Aestiva 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.

Aestiva 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 Aestiva Anesthesia Machine.

1.1 What this manual includes

Anesthesia Machine

This manual covers the service information for the Aestiva line of anesthesia machines. It covers the following components:

- gas delivery components,
- breathing system components,
- frame component (except those strictly associated with a specific ventilator).

Ventilator

The ventilators associated with the Aestiva machine have their own service manuals:

- for the Aestiva 7900 SmartVent see service manual 1006-0453-000,
- for the Aestiva 7100 Ventilator see service manual 1006-0836-000.

MRI Machine

The Aestiva MRI Anesthesia Machine includes special components that allow it to operate in an MRI environment.

- for MRI related issues see the service manual supplement 1006-0858-000.

1.2 Standard service procedures

1.2.1 Operation manuals

You must have, and be familiar with, the operation manuals for this product. Refer to the Aestiva operation manuals if you need further information about the operation of the system.

1.2.2 Service manuals

You must determine where a problem is located before you can determine which service manual to use:

- Use this manual for machine and breathing system related issues.
- Use the appropriate Ventilator service manual for ventilator related issues.
- Use the MRI service manual supplement for MRI component issues.

1.3 What is an Aestiva

The Aestiva is a flexible anesthesia delivery machine. A wide selection of frames, gases, and vaporizers give the user full control of the system configuration.

Options include pendant mounted systems, extra gas cylinders or vaporizers, and left-hand (LH) or right-hand (RH) breathing systems (TNA).

Components	Number of vaporizers	Number of gases	Optional gases (CO_2 cylinder only)	Breathing system and ventilator display mounting	Total number of cylinders (2 per gas maximum)
2-Vap Trolley	2	2 or 3	Air or Heliox; CO_2	Left or Right	Up to 4
3-Vap Trolley	3	2, 3, or 4	Air, Heliox, CO_2 (up to two)	Left or Right	Up to 5
Pendant	2	2 or 3	Air or Heliox; CO_2	Left or Right	Up to 2
MRI	2	2 or 3	Air or Heliox; CO_2	TNA Left; 7900 display center	Up to 4
Compact	2	2 or 3	Air or CO_2	Left	Up to 4
Compact wall-rail mount	2	2 or 3	Air	Left	Up to 2
Induction	2	2 or 3	Air or CO_2	None (LH machine)	Up to 4
Induction wall-rail mount	2	2 or 3	Air	None (LH machine)	Up to 2

Ventilators and monitors

The machine can be configured with either of two microprocessor-controlled ventilators (7900 SmartVent or Aestiva 7100 Ventilator) that include monitoring of certain patient parameters.

The ventilators include communication software that can output patient data through a serial communications port.

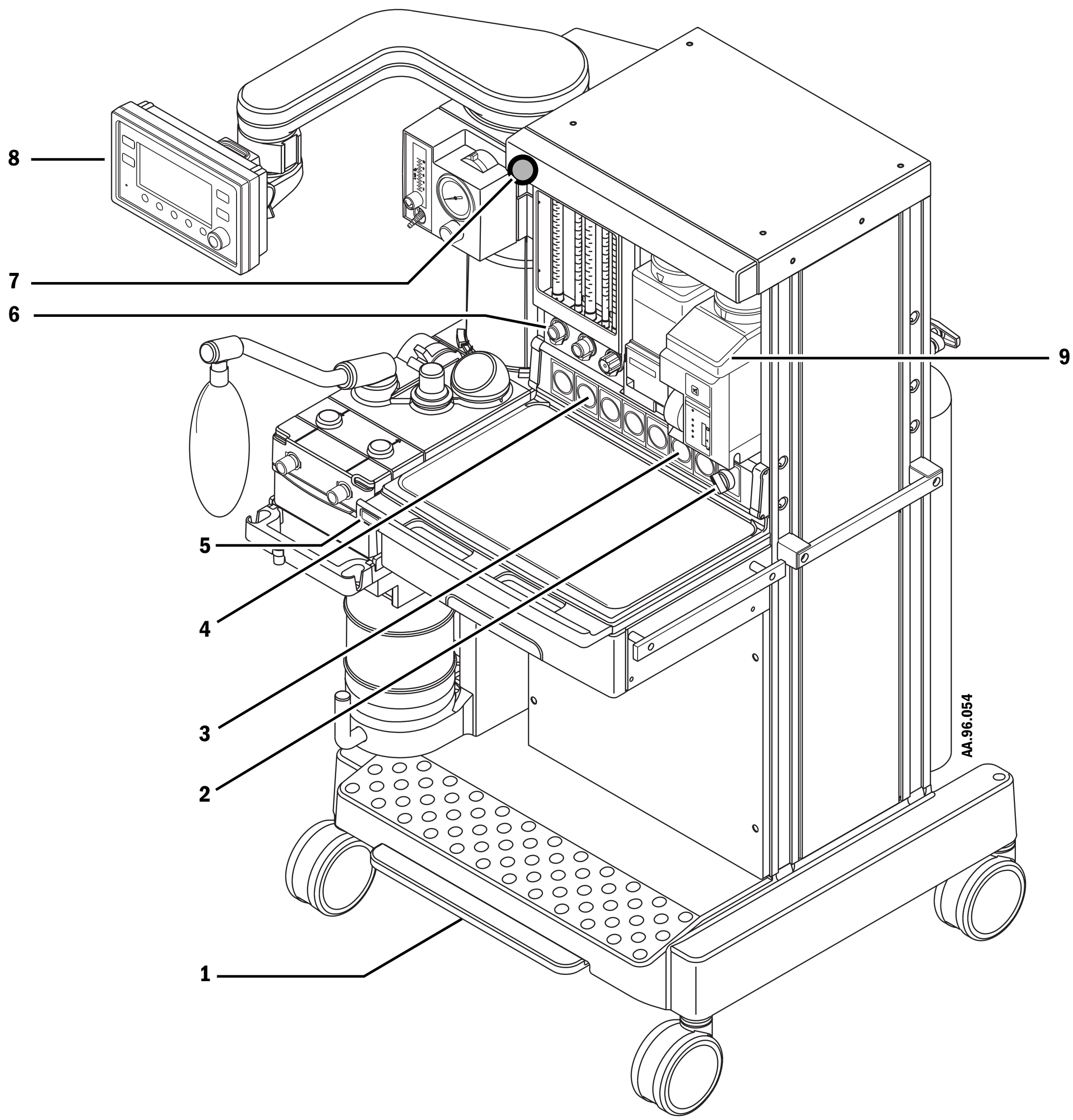
Monitoring features can be further expanded with additional Datex-Ohmeda monitors.

