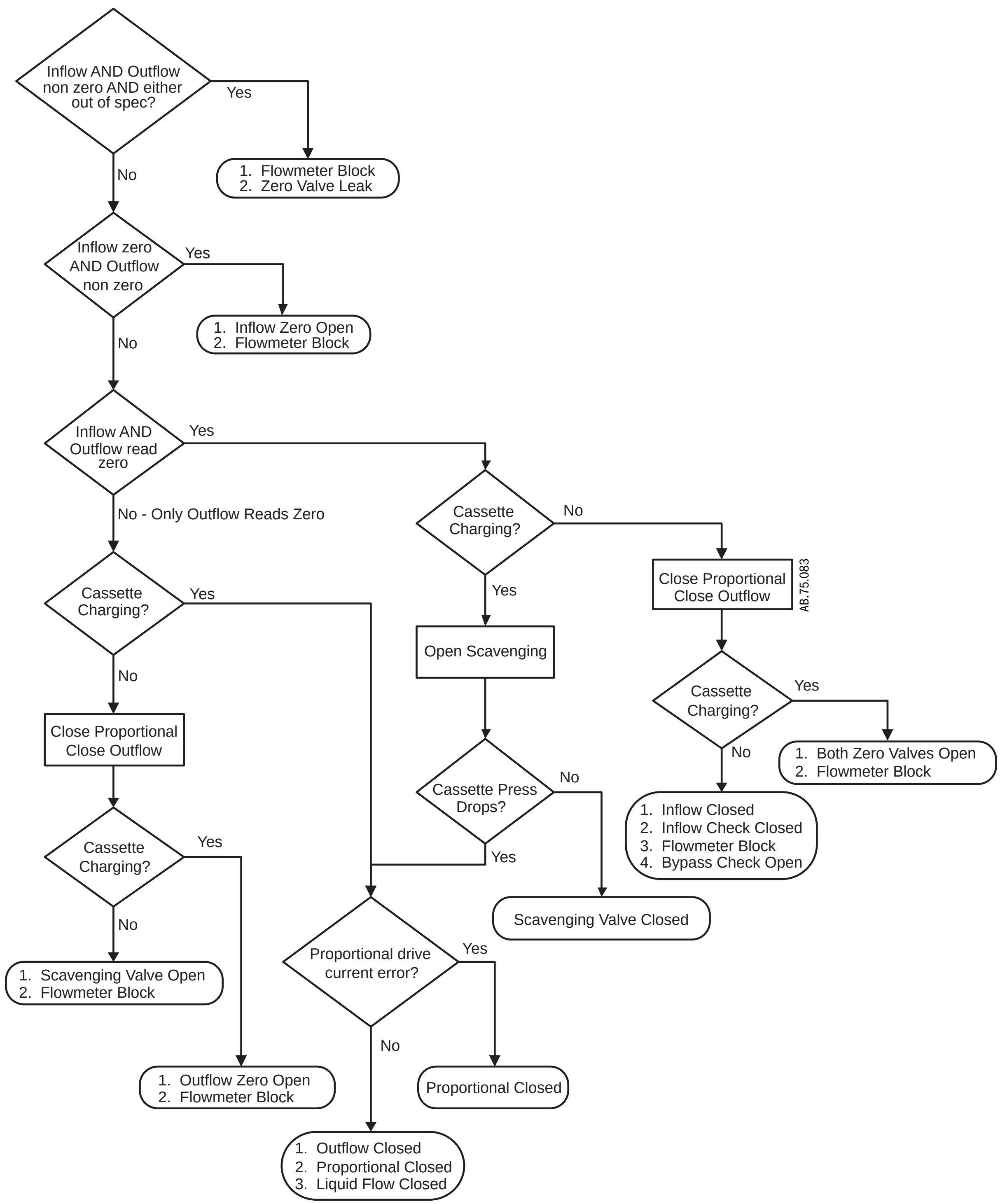
If the test passes, the message **PASSED: Electronic Vaporizer Subsystem Check** is displayed along with the data used during the check. This indicates that the vaporizer is ready for use.

If the check encounters a problem, it will perform an automated fault isolation procedure (Section 7.5.2). With most single fault failures the automated procedure will identify the failed component or a small set of possibilities.

In the event of a failure a variety of messages are possible. Refer to the table below for corrective actions.

7.5.2 Automated fault isolation procedure

In the event of a Vaporizer Test failure, an automated fault isolation procedure is performed. Refer to the following flowchart for insight into the tests performed by this automated procedure.



Flowchart **18**

7.5.3 Vaporizer Test Results troubleshooting procedures

Vaporizer Test message	Corrective Action
Check Terminated: No Cassette detected.	Insert Test cassette.
Check Terminated: O2 supply or mixer flow failure.	Correct O_2 supply or Mixer flow function faults before proceeding with Vaporizer Test.
Check Terminated: Ventilator in bag mode or non-circle selected (ACGO).	Place Bag/Vent switch to Vent, select circle, and retest.
FAILED: Cassette Circuit Flow Error - Inflow	Replace and retest in the following order: • Flowmeter Block • Inflow Zero Valve • ADB
FAILED: Cassette Circuit Flow Error - Outflow	Replace and retest in the following order: • Flowmeter Block • Outflow Zero Valve • ADB
FAILED: Cassette Pressure Incorrect.	Replace and retest in the following order: • Both zero valves leaking/stuck open. • Flowmeter Block • ADB
FAILED: Cassette: Leak detected.	Measured inflow is excessive when outflow and scavenging circuits are closed. If pre-use check also fails with a therapy cassette, replace and retest in the following order: • Missing, damaged, worn Mechanical Connector Valve o-rings. • Mechanical Connector Valves • Valve Block • Flowmeter Block NOTE: If pre-use test passes with a therapy cassette the Test Cassette may be leaking.
FAILED: Fault Detected. Invalid Outflow.	Replace and retest in the following order: • Outflow Zero Valve • Flowmeter Block • ADB
FAILED: Fault Detected. No cassette pressure rise.	Replace and retest in the following order: • Inflow Valve • Inflow Check Valve • Flowmeter Block • Bypass Check Valve • ADB
FAILED: Fault Detected. No output flow.	Replace and retest in the following order: • Scavenging Valve • Flowmeter Block • ADB

Vaporizer Test message	Corrective Action
FAILED: Flow Meter Block: Cassette pressure out of range.	If ‘Reading’ is significantly below ambient pressure, replace flowmeter block and retest. If ‘Reading’ is high, manually depressurize cassette and retest. If failure persists, replace and retest in the following order: • Flowmeter Block • ADB
FAILED: Flow Meter Block: Inflow/Outflow mismatch. (3000mL/min)	Replace and retest in the following order: • Flowmeter Block • ADB
FAILED: Flow Meter Block: Inflow/Outflow mismatch. (500mL/min)	Replace and retest in the following order: • Flowmeter Block • ADB
FAILED: Flow Meter Block: Mixer and cassette pressure sensors disagree. (High Pressure)	Mixer and Vaporizer measured pressures do not agree at the second of two test pressures (high pressure). Replace Flowmeter Block and retest. If problem persists, check troubleshooting procedures for Electronic Mixer. If mixer is not at fault, replace the ADB and retest.
FAILED: Flow Meter Block: Mixer and cassette pressure sensors disagree. (Low Pressure)	Mixer and Vaporizer measured pressures do not agree at the first of two test pressures (low pressure). Replace Flowmeter Block and retest. If problem persists, check troubleshooting procedures for Electronic Mixer. If mixer is not at fault, replace the ADB and retest.
FAILED: Flow Meter Block: Mixer/Inflow mismatch. (100mL/min)	Replace and retest in the following order: • Flowmeter Block • Mixer • ADB
FAILED: Flow Meter Block: Mixer/Inflow mismatch. (3000mL/min)	Replace and retest in the following order: • Flowmeter Block • Mixer • ADB
FAILED: Flow Meter Block: Mixer/Inflow mismatch. (500mL/min)	Replace and retest in the following order: • Flowmeter Block • Mixer • ADB
FAILED: Flow Meter Block: Noisy cassette pressure signal.	Cassette Pressure Sensor signal is noisier than can be expected under normal conditions. Replace and retest in the following order: • Flowmeter Block • ADB
FAILED: Inflow Check Valve: Leaking/Stuck open.	Replace and retest in the following order: • Inflow Check Valve • ADB
FAILED: Inflow Read Failure	Replace and retest in the following order: • Inflow Zero Valve • Flowmeter Block • ADB

Vaporizer Test message	Corrective Action
FAILED: Inflow Valve: Leaking/stuck open.	Replace and retest in the following order: • Inflow Valve • ADB
FAILED: Inflow Zero Valve: Failed closed.	Replace Inflow Zero Valve and retest.
FAILED: Maximum Cassette Circuit Flow Not Achieved.	Replace and retest in the following order: • Proportional Valve • Mechanical Connector Valves • Flowmeter Block • Outflow Valve • Inflow Valve • Scavenging Valve • ADB
FAILED: Mixer: Measured flow does not match set. (3000mL/min)	Mixer is not delivering commanded flow at a setting of 3000 mL/min. Check troubleshooting procedures for Electronic Mixer.
FAILED: Mixer: Measured flow does not match set. (500mL/min)	Mixer is not delivering commanded flow at a setting of 500 mL/min. Check troubleshooting procedures for Electronic Mixer.
FAILED: Outflow Read failure	Replace and retest in the following order: • Outflow Valve • Proportional Valve • Liquid Flow Valve • ADB
FAILED: Outflow Valve: Leaking/stuck open.	Replace and retest in the following order: • Outflow Valve • ADB
FAILED: Outflow Zero Valve: Failed closed.	Replace Outflow Zero Valve and retest.
FAILED: Proportional Valve: Drive current error detected	Replace and retest in the following order: • Proportional Valve • ADB
FAILED: Proportional Valve: Erratic operation, sticking	Replace and retest in the following order: • Proportional Valve • ADB
FAILED: Proportional Valve: Leaking/stuck open.	Replace and retest in the following order: • Proportional Valve • ADB
FAILED: Scavenging Valve: Failed closed	Replace and retest in the following order: • Scavenging Valve • Proportional Valve • ADB

7.6 Technical Alarms

The Error Log includes technical alarms and other error conditions reported by the system.

A technical alarm, as apposed to a parameter alarm, is an alarm condition that exists wether or not a patient is connected to the machine. Technical alarms include:

- Failed state alarms - internal problem prevents normal operation
- Ventilator failure alarms
- Vent Fail. Monitoring Only alarms
- Alternate O_2 state alarms - caused by electronic gas mixer failure

Alarms that do not fit into any particular category but are technical in nature are referred to as a Status alarms in this table.

Source table: AC = Anesthesia Computer
DC = Display Controller
EV = Electronic Vaporizer
Mixer = Electronic Gas Mixer
PC = Power Controller
Vent = Ventilator Interface

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
+12.0V H AMPS GAS SEL VALVES	Alternate O_2 Screen.	AC detected high current to the Gas Select Valves.	Medium	AC	Fresh gas select valves +10VA is turned On.
	Disconnect the flex cable from each three-way and NC gas select valves. Measure the resistance of each valve: • should be approximately 75Ω.				
+12.0V H AMPS ALT O2	Alternate O_2 Screen.	AC detected high current.	Medium	AC	Alternate O_2 valve +10VA turned On.
	Disconnect the flex cable from the NO Alternate O_2 valve. Measure the resistance of the NO Alternate O_2 Bypass Valve: • should be approximately 75Ω				
+12.0V H AMPS MIXER	Alternate O_2 Screen.	Status bit shows current high.	Medium	AC	Mixer +10VA turned On.
	On the Anesthesia Board Power window (Section 12.6.2) of the PC Service App, observe that ***Mixer 10VA Amps*** is reported as ***Fail***. Turn off power to the machine and disconnect the system interface harness from the Mixer. If the ***Mixer 10VA Amps*** is now reported as ***OK***, • replace the Mixer. If the ***Mixer 10VA Amps*** is still reported as ***Fail***, • inspect the harnesses from the ACB to PCB and PCB to Mixer for cross connections or damaged pins. • replace the ACB.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
+12.0V H AMPS VENTSIB	Ventilator failure!	Status bit shows current high.	High	AC	Ventilator Interface board 10VA is turned on.
	Reboot system. If problem continues, replace VIB.				
+12.0V H AMPS MGAS	Gas monitoring not available	Status bit shows current high.	Medium	AC	MGAS 10 VA is turned On
	Remove Gas Module from the Module Bay. If the problem continues, replace the M-Gas Monitoring board. If the message disappears when module is removed, repair the M-Gas module: • (see S/5 AM Technical Reference Manual for repair instructions).				
+12.0V H AMPS VENT&OUTLET VALVES	Vent Fail. Monitoring Only.	Status bit shows current high.	Medium	AC Vent	Ventilator valves +10VA is On.
	Disconnect the GIV and Insp Flow Valve. Measure the resistance of each valve: • should be approximately 25Ω for the GIV and 75Ω for the Insp Flow Valve.				
+12.5V TO ACB	Alternate O_2	<11.9 or > 12.9 Vdc	High	AC - DC checks the service state.	
	Reboot system. If problem continues, replace the Power Controller board.				
+5V H AMP GAS SUPPLY XDUCERS	Cannot read gas supply pressures	Status bit shows current high.	Medium	AC	Pressure transducer +10VA turned On.
	Reboot system. If problem continues: 1. With system in Standby, disconnect all gas supply pressure transducers from ABS Filter board. 2. Reboot system. • If problem continues, replace the ACB. • If error is no longer present, set system to Standby and reconnect one pressure transducer at a time. 3. Reboot system and check for error with each transducer connected. Replace the transducer that causes the error to appear.				
12 HR TEST	Turn power Off and On for self tests	System has been operating for longer than 12 hours without a power up self test.	Low	AC - Vent DC checks enable criteria	System state is in Checkout.
	At next available time, move the system switch from the On position to the Off position, then back to the On position.				
ACB 4.096V ADC REF	Cannot monitor gas supplies	<4.018 or > 4.176 Vdc	Low	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB ADC FAIL	Cannot monitor gas supplies	ADC timeout on any MUX channel.	Low	AC	
	Reboot System. If problem continues, replace the ACB.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
ACB CLOCK SPEED	System Malfunction	clock frequency > 1.1 • expected value or <0.9* expected value. AC Clock frequency incorrect.	High	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB COM FAIL	System Malfunction	After establishing initial communication, the DC does not receive any messages from AC in 10 sec.	High	DC	
	Reboot System. If problem continues, replace the ACB.				
ACB CPU TEST FAIL	System Malfunction	CPU instruction Test Failure	High	AC	
	Reboot System. If problem continues, replace the ACB				
ACB DCB COM FAIL	System Malfunction	The Anesthesia Computer receives no system state messages from the Display Computer for 10 seconds.	High	AC	Initial communications established.
	Reboot System. If problem continues, check the ACB to Mixer communication LED’s (or VIB communication LED’s). If the RCV and XMT (or TXD and RXD) LED’s indicate activity, check DU cable connections, replace Display Controller PCB if problem continues. If the RCV and XMT (or TXD and RXD) LED’s indicate no activity, check the Anesthesia Control board connection, replace the Anesthesia Control board if problem continues.				
ACB EEPROM FAIL	Memory (EEPROM) failure	Read/Write failure or CRC failure of the EEPROM located on the Anesthesia Control Board.	Low	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB FLASH FAIL	System Malfunction	CRC Failure in code space.	High	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB HW WATCHDOG	System Malfunction	Hardware watchdog fails boot up test, times out, or detects an incorrect code sequence	High	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB MICROPROC ERROR	System Malfunction	Unexpected microcontroller exception (bus error, address error, etc.)	High	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB RAM ERROR	System Malfunction	Memory Test Failure, Multiple bit errors detected.	High	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB REDUNDANT MEMORY FAIL	System Malfunction	A redundantly stored parameter could not be stored properly or was corrupted.	High	AC	
	Reboot System. If problem continues, replace the ACB.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
ACB SW ERROR	System Malfunction	Unexpected software error	High	AC	
	Reboot System. If problem continues, reload ACB Software. If problem continues, replace the ACB.				
ACB SW WATCHDOG	System Malfunction	Software watchdog failed power-up test, timed out, or a software function was delinquent for too long.	High	AC	
	Reboot System. If problem continues, replace the ACB.				
ACB UNEXPECTED RESET	System Malfunction	Unexpected reset of AC	High	AC	
	Reboot system. If problem continues, replace the ACB.				
ACGO	Vol and Apnea monitoring off	Non Circle (ACGO) selected	Low	DC	System has ACGO
	No Service Action Required.				
ACMains POWER FAIL	Plug in power cable. On battery	ACMains_GOOD goes and stays low for at least 300 msec (3 software loops)	Medium	PC	30 minutes of battery power available.
	No Service Action Required.				
ADB 10VA POWER ERROR	Vaporizer Failure	Overcurrent condition detected by the AC. Circuit disabled.		AC	
	Disconnect ADB power harness and restart the system. If the error does not reappear in the log, • replace the ADB and retest. If the error persists, • proceed to the interconnect fault isolation procedure (Section 7.6.1). (Also see Section 7.5.)				
ADB VOLTAGE ERROR	Vaporizer Failure	One or more of the measured ADB voltages have failed. These include the ADC reference voltage, 12P1 power supply, and five volt supply.		AC	
	Replace ADB and retest. (Also see Section 7.5.)				
AIR PIPE INVALID	Cannot monitor Air pipeline	Air Pipeline pressure is invalid.	Medium	DC	
	Check Air Pipeline Supply. Check/Replace Air Pipeline Pressure Transducer.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
AIR PRESS LOW	Air supply pressure low	Air pipeline pressure is less than 252 kPa and the air cylinder has a pressure less than 2633 kPa for one second.	Medium	AC, DC	Air is selected as the balance gas with a non zero flow of air or the ventilator uses air as the drive gas and mechanical ventilation is ON
	Check Air Supply. Check/Replace Air Pipeline/Cylinder Pressure Transducer				
AIR PRESS LOW DURING 21% O2	Air pressure low. Increase O2%.	Air pipeline pressure is less than 252 kPa and the air cylinder has a pressure less than 2633 kPa for one second.	High	AC DC	21% O2 (Air) is selected for fresh gas flow
	Check Air Supply. Check/Replace Air Pipeline/Cylinder Pressure Transducer				
AIRWAY SENSOR CAL ERROR	Calibrate flow sensors	Airway Pressure Sensor zero offset out of range	Low	AC, Vent	Flow sensor detected
	In the Service Software / Vent Flow & Pressure Diagnostics, verify the Airway Pressure counts is 800 ± 250. Disconnect the Black in-line connector in the Patient Airway. If the counts return within specified range, check for occlusions in the Bulkhead harness. If the counts do not return within the specified range, replace the VIB.				
ALT O2 SWITCH FAIL		Alternate O_2 switch status indicates Alt O_2 switch fault. The fault detection condition must persist for 1 second.	Medium	AC	
	Replace the Alt O_2 Switch.				
AUX OUTLET FAIL	No fresh gas flow?	The measured SCGO position does not match commanded position.	High	AC, Vent	
	In the Service Software / Vent Diagnosis, view the Circuit Feedback status. If the feedback indicates “Fault”, toggle the Circuit. If the Status changes to match the Circuit setting, check / replace the SCGO / ACGO Micro-switches.				
BACKUP MODE ENTERED	Backup Mode active	No spontaneous breaths in set period of time (Backup Time (sec)) and 30 seconds has elapsed since starting PSVPro mode.	Low	DC	
	No spontaneous breaths in set period of time (Apnea time) and 30 seconds has elapsed since starting PSVPro mode. No Service Action Required.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
BAL FLOW CTRL FAIL		Mixer status bit STS_FLOW_CTRL_CH2_FAIL indicates flow attainment failure.	Medium	AC, Mixer	Balance gas supply pressure OK
	Reboot System. If problem continues, replace the Mixer.				
BAL PROP VALVE FAIL		Mixer status bit STS_CH2_PROPN VALVE FAIL indicates proportional valve failure (over current, etc.)	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
BATT V VERY LOW	Plug in power cable. On battery	Available battery power decreases to between 10 and 5 min	Medium	PC	AC Mains Power Failure in progress.
	Leave the system plugged in to charge the battery. If problem continues, check the battery charge circuit in Service Software. Replace Battery.				
BATTERY <1MIN	System shutdown in <1min	Available battery power is <1min	High	PC	AC Mains Power Failure in progress.
	Leave the system plugged in to charge the battery. If problem continues, check the battery charge circuit in Service Software. Replace Battery.				
BATTERY CHARGE FAIL	No battery backup	The system is in standby and the battery charge current is >4.0 amps for Or The system is powered on with a battery current >1.7 amps.	Medium	PC	
	Check the battery charge circuit in Service Software. Replace Battery.				
BATTERY EMPTY	System shutdown in <5 min	Available battery power is between 1 and 5 minutes	High	PC	AC Mains Power Failure in progress.
	Leave the system plugged in to charge the battery. If problem continues, check the battery charge circuit in Service Software. Replace Battery.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
BATTERY FAIL	No Battery Backup.	Battery voltage <10.5 V or While in bulk, over, or float charging battery is <10.5VDC or Battery has been bulk charging for >12 h in Standby or 24 h while powered on. Or Voltage > 16.5V during bulk or over charging and normal current >0.25 Amps	Medium	PC	
	Leave the system plugged in to charge the battery. If problem continues, check the battery charge circuit in Service Software. Replace Battery.				
BATTERY LOW	Plug in power cable. On battery	Available battery power decreases to between 20 and 30 min	Medium	PC	Mains AC Mains Power Failure in progress.
	Leave the system plugged in to charge the battery. If problem continues, check the battery charge circuit in Service Software. Replace Battery.				
BATTERY MISSING	No battery backup	Any battery voltage is between ±1.0 VDC.	Medium	PC	POST state
	Connect Battery Leave the system plugged in to charge the battery. If problem continues, check the battery charge circuit in Service Software. Replace Battery.				
BATTERY REVERSED CONNECTIONS	No battery backup	Any battery voltage is less than –1.0 VDC	Medium	PC	
	Check Battery Connections				
BATTERY V LOW	Plug in power cable. On battery	Available battery power decreases to between 10 and 20 minutes	Medium	PC	AC Mains Power Failure in progress.
	Leave the system plugged in to charge the battery. If problem continues, check the battery charge circuit in Service Software. Replace Battery.				
BELLOWS COLLAPSED	Unable to drive bellows	Manifold pressure > Paw + 10 + (0.25* Inspiratory valve flow)	Low	AC, Vent	In range Paw and manifold pressure data available and mechanical ventilation On.
	Check the breathing circuit for leaks or hose occlusions. Perform flow sensor calibration. Check drive gas check valve. Check VIB cabling. Replace VIB.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
BREATHING SYSTEM NOT LATCHED	Breathing system loose	Breathing system detection switch indicates breathing system not latched.	Low	AC, Vent	
	Check/replace ABS On switch. Check/replace harness (ABS switches to Filter board).				
CASSETTE LEVEL LOW	Cassette almost empty	Cassette reporting a value of '1/4' or 'EMPTY'.	Low	AC	Cassette supports liquid level measurement
	After insertion, this error is logged the first time the cassette reports a level of 'EMPTY' or 'QUARTER FULL'.				
CASSETTE OVERFILL DETECTED	Cassette overfilled, replace cassette	Agent level sensor indicates overfilled condition.	Medium De-escalating	AC	
	After insertion, this error is logged the first time the cassette reports a level of 'OVERFILLED'.				
CASSETTE PRESSURE ERROR	Check cassette. Set agent.	Cassette pressure out of range.	Medium De-escalating	AC	
	Check all connections of the Flowmeter Block to the ADB. If the cassette is DES and the problem persists, bleed and retry. Otherwise, run the Vaporizer Test (Section 12.9.2). (Also see Section 7.5.)				
CASSETTE REMOVED DURING DELIVERY	Insert cassette	Cassette removal was detected during active delivery.	Low	AC	System state is Therapy
	Reported whenever the cassette is removed while the vaporizer is actively delivering agent.				
CASSETTE TEMPERATURE FAILURE	Vaporizer Failure	Temperature difference between dual cassette temperature sensors greater than limit.		AC	
	Check connection of Cassette Temperature Sensor to the ADB. If the problem persists, check value of cassette temp ADC using PC Service App (Section 12.9.1). If reading does not change when the cassette temp cable is disconnected, replace the ADB. If the reading does change, replace the cassette temp sensor. (Also see Section 7.5.)				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
CASSETTE TEMPERATURE EEPROM FAILURE	Vaporizer Failure	Cassette temperature sensor calibration data EEPROM read error or cassette temperature sensor hardware revision data EEPROM read error or software compatibility failure.		AC	
	Check connection of Cassette Temperature Sensor to the ADB. If the problem persists replace and retest, in the following order (Also see Section 7.5.): ▪ Cassette temp sensor ▪ ADB				
CAL DATA FAILURE IN EEPROM	Service calibration advised	Default cal data is being used due to corrupt data in cal region.	Low	AC	
	Perform complete service level calibrations (ventilator).				
CHECK FLOW SENSOR	Check flow sensors	During Mechanical breaths, the measured flow for 6 consecutive breaths, to and from the patient, does not meet certain criteria. No or negative flow on Insp flow sensor during inspiration or negative flow on Exp flow sensor.	Medium	AC, Vent	In-range flow data available during mechanical ventilation
	Check flow sensor connections. Check the breathing circuit. Check VIB sensor tubing for leaks. Perform flow sensor calibration. Check Insp/Exp check valves. Check/Replace flow sensors.				
CLOSED LOOP CONTROL FAILURE	Check cassette. Set agent.	Closed loop controller was unable to control output flow from the cassette.	Medium De-escalating	AC	System state is Therapy
	Run PC Service App Vaporizer Test (Section 12.9.2) to verify hardware performance. Replace and retest in the following order (Also see Section 7.5.): ▪ Proportional Valve ▪ ADB This error can also be caused by the following: ▪ Liquid Flow Prevention Valve actuated. Look for occurrences of CONDENSATION CONDITIONS EXIST and CASSETTE OVERFILL DETECTED errors preceding this error. ▪ Cassette held in place, but not latched, during agent delivery. It is possible to hold the cassette in a position such that the cassette ID is recognized but the cassette valves are not open, preventing flow. This error will result.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
COM ERROR VENT TO ACB	System Malfunction	After regular communications has been established between the Ventilator boundary object and the Vent SIB CPU, a total loss of communications shall be declared if the Ventilator boundary object receives no messages from the Vent SIB CPU for 35 milliseconds.	High	AC Vent	
	Reboot System. If problem continues: 1. Check cabling. 2. Replace VIB. 3. Replace ACB.				
CONDENSATION CONDITIONS EXIST		Measured cassette temperature is at least 5 degrees warmer than Flowmeter Block temperature. Extreme condensation of agent vapor in the Flowmeter Block can result in erratic delivery and/or CLOSED LOOP CONTROL FAILURE due to closure of the Liquid Flow Prevention valve.		EV	
	Advise user to avoid storage of cassettes in warm environments that could result in warm cassettes being placed in relatively colder machines.				
DCB RAM ERROR	System Malfunction	Self test failure or multi bit error detected.	High	DC	
	Reboot System. If problem continues, replace the Display Controller Board.				
DRIVE GAS LOST	Ventilator has no drive gas	O_2 supply low if O_2 is selected drive gas OR AIR supply low if Air is selected drive gas.	High	AC DC checks enable criteria	Mechanical Ventilation is ON.
	Connect O_2 or AIR supply. See Action/Troubleshooting for O_2 PRESS LOW or AIR PRES LOW.				
ENHANCED CASSETTE TEMPERATURE FAILURE		The two independent temperature sensing elements disagree by more than the allowed amount indicating that one has failed. Cassette temperature sensing reverted to legacy Cassette Temperature Sensor at the time this was logged.		EV	
	$Aladin_2$ cassette failure. Replace cassette and retest.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
EXP FLOW SENSOR CAL ERROR	Calibrate flow sensors	Exp Flow Sensor zero offset out of range	Low	AC, Vent	Flow sensor detected
	In the Service Software / Vent Flow & Pressure Diagnostics, verify the Expiratory Flow counts is 2050 ± 250. Disconnect the Blue and Yellow in-line connectors. If the counts return within specified range, check for occlusions in the Bulkhead harness. If the counts do not return within the specified range, replace the VIB.				
EXP FLOW SENSOR EEPROM FAILURE	Replace exp flow sensor	EEPROM cal data read failure	Low	AC, Vent	
	Replace Exp Flow Sensor.				
FAN FAIL	Cooling fan needs service. System OK	Fan Power Status Bit is Low (FAN1_GOOD).	Medium	PC	Communication between Power Controller and Display Computer.
	Connect cooling fan. Replace cooling fan.				
FANS FAIL	Cooling fans failed. May overheat.	Both of the Fan Power Status Bits are Low (FAN1_GOOD, FAN2_GOOD)	Medium	PC	Communication between Power Controller and Display Computer.
	Connect cooling fans. Replace cooling fans. Replace PCB.				
FLOW SENSOR CAL ERROR	Calibrate flow sensors	Insp or Exp flow sensor or the airway or manifold pressure sensor zero offset out of range (flow calibration failure)	Low	AC, Vent	Flow sensor detected
	See associated Errors. i.e. EXP FLOW SENSOR CAL ERROR or AIRWAY SENSOR CAL ERROR				
FRONT PANEL COM FAIL	Display panel controls failure	Key pad controller fails to send “life tick” for greater than 10 Sec.	Medium (Yellow)	DC	
	Reboot system. If problem continues, replace Display Controller Board.				
GAS INLET VALVE BOOTUP	Vent Fail. Monitoring Only	Boot-up test failed.	High	AC, Vent	
	1. Check GIV solenoid connection. 2. Replace GIV. 3. Replace VIB.				
INFLOW CHECK VALVE FAILURE	Vaporizer Failure	Negative flow in the cassette inflow limb greater than limit.		AC	
	Replace Inflow check valve. (Also see Section 7.5.)				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
INFLOW OUTFLOW CROSSCHECK FAILURE	Vaporizer Failure	Output concentration measured by the output and input flowmeter disagree by more than limit.		AC	
	Replace and retest in the following order (Also see Section 7.5.): • Zero Valve (Inflow or Outflow depending on Vaporizer Test results). • Flowmeter Block • ADB				
INSP FLOW SENSOR CAL ERROR	Calibrate flow sensors	Insp Flow Sensor zero offset out of range.	Low	AC, Vent	Flow sensor detected
	In the Service Software / Vent Flow & Pressure Diagnostics, verify the Inspiratory Pressure counts is 2050 ± 250. Disconnect the Black and White in-line connectors. If the counts return within specified range, check for occlusions in the Bulkhead harness. If the counts do not return within the specified range, replace the VIB.				
INFLOW ZERO 10VA POWER ERROR	Vaporizer Failure	Overcurrent condition detected by the AC. Circuit disabled.		AC	
	If the P3 indicator never lights or lights only briefly, • proceed to the interconnect fault isolation procedure (Section 7.6.1). If the P3 indicator remains lit for more than 2 seconds, • isolate the failed valve (Inflow, Inflow zero or Outflow zero) circuit with manual valve controls. Replace and retest in the following order (Also see Section 7.5.): • Valve • ADB				
INFLOW ZERO POINT ERROR	Vaporizer Failure	Input flowmeter measured value during zeroing is out of range.		AC	
	Replace and retest in the following order (Also see Section 7.5.): • Inflow Zero Valve • Flowmeter Block • ADB				
INSP FLOW SENSOR EEPROM FAILURE	Replace insp flow sensor	EEPROM cal data read failure	Low	AC, Vent	
	Replace the Inspiratory Flow Sensor.				
INSERT CASSETTE	None	The system does not detect a vaporizer cassette	Low	AC	Agent delivery not on (agent Off or state is checkout)
	Occurs whenever a cassette is not inserted.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
INVALID CASSETTE ID	Cannot identify cassette	Invalid cassette ID code	Medium De-escalating	AC	
	If failure occurs with multiple cassettes of the same type (agent), • insert test cassette and verify test cassette is identified in the PC Service App. Remove test cassette and verify PC Service App indicates 'NONE'. If either PC Service App test fails, • replace ADB. (Also see Section 7.5.)				
LOSS OF GAS DELIVERY USER SETTINGS LOSS OF VAPORIZER USER SETTINGS LOSS OF VENT PARAMETER SETTINGS	 Vaporizer Failure Vent Fail. Monitoring Only	After regular communications has been established between the AC and the Display Computer, this alarm is declared if the system is in the Therapy State and the AC determines the Gas Delivery User Setting (Vaporizer User Settings) (Ventilator Parameter Settings) from the Display Computer arrived more than 10 seconds ago.		AC	
	Reboot system. If problem continues, check the ACB to Mixer communication LED's (or VIB communication LED's). 1. If the RCV and XMT (or TXD and RXD) LED's indicate activity, • check DU cable connections. • replace Display Controller board if problem continues. 2. If the RCV and XMT (or TXD and RXD) LED's indicate no activity, • check the Anesthesia Control board connection. • replace the Anesthesia Control board if problem continues.				
MANIFOLD TEMPERATURE EEPROM FAILURE	Vaporizer Failure	Manifold Temperature sensor calibration data EEPROM read error.		AC	
	Check connection of Manifold Temperature Sensor to the ADB. If the problem persists, replace and retest in the following order (Also see Section 7.5.): • Manifold temp sensor • ADB				
MANIFOLD TEMPERATURE FAILURE	Vaporizer Failure	Temperature difference between dual manifold temperature sensors greater than limit.		AC	
	Check connection of Manifold Temperature Sensor to the ADB. If the problem persists, • check value of manifold temp ADC using PC Service App (Section 12.9.1). If reading does not change when the manifold temp cable is disconnected, • replace the ADB. If the reading does change, • replace the manifold temp sensor. (Also see Section 7.5.)				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
MAN CASS OVER UNDER TEMP	Check cassette. Set agent.	Either manifold temperature reading or cassette temperature reading outside of limit.	Medium De-escalating	AC	
	Operating temperature as measured by one of the Electronic Vaporizer temperature sensors was out of allowed operating range.				
MANIFOLD PAW SENSOR FAIL	Vent Fail. Monitoring Only	Calibration failure at bootup.	Medium	AC, Vent	
	In the Service Software / Vent Flow & Pressure Diagnostics, verify the Manifold Flow counts is 800 ± 250. Disconnect the White in-line connector in the Manifold Pressure. If the counts return within specified range, check for occlusions in the Bulkhead harness. If the counts do not return within the specified range, replace the VIB.				
MGAS CHECK SAMPLE GAS OUT >20 SEC	Check sample gas out	MGAS SPEC. Continuous Occlusion Bit set.	Medium	MGAS	MGAS present and MGAS communicates continuous occlusion for 20 seconds
	Replace sample line. See AM TRM for further Troubleshooting.				
MGAS INLET FILTER RESIDUE >40 SEC	Replace D-Fend	MGAS SPEC (Residue build-up on the water trap membrane. This decreases air flow).	Medium	MGAS	MGAS present and MGAS communicates this the Replace Trap alarm bit for 40 seconds
	Replace D-Fend. See AM TRM for further Troubleshooting.				
MGAS LINE BLOCKED >20 SEC	Sample line blocked	MGAS SPEC states The sample tubing inside or outside the monitor blocked, or the water trap is occluded.	Medium	MGAS	MGAS present and MGAS communicates this the continuous occlusion alarm for 20 seconds
	Replace sample line. See AM TRM for further Troubleshooting.				
MGAS SAMPLE LINE NOT CONNECTED >40 S	Check D-Fend	MGAS SPEC states The sample tubing or the D-Fend module is not installed.	Medium	MGAS	MGAS present and MGAS communicates this the OpenGasCircuit alarm for 40 seconds
	Replace D-Fend. See AM TRM for further Troubleshooting.				
MGAS SENSOR INOP > XX	Module fail. No CO_2, AA, O_2 data	MGAS SPEC Mgas communicates hardware failure (RAM failure; ROM checksum error; Error in CPU eeprom; Error O_2 preamp eeprom; Error in SSS board eeprom; Voltage error; Lamp control failure.) or UPI does not initialize.	Medium	MGAS	
	See AM TRM for further Troubleshooting.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
MIXER BAL GAS CHANGE FAIL	Alternate O_2 Screen	Mixer Status Bit: STS__BALGAS_CHANGE_OVER_FAIL After the mixer commanded a change to the balance gas, the status of the selector valve shows the old balance gas is still connected.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER BALGAS Flow FAIL		Mixer error bit STS_CH2_DELTAP_FLOW_FAIL Pressure difference between P3 and P2 differs from the drop expected at the measured flow for channel 2 (Balance Gas).	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER O2 Flow FAIL	Alternate O_2 Screen	Mixer error bit STS_CH1_DELTAP_FLOW_FAIL Pressure difference differs from the drop expected at the measured flow for Channel 1 (O_2).	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER ACB COM FAIL	Alternate O_2 Screen	Five seconds pass without measured flow data from the mixer.	Medium	AC	Communication has been established between mixer and AC.
	Reboot System. If problem continues, • check/replace Pan Connector to Mixer cable. • replace the Mixer.				
MIXER ACB COM FAILLOST CMD	Alternate O_2 Screen.	Mixer status Bit STS_LOSS_OF_SETFLOW_CMD. Mixer has lost AC flow commands for 5 sec or received “illegal” commands.(hypoxic mix, settings not allowed)	Medium	AC, Mixer	
	Reboot System. If problem continues, • check/replace Pan Connector to Mixer cable. • replace the Mixer.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
MIXER AIR SELECTION VLV FAIL	Alternate O_2 Screen.	Mixer Status Bit: STS_SELV_VAIR_NOTIFY_FAIL The status of the air selector valve does not match the commanded state.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER BAL GAS F SENSOR FAIL	Alternate O_2 Screen.	Mixer error bit STS_F2_SENSOR_FAIL Balance gas flow sensor failure.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER BAL GAS TSENSOR FAIL		Mixer error bit STS_T2_SENSOR_FAIL (Balance Gas). Balance gas temperature sensor failure.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER BAL GAS FLOW CHECK FAIL		Mixer status bit 1LPM_FLOW_TEST_FAIL. Bal gas proportional valve fails flow check STS_FLOW_TEST_BAL_CHAN_FAILshows balance gas proportional valve failed self test.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER BAL GAS TEMP LIMIT		Mixer error bit STS_CH2_TEMP_LIMIT (Balance Gas). Balance gas temperature exceeds 50 °C.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER BAL GAS ZERO FAILLEAK		Mixer status bit STS_CH2_ZERO_FLOWPROPN_V_CH2_LEAK_FAIL_TEST_FAIL. Bal gas proportional valve fails zero flow check shows flow while closed.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER CRC EEPROM FAIL	Alternate O_2 Screen	Runtime CRC check on EEPROM failed. Mixer Status Bit STS_EEPROM_CRC_FAIL.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
MIXER CRC FLASH FAIL	Alternate O_2 Screen	Runtime CRC check on Flash failed. Mixer Status Bit STS_FLASH_CRC_FAIL	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER CRC RAM FAIL	Alternate O_2 Screen	Runtime CRC walking pattern check on RAM failed. Mixer Status Bit STS_RAMCRC_FAIL.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER N2O SELECTION VLV FAIL		Mixer Status Bit: STS_SELV_VN2O_NOTIFY_FAIL The status of the N_2O selector valve does not match the commanded state.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER O2 TSENSOR FAIL	Alternate O_2 Screen.	Mixer error bit STS_T1_SENSOR_FAIL O_2 temperature sensor failure	Medium	AC, Mixer	
	Reboot System. If problem continues, Replace the Mixer.				
MIXER O2 F SENSOR FAIL	Alternate O_2 Screen	Mixer error bit STS_F2F1_SENSOR_FAIL (O_2). O_2 flow sensor fail.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER O2 FLOW CHECK FAIL	Alternate O_2 Screen	Mixer status bit STS_FLOW_TEST_CH1_FAIL1LPM_FLOW_TEST_FAIL. O_2 proportional valve fails flow check.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER O2 SELECTION VLV FAIL	Alternate O_2 Screen	Mixer Status Bit: STS_SELV_VOXY_NOTIFY_FAIL The status of the O_2 selector valve does not match the commanded state.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER O2 TEMP LIMIT	Alternate O_2 Screen	Mixer error bit STS_CH1_TEMP_LIMIT (O_2). O_2 temperature exceeds 50 °C.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
MIXER O2 ZERO LEAK FAIL		Mixer status bit STS_CH1_ZERO_FLOW_TESPROPN_V_LEAK_FAILT_FAIL. O_2 proportional valve fails zero flow checks for leaks when it should be closed.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER P SENSOR P2 FAIL		Mixer error bit STS_PRESS_SENSOR_FAIL_P2 Pressure sensor 2 in the mixer has failed.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER POST FAIL	Alternate O_2 Screen	Mixer tells AC that Power Up Self Test Fail	Medium	AC, Mixer	
	See associated Error in Error Log. i.e. “MIXER O_2 FLOW CHECK FAIL” or “Mix: FLOW VERIFICATION FAILURE (dP) CH1”				
MIXER PRES SENSOR P1P3 FAIL		Mixer error bit STS_PRESS_SENSOR_FAIL_P1P3 One of the pressure sensors in the Mixer has failed (P1 or P3).	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER SW WDOG FAIL	Alternate O_2 Screen	Mixer status Bit STS_SW_WDOG_FAIL.	Medium	AC, Mixer	
	Reboot System. If problem continues, replace the Mixer.				
MIXER VOLTS FAIL	Alternate O_2 Screen	Mixer power supply (on board) is out of tolerance. Status bit STS_VOLT_REF_FAIL.	Medium	AC, Mixer	+12.5 V (10 VA) to mixer OK.
	In the Service Software / Mixer Power Diagnosis, view the “Mixer 10VA Voltage” from Anes Cntrl Bd: If “Mixer 10VA Volts” reads “OK, and +12.5 Vdc reads “Fail”, replace the Mixer. If “Mixer 10VA Volts” reads “Fail”, Check cabling between ACB and Mixer, replace ACB if ca.				
MODULE NOT COMPATIBLE	Module not compatible	The Monitoring Module detected is not compatible with system software. System is designed to work with the following Compact Airway Module versions: M-CaiO (HW rev 00 and above, SW rev 3.2 and above) and M-CaiOV (HW rev 00 and above, SW Rev 3.2 and above).	Low	DC	
	Replace M-Gas module with compatible module.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
N2O PRESS LOW	N_2O supply pressure low	N_2O pipeline pressure is less than 252 kPa and the N_2O cylinder pressure is less than 2633 kPa.	Low	AC	N_2O is selected as the balance gas with a non zero flow of N_2O
	Check N_2O Supply. Check / Replace N_2O Pipeline/Cylinder Pressure Transducer.				
NO EXPIRATORY FLOW SENSOR	No exp flow sensor	No Expiratory sensor connected and not calibrating	Medium	A, Vent	
	Connect Expiratory flow sensor. Check/Replace Bulkhead harness. Replace VIB Board.				
NO INSPIRATORY FLOW SENSOR	No insp flow sensor	No inspiratory sensor connected and not calibrating.	Medium	AC, Vent	AC -Vent
	Connect Inspiratory flow sensor. Check/Replace Bulkhead harness. Replace VIB Board.				
O2 PROP VALVE FAIL		Mixer status bit STS_CH1_PROPN VALVE FAIL indicates proportional valve failure.	Medium	AC, Mixer	
	Reboot System. If problem continues, Replace the Mixer.				
O2 FLOW CTRL FAIL		Mixer status bit STS_FLOW_CTRL_CH1_FAIL indicates flow control failure.	Medium	AC, Mixer	O_2 gas supply pressure OK
	Reboot System. If problem continues, Replace the Mixer.				
O2 FLUSH FAILURE	O_2 flush stuck on?	Switch is detected "on" continuously > 30 sec.	Low	AC, Vent	
	Alarm condition becomes false for 2 consecutive switch readings.				
O2 PIPE INVALID	Cannot monitor O_2 pipeline	O_2 Pipeline pressure is invalid.	Medium	DC	
	Check O_2 Pipeline Supply. Check / Replace O_2 Pipeline Pressure Transducer				
O2 PRESS LOW	O_2 supply pressure low	O_2 pipeline pressure is less than 252 kPa and the O_2 cylinder has a pressure less than 2633 kPa for one second.	High	AC, DC	N_2O flow stops on threshold detection and Air continues to flow if selected.
	Check O_2 Supply. Check / Replace O_2 Pipeline/Cylinder Pressure Transducer				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
O2 SENSOR FAILURE	Replace O_2 sensor	$O_2 < 5\%$	Low	AC, Vent	Galvanic O_2 sensor connected
	Calibrate O_2 Sensor. If calibration fails, replace O_2 Sensor. If calibration continues to fail, wait 90 minutes and repeat calibration. If calibration fails after 90 minute, replace VIB				
O2CAL ERROR	Calibrate O_2 sensor	Offset, slope, or cell voltage not in range or $O_2 > 110\%$	Low	AC, Vent	Galvanic O_2 sensor connected
	Calibrate O_2 Sensor. If calibration fails, replace O_2 Sensor. If calibration continues to fail, wait 90 minutes and repeat calibration. If calibration fails after 90 minute, replace VIB.				
ON/STANDBY SWITCH TO STANDBY	Turn switch on to continue use	On/Standby switch transitions from On to Standby.	High	PC	System state is Therapy and Power Controller is communicating with DC
	No Service Action Required.				
OUTFLOW SCAV 10VA POWER ERROR	Vaporizer Failure	Overcurrent condition detected by the AC. Circuit disabled.		AC	
	If the P2 indicator never lights or lights only briefly, • proceed to interconnect fault isolation procedure (Section 7.6.1). If the P2 indicator remains lit for more than 2 seconds, • isolate the failed valve (outflow or scavenging) circuit with manual valve controls. Replace and retest in the following order (Also see Section 7.5.): • Valve • ADB				
OUTFLOW ZERO POINT ERROR	Vaporizer Failure	Output flowmeter measured value during zeroing is out of range.		AC	
	Replace and retest in the following order (Also see Section 7.5.): • Outflow Zero Valve • Flowmeter Block • ADB				
OUTPUT FLOW LIMIT REACHED	Cannot deliver agent setting at set flow	Commanded cassette flow >= 6.0 L/min for > 10 seconds OR Commanded flow >= 4.0 L/min and flow valve is at max for > 10 seconds.	Low	AC	Agent delivery on
	Indicates commanded agent flow could not be achieved because the vaporizer reached its maximum flow capability. This occurs at high flow and agent settings, primarily with Sevoflurane. The user sees an alarm message advising them to reduce flows and the agent monitor may show an under delivery.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
PATIENT VOLUME MISMATCH OCCURRED	Calibrate, dry, or replace flow sensors	PATIENT VOLUME MISMATCH alarm occurred.	Low	AC, Vent, DC checks enable criteria	System state is in Checkout.
	1. Check flow sensor connections. 2. Replace flow sensors. 3. Check the VIB tubing for moisture. 4. Replace VIB.				
PCSELF TEST	Internal failure. System may shut down	PC failed self tests (memory, voltages, or CPU).	High	PC	
	Reboot system. If problem continues, check power supplies in the Service Software. Replace Power Controller Board if continues.				
PEEP PCV NOT AVAILABLE	Vol vent only. No PEEP or PSV	Paw data is in range but the Pmanifold <= -15 cmH_2O	Medium Or Low	DC	None
	Perform flow sensor calibration. If calibration fails, in the PCMCIA service application use the Vent diagnostics to check the transducer precision. Use the Flow valve control to compare linearity of the Manifold transducer to the Paw transducer.				
PORT ZERO READ BACK FAIL		Read back of a latch storing valve state did not match the commanded state of the valves indicating internal Agent Delivery Board failure.		EV	
	Replace ADB. (Also see Section 7.5.)				
POWER CONTROLER COM FAIL	Internal failure. System may shut down	Communications with PC and DC cannot be established for ten seconds.	Medium	DC	
	Reboot system. If problem continues: 1. Check DU cable connections. 2. Check the Display Connector board cable connections. 3. Replace the Power Controller board.				
POWER SUPPLY 75C	Circuitry >75C shutdown possible	Power supply temperature exceeds 75C.	Medium	PC	
	Check / Clean cooling fan.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
PRESSURE SENSOR EEPROM FAILURE	Vaporizer Failure	Cassette pressure and flow meter calibration data EEPROM read error or cassette pressure and flow meter hardware revision data EEPROM read error or software compatibility failure.		AC	
	Check all connections of the Flow Meter Block to the ADB. If the problem persists replace and retest, in the following order (Also see Section 7.5.): ▪ Flowmeter Block ▪ ADB				
PROP VALVE DRIVE SENSE		Monitored Proportional Valve drive current did not match the commanded value indicating failure of the proportional valve, connection, or drive circuit.		EV	
	Replace and retest in the following order (Also see Section 7.5.): ▪ Proportional valve/check connection ▪ ADB				
PROP VALVE HTR 10VA POWER ERROR	Vaporizer Failure	Overcurrent condition detected by the AC. Circuit disabled.		AC	
	If the P4 indicator never lights or lights only briefly, ▪ remove the Cassette Interface Board jumper at the Cassette Interface Board and retest. If the problem persists, ▪ remove the jumper completely and retest. If the problem is still present, ▪ proceed to interconnect fault isolation procedure (Section 7.6.1 If the P4 indicator remains lit for more than 2 seconds, ▪ check for a failed Proportional valve circuit with manual valve controls. If the Proportional valve does not generate the failure, ▪ evaluate cassettes that have been used in the machine to determine if any of the cassettes in use are faulty. Replace and retest in the following order (Also see Section 7.5.): ▪ Proportional Valve ▪ Cassette ▪ ADB				
PWR CNTRL DC-DC FAIL	Using battery. PC fail	AC supply is OK (AC GOOD HIGH) but the system reports using the battery (BATT STAT 1 and 2 LOW).	Medium	PC	
	Check U-frame wiring. Set system switch to Standby; remove mains; wait 20 seconds; power up system. If problem continues, replace PCB.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
REVERSE EXPIRATORY FLOW	Reverse exp flow. Check valves OK?	Flow towards the patient (volume >= 20 mL) on expiratory sensor and flow towards the patient (volume >= 5 mL) on the inspiratory sensor during inspiration for 6 consecutive mechanical breaths.	Medium	AC Vent	In-range flow data available, mechanical ventilation on
	Check flow sensor connections for “No Flow Sensor” alarm. Check the breathing circuit. Perform flow sensor calibration. Check Insp/Exp check valves. Replace the flow sensors. Check for kinked VIB tubing. Check the VIB cabling.				
SCGO	Vol and Apnea monitoring off	Non Circle SCGO selected.	Low	DC	System has SCGO
	No service action required.				
STANDBY PATIENT DETECTION	No fresh gas flow!	3 volume breaths are detected within 30 seconds or 3 CO_2 breaths are detected within 30 seconds	High	DC	System in Checkout: General or Checkout: Start Case
	No service action required.				
VAP-MIXER FAN FAIL	Cooling fan needs service. System OK	Fan current < 0.09 Amps > 0.25 Amps	Medium	Mixer	Communication between Display Computer - ACB and ACB - Mixer.
	Connect rear panel fan. Replace rear panel fan. Replace Mixer if no voltage.				
VAPORIZER LOST MIXER FLOW	Vaporizer Failure	Five seconds pass without valid measured flow data from the mixer.		AC	
	Check trouble shooting procedures for Electronic Mixer				
VAPORIZER SUBSYSTEM COMM FAILURE	Vaporizer Failure	Anesthesia Computer and Agent Delivery Subsystem communication lost or error for greater than 1 second.		AC	
	Verify harnesses from ACB to PCB and ACB to ADB are connected. Replace and retest, in the following order (Also see Section 7.5.): • ADB • ACB • PCB/Harnesses				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
VAP SENSOR ERROR	Vaporizer Failure	One or more of the vaporizer sensors is grossly out of range (indicating electrical fault or disconnect).		AC	
	Check all temp/pressure/flow sensors connections to the ADB. If problem persists, • run PC Service App Vaporizer Test (Section 12.9.2). (Also see Section 7.5.)				
VENT FLOW VALVE FAIL DAC	Vent Fail. Monitoring Only	Incorrect DAC feedback for 3 consecutive readings	Medium	AC, Vent	
	Reboot System. If problem continues, in the Service Software / Vent Flow & Pressure Diagnosis, increase the Flow Valve counts and view the Flow Valve Feedback mV and Counts. Verify the settings match.				
VENT +12.5V FAIL	Vent Fail. Monitoring Only	Nominal 12.5V <11.3 Vdc or >13.13 Vdc	Medium	AC, Vent	
	In the Service Software / Vent Interface Bd Power Diagnosis, view the “Vent Int Bd 10VA Voltage” from Board Supplies: If “Vent Int Bd 10VA Voltage” reads “OK, and +12.5 Vdc reads “Fail”, replace the VIB. If “Vent Int Bd 10VA Voltage” reads “Fail” and the “Vent Int Bd 10VA Voltage” from the Anes Cntrl Bd reads “OK”, Check cabling between ACB and VIB.				
VENT +6V FAIL	Vent Fail. Monitoring Only	VSIB +6V out of range<5.51 Vdc or > 6.5 Vdc	High	AC, Vent	Vent +12.5 V (10 VA) is OK
	In the Service Software / Vent Interface Bd Power Diagnosis, view the “Vent Int Bd 10VA Voltage” from Board Supplies: If “Vent Int Bd 10VA Voltage” reads “OK, and +6.0Vdc reads “Fail”, replace the VIB. If “Vent Int Bd 10VA Voltage” reads “Fail” and the “Vent Int Bd 10VA Voltage” from the Anes Cntrl Bd reads “OK”, Check cabling between ACB and VIB.				
VENT 1.22V FAIL	Vent Fail. Monitoring Only	Voltage < 1.074Vdc or Voltage > 1.367 Vdc	Medium	AC, Vent	Vent +12.5 V (10 VA) is OK
	In the Service Software / Vent Interface Bd Power Diagnosis, view the “Vent Int Bd 10VA Voltage” from Board Supplies: If “Vent Int Bd 10VA Voltage” reads “OK, and 1.22 Vdc reads “Fail”, replace the VIB. If “Vent Int Bd 10VA Voltage” reads “Fail” and the “Vent Int Bd 10VA Voltage” from the Anes Cntrl Bd reads “OK”, Check cabling between ACB and VIB				
VENT -6V FAIL	Vent Fail. Monitoring Only	VSIB -6V out of range<-6.72 Vdc or > -5.28 Vdc	High	AC, Vent	Vent +12.5 V (10 VA) is OK
	In the Service Software / Vent Interface Bd Power Diagnosis, view the “Vent Int Bd 10VA Voltage” from Board Supplies: If “Vent Int Bd 10VA Voltage” reads “OK, and -6.0Vdc reads “Fail”, replace the VIB. If “Vent Int Bd 10VA Voltage” reads “Fail” and the “Vent Int Bd 10VA Voltage” from the Anes Cntrl Bd reads “OK”, Check cabling between ACB and VIB.				

Error Log Entry	Alarm Text	Condition (Basic info)	Priority	Source	Enabling Criteria
	Action/Troubleshooting				
VENT ADC VREF FAIL	Vent Fail. Monitoring Only	VSIB ADC3.200V ref voltage out of range <3.179 or >3.221 Vdc	High	AC, Vent	Vent +12.5 V (10 VA) is OK
	In the Service Software / Vent Interface Bd Power Diagnosis, view the “Vent Int Bd 10VA Voltage” from Board Supplies: If “Vent Int Bd 10VA Voltage” reads “OK, and 3.2 Vdc reads “Fail”, replace the VIB. If “Vent Int Bd 10VA Voltage” reads “Fail” and the “Vent Int Bd 10VA Voltage” from the Anes Cntrl Bd reads “OK”, Check cabling between ACB and VIB.				
VENT AIRWAY OVERPRESS SIGNAL	Inspiration stopped	High airway overpressure signal set.	Medium	AC, Vent	Mechanical Ventilation On
	No Service Action. Reboot system. If problem continues, check Airway Pressure signal in Service Mode.				
VENT AIRWAY OVERPRESS SIGNAL FAIL	Vent Fail. Monitoring Only	Ventilator SIB indicates the High Airway overpressure signal was set and Paw < 90 cmH_2O and Pmanifold <80 cm H_2O.	Medium	AC, Vent	Mechanical Ventilation On
	No Service Action. Reboot system. If problem continues, check Airway Pressure signal in Service Mode.				
VENT FLOW VALVE FAIL CURRENT	Vent Fail. Monitoring Only	Incorrect current feedback for 7 consecutive readings.	Medium	AC, Vent	
	Reboot System. If problem continues, in the Service Software / Vent Flow & Pressure Diagnosis, increase the Flow Valve counts and view the Flow Valve Current mA and Counts.				
VENT SUSTAINED PAW SDOWN	Vent Fail. Monitoring Only	Paw > 100 cmH_2O for 10 seconds.	Medium	AC, Vent	In-range Paw data available
	No Service Action. Reboot system. If problem continues, check Airway Pressure signal in Service Mode.				
VENT VALVE POWER FAIL	Vent Fail. Monitoring Only	Nominal 12.5V <11.3 V or >13.13Vdc	Medium	AC, Vent	
	In the Service Software / Vent Interface Bd Power Diagnosis, view the “Vent Int Bd 10VA Voltage” from Board Supplies: If “Vent Int Bd 10VA Voltage” reads “OK, and the Vent Valve 10VA Volts reads “Fail”, disconnect the VIB to Pan connector harness. If the Vent Valve 10VA Volts continues to read “Fail”, replace the VIB. If “Vent Int Bd 10VA Voltage” reads “Fail” and the “Vent Int Bd 10VA Voltage” from the Anes Cntrl Bd reads “OK”, Check cabling between ACB and VIB.				

7.6.1 Electronic vaporizer 10VA power interconnect fault isolation

Troubleshooting of the following Error Log Entries may lead you to further troubleshoot the problem as detailed below:

- ADB 10VA POWER ERROR
- INFLOW ZERO 10VA POWER ERROR
- OUTFLOW SCAV 10VA POWER ERROR
- PROP VALVE HTR 10VA POWER ERROR

10VA power interconnect fault isolation procedure:

Continue to disconnect harnesses in the following order and retest until problem resolved:

1. Disconnect the ADB harness at PCB.
   - If problem goes away, replace ADB-PCB harness.
2. Disconnect the ACB harness at PCB.
   - If problem goes away, replace PCB.
3. Disconnect the ACB harness at ACB.
   - If problem goes away, replace ACB-PCB harness.
4. If cable disconnects do not eliminate the failure, replace ACB and retest.

8 Service Diagnostics and Software Download

In this section

8.1 Aisys Service Application

This section documents the Aisys Service Application that loads from a PCMCIA card and is used to download software or to access logs (Special Functions) from the Display Unit.

To run the application, first set the system switch to Standby and set the AC Inlet power switch to Off. Insert the card carrier (with card facing to the rear) into the rear PCMCIA interface slot of the display unit (behind left side door), then set the AC Inlet power switch and the system switch to On. The service application will load and display the Main Menu along with the System Information page.

8.1.1 Main Menu and System Information

The Main Menu appears on the left-hand side of the screen and includes the following selections as shown in the table below:

Main Menu	Remarks
Software Download	Access to the Software Download function.
Special Functions	Access to logs from the Display Unit.

Note You can not return to the Diagnostic section of the service application after entering the software download section. You must reboot the system to exit Software Download.

The System Information page appears on the right-hand side of the screen and displays the following system information as shown in the table below:

System Information

Subsystem	HW Rev	Serial #	SW Ver #	Boot
Front Panel Cntl	- - -	- - -	XX.XX	XXaXX
Power Controller	XXXX/A/XXX	ABCXXXXX	XX.XX	XX.XX
Electronic Mixer	XXXX/A/XXX	ABCXXXXX	XX.XX	XX.XX
Vent Intface Bd	XXXX/A/XXX	ABCXXXXX	XX.XX	XX.XX
Vaporizer	XXXX/A/XXX	ABCXXXXX	XX.XX	XX.XX
Anes Control Bd	XXXX/A/XXX	ABCXXXXX	XX.XX	XX.XX
Dsply Unit BIOS	XXXX/A/XXX	ABCXXXXX	XX.XX	
Dsply Unit App	XXX/A/XXX	ABCXXXXX	XX.XX	
Machine Serial Number: ABCDXXXXX				
PC Card ID: ABXXX				

8.2 Software Download

Main Menu
Software Download
Special Functions

Selecting ***Software Download*** bring up the following information page:

ENTERING SOFTWARE DOWNLOAD MODE!

To return to Diagnostics: turn On/Standby switch to Standby, and turn off AC mains switch in rear. Wait 20 seconds, then turn on power with the AC mains switch and the On/Standby switch.

(Press ComWheel to continue with Download.)

Note You can not return to the Diagnostic section of the service application after entering the software download section. You must reboot the system to exit Software Download.

Entering software download brings up the Software Download menu.

Software Download	Remarks
Download All	Downloads all software subsystems.
Download New	Downloads only new software versions not found on the system and compatible with installed subsystem hardware.

Since downloading all the subsystem software can take an hour or more, you should normally choose "Download New" to install only the updated subsystem software or software required for newly installed subsystems.

Software Download
Download All
Download New

Software Download Status

Loading System Version XX.XX

Subsystem	HW Rev	Installed SW Ver #	New SW Ver #	Status
Front Panel Cntl	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Power Controller	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Electronic Mixer	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Vent Intface Bd	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Vaporizer	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Anes Control Brd	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Dsply Unit BIOS	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Dsply Unit App	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx
Dsply Unit Fonts	XXX/A/XX	XX.XX	XX.XX	Xxxxxxx

Loading Xxxx Xxxxxxxxx Xxxxx:
****

Notes about downloading software

If there is no Front Panel Control software installed in the system (as would be the case when the display units control board is replaced), the Service Application automatically downloads the Front Panel Controls software at startup. During the download the two display unit LEDs will flash and the display speaker will sound an alarm tone to indicate that Software Download is proceeding. The display will be black until the automatic download is complete.
To ensure that all software versions on the system are compatible, the end result of “Download All” or “Download New” will be the same. The software loaded on the machine will exactly match what is on the card. Be sure to have the latest/correct version of software before attempting a download to avoid inadvertent overwrites of newer software with an older version.
If, during the “Download New” process, the compatibility checker detects a newer version of software component on the system, a “Notice” appears on the screen that asks you to confirm the downgrade.
“Download All” will download all compatible software from the card to the system without issuing a notice that newer version of software component may be on the system.

Download process

The PCMCIA card includes only the latest software for each subsystem along with the diagnostic application.

As each subsystem software segment is being downloaded, the following status messages note the state of each subsystem and the result of the download:

- ***Busy*** - System is running its application code; not ready for download.
- ***Ready*** - System is in its boot code; ready for download.
- ***CRCtest*** - System is analyzing the download CRC.
- ***Loading*** - System is accepting download data.
- ***Done*** - Software download has completed successfully.
- ***Fail*** - Software download did not complete successfully. A “Fail” message will require reloading of the software; or repair of the system may be necessary.
- ***Skipped*** - Software download was bypassed.
- ***Linked*** - System is communicating, but status is not yet known.
- ***Not Compatible*** - The software version on the PCMCIA card is not compatible with the subsystem.

If the subsystem is communicating but the HW Rev or current SW Rev are not known, the message ***Unknown*** will appear under the columns for those values. If the HW Rev or current SW Rev are not known, the download function will still be available.

As the software loads, an activity bar at the bottom of the screen shows the download progress for each subsystem.

Download complete

When all the required subsystem software is download, the following message appears on the screen. You must shut down the system to exit the download function.

DOWNLOAD IS COMPLETE.
Remove PCMCIA card. Turn ON/STANBY switch to STANDBY. Turn OFF AC mains switch in rear.

Note

After powering down the system, be sure to wait at least 20 seconds before restarting the system.

8.3 Special Functions

Selecting ***Special Functions*** on the Main Menu brings up the following menu selections in the left-hand frame:

Main Menu
Software Download
Special Functions

Special Functions	**Special Functions**
Display Diagnostics	
Compatibility Table	
System Download Log	
PC Card Install Log	
View Install Errors	
View Event Log	
-> Main Menu	

Check Display Functions

Refer to section 8.3.1.

Compatibility Table

The Compatibility Table lists the current software components that last downloaded on to the system. In essence, it is the latest listing that appears in the Revision Log, which allows you to view the current log directly without having to scroll to it.

System Download and PC Card Install Logs

Whenever a Software Download is completed, the specific software download is recorded in the System Download Log (*Refer to section 8.3.2*) that resides on the system (Display Unit) and in the PC Card Install Log (*Refer to section 8.3.3*) that resides on the Compact Flash Card.

8.3.1 Check Display Functions

Selecting ***Check Display Controls*** brings up the Display Diagnostics menu.

Display Diagnostics	Display Diagnostics Instructions
Test LEDs Test Speaker Test Backlight 1 Test Backlight 2 Test Keys -> Main Menu	Select a menu item To troubleshoot a display problem, start with Test LEDs and work forward

Display Diagnostics	Action when selected
Test LEDs	Selecting ***Test LEDs*** causes the red and yellow LEDS next to the **Silence Alarms** key to flash for 10 seconds.
Test Speaker	Selecting ***Test Speaker*** causes the speaker to sound for 5 seconds.
Test Backlight 1	Selecting ***Test Backlight 1*** turns backlight 2 off for 10 seconds. “If screen goes black during test, a backlight is out.”
Test Backlight 2	Selecting ***Test Backlight 2*** turns backlight 1 off for 10 seconds. “If screen goes black during test, a backlight is out.”
Test Keys	Selecting ***Test Keys*** brings up a representative display of the front panel controls. Pressing a softkey will cause the corresponding key text to be highlighted.
Main Menu	Selecting ***Main Menu*** returns to the Main Menu.

Set system switch to Standby. Remove PCMCIA card.

8.3.2 System Download Log

Selecting ***System Download Log*** brings up the Revision Log for the system. The log includes chronological entries for every Software Download that was completed to the system. Each entry includes two header lines and eight data lines in the following format:

Note: To view currently downloaded system software, scroll to last entry in log. Also, see Compatibility Table.

View System Download Log

 # Software configuration after download on (day) (date) (time)
 # SvcApp Ver (XX.XX), Machine Serial Number (ABCDXXXXX), Card# XXXXXXX/ABXXX

Aisys ACB,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	AnesControl B
Aisys MXR,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Electronic Mix
Aisys VAP,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Vaporizer
Aisys VNT,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Vent Intface B
Aisys FPC,		*,	(Software Level),	(File Name)	(#---------)	Front Panel CN
Aisys PSC,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Power Controll
Aisys DUA,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Dsply Unit App
Aisys DUB,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Dsply Unit BIO
Aisys DUF,	(Stock Number)	(Rev X),	(Software Level),	(File Name)	(Serial #)	Dsply Unit Fon

Note The Stock Number listed is for the board assembly and may not represent an orderable service item. Refer to the parts lists in Section 10 for service level stock numbers.

The Front Panel Control (FPC), Display Unit Application (DUA), and the Display Unit Flash (DUF) reside, along with the Display Unit BIOS (DUB), on the Display Unit CPU board.

8.3.3 View PC Card Install Log

Selecting ***View PC Card Install Log*** brings up the CF (CompactFlash) Card Install Log for the software download card. The log includes chronological entries for every Software Download that was completed with the card. Each entry includes two header lines and eight data lines in the following format:

CF Card Install Log

INSTALLATION LOG for PC Card # XXXXXXX/ABXXX

 # Software configuration after download on (day) (date) (time)
 # SvcApp Ver (XX.XX), Machine Serial Number (ABCDXXXXX), Card # XXXXXXX/ABXXX

Aisys ACB,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	AnesControl B
Aisys MXR,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Electronic Mix
Aisys VAP,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Vaporizer
Aisys VNT,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Vent Intface B
Aisys FPC,		*,	(Software Level),	(File Name)	(#---------)	Front Panel CN
Aisys PSC,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Power Controll
Aisys DUA,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Dsply Unit App
Aisys DUB,	(Stock Number)	(RevX),	(Software Level),	(File Name)	(Serial #)	Dsply Unit BIO
Aisys DUF,	(Stock Number)	(Rev X),	(Software Level),	(File Name)	(Serial #)	Dsply Unit Fon

Notes

9 Repair Procedures

In this section

⚠ **WARNING** To prevent fires:

- Use lubricants approved for anesthesia or O_2 equipment, such as Krytox.
- Do not use lubricants that contain oil or grease; they burn or explode in high O_2 concentrations.
- All covers used on the system must be made from antistatic (conductive) materials. Static electricity can cause fires.

⚠ Obey infection control and safety procedures. Used equipment may contain blood and body fluids.

⚠ A movable part or a removable component may present a pinch or a crush hazard. Use care when moving or replacing system parts and components.

⚠ Some internal parts have sharp edges and can cause cuts or abrasions. Use care when servicing internal components.

⚠ After repairs are completed, always perform the checkout procedure. Refer to Section 3 of this manual.

⚠ **CAUTION** Electrostatic discharge through circuit boards may damage the components on them. Wear a static control wrist strap before touching the circuit boards. Handle all circuit boards by their non-conductive edges. Use anti-static containers when transporting them.

9.1 Circuit board replacement precautions

The Aisys anesthesia system has processors on several boards. On three of these boards, information such as the machine serial number and optional ventilation modes (PCV, SIMV, and PSVPro) are stored redundantly.

During power-up, the machine serial number and installed options information stored on the boards are compared. If one board differs, information from the two agreeing boards will be written to the new board. If three boards differ (in the case of two boards replaced) the system defaults to “NO OPTIONS” and default machine serial number.

To retain the installed options, **install only one replacement board at a time**.

If multiple boards are to be installed, install the first board, load software on the new board, and power-up the machine in normal mode. Repeat this procedure for each board installation.

The following table lists the actions required after replacing printed circuit boards:

Board Name (Short Name)	Required Action After Installation
Display Unit CPU (DU CPU)	Load Software (see **Note**). Check / Re-Configure Machine Configurations. Affix the new Key Code and Board ID Label to Vent Casting. Preoperative Checkout.
Anesthesia Control Board (ACB)	Load Software. Check / Re-Configure Machine Configurations. User Calibrations (O2 Cell, Flow Sensor, etc.). Gas Transducer Zero. All Ventilator Calibrations. Preoperative Checkout.
Power Controller (PCB)	Load Software. Preoperative Checkout.
Ventilator Interface Board (VIB)	Load Software. User Calibrations (O2 Cell, Flow Sensor, etc.). All Ventilator Calibrations. Preoperative Checkout.
Electronic Mixer (Mixer)	Load Software. Zero Mixer Pressure Sensors. Preoperative Checkout.
Agent Delivery Board (ADB)	Load Software. Do Agent Delivery test with Test Cassette (Section 3.3.6). Preoperative Checkout.
All Others	Preoperative Checkout.
Note: Flash software starts loading immediately when the Download Application first boots. Do not interrupt the Flash download. Allow the download to complete before proceeding.	

9.1 How to bleed gas pressure from the machine

Before disconnecting pneumatic fittings, bleed all gas pressure from the machine.

1. Close all cylinder valves and disconnect all pipeline supplies from the source.
2. Set the system switch to On.
3. Ensure that all cylinder and pipeline pressures read zero.
4. Establish a flow for the affected gas to bleed down the pressure.
5. Set the system switch to Standby.

9.2 How to remove the rear panels

To access components in the upper electronic enclosure from the rear of the machine, you must remove the rear cosmetic panel and an inner enclosure cover.

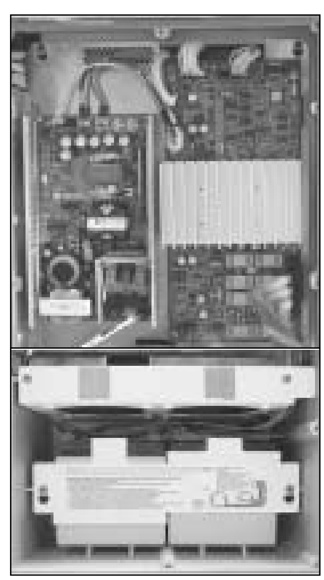
To access components in the lower electronics enclosure, you must remove the lower access panel.

9.2.1 To remove the rear upper panel

1. Bleed all gas pressure from the machine (Section 9.1).
2. Ensure that all cylinder and pipeline pressures read zero before proceeding.
3. Disconnect all electrical cables.
4. To remove the rear cosmetic panel, fully loosen the four captive screws that hold the panel in place. Remove the panel.
5. To remove the inner access panel, remove the 18 mounting screw around the periphery of the panel. Disconnect the fan cable to remove the panel.

9.2.2 To remove the lower access panels

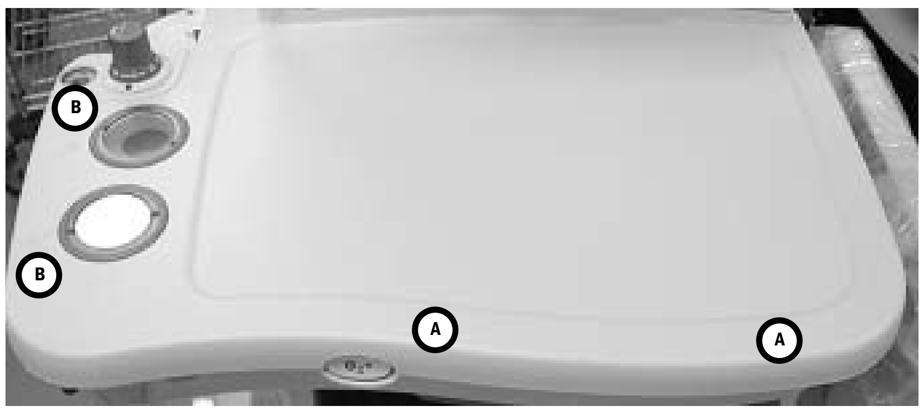
1. Disconnect the power cord from the AC mains supply.
2. Bleed all gas pressure from the machine (Section 9.1).
3. Ensure that all cylinder and pipeline pressures read zero before proceeding.
4. If present, remove the inboard cylinders.
5. To remove the lower access panel, remove the 11 mounting screws around the periphery of the panel.
6. Loosen the thumbscrew (**A**) at the top edge of the panel to remove it.



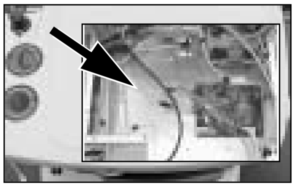
9.3 How to remove the tabletop

The tabletop is held in place with four captive screws along the periphery of the pan assembly (accessed from below the rim of the tabletop).

- Two screws (**A**) are at the front of the tabletop: one screw is at the right corner of the tabletop, one is near the O_2 Flush button.
- To access the remaining two screws (**B**), you must remove the ABS: one screw is at the left corner of the tabletop, one is near the APL Valve.



9.4 Servicing the pan electrical enclosure components



The pan electrical enclosure includes the following components (Section 10.9):

- the Electronic Gas Mixer assembly
- the Ventilator Interface board
- the Filter board
- the Pan Connector board
- O_2 Flush Regulator

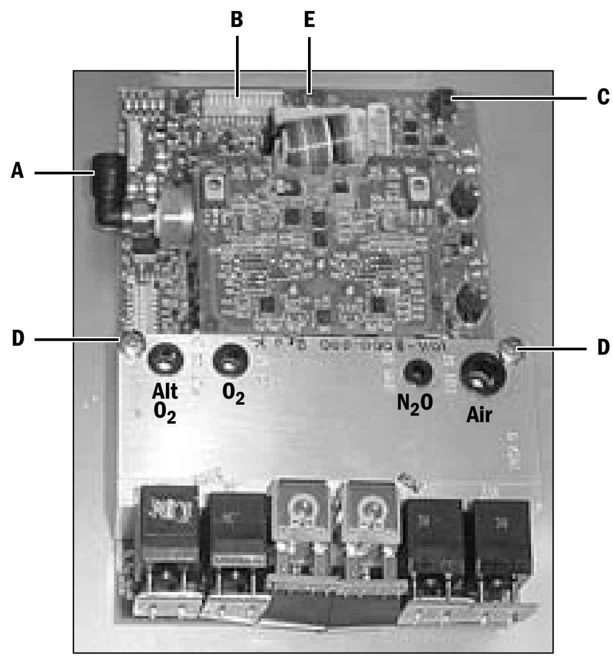
To replace these components, remove the tabletop (Section 9.3) and the pan enclosure cover.

Access to some of these components require further disassembly for replacement.

9.4.1 Electronic Gas Mixer assembly

The following procedure describes how to replace the Electronic Gas Mixer assembly.

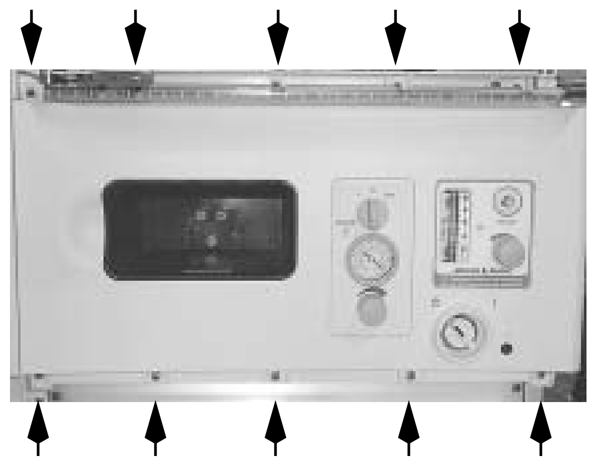
1. Bleed all gas pressure from the machine (Section 9.1).
2. Ensure that all cylinder and pipeline pressures read zero before proceeding.
3. Loosen the mounting screws and move the dashboard to the service position (Section 9.5).
4. Disconnect the inlet tubing or fittings from the manifold. If the machine does not include N_2O, transfer the plug from the N_2O inlet to the replacement assembly.
5. Disconnect the tubing from the elbow outlet fitting (**A**).



6. Disconnect the ribbon cable from the Pan Connector board (**B**).
7. Disconnect the fan harness (**C**).
8. Remove the two screws (**D**) that hold the manifold to the enclosure.
9. Remove the mounting screw (**E**) at the front edge of the main circuit board.
10. Temporarily remove the Ventilator Interface board to provide clearance to slide the mixer forward and out of the pan enclosure.
11. Replace the Electronic Gas Mixer assembly and reassemble the removed components in reverse order.

9.5 How to access dashboard components

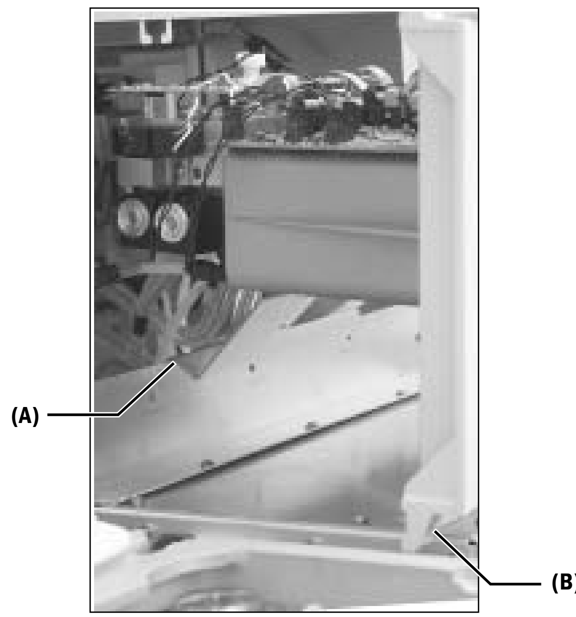
1. Bleed all gas pressure from the machine (Section 9.1).
2. Ensure that all cylinder and pipeline pressures read zero before proceeding.
3. Remove the tabletop (Section 9.3).
4. Remove the upper bezel located above the dashboard.
5. Loosen 10 captive dashboard mounting screws and move the dashboard forward to the stop position.



⚠ **CAUTION** When replacing the dashboard back into the machine, take care not to trap, kink, or snag any tubing or wiring harnesses.

9.6 Replace electronic vaporizer and components

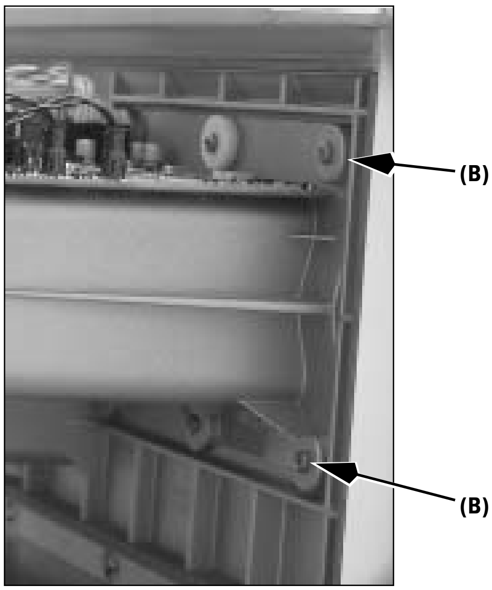
1. Move the dashboard forward to the service position (Section 9.5).
2. Lift the assembly slightly to release the hanging pin from the rail.

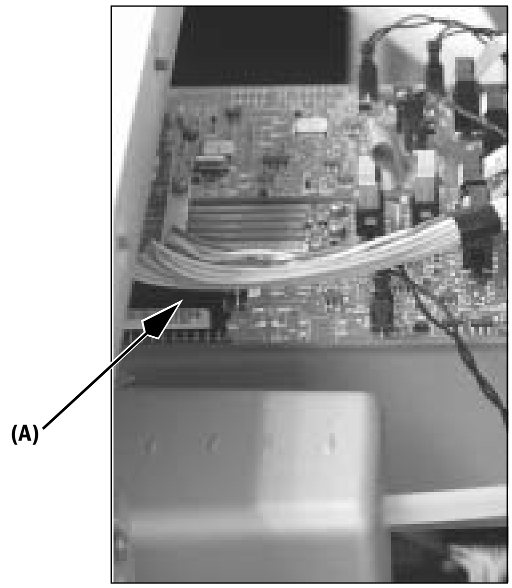


3. Position the dashboard so that the EV support bracket (**A**) rests on the edge of the chassis and the bottom edge of the dashboard (**B**) straddles the pan electronic enclosure.
4. In the forward position, the following EV components can be replaced without removing the EV from the machine. Refer to the following sections for details.
   - Flowmeter subassembly
   - Flowmeter inflow and outflow zero valves
   - Manifold temperature sensor board
   - Agent delivery board
   - Cassette interface board
5. To replace the EV, or components not mentioned above, remove the EV from the machine as detailed in the following section.

9.6.1 Remove the electronic vaporizer

1. Disconnect the tubing from the inlet port, outlet port, and the scavenging port of the EV.
2. Disconnect the pan connector harness (**A**) from the Agent Delivery board.
3. Clip the tie-wrap holding the pan connector harness to the EV support bracket.
4. Remove the six screws (**B**) holding the EV to the dashboard.





5. **Note**: The EV assembly weighs approximately 5 kg (11 lb). Most of the weight of the EV is at the rear.

⚠ **CAUTION** When handling the EV, be careful not to damage the Flow Control Valve at the back of the flowmeter block.

6. To remove the EV:
   - Firmly take hold of the EV at the rear with one hand.
   - Support the front of the EV with the other hand.
   - Raise the rear of the EV tilting the dashboard forward.
   - When clear, remove the EV from the machine.

9.6.2 Replacing EV components

Do not remove any components on the EV flowmeter subassembly that are fastened with Torx head fasteners. The components are not serviceable items.

Most components can be replaced by disconnecting associated wiring, removing mounting hardware and remounting the replacement component in place. Where applicable, note the additional comments for specific components detailed below.

Cassette Interface board (A)

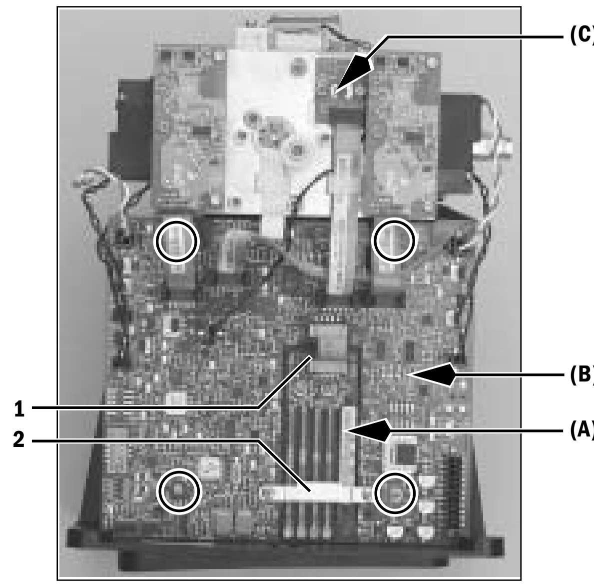
- Disconnect jumper cable (**1**).
- Remove retaining bracket (**2**).
- Be careful not to bend fingers.

Agent Delivery board (B)

- Remove the cassette interface board retaining bracket and jumper cable as above.
- Disconnect harnesses and ribbon cables.
- Remove mounting screws (circled).
- Raise the rear edge of the board to free it from the assembly.

Manifold Temperature Sensor board (C)

- The bottom of the board includes two thermistors that contact a thermal transfer pad. When removing the board, ensure that the pad remains with the manifold. If required, reposition the pad before replacing the board.



Cassette Temperature subassembly (D)

- Do not overtighten the mounting screws. Tighten the screws until just snug.

Flow Control valve (E)

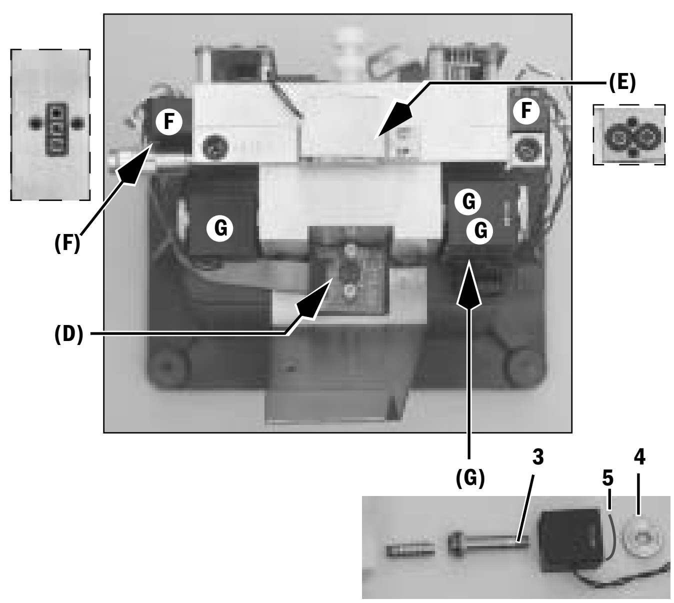
- Inspect o-rings; replace as necessary.

Inflow/Outflow zero valves (F)

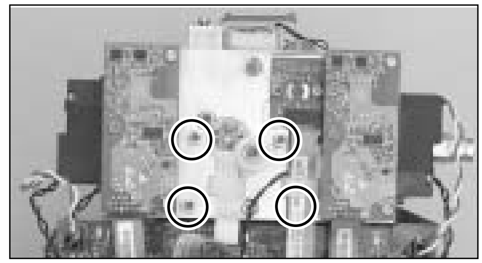
- Inspect gasket; replace as necessary.

Inflow/Outflow/Scavenging solenoid valves (G)

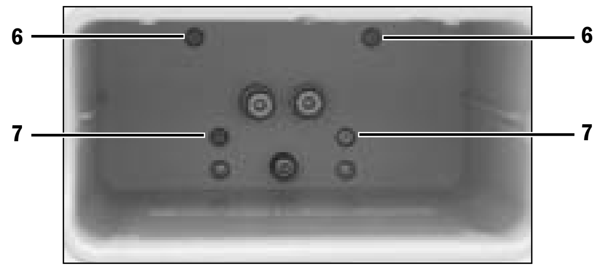
- Apply thin coat of silicone sealant to threads of mounting post (**3**) before securing solenoid with thumb nut (**4**). Install washer (**5**) with dome facing outward (toward nut).



Remove Flowmeter subassembly



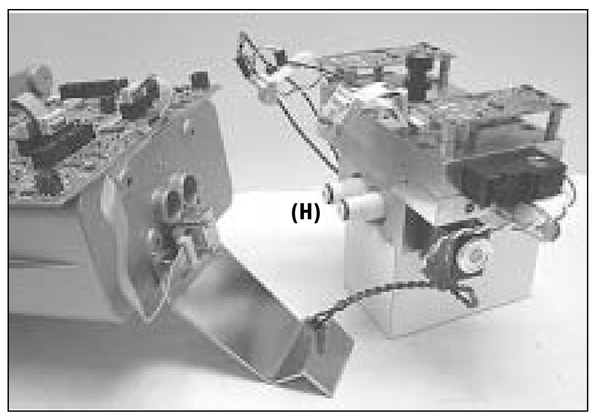
- Disconnect harnesses and ribbon cables from the agent delivery board.
- Remove four socket head hex screws (**circled**) to free the flowmeter subassembly from the valve block below.
- Remove the top two screws (**6**) from inside the cassette bay to release the flowmeter subassembly.
- Lift the flowmeter subassembly from the valve block subassembly.
- When replacing the flowmeter subassembly, position it directly over the valve block assembly and lower it in place.



⚠ **CAUTION**: Avoid sliding the flowmeter subassembly when it is in contact with the valve block; you could damage the flapper valve (see Item **15**).

Access mechanical connector valves (H)

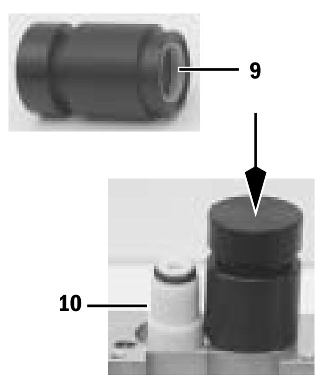
You can access the connector valves by removing the flowmeter and valve block subassemblies from the cassette bay as a unit.

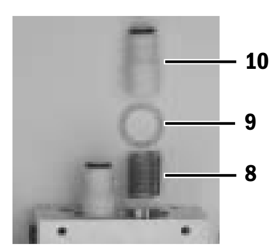


- Disconnect harnesses and ribbon cables from the agent delivery board.
- Remove the top two screws (**6**) from inside the cassette bay to release the flowmeter subassembly.
- Remove the middle two screws (**7**) from inside the cassette bay to release the valve block subassembly.

Replace connector valve assembly

- Place a wave spring (**8**) into the valve block.
- Insert a spring energized seal (**9**) into the insertion tool (spring surface facing out).
- Position the insertion tool into the valve cavity.
- Press the seal in place to retain the wave spring.
- Position the connector valve (**10**) into the valve block cavity.



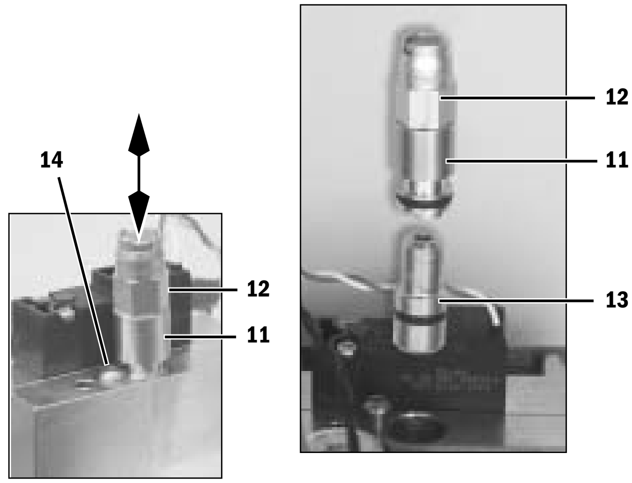


Replace the relief valve

- Hold the back pressure plug (**11**) with non-marring pliers while turning the relief valve (**12**) counterclockwise to remove it.
- If you are replacing the relief valve and the back pressure valve (**13**), remove the relief valve and the back pressure plug as a unit before replacing the relief valve.

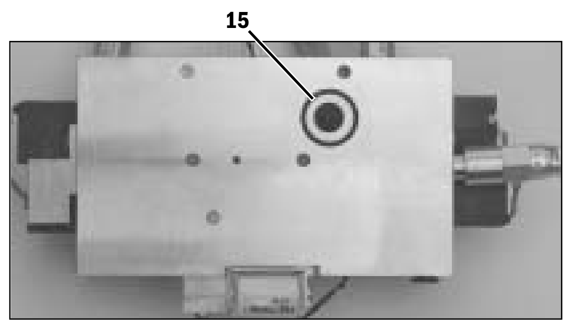
Replace the back pressure valve

- Loosen the mounting screw (**14**).
- Pull up on the back pressure plug as you continue to loosen the mounting screw until both the screw and plug come loose.
- Use an angled probe to grab the back pressure valve (**13**) and pull it out of the manifold.
- Inspect and replace the plug o-ring if required.
- Lubricate the plug o-ring and back pressure valve o-ring sparingly with Krytox.
- Insert the back pressure valve into the manifold; note the direction (flow arrow out of the manifold).
- Position the plug assembly and the mounting screw together in place.
- Tighten the mounting screw while pushing down on the plug assembly until it is fully seated.



Replace the inflow check valve (flapper)

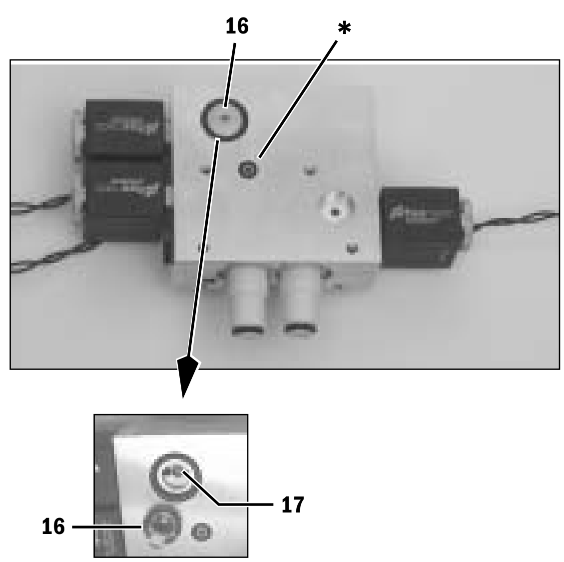
- Remove the flowmeter subassembly from the valve block subassembly.
- Use a small pick to lift the edge of the flapper disk (**15**).
- Inspect and replace the flapper and o-ring as required.



Replace the liquid flow prevention components

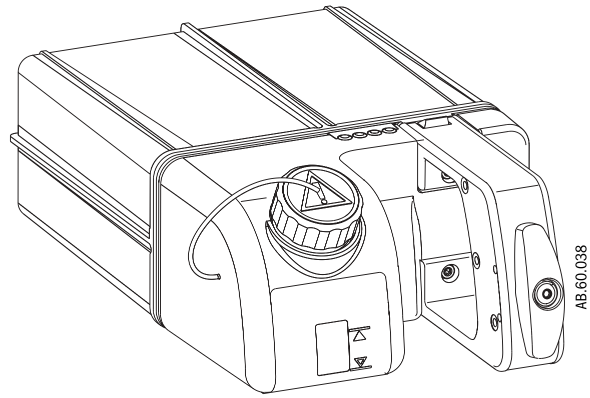
- Use a small pick to lift off the cap (**16**) from the valve block to access the flow prevention ball (**17**) underneath.
- Inspect and replace the ball and o-ring as required.

*Note: A replacement valve block assembly includes a strip of tape over this o-ring to hold it in place. Be sure to remove the tape before replacing the valve block assembly.



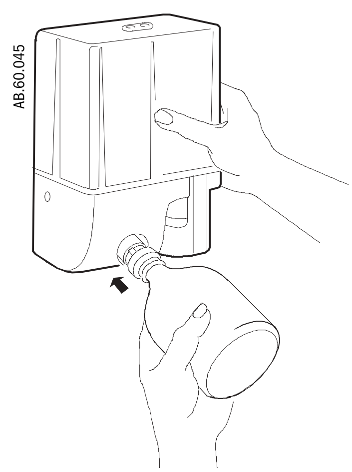
9.7 Servicing Aladin$_2$ cassettes

Note Before service or returning a cassette to the manufacturer, make sure that the cassette is empty. All types of Aladin$_2$ cassettes must be emptied before shipping. Package and ship the cassettes in a suitable container.



Emptying an Aladin$_2$ cassette

1. Connect an empty bottle to the filling system and hold it tight.
2. Turn the Aladin$_2$ cassette so that agent flows into the bottle and wait until the cassette is empty.

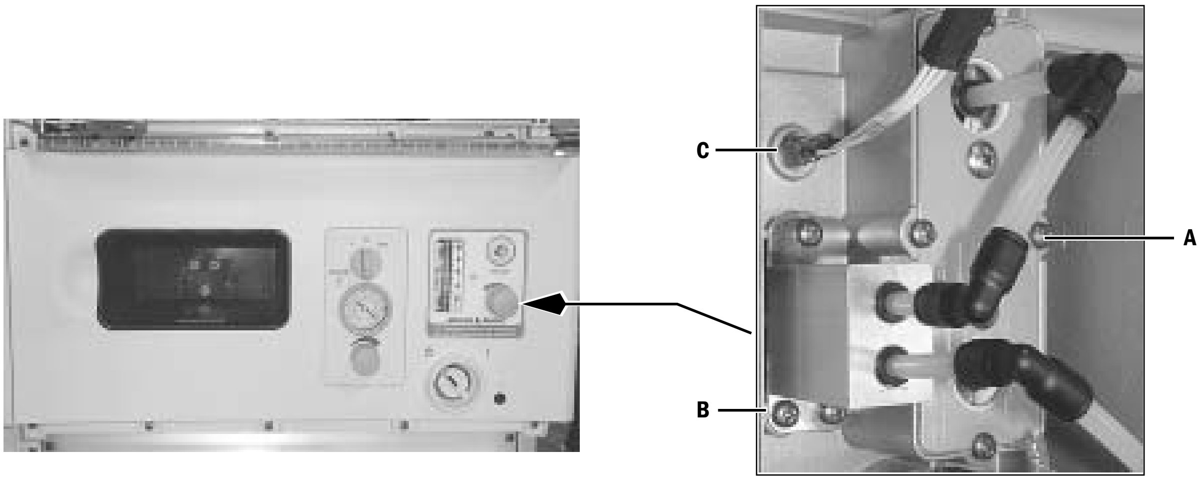


3. To get the maximum amount of agent out, rock the cassette from left to right and tip it forward and back several times.
4. Remove the bottle before returning the cassette to the horizontal position.

Note For replacement parts and repair procedures, refer to Section 10.28.

9.8 Replace Alt O_2 components

1. Move the dashboard forward to the service position (Section 9.5).



Alt O_2 Flowmeter (A)

Disconnect the tubing from the flowmeter.
Remove the four screws that hold the flowmeter mounting bracket to the dashboard.
Transfer the mounting bracket to the new flowmeter.

Needle Valve Assembly (B)

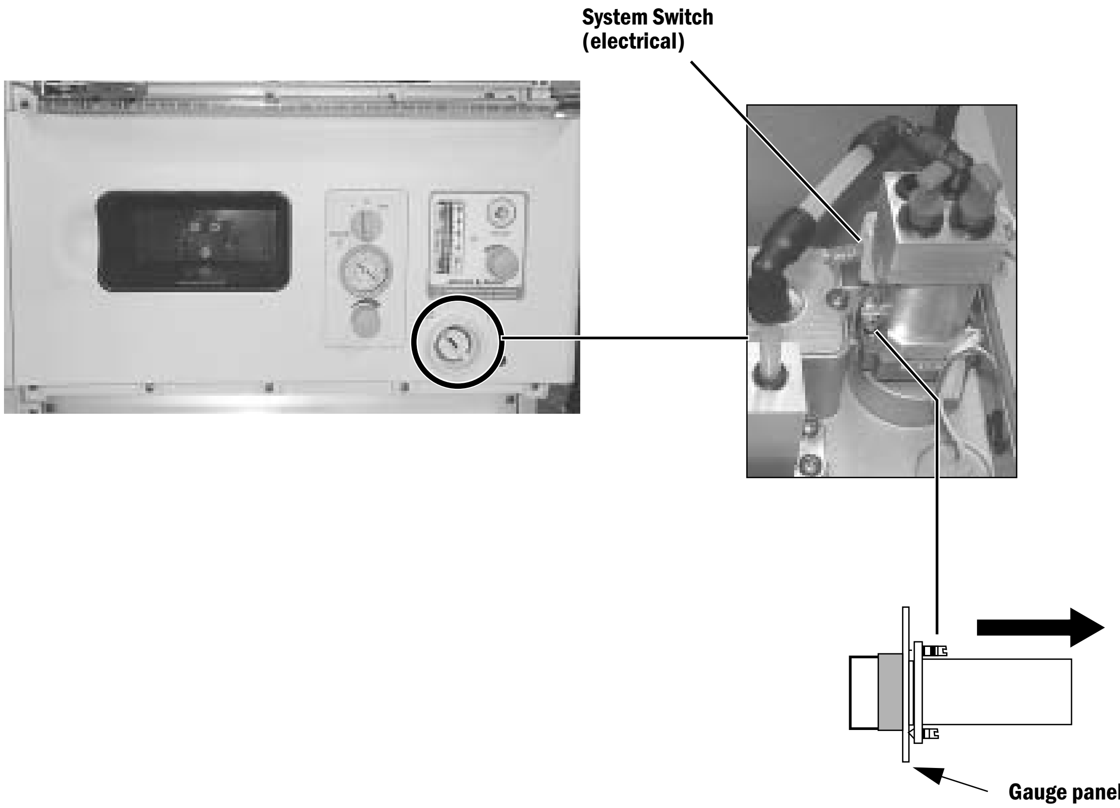
Loosen the set screw that holds the knob to the needle valve; remove knob.
Disconnect the tubing from the needle valve assembly.
Remove the three screws that hold the needle valve assembly to the dashboard.
Transfer the mounting plate to the new needle valve assembly.

Alt O_2 Switch (C)

Disconnect the switch harness.
When replacing the switch, face the tab on the washer toward the switch body (tab not used for positioning).

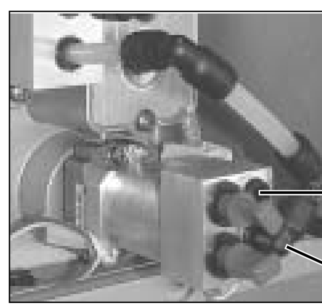
9.9 Replace system switch assembly

1. Move the dashboard forward to the service position (Section 9.5).



2. Disconnect the wires from the electrical switch.
3. Back out the system switch mounting screws just enough to allow the knob collar to be released.
4. While holding the switch assembly, push in the knob and turn it counterclockwise.
5. Pull the knob and collar out from the front and remove the switch assembly.

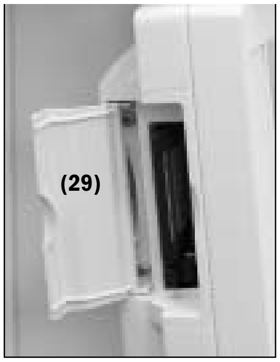
6. Install the replacement switch assembly:
   a. Transfer the 8-mm plugs from the old system switch to the new system switch on the pneumatic module (pull on the plug to ensure that it is locked into the module).
   b. Turn back the system switch mounting screws until their tips recede.
   c. Orient the switch assembly with the plugged fittings toward the left (facing the back of the dashboard).
   d. Install the switch assembly through the dashboard.
   e. Push the knob collar in with the indicator up and turn it clockwise until it locks.
   f. Tighten the mounting screws. Make sure that the top edge of the switch assembly is parallel to the top edge of the dashboard.
   g. Loosen the two screws on the electrical module.
   h. Insert the wires in the electrical module and tighten the screws.
   i. Pull the wires on the electrical module to ensure that there is a good connection.
   j. Transfer the tubing from the old system switch to the new system switch on the pneumatic module (pull on the tubing to ensure that it is locked into the module).



7. Test the replacement switch assembly:
   a. Connect an O_2 supply.
   b. Connect the power cable to an electrical outlet.
   c. Set the system switch to On.
   d. Make sure that the display comes On.
   e. Select Alt O_2 flow.
   f. Increase the Alt O_2 flow. Make sure that gas flows.
   g. Make sure that you do not feel or hear any leaks.
   h. Set the system switch to Standby.
   i. Make sure all gas flow stops and the display turns Off.
8. Reinstall the dashboard, the upper cosmetic panel, and the tabletop.
9. Perform the checkout procedure (Section 3).

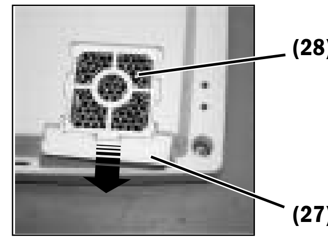
9.10 Servicing the Display Unit

Note The item numbers appearing in parenthesis in this section refer to items in the parts list in Section 10.7.



The fan filter (28) and the access door (29) to the PCMCIA interface can be replaced with the Display Unit in place.

To replace the filter, slide the filter capsule (27) downward to remove it from the Display Unit.



To service other components of the Display Unit, you must first remove the Display Unit from the machine.

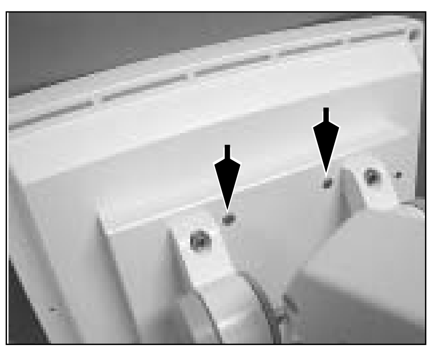
9.10.1 Remove the Display Unit

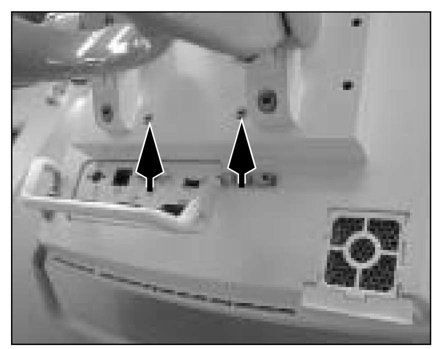
The Display Unit is mounted to the wrist assembly on the display arm. It is held in place with four screws.

1. Remove the cables from the DUs rear connector panel.
2. Before removing the display, move the display arm to its highest position.

If the DU is the only display, it is mounted to a counterweight that is attached to the wrist assembly.

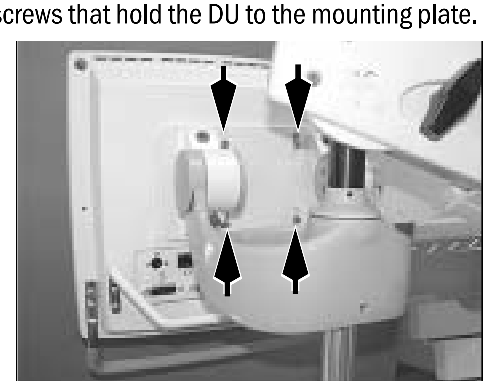
- Remove the four screws that hold the DU to the counterweight.





If the display arm also supports an optional monitor display, the DU is attached to a vertical or horizontal mounting plate through four keyhole slots.

- Loosen the four screws that hold the DU to the mounting plate.

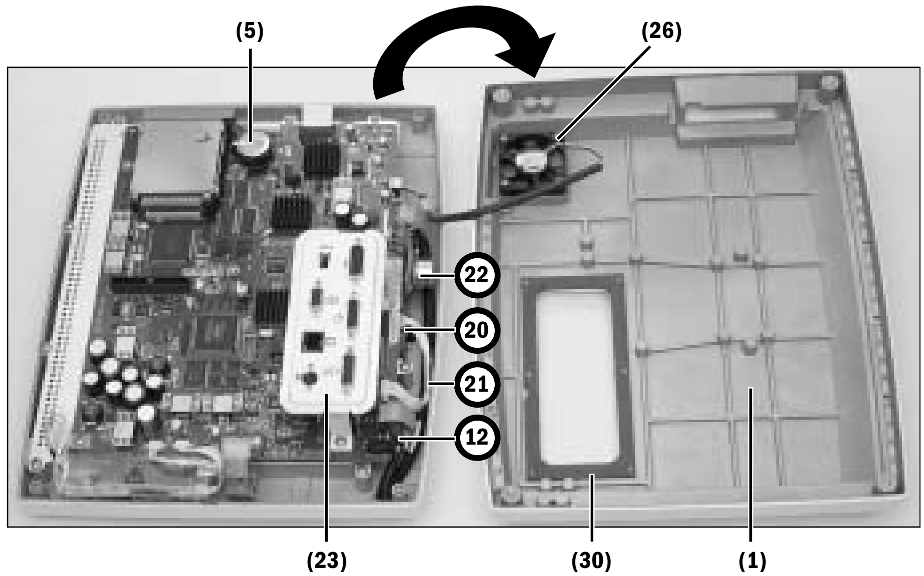


3. Remove the DU from the display arm.

9.10.2 Disassemble the Display Unit

Place the Display Unit face down on an anti-static pad. Before removing the rear enclosure, ensure that the release tabs on the PCMCIA frame are fully depressed.

1. Loosen (**L**) the four captive screws at each corner of the rear enclosure.
2. Lift the rear enclosure slightly and pivot it away from the lower enclosure at the bottom side of the Display Unit.



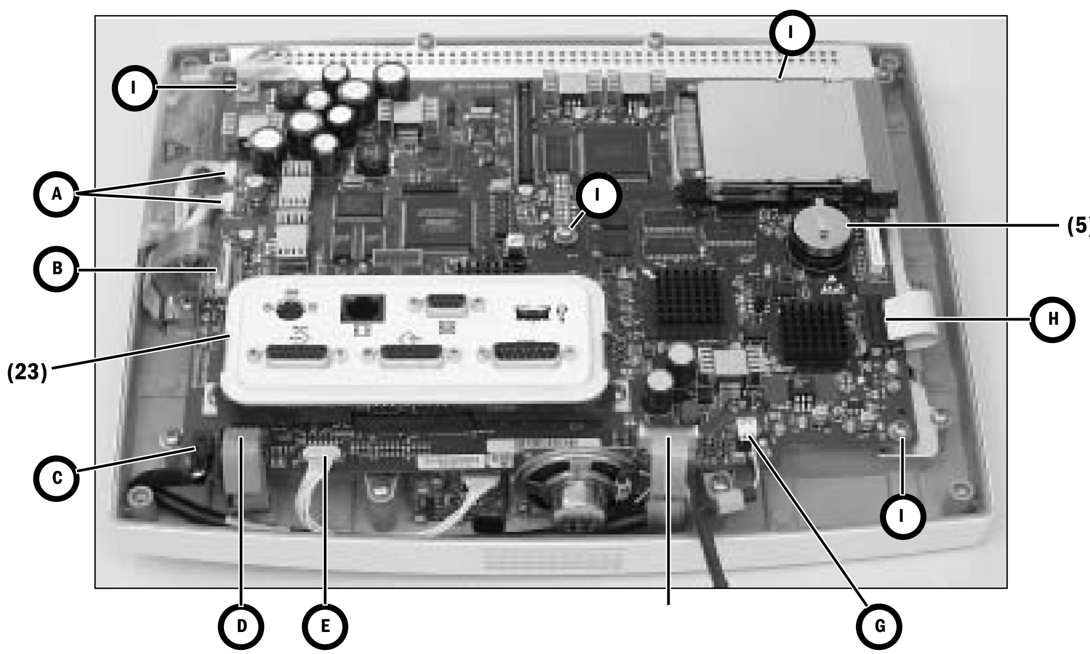
At this point, you can replace the following items (The item numbers refer to the parts list in Section 10.7):

- the **fan** (26)
- the **connector panel assembly** (23)
- the **encoder assembly** (12)
- the **IRDA board** (20) or **IRDA board harness** (21)
- the **battery** (5)
- the **speaker** (22) – To access the mounting screws for the speaker, you must first remove the ten screws that hold the mounting plate to the front enclosure so that you can raise the bottom edge of the assembly slightly – Refer to section 9.10.4.)
- the **rear enclosure** (1) – You can transfer the captive screws to the new enclosure. However, the **gasket** (30) is held in place with adhesive. When replacing the rear enclosure, also include a new gasket.

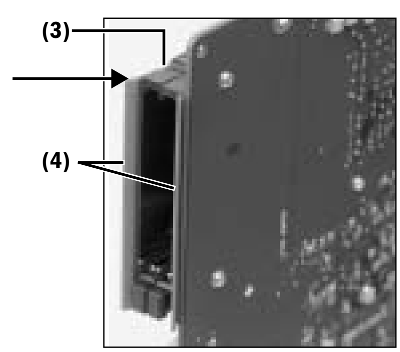
To replace the remaining items requires further disassembly.

9.10.3 To replace the CPU board

1. Remove the **connector panel assembly** (23) — two screws.
2. Disconnect the following cables:
   - Inverter harnesses (**A**)
   - Membrane switch flex-cable at ZIF (zero insertion force) connector (**B**)
   - Speaker cable (**C**)
   - Encoder assembly cable (**D**)
   - IRDA board cable (**E**)
   - Membrane switch flex-cable at ZIF (zero insertion force) connector (**F**)
   - Fan cable (**G**)
   - LCD cable (**H**)



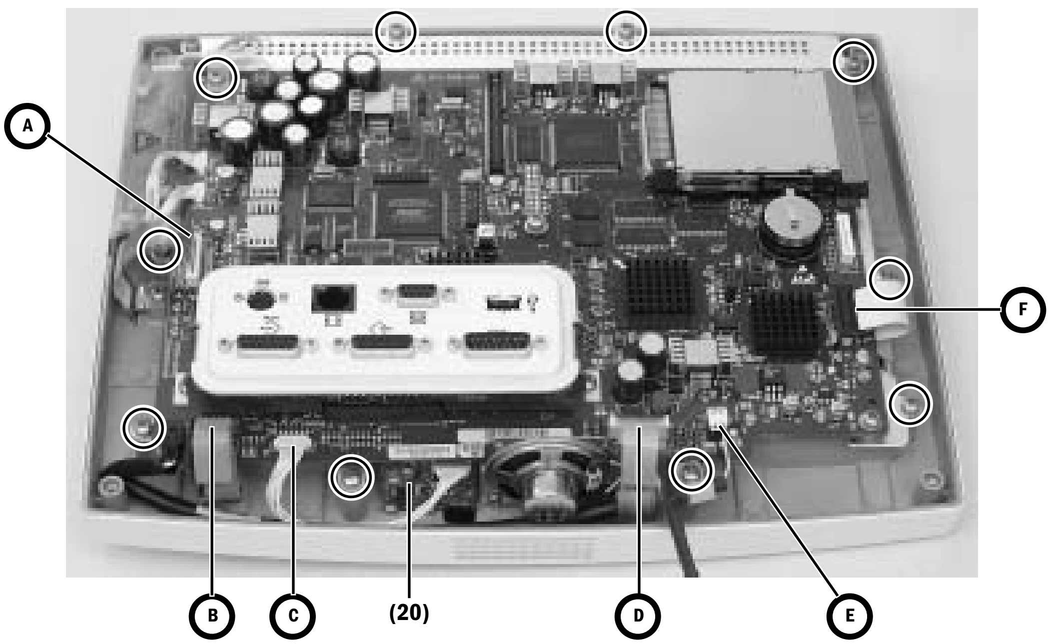
3. Remove the remaining four screws (**I**) that hold the CPU board to the mounting plate.
4. Remove the CPU board from the mounting plate.
5. If you are **replacing the PCMCIA frame** (3) on an existing CPU board (remove four screws on back of CPU board), you must also apply new gaskets (4) to the frame. Align the ends of the gaskets with the top edge of the frame.



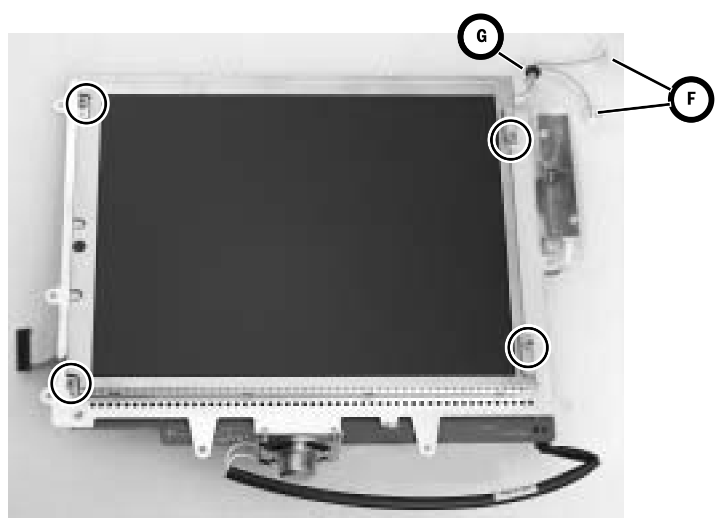
6. Transfer the battery (5) to the new CPU board.
7. Reassemble in reverse order.

9.10.4 To replace the LCD display

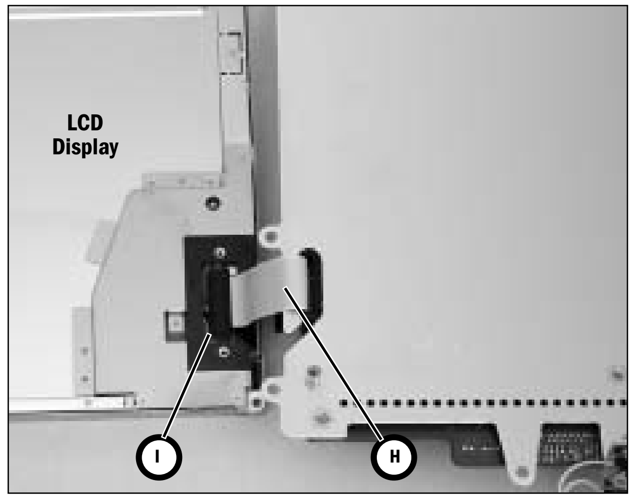
1. Disconnect the following cables:
   - Membrane switch flex-cable at ZIF (zero insertion force) connector (**A**)
   - Encoder assembly cable (**B**)
   - IRDA Interface cable (**C**) — remove IRDA Interface board (20)
   - Membrane switch flex-cable at ZIF (zero insertion force) connector (**D**)
   - Fan cable (**E**)
   - LCD cable (**F**)
2. Remove the ten screws (**circled**) that hold the mounting plate to the front enclosure.



3. Remove the mounting plate assembly from the front enclosure.
4. Disconnect the backlight harnesses (**F**) from the inverter boards.
5. Slide the grommet (**G**) out of the mounting plate slot (transfer to new LCD).
6. Remove the four screws (**circled**) that hold the LCD to the mounting plate.



7. Lift the left side of the LCD display slightly away from the mounting plate to pull some of the display ribbon cable (**H**) to the top side of the plate. Flip the LCD over to the left of the assembly.
8. Disconnect the display ribbon cable (**I**).



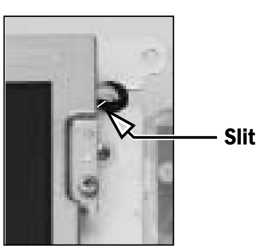
9. Reassemble in reverse order.

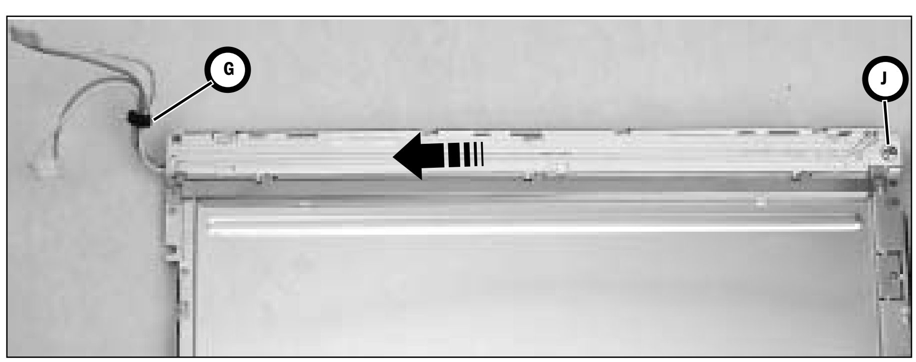
   Note: When replacing the LCD, pull the excess ribbon cable to the bottom side of the plate as you lower the LCD on to the plate. For the backlight harness grommet (**G**), ensure that the slit in the grommet faces toward the inside of the keyhole.

9.10.5 To replace the backlights

The backlight replacement kit includes a backlight assembly (with two backlights) and two inverters with mounting hardware. To replace the backlight assembly follow the procedure in Section 9.10.4 to gain access to the assembly. To replace the inverters, follow the procedure in the next section.

1. Remove the one screw (**J**) that holds the backlight assembly to the LCD.
2. Slide the backlight assembly to the left to free it from the retaining tabs and then lift it out of the holder.





3. Transfer the grommet (**G**) to the new backlight assembly.
4. Reassemble in reverse order.

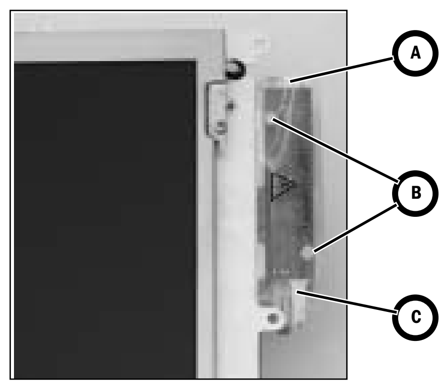
9.10.6 To replace the Inverters

The Display Unit includes two inverters (one for each backlight).

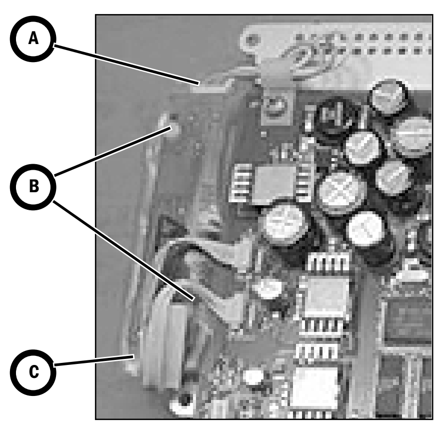
The inverters “sandwich” the mounting plate and use it as a heatsink. Follow the procedure in Section 9.10.4 to gain access to the inverters. Replace one inverter at a time.

1. Disconnect the backlight cable (**A**) from the inverter.
2. Remove the two Nylon screws (**B**) that hold the inverter to the backplate.
3. Slide the inverter out of the sleeve and disconnect it from the CPU harness (**C**).
4. Reassemble in reverse order.

The “front” inverter



The “rear” inverter



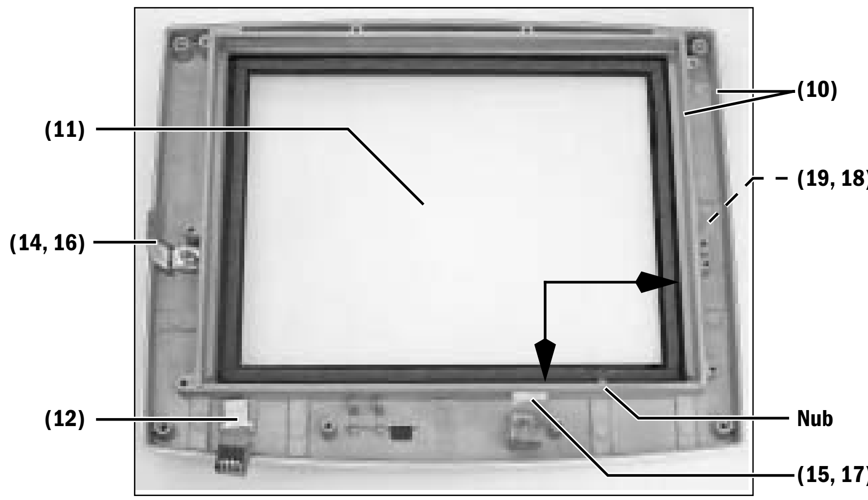
9.10.7 To replace the front enclosure or components

Disassemble the Display Unit following procedures in the previous sections to the point where you have removed the mounting plate assembly from the front enclosure.

If you are replacing the front enclosure, you can transfer the encoder (12) assembly to the new enclosure; but, you must build up the replacement enclosure with:

- a new window (11)
- new membrane switches — right-side (14), lower (15), left-side spacer (19)
- new keypads - right-side (16), lower (17), left-side blank (18)
- new EMC gasket (10)

If you are replacing a keypad or a membrane switch, you must replace both items.

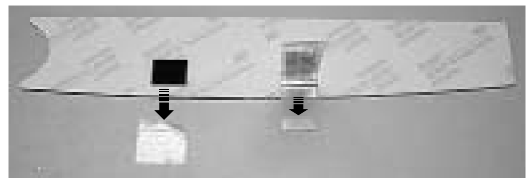


To replace the window

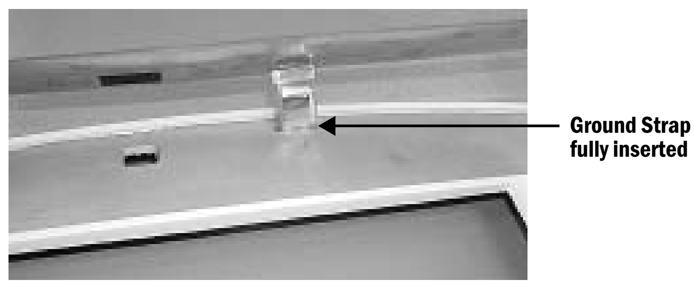
1. Place the front enclosure face up on a flat surface.
2. Press down on one corner of the window to free it from the enclosure.
3. Work your way around the window until you can get a hold of it from the back.
4. Slowly pry the window from the enclosure.
5. Place the front enclosure face down on a flat surface, taking care not to damage the encoder.
6. Remove any remaining residue from the mounting area; clean with isopropyl alcohol.
7. Remove the inside protective material from the front of the window.
8. Peel the front outside frame of the release liner.
9. Lower the window straight down in the enclose, noting the notch in the window and the matching nub on the enclosure.
10. Before seating the window, position it in contact with the bottom and right sides of the frame (see arrows) so that the larger gap between the window and the enclosure is at the top and left edges (as viewed from behind).
11. Remove the protective film from the back side of the window.

To replace a membrane switch and keypad

1. Remove the screw that attaches the grounding strap to the enclosure.
2. Pry the membrane switch and keypad from the enclosure.
3. Remove any remaining residue from the mounting area; clean with isopropyl alcohol.
4. Remove the backing from the membrane. Be sure to remove the small backing below the flex cable. For the lower membrane, remove the protective film from the IRDA window.



5. Insert the flex cable and ground strap through the slot in the enclosure. Ensure that all of the ground strap passes through the slot an does not remain folded over under the membrane.



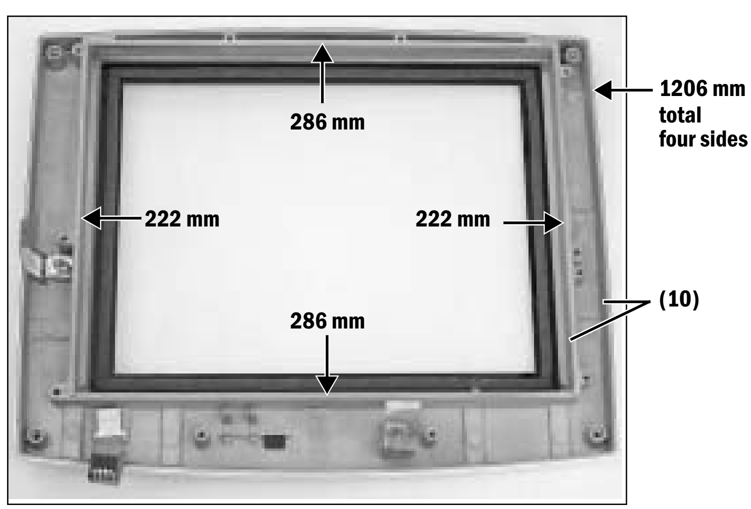
6. Carefully lower the membrane straight down to the enclosure. Seat the membrane in place.
7. Remove the backing from the keypad and install it over the membrane switches.
8. Attach the ground strap to the enclosure.

To install the EMI gasket

To fully seal the Display Unit enclosure, you will need approximately 2.3 meters of EMC gasket (10). Cut the gasket into five strips shown below.

Insert a continuous length of gasket in the outside grove of the enclosure (sparingly apply “Super Glue Gel” to the channels near the corners before installing the gasket).

Insert individual lengths of gasket in the inside grove around the window (sparingly apply “Super Glue Gel” to the channels near the corners before installing the gasket).



9.11 Servicing the lower electrical enclosure components

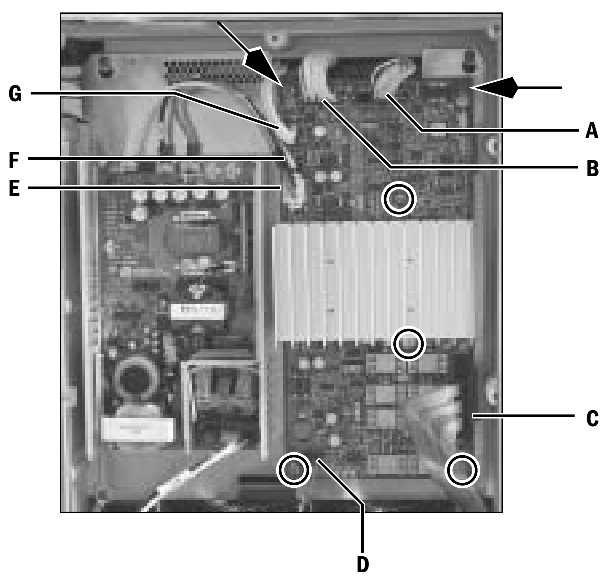
The lower electrical enclosure includes the following components (Section 10.8):

- the Power Controller board
- the Anesthesia Control board
- the Display Connector board
- the backup batteries and the lower enclosure fans.

To replace these components, remove the access panel at the rear of the machine (Section 9.2).

9.11.1 Power Controller board

1. Disconnect the cables coming from the following components:
   - the Display Connector board (**A**),
   - the Anesthesia Control board (**B**),
   - the batteries (**C**),
   - the fans (**D**),
   - the power supply (**E**) and (**F**).
   - the auxiliary connector board (**G**), if present.

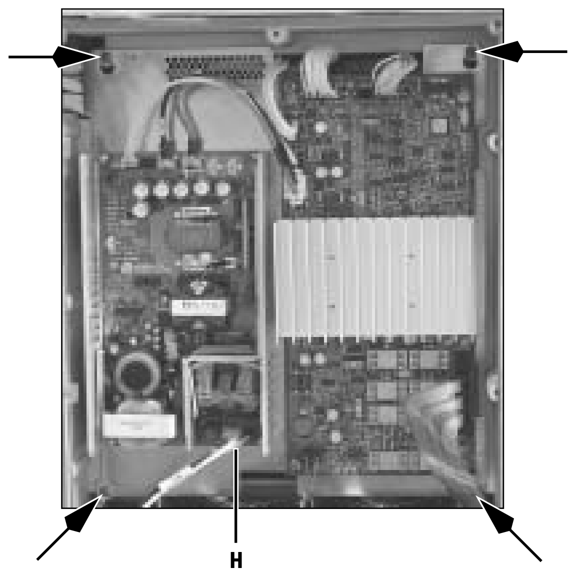


2. Remove the four screws (**circled**) that hold the Power Controller to the mounting plate.
3. Loosen the two screws (**arrows**) at the top edge of the Power Controller.
4. Lift the Power Controller slightly to release it from the keyhole slots.
5. To replace the Power Controller assembly, reassemble in reverse order.

9.11.2 Power Supply

The power supply is secured to the mounting plate with hardware from the back side of the plate. To replace the power supply, you must remove the plate assembly (power supply and controller board) from the electrical enclosure.

1. Disconnect the cables from the power controller board as described in the previous section.
2. Also disconnect the AC power input harness (H) from the power supply.

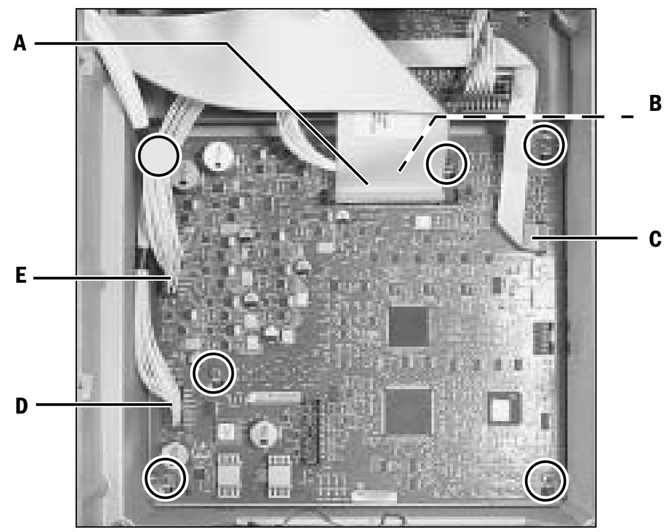


3. Loosen the four screws (**arrows**) at each corner of the mounting plate.
4. Lift the assembly slightly to release it from the keyhole slots.
5. Note that the assembly is still attached to a ground wire at the lower right-hand corner of the mounting plate.
6. Lower the assembly to a convenient position and replace the power supply.
7. Transfer the power supply output harness to the new power supply.
8. Reassemble in reverse order.

9.11.3 Anesthesia Control board

To replace the Anesthesia Control board, first remove the Power Supply/Power Controller board assembly (Section 9.11.2). Then, follow the procedure below:

1. Disconnect the cables coming from the following components:
   - the large ribbon cable from the Pan Connector board (**A**),
   - the harness from the Display Connector board (**B**),
   - the small ribbon cable from the Display Connector board (**C**),
   - the harness from the Power Controller board (**D**),
   - the harness from the Pan Connector board (**E**).

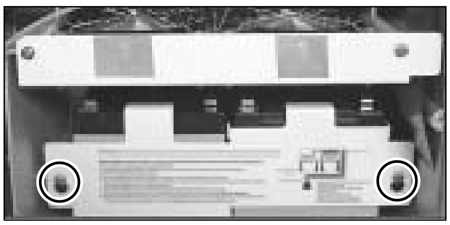


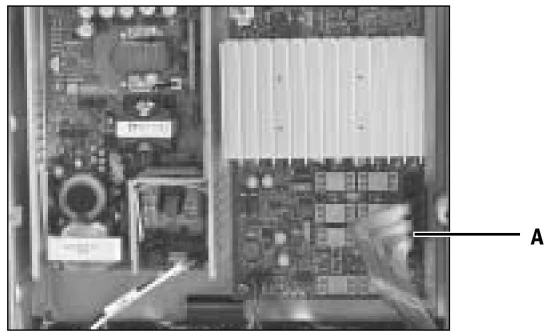
2. Loosen the six screws (**circled**) that hold the Anesthesia Control board to the enclosure.
3. Lift the Anesthesia Control board slightly to release it from the keyhole slots.
4. To replace the Anesthesia Control board, reassemble in reverse order.

9.11.4 Backup batteries

To remove the batteries

1. Loosen the two screws (**circled**) that hold the battery retainer to the enclosure.
2. Remove the retainer.
3. Disconnect the flex-cable from the Power Controller board (**A**).