1.4 Configuration options

Figures 1-1 and 1-2 show the front and rear views of the machine; Figure 1-3 shows breathing system components. There are some differences between models:

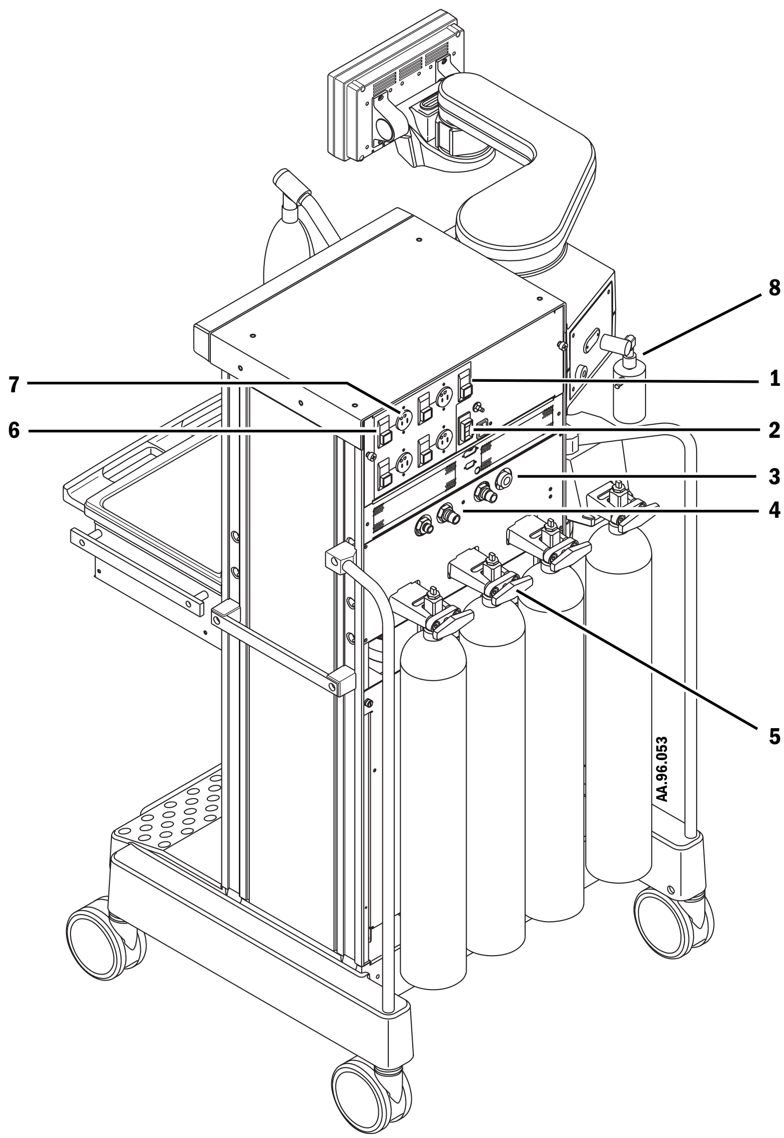
- Breathing systems can be on the left or right side. The part locations are the mirror image.
- ANSI and ISO systems use the same pneumatic manifold rotated 180°. Viewed from the rear, ANSI units have the pneumatic outlet on the right and ISO units have it on the left.
- All models use the same relative cylinder positions with the O_2 cylinder farthest from the breathing system.
- ANSI and ISO systems use the same flowhead assembly but the flowmeter modules are in opposite order.
- Machines include active or passive gas scavenging.
- Options include an auxiliary common gas outlet (ACGO), different breathing circuit modules (Circle and Bain/Mapleson D), a CO_2 (absorber) bypass, a suction regulator and an auxiliary O_2 flowmeter (in display arm), a folding mount display bracket in place of the display arm.