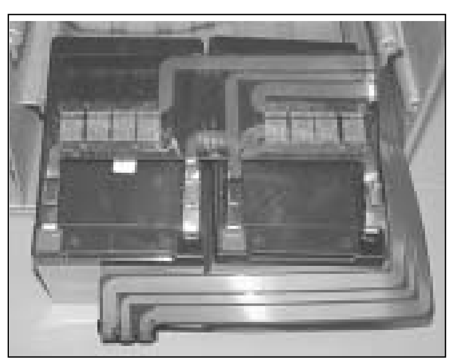


4. Remove the battery pack from the machine.

To replace the batteries

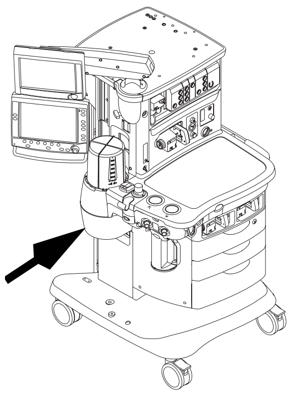
⚠ **CAUTION** To avoid damaging the flex-cable, handle it with care.

1. Transfer the flex-cable to the new batteries.



2. To replace the batteries, reassemble in reverse order.

9.12 Servicing the Vent Engine

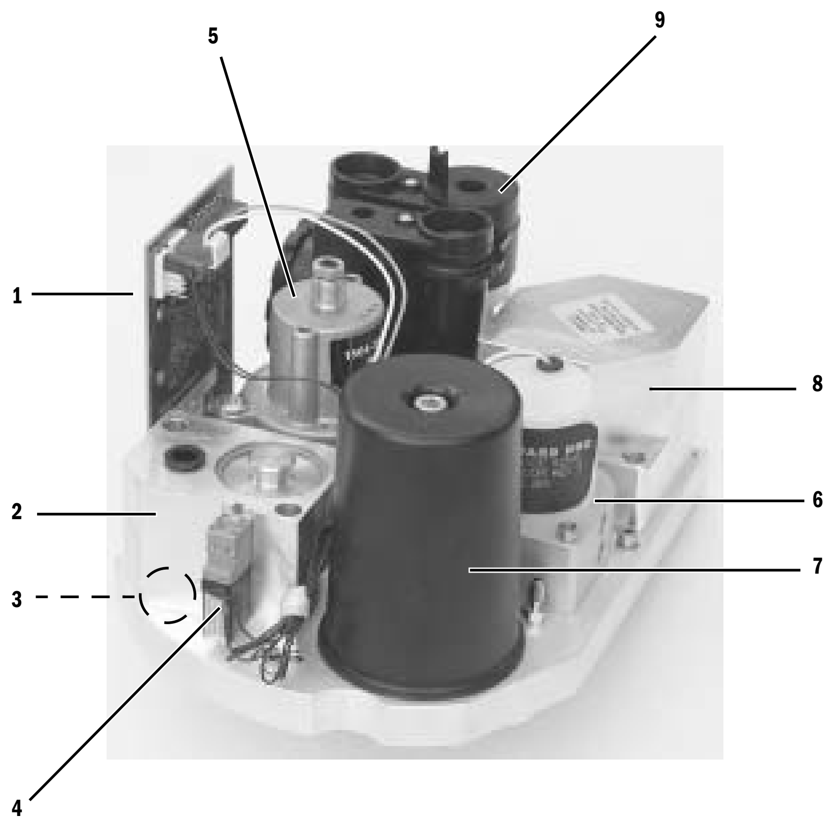


The Vent Engine is found in a housing located below the breathing system bellows assembly.

The Vent Engine includes the following subassemblies.

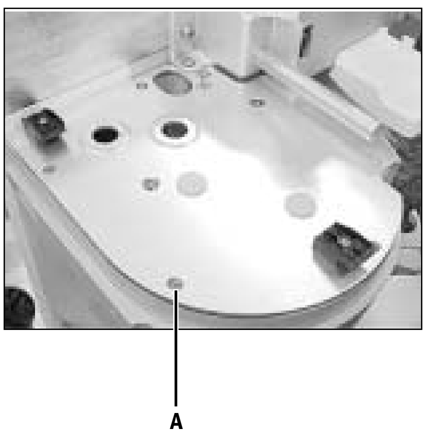
- Vent Engine Connector board (**1**)
- Gas Inlet Valve Assembly (**2**)
- Inlet Filter (**3**) - located under the gas inlet valve
- Inlet Valve Solenoid (**4**)
- Drive Gas Regulator (**5**)
- Flow Control Valve (**6**)
- Reservoir (**7**)
- Drive Gas Check Valve (**8**)
- Interface Manifold (**9**)

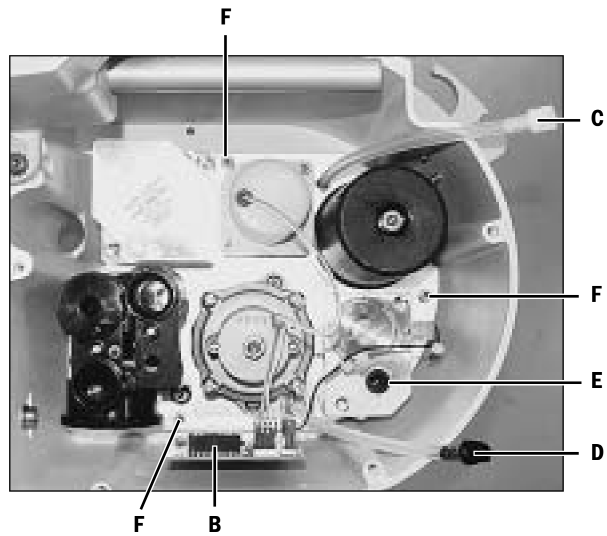
To replace any of the Vent Engine components, you must first remove the Vent Engine from the housing (refer to Section 9.12.1).



9.12.1 To remove the Vent Engine

1. Disconnect pipeline supplies; close cylinder valves; bleed off pressure.
2. Remove the ABS breathing system.
3. Remove the Exhalation valve.
4. Remove the scavenging downtube.
5. Loosen the five captive screws (**A**) that hold the Vent Engine cover to the housing. Raise the cover to access the Vent Engine.

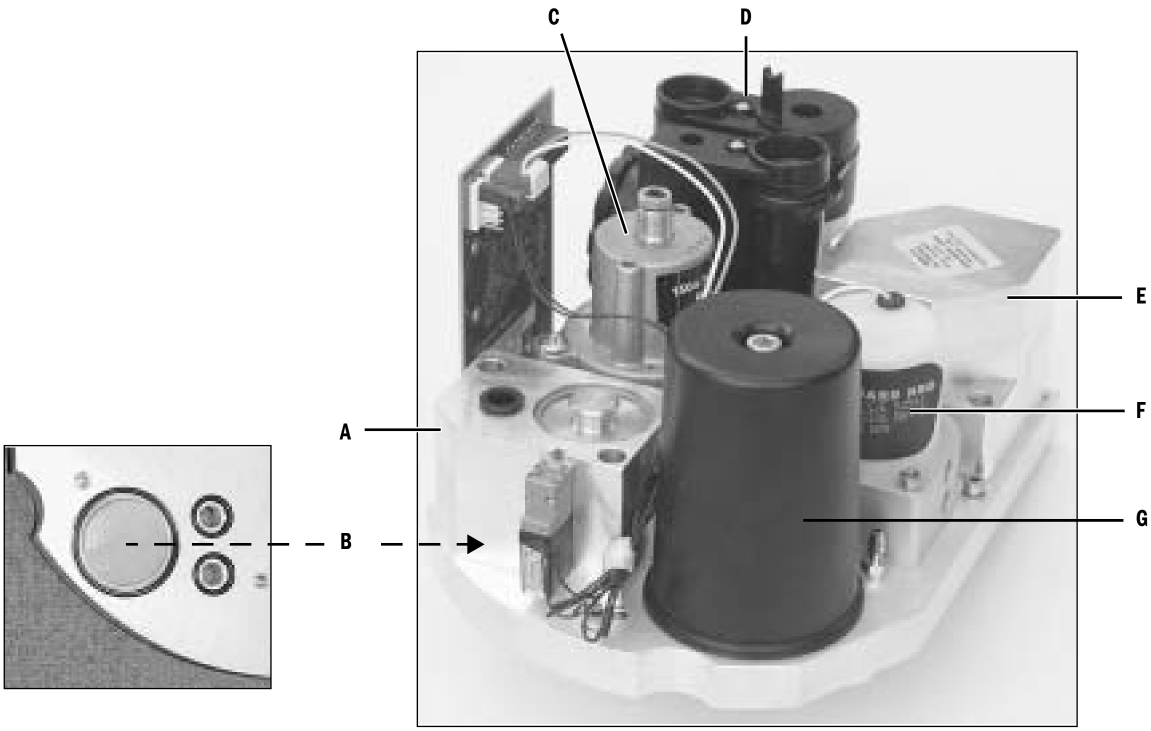




6. Disconnect the Vent Engine harness (**B**).
7. Disconnect the white tube-coupler (**C**) — inline with tube to manifold pressure transducer on the Ventilator Interface Board.
8. If present, disconnect the black tube-coupler (**D**), inline with tube to AGSS flow indicator.
9. Disconnect the drive gas hose (**E**).
10. Loosen the three captive screws (**F**) that hold the engine manifold to the housing.
11. Lift the Vent Engine out of the housing.
12. To replace the Vent Engine, reassemble in reverse order.

9.12.2 Replacing Vent Engine components

Refer to Section 6 for Vent Engine components that are to be serviced under regular maintenance. Most of the components on the Vent Engine can be replace by removing the mounting screws and remounting the replacement part in place.



Gas Inlet Valve (A)
Inspect the two o-rings that seal it to the manifold. Replace as necessary.
To replace GIV shuttle valve components, refer to Section 9.12.3.

Inlet Filter (B)
Install the filter with the smooth side facing up.
Inspect the o-ring. Replace as necessary.

Regulator (C)
Inspect the two o-rings that seal it to the manifold. Replace as necessary.
Perform the Drive Gas Regulator calibration in Section 5.3.

Interface Manifold (D)
Inspect the two o-rings that seal it to the manifold. Replace as necessary.
Lubricate o-rings sparingly with Krytox.

Drive Gas Check Valve (E)
Inspect the o-ring that seal it to the manifold. Replace as necessary.
Clean the seat on the manifold and the seal on Drive Gas Check Valve with isopropyl alcohol.

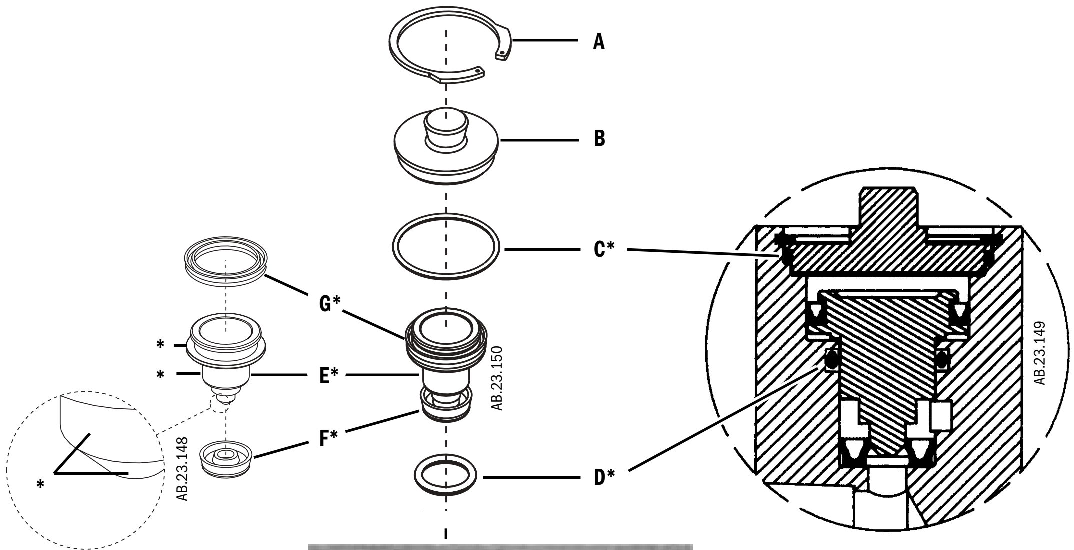
Inspiratory Flow Valve (F)
Note orientation of the flow valve. Inspect the two o-rings that seal it to the manifold. Replace as necessary.
Perform the Inspiratory Flow Valve calibration in Section 5.4.4.

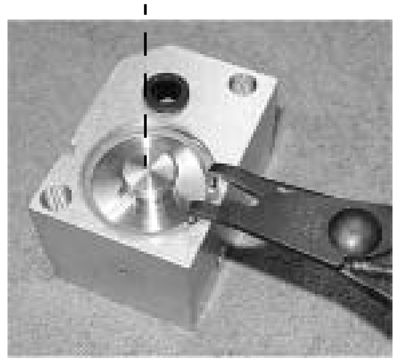
Reservoir (G)
Inspect the two o-rings: reservoir to manifold, reservoir to screw head.
Replace as necessary.

Inlet Valve Solenoid (H)
Inspect seal between solenoid and GIV body.
Replace as necessary (included with solenoid).

9.12.3 Replacing GIV components

Lubricate items marked with and asterisk (*****) sparingly with Krytox.





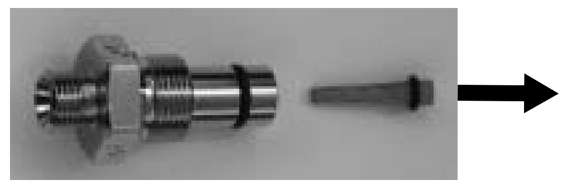
1. Remove the retaining ring (**A**) and the GIV cap (**B**).
2. Use pneumatic pressure to remove the shuttle. Cover the shuttle with a cloth and briefly apply pressure (connect the drive gas hose or use pipeline pressure) through the drive gas inlet.
3. Remove the upper o-ring (**C**) and the lower o-rings (**D**).
4. Install the lower o-ring (**D***).
5. Lubricate the shuttle (**E**) at the three areas (*****) shown: the circumference of the shuttle where the upper and lower u-cup seals are placed and the body part of the shuttle that slides along the lower o-ring.
6. Install the lower u-cup seal (**F***) and the upper u-cup seal (**G***) on the shuttle.
7. Press the shuttle assembly into the GIV manifold.
8. Install the upper o-ring (**C***).
9. Install the cap (**B**) and the retaining ring (**A**).
10. Reassemble in reverse order.

9.13 Servicing the pipeline inlet manifold components

The pipeline inlet filter and the inlet check valve can be replaced without removing the pipeline manifold from the machine. To replace the pressure transducer, you have to remove the manifold.

9.13.1 Replace pipeline inlet filter

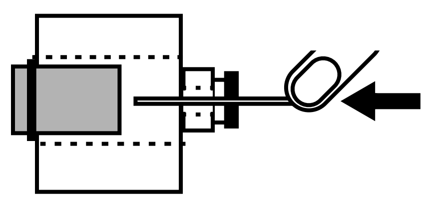
1. Remove the pipeline inlet fitting.
2. Pull the pipeline inlet filter out of the fitting. The o-ring should come out with the filter.



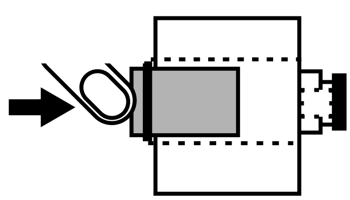
3. Install the new pipeline inlet filter in the pipeline inlet fitting. The new filter comes with an o-ring.

9.13.2 Replace pipeline inlet check valve

1. Remove the rear panel (Section 9.2).
2. Remove the pipeline inlet fitting.
3. The Air and O_2 pipeline manifolds include a drive gas connection at the back of the manifold. Remove the drive gas tube or plug to access the check valve.
4. From the back of the pipeline manifold, use a thin tool to push out the check valve. (For an N_2O manifold, you will have to carefully apply pressure at the outlet of the manifold — with a syringe for example — to gently force the check valve out of the manifold).



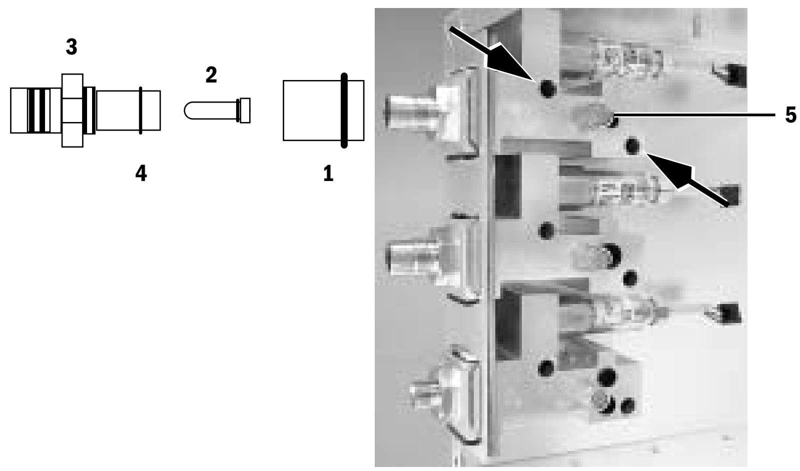
5. Push the new check valve into the opening, using the same thin tool. The new check valve includes an o-ring — orient it toward the pipeline inlet. **Note:** Make sure to push the new check valve all the way back into the opening until it bottoms out on the shoulder.



6. Install the pipeline inlet fitting.

9.13.3 Replace the inlet manifold

1. Remove the rear panel (Section 9.2).
2. Disconnect the tubing from the manifold outlet(s).
3. Disconnect the transducer harness.
4. Remove the two screw that hold the manifold to the side extrution.



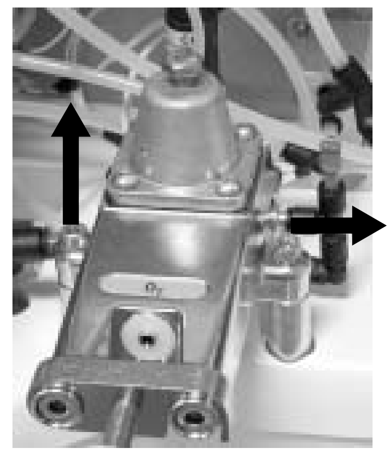
5. Transfer the following items to the replacement manifold or install new as required.
   - pipeline check valve (1)
   - inlet filter (2)
   - inlet fitting (3) and o-ring (4)
   - relief valve (5)
6. Transfer the pressure transducer to the new supply (Section 9.15).
   - Ensure the o-ring is in place.
   - Install the transducer.
7. To reassemble, perform the previous steps in reverse order.
8. Perform the checkout procedure (Section 3).

9.14 Service the cylinder supply modules

⚠ **WARNING** Be careful not to expose internal components to grease or oil (except Krytox or equivalent).

9.14.1 Replace primary regulator module (complete replacement)

1. Bleed all gas pressure from the machine (Section 9.1).
2. Ensure that all cylinder and pipeline pressures are at zero before proceeding.
3. Remove the rear panel (Section 9.2).
4. Disconnect the output tube fitting.
5. Remove the three mounting screws and lockwashers.
6. Remove the elbow fitting from the replacement gas supply.
7. Transfer the pressure transducer to the new supply (Section 9.15).
   - Remove any teflon tape remnants from the transducer mounting threads (transducer and module).
   - Apply 1-1/4 turns of new teflon tape around the treads. Verify that the first few threads are free of tape.
   - Install the transducer.



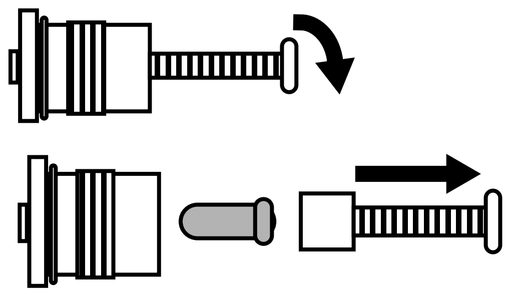
8. To reassemble, perform the previous steps in reverse order.
   - Pull on the cylinder output fitting to ensure it is locked in place.
9. Check the output of the regulator BEFORE you install the rear panel. Adjust if necessary (Section 5.1).
10. Perform the checkout procedure (Section 3).

9.14.2 Replace cylinder inlet filter

1. Open the cylinder yokes.
2. Remove the inlet adapter from the cylinder yoke, using a 4 mm hex wrench.

   Note: A brass retaining ring keeps the filter inside the inlet adapter.
3. Thread a 6-mm screw (two turns only) into the brass retaining ring and pull it out.

⚠ **CAUTION** Be careful not to crush the filter. Do not thread in the screw more than two full turns.



4. Remove the filter.
5. Install the new filter and brass retaining ring.
6. Install the inlet adapter in the cylinder yoke.
7. Perform the checkout procedure (Section 3).

9.14.3 Replace cylinder check valve

The cylinder check valve is not a replaceable item. If the check valve is defective, you must replace the complete cylinder supply module.

9.15 Replace gas-supply pressure transducers

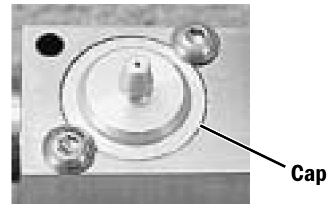
The gas-supply pressure transducer includes an integral cable that connects to the Filter board on the pan enclosure. The transducer itself is mounted directly to the supply module. To replace a pressure transducer (pipeline or cylinder) you have to remove the module from the machine.

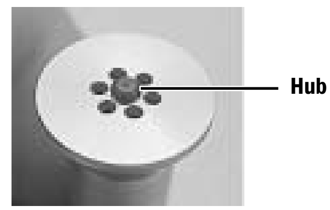
1. To access the Filter board, remove the tabletop (Section 9.3).
2. Disconnect the transducer cable from the Filter board.
3. Remove the supply module to access transducer.
   - For cylinder supplies, refer to Section 9.14.
   - For pipeline supplies, refer to Section 9.13.
4. Remove the transducer from the module.
5. Install the new transducer.
   - For pipeline transducers:
     - Be sure that an o-ring is in place.
   - For cylinder transducers:
     - Remove any teflon tape remnants from the module.
     - Apply 1-1/4 turns of teflon tape around the treads of the transducer. Verify that the first few threads are free of tape.
     - Install the transducer.

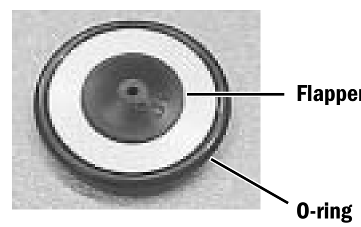
6. To reassemble, perform the previous steps in reverse order.
7. Perform the checkout procedure (Section 3).

9.16 Clean or replace ACGO port flapper valve

1. Remove the tabletop (Section 9.3).
2. Remove the ACGO cap mounting screws.
3. Remove the cap.
4. Examine the flapper and disk for obstructions or debris. Clean with isopropyl alcohol if necessary; retest.
5. If leak persists, replace the flapper.
    - Remove the flapper from the check valve disk.
    - Clean the new flapper with isopropyl alcohol.
    - Apply a drop of isopropyl alcohol to the center hub of the new flapper.
    - Before the alcohol evaporates, align the center hub of the new flapper with the center hole of the check valve disc.
    - While pressing the flapper against the disc, use you fingernail to help pull the hub through the disc from the other side.



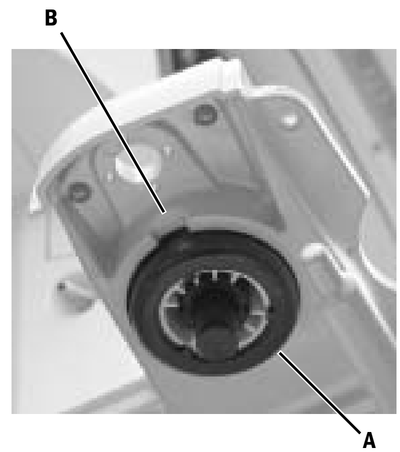




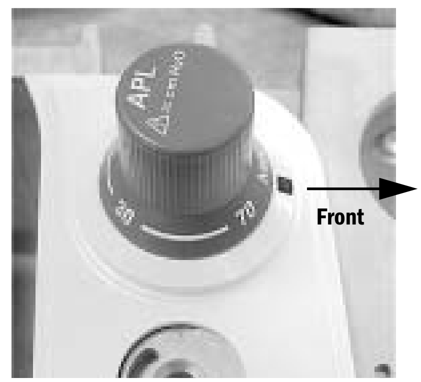
6. Lubricate the o-ring sparingly with Krytox (do not get Krytox on the flapper).
7. Insert the flapper assembly into the ACGO outlet with the flapper up.
8. Replace the cap.

9.17 Replace the APL valve

1. Remove the ABS breathing system.
2. The APL valve is held in place with a spring and a retainer (**A**) that snaps into a recess in the lower body of the APL valve. To release the retainer, place an appropriately sized straight blade screwdriver into the housing cutout (**B**). Twist the screwdriver to release the retainer.



3. Place the new APL valve into position with the setting indicator facing to the front of the machine.
4. Place the spring into the retainer.
5. While holding the APL valve tight to the housing, snap the spring and retainer onto the valve body from below.
6. Reinstall the ABS breathing system.
7. Perform the checkout procedure (Section 3).

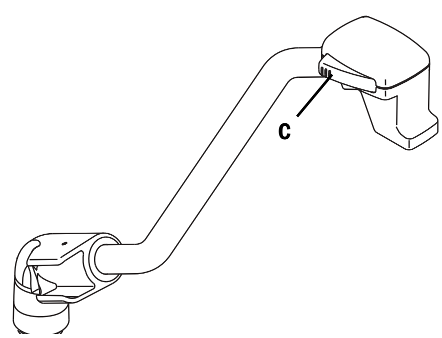


9.18 Replace the bag support arm

1. Remove the ABS breathing system from the machine.
2. From the underside of the casting, remove the two screws/lockwashers (**A**) that hold the arm in place.

3. Install the new bag support arm assembly.
   - Position the bag arm over mounting pattern of 4 small holes in the support casting. The arm should extend towards the front of the machine. Align the two pins (**B**) extending from the base of the bag arm assembly, with two of the small holes in the casting that are in line with the APL valve.

   - Lower the bag arm, pushing the two pins into the holes.
   - From the underside of the casting, secure the bag arm with two M3x16 screws and lockwashers.
4. Test the force required to swing the bag arm from side to side and adjust if necessary.

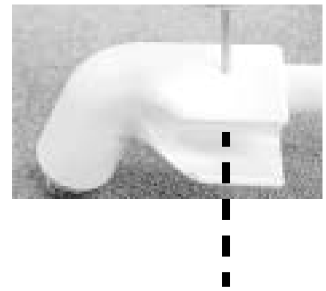


   - Swing the bag arm sideways through the 90 degree arc permitted by its internal stop. The force required may be adjusted by turning the lock nut (8.5 mm socket) which is accessible from underneath the support casting. Turn clockwise to increase the force and counterclockwise to reduce the force.
   - Adjust to just enough friction to prevent the bag arm from swinging sideways as the bag height is being changed. The bag arm height is changed by squeezing the lock release lever (**C**) at the free end of the bag arm and rotating it to the desired position.
5. Replace the ABS breathing system.

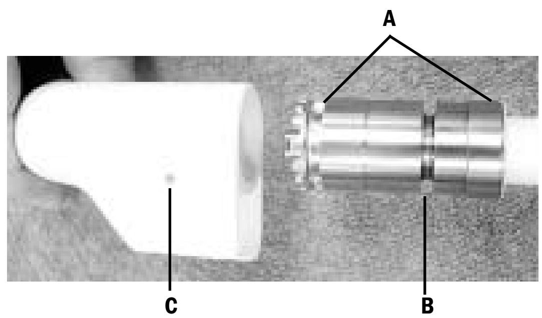
9.18.1 Servicing the bag support arm

Service parts for the bag support arm include the upper and lower assemblies. Refer to Section 10.40.11. To replace either assembly:

1. Remove the bag support from the machine (Section 9.18).
2. To separate the upper assembly from the lower assembly, use a small (3 mm) pin punch to drive out the dowel pin that holds the assemblies together.



3. To assemble the bag arm, apply a light coat of Krytox to the area of the upper arm (**A**) that extends into the lower arm.
4. Insert the upper assembly into the lower assembly. Align the groove (**B**) with the dowel pin hole (**C**).

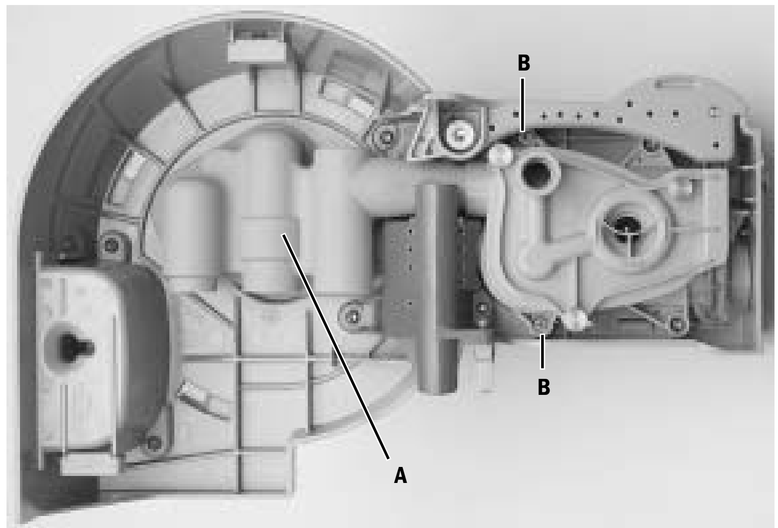


5. Insert the dowel pin into the hole (from the top side as shown). Drive the dowel pin into the bag arm until it is flush with the surface.

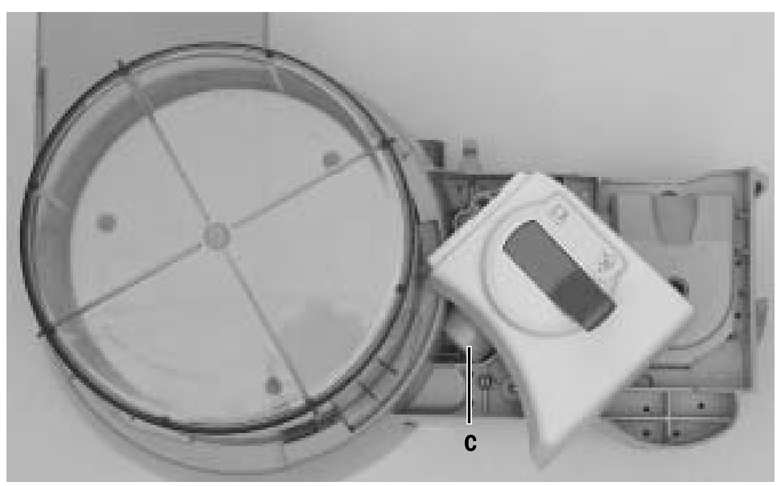
9.19 Replace ABS breathing system components

9.19.1 Replace Bag/Vent switch assembly

1. Remove the ABS breathing system.
2. From the underside, remove the bellows base manifold (**A**) and fully loosen the two captive screws (**B**) at the bag port side of the APL/BTV manifold.



3. From the topside, rotate the Bag/Vent switch cartridge counterclockwise until the Bag/vent switch outlet port (**C**) clears the bellows housing.

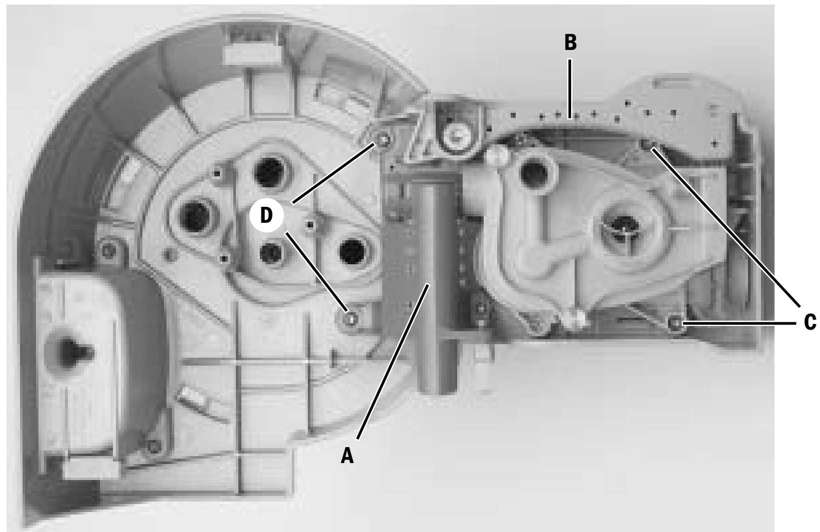


4. Lift out the Bag/Vent switch cartridge from the housing.
5. Replace the Bag/Vent switch cartridge in reverse order.
6. Reinstall the ABS breathing system.
7. Perform the checkout procedure (Section 3).

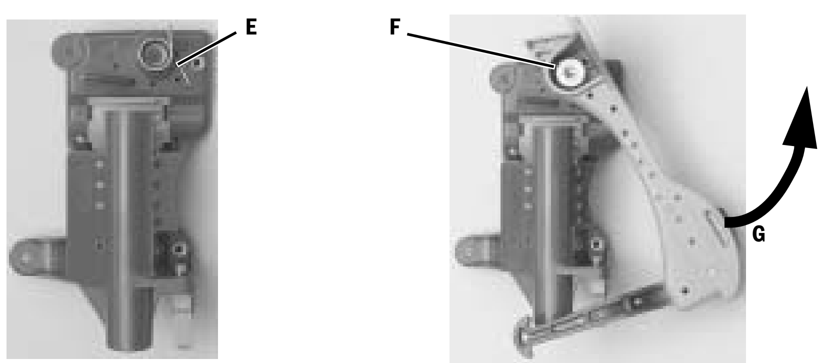
9.19.2 Replace bellows base latch assembly

To replace the latch assembly, you must disassemble the bellows base assembly to the point where you can remove the guide (**A**) and latch assembly (**B**) as a unit.

1. Remove the Bag/Vent switch cartridge (Section 9.19.1).
2. Remove the two remaining screws (**C**) that hold the APL/BTV manifold to the bellows base assembly. Remove the APL/BTV manifol.



3. To remove the guide/latch assembly, remove two mounting screws (**D**) from the underside. Remove two additional mounting screws from the topside. Remove the guide/latch assembly from the bellows base assembly.
4. Separate the latch assembly from the guide assembly.
5. To install the new latch assembly, put the spring (**E**) into place in the guide assembly (long leg down).
6. Place the latch assembly on the guide assembly so that the latch engages the short leg of the spring. Secure the latch assembly (**F**) to the guide assembly.



7. Mount the guide/latch assembly into the bellows base assembly.
   - Extend the latch (**G**) while placing the assembly into the base.
8. Reassemble the breathing system in reverse order.
9. Perform the checkout procedure (Section 3).

9.20 Replace casters

⚠ **WARNING** Replacing a caster requires at least two people to maneuver and tip the machine. Personal injury and/or machine damage is possible if one person attempts this procedure alone.

1. Disconnect all pipeline hoses from the wall and the machine, close all gas cylinders, unplug the power cord, and set the system switch to standby.
2. Remove the absorber, the Aladin cassettes, gas cylinders, drawers and all auxiliary equipment.

⚠ **CAUTION** To prevent damage, do not tip the Aisys machine more than 10 degrees from vertical.

3. Block the opposite wheels; then, block up the machine until there is enough room to remove the defective caster.

   To block up the machine, tip and slide blocks under the caster base. Raise both sides evenly until the unit is high enough to remove the caster.

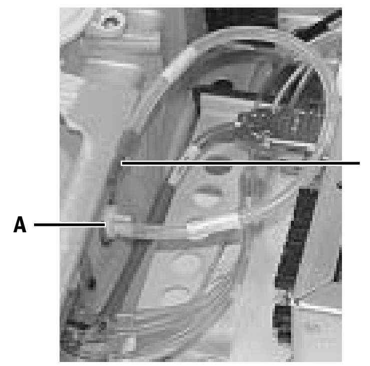
4. The casters are threaded into the base and held with a Loctite compound. Remove the caster with an appropriately sized open-end wrench.
5. If required, clean the treads of the new caster with denatured alcohol.
6. Apply Loctite 242 to the threads of the new caster. Install the caster securely into place.
7. Make sure the caster turns freely.
8. Carefully lower the machine to the floor.
9. Perform the checkout procedure (Section 3).

9.21 Reconfigure sample gas return line

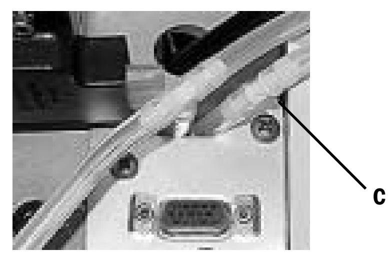
Note In the U.S., it is not permitted to return sample gas to the breathing circuit.

Sample gas return is directed to the scavenging system as a factory default. Perform the following to reroute the sample gas back to the breathing system. Refer to "Tubing" on page 11-11.

1. Remove the tabletop (Section 9.3).
2. Port 4 (**A**) of the ABS breathing system is connected to the expiratory circuit, downstream of the expiratory check valve. As a factory default, Port 4 is plumbed with a length of tubing that is plugged (**B**) at the far end.
3. Remove the plug from the tube.



4. Find the sample return line at the left-rear corner of the pan assembly. The sample return line includes an inline connector (**C**) at the point where the sample line goes down into the vent engine housing.



5. Separate the scavenging tube, removing the inline connector from the portion of the tube that extends into the vent engine housing. Plug the open end of the scavenging tube with the plug removed in step 3.
6. Insert the inline connector from the sample return port into the open tube to Port 4. Pull on the connector to ensure that it is securely connected.
7. Replace the tabletop.
8. Perform the checkout procedure (Section 3).

9.22 Change drive gas

⚠ **CAUTION** If you change the drive gas, you must also change the drive gas selection on the ventilator service setup screen. Refer to Section 4 of the ventilator Technical Reference manual.

- If the drive gas selection and the actual drive gas do not agree, volumes will not be correct.

The ventilator will alarm with the message "Low Drive Gas Press" if the selected drive gas pressure, either O_2 or Air, is lost.

1. Remove the rear panel (Section 9.2).

Note: The O_2 and Air pipeline manifolds have a drive gas connection at the back. The connection not in use is plugged.

2. Remove the plug from the new connection.
3. Disconnect the drive gas hose from the present connection.
4. Install the plug in this connection (pull on the plug to ensure that it is locked into the fitting).
5. Reroute the drive gas hose so that it does not cause kinks in other tubing.
6. Connect the drive gas hose to the new connection (pull on the hose connector to ensure that it is locked into the fitting).
7. Do a high-pressure leak test (Section 3.5).
8. Enter the service mode and select the correct drive gas.
9. Test the primary regulator. Verify that it functions within specifications now that it will be supplying drive gas to the ventilator (Section 5.1).
10. Perform the checkout procedure (Section 3).

Notes

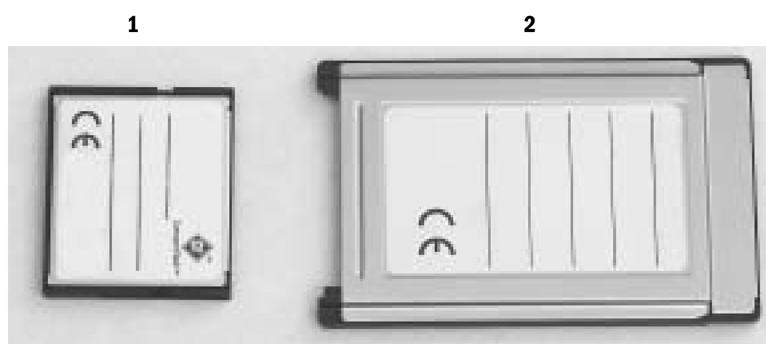
10 Illustrated Parts

In this section

10.1 Service tools

10.1.1 Software tools

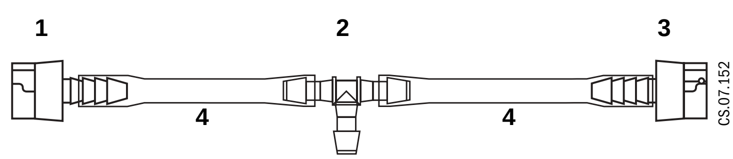
Item	Description	Stock Number
1	Service Application/System Software 1.0 (on Compact Flash card)	M1045339
2	Compact Flash Adapter, PCMCIA carrier	1009-5874-000
3	Service Application, PC based	1011-4038-000
4	Cable, DU serial port to PC serial port	1011-3984-000



10.1.2 Manifold pressure test adapter

The manifold pressure test adapter is used to tee into the manifold pressure line for the Manifold P Span calibration (Section 5.4.2).

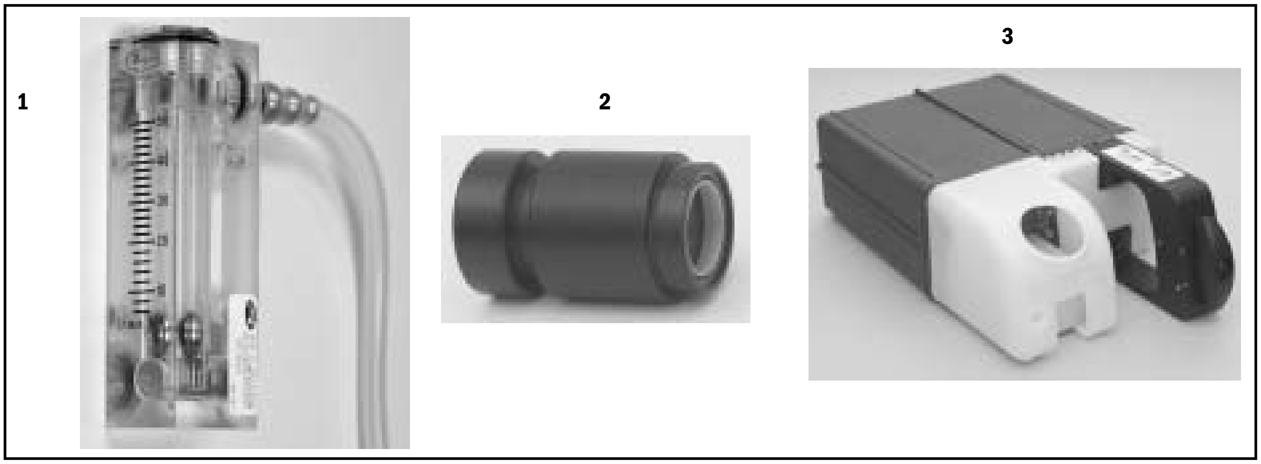
Assemble the adapter using the parts shown.



Item	Description	Stock Number
1	Coupler, male - white	1503-3236-000
2	Tee (male barb)	1009-3011-000
3	Coupler, female - white	1503-3119-000
4	Tubing (low-pressure) 1/4 inch	1605-1001-000

10.1.3 Test Devices and service tools

Item	Tool	Stock Number
1	Test flowmeter, 6–50 L/min (Suction Flow Test)	1006-8431-000
2	Spring seal insertion tool, EV	1011-8004-000
3	Test cassette, Aisys EV	1011-8006-000



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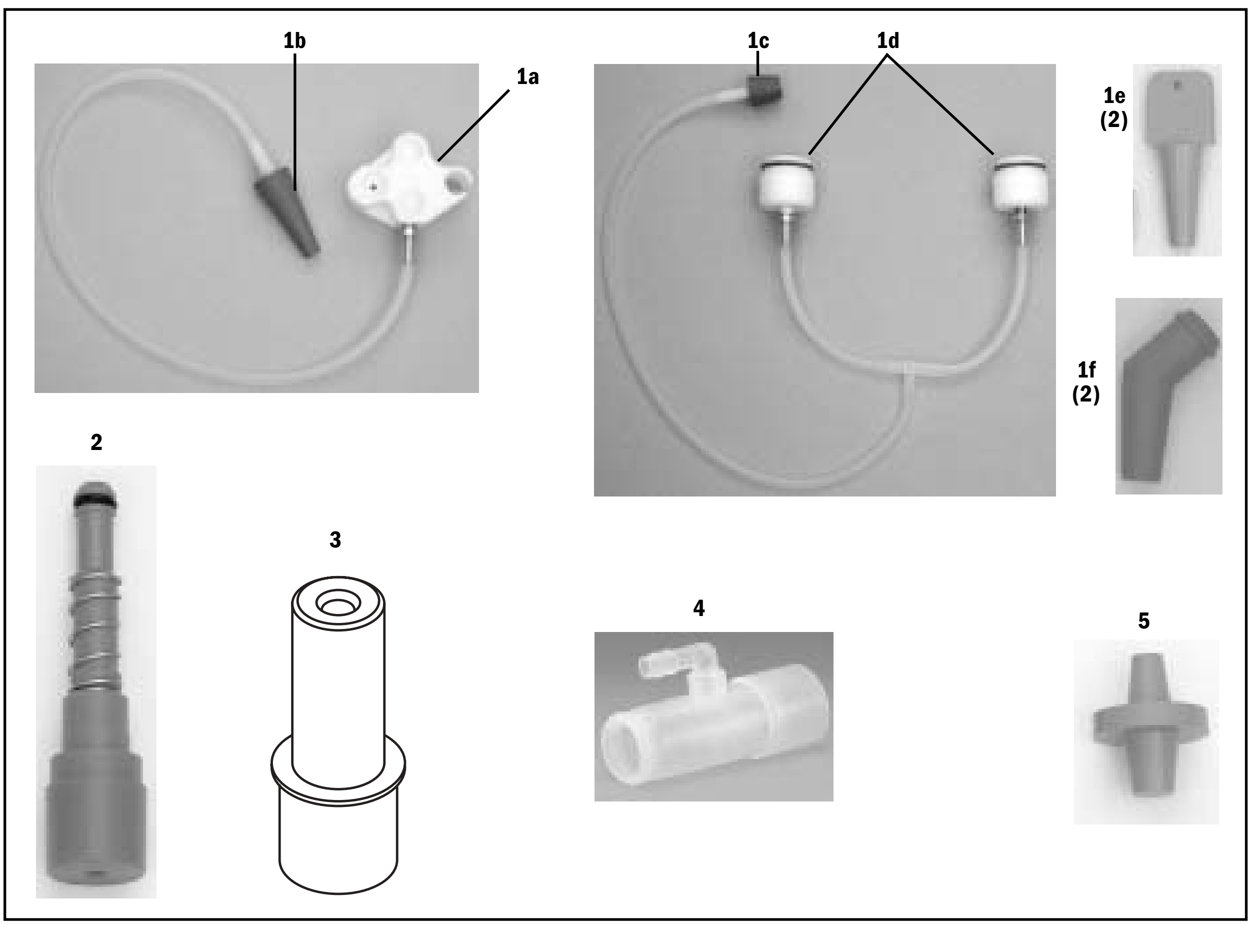
Low-pressure Leak Test Device	(negative pressure)	0309-1319-800
Low-pressure Leak Test Device	(positive pressure - ISO)	1001-8976-000
Low-pressure Leak Test Device	(positive pressure - BSI)	1001-8975-000
Flow test device capable of measuring 0–15 L/min with an accuracy of ±2% of reading		Refer to section 6.7
Vacuum test gauge capable of measuring 0 to 550 mm Hg with an accuracy of ±1% of reading		Refer to section 6.9
Test device capable of measuring 0–30 L/min (see Item 1 above)		Refer to section 6.9
Leakage current test device		Refer to section 3.12
Test device capable of measuring 689 kPa (100 psi)		Refer to section 5.1.1

10.1.4 Lubricants and Adhesives

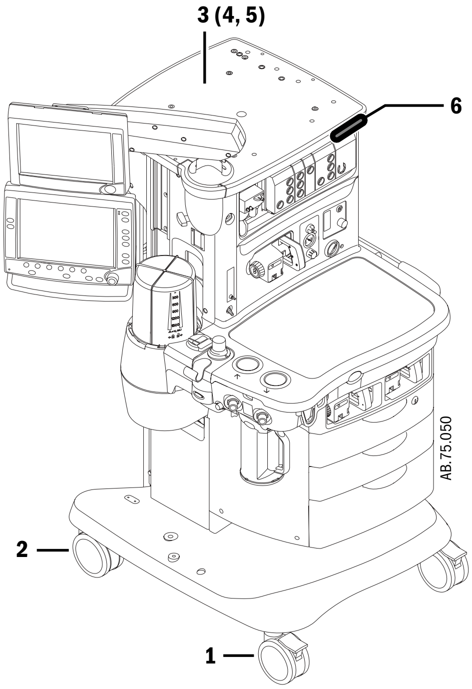
Item	Description	Stock Number
1	Lubricant, Krytox GPL 205, 2 oz	1001-3854-000
2	Lubricant, Dow 111, 5.3 oz	6700-0074-200
3	Thread Lock, Loctite No 24221, 10 ml	0220-5017-300
4	“Super Glue Gel”, Loctite 454	6812-2160-010

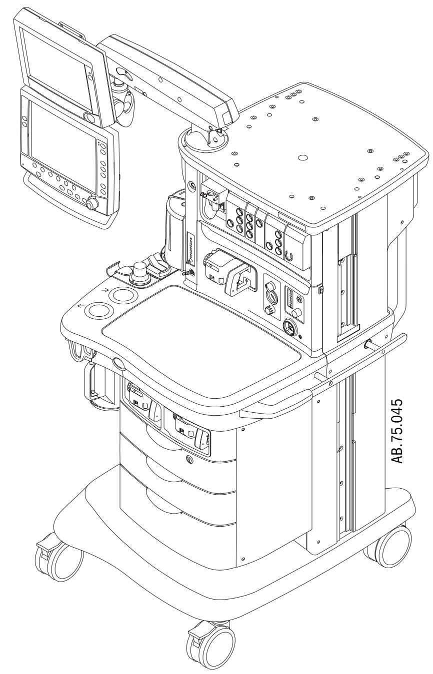
10.1.5 Test Tools

Item	Tool	Stock Number
1	Leak Test Tool Kit, ABS breathing system	1407-7013-000
1a	Test Tool, bulkhead	1407-8500-000
1b	Plug, tapered 27x12 mm	1407-8505-000
1c	Plug, tapered 24x18 mm	1407-8506-000
1d	Test Tool, circle module (2 each)	1407-8502-000
1e	Plug, service B/S 11 mm (2 each)	1407-8504-000
1f	Plug, service BTV 18 mm (2 each)	1407-8503-000
2	Adapter, positive low-pressure leak test	1009-3119-000
3	PEEP/INSP Calibration Flow Orifice	1504-3016-000
4	Airway Pressure Sensing Tee	1504-3011-000
5	Plug, stopper	2900-0001-000
Not Shown		
	Tool to help disconnect tubing from Legris fittings	2900-0000-000
	Test Lung	0219-7210-300
	Leak detection fluid, Snoop	obtain locally

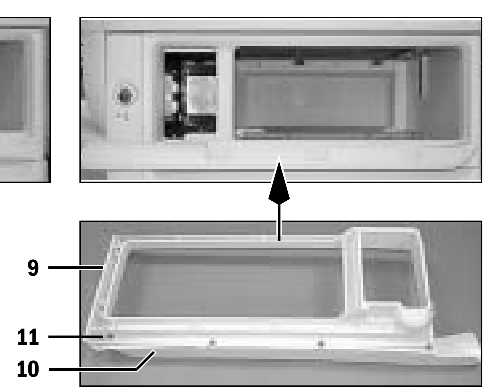


10.2 Components - front view

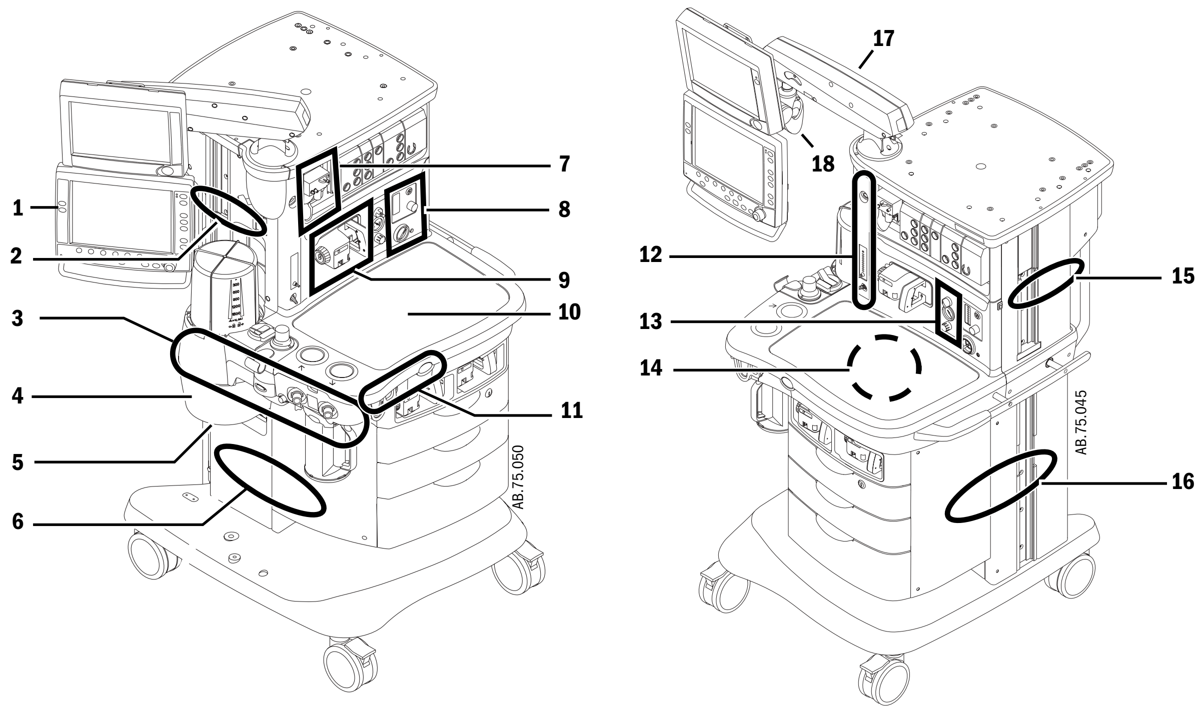




Item	Description	Stock Number
1	Caster, 125-mm with brake (front)	1011-3811-000
2	Caster, 125-mm no brake (rear)	1011-3812-000
3	Shelf, top	1011-3304-000
4	Screw, M6x14 (3 front)	0144-2131-922
	Screw, M6x35 (3 each side)	0144-2131-912
5	Lockwasher, M6 internal	0144-1118-130
6	Label, S/5 Aisys	1011-3566-000
7	Bezel, cassette storage	1011-3618-000
8	Bezel, upper module rack	1011-3356-000
9	Bezel, upper module rack (for cable raceway)	1011-3382-000
10	Raceway, upper cable manage	1011-3383-000
11	Screw, M4x20 PAN HD	0140-6226-121

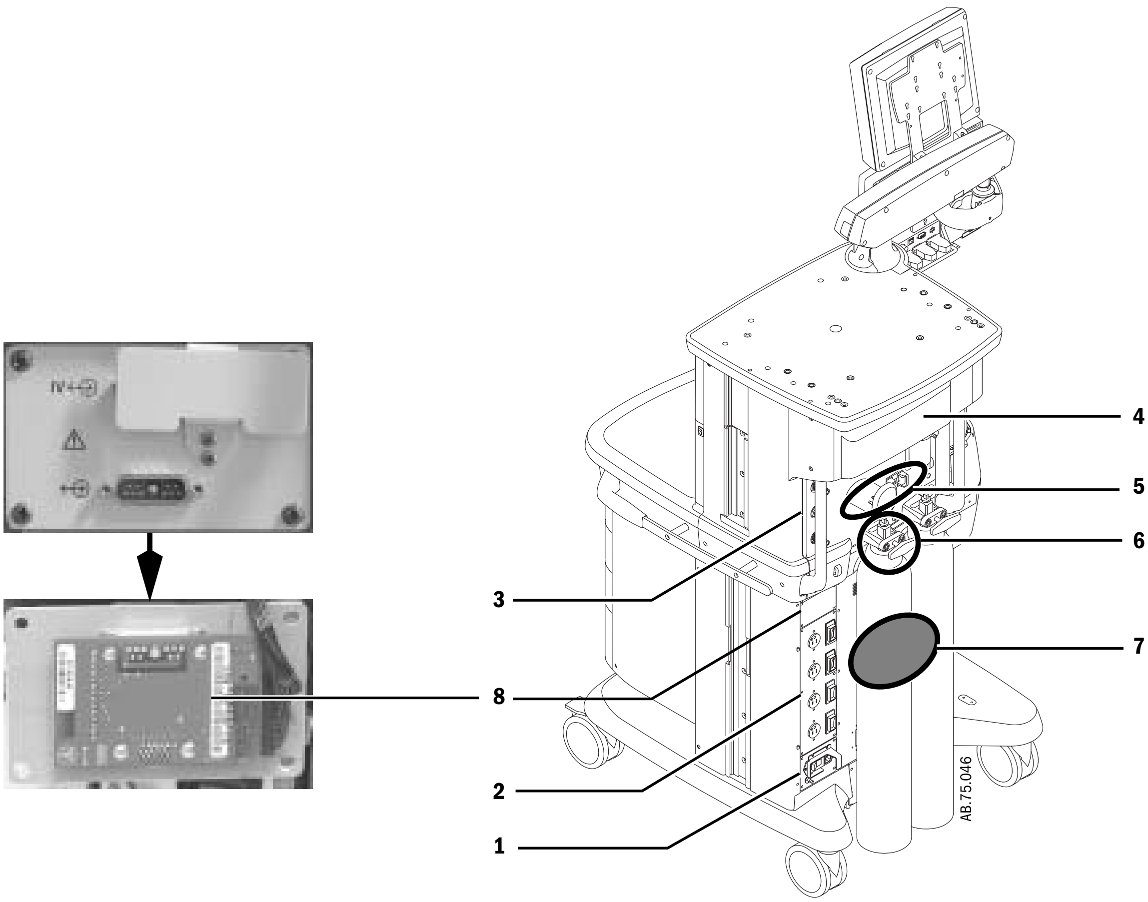


10.3 Components - front view references



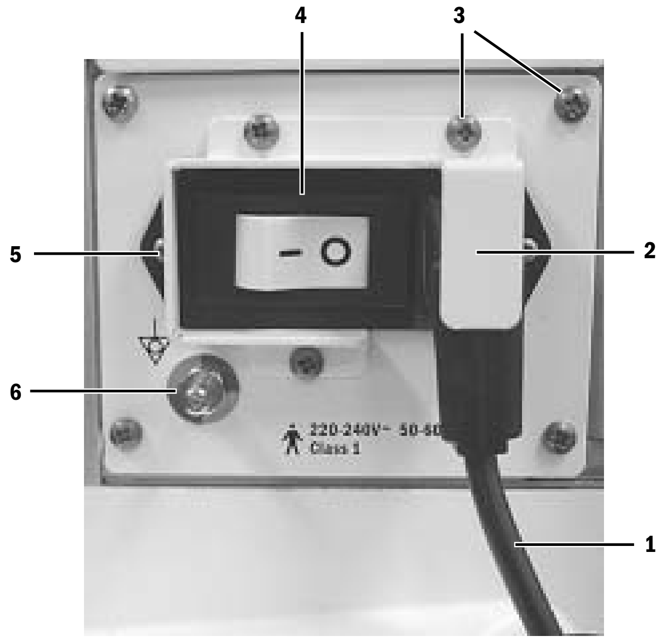
Item	Description	Section number
1	"Display Unit"	Refer to section 10.7
2	"Panel, cosmetic upper left-side"	Refer to section 10.25
3	"Breathing system interface"	Refer to section 10.40
4	"Vent Engine Housing"	Refer to section 10.17
5	"Anesthetic Gas Scavenging System — AGSS"	Refer to section 10.29
6	"Panel, cosmetic lower left-side"	Refer to section 10.26
7	"Airway module (M-Gas) components"	Refer to section 10.39
8	"Front panel, Alt O2, and system switch"	Refer to section 10.16
9	"Electronic Vaporizer"	Refer to section 10.27
10	"Tabletop components"	Refer to section 10.30
11	"ABS to machine Interface Components (SCGO)" "ABS to machine Interface Components (ACGO)" "O_2 Flush Valve"	Refer to section 10.13 Refer to section 10.14 Refer to section 10.15
12	"Auxiliary O_2 Flowmeter and Sample Gas Return"	Refer to section 10.20
13	"Integrated Suction Regulator"	Refer to section 10.19
14	"Upper (pan) electronic enclosure components"	Refer to section 10.9
15	"Panel, cosmetic upper right-side"	Refer to section 10.23
16	"Panel, cosmetic lower right-side"	Refer to section 10.24
17	"Display arm"	Refer to section 10.41
18	"Wrist casting assembly"	Refer to section 10.42

10.4 Components - rear view



Item	Description	Stock Number
1	AC Inlet	Refer to section 10.5
2	AC Outlets	Refer to section 10.6
3	Pipeline Inlets	Refer to section 10.11
4	Panel, cosmetic upper rear	1011-3228-000
5	Rear panel components Upper enclosure panel items	Refer to section 10.21 Refer to section 10.22
6	Cylinder Gas Supplies	Refer to section 10.12
7	Lower electronic enclosure components Enclosure panel	Refer to section 10.8 Refer to section 10.22
8	Auxiliary Connector Board	1011-3579-000

10.5 AC Power cords and AC Inlet

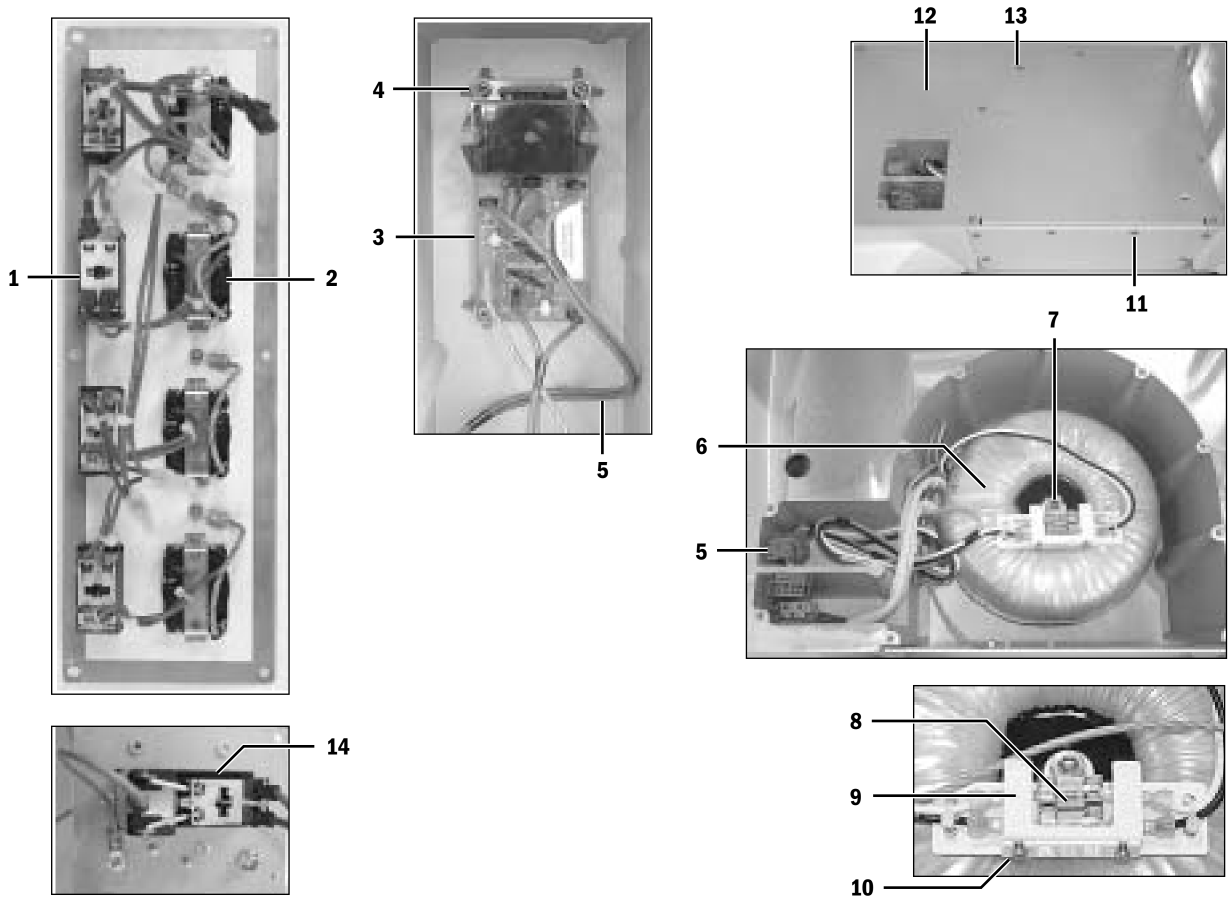


Item	Description	Stock Number
1	Power Cord	
	100-120V~ 50-60Hz, NEMA, Japan and US	1006-3907-000
	220-240V~ 50-60Hz, AS 3112, Australia and China	1006-3888-000
	220-240V~ 50-60Hz, BS1363, UK	1006-3884-000
	220-240V~ 50-60Hz, BS546, India and South Africa	1006-3885-000
	220-240V~ 50-60Hz, CEE 7/7, EURO and France	1001-3380-000
	220-240V~ 50-60Hz, Danish	1011-3696-000
	220-240V~ 50-60Hz, SEV 1011, Swiss	1006-3889-000
	220-240V~ 50-60Hz, NEMA, Peruvian	1006-3882-000
2	Guard, power cord retainer	1011-3221-000
3	Screw, M4x8 Pozidriv DIN84	1006-3178-000
4	AC Inlet	Refer to section 10.6
5	Screw, M3x6 Pozidriv Sems	0140-6219-128
6	Stud, 6mm Equipotential	0208-0070-300

10.6 AC Inlet/Outlet Components

Item	Description	Stock Number
1	Circuit Breaker, 1A, Rocker	1009-5722-000
	Circuit Breaker, 2A Rocker	1009-5721-000
	Circuit Breaker, 3A Rocker	1009-5720-000
	Circuit Breaker, 4A Rocker	1009-5719-000
2	Outlet Receptacle, Australia, AS 3112	1001-3305-000
	Outlet Receptacle, Danish, AFSNIT 107-2-01	1011-3910-000
	Outlet Receptacle, EURO, CEE 7/7	1202-3551-000
	Outlet Receptacle, France, CEE 7/4 Support Frame, snap in	1006-4421-000 1006-4422-000
	Outlet Receptacle, India and South Africa, BS 546	1006-3805-000
	Outlet Receptacle, Japanese	1006-3578-000
	Outlet Receptacle, NA, Nema 5-15	1006-3555-000
	Outlet Receptacle, Swiss, SEV 1011	1006-3807-000
	Outlet Receptacle, UK, BS1363	1001-3309-000
3	Circuit board, Inrush, 100-120V Circuit board, Inrush, 220-240V	1006-3245-000 1006-3246-000
4	Screw, M4x8 Pozidriv Sems	0140-6226-113
5	Harnesses	Refer to section 10.36
6	Toroid, 100-240V	1009-5692-000
7*	Screw, M8x70 Lockwasher, M8 external Washer, M8	1006-3905-000 0144-1118-225 9213-0180-006
8	Fuse, 5A - 5x20mm Fuse holder Screw, M2x6	1202-3345-000 1009-5674-000 0140-6712-102
9	Guard, fuse holder	1011-3622-000
10	Screw, M3x6 Pozidriv Sems	0140-6219-128
11	Screw, M4x8 DIN84	1006-3178-000
12	Cover, transformer	1011-3371-000
13	Screw, M4x8 FLAT HD	0140-6226-107
14	Inlet, 100-120A~, with line filter and 15 A circuit breaker Inlet, 220-240A~, with line filter and 8 A circuit breaker	1009-5698-000 1009-5757-000

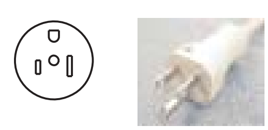
* Apply Loctite 242.

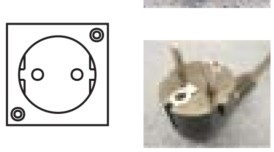


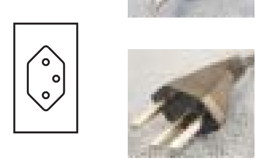

AS 3112
Australia/China

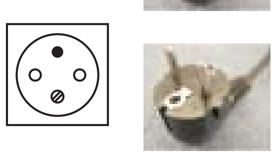
AA.96.228

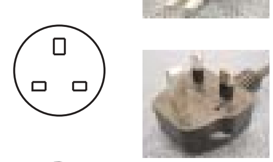

AFSNIT 107-2-01
Danish,

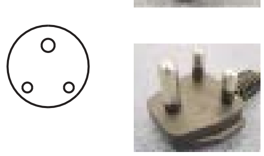

Nema 5-15
Japanese


CEE 7/7
EURO


SEV 1011
Swiss,


CEE 7/4
France


BS1363
UK


BS 546
India and South Africa


Nema 5-15
NA

10.7 Display Unit

Item	Description	Stock Number
	Display Assembly, complete, without keypads	1011-8082-000
1	Enclosure, rear	1009-5673-000
2	CPU Board, display unit (with PCMCIA frame)	1009-8289-000
3	Frame, PCMCIA	1009-5761-000
4	Gasket, knife edge (2 each)	1009-5804-000
5	Battery, Lithium 3V (positive side up)	1009-5800-000
6	Display (DG 41), LCD 12-inch color (includes backlights)	1009-5938-000
7	Backlight Kit for DG 41 display (backlight assembly, 2 inverters, and hardware)	1009-8422-000
7a	Inverter, backlight	1009-5694-000
7b	Harness, inverter	1009-5527-000
7C	Spacer, 8mm Nylon	1009-5695-000
8	Grommet, diagonal cut (backlight cable)	1009-3152-000
9	Enclosure, front	1009-5672-000
10	Gasket, EMC 1.8mm OD hollow RND (2.3 m per enclosure)	1009-5802-000
11	Window	1009-5676-000
12	Encoder assembly	1503-3012-000
13	Knob, ComWheel	898794
14	Membrane switches, right	1009-5505-000
15	Membrane switches, lower	1009-5507-000
16	Membrane switches, left	1009-5506-000
17	Keypad, right-side (part of keypad set)	Refer to Table 1
18	Keypad, lower (part of keypad set)	Refer to Table 1
19	Keypad, left (part of keypad set)	Refer to Table 1
20	Speaker assembly, 8-ohm	1605-3263-000
21	Rear Connector Panel Assembly (with interface boards)	1009-8244-000
22	Cable, ribbon CPU to Display	1009-5520-000
23	Grommet	1009-3151-000
24	Fan, 5Vdc	1504-3516-000
25	Capsule, fan filter	896089
26	Filter, fan	897010
27	Door, PCMCIA	1009-5679-000
28	Gasket, cover plate	1009-5678-000
29*	Screw, M3x6 Sems	0140-6219-128
30*	Screw, M4x8 Sems	0140-6226-113
31*	Screw, M4x12 relieved body	1504-3001-000
32*	Lockwasher, M4 external	9213-0540-003
33*	Screw, M3x16	1504-3003-000
34*	Lockwasher, M3 external	9213-0530-003
35*	Screw, M3x6 Nylon	9211-1730-065
36*	Screw, M2x16	0140-6216-100

* Refer to Table 2 for where used.

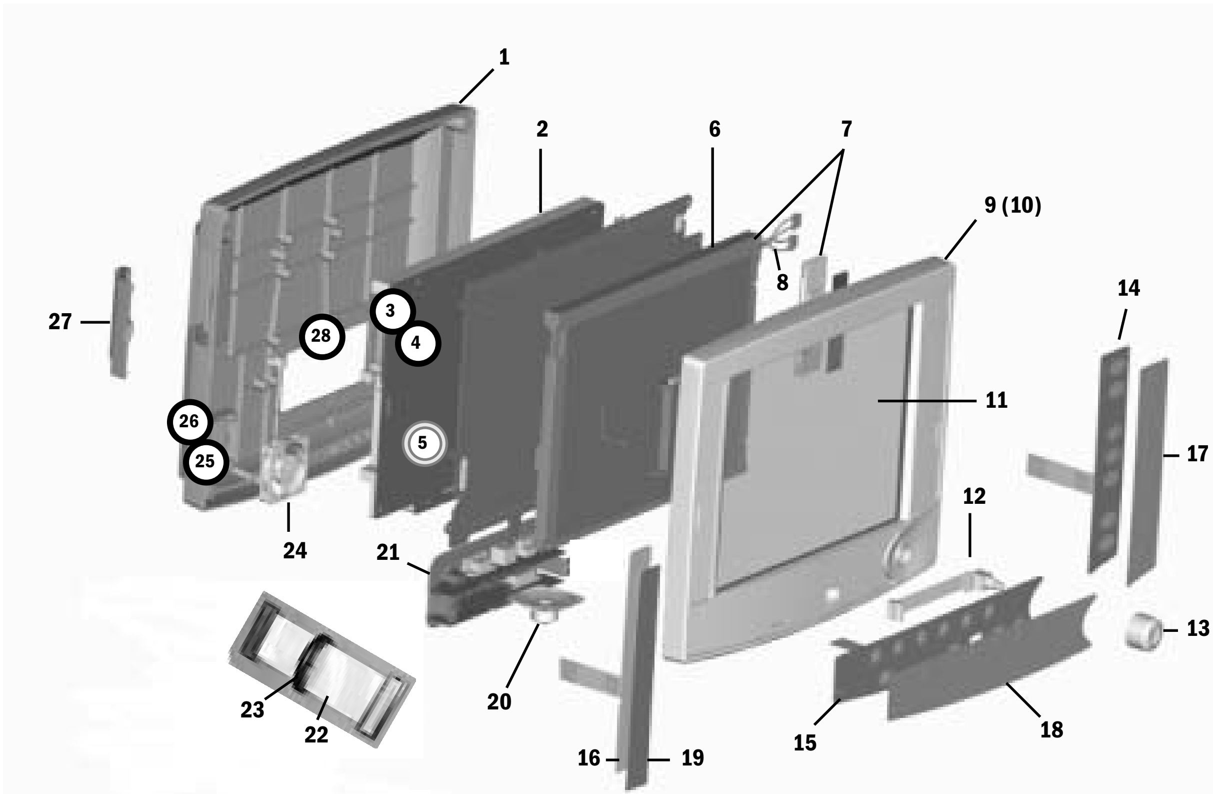
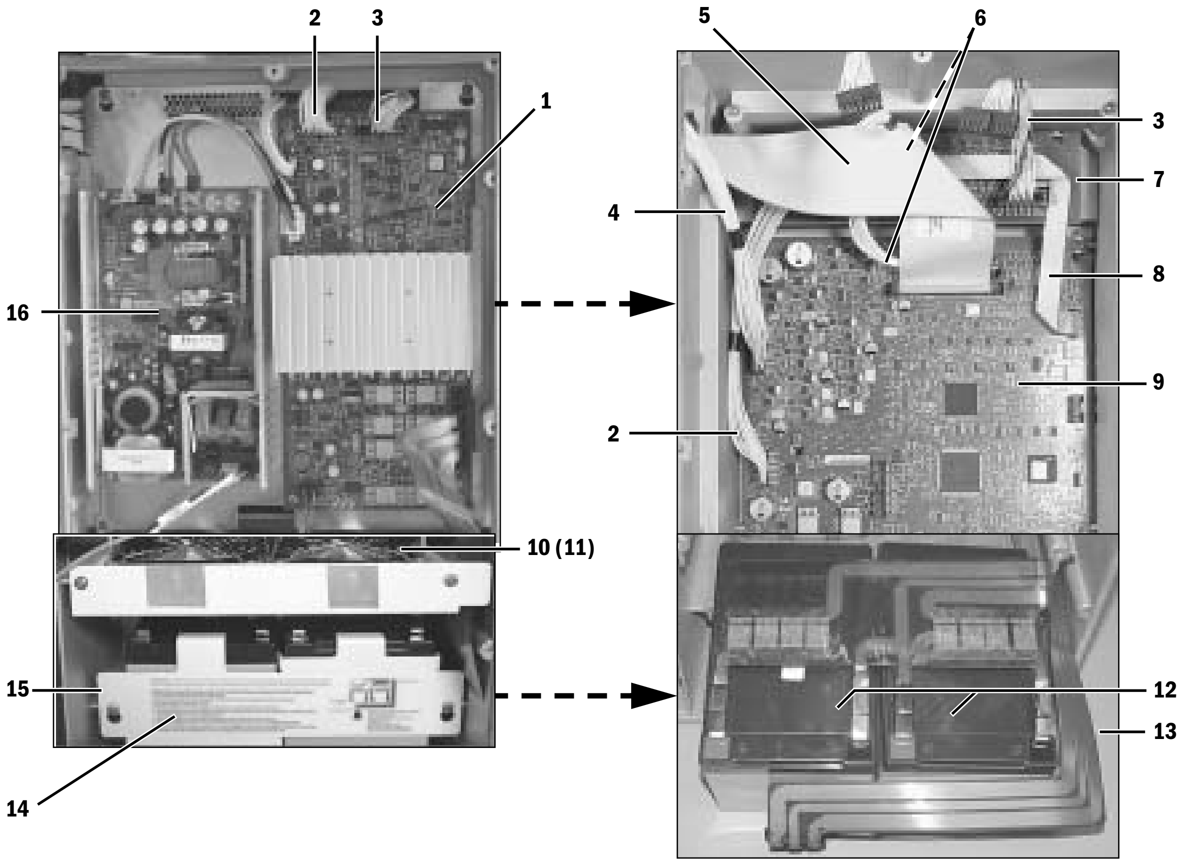


Table 1:	
Language	**Keypad Set**
Chinese	1011-3892-000
Czech	1011-3883-000
Danish	1011-3891-000
Dutch	1011-3878-000
English	1011-3875-000
Finnish	1011-3879-000
French	1011-3876-000
German	1011-3877-000
Greek	1011-3887-000
Hungarian	1011-3888-000
Italian	1011-3925-000
Japanese	1011-3880-000
Norwegian	1011-3885-000
Polish	1011-3884-000
Portuguese	1011-3882-000
Russian	1011-3890-000
Spanish	1011-3881-000
Swedish	1011-3889-000
Turkish	1011-3886-000

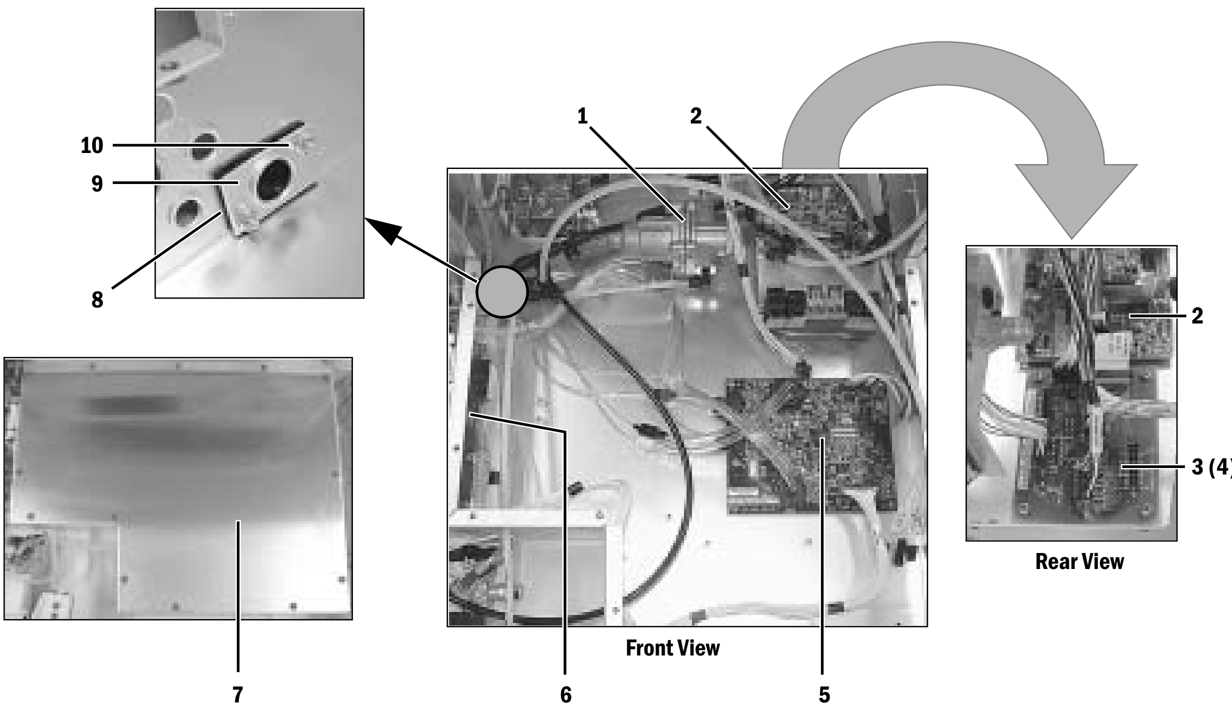
Table 2:
Hardware Item where used (Qty)
Speaker: 29(2)
Door: 29(2)
CPU to plate: 30(4)
Rear connector panel assembly: 30(2)
Ground straps for keypads: 30(2)
Mounting plate to Front enclosure: 30(10)
Rear enclosure: 31(4), 32(4)
Fan: 33(4), 34(4)
Inverters: 35(4)
PCMCIA frame: 36(4)

10.8 Lower electronic enclosure components



Item	Description	Stock Number
1	Power Controller board (Tested)	1011-8402-000
2	Harness, J4-ACB to J4-PCB	1009-5551-000
3	Harness, J3-PCB to J5-DCB	1009-5552-000
4	Harness, J3-ACB to underside of Pan Connector Board	1011-3199-000
5	Cable, ribbon J1-ACB to underside of Pan Connector Board	1011-3186-000
6	Harness, J7-ACB to J6-DCB	1009-5556-000
7	Display Connector Board (requires Rev D or later board for battery backup of S5 monitor)	1009-3005-000
8	Cable, ribbon J2-ACB to J9-DCB	1009-5561-000
9	Anesthesia Control board (tested)	1011-8400-000
10	Fan (flow upward)	1009-5697-000
11	Guard, fan wire form	0208-2737-300
12	Battery, sealed lead acid, 12V 12AH	1011-3557-000
13	Flex-cable, battery to PCB	1011-3698-000
14	Guard, battery terminal	1011-3378-000
15	Cable tie, 4-inch	0203-5915-300
16	Label, battery service instructions	1011-3556-000
17	Bracket, battery restraint	1011-3212-000
18	Power Supply, universal 225W (Tested)	1011-8403-000

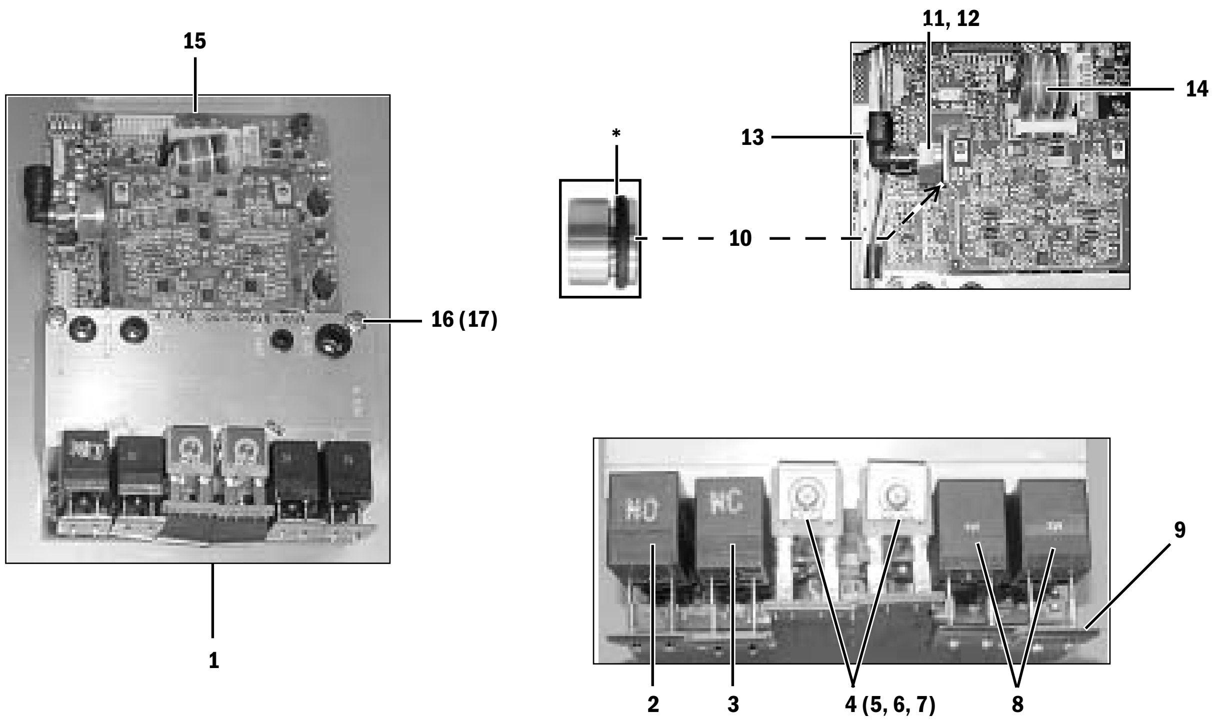
10.9 Upper (pan) electronic enclosure components



Item	Description	Stock Number
1	Regulator, O_2 Flush	1011-3168-000
2	Gas Mixer Assembly, complete	Refer to section 10.10
3	Pan Connector Board	1009-3003-000
4	Gasket, Pan Connector Board	1011-3216-000
5	Ventilator Interface Board, calibrated	1009-8236-000
6	Filter Board, ABS	1009-3007-000
7	Cover, upper electronic enclosure	1011-3239-000
8	Seal	1011-3816-000
9	Retainer, seal	1011-3815-000
10	Nut, M4 Keps	0144-3717-314

10.10 Electronic Gas Mixer

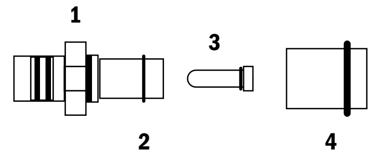
⚠ **CAUTION** Ensure a clean environment when servicing the gas mixer.

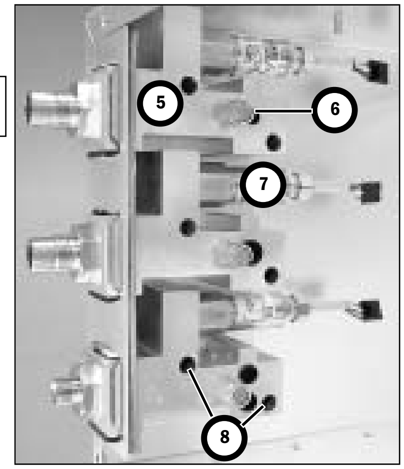


Item	Description	Stock Number
1	Mixer Assembly - complete	1011-8000-000
2	Valve, 2-way NO (includes screws and gasket)	1009-3014-000
3	Valve, 2-way NC (includes screws and gasket)	1009-3013-000
4	Valve, proportional	1011-3560-000
5	O-ring (2 used with each proportional valve)	6027-0000-165
6	Screw, M3x16 (2 used for mounting each valve)	0140-6719-103
7	Lockwasher, M3 external	9213-0530-003
8	Valve, 3-way NC (includes screws and gasket)	1009-3346-000
9	Flex-cable, valve interface	1009-3359-000
10	Outlet check valve, replacement kit (includes o-ring and flapper valve)	1009-8246-000
11	Retainer, flapper valve	1011-3516-000
12	O-ring, retainer	1011-3518-000
13	Elbow, 1/4 inch tube to 1/8 inch NPT	1011-3071-000
14	Cable, TSI interface	1011-3082-000
15	Screw, M4x6	1009-3283-000
16	Screw, M4x40	0140-6226-128
17	Lockwasher, M4 external	9213-0540-003

* Lubricate sparingly with Krytox.

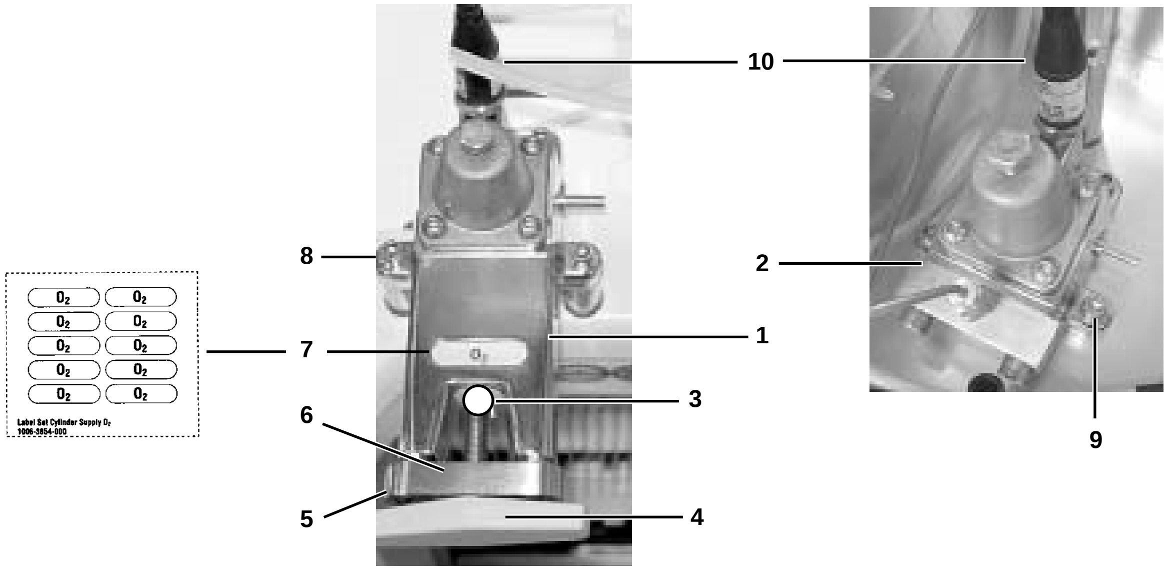
10.11 Pipeline inlet fittings





Item	Description	Stock Number
1	**Pipeline inlet - O_2 fittings**	--------------------
	Body, O_2 DISS	1006-5149-000
	Body, O_2 NIST	1006-5158-000
	Body, O_2 DIN	1006-5161-000
	Body, O_2 G 3/8 BSPP	1006-5170-000
	Pipeline inlet assembly O_2 France	1006-8363-000
	Pipeline inlet assembly O_2 Canada	1006-8360-000
	Pipeline inlet assembly O_2 Australia	1006-8396-000
1	**Pipeline inlet - N2O fittings**	--------------------
	Body, N_2O DISS	1006-5150-000
	Body, N_2O NIST	1006-5159-000
	Body, N_2O DIN	1006-5162-000
	Body, N_2O G 3/8 BSPP	1006-5171-000
	Pipeline inlet assembly N_2O France	1006-8362-000
	Pipeline inlet assembly N_2O Canada	1006-8359-000
	Pipeline inlet assembly N_2O Australia	1006-8397-000
1	**Pipeline inlet Air fitting**	--------------------
	Body, Air DISS	1006-5151-000
	Body, Air NIST	1006-5160-000
	Body, Air DIN	1006-5163-000
	Body, Air G 3/8 BSPP	1006-5172-000
	Pipeline inlet assembly Air France (service kit)	1006-8361-000
	Pipeline inlet assembly Air Canada (service kit)	1006-8358-000
	Pipeline inlet assembly Air Australia (service kit)	1006-8398-000
2	O-ring, bore seal	---------------------
	O_2 and N_2O	0210-0479-300
	Air	0210-0539-300
3	Sintered metal filter with o-ring	1006-8351-000
4	Pipeline check valve with o-ring	1006-3160-000
5	Gas Inlet Manifold (replacement) O_2	1009-8066-000
	N_2O	1009-8067-000
	Air	1009-8068-000
6	Relief valve, 689/758 kPa (100/110 psi)	1011-3049-000
7	Transducer, pipeline pressure (includes cable)	1011-3413-000
8	Screw, M4x20	0144-2124-218
	Lockwasher, M4	0144-1118-128

10.12 Cylinder Gas Supplies



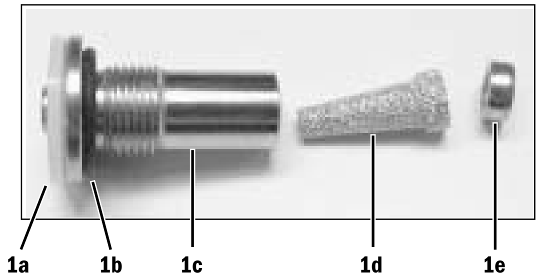
Item	Description	Pin Index	DIN
1	Gas supply O_2	1006-3201-000	1006-3207-000
1	Gas supply N_2O	1006-3202-000	1006-3208-000
1	Gas supply Air	1006-3203-000	1006-3209-000
		Third Cylinder	
2	Gas supply O_2	1011-8150-000	
	Gas supply N_2O	1011-8154-000	

Item	Description	Stock Number
3	Cylinder inlets (Pin Index or DIN for external cylinder)	Refer to section 10.12.1
4	Tee handle beige	0219-3372-600
5	Spacer, gas block (2) Screw, M8 x 25 long socket head cap (2)	1001-4077-000 9211-0680-253
6	Clamp, yoke	1001-4076-000
7	Label Set, cylinder supply, O_2 Label Set, cylinder supply, N_2O Label Set, cylinder supply, Air	1006-3854-000 1006-3855-000 1006-3856-000
8	Screw M6x35 socket head cap Lockwasher, M6 internal Spacer (*)	0144-2131-912 0144-1118-130 1011-3241-000
9	Screw M6x25 socket head cap Lockwasher, M6 internal	1102-3023-000 0144-1118-130
10	Transducer, cylinder pressure (includes cable)	1011-3001-000

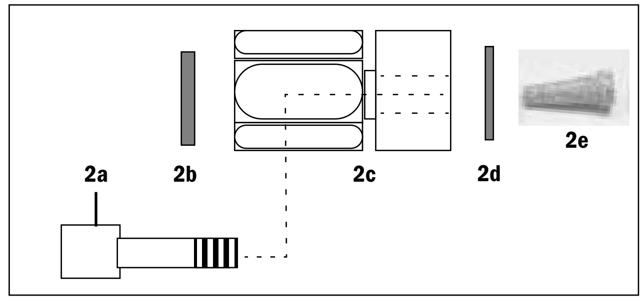
* Apply Loctite 242.

10.12.1 Cylinder inlet fittings

1 Pin Index



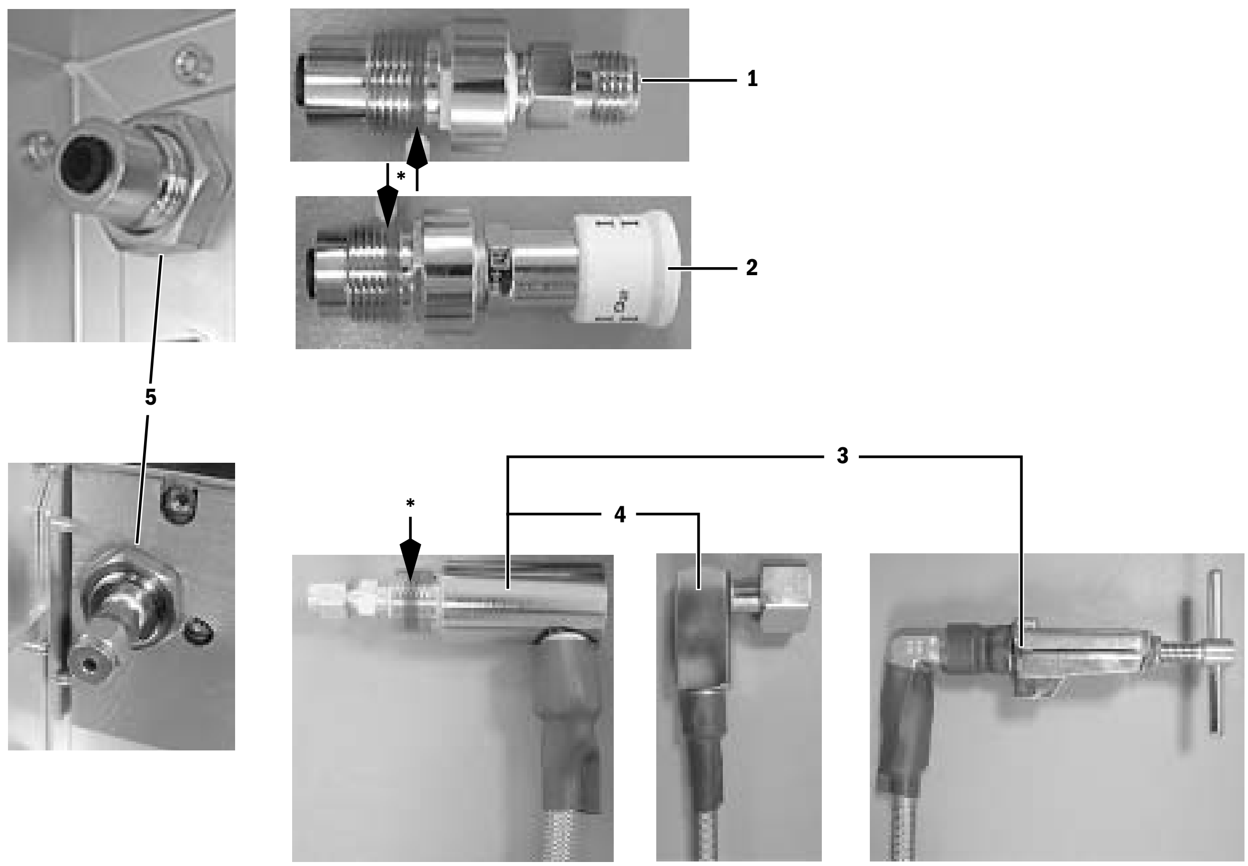
2 DIN (external cylinder)



Item	Description	Stock Number
1	**Cylinder inlets (Pin Index)**	--------------------
1a	Gasket	0210-5022-300
1b*	O-ring	9221-3013-116
1c	Adapter, inlet	1001-4075-000
1d	Filter, sintered bronze	9914-6380-000
1e	Retaining ring, filter	1001-5954-000
2	**Cylinder inlets (DIN)**	--------------------
2a	Screw, M8x16	0144-2140-242
2b	Sealing ring (DIN)	1001-3812-000
2c	DIN Adapter (O_2)	1006-4000-000
	DIN Adapter (N_2O)	1006-4001-000
	DIN Adapter (Air)	1006-4002-000
2d	O-ring, 0.687 ID, 0.812 OD	0210-0544-300
2e	Filter, sintered bronze	9914-6380-000

* Lubricate sparingly with Krytox

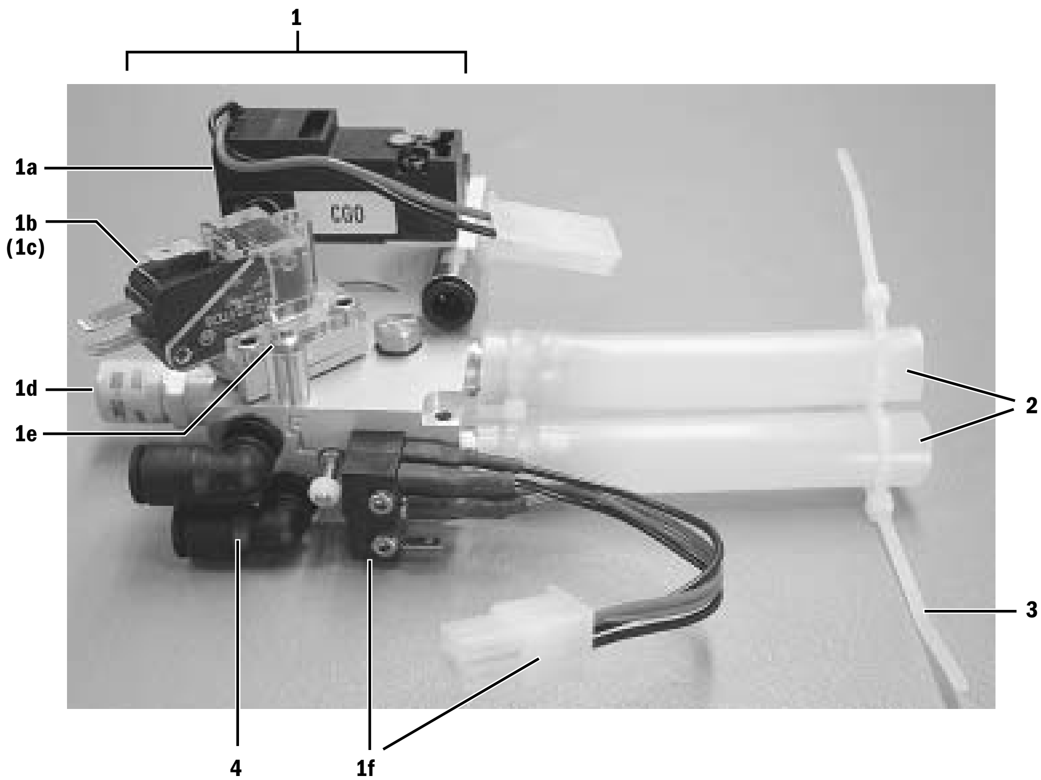
10.12.2 Power outlets and third cylinder high-pressure hoses



Item	Description		Stock Number
1*	Outlet, pneumatic power - DISS		1011-8074-000
2*	Outlet, pneumatic power - Euro		1011-8076-000
3*	Hose assembly, high pressure, Pin Index	O_2 -	1011-3869-000
		N_2O -	1011-3870-000
4*	Hose assembly, high pressure DIN	O_2 -	1011-3871-000
		N_2O -	1011-3872-0000
5	Nut, M20x1.5 Brass		1006-5065-000

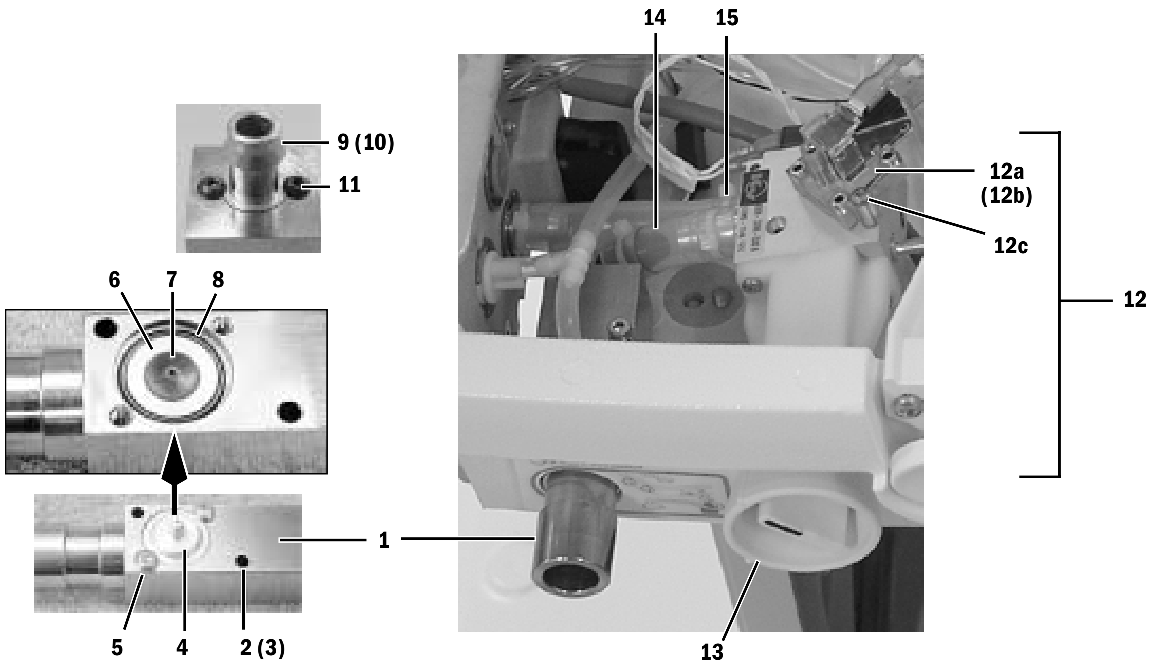
* Apply Loctite 242.

10.13 ABS to machine Interface Components (SCGO)



Item	Description	Stock Number
1	SCGO Selector Module, complete	1009-3098-000
1a	Solenoid kit CGO	1009-3279-000
1b	Flush pressure switch (includes o-ring)	1006-3972-000
1c	O-ring	1006-3213-000
1d	Valve, relief 150 cmH2O	1009-3052-000
1e	Screws	0144-2124-201
1f	Switch, mode (CGO/SCGO), kit	1009-3282-000
2	Tubing, silicone (110 mm, 100 mm)	1009-3164-000
3	Tie wrap	0203-5915-300
4	Elbow, Legris 1/4 inch	1006-3737-000

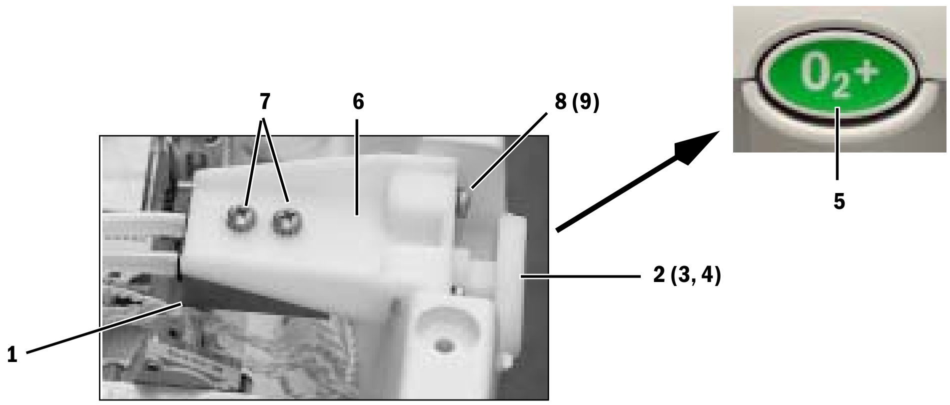
10.14 ABS to machine Interface Components (ACGO)



Item	Description	Stock Number
1	Port, ACGO body	1009-3096-000
2	Screw, M4x30	9211-0640-304
3	Lockwasher, M4	9213-0540-003
4	Cap, ACGO check valve	1009-3095-000
5	Screw, M4x8	9211-1040-069
6	Disk, ACGO check valve	1009-3062-000
7	Flapper, ACGO check valve	1009-3097-000
8*	O-ring	0210-0543-300
9	Fitting, barbed	1011-3830-000
10*	O-ring	0210-0691-300
11	Screw, M3x6	9211-1030-055
12	ACGO Selector Switch, complete (without guard - item 13)	1009-3099-000
12a	Flush pressure switch	1006-3972-000
12b	O-ring	1006-3213-000
12c	Screws	0144-2124-201
13	Guard	1009-3140-000
14	Tubing, silicone (80 mm, 60 mm)	1009-3164-000
15	Tie wrap	0203-5915-300

* Lubricate sparingly with Krytox.

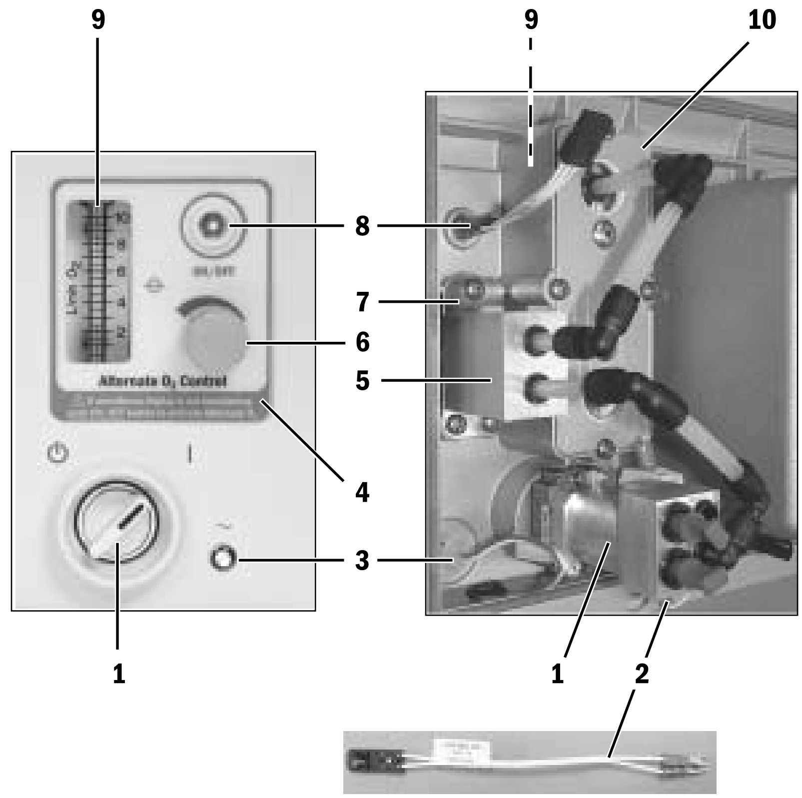
10.15 O_2 Flush Valve



Item	Description	Stock Number
1	Flush valve, without button	1006-8357-000
2	Flush Button with rod (O_2^+ black text)	1011-3354-000
3	Spring	1006-3186-000
4	E-clip	0203-5225-300
5	Able, O_2^+ green (for locations that require green)	1011-3988-000
6	Bracket	1011-3355-000
7	Screw, M4x8	1006-3178-000
8	Screw, M4x12	0140-6226-111
9	Lockwasher, M4	9213-0540-003

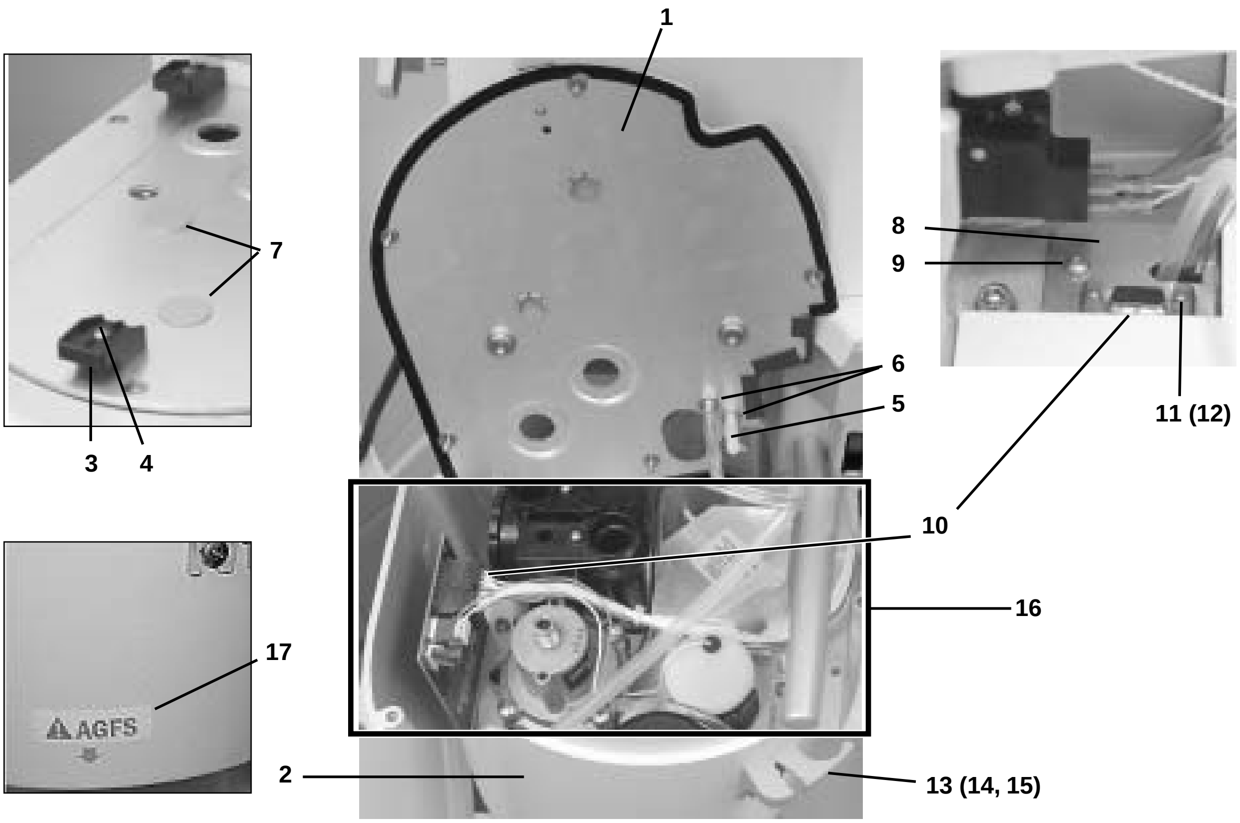
10.16 Front panel, Alt O2, and system switch

Table 1:	
Language	**Alt O_2 Label**
Chinese	1011-3913-000
Czech	1011-3939-000
Danish	1011-3949-000
Dutch	1011-3931-000
English	1011-3567-000
Finnish	1011-3932-000
French	1011-3929-000
German	1011-3930-000
Greek	1011-3943-000
Hungarian	1011-3944-000
Italian	1011-3936-000
Japanese	1011-3933-000
Norwegian	1011-3941-000
Polish	1011-3940-000
Portuguese	1011-3938-000
Russian	1011-3912-000
Spanish	1011-3937-000
Swedish	1011-3945-000
Turkish	1011-3942-000



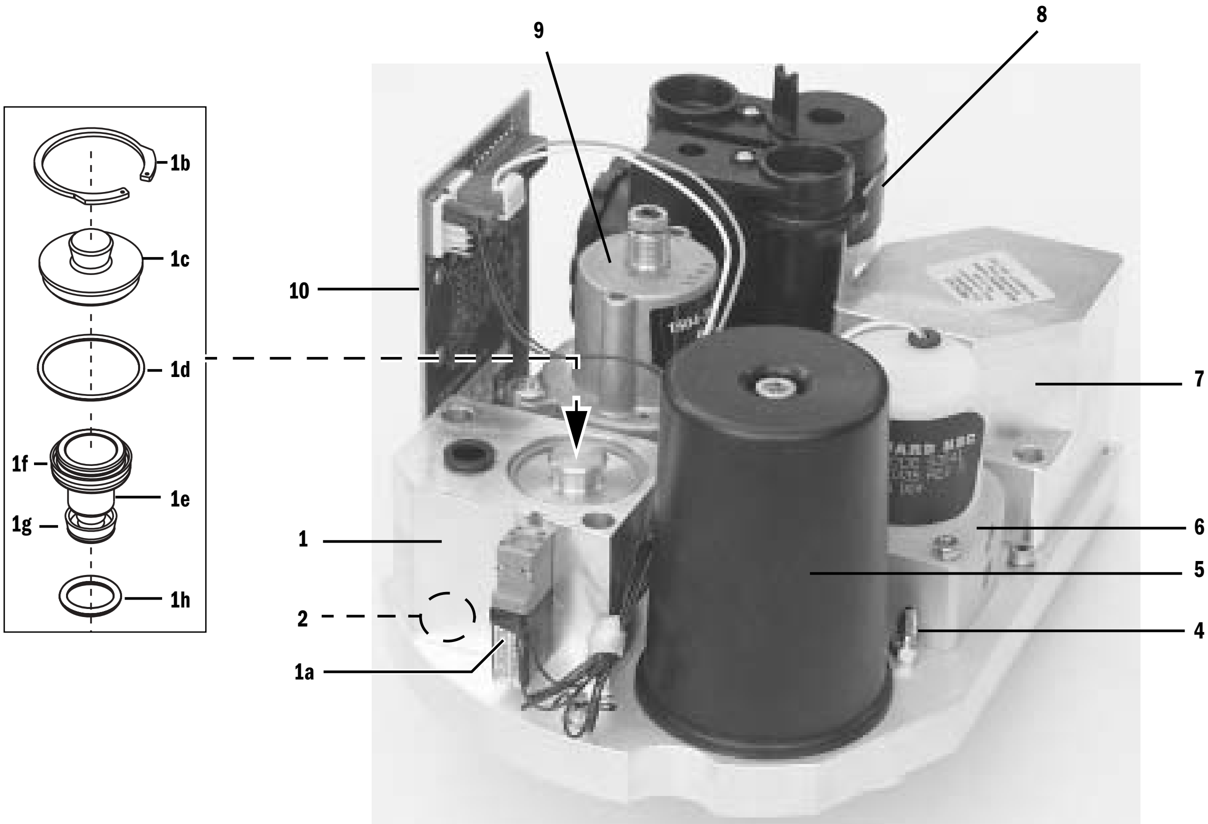
Item	Description	Stock Number
1	Switch, D-O system	1006-8452-000
2	Harness, On/Standby system switch	1009-5542-000
3	LED assembly, mains green	1009-5514-000
4	Label, Alt O_2	See Table 1
5	Needle Valve assembly, flow control	1011-3429-000
6	Knob (set screw not included)	1011-3472-000
	Set screw	9211-0830-053
7	Plate, needle valve	1011-3639-000
	Screw, M4x8	1006-3178-000
8	Switch, Alt O_2 (includes harness)	1009-5517-000
9	Flowmeter, Alt O_2	1011-3428-000
10	Plate, flowmeter	1011-3270-000
	Screw, 10-32x3/8 (bracket to flowmeter - 2 each)	0140-6631-107
	Screw, M4x8 (assembly to front panel - 4 each)	1006-3178-000

10.17 Vent Engine Housing



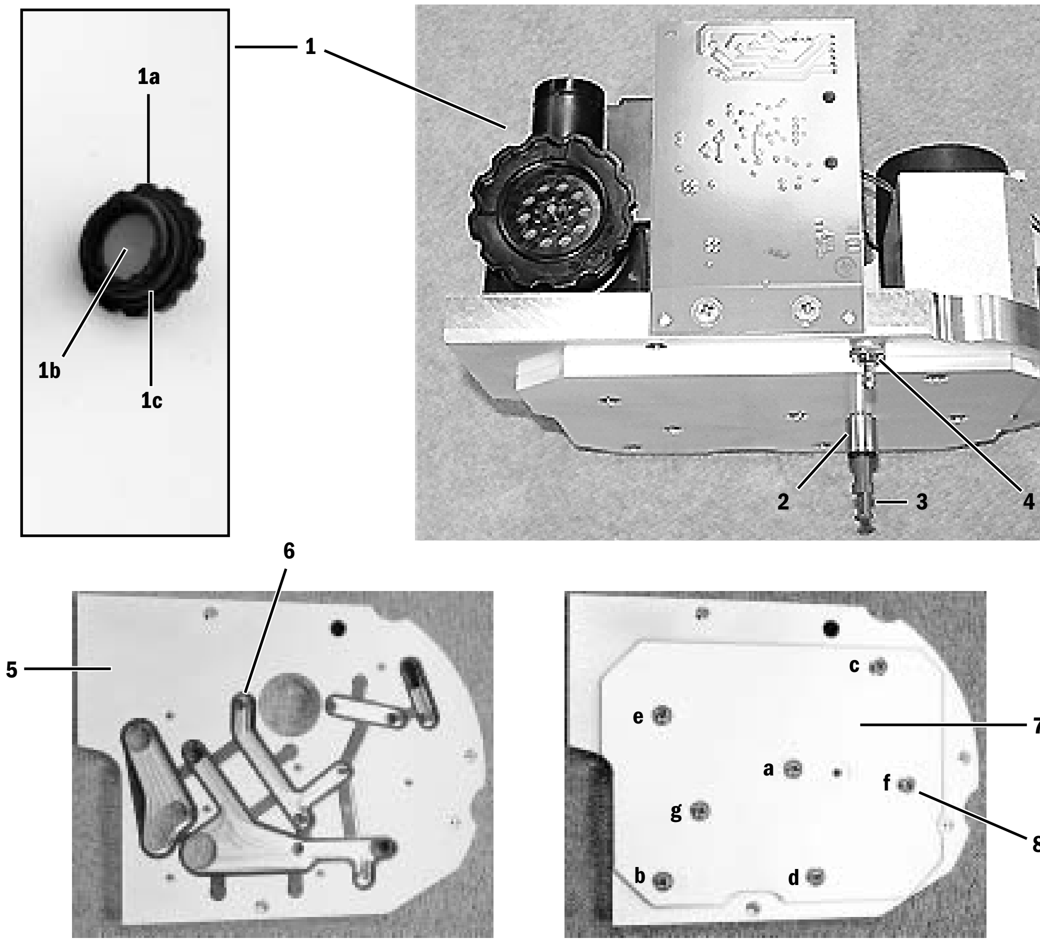
Item	Description	Stock Number	Qty
1	Vent Engine Cover Plate Assy	1407-7009-000	
2	CASTING VENT ENG HOUSING	1407-3301-000	
3	TAB GUIDE BELLOWS BASE	1407-3313-000	(2)
4	SCR M3X16 POSI DR PAN HD A4 SST	1504-3003-000	(2)
5	Cap, Plug	1406-3524-000	
6	FITTING PNL MOUNT 3.18 HOSE BARB UNION	1504-3014-000	(2)
7	PLUG HOLE 15.9 DIA NYLON MICRO PLASTICS	1006-1473-000	
8	PLATE CONN VENT	1407-3321-000	
9	SCR M4X8 POZI-DR DIN84 PAN SERRATED	1006-3178-000	(3)
10	Harness, Vent Engine Board to Connector Plate	1009-5545-000	
11	BLOCK LATCHING DSUB CONN	1504-3617-000	(2)
12	SCR 4-40 X 3/8 SKT BCG HD CAP	0144-2117-206	(2)
13	CLIP-SUCTION BAG HOSE	1407-3327-000	
14	SCR M5 X 16 PAN PH HD SST	9211-8350-163	(2)
15	Lockwasher	0144-1118-220	(2)
16	Vent Engine	Refer to section 10.18	
17	Label, AGFS (for German variant)	1009-3300-000	

10.18 Vent Engine



Item	Description	Stock Number
	Vent Engine Assembly, Service (Avance)	1009-8216-000
1	Gas Inlet Valve (GIV) components	Refer to section 9.12.3
1a	Solenoid, 3-way NO (with mounting screw)	1503-3853-000
1b	Retaining ring, 34.9 mm	1500-3158-000
1c	Cap, inlet valve	1503-5006-000
1d	O-ring, upper Viton	9221-3032-116
1e	Shuttle, inlet valve	1503-5018-000
1f	U-cup, upper EDPM (fits on shuttle valve)	1503-3090-000
1g	U-cup, lower Viton (fits on shuttle valve)	1503-3089-000
1h	O-ring, lower Viton	1503-3108-000
2	Filter (under GIV), 2-micron (install course side DOWN)	1504-3708-000
4	Fitting, manifold pressure	1500-3116-000
5	Reservoir, pneumatic engine	1504-3704-000
	O-ring, base, 56.87 ID x 60.43 OD	1504-3614-000
	O-ring, screw head, 0.219 ID x 0.344 OD	0210-0686-300
	Screw, M6x90	1504-3004-000
6	Flow control valve (HSC) BCG	1503-3854-000
	O-ring under flow control valve (2 each)	1503-3056-000
7	Drive gas check valve	1503-3006-000
	O-ring under drive gas check	1503-3213-000
8	Interface Manifold	Refer to section 10.18.1
9	Regulator, 172 kPa BCG	1504-3623-000
10	Vent Engine Connector board (not part of assembly)	1011-3165-000

10.18.1 Vent Engine - under side



Item	Description	Stock Number
1	Interface Manifold, pneumatic engine (with free breathing valve and mechanical overpressure valve)	1504-8505-000
	O-ring, 12.42 ID x 15.98 OD (2)	1006-3615-000
1a	Seat, free breathing valve	1503-3204-000
1b*	Valve, flapper	0211-1454-100
1c	O-ring	1503-3208-000
2	Fitting, 6.35-mm (1/4-inch)	1504-3621-000
3	Plug, 6.35-mm (1/4-inch)	1503-3245-000
4	Fitting, barbed	1504-3014-000
5	Manifold	1503-3843-000
6**	Gasket, manifold	1503-3845-000
7	Plate, manifold	1503-3844-000
8***	Screw, M4x8 Pozidriv PAN	1006-3178-000

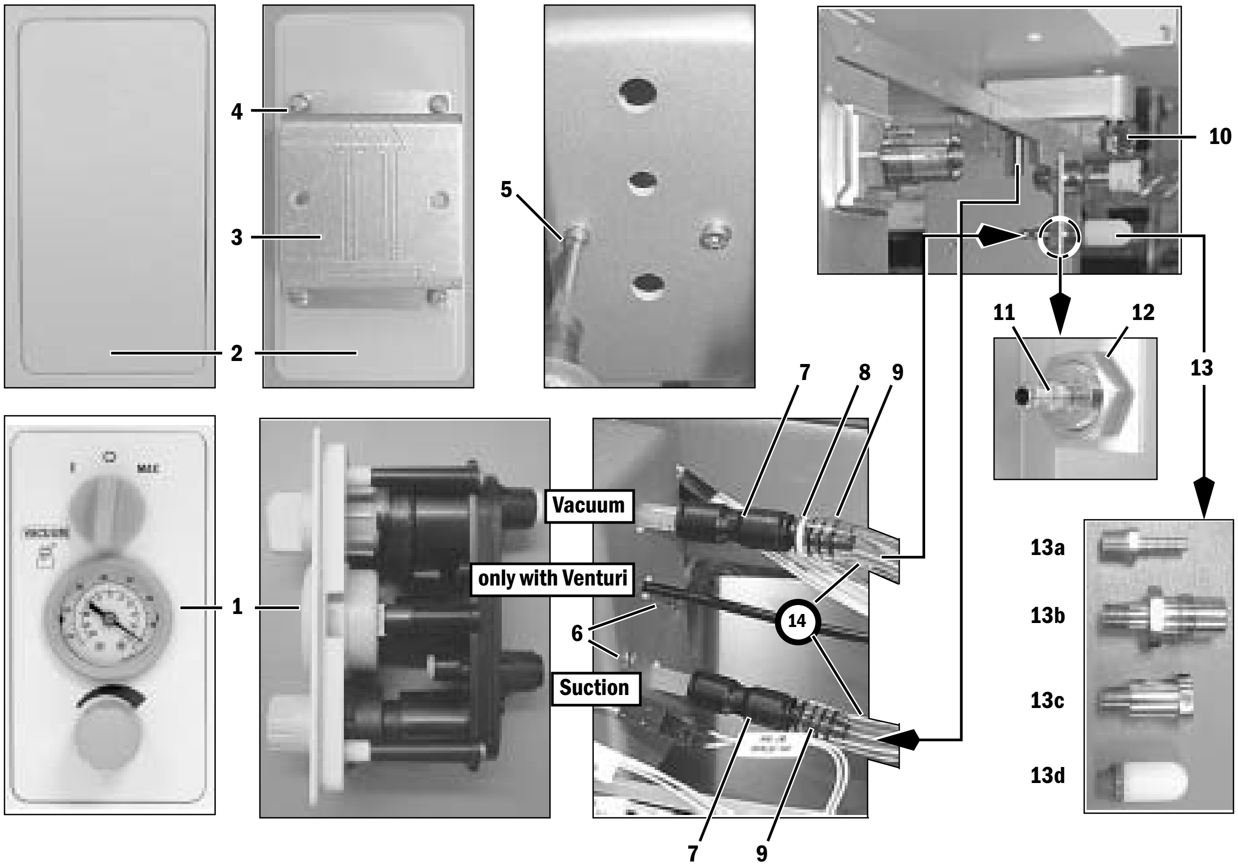
* If necessary, clean with alcohol before installing new; trim off flush with outside surface of seat (refer to removed flapper).

** Install gasket into manifold. Check to see that it is properly positioned.

*** Carefully install plate onto manifold making sure not to disturb the gasket. First, start all screws. Then, torque to 1.7 N-m (15 lb-in) using sequence shown.

10.19 Integrated Suction Regulator

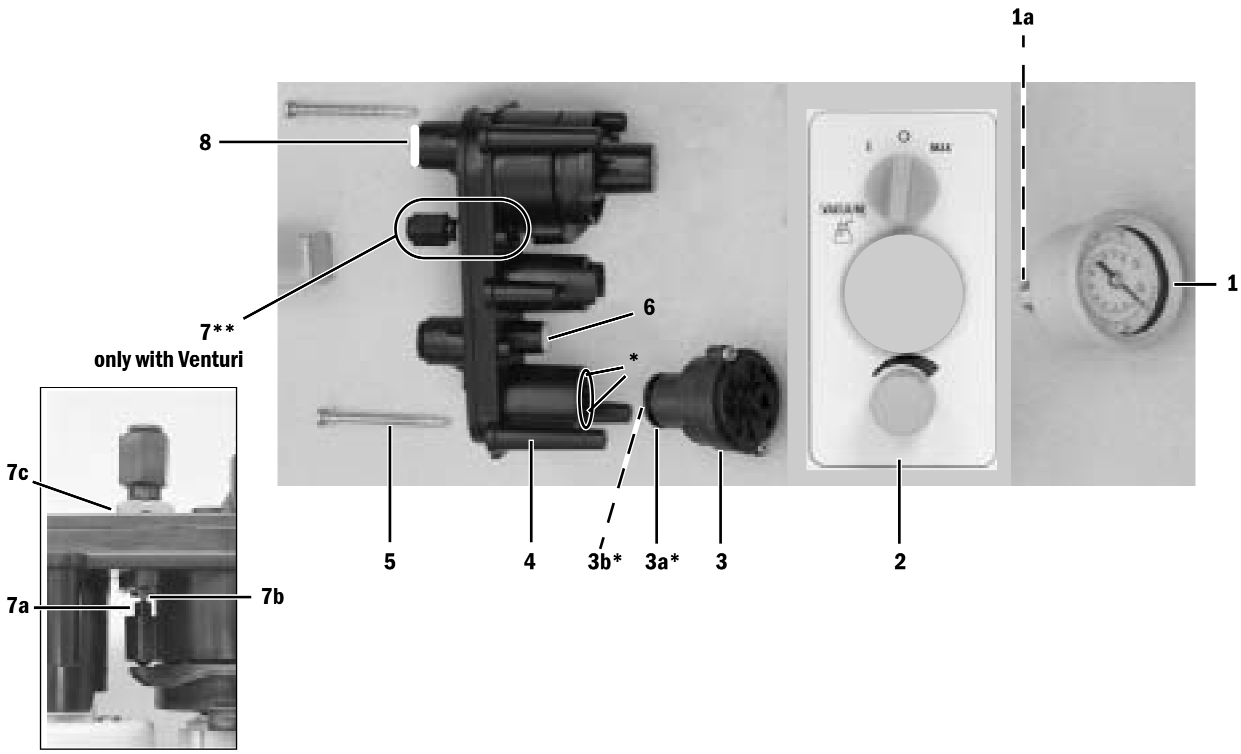
10.19.1 Components



Item	Description	Stock Number
1	Suction Control Module	Refer to section 10.19.2
2	Cover, blank (if no Suction)	1011-3200-000
3	Bracket, blank cover mounting	1011-3202-000
4	Screw, M4x10 self-tapping	1009-5534-000
5	Screw, M4x45 Hex	N122024
6	Screw, #6 - 2 inch	1009-3340-000
7	Union, 8mm Legris	1006-3973-000
8	Cap, white	1009-3192-000
9	Fitting, barb to 8-mm Legris	1009-3137-000
10*	Coupling, Colder insert metal	1009-3135-000
11**	Adapter, 1/4 NPTF hose	1011-3603-000
12	Nut, M20x1.5 Brass	1006-5065-000
13a	Connector, Barb	0221-0702-300
13b	Connector, NIST	1011-3524-000
13c	Connector, Air Liquide	1009-8292-000
13d	Muffler, for Venturi Drive	1011-3511-000
Tubing	Refer to section 10.35	14

* Apply Teflon tape to threads.
** Apply Loctite 242.

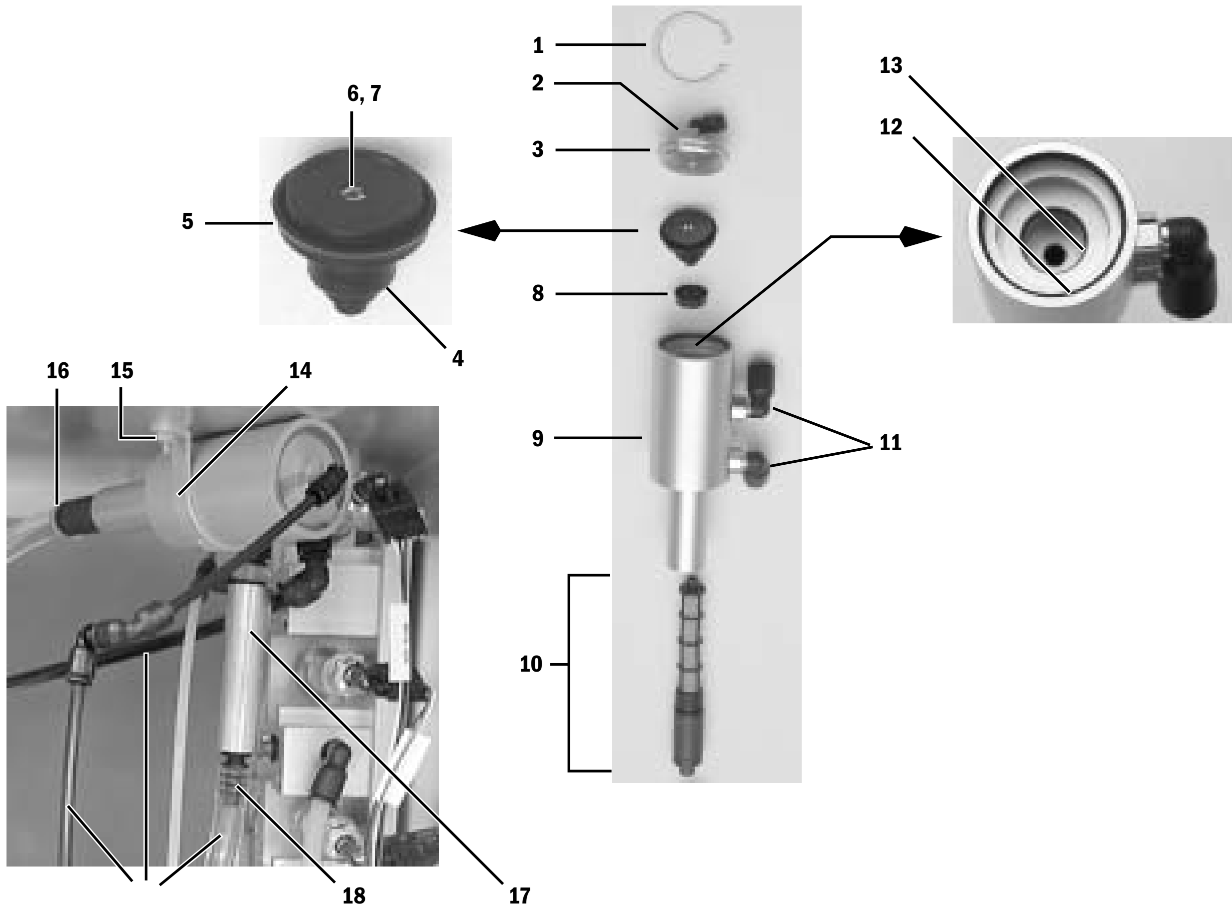
10.19.2 Suction Control Module



Item	Description	Stock Number
1	Gauge, 760 mmHg	1009-3227-000
1a	O-ring, Gauge (included with gauge assy, 2ea. required)	6700-0133-500
2	Control panel assembly, with suction regulator knob and mode control knob	1009-3274-000
3	Regulator Module (plugs into manifold assembly)	6700-1225-800
3a	O-ring, Regulator Module, Large (included with regulator module)	6700-0136-500
3b	O-ring, Regulator Module, Stem (included with regulator module)	0210-0527-300
4	Manifold Assembly, without Gauge and Regulator Module	1009-3277-000
5	Screw, #6 - 2 inch	1009-3340-000
6	Filter	0206-5159-300
7	Pilot valve adapter assembly (includes plunger, jam nut, and valve assembly)	1009-3278-000
8	Cap, white	1009-3385-000

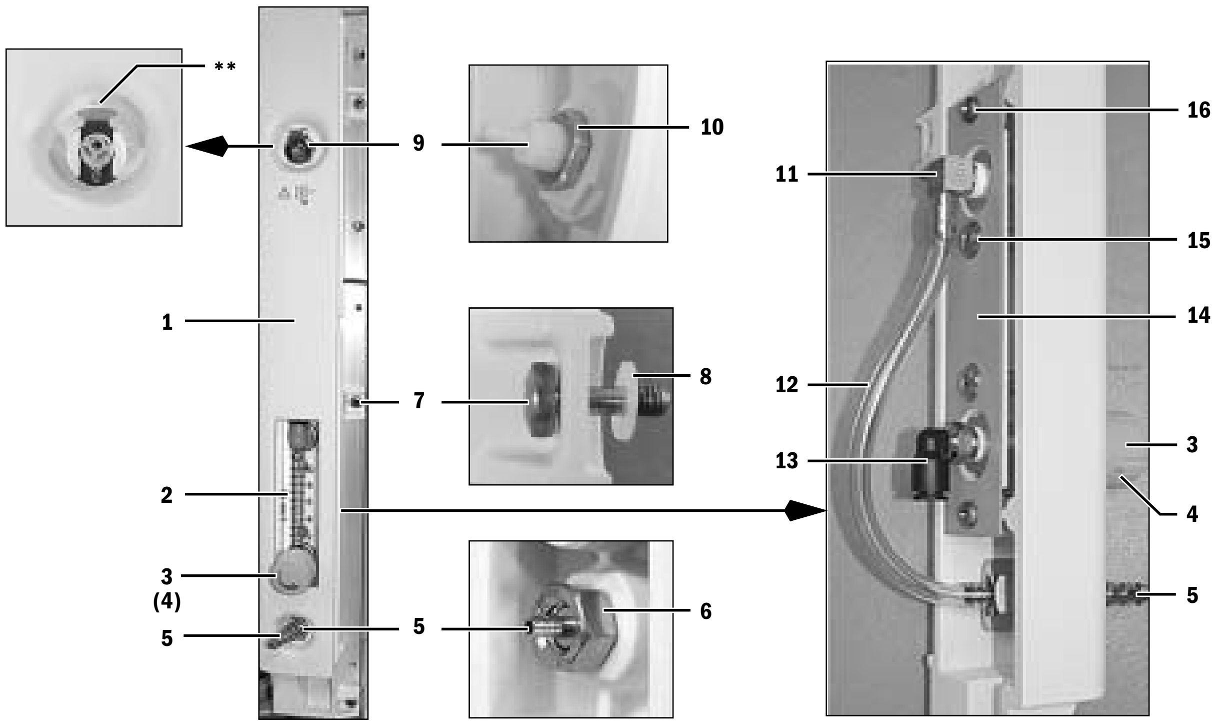
* Lubricate the regulator module o-rings and the mating bore of the manifold sparingly with Dow 111 lubricant.
** Drop the plunger (**7a**), round end first, into the manifold. Thread the pilot valve into the manifold body. Set the mode switch to raise the plunger. Adjust the pilot valve (**7b**) so that the plunger actuates the pilot valve approximately half of its travel. Tighten the jam nut (**7c**).