Note: *Newer machine variants include individual pipeline inlet manifolds in place of the single pneumatic manifold used in previous production machines. The pipeline inlets are arranged in the same order for both the ANSI and ISO units.*



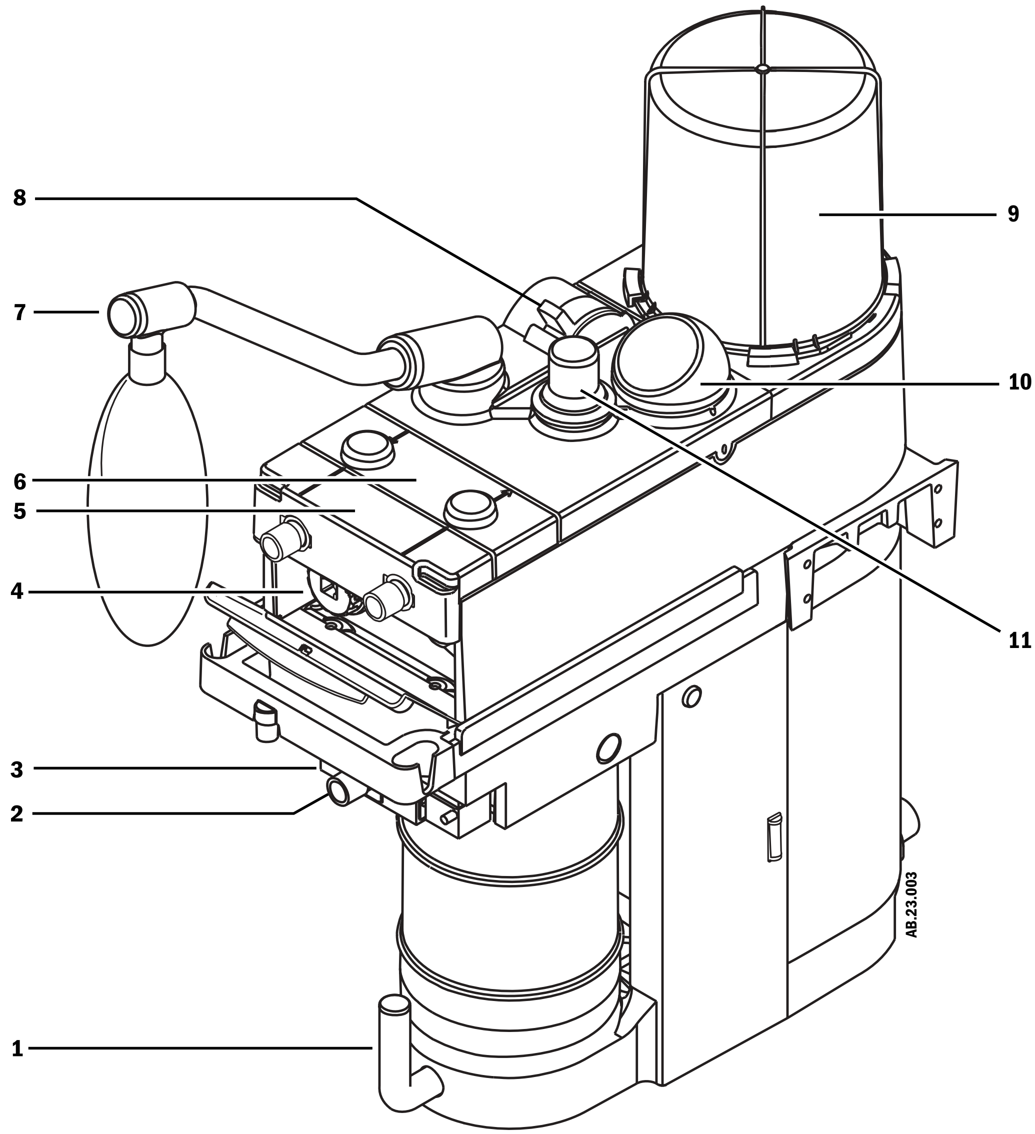
1. **Brake**
2. **System switch**
3. **Pressure gauges (cylinder)**
4. **Pressure gauges (pipeline)**
5. **O_2 Flush**
6. **Flow controls**
7. **Light switch and connector**
8. **Ventilator display**
9. **Vaporizers**

Figure 1-1 • Aestiva with 7900 Ventilator (front view)