10.19.3 Venturi assembly



Item	Description	Stock Number
1	C-clip retainer, Truarc	1500-3158-000
2	Elbow fitting, 4-mm Legris	1006-3663-000
3	Cap	1011-5002-000
4	Spoppet	1011-5001-000
5	Seal, u-cup large	1503-3090-000
6	Orifice	1011-3508-000
7	Screen, 150 mesh monel	1001-3808-000
8	Seal, u-cup small	1503-3089-000
9	Body	1011-5000-000
10	Venturi	1011-3509-000
11	Elbow fitting, 8-mm Legris	1011-3510-000
12	O-ring, large	9221-3032-116
13	O-ring, small	1503-3108-000
14	Check valve	1011-8002-000
15	Bracket, Venturi mounting	1011-3359-000
16	Nut, M4 Keps	0144-3717-000
17	Cable tie	0203-5915-300
18	Fitting, barbed Legris	1009-3137-000
19	Tubing	Refer to section 10.32

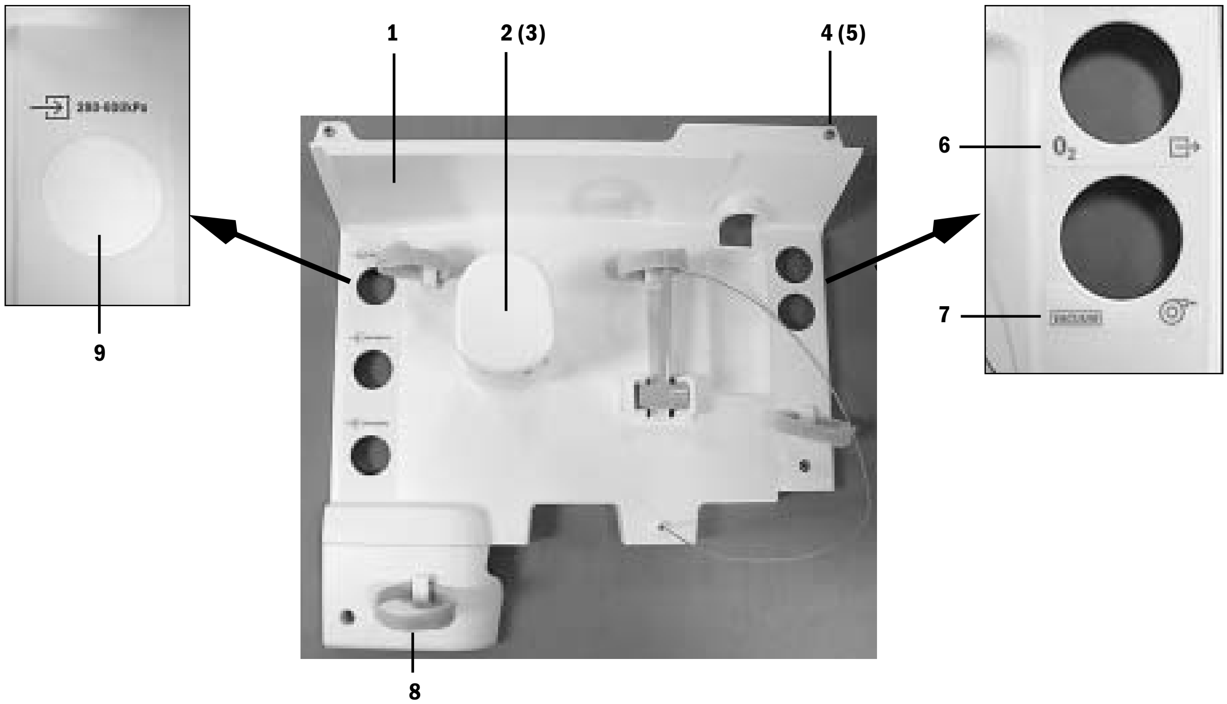
10.20 Auxiliary O_2 Flowmeter and Sample Gas Return



Item	Description	Stock Number
1	Cover, panel for machines with Auxiliary O_2 Cover, panel for machines without Auxiliary O_2	1011-3230-000 1011-3263-000
2	Flowmeter, 1-10 L/min, without fittings	1006-3841-000
3	Knob, gray	1011-3471-000
4	Setscrew	9211-0830-053
5*	Nipple, Panel-Mount, Auxiliary O_2 Outlet	1006-5177-000
6	Nut, M12x1.75, SST	0144-3132-140
7	Screw, M4X12 Pozidriv Pan HD	1504-3001-000
8	Washer, M4 retaining Nylon	1009-3178-000
9**	Coupling, Colder	1009-3134-000
10	Jam Nut	0402-1787-500
11***	Fitting, 1/8 NPTM, barb elbow	0204-8788-300
12	Tubing	Refer to section 10.32
13***	Fitting, 1/8 NPTM, 6-mm Legris elbow	1011-3824-000
14	Plate, Flowmeter Mounting	1011-3270-000
15	Screw, 10-32 x 3/8	0140-6631-107
16	Screw, M4x8 Pozidriv DIN84	1006-3178-000

* Apply Loctite 242.
** Note orientation of release; do not apply Loctite; tighten the nut until it is snug, so that the coupler cannot be rotated by hand — do not overtighten.
*** Apply Teflon tape.

10.21 Rear panel components

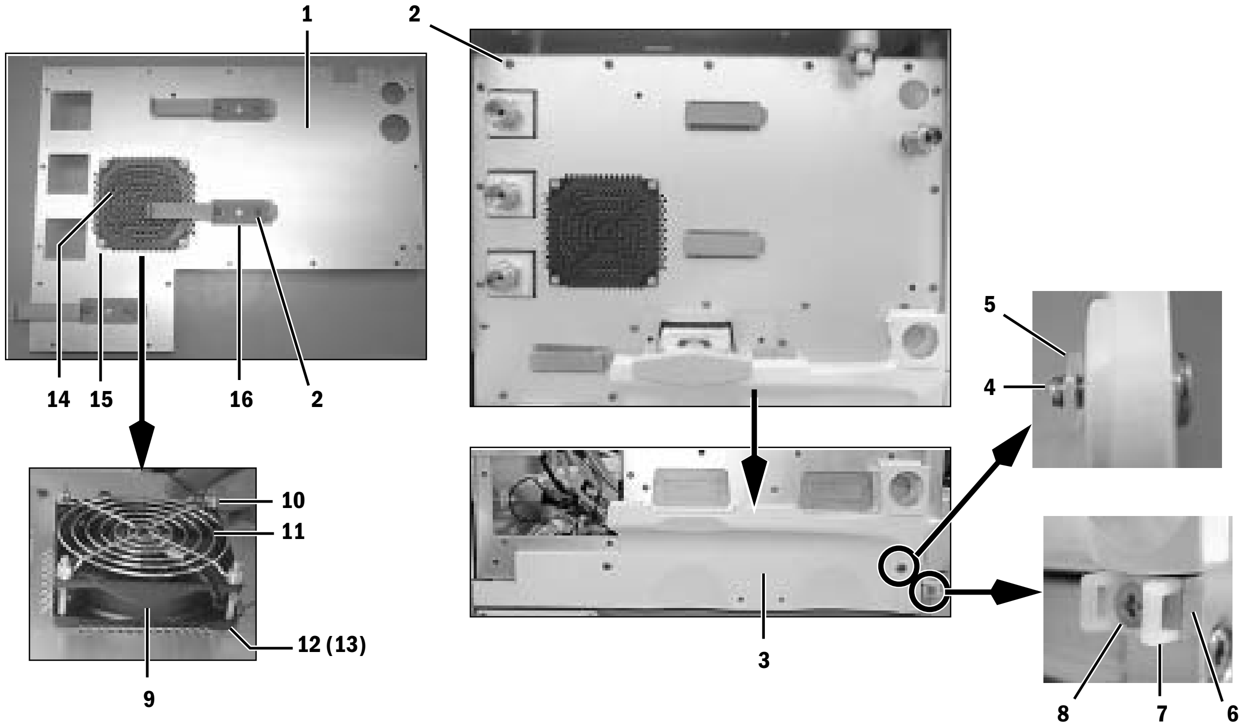


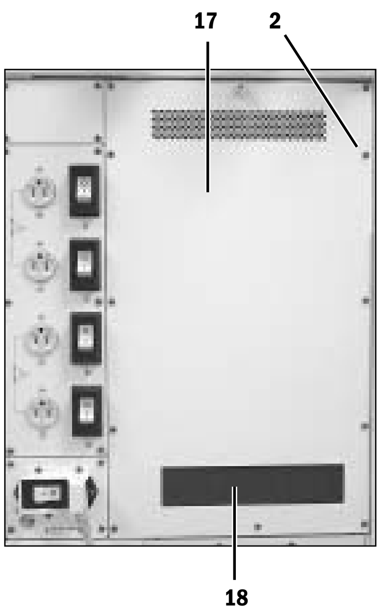
10 (12, 13)

11 (12, 13)

Item	Description	Stock Number
1	Cover, rear upper	1011-3227-000
2	Cap, hose reel	1009-3075-000
3	Screw, M5x20 BHSCS PT THD FORMING	1009-3384-000
4	Screw, M4x12	1504-3001-000
5	Washer, M4 retaining Nylon	1009-3114-000
6	Label, power outlet	1011-3563-000
7	Label, vacuum (suction))	1011-3564-000
8	Strap, hook/loop	1009-3233-000
9	Plug, 31.8 DIA HOLE	1011-3822-000
10	Wrench, pin index cylinder (with cable)	0219-3415-800
11	Wrench, DIN cylinder (does not include cable)	1202-3651-000
12	Cable	1010-3049-000
13	Ferrule, cylinder wrench cable retainer	1001-3708-000

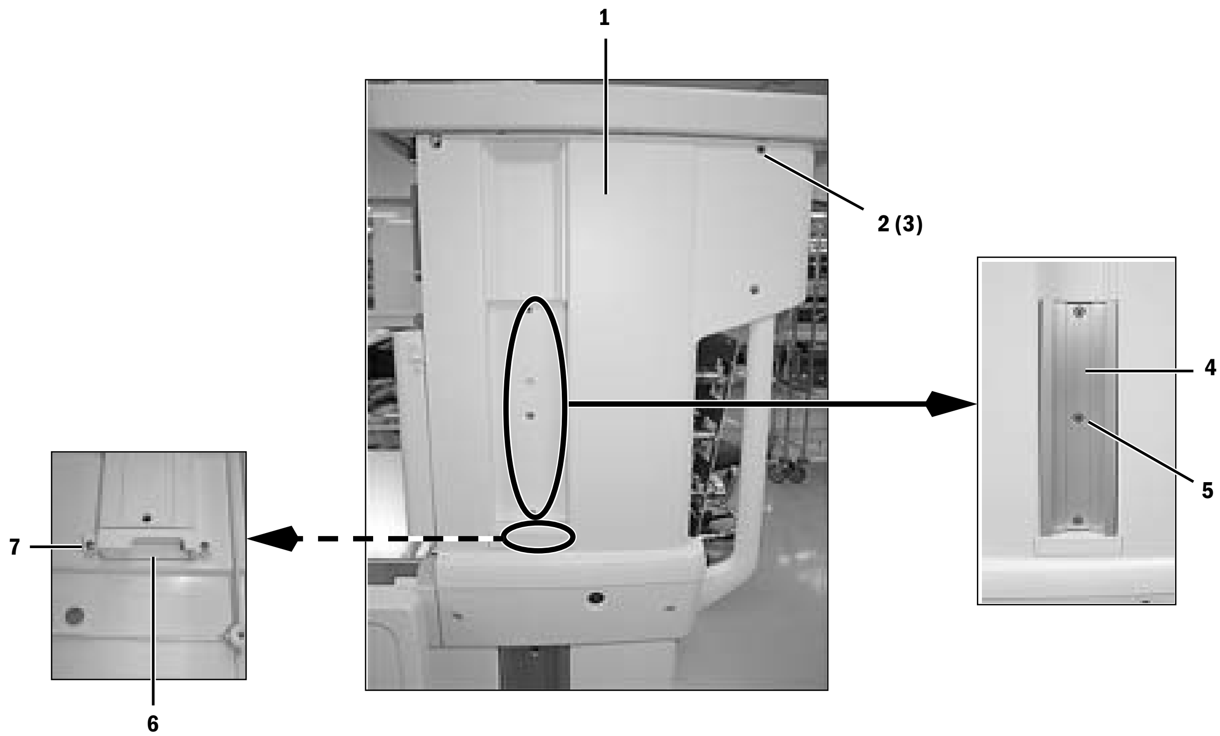
10.22 Panels, rear





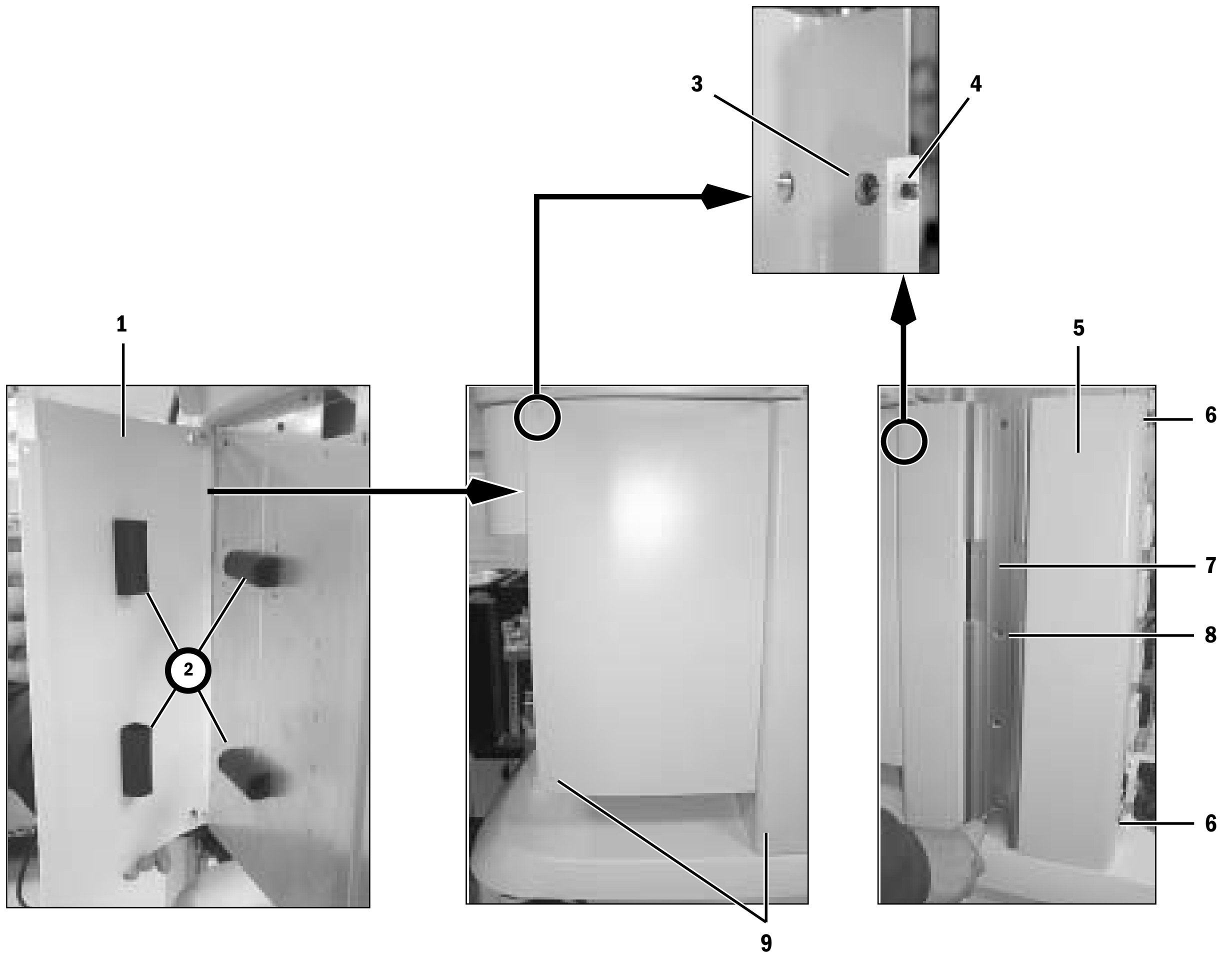
Item	Description	Stock Number
1	Panel, upper electrical rear	1011-3240-000
2	Screw, M4x8	1006-3178-000
3	Panel, cosmetic rear lower	1011-3655-000
4	Screw, M4x12 relieved	1504-3001-000
5	Washer, M4 retainer Nylon	1009-3178-000
6	Spacer, cable tie	1011-3657-000
7	Holder, cable tie	1011-3607-000
8	Screw, M4x20	0140-6226-116
9	Fan	1009-5697-000
10	Nut, M4 Keps	9212-0340-001
11	Guard, fan	0208-2737-300
12	O-ring, retaining	0210-0526-300
13	Washer, flat	0140-1025-165
14	Filter with mount	0208-2734-300
15	Screw, M4x20	0144-2117-724
16	Clip, cable flat	1011-3653-000
17	Panel, lower electrical rear	1011-3208-000
18	Filter, foam	1011-3214-000

10.23 Panel, cosmetic upper right-side



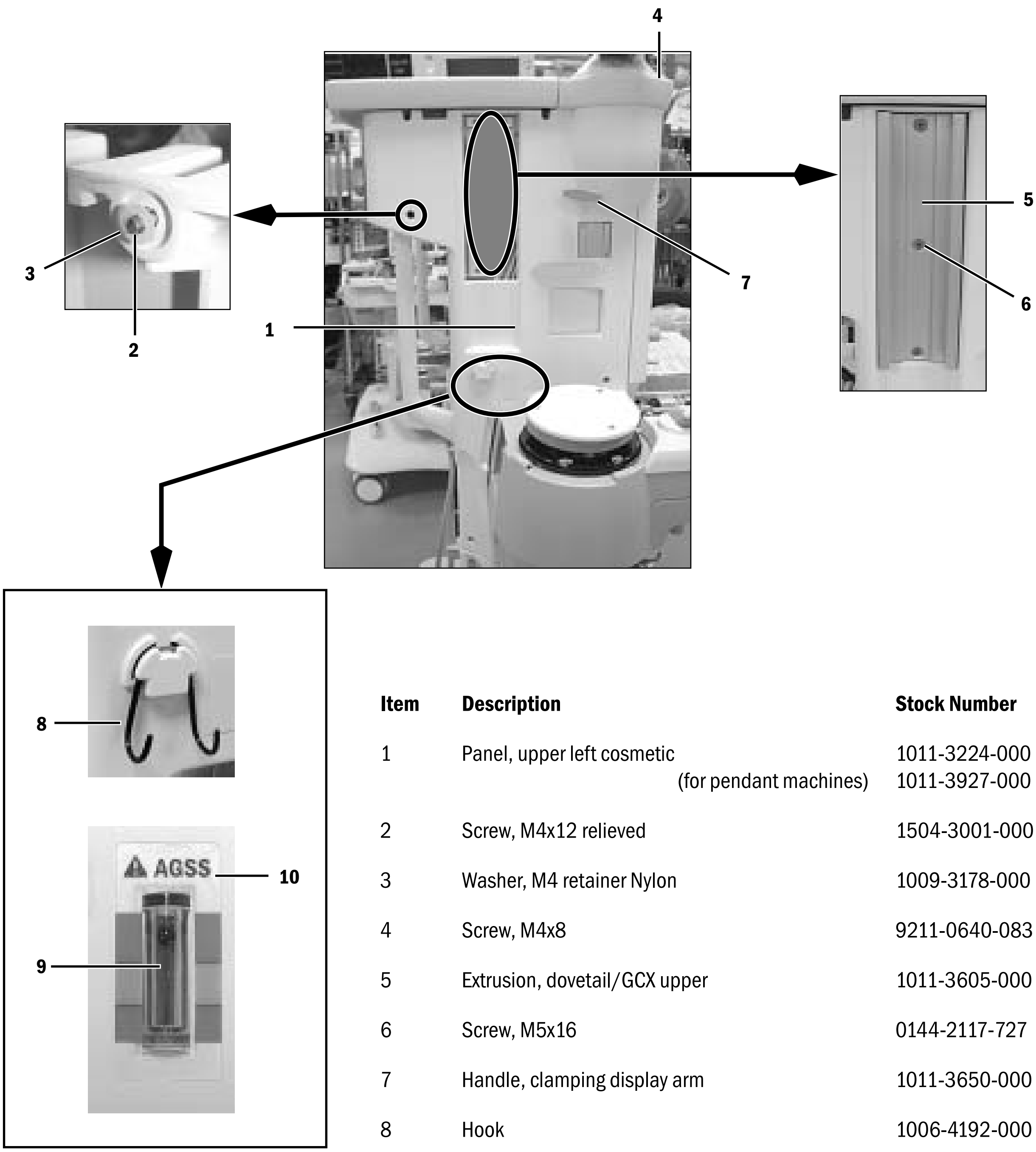
Item	Description	Stock Number
1	Panel, upper right cosmetic	1011-3222-000
2	Screw, M4x12 relieved	1504-3001-000
3	Washer, M4 retainer Nylon	1009-3178-000
4	Extrusion, dovetail/GCX upper	1011-3605-000
5	Screw, M5x16	0144-2117-727
6	Plug	1011-3619-000
7	Screw, M4x8	1006-3178-000

10.24 Panel, cosmetic lower right-side



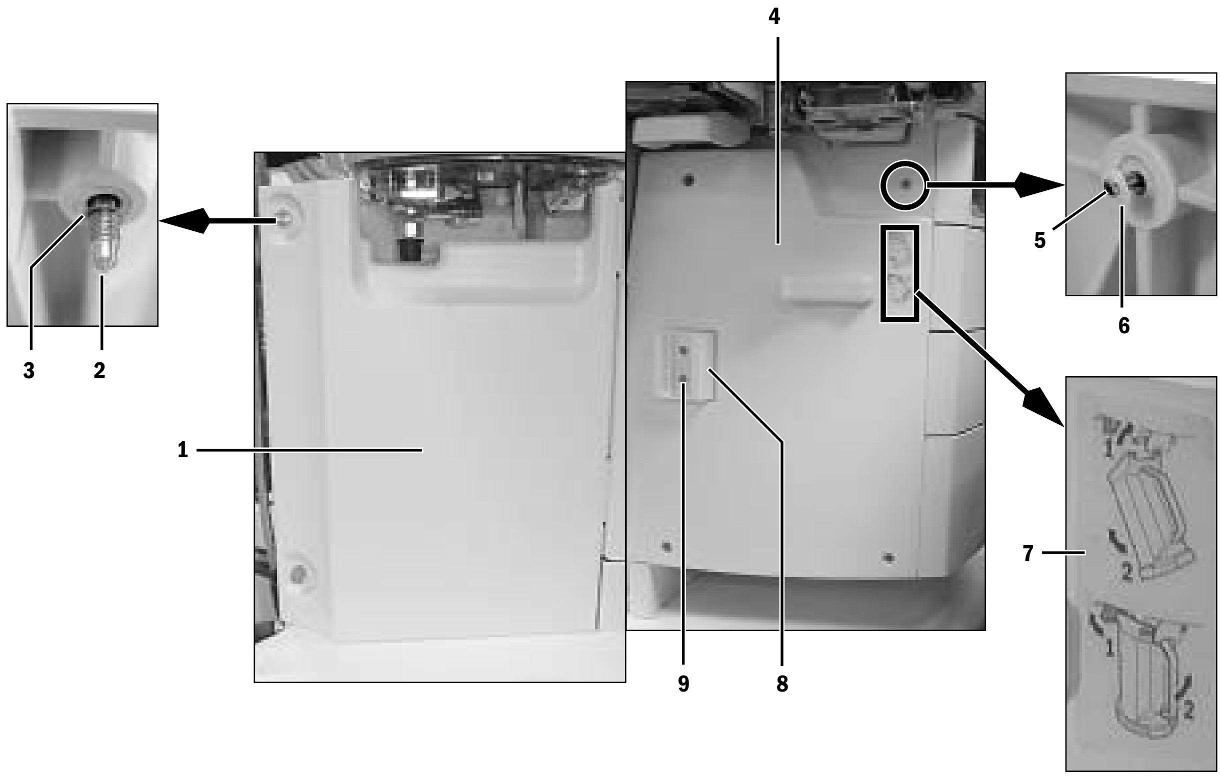
Item	Description	Stock Number
1	Panel, lower drawer cosmetic	1011-3379-000
2	Seal	1006-4154-000
3	Screw, M4x12 relieved	1504-3001-000
4	Washer, M4 retainer Nylon	1009-3178-000
5	Panel, lower right-rear cosmetic (for pendant machines)	1011-3223-000 1011-3926-000
6	Screw, M4x8	1006-3178-000
7	Extrusion, dovetail/GCX lower	1011-3606-000
8	Screw, M5x16	0144-2117-727
9	Plug, 7.9 mm DIA hole	1011-3823-000

10.25 Panel, cosmetic upper left-side



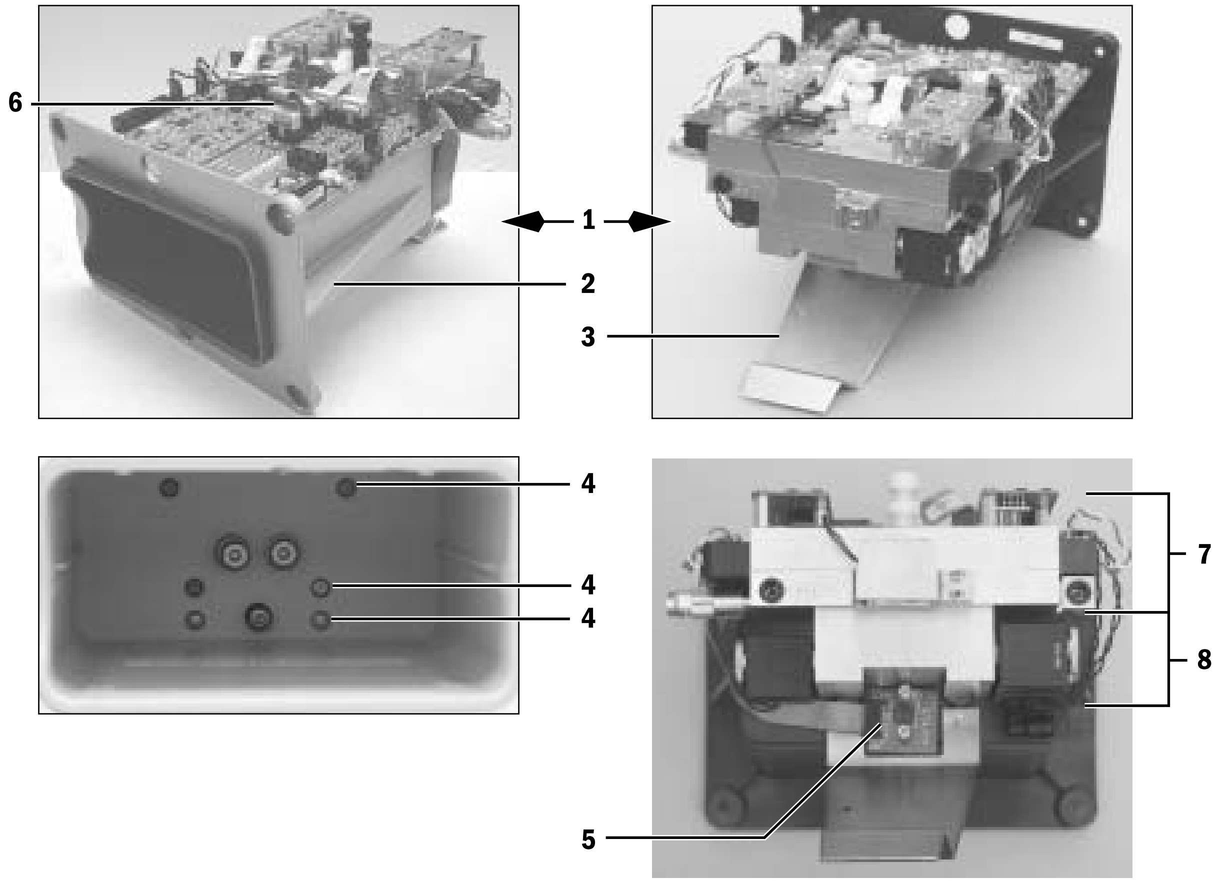
Item	Description	Stock Number
1	Panel, upper left cosmetic	1011-3224-000
	(for pendant machines)	1011-3927-000
2	Screw, M4x12 relieved	1504-3001-000
3	Washer, M4 retainer Nylon	1009-3178-000
4	Screw, M4x8	9211-0640-083
5	Extrusion, dovetail/GCX upper	1011-3605-000
6	Screw, M5x16	0144-2117-727
7	Handle, clamping display arm	1011-3650-000
8	Hook	1006-4192-000
9	Flowtube, AGSS	1406-3560-000
10	Label, flow indicator AGSS	1406-3527-000
	Label, flow indicator AGFS (for German variant)	1009-3301-000
	Label, blank (for machines without flow indicator)	1009-3241-000

10.26 Panel, cosmetic lower left-side



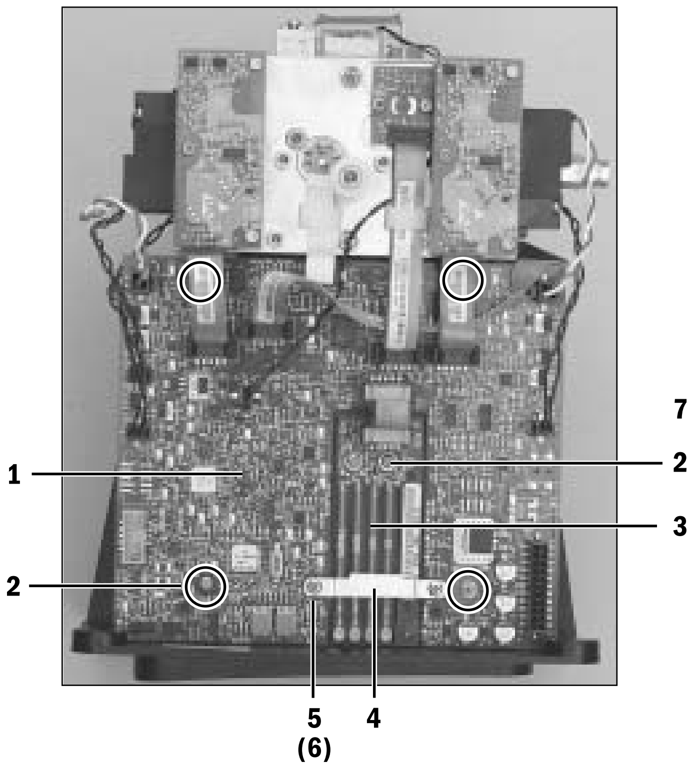
Item	Description	Stock Number
1	Panel, lower left AGSS cover	1011-3225-000
	(for pendant machines)	1011-3928-000
2	Screw, M6x43 thumb	1406-3304-000
3	Washer, split	1406-3319-000
4	Panel, cosmetic drawer left	1011-3277-000
5	Screw, M4x12 relieved	1504-3001-000
6	Washer, M4 retainer Nylon	1009-3178-000
7	Label, CO_2 canister	1011-3946-000
8	Bracket, suction reservoir	1009-3107-000
9	Screw, M4x16	9211-0440-163
10	Lockwasher, M4	9213-0540-003

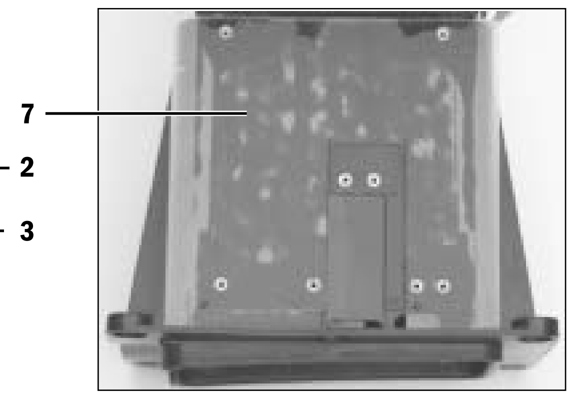
10.27 Electronic Vaporizer



Item	Description	Stock Number
1	Electronic Vaporizer Assembly	1011-7004-000
2	Cassette Bay	1011-3054-000
3	Bracket, Support	1011-3137-000
4	Screw, M4x8 BT SKT HD SST Type 316	0140-6226-118
5	Cassette Temperature Subassembly	1011-7002-000
6	Cable, Jumper	1011-3552-000
7	Flowmeter Subassembly	Refer to section 10.27.3
8	Valve Block Subassembly	Refer to section 10.27.2

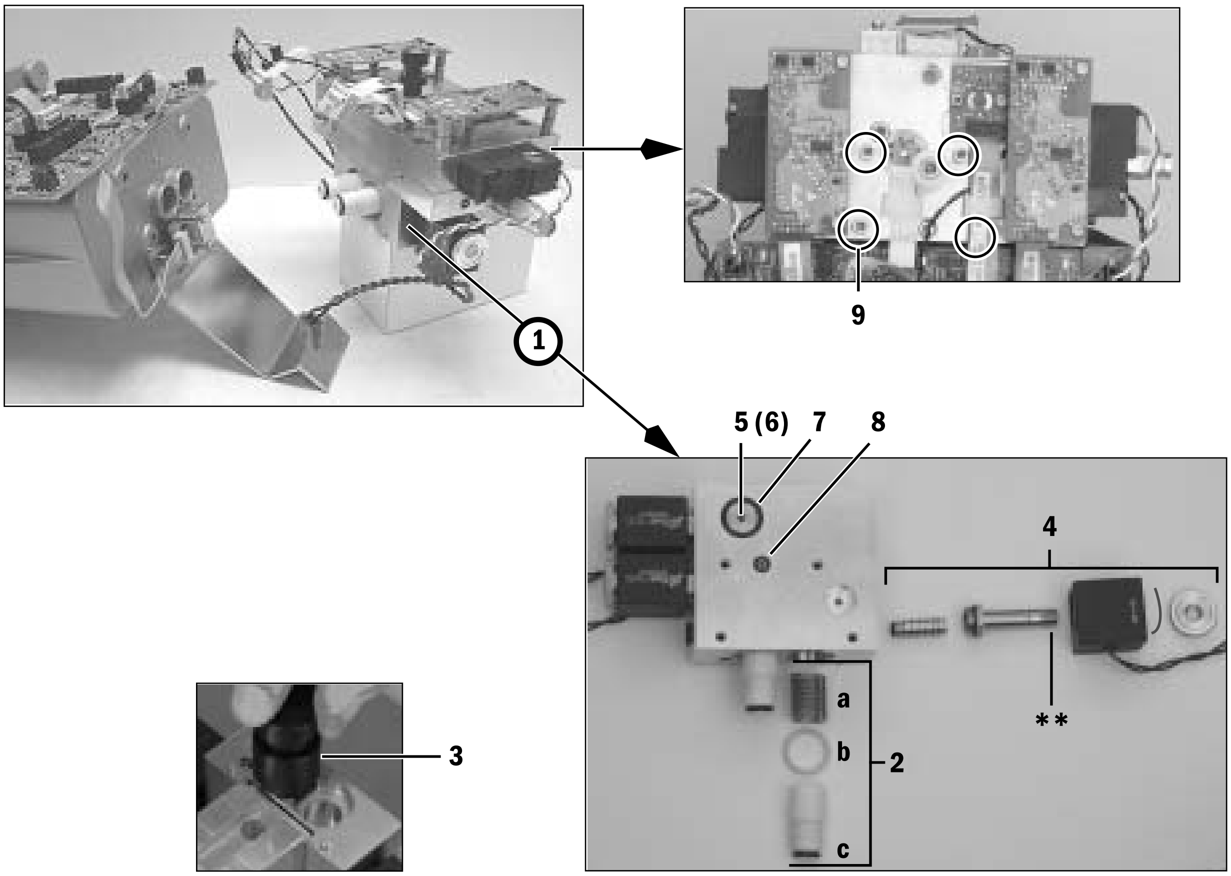
10.27.1 Electronic Vaporizer Agent Delivery





Item	Description	Stock Number
1	Agent Delivery Board	1011-3105-000
2	Screw, Sems M3X6 POZI-DR PAN PH A2 SST	0140-6219-128
3	Cassette Interface Board	1011-3104-000
4	Bracket, Cassette Interface Board	1011-3571-000
5	Screw M3x8 POZI-DR PAN HD	N111301
6	Lockwasher, M3 External	9213-0530-003
7	Insulator, included with cassette bay	Refer to 10.27

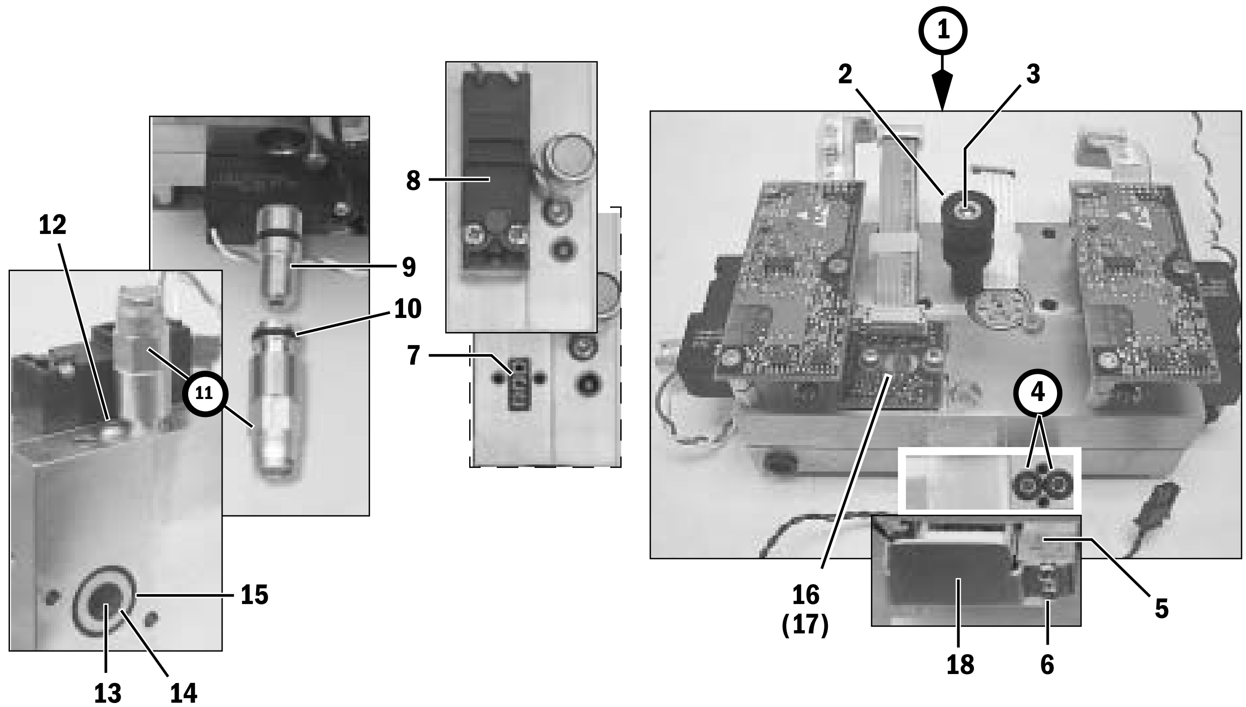
10.27.2 Electronic Vaporizer - Valve Block



Item	Description	Stock Number	Qty
1*	Valve Block Subassembly	1011-7000-000	
2	Valve Connector Assembly	1011-7003-000	(2)
	a - Spring, Wave	1011-3126-000	
	b - Seal, Spring energized	1011-3124-000	
	c - O-ring ID7.00 BCG OD11.00 Viton Duro 75	1011-3125-000	
3	Insertion tool, spring energized seal	Refer to section 10.1	
4	Valve, Solenoid 2-way BCG	1011-3115-000	(3)
5	Cap, Liquid Flow Prevention	1011-3129-000	
6	Ball, 4.00 DIA BCG Polypropylene	1011-3127-000	
7	O-ring, ID12.37 BCG OD17.61 Viton Duro 75	1011-3128-000	
8*	O-ring, ID3.68 OD7.24 BCG Viton Duro 75	1011-3139-000	
9	Screw, M4x45 Hex Cap Head	N122024	(4)

* A replacement valve block assembly (**Item 1**) includes a strip of tape over the o-ring (**Item 8**) to hold it in place. Be sure to remove the tape before replacing the valve block assembly.
** Apply thin coat of silicone sealant to threads of mounting post before securing solenoid with thumb nut. Install washer with dome facing outward (toward nut).

10.27.3 Electronic Vaporizer - Flowmeter Assembly



Item	Description	Stock Number	Qty
1	Flowmeter Subassembly	1011-7001-000	
2	Hanging Pin	1011-3144-000	
3	Screw, M5x30 SKT HD CAP SST	1102-3049-000	
4	O-ring, ID3.68 OD7.24 BCG Viton Duro 75	1011-3139-000	(2)
5	Valve, Flow Control BCG	1011-3118-000	
6	Screw, M3x20 Pan Pozidriv	0140-6719-103	(2)
7	Gasket	1011-3136-000	(2)
8	Valve, 3-Way Inflow/Outflow Zero	1011-3117-000	(2)
9*	Valve, Back Pressure	1011-3983-000	
10*	O-ring, Viton .364ID BCG .504OD X .070W	1605-3071-000	
11	Valve, Relief 5.5 psi	1006-4128-000	
12	Screw, M4x8 BT SKT HD SST TYPE 316	0140-6226-118	
13	Flapper Valve, BCG 10.2 Viton	1009-3097-000	
14	Disc, Check Valve	1009-3062-000	
15	O-ring, ID15.60 BCG OD19.15 Viton Duro75	1011-3141-000	
16	Manifold Temperature Sensor Board	1011-3107-000-S	
17	Screw, Sems M3X6 POZI-DR PAN PH A2 SST	0140-6219-128	2
18	Bracket	1011-3989-000	

* Lubricate sparingly with Krytox.

10.28 Enhanced Aladin Cassette Components

Item	Description		Stock Number	Qty
1	Filler cap (includes O-ring and tether)		1100-3043-000	
2	O-ring, filler cap		1100-3135-000	
3	Handle		1100-8001-000	
4	Screw, handle		1100-3134-000	(2)
5	Screw, bottom plate		6019-5404-301	(2)
6	Front labels			
		Des	1100-3052-000	
		Enf	1100-3053-000	
		Hal	1100-3054-000	
		Iso	1100-3055-000	
		Sevo	1100-3056-000	
7	Masks			
		Des	1100-3058-000	
		Enf	1100-3059-000	
		Hal	1100-3060-000	
		Iso	1100-3061-000	
		Sevo	1100-3062-000	
		Test	1011-3920-000	
8	Screw, mask		9211-0630-104	
9	Agent Cassette board		1011-3170-000	
10	Screw, circuit board		9211-0630-104	(2)
11	Contact retainer		1100-3044-000	
12	Sight glass		1100-3083-000	
13	Screw, sight glass		1100-3134-000	
14	O-ring, sight glass		1100-3114-000	(2)
15	Label, OEM			
		Baxter	1100-3138-000	
		Abbott	1100-3139-000	

(**A**) - You can replace the handle (**Item 3**) and the o-ring (**Item 2**) for the filler cap without further disassembly. To prevent scratching the cap sealing surface, **use caution when removing the o-ring**.

For the remaining components, follow the outlined sequence to access the individual components.

(**B**) - Ensure that the cassette is empty of agent (refer to Section 9.7). Remove the bottom plate.

(**C**) - Remove the label (**Item 6**) to access the mounting screw (**Item 8**) for the mask.

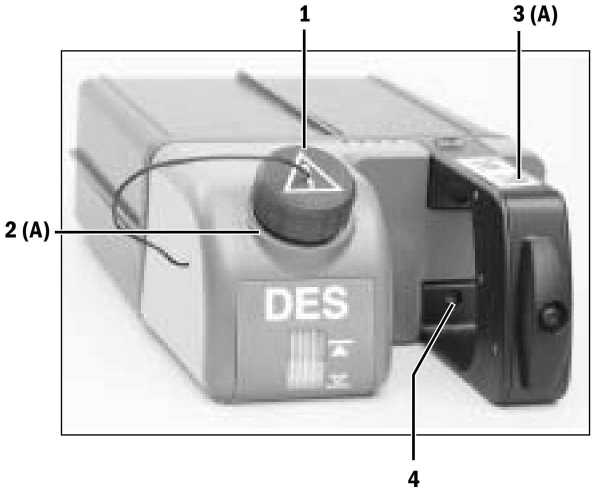
(**D**) - This is a **ZIF** (zero insertion force) connector; pull tabs toward ribbon cable to release.

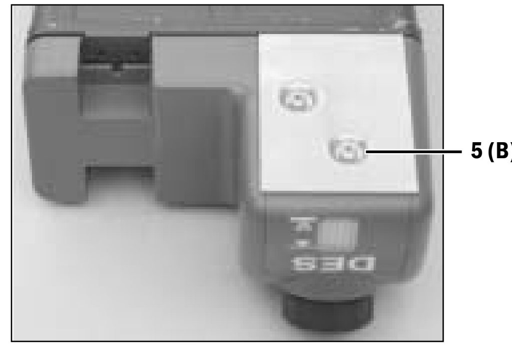
(**E**) - When replacing the sight glass (**Item 12**), orient it so that the rounded edge is facing down. Ensure that the two o-rings (**Item 14**) are seated before tightening the mounting screws (**Item 13**).

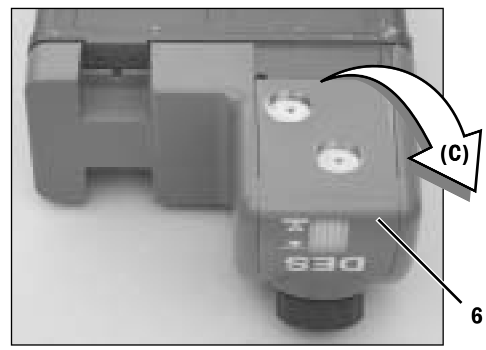
(**F**) - When replacing the filler cap (**Item 1**), thread the cord through the hole in the mask and tie a knot so that **at least 95 mm** of cord remain external.

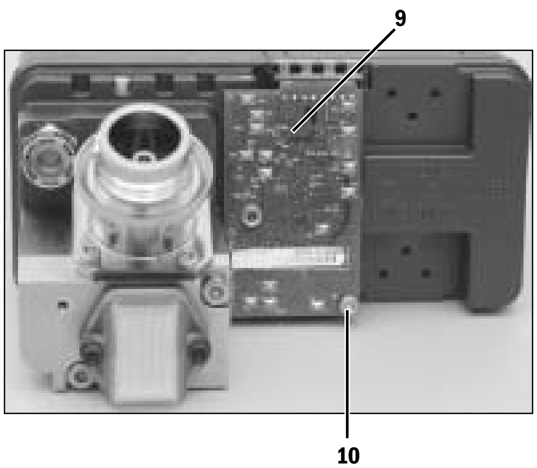
(**G**) - When replacing the label (**Item 6**), be sure to align the top of the label with the top edge of the recess in the mask (**Item 7**).

(**H**) - When reattaching the mask (**Item 7**), be sure that the contract retainer (**Item 11**) engages the slot in the mask.


1
3 (A)
2 (A)
DES
4


5 (B)


(C)
6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10


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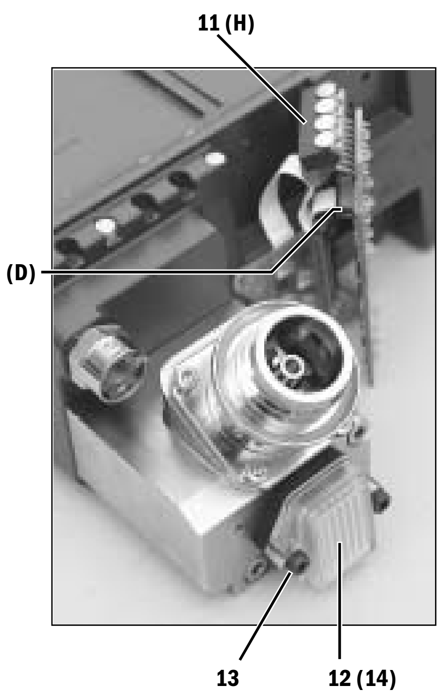
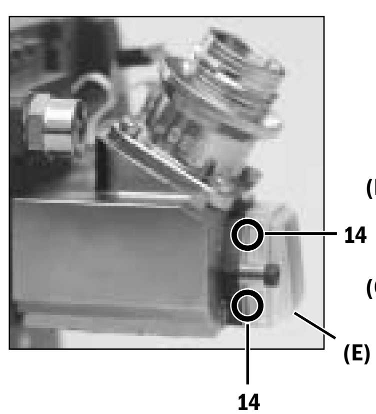
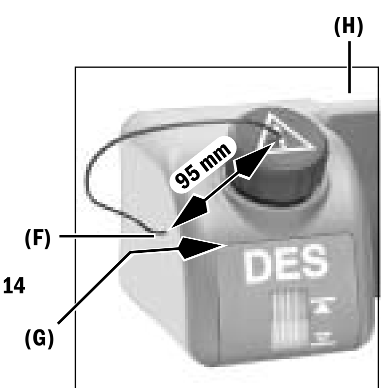

11 (H)
(D)
13
12 (14)


14
14
(E)


(H)
95 mm
(F)
(G)
DES

10.29 Anesthetic Gas Scavenging System — AGSS

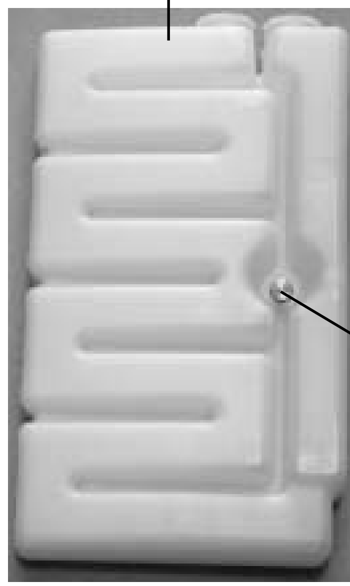
10.29.1 Passive AGSS

Items 1 through 12 are included in all AGSS kits.

Item	Description, Common Parts	Stock Number	Qty
1	Seal, Receiver Body	1407-3901-000	
2	Reservoir	1407-3903-000	
3	Seal and scavenging down-tube	1407-3904-000	
4	Thumbscrew, M6x28.5	1406-3305-000	
5	O-ring, 4.42 ID, 9.65 OD	1407-3923-000	(2)
6	Thumbscrew, M6x43	1406-3304-000	
7	Valve, unidirectional (negative pressure relief)	1406-8219-000	
7a	Seat, Valve, Negative Pressure	1406-3396-000	
7b	Retainer, disc	1400-3017-000	
*7c	O-ring, 20.35 ID, 23.90 OD	1406-3397-000	
7d	Disc, check-valve	0210-5297-100	
8*	O-ring, 22 ID, 30 OD silicone	1407-3104-000	(2)
9*	O-ring, 21.95 ID, 25.51 OD	1406-3558-000	
10	Screw, M4x8	9211-0640-083	(2)
11	Cap, 3.18 Barb, Silicone	1406-3524-000	
12	Adapter, auxiliary inlet, 30-mm male to 30-mm male	M1003134	
13	Adapter, auxiliary inlet, 30-mm male to 19-mm male	M1003947	
Passive AGSS Specific Parts			
14	Receiver, Passive/Adjustable	1407-3908-000	
15	Plug Assembly, tethered	1407-3909-000	(2)
16	Screw, shoulder M3	1407-3915-000	
17	Connector, 30-mm ISO, Male	1406-3555-000	
18	Adapter, scavenging, 30-mm female to 19-mm male	1500-3376-000	(5 pack)

* Lubricate sparingly with Krytox


1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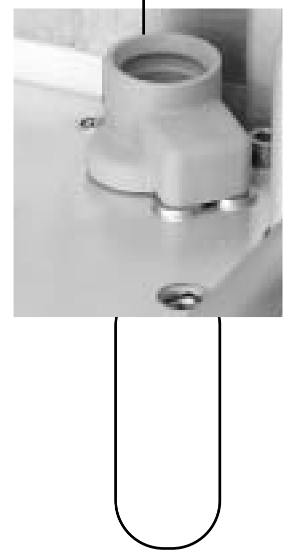
6 (5)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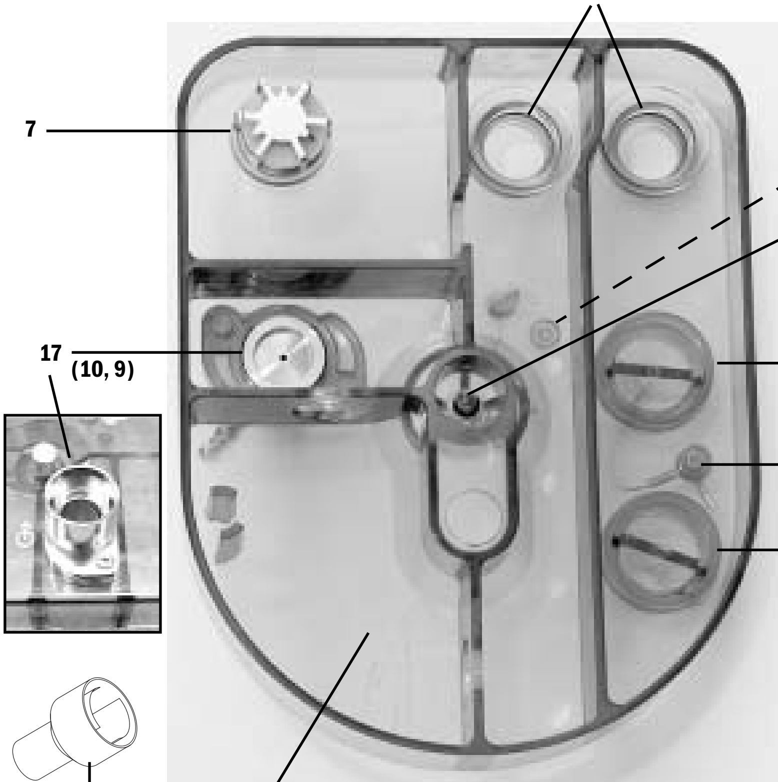
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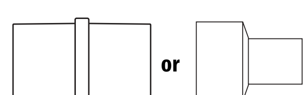
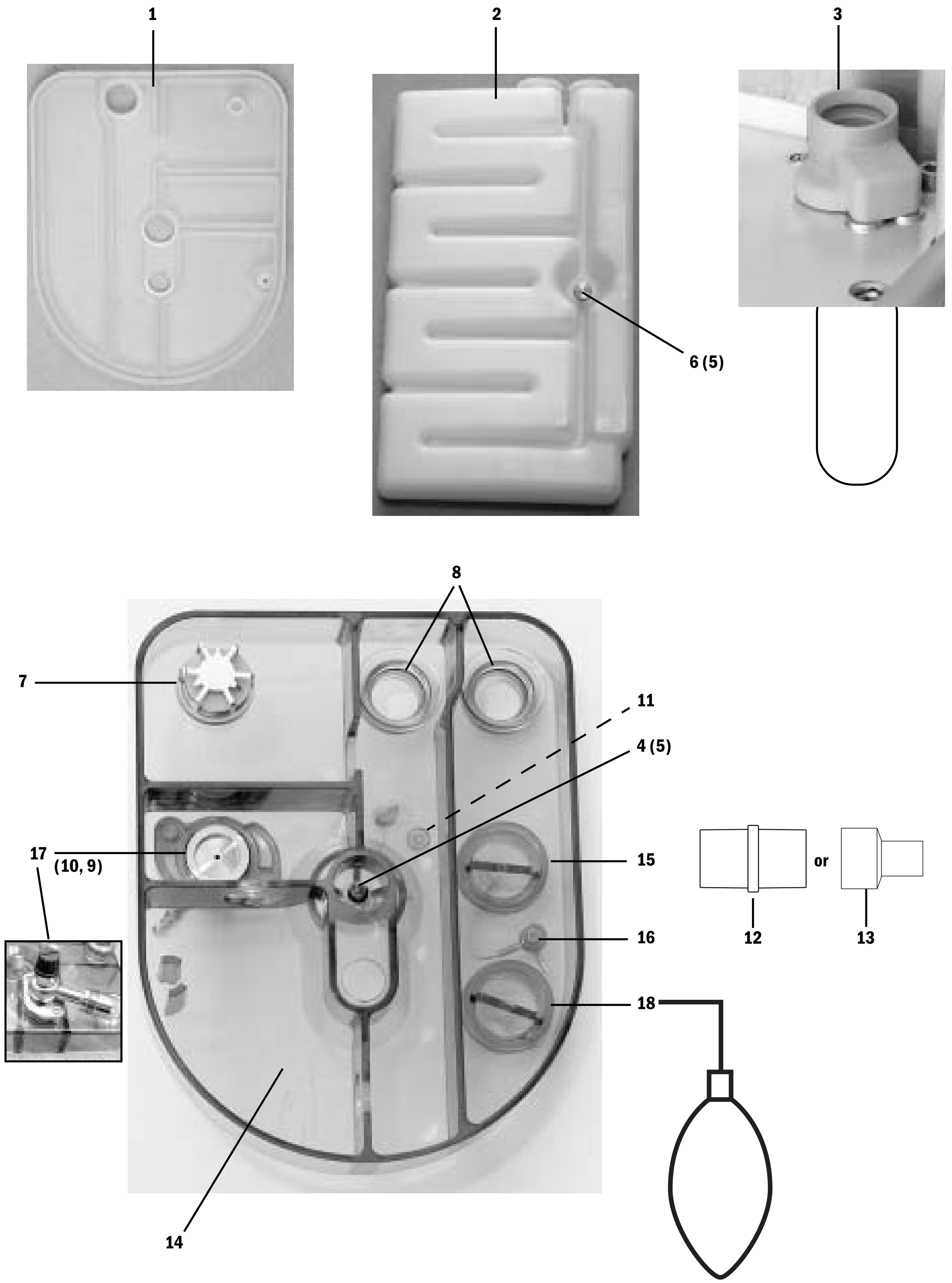

or
12
13

10.29.2 Adjustable AGSS

Items 1 through 12 are included in all AGSS kits.

Item	Description, Common Parts	Stock Number	Qty
1	Seal, Receiver Body	1407-3901-000	
2	Reservoir	1407-3903-000	
3	Seal and scavenging down-tube	1407-3904-000	
4	Thumbscrew, M6x28.5	1406-3305-000	
5	O-ring, 4.42 ID, 9.65 OD	1407-3923-000	(2)
6	Thumbscrew, M6x43	1406-3304-000	
7	Valve, unidirectional (negative pressure relief)	1406-8219-000	
7a	Seat, Valve, Negative Pressure	1406-3396-000	
7b	Retainer, disc	1400-3017-000	
*7c	O-ring, 20.35 ID, 23.90 OD	1406-3397-000	
7d	Disc, check-valve	0210-5297-100	
8*	O-ring, 22 ID, 30 OD silicone	1407-3104-000	(2)
9*	O-ring, 21.95 ID, 25.51 OD	1406-3558-000	
10	Screw, M4x8	9211-0640-083	(2)
11	Cap, 3.18 Barb, Silicone	1406-3524-000	
12	Adapter, auxiliary inlet, 30-mm male to 30-mm male	M1003134	
13	Adapter, auxiliary inlet, 30-mm male to 19-mm male	M1003947	
Adjustable AGSS Specific Parts			
14	Receiver, Passive/Adjustable	1407-3908-000	
15	Plug Assembly, tethered	1407-3909-000	
16	Screw, shoulder M3	1407-3915-000	
17	Needle Valve Assembly (with DISS EVAC connector)	1407-3918-000	
18	Bag with 30 mm male connector	8004460	

* Lubricate sparingly with Krytox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or
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10.29.3 Active AGSS

Items 1 through 12 are included in all AGSS kits.

Item	Description, Common Parts	Stock Number	Qty
1	Seal, Receiver Body	1407-3901-000	
2	Reservoir	1407-3903-000	
3	Seal and scavenging down-tube	1407-3904-000	
4	Thumbscrew, M6x28.5	1406-3305-000	
5	O-ring, 4.42 ID, 9.65 OD	1407-3923-000	(2)
6	Thumbscrew, M6x43	1406-3304-000	
7	Valve, unidirectional (negative pressure relief)	1406-8219-000	
7a	Seat, Valve, Negative Pressure	1406-3396-000	
7b	Retainer, disc	1400-3017-000	
*7c	O-ring, 20.35 ID, 23.90 OD	1406-3397-000	
7d	Disc, check-valve	0210-5297-100	
8*	O-ring, 22 ID, 30 OD silicone	1407-3104-000	(2)
9*	O-ring, 21.95 ID, 25.51 OD	1406-3558-000	
10	Screw, M4x8	9211-0640-083	(2)
11	Cap, 3.18 Barb, Silicone	1406-3524-000	
12	Adapter, auxiliary inlet, 30-mm male to 30-mm male	M1003134	
13	Adapter, auxiliary inlet, 30-mm male to 19-mm male	M1003947	

Active AGSS Specific Parts

14	Receiver, with air brake	1407-3900-000	
15	Seal, for filter and orifice	1407-3902-000	(2)
16	Filter	1406-3521-000	

Active High Flow Specific Parts

17a	Connector, high flow M30 thread	1406-3557-000
18	Orifice, high flow	1407-3920-000

Active Low Flow with EVAC connector Specific Parts

17b	Connector, low flow EVAC	1406-3597-000
18	Orifice, low flow	1407-3919-000

Active Low Flow with 25 mm connector Specific Parts

17c	Connector, low flow 25 mm	1406-3573-000
18	Orifice, low flow	1407-3919-000

Active Low Flow with 12.7 mm hose barb connector Specific Parts

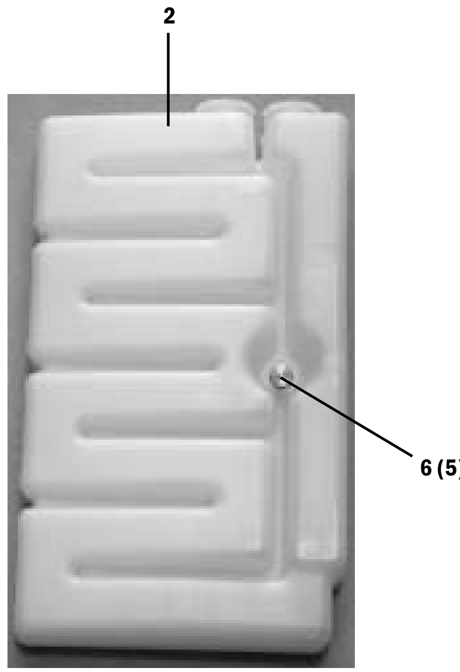
17d	Connector, low flow 12.7 mm (1/2 inch)	1406-3574-000
18	-none-	

Active Low Flow with 30 mm ISO male connector Specific Parts

17e	Connector, low flow 25 mm	1406-3555-000
18	Orifice, low flow	1407-3919-000

* Lubricate sparingly with Krytox


1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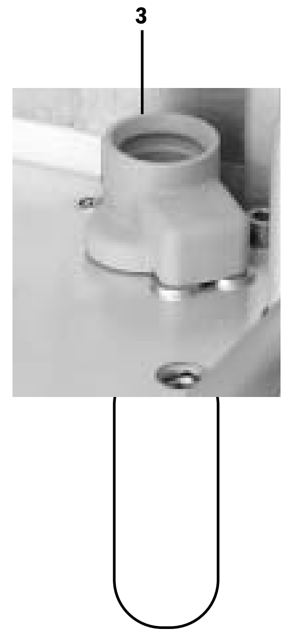
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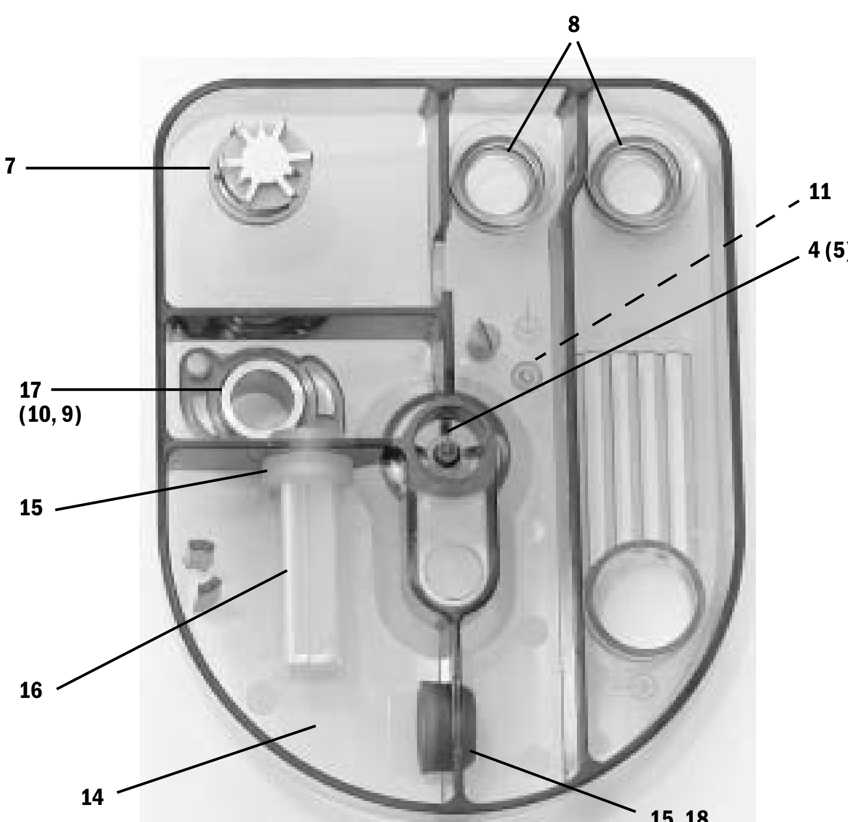
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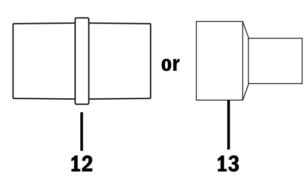
or
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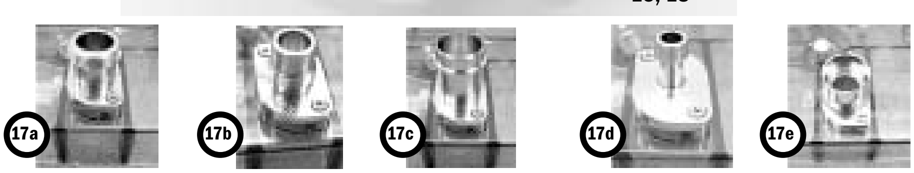
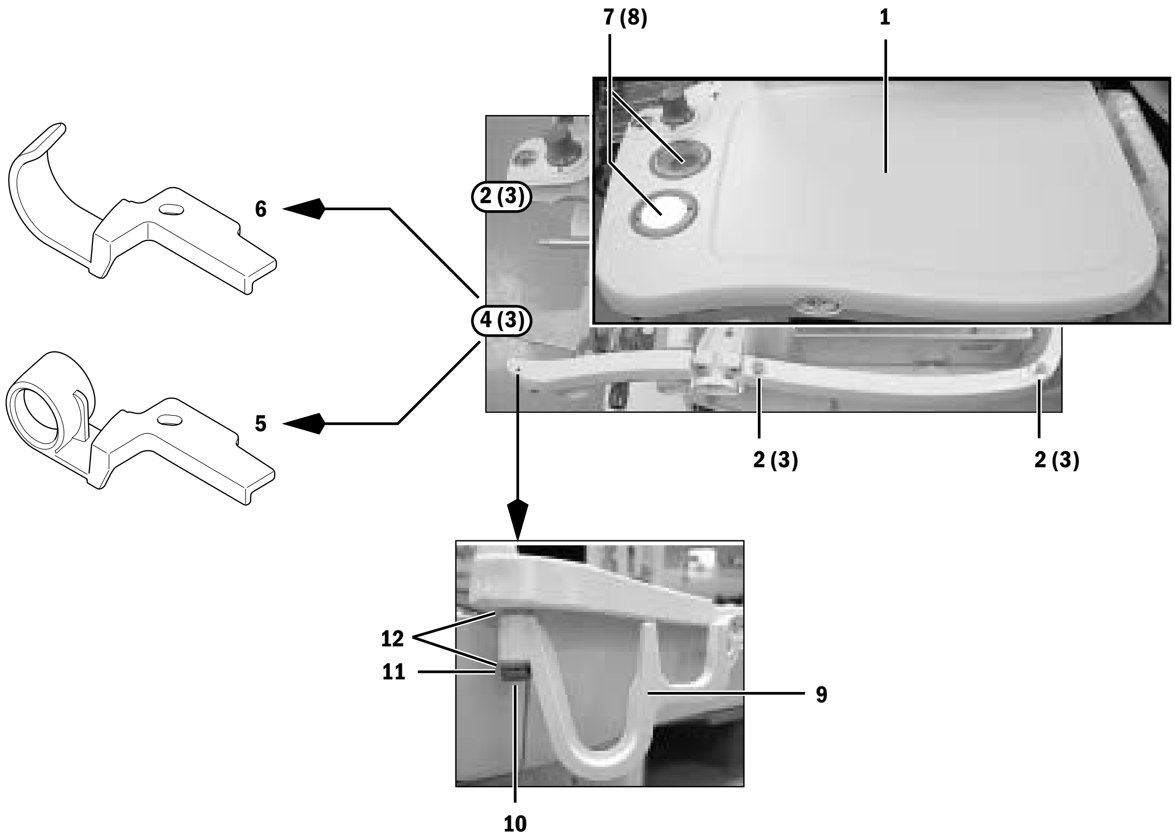
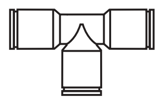
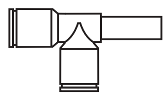
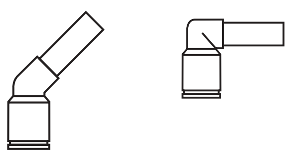
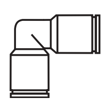
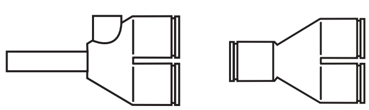
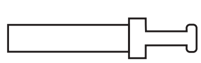

17a
17b
17c
17d
17e

10.30 Tabletop components



Item	Description	Stock Number
1	Tabletop, work surface	1011-3255-000
2	Screw, M4x12 relieved	1504-3001-000
3	Washer, M4 retainer Nylon	1009-3178-000
4	Screw, relieved M4x16	1011-3980-000
5	Clip (used with bag arm)	1009-3142-000
6	Clip (used with bag on hose)	1009-3139-000
7	Window, check-valve	1009-3088-000
8	Palnut	1009-3090-000
9	Hook, breathing circuit	1009-3086-000
10	Bolt, shoulder	1009-3172-000
11	Washer, wave	1009-3035-000
12	Washer, Nylon	1009-3150-000

10.31 Legris quick-release fittings

Item	Description	Stock Number
 1	**Tees — (tube/tube/tube)**	
	4 mm (N_2O)	1202-3653-000
	6 mm (O_2)	1006-3544-000
	8 mm (Air)	1006-3545-000
	8 mm/6 mm/8 mm (SCGO pilot)	1009-3297-000
 2	**Tees — (tube/tube/standpipe)**	
	6 mm (O_2)	1006-3862-000
	8 mm (Air - Drive gas)	1009-3370-000
 3	**Elbow — (tube/standpipe)**	
	4 mm (N_2O)	1006-3533-000
	6 mm (O_2)	1006-3534-000
	8 mm (Air)	1006-3535-000
	1/4 inch (mixed gas)	1006-3737-000
	1/4 inch (45° - mixed gas)	1009-3368-000
 4	**Elbow — (tube/tube)**	
	1/4 inch (mixed gas)	1202-3804-000
 5	**Y**	
	6 mm (O_2)	1009-3043-000
	8 mm (Air)	1009-3044-000
	8 mm Y with tailpiece	1009-3360-000
 6	**Plug**	
	4 mm (N_2O)	1006-3530-000
	6 mm (O_2)	1006-3531-000
	8 mm (Air)	1006-3532-000

Note: Not every fitting is used in all machines.

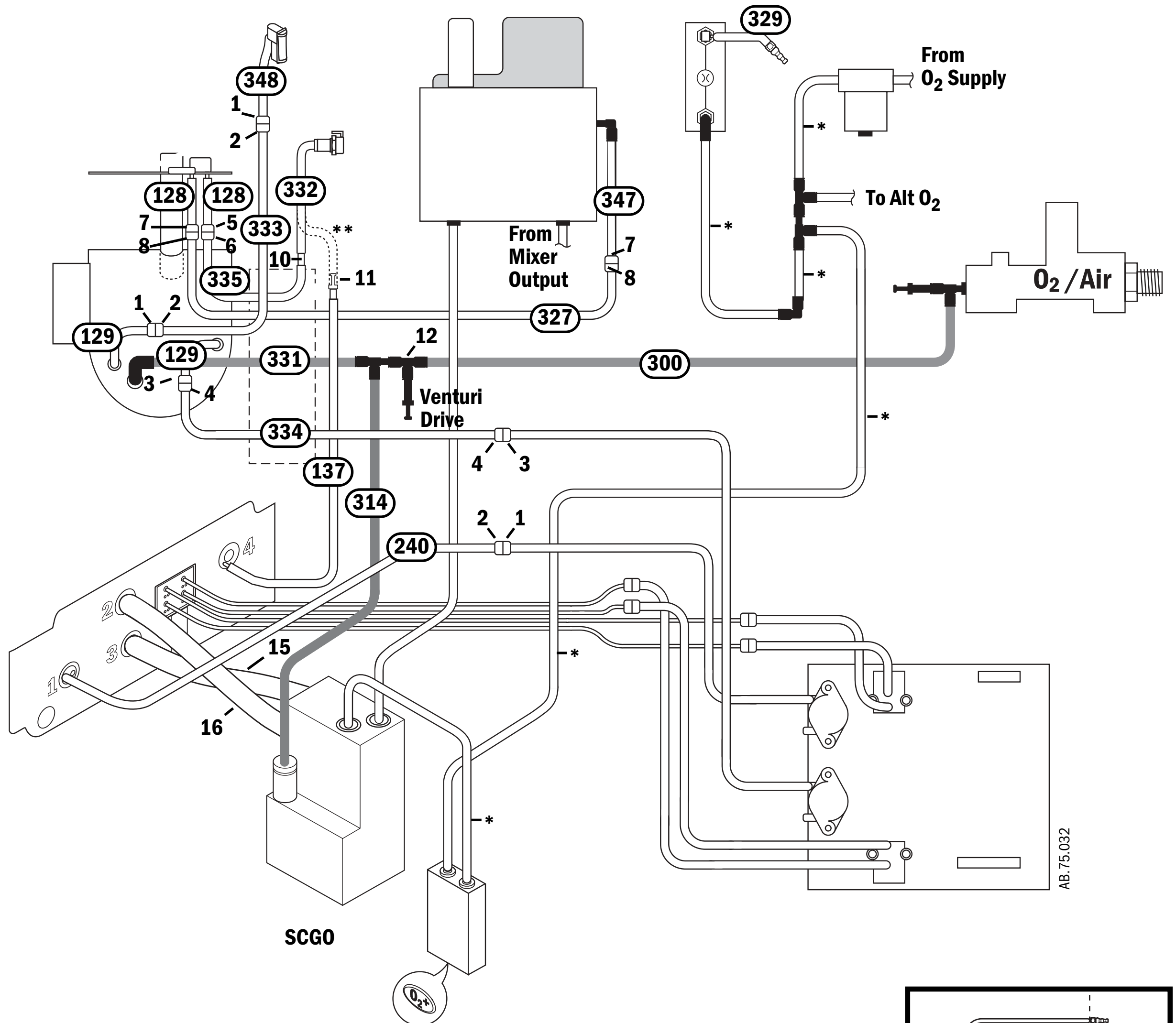
10.32 Vent Drive and low-pressure tubing

Item	Description	Length — Size	Stock Number
1	Coupler, female - black		1503-3128-000
2	Coupler, male - black		1503-3237-000
3	Coupler, female - white		1503-3119-000
4	Coupler, male - white		1503-3236-000
5	Coupler, female - yellow		1503-3132-000
6	Coupler, male - yellow		1407-3330-000
7	Coupler, female - blue		1503-3130-000
8	Coupler, male - blue		1407-3331-000
9	Tee (male barb)		1009-3011-000
10	Fitting, coupler barb ends		1009-3077-000
11	Plug, 4-mm		1006-3530-000
12	Tee (8mm/6mm/8mm)		1009-3297-000
13	Tubing (silicone)	72 mm - 3/8 inch	1009-3164-000
14	Tubing (silicone)	62 mm - 3/8 inch	1009-3164-000
15	Tubing (silicone)	70 mm - 3/8 inch	1009-3164-000
16	Tubing (silicone)	70 mm - 3/8 inch	1009-3164-000

	Tube Markings (factory build only)		Length — Size	
128	unmarked	(low-pressure)	300 mm - 1/4 inch	1605-1001-000
129	unmarked	(low-pressure)	151 mm - 1/4 inch	1605-1001-000
134	unmarked	(low-pressure)	25 mm - 1/4 inch	1605-1001-000
135	unmarked	(low-pressure)	50 mm - 1/4 inch	1605-1001-000
137	RGM to Circuit	(low-pressure)	300 mm - 1/4 inch	1605-1001-000
240	PAW	(low-pressure)	500 mm - 1/4 inch	1605-1001-000
300	VENT DRIVE	(black)	360 mm - 8 mm	1009-3296-000
314	unmarked	(black)	550 mm - 6 mm	1009-3295-000
315	unmarked		60 mm - 8 mm	1001-3063-000
316	unmarked		270 mm - Tygon	6700-0005-300
317	unmarked		470 mm - Tygon	6700-0005-300
318	unmarked		690 mm - Tygon	6700-0005-300
321	unmarked	(black)	640 mm - 8 mm	1009-3296-000
322	unmarked	(black)	235 mm - 4 mm	1009-3363-000
323	unmarked	(black)	110 mm - 4 mm	1009-3363-000
327	VAP SCAV B/S SCAV	(blue)	940 mm - 1/4 inch	1011-3905-000
329	unmarked	(clear)	140 mm - 1/8 inch	0994-6370-000
331	VENT DRIVE	(black)	430 mm - 8 mm	1009-3296-000
332	M GAS SCAV B/S SCAV	(low-pressure)	550 mm - 1/4 inch	1605-1001-000
333	B/S SCAV AGSS FLWMTR	(low-pressure)	500 mm - 1/4 inch	1605-1001-000
334	B/S PEEP PORT VIB	(low-pressure)	500 mm - 1/4 inch	1605-1001-000
335	M GAS SCAV B/S SCAV	(low-pressure)	200 mm - 1/4 inch	1605-1001-000
340	unmarked		40 mm - 8 mm	1001-3063-000
347	unmarked	(blue)	50 mm - 1/4 inch	1011-3905-000
348	unmarked	(low-pressure)	110 mm - 1/4 inch	1605-1001-000

* Refer to section 10.35

** Sample gas return is directed to the scavenging system as a factory default. A qualified service representative can reroute the sample gas back to the breathing system (refer to Section 9.21).


329
From
O_2 Supply
348
1
2
128
128
332
347
7
5
333
8
6
**
10
11
335
From
Mixer
Output
7
8
To Alt O_2
O_2 / Air
1
2
327
129
129
331
12
300
3
4
Venturi
Drive
334
4
3
137
314
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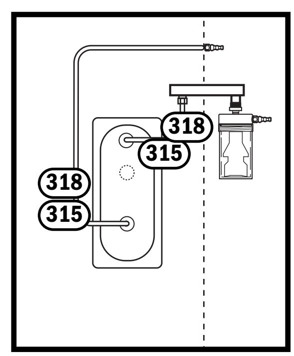
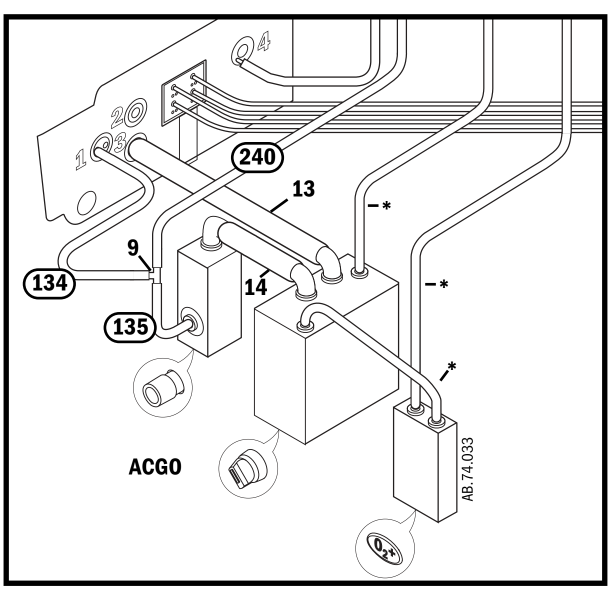
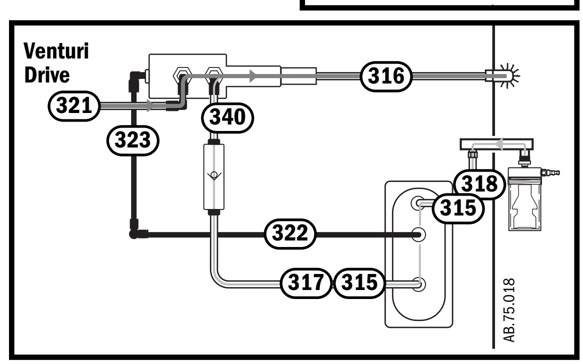
SCGO
AB.75.032


318
315
318
315

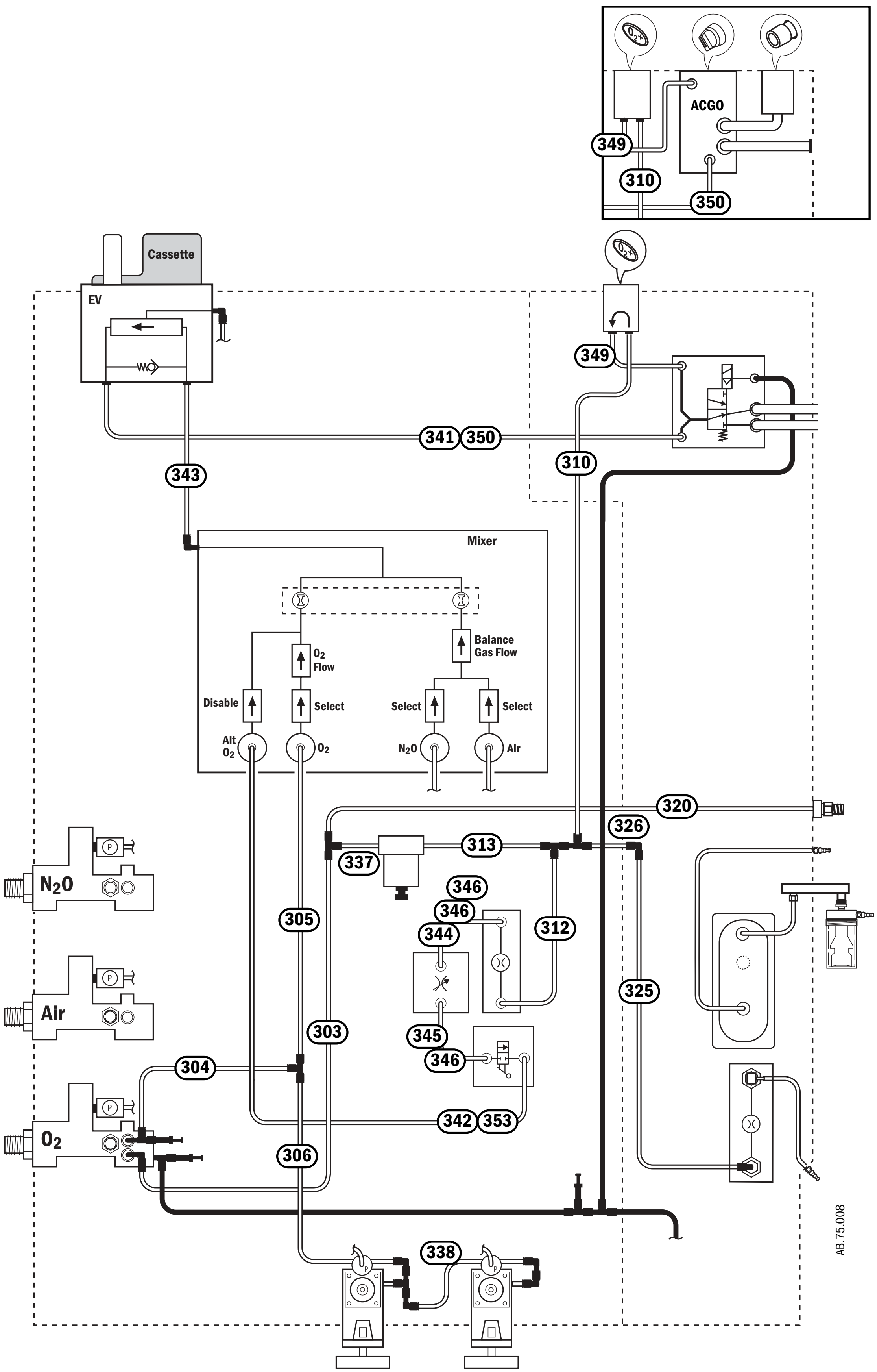

240
13
9
14
134
135
ACGO
AB.74.033


Venturi
Drive
316
321
340
323
318
315
322
317
315
AB.75.018

10.33 Tubing for use with Legris fittings (O_2 supplies)

This tubing is a flexible, Nylon-type tubing for use with quick-release fittings.

Item	Description	Length — Size	Stock Number
	Tube Markings (factory build only)		
303	unmarked	200 mm - 6 mm	1001-3062-000
304	unmarked	150 mm - 6 mm	1001-3062-000
305	unmarked	110 mm - 6 mm	1001-3062-000
306	unmarked	120 mm - 6 mm	1001-3062-000
306	unmarked	120 mm - 6 mm	1001-3062-000
310	unmarked	310 mm - 6 mm	1001-3062-000
312	ALT O2 FLOWMETER TEE	620 mm - 6 mm	1001-3062-000
313	unmarked	140 mm - 6 mm	1001-3062-000
320	unmarked	420 mm - 6 mm	1001-3062-000
325	unmarked	130 mm - 6 mm	1001-3062-000
326	unmarked	80 mm - 6 mm	1001-3062-000
337	unmarked	45 mm - 6 mm	1001-3062-000
338	unmarked	130 mm - 6 mm	1001-3062-000
341	A/SCGO FG VAP OUT	600 mm - 1/4 inch	1001-3064-000
342	SWITCH PORT 4 ALT O2 IN	500mm - 6 mm	1001-3062-000
343	MIXER OUT VAP IN	660 mm - 1/4 inch	1001-3064-000
344	unmarked	40 mm - 6 mm	1001-3062-000
345	unmarked	55 mm - 6 mm	1001-3062-000
346	unmarked	60 mm - 6 mm	1001-3062-000
349	unmarked	130 mm - 1/4 inch	1001-3064-000
350	unmarked	170 mm - 1/4 inch	1001-3064-000
353	unmarked	75 mm - 6 mm	1001-3062-000



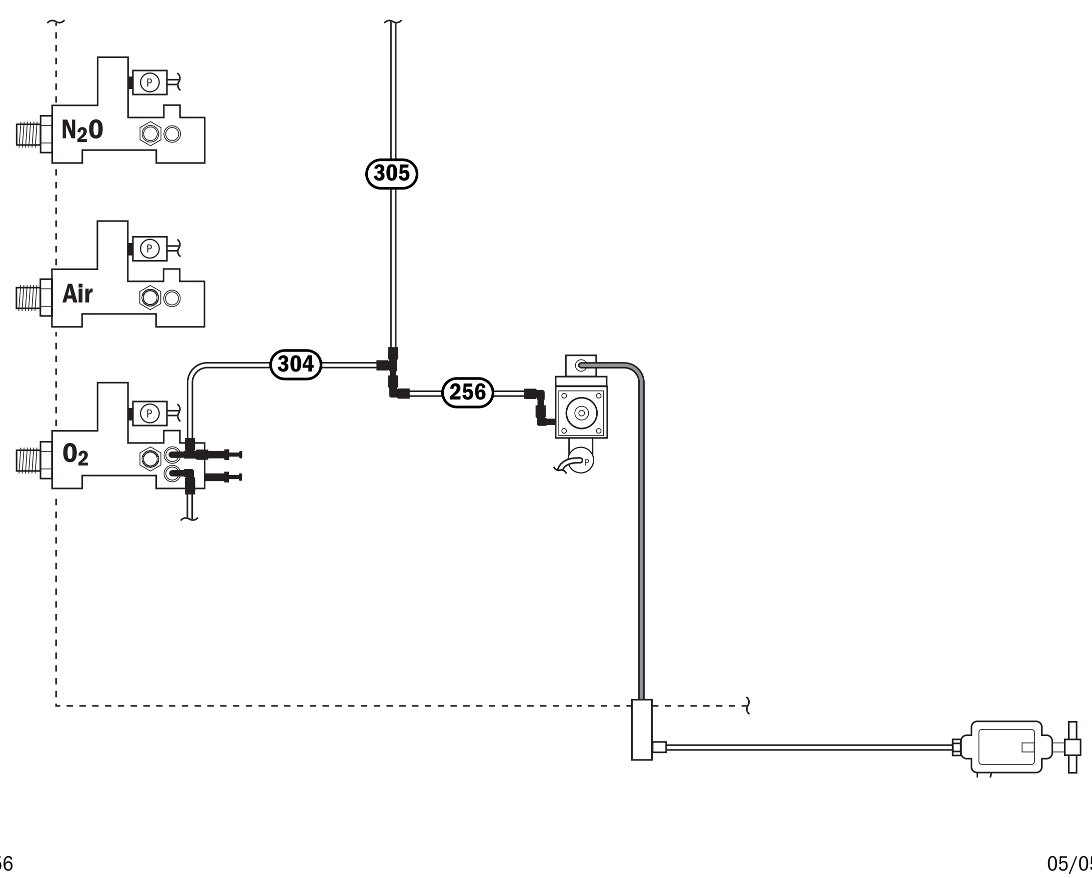
ACGO
349
310
350
Cassette
EV
349
341
350
310
343
Mixer
O_2 Flow
Balance Gas Flow
Disable
Select
Select
Select
Alt O_2
O_2
N_2O
Air
320
326
313
337
346
346
344
312
305
325
303
345
346
304
342
353
306
338
N_2O
Air
O_2
AB.75.008

10.34 Tubing for use with Legris fittings (3rd cylinder)

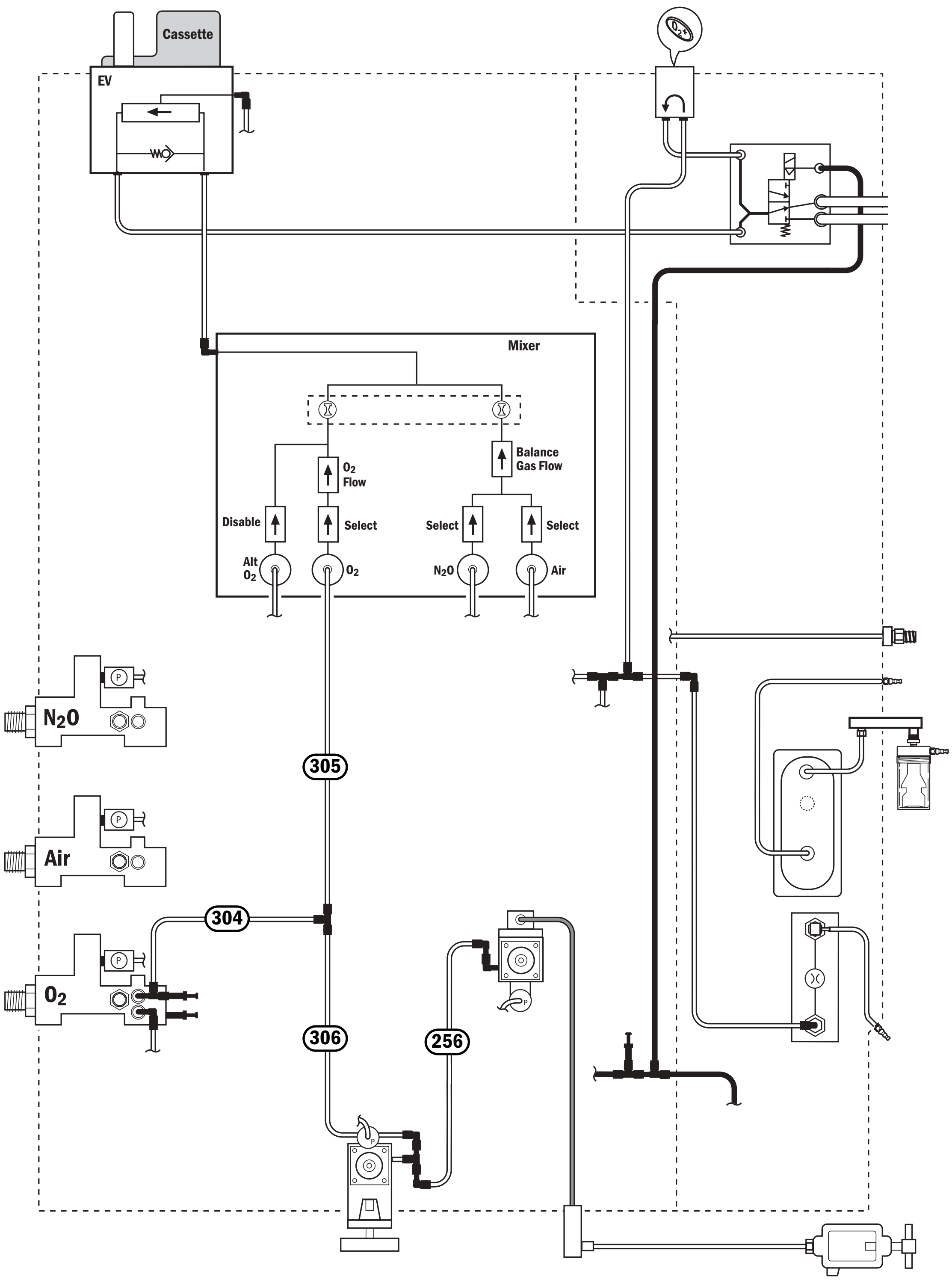
This tubing is a flexible, Nylon-type tubing for use with quick-release fittings.

Item	Description	Length — Size	Stock Number
	Tube Markings (factory build only)		
256	unmarked	150 mm - 6 mm	1001-3062-000
304	unmarked	150 mm - 6 mm	1001-3062-000
305	unmarked	110 mm - 6 mm	1001-3062-000
306	unmarked	120 mm - 6 mm	1001-3062-000

Single O_2 - Third Cylinder



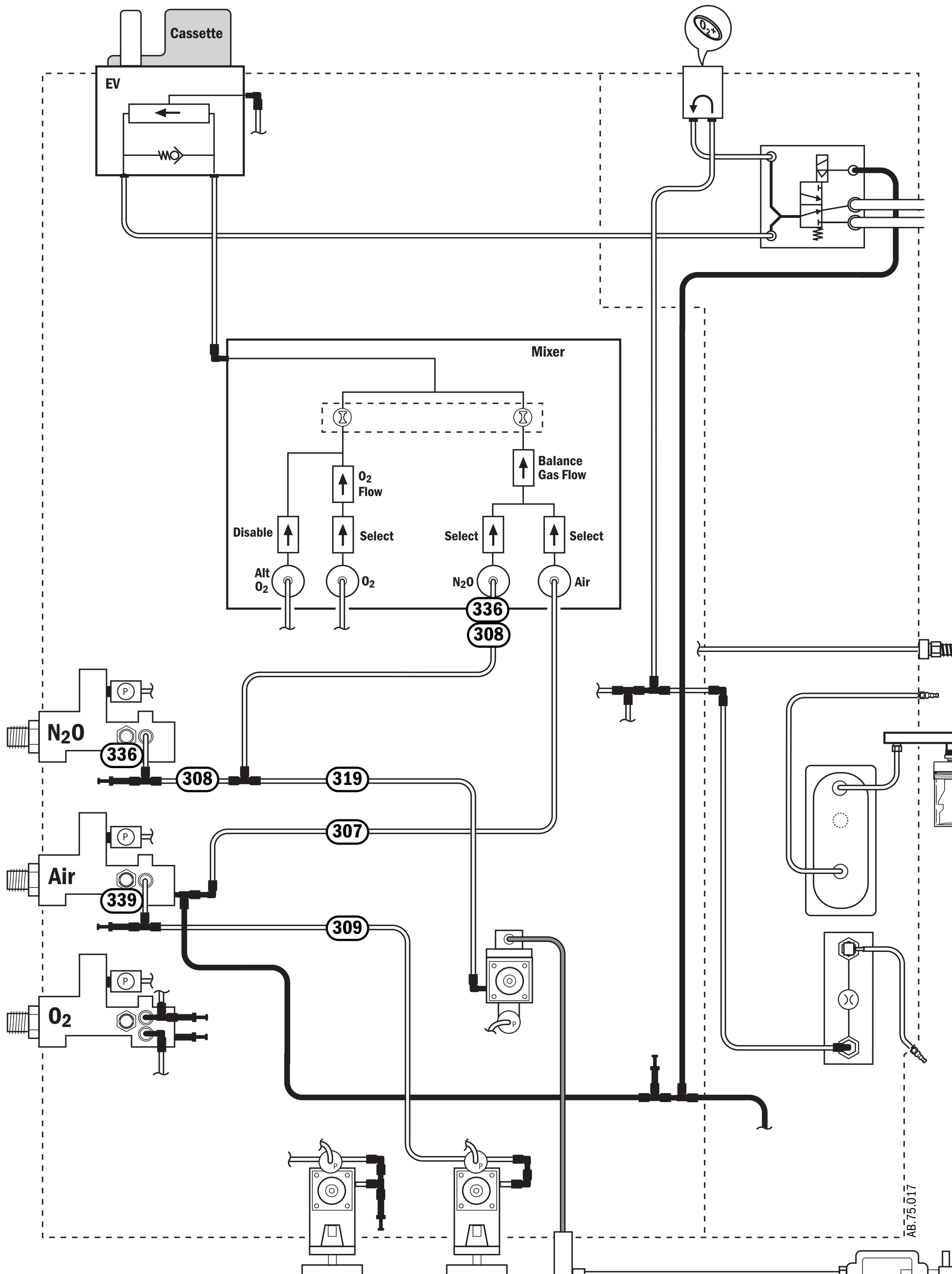
Single O_2 - Third Cylinder



10.35 Tubing for use with Legris fittings (Air and N_2O supplies)

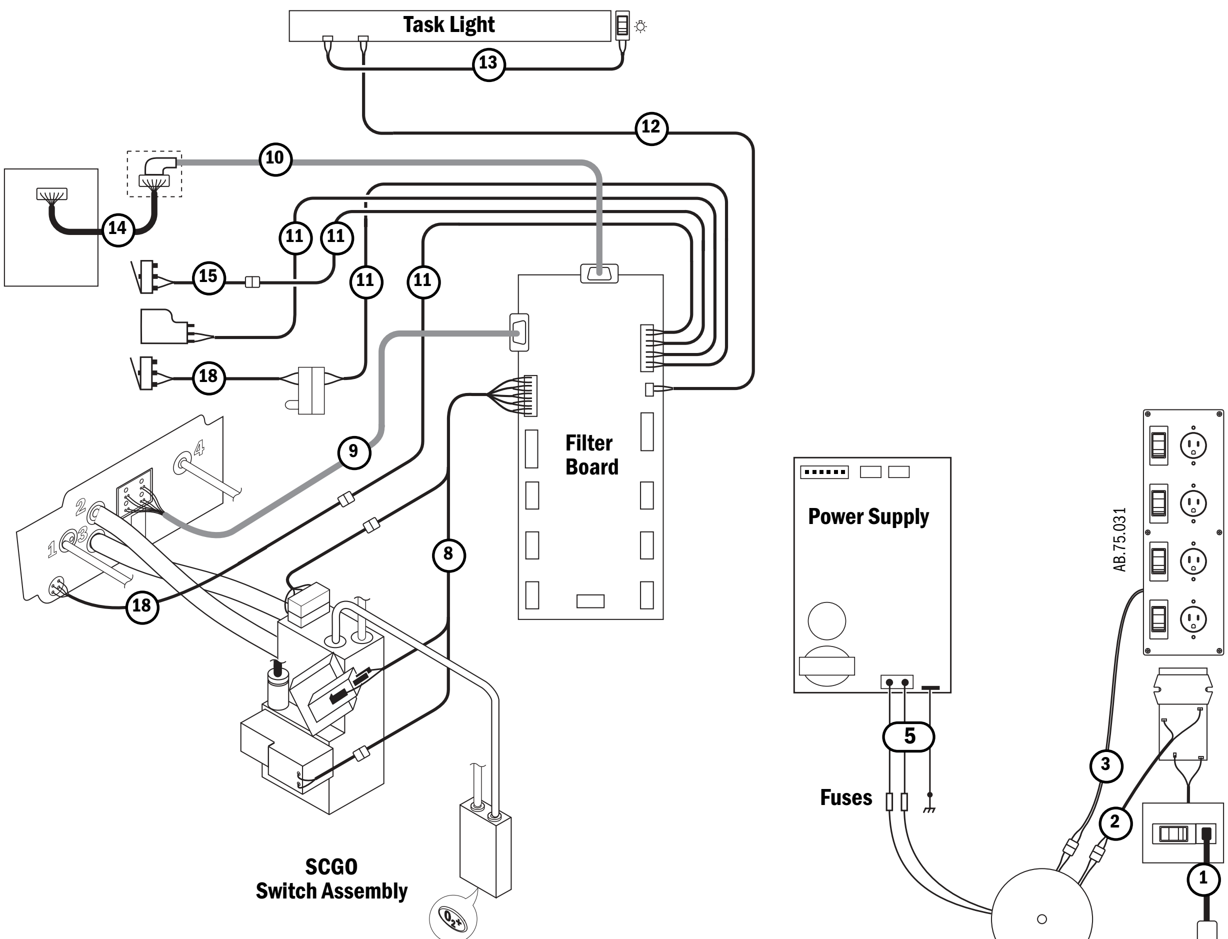
This tubing is a flexible, Nylon-type tubing for use with quick-release fittings.

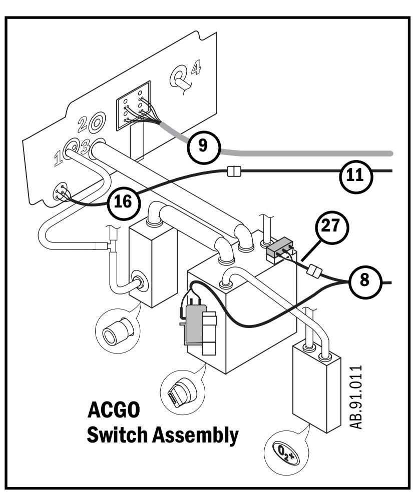
Item	Description	Length — Size	Stock Number
	Tube Markings (factory build only)		
307	unmarked	200 mm - 8 mm	1001-3063-000
308	unmarked	230 mm - 4 mm	1001-3060-000
309	unmarked	440 mm - 8 mm	1001-3063-000
319	unmarked	310 mm - 4 mm	1001-3060-000
336	unmarked	40 mm - 4 mm	1001-3060-000
339	unmarked	40 mm - 8 mm	1001-3063-000


Cassette
EV
Mixer
Balance
Gas Flow
O2
Flow
Disable
Select
Select
Select
Alt
O2
O2
N2O
Air
336
308
N2O
336
308
319
307
Air
339
309
O2
AB.75.017

10.36 Cables and harnesses

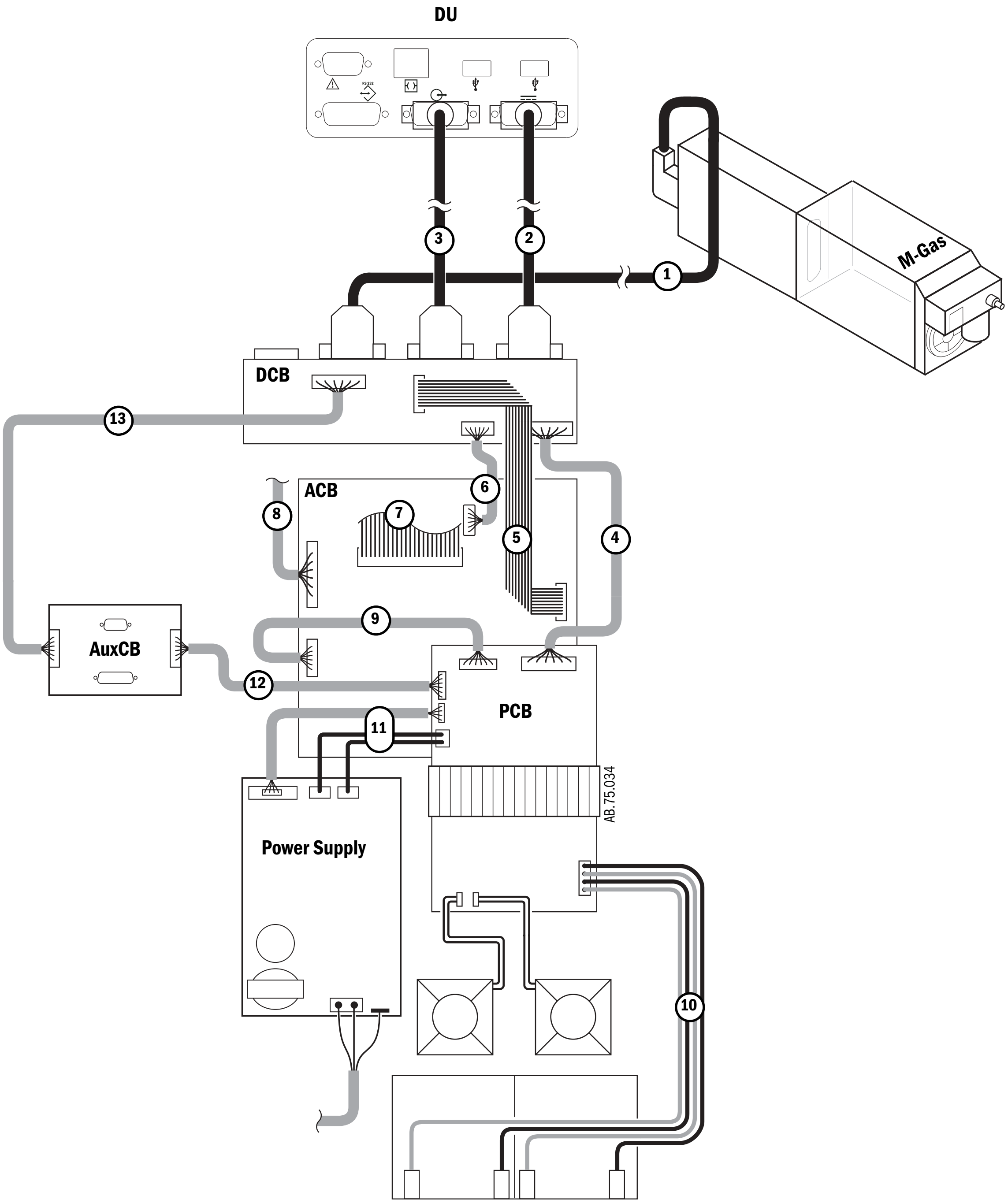
Item	Description	Stock Number
1	Power Cord	Refer to section 10.5
2	Harness, 100/120 V to Toroid Harness, 220/240 V to Toroid	1011-3538-000 1011-3539-000
3	Harness, to 100/120 V outlets Harness, to 220/240 V outlets	1011-3526-000 1011-3527-000
5	Harness, Fuse block to Power Supply	1011-3581-000
8	Harness, Filter Board to SCGO/ACGO	1009-5528-000
9	Harness, Filter Board to ABS flow sensors (includes tubing)	1009-8223-000
10	Cable, Filter Board to Vent Engine harness connector	1009-5521-000
11	Harness, Filter Board to O_2 Cell and ABS switches	1009-5531-000
12	Harness, Filter Board to Task Light	1011-3400-000
13	Harness, Task Light switch	1011-3545-000
14	Harness, Vent Engine Board	1009-5545-000
15	Harness, Bag/Vent switch to Filter Board harness	1009-5585-000
16	Harness, O_2 Cell to Filter Board harness	1009-5586-000
17	Harness, ACGO switch to Filter Board harness	1009-5872-000
18	Harness, Canister Release switch (CO_2 Bypass)	1407-3144-000


Task Light
13
12
10
14
11
11
15
11
11
18
9
Filter
Board
8
18
SCGO
Switch Assembly
Power Supply
AB.75.031
5
Fuses
3
2
1


9
11
16
27
8
ACGO
Switch Assembly
AB.91.011

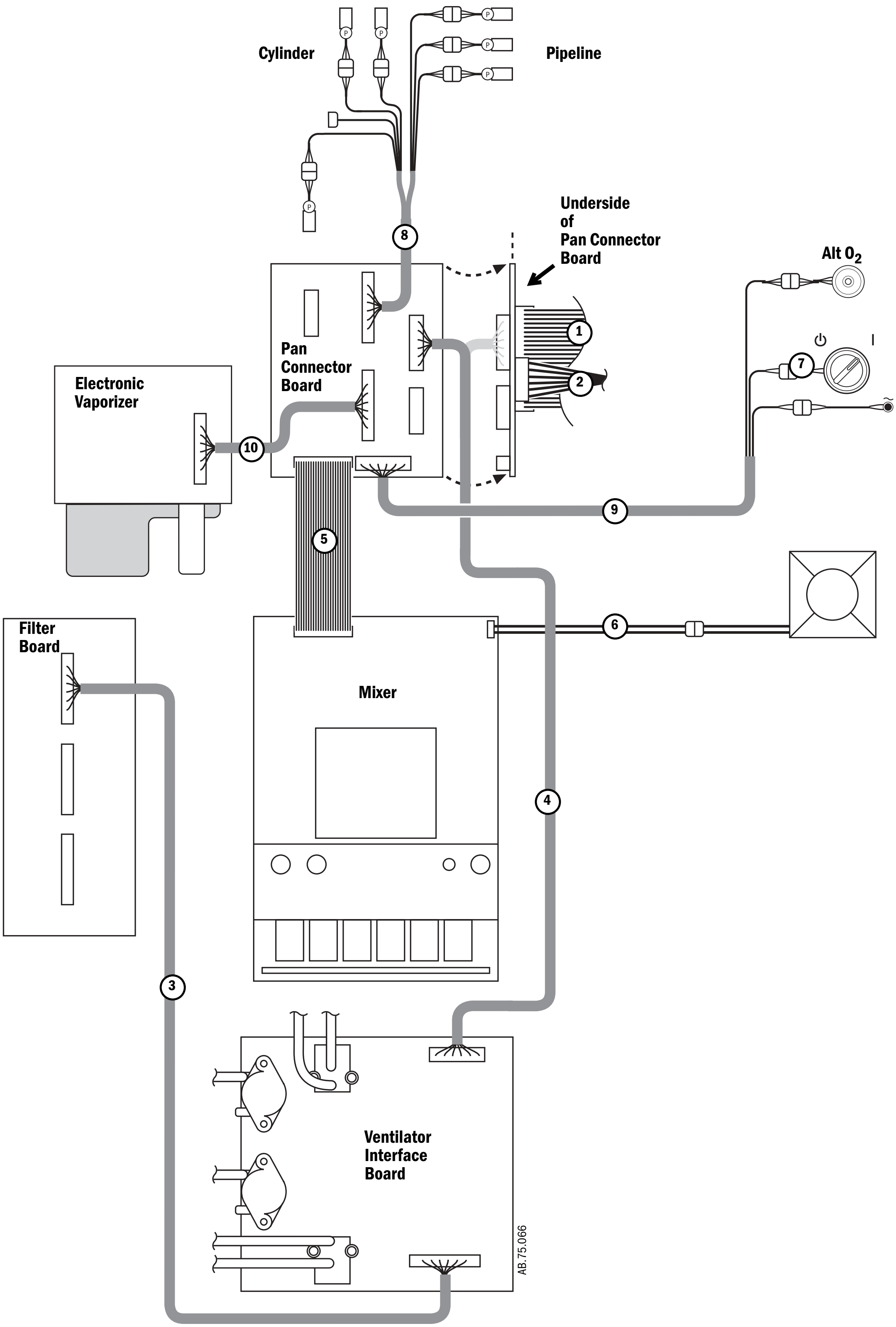
10.37 Cables and harnesses in lower electronic enclosure

Item	Description	Stock Number
1	Cable, to M-Gas (Airway module) power supply	1011-49-000
2	Cable, to Display Unit system power interface	1011-3547-000
3	Cable, to Display Unit system signal interface	1011-3548-000
4	Harness, J3-PCB to J5-DCB	1009-5552-000
5	Cable, ribbon J2-ACB to J9-DCB	1009-5561-000
6	Harness, J7-ACB to J6-DCB	1009-5556-000
7	Cable, ribbon J1-ACB to underside of Pan Connector Board	1011-3186-000
8	Harness, J3-ACB to underside of Pan Connector Board	1011-3199-000
9	Harness, J4-ACB to J4-PCB	1009-5551-000
10	Harness, (flex cable) battery	1011-3698-000
11	Harness, Power Supply to PCB	1011-3591-000
12	Harness, PCB to AuxCB	1011-3590-000
13	Harness, DCB to AuxCB	1011-3582-000

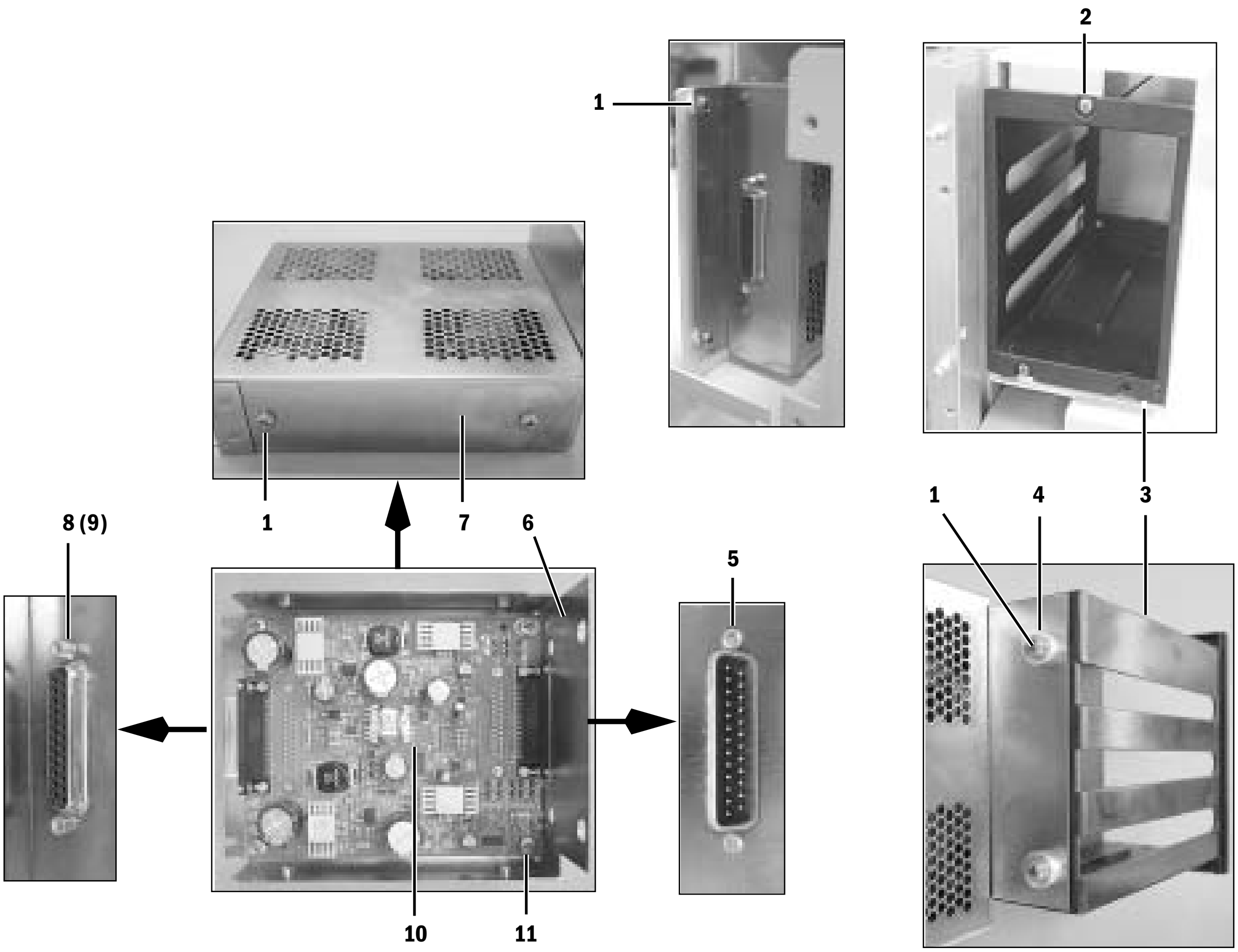

DU
M-Gas
DCB
ACB
AuxCB
PCB
Power Supply
1
2
3
4
5
6
7
8
9
10
11
12
13
AB.75.034

10.38 Cables and harnesses in Pan enclosure

Item	Description	Stock Number
1	Cable, ribbon J1-ACB to underside of Pan Connector board	1011-3186-000
2	Harness, J3-ACB to underside of Pan Connector board	1011-3199-000
3	Harness, Filter board to VIB	1011-3408-000
4	Harness, Pan Connector board to VIB	1009-5547-000
5	Cable, ribbon, Pan Connector board to Mixer	1011-3195-000
6	Harness, Pan Fan extension	1011-3561-000
7	Harness, On/Standby (System) switch	1009-5542-000
8	Harness, Pan Connector board to gas supply transducers	1011-3404-000
9	Harness, Pan Connector board to Alt O_2 and System switch	1011-3403-000
10	Harness, Pan Connector board to EV	1011-3108-000

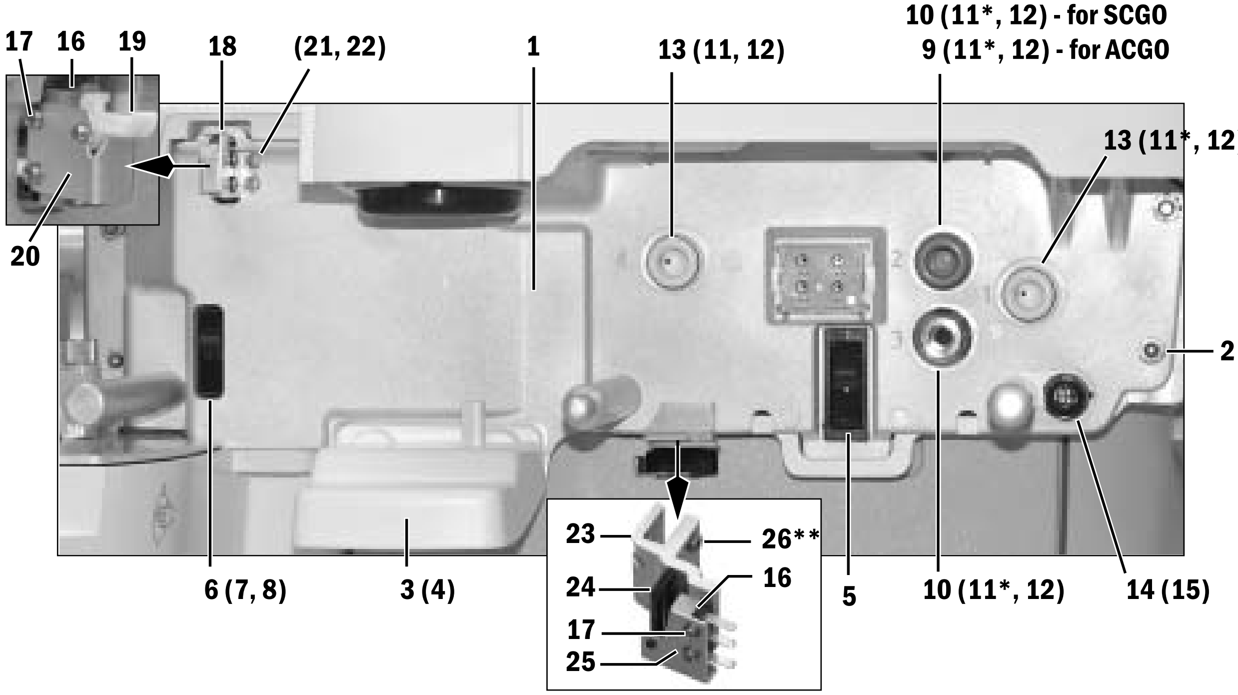

Cylinder
Pipeline
Underside
of
Pan Connector
Board
Alt O_2
8
1
2
7
Pan
Connector
Board
Electronic
Vaporizer
10
9
5
6
Filter
Board
Mixer
4
3
Ventilator
Interface
Board
AB.75.066

10.39 Airway module (M-Gas) components



Item	Description	Stock Number
1	Screw, M4x8	1006-3178-000
2	Screw, M3x8 PAN	9211-0430-083
3	Guide, MGAS module	1009-3072-000
4	Spacer	1011-3373-000
5	Screw, 4-40x3/8	0144-2117-206
6	Base, M-Gas power supply	1011-3350-000
7	Cover, M-Gas power supply	1011-3351-000
8	Standoff	1504-3007-000
9	Lockwasher, #4 split	0144-1104-331
10	Power Supply board, M-Gas	1011-3178-000
11	Screw, M4x8	0140-6226-113

10.40 Breathing system interface

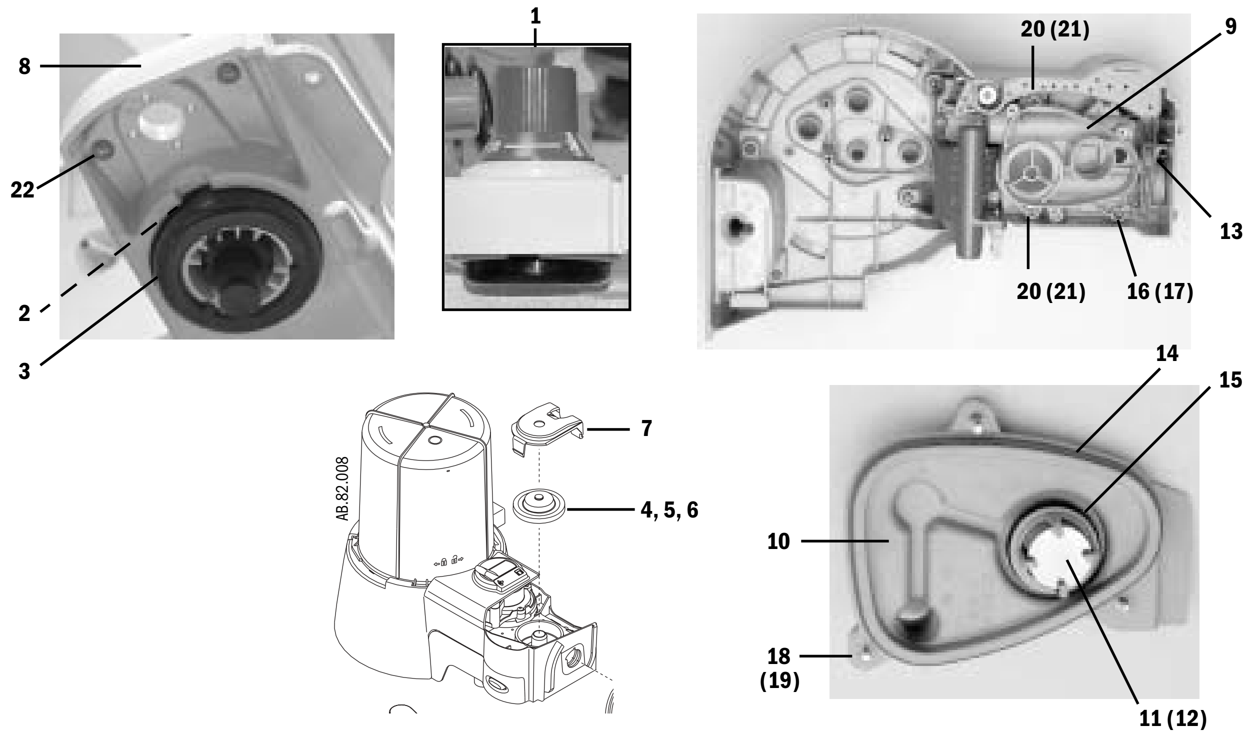


Item	Description	Stock Number	Qty
1	Assembly, main support casting	1407-7010-000	
2	Bolt, M6x16 flange	1009-3125-000	(5)
3	Handle, grip	1407-3317-000	
4	Screw, M6X16 Sems	0144-2436-109	(2)
5	Latch, push to close	1407-3309-000	
6	Latch, push to close w/microswitch	1407-3310-000	
7	Screw, SKT HD CAP M3x8 SST	1006-3865-000	(2)
8	Washer, lock external M3	9213-0530-003	(2)
9	Port, plug circuit	1407-3333-000	
10	Port, fresh gas	1407-3314-000	
11*	Seal, U-Cup 12.7 ID BCG 19.05 OD EPR	1407-3320-000	(4)
12	Ring, retaining 15.88 SHAFT DIA TYPE E SST	1406-3446-000	(4)
13	Port, sample gas	1407-3318-000	(2)
14	Connector, bulkhead O2 Cell, with harness	1009-5586-000	
15	Ring, retaining 9.53 SHAFT DIA TYPE E SST	1406-3277-000	
16	Switch, subminiature w/QDISC terminals	1406-3296-000	(2)
17	Screw, M2.5 x10	1009-3153-000	(4)
18	Bracket, BTV switch	1407-3319-000	
19	Lever, BTV switch	1407-3325-000	
20	Bracket, cap BTV	1407-3324-000	
21	Screw, SKT HD CAP M3x8 SST	1006-3865-000	(2)
22	Washer, lock external M3	9213-0530-003	(2)
23	Bracket, bypass switch	1407-3139-000	
24	Paddle, switch actuator	1407-3141-000	
25	Bracket, paddle hinge	1407-3140-000	
26**	Screw, M6x6 set cup	1007-3329-000	(2)

* Lubricate sparingly with Krytox.

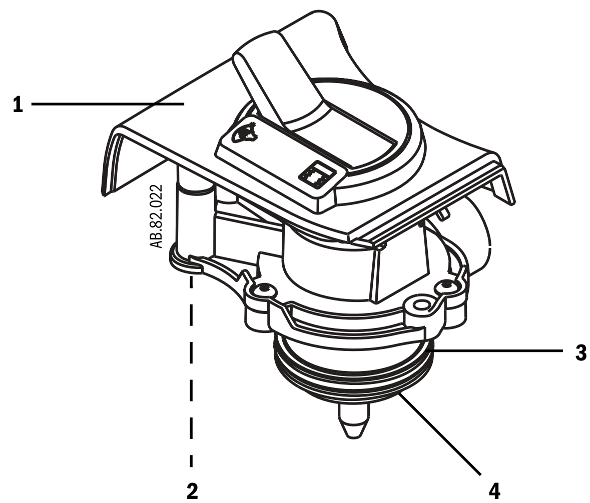
** Apply Loctite 242.

10.40.1 APL Valve



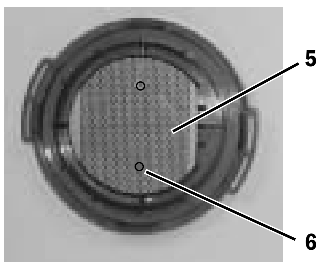
Item	Description	Stock Number	QTY
1	APL Valve Assy (includes items 2 through 6)	1009-8200-000	
2	SPRING CPRSN 53.14 OD 36.8 L 1.48 N/MM	1406-3328-000	
3	RETAINER SPRING APL	1407-3404-000	
4	DIAPHRAGM APL	1406-3331-000	
5	CAGE APL	1406-3333-000	
6	POPPET APL VALVE	1406-3332-000	
7	RAMP APL	1407-3400-000	
8	COVER APL	1407-3405-000	
9	MANIFOLD APL/BTV	1407-3401-000	
10	Cover, Manifold APL/BTV (with 22-mm male bag port)	1407-3402-000	
	Cover, Manifold APL/BTV (with Australian bag port - 22 mm female)	1407-3412-000	
11	WEIGHT DEAD 14CM H2O BCG ABS NEG RELIEF	1407-3406-000	
12	SEAL ABS NEG RELIEF VLV	1407-3407-000	
13	O-RING 22 ID 30 OD 4 W SI 40 DURO	1407-3104-000	
14	O-RING 88.49 ID 95.55 OD 3.53 W SILICONE 50 DURO	1407-3403-000	
15	O-RING 1.049ID 1.255OD .103W EPDM NO 121	1407-3408-000	
16	SCR M4X16 BT SKT HD SST TYPE 316	0140-6226-115	(2)
17	Lockwasher, M4 external	9213-0540-003	(2)
18	SCR THUMB M4 SHLDR 7.5 X 7	1407-3410-000	(3)
19	RING RETAINING 3.96 SFT DIA CRESCENT SST	1407-3411-000	(3)
20	SCR M4 X 40 FL HD SST PH	0140-6226-122	(2)
21	O-RING 2.9 ID 6.46 OD 1.78 W EP 70 DURO	1407-3409-000	(2)
22	SCR SEMS M4X8 BT SKT HD W/EXT L/W SST 316	0144-2436-108	(3)

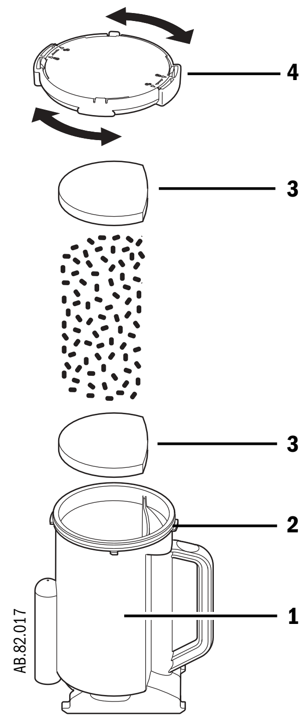
10.40.2 Bag/Vent Switch



Item	Description	Stock Number	QTY
	BTV Switch Cartridge	1407-7003-000	
1	COVER BTV	1407-3500-000	
2	SCR SEMS M4X8 BT SKT HD W/EXT L/W SST 316	0144-2436-108	(2)
3	O-RING 44.02 ID 51.1 OD 3.53 W SI 70 DURO	1407-3507-000	
4	SEAL, BTV	1407-3506-000	

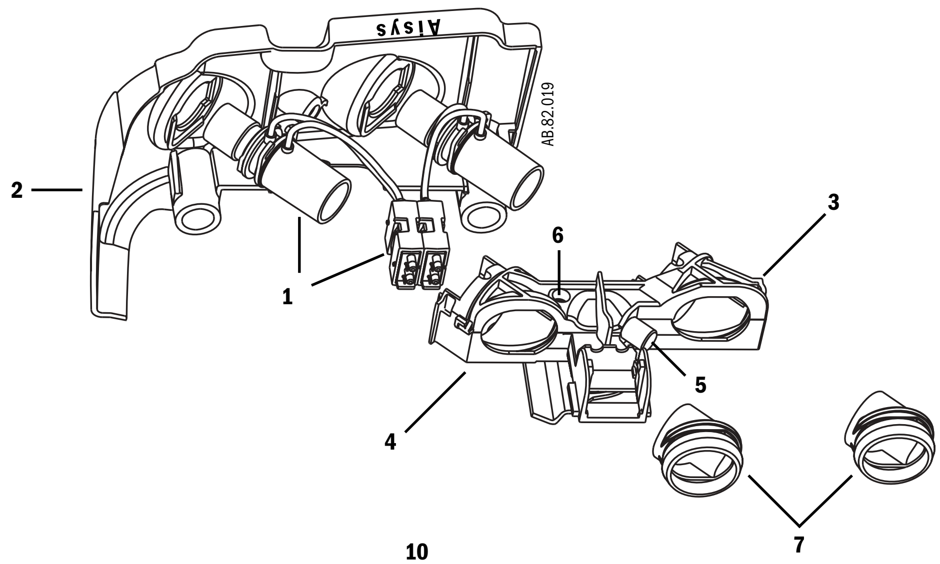
10.40.3 Absorber canister

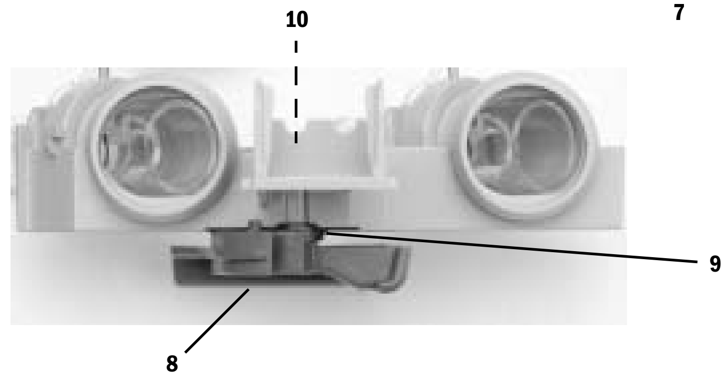




Item	Description	Stock Number	Qty
	Absorber Canister, Reusable	1407-7004-000	
1	CANISTER, CO2	1407-3200-000	
2	O-RING 110.72 ID 117.78 OD 3.53 W EPR 50 DURO	1407-3204-000	
3	FOAM, CO2 CANISTER (PKG 40)	1407-3201-000	
4	COVER, CO2 CANISTER with LOCKING RING (does not include items 5 and 6)	1407-3203-000	
5	SCREEN, CO2 CANISTER COVER	1407-3205-000	
6	SCREW, M3X8 FL PH HD SST	9211-0530-083	(2)

10.40.4 Flow Sensor Module

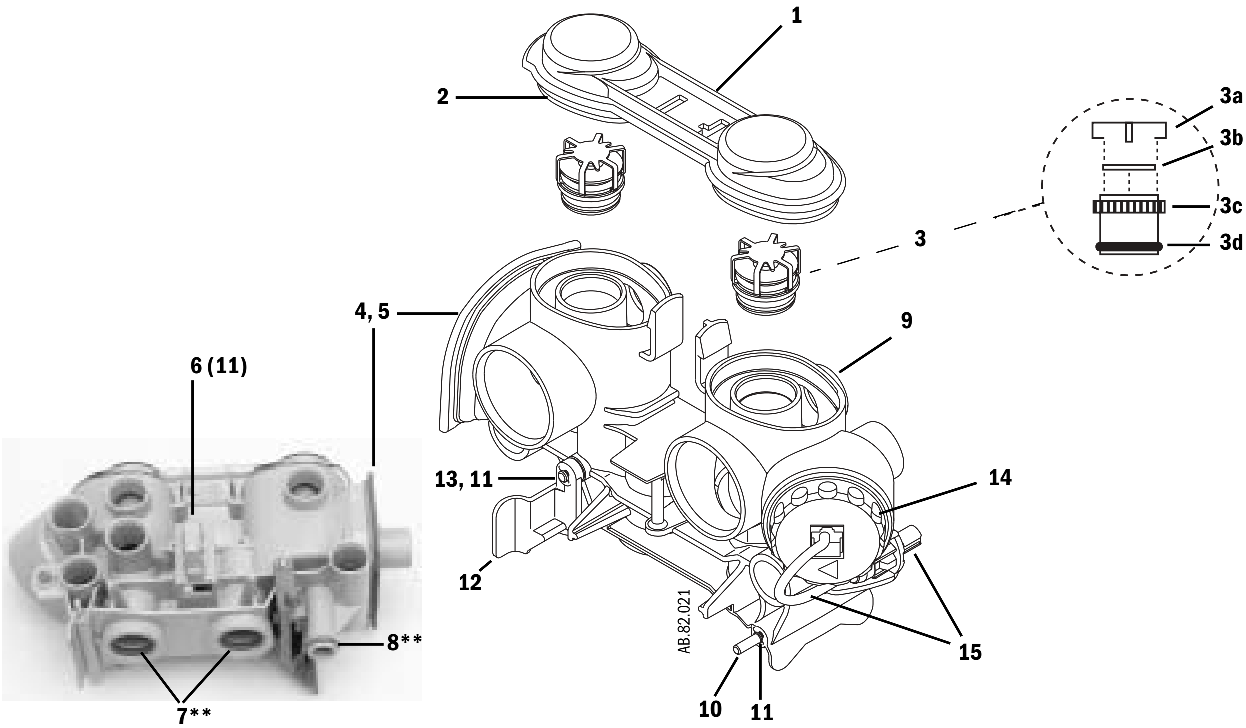




Item	Description	Stock Number	Qty
	Flow Sensor Module (*)	1407-7022-000	
1*	Flow Sensor (plastic - moisture resistant)	1503-3858-000	
	Flow Sensor (metal - autoclavable)	1503-3244-000	
2	COVER FLOW SNSR	1011-3283-000	
3	HOLDER FLOW SNSR UPPER	1407-3002-000	
4	HOLDER FLOW SNSR LOWER	1407-3003-000	
5	SCR THUMB M6X43 SST	1406-3304-000	
6	SCR M4 .07 X 10 SKT CAP BUTTON HEAD SST	0144-2117-718	(2)
7	CUFF FLOW SNSR	1407-3004-000	(2)
8	LATCH FLOW SNSR	1407-3001-000	
9	SPR TORSION FLOW SNSR LATCH	1407-3005-000	
10	RING TRUARC .188 SHAFT E-RING SST	0203-5225-300	

* The flow sensors are not included in the flow sensor module.