1. **Circuit breaker(Total outlet current)**
2. **Circuit breaker (mains inlet)**
3. **Pneumatic power outlet(O_2 — DISS or ISO)**
4. **Pipeline inlets**
5. **Cylinder connections**
6. **Outlet circuit breaker**
7. **Electrical outlet**
8. **Overflow safety trap (optional suction regulator)**

Figure 1-2 • Aestiva (rear view)



1. **Canister release**
2. **Auxiliary common gas outlet — ACGO (optional)**
3. **ACGO switch**
4. **O_2 sensor**
5. **Flow sensor module**
6. **Circuit module**
7. **Bag arm**
8. **Bag/Vent switch**
9. **Bellows**
10. **Airway pressure gauge**
11. **APL valve**

Figure 1-3 • Breathing system parts

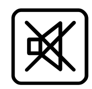
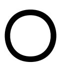
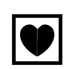
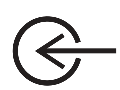
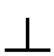
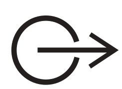
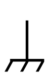
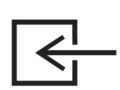
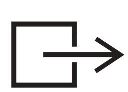
1.5 Symbols used in the manual or on the equipment

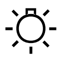
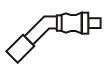
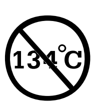
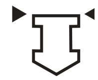
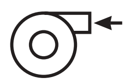
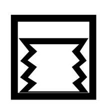
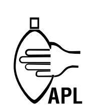
Symbols replace words on the equipment, on the display, or in Datex-Ohmeda manuals. No one device or manual uses all of the symbols.

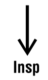
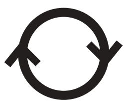
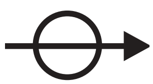
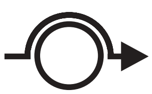
Warnings and Cautions tell you about dangerous conditions that can occur if you do not follow all instructions in this manual:

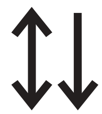
- Warnings tell about a condition that can cause injury to the operator or the patient.
- Cautions tell about a condition that can cause damage to the equipment.

Read and follow all warnings and cautions.

	On (power)		Alarm silence
	Off (power)		Alarm silence
	Standby		Type B equipment
	Standby or preparatory state for part of the equipment		Type BF equipment
	“ON” only for part of the equipment		Type CF equipment
	“OFF” only for part of the equipment		Caution, ISO 7000-0434
	Direct current		Attention, refer to product instructions, IEC 60601-1
	Alternating current		Dangerous voltage
	Protective earth ground		Electrical input
	Earth ground		Electrical output
	Frame or chassis ground		Pneumatic input
	Equipotential		Pneumatic output

+	Plus, positive polarity
-	Minus, negative polarity
	Variability
	Variability in steps
	Lamp, lighting, illumination
	This way up
	Pipeline
	Lock
	Unlock
	Close drain
	Drain (remove condensate)
	Not autoclavable
134°C	Autoclavable
⚠ ≈ cmH_2O	APL settings are approximate
⟶	Movement in one direction
⟷	Movement in two directions
	Read top of float
	Read to center of float
	Vacuum inlet
	Suction bottle outlet
	Cylinder
	Isolation transformer
	Linkage system
	Risk of Explosion.
	Low pressure leak test
	Mechanical ventilation
	Bag position/ manual ventilation
O_2+	O_2 Flush button

	Inspiratory flow
	Inspiratory flow
	Pinch hazard
	Circle breathing circuit module
	The primary regulator is set to pressure less than 345 kPa (50 psi)
	Absorber on
	Absorber off (CO_2 Bypass active)
	No battery/battery failure
REF	Stock Number
SN	Serial Number
EC REP	Authorized representative in the European Community
	Manufacturer

	Expiratory flow
	Expiratory flow
	Submenu
	Bain/Mapleson D breathing circuit module
	The primary regulator is set to pressure less than 414 kPa (60 psi)
	CO_2 Bypass Option
	EZchange Canister (CO_2 bypass)
	Battery in use. Bar indicates amount of battery power remaining.
MAX	Maximum
℞ ONLY	Caution: federal law prohibits dispensing without prescription.
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.

2 Theory of Operation

In this section

2.1 Theory overview

This section describes:

- The flow of gas through the anesthesia machine.
- The flow of gas through the breathing system.
- Electrical signals between the anesthesia machine, including the breathing system, and the ventilator.

Note Newer machine variants include individual pipeline inlet manifolds in place of the single pneumatic manifold used in previous production machines. Additionally, the common gas manifold has been redesigned (check valve removed) and the second regulator (O_2 Flush and Aux O_2) has been eliminated.

2.2 Gas flow through the anesthesia machine

2.2.1 Overview

Figure 2-4 shows the portion of the pneumatic circuit that is affected by the individual pipeline inlet manifolds and the changes to the common gas manifold.

Figure 2-5 shows the complete pneumatic circuit with the original pneumatic manifold.

Gas supplies (items 1–6)

Gas enters the system through a pipeline (**2**) or cylinder (**4**) connection. All connections have indexed fittings, filters, and check valves (one-way valves). Gauges show the cylinder (**3**) and pipeline (**1**) pressures.

A primary regulator (**5**) decreases the cylinder pressures to approximately pipeline levels. A pressure relief valve (**6**) 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 connected, keep the cylinder valve closed.

O_2 flow (items 7–14, 27)

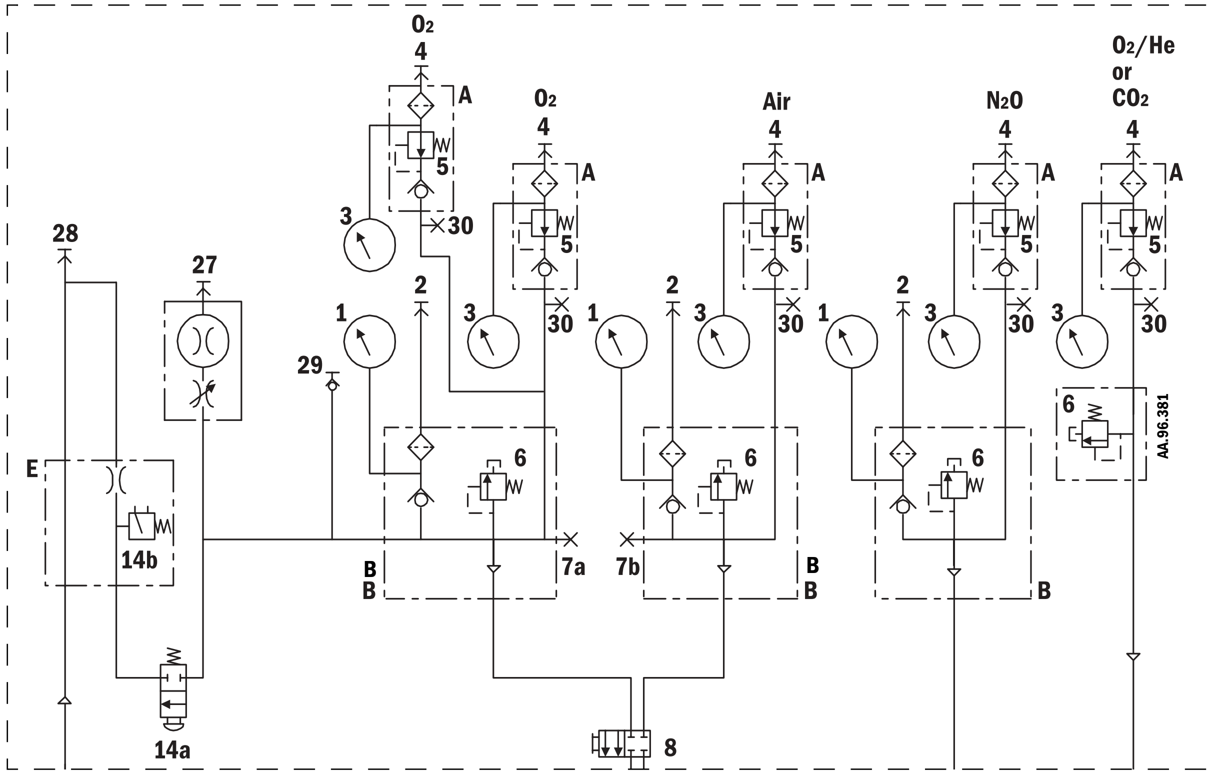
Pipeline or regulated cylinder pressure supplies O_2 directly to the pneumatic outlet and to the ventilator supply connection (**7a**). A second regulator (**13**) (not used in newer machine variants) decreases the pressure for the flush valve (**14a**) and the auxiliary flowmeter (**27**).

The flush valve supplies high flows of O_2 to the fresh gas outlet when you push the flush button. The flush pressure switch (**14b**) monitors activation of the flush valve.

When the system switch (**8**) is On, O_2 flows to the rest of the system and there is a minimum flow of 25 to 75 mL/min through the O_2 flowmeter (**12**).

A secondary regulator (**10**) supplies a constant O_2 pressure to the flowmeter.

An electrical switch (**9**) monitors the O_2 supply pressure. If the pressure is too low, an alarm appears on the ventilator display.



A. Cylinder Supply
B. Pipeline Inlet Manifold
E. Common Gas Manifold

Figure 2-4 ▪ Pneumatic circuit diagram (machines with individual pipeline inlet manifolds)

Air, N_2O, and third gas flow (items 7b, 8, and 15–23)