10.40.5 Breathing Circuit Module

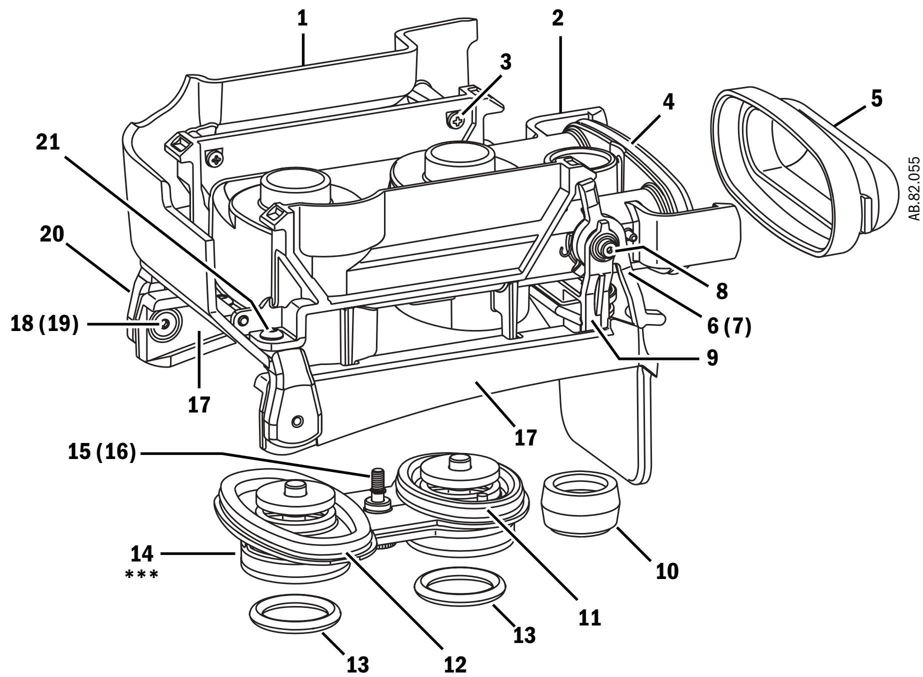


Item	Description	Stock Number	Qty
	Breathing Circuit Module	1407-7002-000	
1	LENS CIRCUIT CHK VALVES	1407-3101-000	
2	O-RING 44.02 ID 51.1 OD 3.53 W SI 70 DURO	1407-3507-000	(2)
3	Check Valve Assembly	1406-8219-000	(2)
3a	RETAINER DISK 26.97D 12.7H 0.76T	1400-3017-000	(2)
3b	DISC CHK V RVSBL 1.025D	0210-5297-100	(2)
3c	SEAT UNIDIRECTIONAL V B/S	1406-3396-000	(2)
3d	O-RING 20.35 ID 23.90 OD 1.78W	1406-3397-000	(2)
4	PLATE CIRCUIT FLANGE	1407-3110-000	
5	SCR SEMS M4X8 BT SKT HD W/EXT L/W SST 316	0144-2436-108	(6)
6	HOOK LATCH	1407-3604-000	
7**	O-RING 22 ID 30 OD 4 W SI 40 DURO	1407-3104-000	(2)
8**	O-RING 13.94 ID 19.18 OD 2.62 W SI 50 DURO	0210-0463-300	
9	MANIFOLD CIRCUIT	1407-3100-000	
10	PIN CANISTER PIVOT	1407-3109-000	
11	RING TRUARC .188 SHAFT NO 5133-18H E-RING SST	0203-5225-300	(5)
12	LEVER CANISTER LATCH	1407-3102-000	
13	PIN CANISTER LEVER	1407-3108-000	
14*	O_2 Cell	6050-0004-110	
	O-ring, cell	1406-3466-000	
15*	Cable, O_2 Cell	1009-5570-000	

* The O_2 cell (or plug) and the cell cable are not included in the breathing circuit module.

** Lubricate sparingly with Krytox.

10.40.6 EZchange Canister system (CO_2 Bypass)



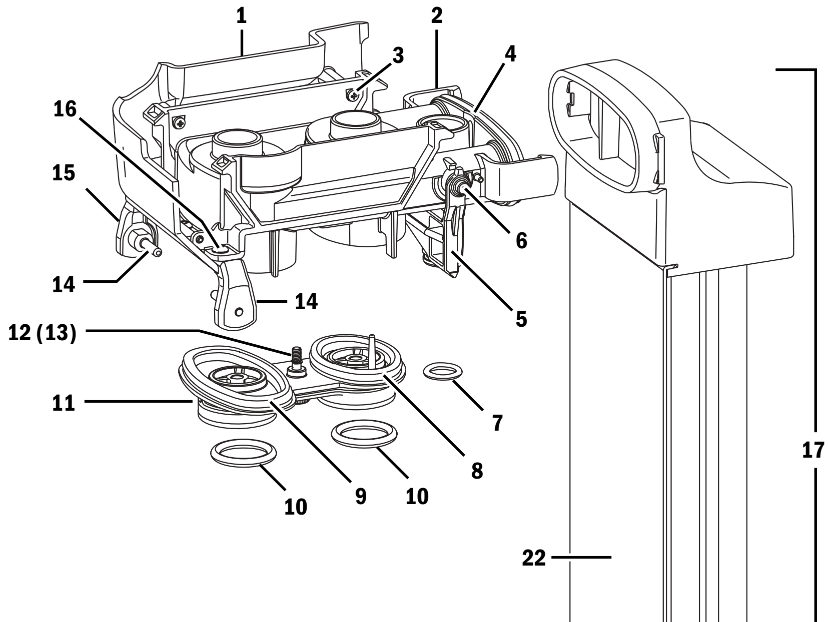
Item	Description	Stock Number	Qty
	EZchange Canister module	1407-7021-000	
	Valve assembly (Items 11 through 16)	1407-7023-000	
1	Cover, Bypass Manifold	1407-3123-000	
2	Manifold, Bypass	1407-3113-000	
3	Screw, M3x8 PT PAN PH SST	0142-4254-106	(2)
4**	O-ring, 59.92 ID 66.98 OD 3.53 W SIL 50 DURO	1407-3142-000	
5	Cap, Manifold	1407-3130-000	
6	Lever, Switch Actuator	1407-3116-000	
7	Spring, Torsion Switch Actuator Lever	1407-3117-000	
8*	Screw, M3x0.5 Shoulder 4 DIA X 4 L SST	1407-3915-000	(2)
9	Lever, Canister Latch	1407-3115-000	
10	Seal, Drain	1407-3121-000	
11**	O-ring, 37.69 ID 44.75 OD 3.53 W SIL 50 DURO	1407-3129-000	
12**	O-ring, 50.39 ID 57.45 OD 3.53 W SIL 50 DURO	1407-3143-000	
13**	O-ring, OD30 ID 22 4W SIL 40 DURO	1407-3104-000	(2)
14***	Valve, Housing Assembly Bypass	1407-3126-000	
15	Screw, Thumb M4 Shoulder 7.5 X 7	1407-3410-000	
16	Ring, Retaining 3.96 Shaft DIA SST	1407-3411-000	
17	Cradle Canister	1407-3118-000	
18	Screw, M4x10 CSK SKT HD SST TYPE 316	0140-6226-119	(2)
19**	Spacer, Shoulder 6.8 DIA x4.1 L	1407-3120-000	(2)
20	Support, Cradle Pivot	1407-3119-000	
21	Screw, M4x8 Sems BT SKT HD SST 316	0144-2436-108	(3)

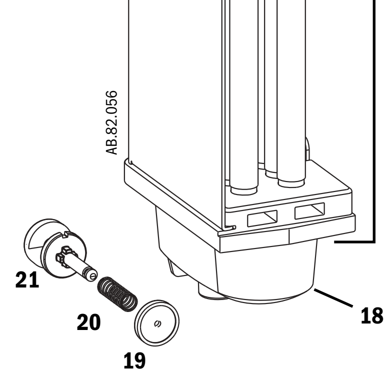
* Apply Loctite 242.

** Lubricate sparingly with Krytox.

*** Rubber valve seats can not be removed from assembly (**Item 14**).

10.40.7 Condenser

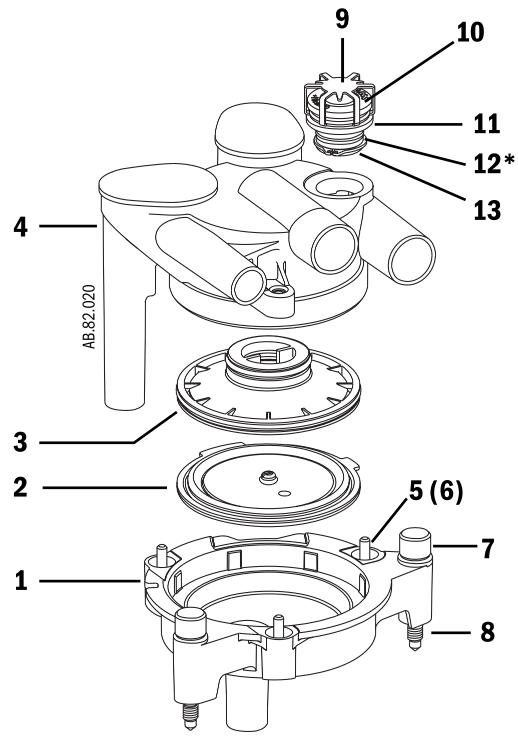




Item	Description	Stock Number	Qty
	Condenser assembly (includes all Items)	1407- 7026-000	
	Condenser module (Items 1 through 16)	1407-7025-000	
	Condenser (Items 17 through 22)	1407-7024-000	
1	Cover, Bypass Manifold	1407-3123-000	
2	Manifold, Condenser	1407-3114-000	
3	Screw, PT PAN PH M3X8 SST	0142-4254-106	(2)
4**	O-ring, 59.92 ID 66.98 OD	1407-3142-000	
5	Lever, Canister Latch	1407-3115-000	
6*	Screw, M3x0.5 Shoulder 4 DIA X 4 L SST	1407-3915-000	(2)
7	O-ring, 12.37 ID 17.6 OD	1006-3968-000	
8**	O-ring, 37.69 ID 44.75 OD	1407-3129-000	
9**	O-ring, 50.39 ID 57.45 OD	1407-3143-000	
10**	O-ring, 22 ID 30 OD	1407-3104-000	(2)
11	Cap, Valve Housing	1407-3125-000	
12	Screw, Thumb M4 Shoulder 7.5 X 7	1407-3410-000	
13	Ring, Retaining 3.96 Shaft DIA SST	1407-3411-000	
14*	Pin, Condenser Manifold	1407-3131-000	(2)
15	Support, Cradle Pivot	1407-3119-000	
16	Screw, M4x8 Sems BT SKT HD	0144-2436-108	(3)
17	Tube Assembly	1407-3133-000	
18	Reservoir, Condenser	1407-3137-000	
19	Seal, Condenser Reservoir	1407-3136-000	
20	Spring, Compression Drain Button	1407-3135-000	
21	Button, Drain	1407-3134-000	
22	Cover, Condenser	1407-3138-000	
23	Guard	1407-3145-000	

* Apply Loctite 242.
** Lubricate sparingly with Krytox.

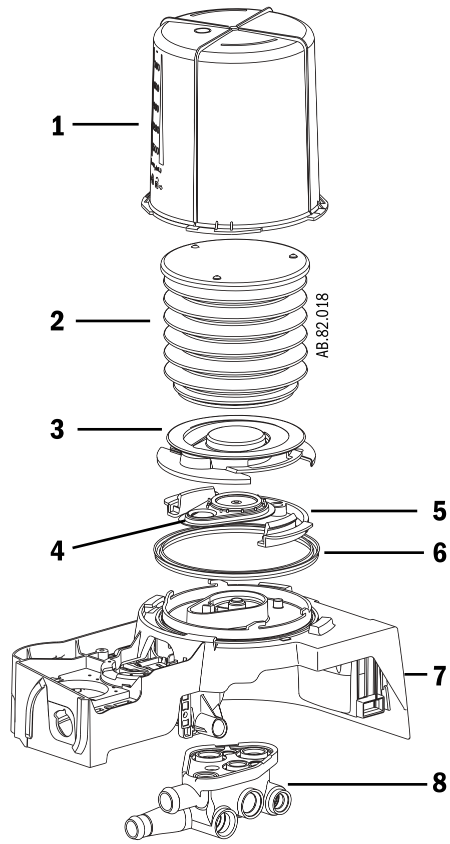
10.40.8 Exhalation valve



Item	Description	Stock Number	Qty
	Exhalation Valve Assy	1407-7005-000	
1	BASE EXHALATION VALVE	1407-3700-000	
2	DIAPHRAGM ASSY EXH VALVE	1503-8121-000	
3	SEAT EXHALATION VLV ABS	1407-3704-000	
4	COVER EXHALATION VALVE	1407-3701-000	
5	SCR M4X16 PH PAN HD SST TYPE 316	9211-0440-163	(3)
6	O-RING 2.9 ID 6.46 OD 1.78 W EP 70 DURO	1407-3409-000	(3)
7	SCR THUMB M6X43 10MM HEAD B/S	1406-3306-000	(2)
8	O-RING 4.47 ID X 8.03 OD 1.78 W EPR 70 DURO	1407-3703-000	(2)
9	RETAINER DISK 26.97D 12.7H 0.76T SST FLUTTER V	1400-3017-000	
10	WEIGHT DEAD 10 CMH2O BCG PASSIVE AGSS	1406-3572-000	
11	SEAT POSITIVE PRESS BCG VALVE PASSIVE AGSS	1406-3571-000	
12*	O-RING OD19.16 BCG ID15.6 EPDM DURO 70 -016	1006-3616-000	
13	RING RETAINING 19.05 SHAFT DIA SST	1406-3577-000	

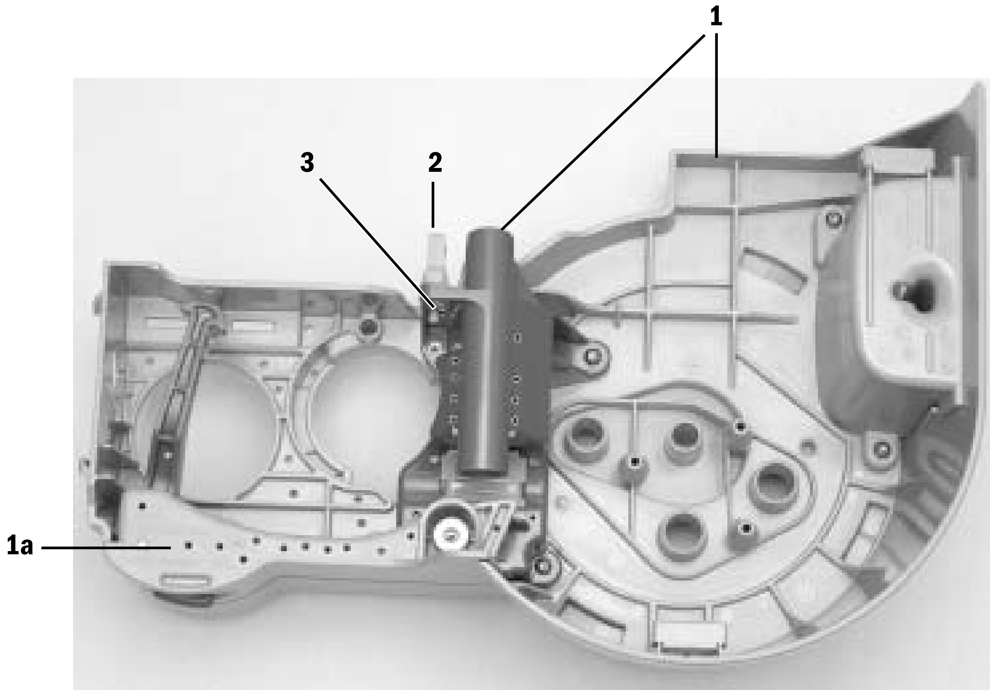
* Lubricate sparingly with Krytox.

10.40.9 Bellows



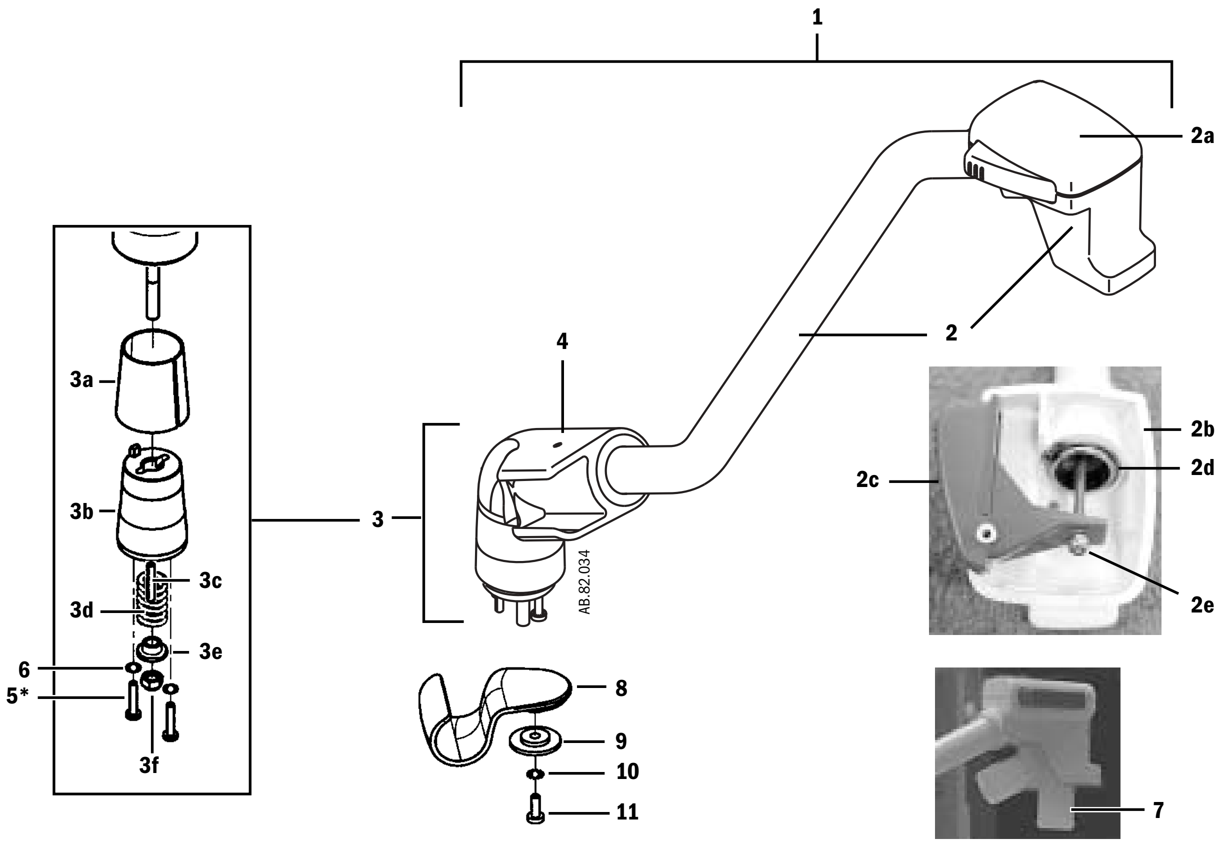
Item	Description	Stock Number
1	Bellows housing	1500-3117-000
2	Bellows	1500-3378-000
3	Rim	1500-3351-000
4	Pressure relief valve assy	1500-3377-000
5	Latch, base	1500-3352-000
6	Seal, base	1500-3359-000
7	Base, bellows	Refer to section 10.40.10
8	Manifold, bellows base	1407-3702-000

10.40.10 Bellow base



Item		Description	Stock Number
1		Bellows Base Assy	1407-7006-000
	1a	Latch Assy	1407-7007-000
2		HOOK LATCH	1407-3604-000
3		E-Ring	0203-5225-300

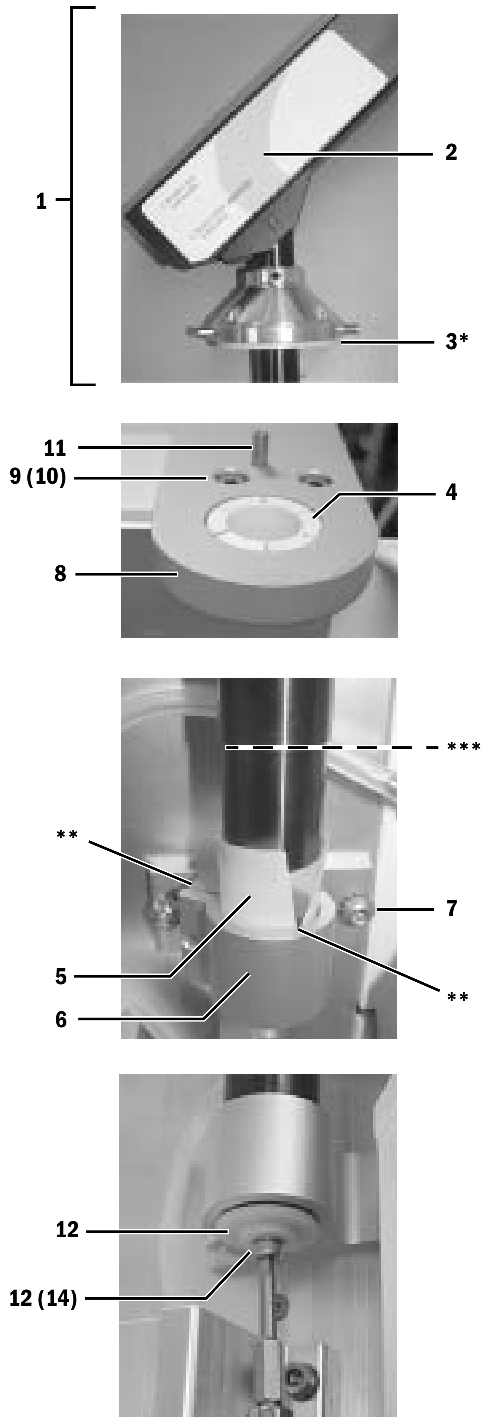
10.40.11 Bag Arms



Item	Description	Stock Number	Qty
1	Bag Arm Assembly (complete)	1009-8159-000	
2	Bag Arm Upper Assembly	1407-7011-000	
2a	Cover, bag port housing	1407-3807-000	
	Screw, M3x20	0140-6719-103	
	Lockwasher, M3 internal	9213-0430-003	
2b	Housing, bag port	1407-3806-000	
2c	Lever, lock release	1407-3808-000	
2d	Ring, retaining	1406-3577-000	
2e	Nut, M3 Nyloc	0144-3536-112	
3	Bag Arm Lower Assembly	1407-7012-000	
3a	Pad, Friction Material	1407-3818-000	
3b	Post	1407-3802-000	
3c	Pin, spirol	9214-2103-020	
3d	Spring	1406-3270-000	
3e	Washer, shoulder	1407-3815-000	
3f	Nut, M5 Nyloc	9212-0350-006	
4	Pin, dowel 3.18 DIA 31.8 L SST	1407-3804-000	
5	Screw, M3x16 POSI DR PAN HD A4 SST	1504-3003-000	(2)
6	Lockwasher, M3 internal	9213-0430-003	(2)
7	Bag arm connector, reusable	8004459	
Items if no Bag Arm			
8	Clip, patient tubing	1407-3810-000	
9	Washer, shoulder	1407-3814-000	
10	Lockwasher, M4 external	9213-0540-003	
11	Screw, M4x16	9211-0440-163	

* Apply Loctite 242.

10.41 Display arm

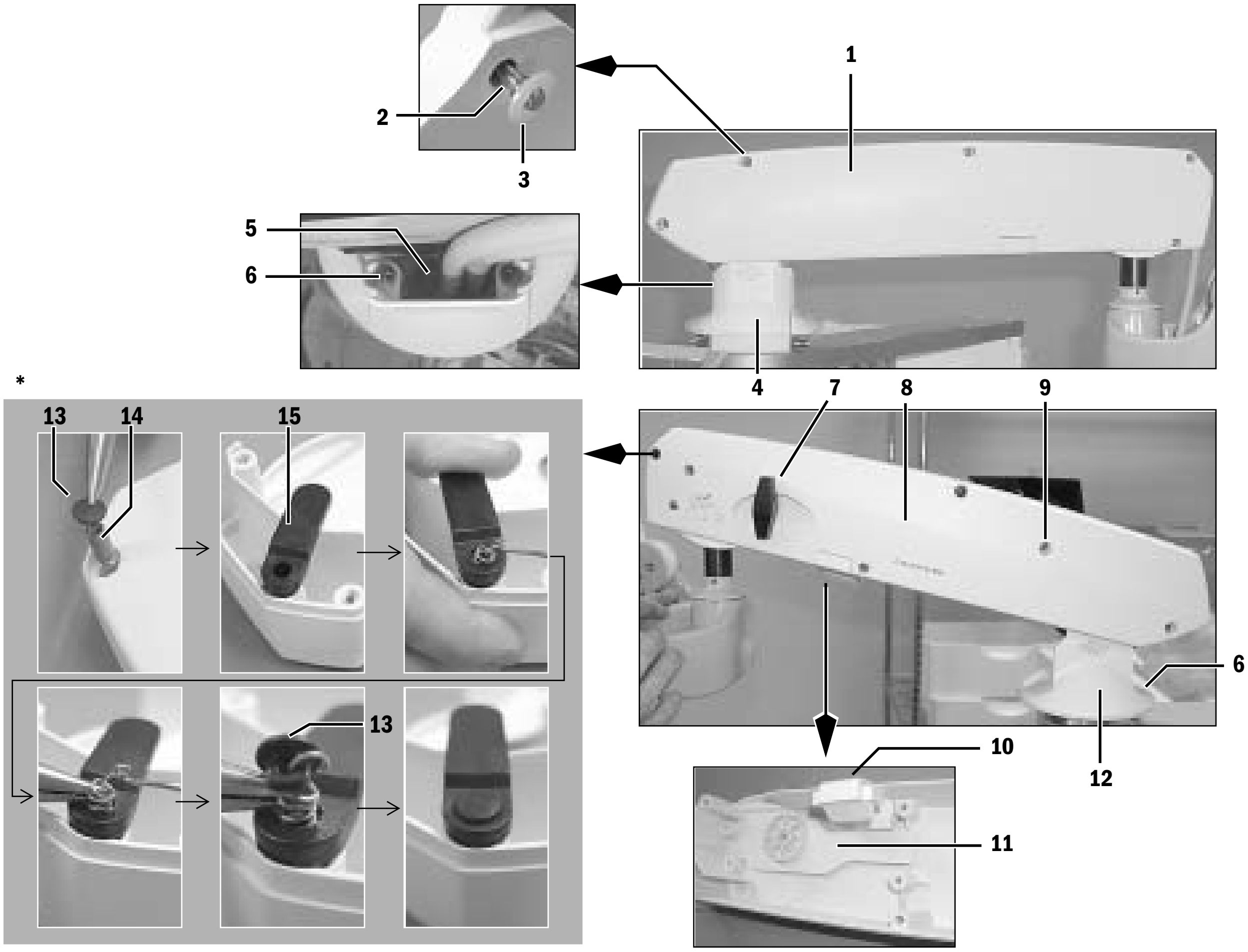


Item	Description	Stock Number	Qty
1	Display arm assembly	1011-3294-000	
2	Label, arm cable routing	1011-3568-000	
3*	Washer, friction shoulder	1011-3390-000	
4	Bearing, Nyliner with key	1006-3228-000	
5**	Spacer, split plastic	1011-3393-000	
6	Support, shaft bottom	1011-3388-000	
7	Screw, M6x16 Sems	0144-2436-109	2
8	Support, shaft top	1011-3389-000	
9	Screw, M6x16 SKT HD CAP	1011-3894-000	4
10	Lockwasher, M6 internal	0144-1118-130	4
11	Roll pin, 0.25 OD	0201-0757-300	
12	Washer, shoulder	1407-3814-000	
13	Screw, M4x12 SKT HD CAP	1102-3006-000	
14	Lockwasher, M4 internal	0144-1118-128	

* Lubricate both sides of friction washer (**Item 3**) and completely around the first 3 cm of shaft next to washer.
** Ensure end-gap of spacer is opposite slot in lower support.
*** Push spacer (**Item 5**) into lower support using shoulder on shaft.

Note:
When replacing the display arm, loosen the mounting screws (**Item 7**) for the bottom shaft support (**Item 6**) to ease alignment. Retighten the screws before replacing the shoulder washer (**Item 12**).

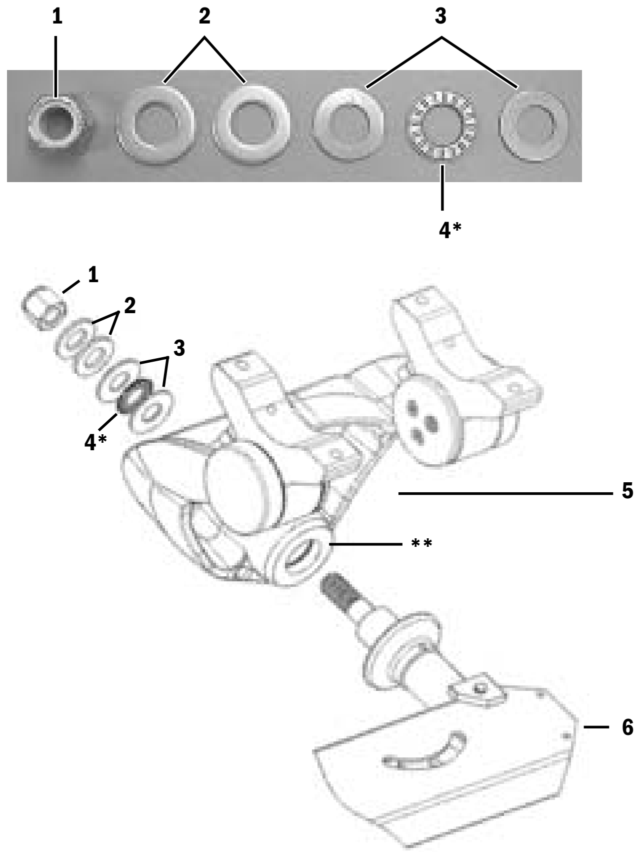
10.41.1 Display arm shroud and covers



Item	Description	Stock Number	Qty
1	Cover, display arm	1011-3629-000	
2	Screw, M4x12 captive	1504-3001-000	5
3	Washer, M4 retaining Nylon	1009-3178-000	5
4	Cover, base	1011-3631-000	
5	Strain relief, sponge	1011-3642-000	
6	Screw, M4x20 SKT HD CAP	0144-2124-218	4
7	Handle, display arm clamping	1011-33915-000	
8	Shroud, display arm	1011-3293-000	
9	Screw, M4x12 Pan HD	0140-6226-111	5
10	Cover, sliding locking handle	1011-3296-000	
11	Bumper, display arm	1011-3814-000	
12	Cover, base display arm rear	1011-3630-000	
13	Button, retaining spring	1602-3010-000	4
14	Spring, 6.1 OD	1602-3022-000	2
15	Swivel, display arm shroud	1602-3011-000	2

* Attach a button at one end of the spring; from the other side, hook the spring and extend it through the swivel; hold the spring with needle nose pliers and attach the second button to the spring to hold the swivel in place.

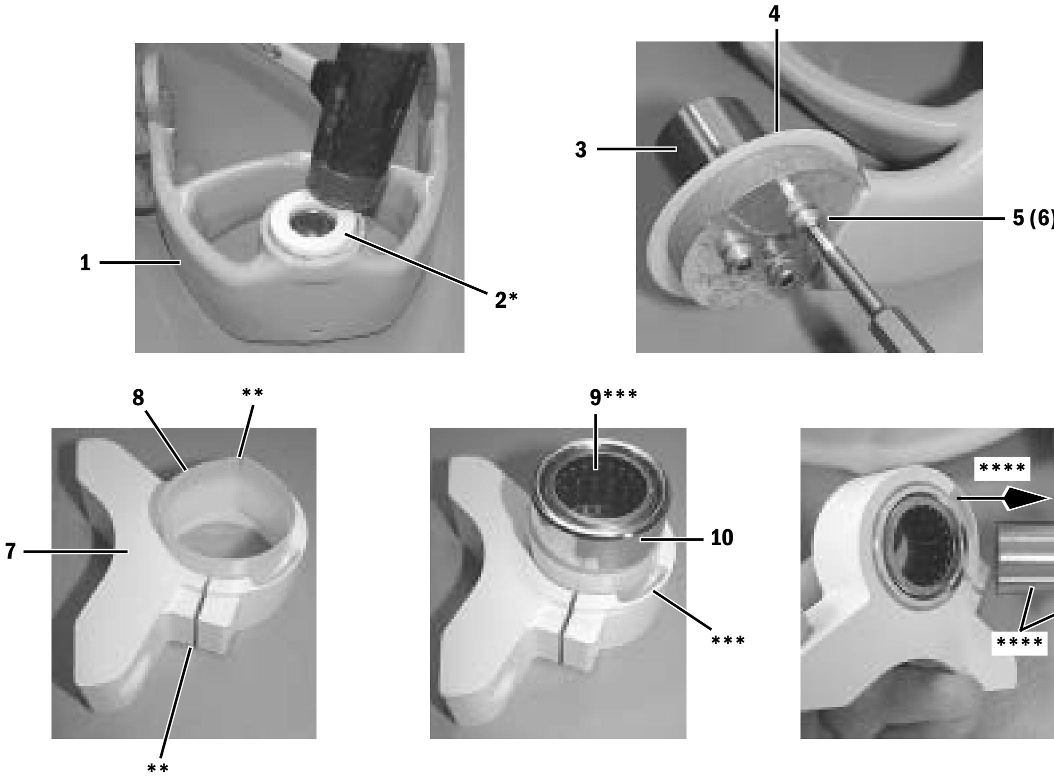
10.42 Wrist casting assembly



Item	Description	Stock Number	Qty
1	Nut, 1/2-13 Hex Nyloc	1006-4595-000	
2	Washer, 13.5 ID 25.4 OD	1006-3828-000	2
3	Washer, bearing 0.5 inch ID	1006-4593-000	2
4*	Bearing, thrust 0.5 inch ID	1006-4594-000	
5	Wrist casting assembly	Refer to 10.42.1	
6	Display arm assembly	Refer to 10.41	

* Lubricate both sides sparingly with Krytox.
** Lubricate surface of friction washer sparingly with Krytox

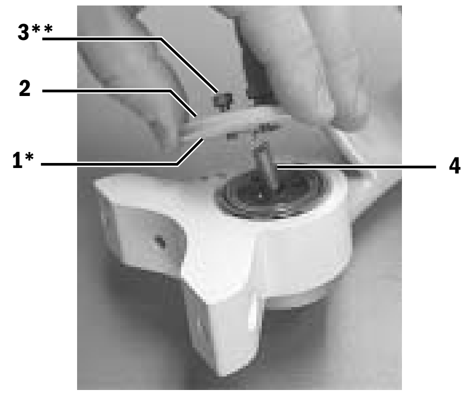
10.42.1 Display arm and wrist casting assembly

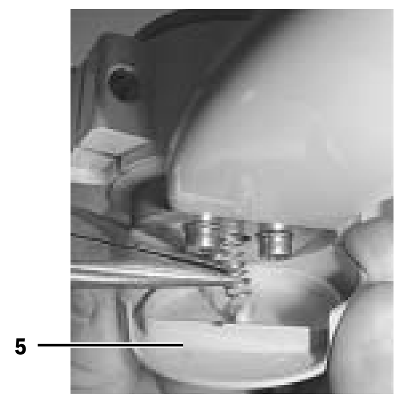


Item	Description	Stock Number	Qty
1	Wrist casting	1011-3294-000	
2*	Washer, friction	1011-3394-000	
3	Axle bearing	1602-3021-000	2
4	Washer, thrust - plastic	1602-3017-000	2
5	Screw, M4x16 SKT HD CAP	1011-3893-000	6
6	Lockwasher, M4 internal	0144-1118-128	6
7	Housing, bearing	1011-3391-000	2
8**	Spacer, slip - plastic	1602-3015-000	2
9***	Bearing, roller	1602-3020-000	2
10	Bushing	1602-5010-000	2

* Use a rubber mallet to tap friction washer into place.
** Ensure end-gap of spacer is opposite slot in housing.
*** Insert bearing into bushing with writing on side of bearing facing up (same side as relief on bearing housing.
**** Lubricate axle bearing and thrust washer sparingly with Krytox. On right-side axle bearing, align relieved area on bearing housing with pin on wrist casting. On left-side axle bearing, the relieved area faces away from the wrist casting.

10.42.2 Wrist casting bearing caps





Item	Description	Stock Number	Qty
1*	Washer, thrust - plastic	1602-3017-000	2
2	Cap, arm bearing inner	1011-3392-000	2
3**	Screw, M4x12 SKT HD CAP	1102-3006-000	6
4	Spring, extension 6.1 OD	1602-3022-000	2
5	Cap, arm bearing outer	1011-3600-000	2

* Lubricate the bearing facing thrust washer sparingly with Krytox.
** Apply Loctite 242.

Notes

11 Schematics and Diagrams

In this section

Schematics are subject to change without notice.

Circuit boards are available only as complete assemblies.

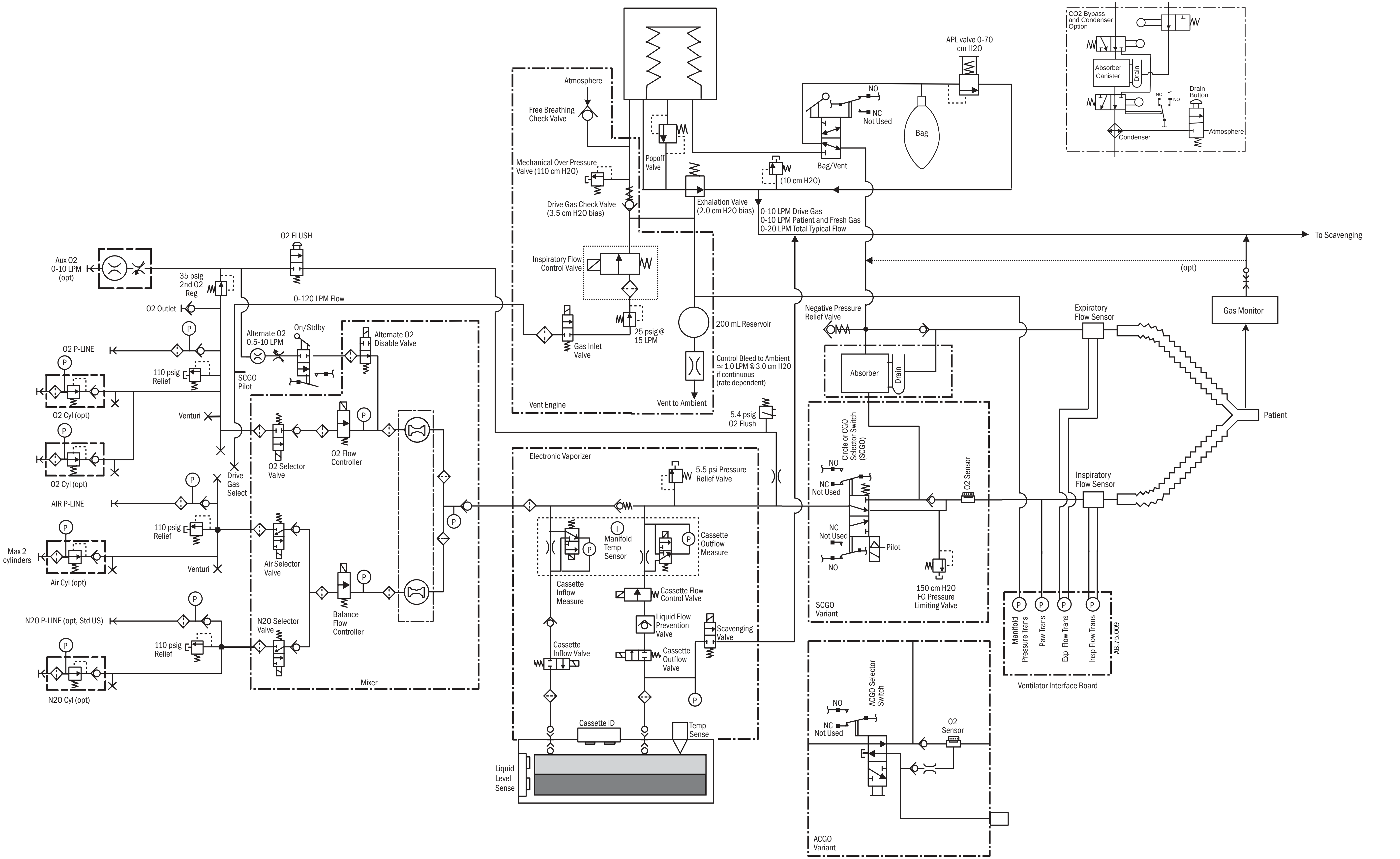
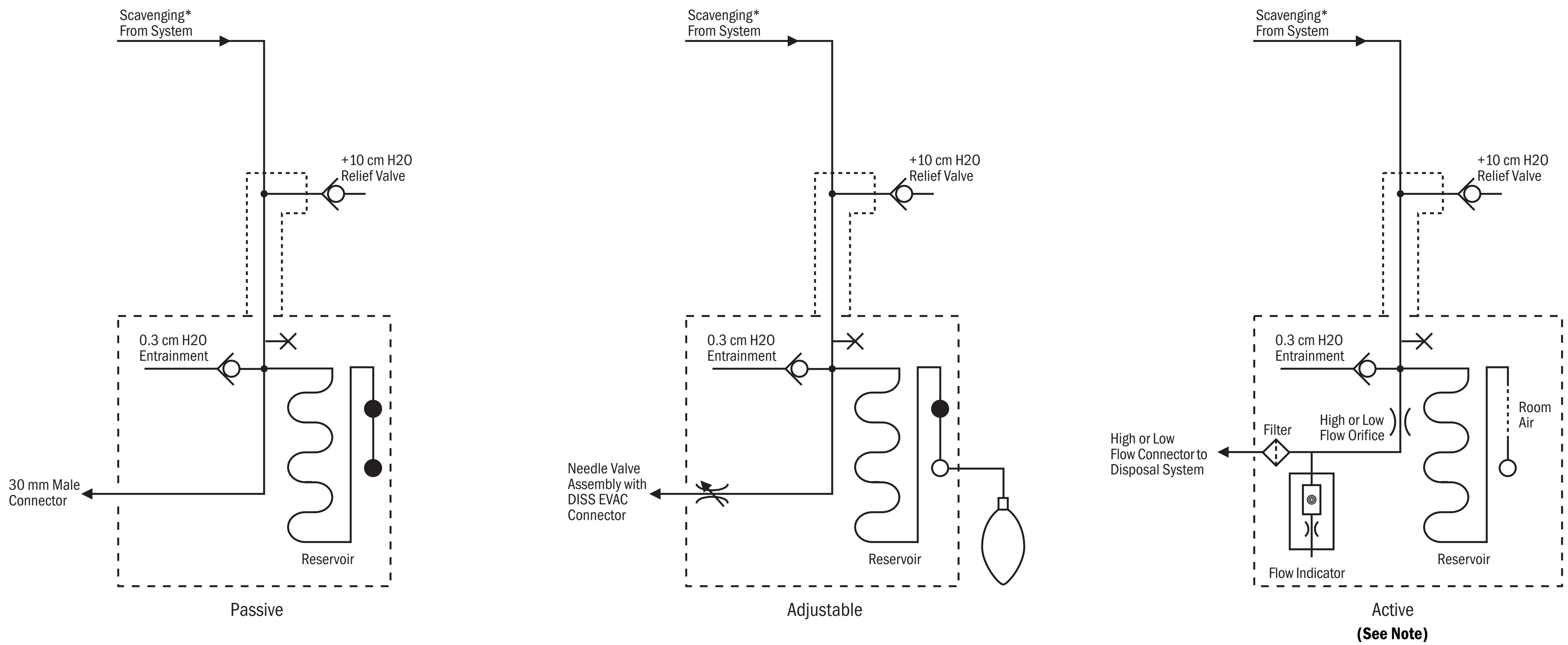


Figure 11-1 • System circuit diagram



Key to Symbols

- ✕ = Plugged port (1/8 inch) for sample gas return.
- ● = Plugged port (30 mm) for auxiliary breathing system scavenging.
- ○ = Open port (30 mm) for auxiliary breathing system scavenging.
- * = 0 to 10 l/min drive gas, 0 to 10 l/min patient and fresh gas, 0 to 20 l/min total typical flow.

Note: Active AGSS systems with a 12.7 mm connector do not include the Flow Orifice and the Flow Indicator.

Figure 11-2 ▪ Gas scavenging circuits

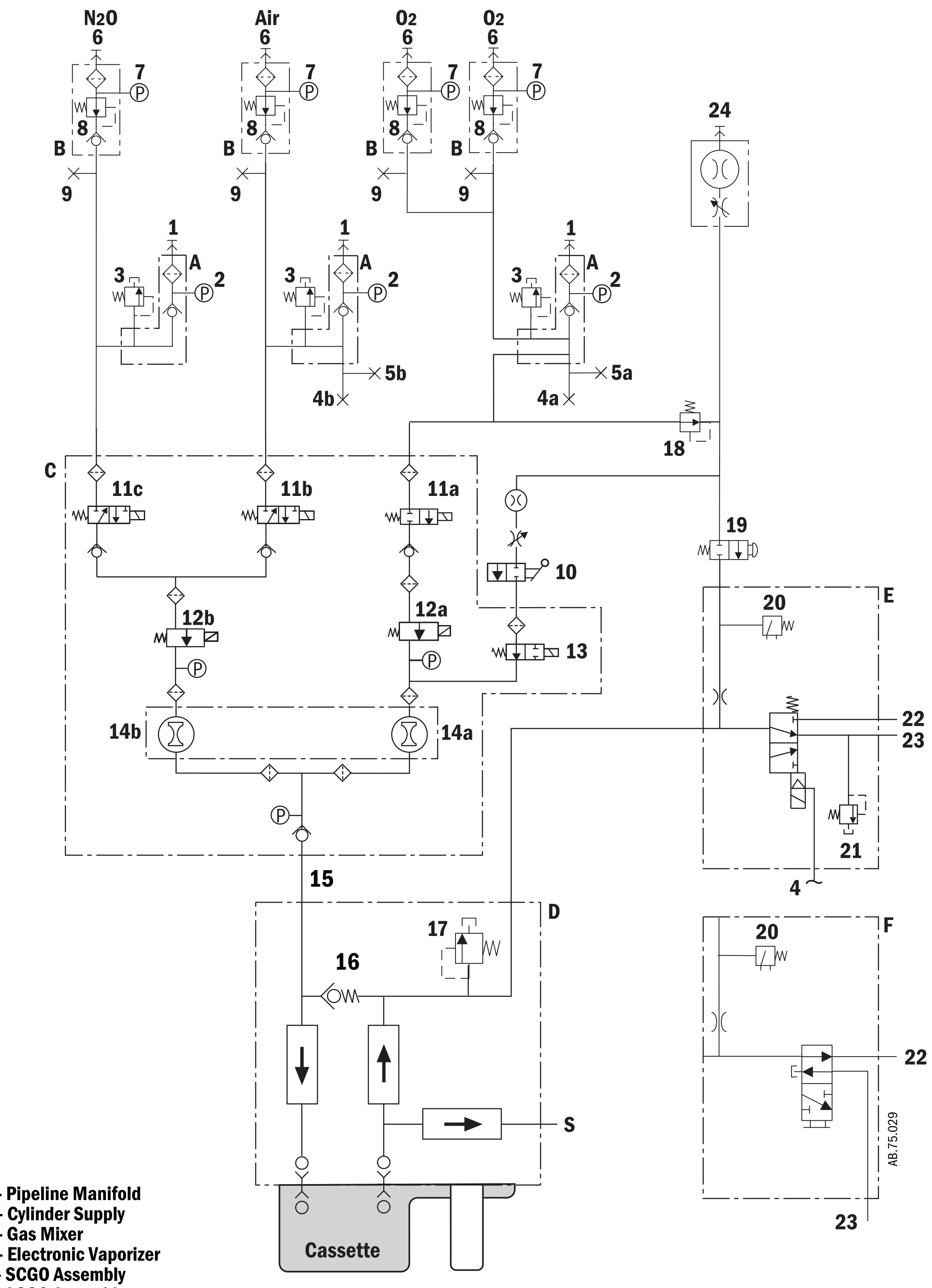
Key to Numbered Components

1. Pipeline inlet
2. Pipeline pressure transducer
3. High-pressure relief valve (758 kPa / 110 psi)*
4. Supply connections for the ventilator and pilot pressure for SCGO
   a. O_2 drive gas
   b. Air drive gas
5. Venturi suction supply connection
   a. O_2 drive gas
   b. Air drive gas
6. Cylinder inlet
7. Cylinder pressure transducer
8. Primary regulator (cylinder pressure)
9. Test port (primary regulator)
10. System switch
11. Selector valve
    a = O_2; b = Air; c = N_2O
12. Flow controller
    a = O_2; b = balance gas
13. Alternate O_2 disable valve
14. Hot-wire anemometer
    a = O_2 flow sensor channel; b = balance gas flow sensor channel
15. Mixed gas
16. Vaporizer bypass flow
17. Low-pressure relief valve (38 kPa / 5.5 psi)*
18. O_2 flush and auxiliary flowmeter regulator (241 kPa / 35 psi)*
19. O_2 Flush valve
20. Pressure switch (used with the ventilator)
21. Breathing system pressure relief valve (SCGO only – 150 cmH_2O)*
22. To Port 3 of ABS interface (circle)
23. For SCGO, to Port 2 of ABS interface (non-circle Inspiratory port)
    For ACGO, to external 22-mm ACGO connector
24. Auxiliary O_2 flowmeter (optional)

* Approximate values

Key to Symbols

⊬ ≻⊢≺	Pneumatic Connection
◇	Filter
▷	Direction of Flow
◇	Check Valve



A - Pipeline Manifold
B - Cylinder Supply
C - Gas Mixer
D - Electronic Vaporizer
E - SCGO Assembly
F - ACGO Assembly
P - Pressure Transducer
S - To Scavenging

25. Backpressure regulator
26. Inflow flowmeter
27. Outflow flowmeter
28. Inflow check valve
29. Inflow valve
30. Outflow valve
31. Scavenge valve
32. Liquid prevention valve
33. Proportional valve

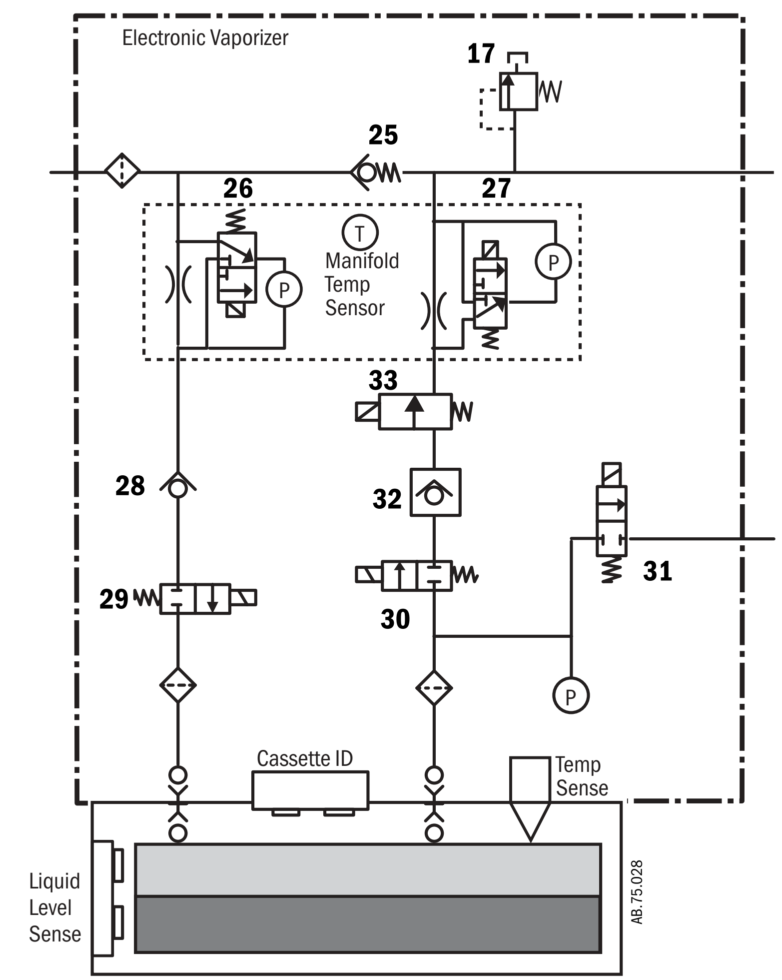


Figure 11-3 • Pneumatic circuit diagram

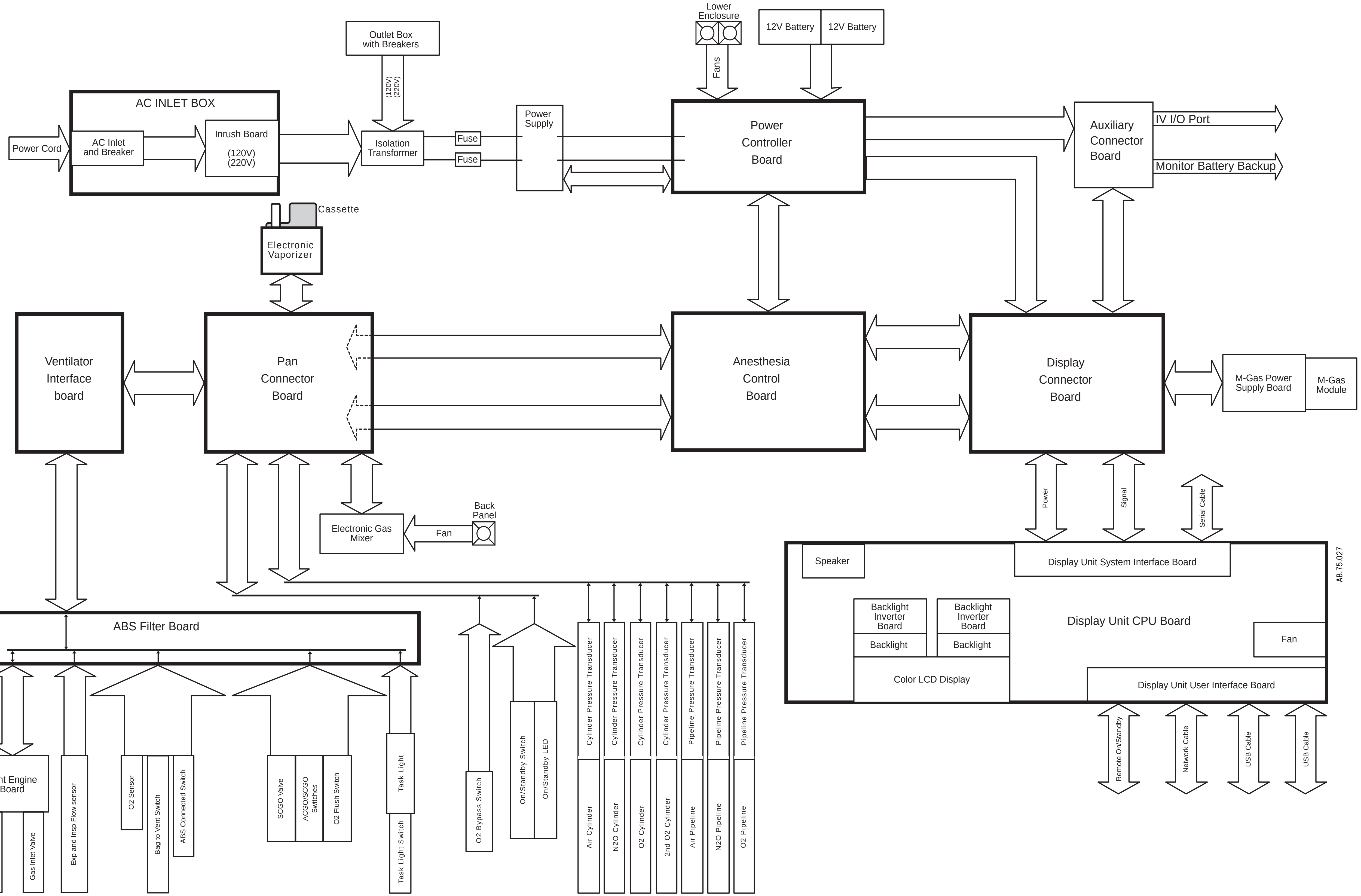


Figure 11-4 ▪ Cabling block diagram

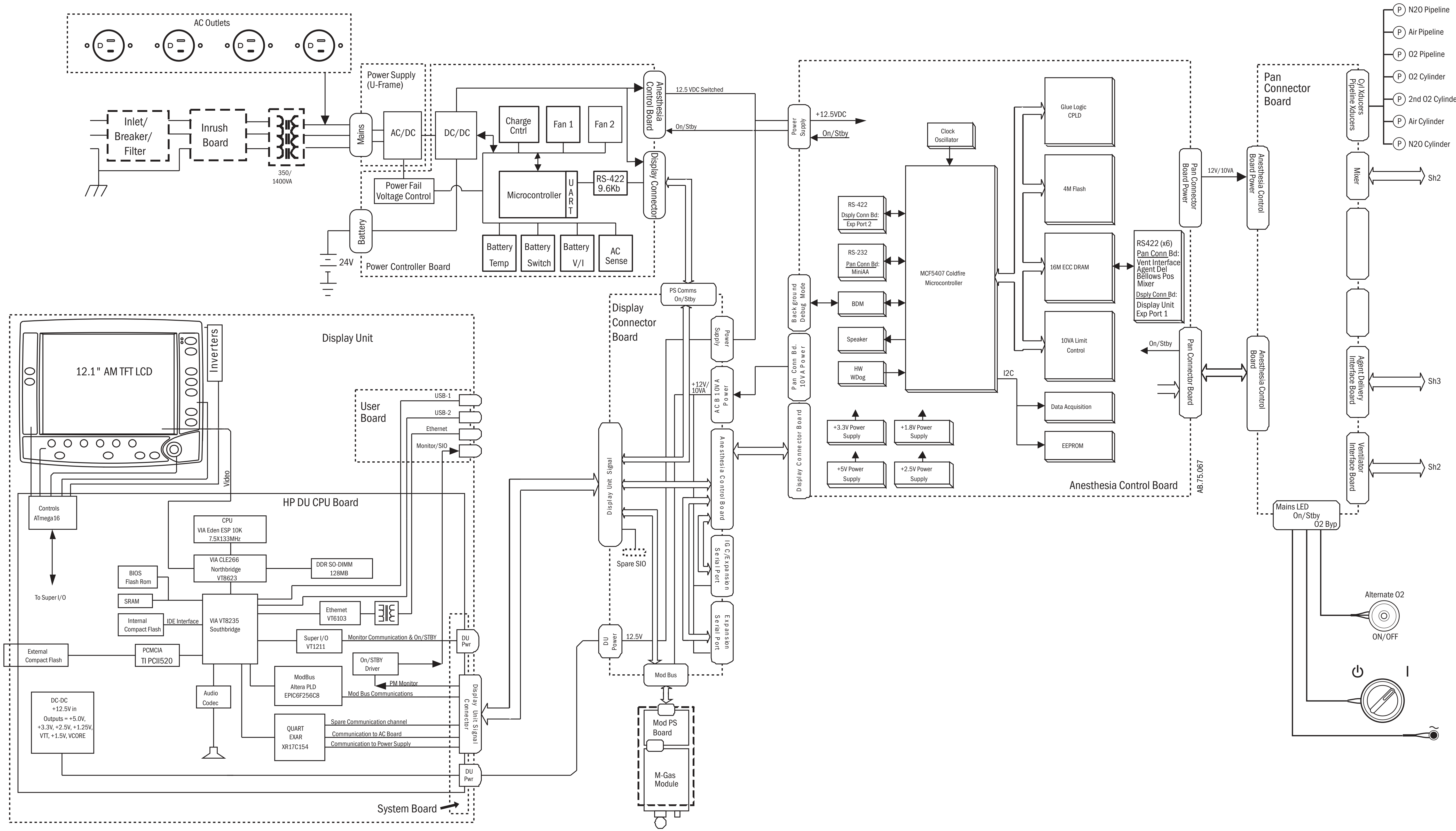


Figure 11-5 • System block diagram (sheet 1 of 3)

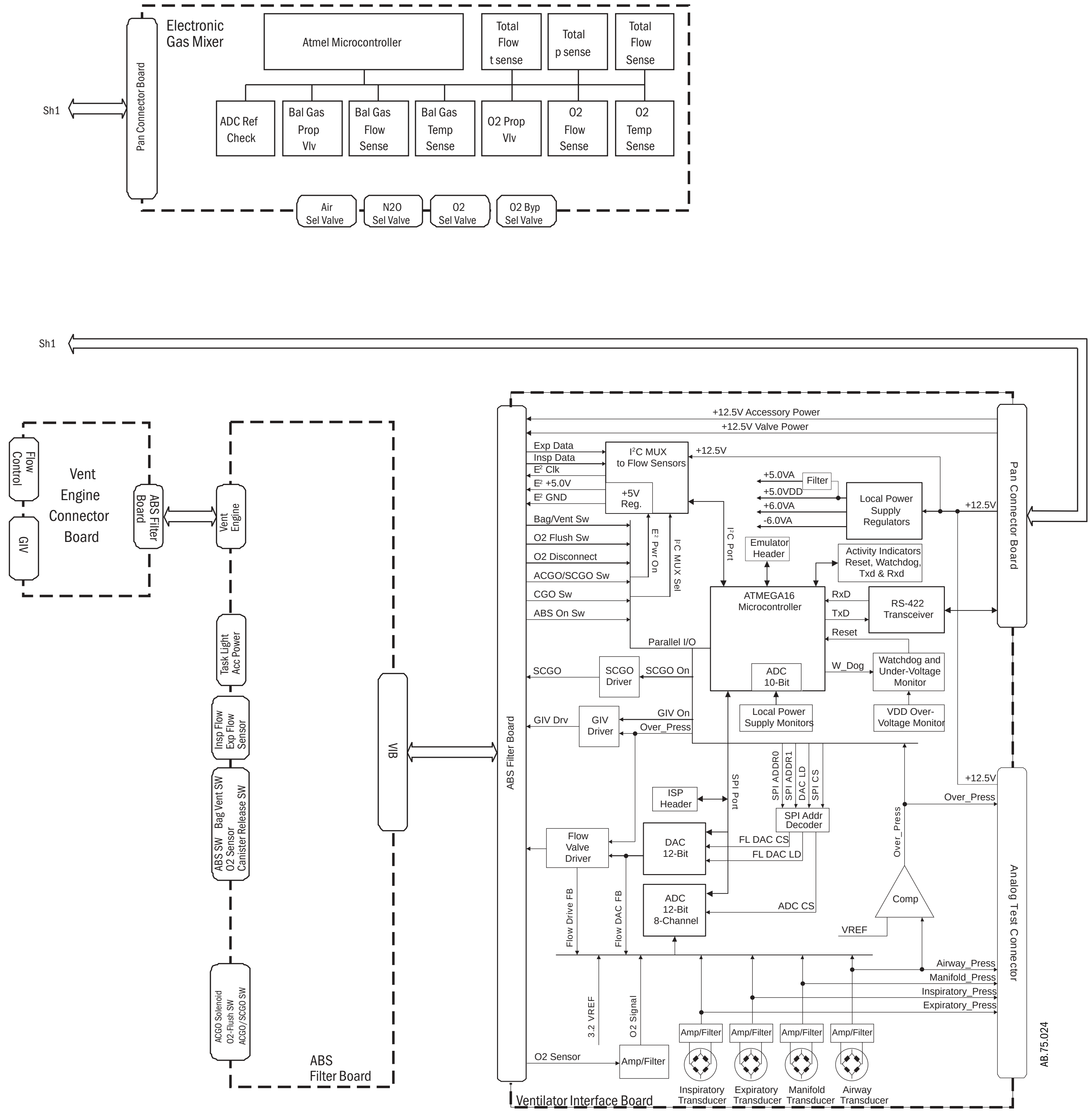


Figure 11-6 ▪ System block diagram (sheet 2 of 3)