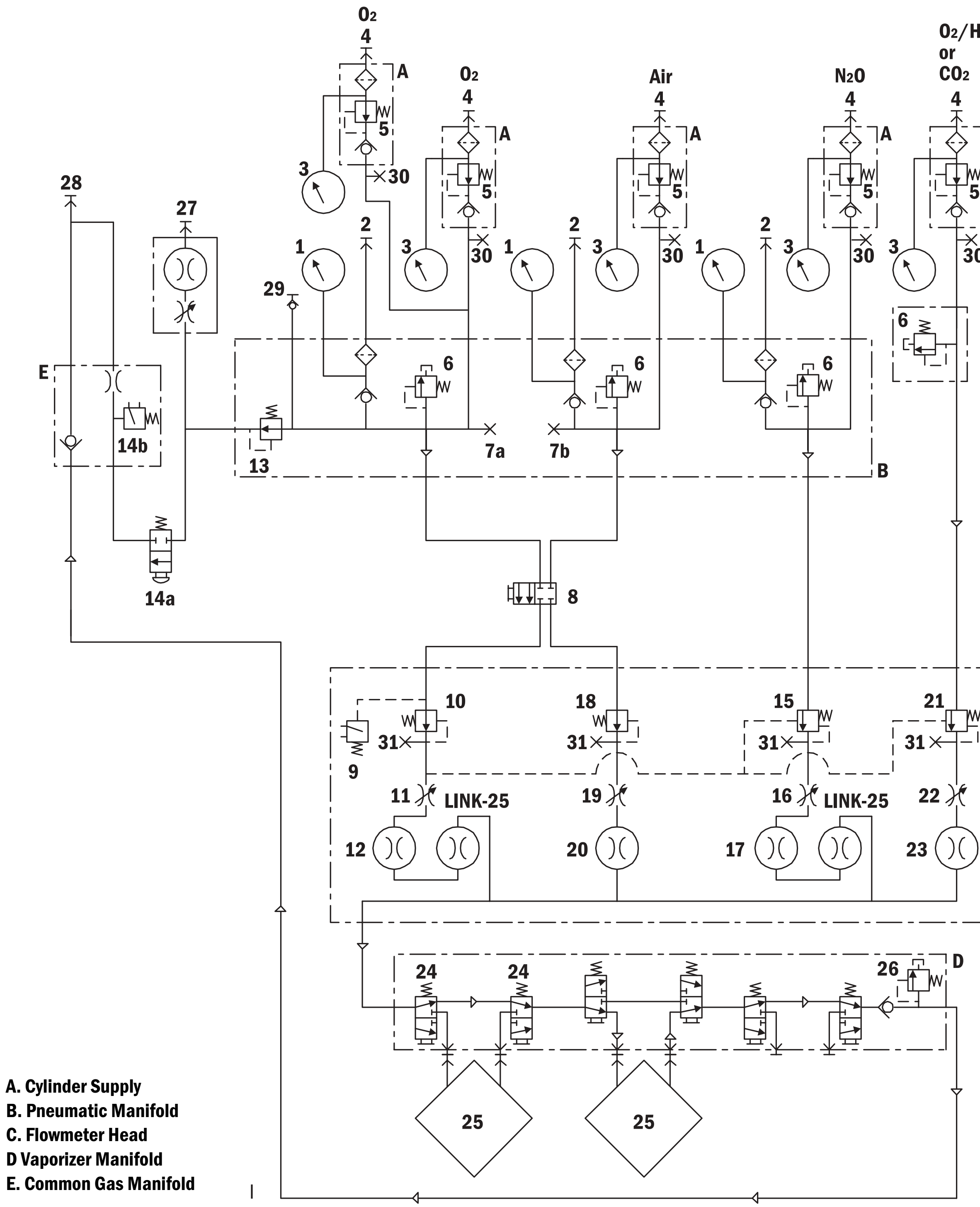
Pipeline or regulated cylinder pressure supplies Air (**7b**) directly to the ventilator (Air Ventilators). When the system switch (**8**) is On, air flows to the rest of the system. A secondary regulator (**18**) supplies the air flow control valve. Because there is no balance regulator, air flow continues at the set rate (**19**) during an O_2 supply failure.

Balance regulators (**15, 21**) control the N_2O and the optional gas (CO_2, Heliox) pressure supply to the needle valve flow controls (**16, 22**). O_2 secondary regulator pressure at a pilot port controls the output of the balance regulator. N_2O, CO_2, and Heliox output pressures drop with decreasing O_2 supply pressure and shut off hypoxic gas flow before the O_2 supply pressure reaches zero.

A chain link system (Link-25) on the N_2O and O_2 flow controls (**16, 11**) helps keep the O_2 concentration higher than 21% (approximate value) at the common gas outlet.

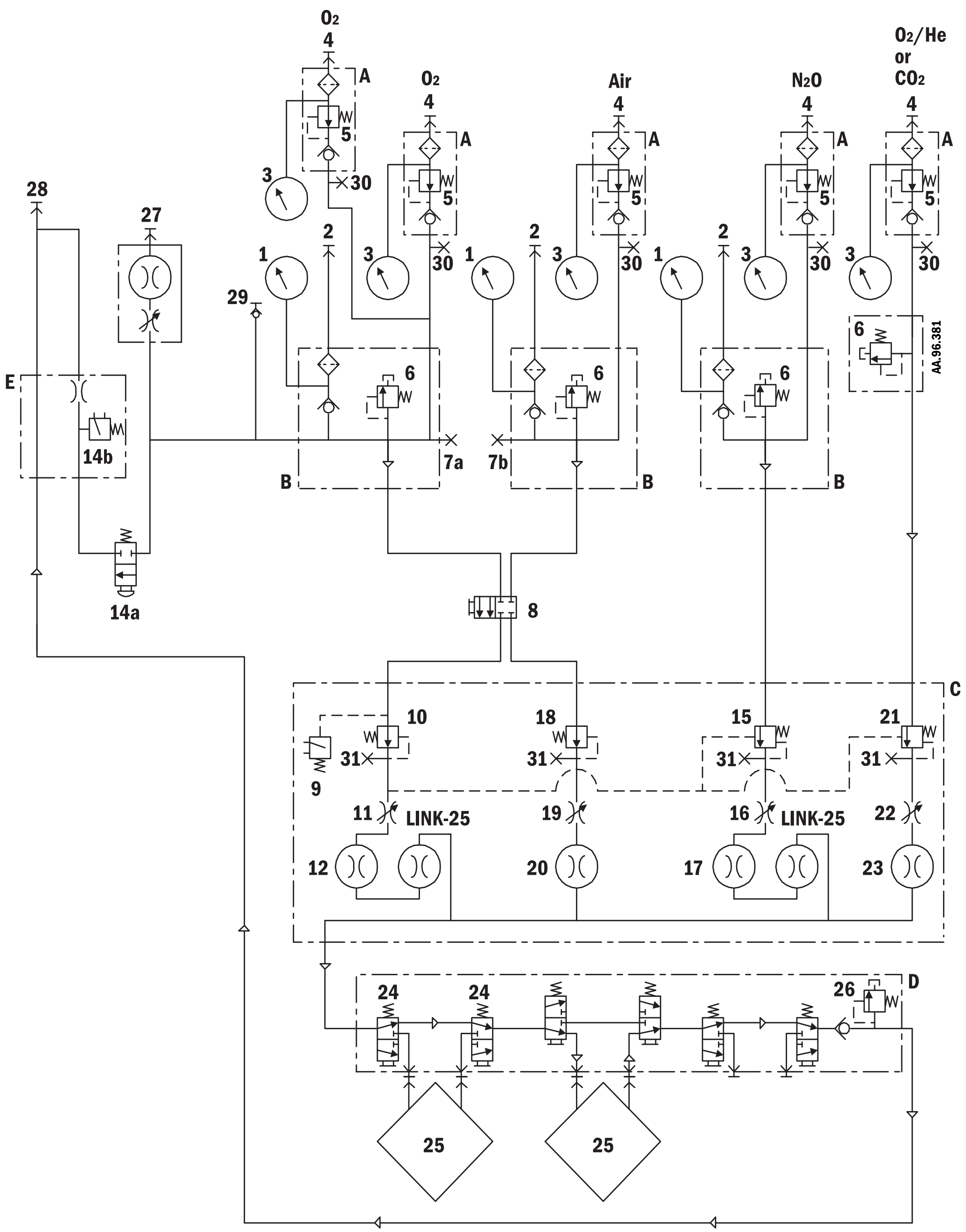
Mixed gas (items 24–26)

The mixed gas goes from the flowmeter outlet, through the vaporizer manifold and vaporizer (**25**) that is On, to the fresh gas outlet, and into the breathing system. A pressure relief valve (**26**) limits the maximum outlet pressure.