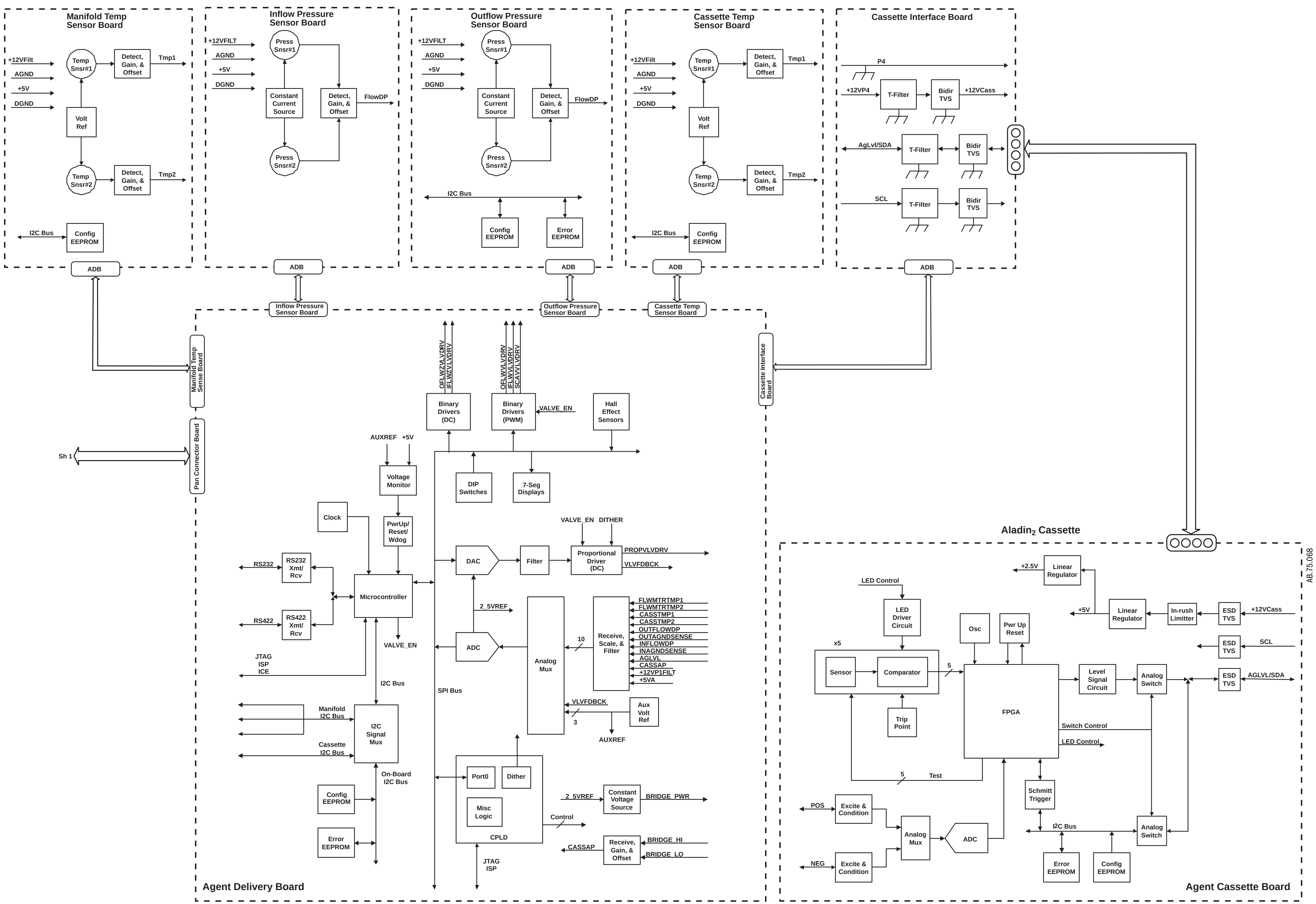
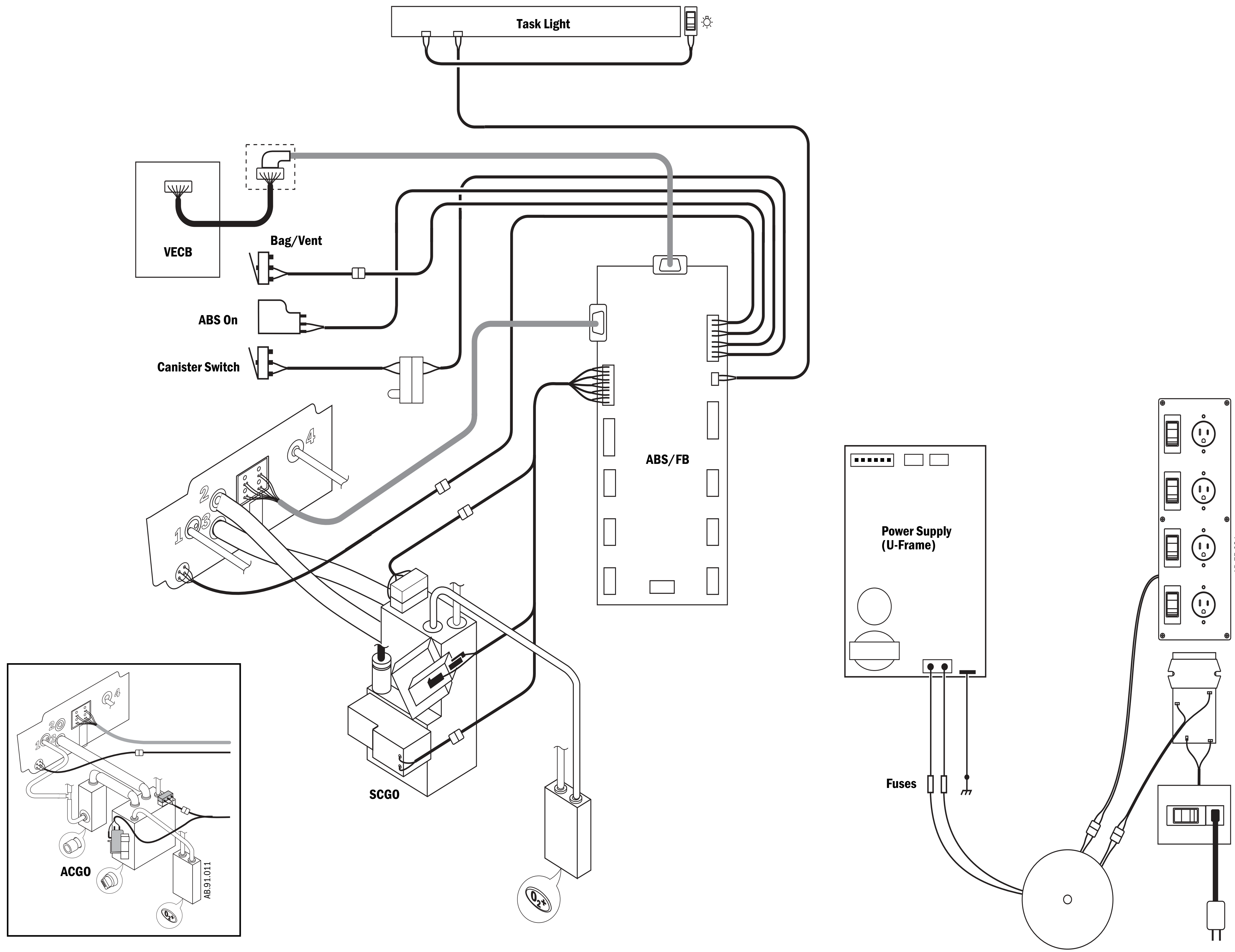


Figure 11-7 • System block diagram (sheet 3 of 3)



Key to Symbols

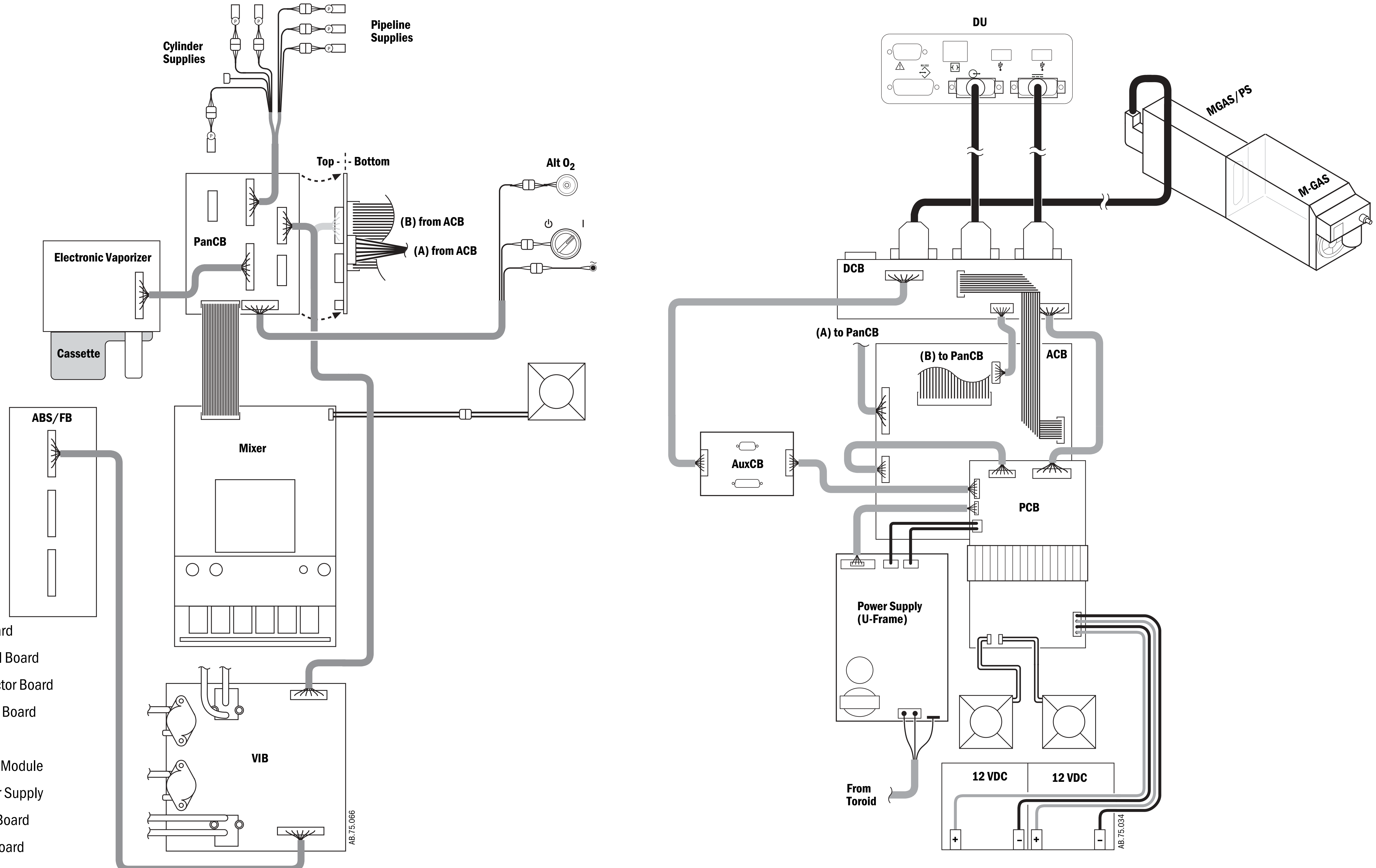
ABS/FB = ABS/Filter Board

ACGO = Auxiliary Common Gas Outlet

SCGO = Switched Common Gas Outlet

VECB = Vent Engine Connector Board

Figure 11-8 • Wiring harnesses



Key to Symbols

ABS/FB = ABS/Filter Board

ACB = Anesthesia Control Board

AuxCB = Auxiliary Connector Board

DCB = Display Connector Board

DU = Display Unit

MGAS = Compact Airway Module

MGAS/PS = MGAS Power Supply

PanCB = Pan Connector Board

PCB = Power Controller Board

VIB = Ventilator Interface Board

Figure 11-9 • Electrical cabling block diagram

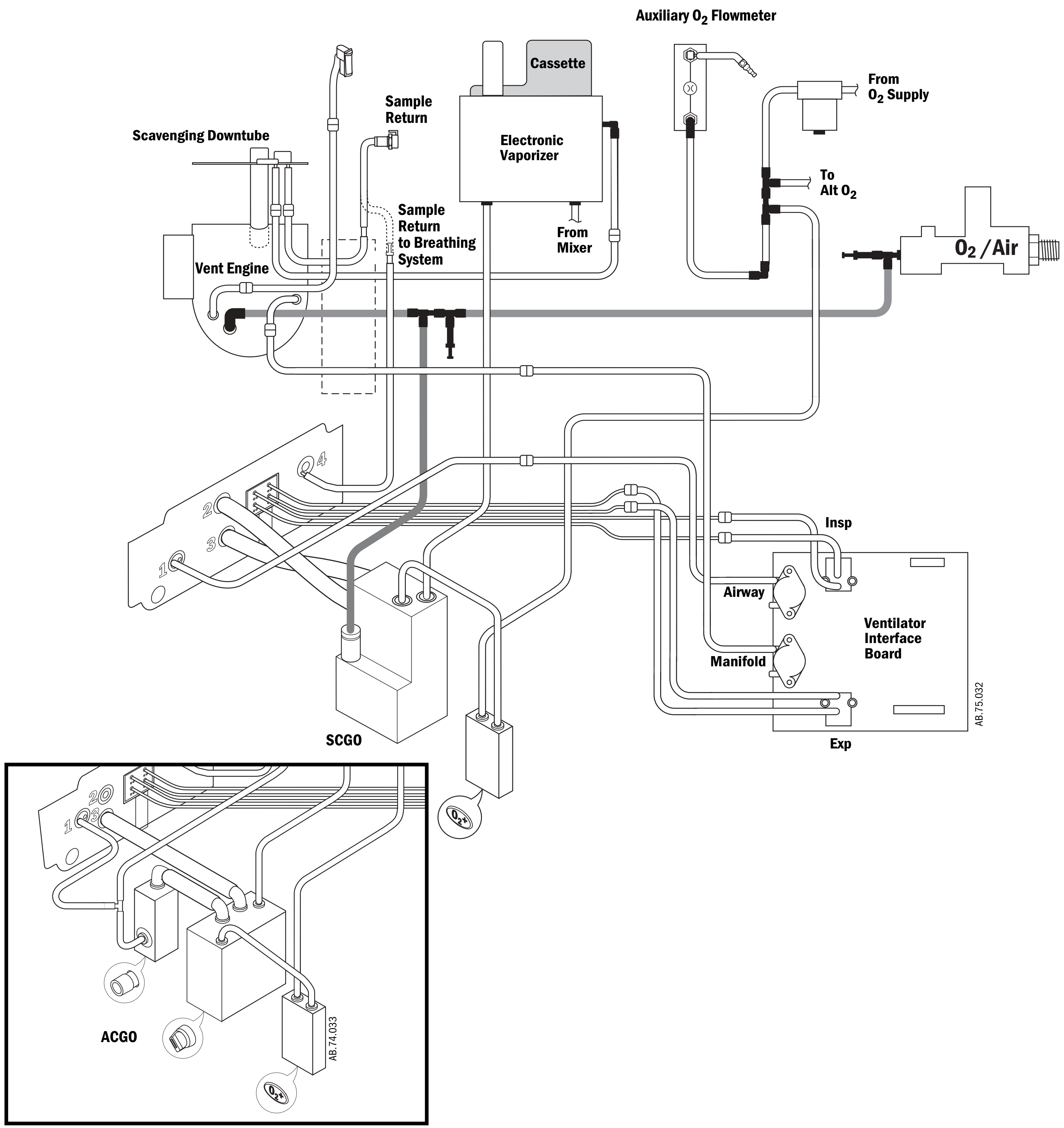
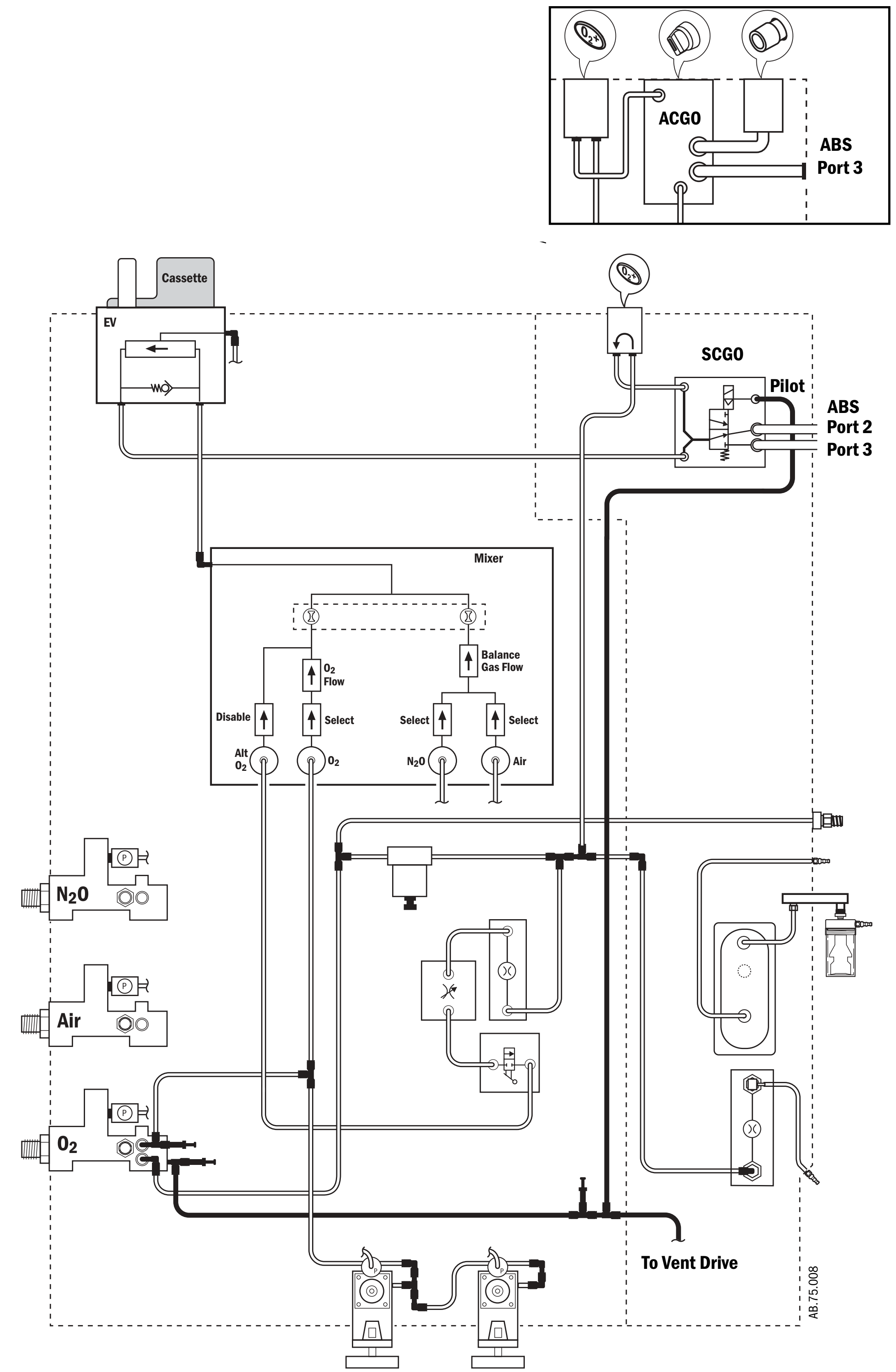


Figure 11-10 • Tubing



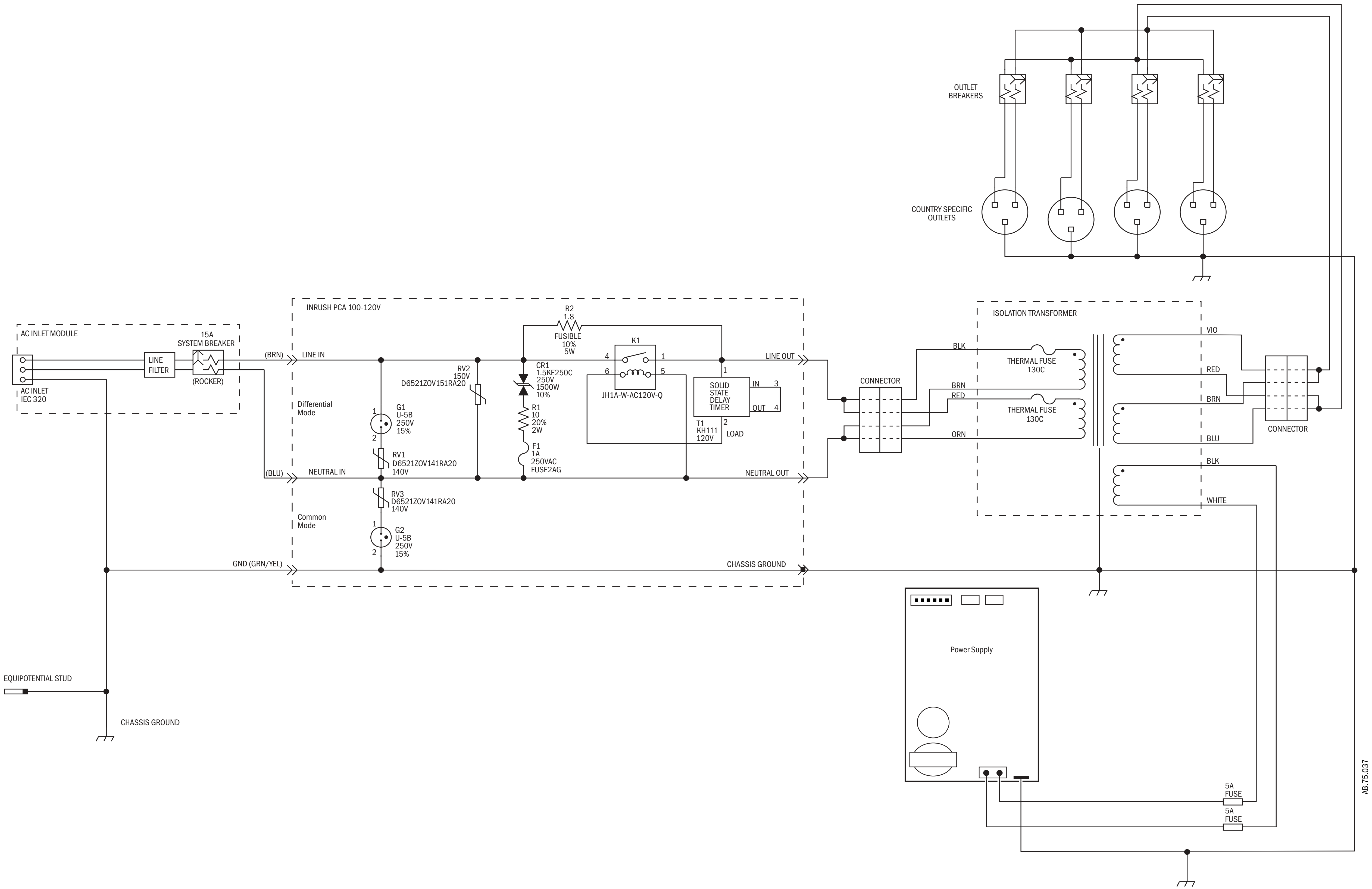


Figure 11-11 ▪ Schematic, AC Inlet module; 100–120 V (with isolated outlets)

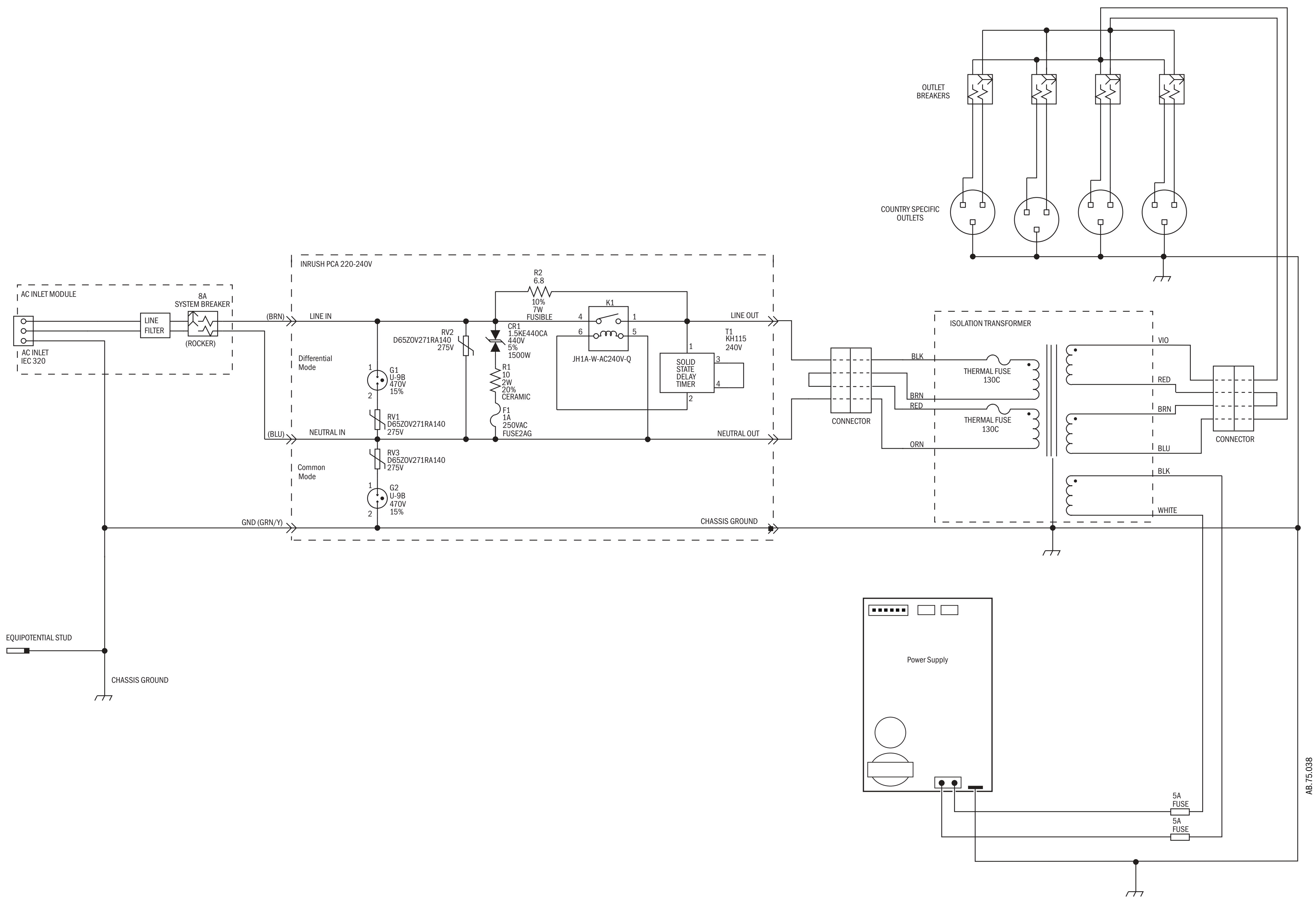


Figure 11-12 ▪ Schematic, AC Inlet module; 220–240 V (with isolated outlets)

Notes

12 Service Application

In this section

12.1 Aisys Service Application (PC based)

This section documents the Aisys Service Application that run on a Windows based computer and communicates with the Display Unit through the serial port.

12.1.1 PC Requirements

Minimum requirements to run the application include:

- Personal computer using a Pentium 600 or higher microprocessor
- Windows 2000/XP
- 1024 by 768 resolution (or higher) video adapter
- Minimum of 128 MB of RAM, 256 MB recommended
- About 150 MB free hard disk space
- Microsoft-compatible mouse or equivalent device
- Serial Port or USB port w/ RS-232 adapter

The PC used should meet the GE laptop standards.

Port Setup

To enable communication between the DU and the PC Service Application, the system must be in the Service mode.

The service application communicates with the system through Com1 port.

Note: Ensure that no other application (such as PDA hot-sync) is using this port while the Service Application is running.

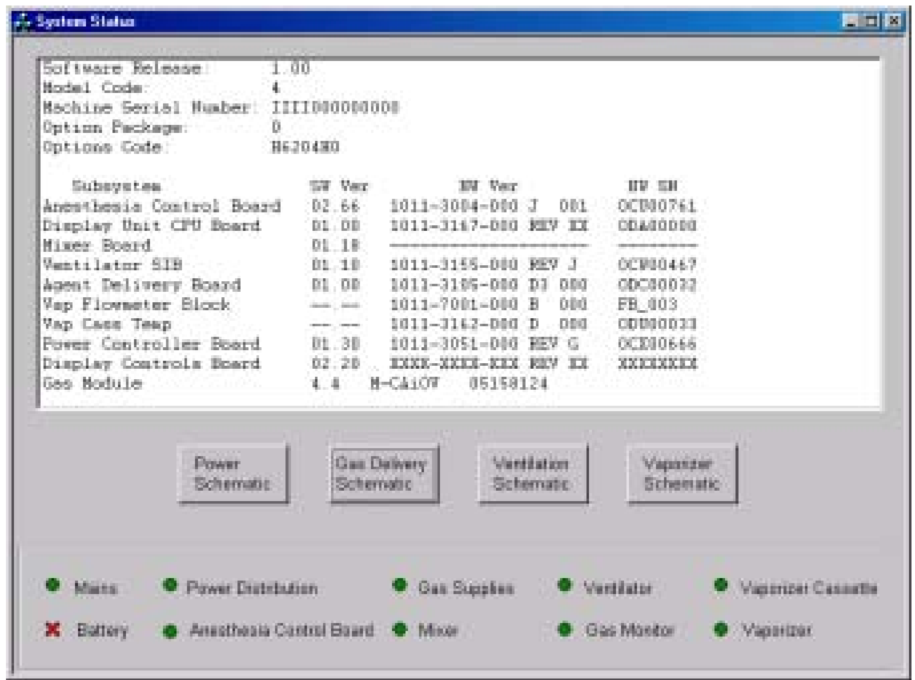
Startup Screen

Launching the Service Application opens the startup screen (Main Menu). The startup screen establishes proper communications with the system.

12.2 Main Menu - System Status

If proper communication is established, the main menu displays the software and hardware revisions of various subsystems in the tested machine.

If there is a communication problem with the system, an error message is displayed and the connection is not completed.



A series of indicator lights at the bottom of the screen give an overall assessment of the system.

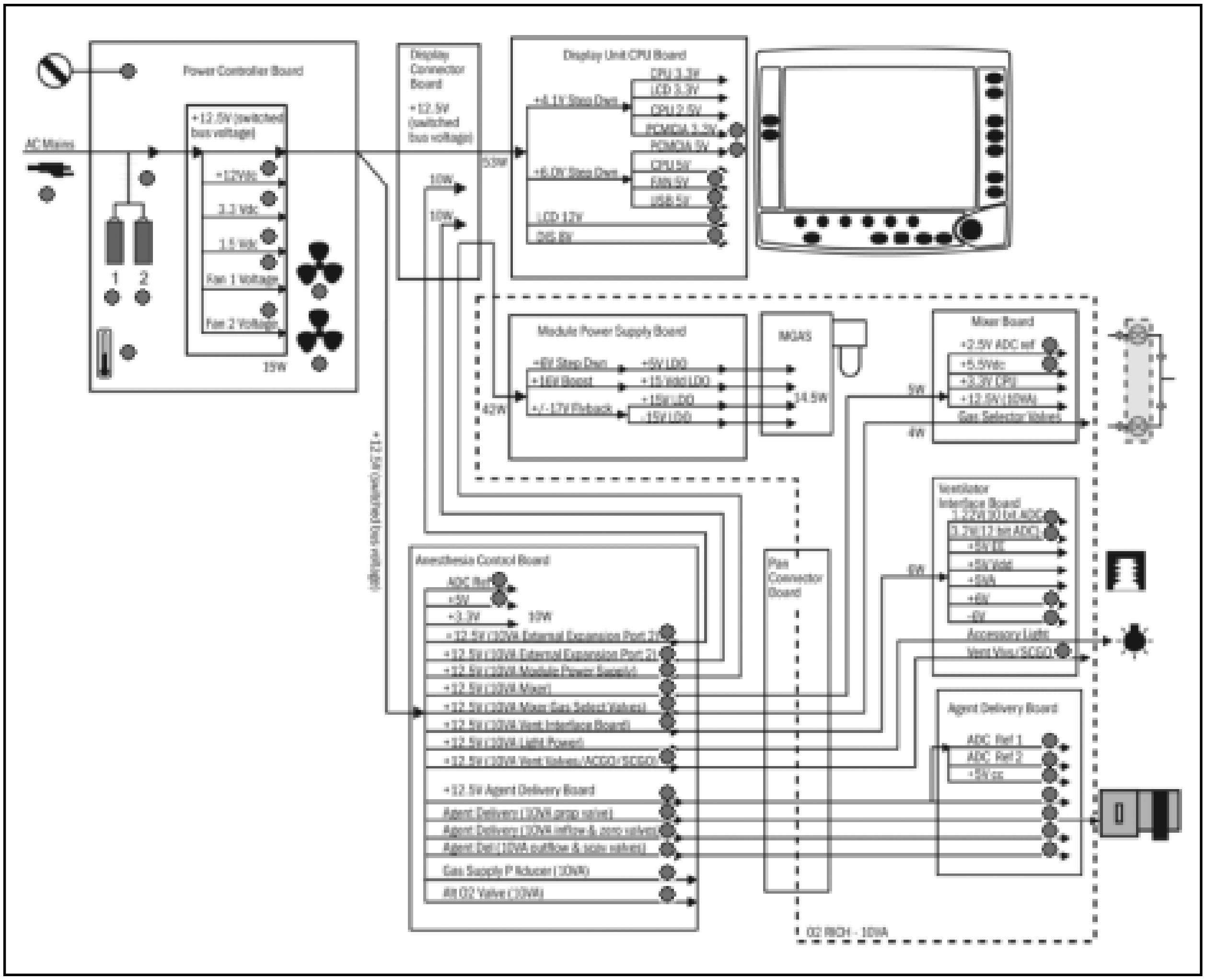
- a green bullet indicates proper operation of the subsystem.
- a red X indicates a failed condition in the subsystem.

Schematics

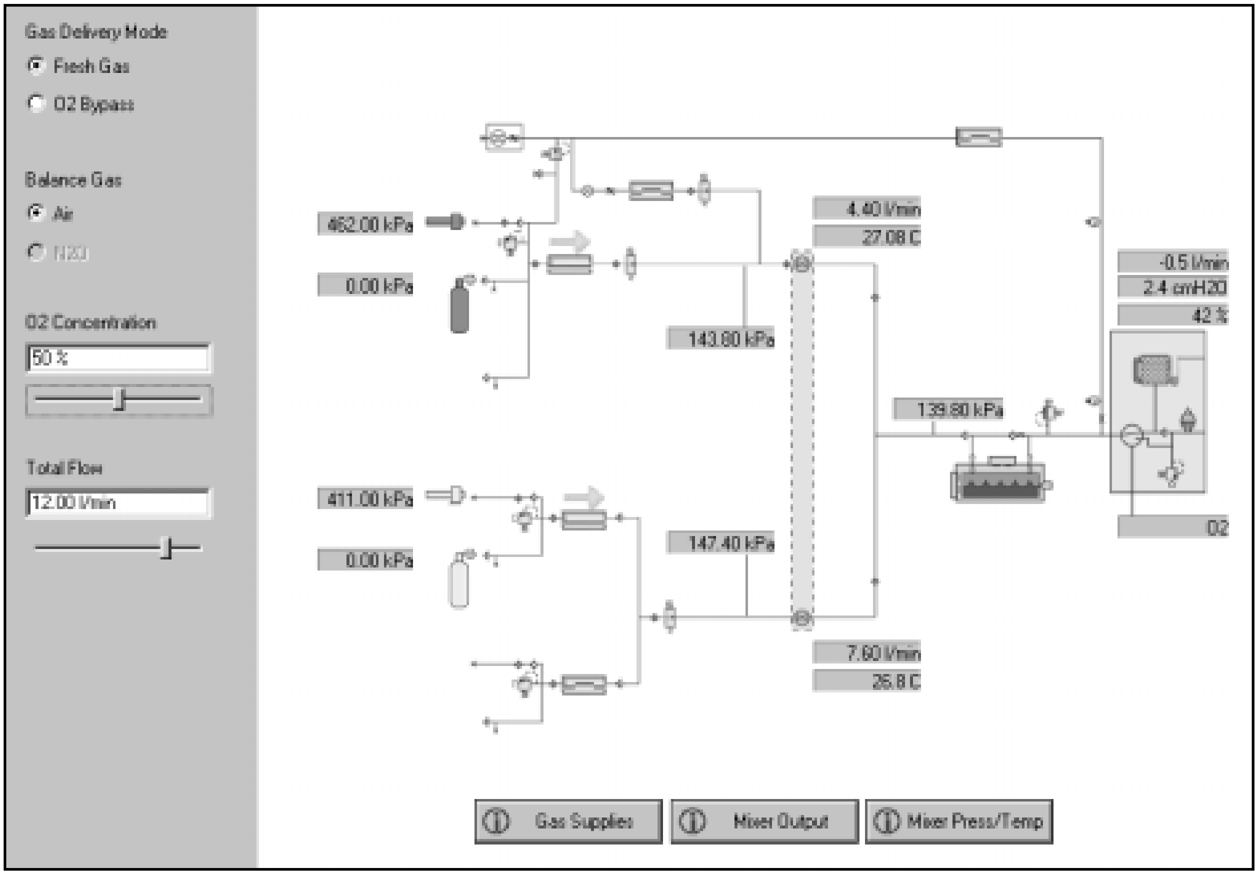
The main menu includes four selection buttons that provide direct access to the schematical representation of a subsystem as shown in the following sections.

- The Power Schematic (*Section 12.2.1*) indicates the condition of power supplies throughout the system.
- The Gas Delivery (*Section 12.2.2*), Ventilation (*Section 12.2.3*), and Vaporizer (*Section 12.2.4*) schematics include control devices that allow direct manipulation of components in the subsystem and displays the resulting output values for select downstream components.

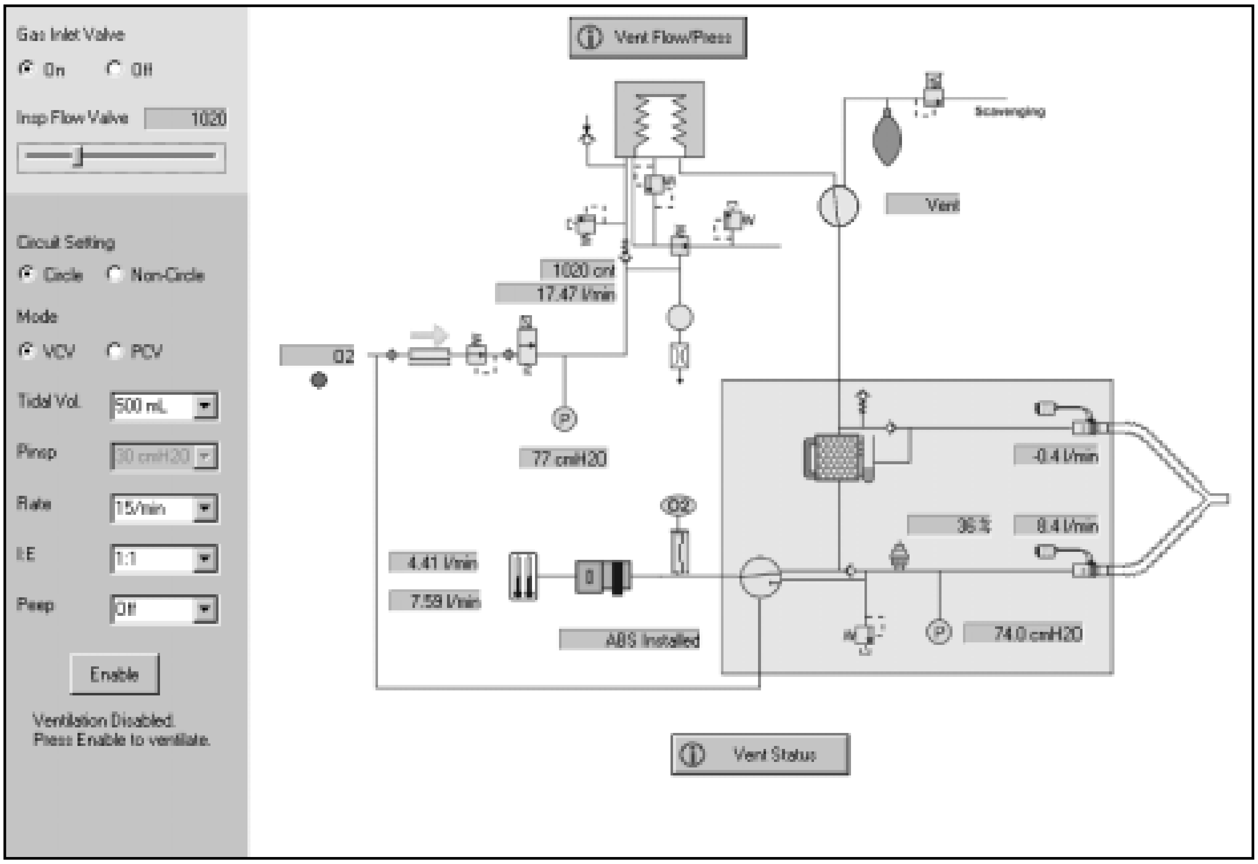
12.2.1 Power Schematic



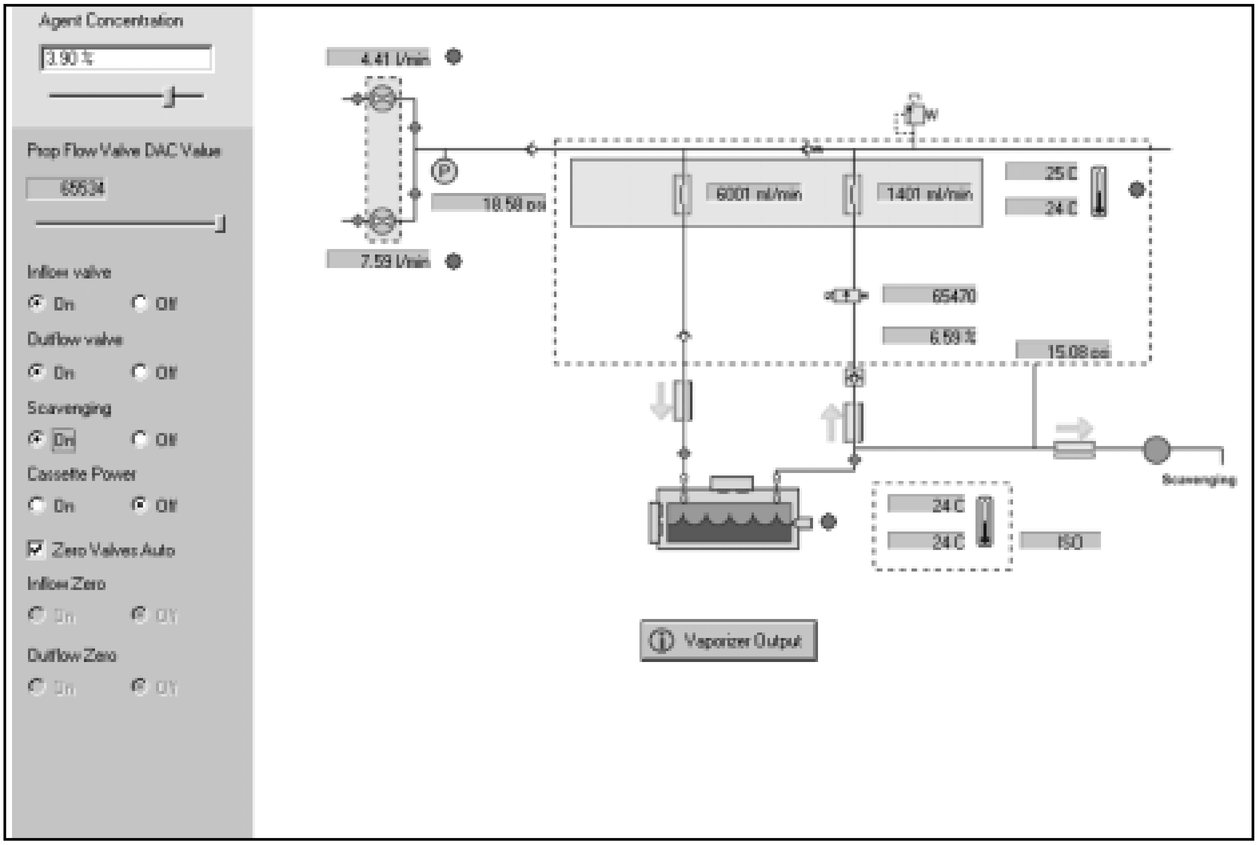
12.2.2 Gas Delivery Schematic



12.2.3 Ventilation Schematic



12.2.4 Vaporizer Schematic



12.3 Menu Items

In addition to the schematic representations, the Service Application provides access to diagnostic screens through the following menu item structure.

File (*Section 12.4*)
- Preferences (*Section 12.4.1*)
- Exit

Tools (*Section 12.5*)
- Communication Status (*Section 12.5.1*)
- System Calibration (*Section 12.5.2*)
- Transfer Logs (*Section 12.5.3*)

Power Diagnostics (*Section 12.6*)
- Power Schematic (*Section 12.2.1*)
- Power Board (*Section 12.6.1*)
- Anesthesia Computer Board Power (*Section 12.6.2*)
- Mixer Board Power (*Section 12.6.3*)
- Ventilator Interface Board Power (*Section 12.6.4*)
- Display Unit Power (*Section 12.6.5*)
- Vaporizer Power (*Section 12.6.6*)

Gas Delivery Subsystem (*Section 12.7*)
- Gas Delivery Schematic (*Section 12.2.2*)
- Gas Supply Status (*Section 12.7.1*)
- Mixer Output (*Section 12.7.2*)
- Mixer Pressure and Temperature (*Section 12.7.3*)
- Gas Delivery Status (*Section 12.7.4*)
- Mixer Post/Checkout Test Results (*Section 12.7.5*)
- Perform Mixer Checkout Tests (*Section 12.7.6*)

Ventilation Subsystem (*Section 12.8*)
- Ventilation Schematic (*Section 12.2.3*)
- Ventilation Status (*Section 12.8.1*)
- Ventilation Flow and Pressure (*Section 12.8.2*)

Vaporizer Subsystem (*Section 12.9*)
- Vaporizer Schematic (*Section 12.2.4*)
- Vaporizer Output (*Section 12.9.1*)
- Perform Vaporizer Test (*Section 12.9.2*)

Window (*Section 12.10*)
- standard “Window” manipulation items
- (list of all open windows)

Help (*Section 12.11*)
- About

12.4 File menu

The File menu includes the following menu items:

- Preferences (*Section 12.4.1*)
- Exit

12.4.1 Preferences

Unit Selection	
Label	**Value**
Gas Supply Pressure	kPa psi bar
Pressure Units	cmH2O kPa hPa mmHg
Temperature Units	Celsius Fahrenheit
Gas Color Code	ANSI ISO

12.5 Tools menu

The Tools menu includes the following menu items:

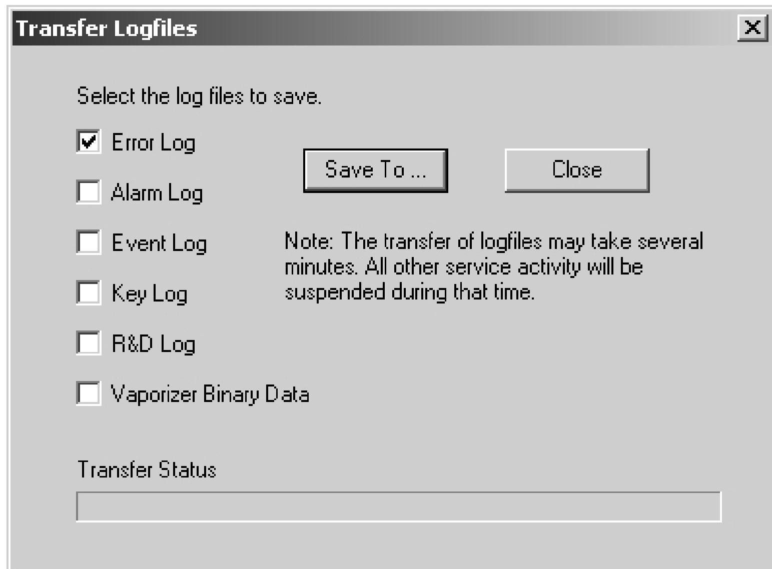
- Communication Status (*Section 12.5.1*)
- System Calibration (*Section 12.5.2*)
- Transfer Logs (*Section 12.5.3*)

12.5.1 Communication Status

Communications Status	
Label	**Value**
Anesthesia Control Board	OK, Fail
Mixer Board	OK, Fail
Ventilator Interface Board	OK, Fail
Agent Delivery Board	OK, Fail
Power Controller Board	OK, Fail
Controls (Front Panel) Board	OK, Fail
Gas Module (MGas)	OK, Fail, not detected

12.5.2 System Calibrations

12.5.3 Transfer Logs



12.6 Power Diagnostics menu

The Power Diagnostics menu includes the following menu items:

- Power Schematic (*Section 12.2.1*)
- Power Board (*Section 12.6.1*)
- Anesthesia Computer Board Power (*Section 12.6.2*)
- Mixer Board Power (*Section 12.6.3*)
- Ventilator Interface Board Power (*Section 12.6.4*)
- Display Unit Power (*Section 12.6.5*)
- Vaporizer Power (*Section 12.6.6*)

12.6.1 Power Board

Power Board			
Label	**Value Format**	**Units**	**Range**
12Vdc Supply	XX.XX	Vdc	11.82 - 12.18
3.3Vdc Supply	X.XXX	Vdc	3.201 - 3.399
1.5 Vdc Supply	X.XXX	Vdc	1.45 - 1.55
Battery Connected	Yes, No		
Calc Battery Time	XX	Min	0 - 30
Battery 1 Volts Battery 2 Volts	XX.X < 6.0 FAIL (red) <10 T Chg (yellow) 10-15.5 (Green)	Vdc	10.0 - 15.5
Battery Current	X.XXX	A	
Battery Status	Fail, Bulk Chg, Over Chg, Float Chg, Trickle Chg, Discharge		
Date battery Tested	--/--/---		
Last Full Discharge	XX	Min	
Board Temperature	<65C OK (green) >65C <75C Warn (Yellow) >75C Fail (red)	Deg C	max 64 (C)
Fan Speed	Slow, Fast		
Fan 1 Voltage	XX.XX	Vdc	Fast 11.52 - 12.48 Slow10.08 - 10.92
Fan 1 Status	Low, High, Fail, OK		
Fan 2 Voltage	XX.XX	Vdc	Fast 11.52 - 12.48 Slow10.08 - 10.92
Fan 2 Status	Low, High, Fail, OK		

12.6.2 Anesthesia Computer Board Power

Anesthesia Board Power			
Label	**Value**	**Units**	**Normal range**
12 Vdc Supply	XX.XX	Vdc	11.90 to 12.90
ADC Ref	X.XXX	Vdc	4.018 to 4.176

Label	Value	Label	Value
Gas Select 10VA Volts	OK, Fail	Periph1 10VA Volts	OK, Fail
Gas Select 10VA Amps	OK, Fail	Periph1 10VA Amps	OK, Fail
Press Transducer 10VA Amps	OK, Fail		
		Periph2 10VA Volts	OK, Fail
Vent Interface Board 10VA Volts	OK, Fail	Periph2 10VA Amps	OK, Fail
Vent Interface Board 10VA Amps	OK, Fail		
Vent Valves 10VA Volts	OK, Fail	Agent Delivery 10VA Volts	OK, Fail
Vent Valves 10VA Amps	OK, Fail	Agent Delivery 10VA Amps	OK, Fail
Acces 1 10VA Volts	OK, Fail	Agent Deliv Prop Valve 10VA Volts	OK, Fail
Acces 1 10VA Amps	OK, Fail	Agent Deliv Prop Valve 10VA Amps	OK, Fail
Gas Unit 10VA Volts	OK, Fail	Agent Deliv Inflow and Zero 10VA Volts	OK, Fail
Gas Unit 10VA Amps	OK, Fail	Agent Deliv Inflow and Zero 10VA Amps	OK, Fail
Mixer 10VA Volts	OK, Fail	Agent Deliv Outflow an Scav 10VA Volts	OK, Fail
Mixer 10VA Amps	OK, Fail	Agent Deliv Outflow and Scav 10VA Amps	OK, Fail
Alt O2 10VA Volts	OK, Fail		
Alt O2 10VA Amps	OK, Fail		

12.6.3 Mixer Board Power

Mixer Board Power			
Label	**Value Format**	**Units**	**Range**
Mixer 10VA Volts	OK, Fail		
12.5 V	XX.X	Vdc	11.8 - 13.0
5.5V	X.XX	Vdc	5.39 - 5.61
3.3V CPU	X.XX	Vdc	3.22 - 3.38
2.5V ADC Ref	X.XX	Vdc	2.47 - 2.53

12.6.4 Ventilator Interface Board Power

Ventilator Interface Board Power			
Label	**Value Format**	**Units**	**Range**
Vent Board 10VA Volts	OK, Fail		
Vent Valves 10VA Volts	OK, Fail		
Vent Board 12.5V	XX.XX	Vdc	11.3 -13.13
Vent Valves 12.5V	XX.XX	Vdc	11.3 -13.13
3.2Vdc (12bit Vref)	X.XXX XXXX	Vdc Counts	3.179 - 3.221
1.22Vdc (10bit Vref)	X.XXX XXXX	Vdc Counts	1.074 - 1.367
+6.0Vdc	X.XX	Vdc	5.51 - 6.5
-6.0Vdc	-X.XX	Vdc	-6.72 - -5.28

12.6.5 Display Unit Power

Display Unit Power			
Label	**Value Format**	**Units**	**Normal range**
5.0Vdc (PCMCIA)	X.XX	Vdc	4.50 - 5.5
3.3Vdc (PCMCIA)	X.XX	Vdc	2.97 - 3.63
5.0Vdc (Fan)	X.XX	Vdc	4.5 - 5.5
5.0Vdc (USB)	X.XX	Vdc	4.5 - 5.5
8.0Vdc (DIS)	X.XX	Vdc	7.2 - 8.8
11Vdc (LCD)	XX.XX	Vdc	10.35 - 13.62

12.6.6 Vaporizer Power

Vaporizer Power			
Label	**Value Format**	**Units**	**Range**
ADB +12.0V	X.XX	Vdc	11.1 - 12.9
ADC Ref 1	X.XX	Vdc	3.99 - 4.2
ADC Ref 2	X.XX	Vdc	3.99 - 4.2
DB +5V Vcc	X.XX	Vdc	4.625 - 5.375
Agent Delivery 10VA Volts	OK, Fail		
Agent Deliv Prop Valve 10VA Volts	OK, Fail		
Agent Deliv Inflow and Zero 10VA Volts	OK, Fail		
Agent Deliv Outflow and Scav 10VA Volts	OK, Fail		

12.7 Gas Delivery Subsystem menu

The Gas Delivery Subsystem menu includes the following menu items:

- Gas Delivery Schematic (*Section 12.2.2*)
- Gas Supply Status (*Section 12.7.1*)
- Mixer Output (*Section 12.7.2*)
- Mixer Pressure and Temperature (*Section 12.7.3*)
- Gas Delivery Status (*Section 12.7.4*)
- Mixer Post/Checkout Test Results (*Section 12.7.5*)
- Perform Mixer Checkout Tests (*Section 12.7.6*)

12.7.1 Gas Supply Status

Gas Supply Status		
Label		**Range**
O2 Cylinder 1	XXXX	0 - 67580 kPa
O2 Cylinder 2	XXXX	0 - 67580 kPa
Air Cylinder	XXXX	0 - 67580 kPa
N2O Cylinder	XXXX	0 - 9805 kPa
O2 Pipeline	XXXX	0 - 697 kPa
Air Pipeline	XXXX	0 - 697 kPa
N2O Pipeline	XXXX	0 - 697 kPa
O2 Select Valve	Open, Closed (Open = connected to Mixer)	
Air Select Valve	Open, Closed (Open = connected to Mixer)	
N2O Select Valve	Open, Closed (Open = connected to Mixer)	
Alt O2 Valve	Open, Closed (Open = O2 bypass)	
Alt O2 Button	Not Pressed, Pressed	
O2 Flush	Not Pressed, Pressed	
Gas Outlet Config.	Circle, SCGO, ACGO	

12.7.2 Mixer Output

Mixer Output			
Label	**Value**	**Units**	**Range**
O2 Flow	XX.X	l/min	0.1 - 15
O2 Flow Verify	XX.X	l/min	2 - 18
O2 Flow Signal	XX	Vdc	0.0986 to 4.01 Vdc
O2 Prop Valve Drive	XX.X	mA	25 mA to 180 mA
Balance Gas ID	None, Air, N2O		
Balance Flow	XX.X	l/min	0.1 - 15 for Air 0.1 - 12 for N2O
Balance Flow Verify	XX.X	l/min	2 - 18 for Air 2 - 14.4 for N2O
Balance Flow Signal	X.XXX	Vdc	0.0986 to 4.01 Vdc
Balance Prop Valve Drive	XXXX	mA	25 mA to 180 mA
O2 Select Valve	Open/Closed		
Air Select Valve	Open/Closed		
N2O Select Valve	Open/Closed		
ADC Ref Voltage	X.XXX	Vdc	2.47 - 2.53 volts

12.7.3 Mixer Pressure and Temperature

Mixer Pressure and Temperature			
Label	**Value**	**Units**	**Range**
O2 Pressure	XX.XX		9 - 35 (psi)
O2 Pressure Cal	X.XXX	Vdc	0.25 - 3.00
Balance Pressure	XX.XX		9 - 35 (psi)
Balance Pres Cal	X.XXX	Vdc	0.25 - 3.00
Mixer Output Pres	XX.XX		9 - 30 (psi)
Mixer Output Pres Cal	X.XXX	Vdc	0.25 - 3.00
O2 Temp	XX.X		5 - 50 (C)
O2 Temp Volts	X.XXX	Vdc	0.25 - 3.00
Balance Temp	XX.X		5 - 50 (C)
Balance Temp Volts	X.XXX	Vdc	0.25 - 3.00

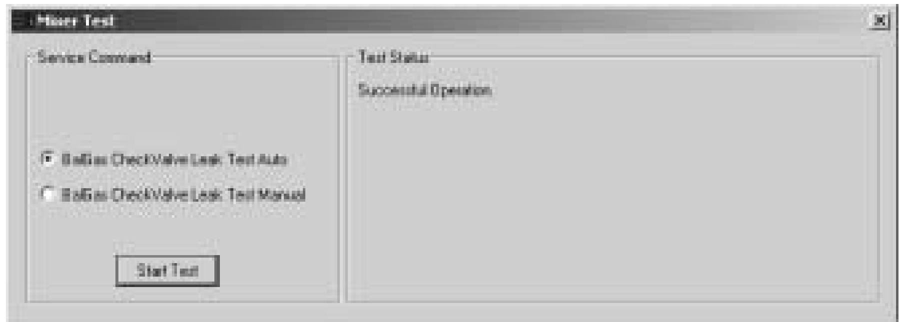
12.7.4 Gas Delivery Status

Gas Delivery Status			
Label	**Value**	**Units**	**Range**
O2 Flow	XX.X	l/min	0.1 - 15.8
Air Flow	XX.X	l/min	0.1 - 15.8
N2O Flow	XX.X	l/min	0.1 - 15.8
Agent	XXX	(requires Gas Module)	
Agent %	X.XX	(requires Gas Module)	
Circuit	ACGO, SCGO		

12.7.5 Mixer Post/Checkout Test Results

Mixer Post/Checkout Test Results	
Label	**Test Results**
O2 Valve Leak	Pass Fail. O2 Bypass valve leaks
Alt O2 Valve Leak	Pass not performed (if O2 Valve Leak fails) Not done. No supply pressure Not done. Selector valve incorrect state Fail. Selector valve leaks Fail. Proportional valve leaks
Balance Gas Valve Leak	Pass Not done. No supply pressure Not done. Selector valve incorrect state Fail. Selector valve leaks Fail. Proportional valve leaks
O2 Flow Test	Pass Not done. No supply pressure Not done. Selector valve incorrect state Fail, 3 LPM test failed Fail, 10 LPM test failed
Balance Flow Test	Pass Not done. No supply pressure Not done. Selector valve incorrect state Fail, 3 LPM test failed Fail, 10 LPM test failed

12.7.6 Perform Mixer Checkout Tests



12.8 Ventilation Subsystem menu

The Ventilation menu includes the following menu items:

- Ventilation Schematic (*Section 12.2.3*)
- Ventilation Status (*Section 12.8.1*)
- Ventilation Flow and Pressure (*Section 12.8.2*)

12.8.1 Ventilation Status

Ventilator Status	
Label	**Value**
Vent Drive Gas	Air or O2
ABS Installed	Installed or Not Installed
Flush Valve	Not Pressed or Pressed
CO2 Bypass	Closed or Open
O2 Cell Status	Connected or None
Bag/Vent Switch	Bag or Vent
Circuit Feedback	Circle, Non-circle, or fault
Over Pressure Circuit	OK or High-Pressure
ACGO/SCGO Config	ACGO or SCGO
Gas Inlet Valve Feedback	Open or Closed

12.8.2 Ventilation Flow and Pressure

Ventilator Flow and Pressure				
Menu Item	**Value**	**Units**	**Range**	**Counts (0-4095)**
Inspiratory Flow	XXX.X	l/min	-120.0 l/min to 120.0 l/min	XXXX
Expiratory Flow	XXX.X	l/min	-120.0 l/min to 120.0 l/min	XXXX
Airway Pressure	XX X		-120.0 l/min to 120.0 l/min	XXXX
Manifold Pressure	XXX		-120.0 l/min to 120.0 l/min	XXXX
O2 Cell	XXX	%	5 to 110 %	XXXX
ADC Ref Voltage	X.XXX	Vdc	3.179 Vdc to 3.221 Vdc	
Flow Valve Setting	XXX.X	l/min	0.0 l/min to 140.0 l/min	XXXX
Flow Valve Feedback	xxxx	mV		XXXX
Flow Valve Current	xxxx	mA		XXXX

12.9 Vaporizer Subsystem menu

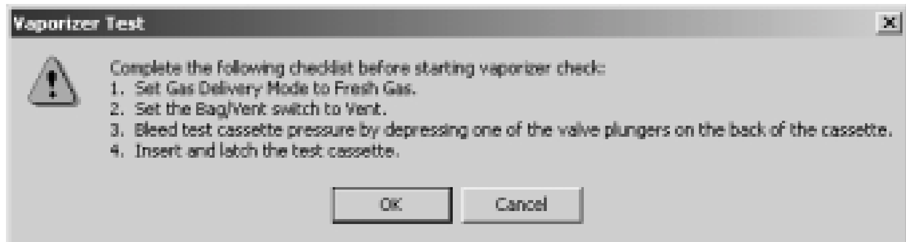
The Vaporizer menu includes the following menu items:

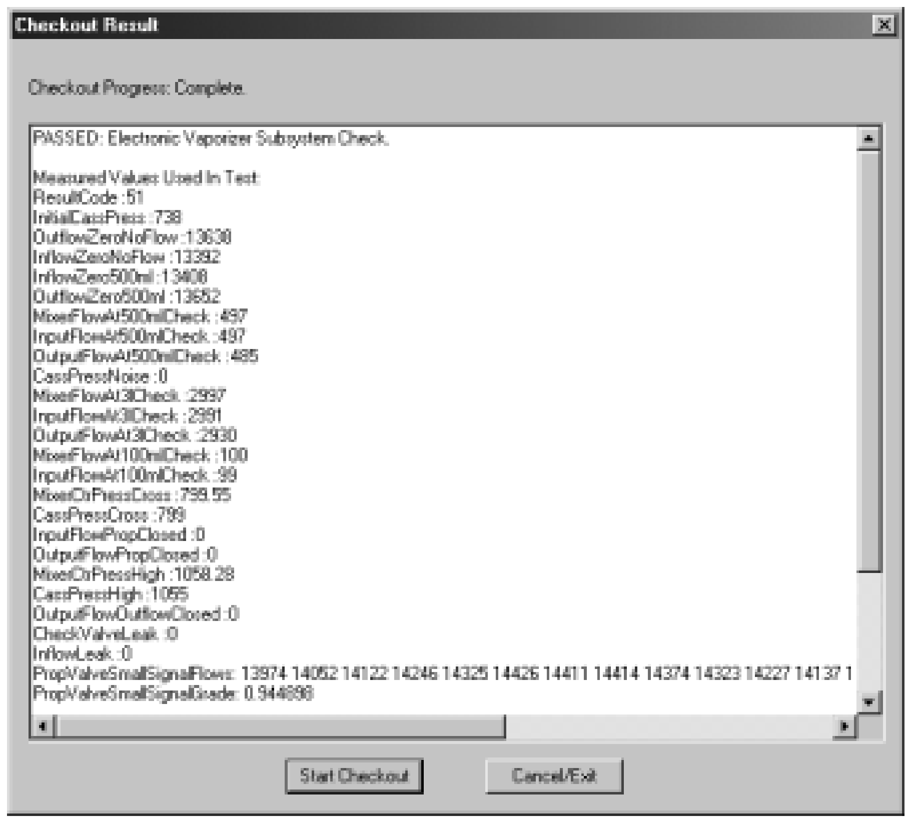
- Vaporizer Schematic (*Section 12.2.4*)
- Vaporizer Output (*Section 12.9.1*)
- Perform Vaporizer Test (*Section 12.9.2*)

12.9.1 Vaporizer Output

Vaporizer Output			
Label	**Value**	**Units**	**Range**
Cassette Temp 1	XX.X		2.5 - 50.0 C
Cassette Temp 2	XX.X		2.5 - 50.0 C
Manifold Temp 1	XX.X		2.5 - 50.0 C
Manifold Temp 2	XX.X		2.5 - 50.0 C
Input Flow	XX.X	ml/min	-200 - 6500 ml/min
Output Flow	XX.X	ml/min	-200 - 6500 ml/min
Valve Drive Sense	XX.X	mA	N/A
Cassette Pressure	XX		77.89 - 192.51 cmH2O
Agent ID	XXX		
Agent Level	Full, 3/4, Half-full, 1/4, - - - (if level can not be detected)		

12.9.2 Perform Vaporizer Test





12.10 Window menu

The Window menu includes the following menu items:

- Cascade
- Tile Horizontal
- Tile Vertical
- Close
- Close All
- (list of all open windows)

12.11 Help menu

The Help menu includes the following menu items:

About . . .

Notes

Datex-Ohmeda, Inc., a General Electric Company, going to market as GE Healthcare.
P.O. Box 7750
Madison, WI 53707-7550
USA

www.gehealthcare.com

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