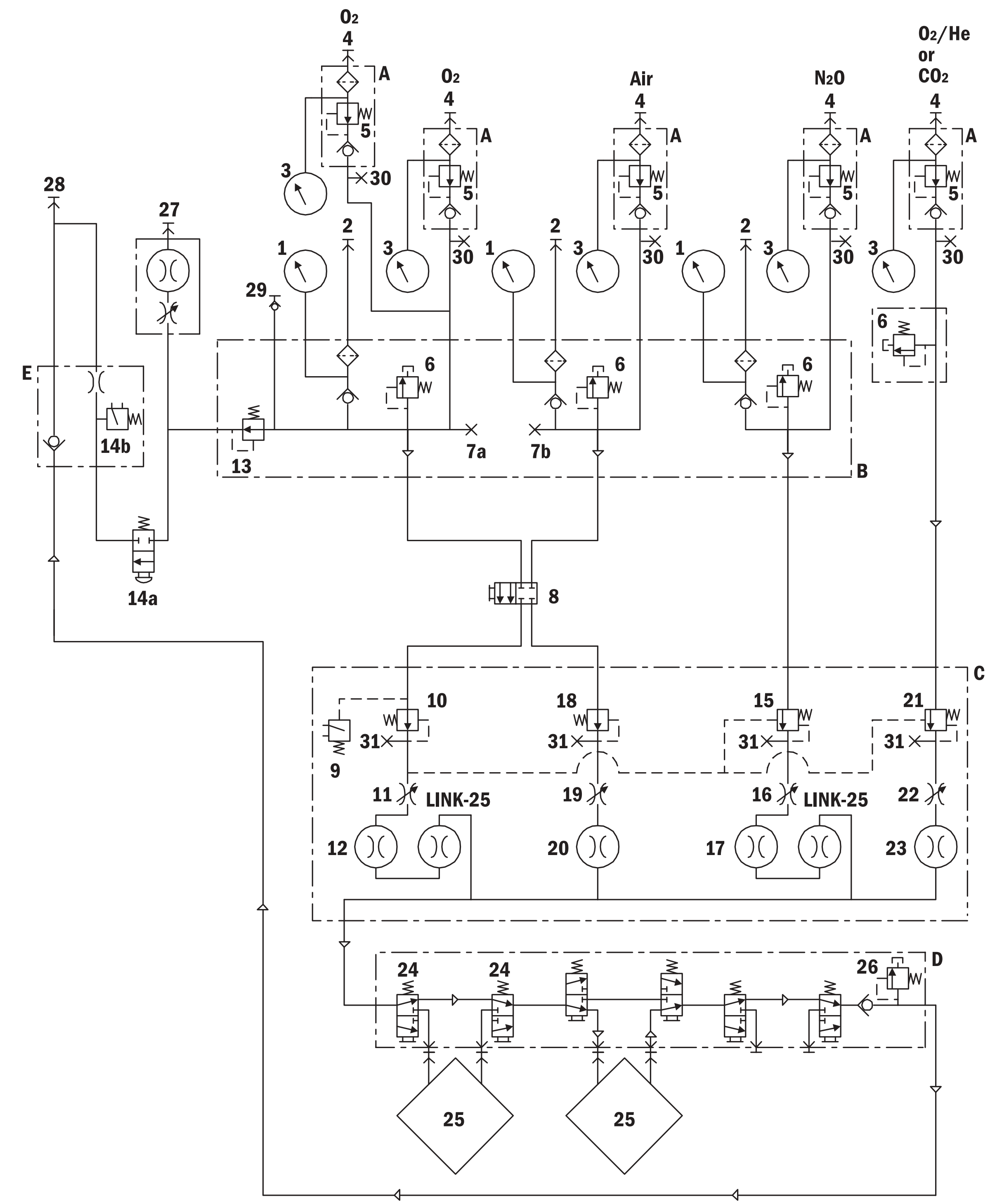
A. Cylinder Supply
B. Pneumatic Manifold
C. Flowmeter Head
D Vaporizer Manifold
E. Common Gas Manifold

Figure 2-5 ▪ Pneumatic circuit diagram (machines with a pneumatic manifold)



A. Cylinder Supply
B. Pipeline Inlet Manifold
C. Flowmeter Head
D Vaporizer Manifold
E. Common Gas Manifold

Figure 2-6 ▪ Pneumatic circuit diagram (machines with individual pipeline inlet manifolds)



A. Cylinder Supply
B. Pneumatic Manifold
C. Flowmeter Head
D Vaporizer Manifold
E. Common Gas Manifold

Figure 2-7 ▪ Pneumatic circuit diagram (machines with a pneumatic manifold)

Key to Numbered Components

1. Pipeline pressure gauge
2. Pipeline inlet
3. Cylinder pressure gauge
4. Cylinder inlet
5. Primary regulator (cylinder pressure)
6. High-pressure relief valve
   - For machines with pneumatic manifold (883 kPa / 128 psi)*
   - For machines with pipeline inlet manifolds (758 kPa / 110 psi)*
7. Supply connections for the ventilator
   a. O_2 drive gas
   b. Air drive gas
8. System switch
9. Switch for low O_2 supply pressure alarm (used with the ventilator)
10. O_2 secondary regulator (207 kPa / 30 psi)*
11. O_2 flow control valve
12. O_2 flow tubes
13. O_2 flush and auxiliary flowmeter regulator (131 kPa / 19 psi)*
14. O_2 Flush
    a. Flush valve
    b. Pressure switch (used with the ventilator)
15. N_2O balance regulator
16. N_2O flow control valve
17. N_2O flow tubes
18. Air secondary regulator (207 kPa / 30 psi)*
19. Air flow control valve
20. Air flow tube
21. Optional gas balance regulator
22. Optional gas flow control valve
23. Optional gas flow tube
24. Vaporizer port valve
25. Vaporizer
26. Low-pressure relief valve (38 kPa / 5.5 psi)*
27. Auxiliary flowmeter (optional)
28. Common gas outlet (CGO)
29. Pneumatic outlet (O_2)
30. Test port (primary regulator)
31. Test port (secondary/balance regulator)

* Approximate values

Key to Symbols

 Pneumatic Connection

 Filter

 Direction of Flow

 Check Valve

2.2.2 Physical connections

Figure 2-5 shows the physical path that the gas takes in machines with a pneumatic manifold. To show all connections, the gas manifold (**B**) and the flowhead (**C**) have the front and the back views next to each other. For tubing connections in machines with individual pipeline inlet manifolds, refer to Section 8.37.2.

Figure 2-6 shows some of the actual parts.

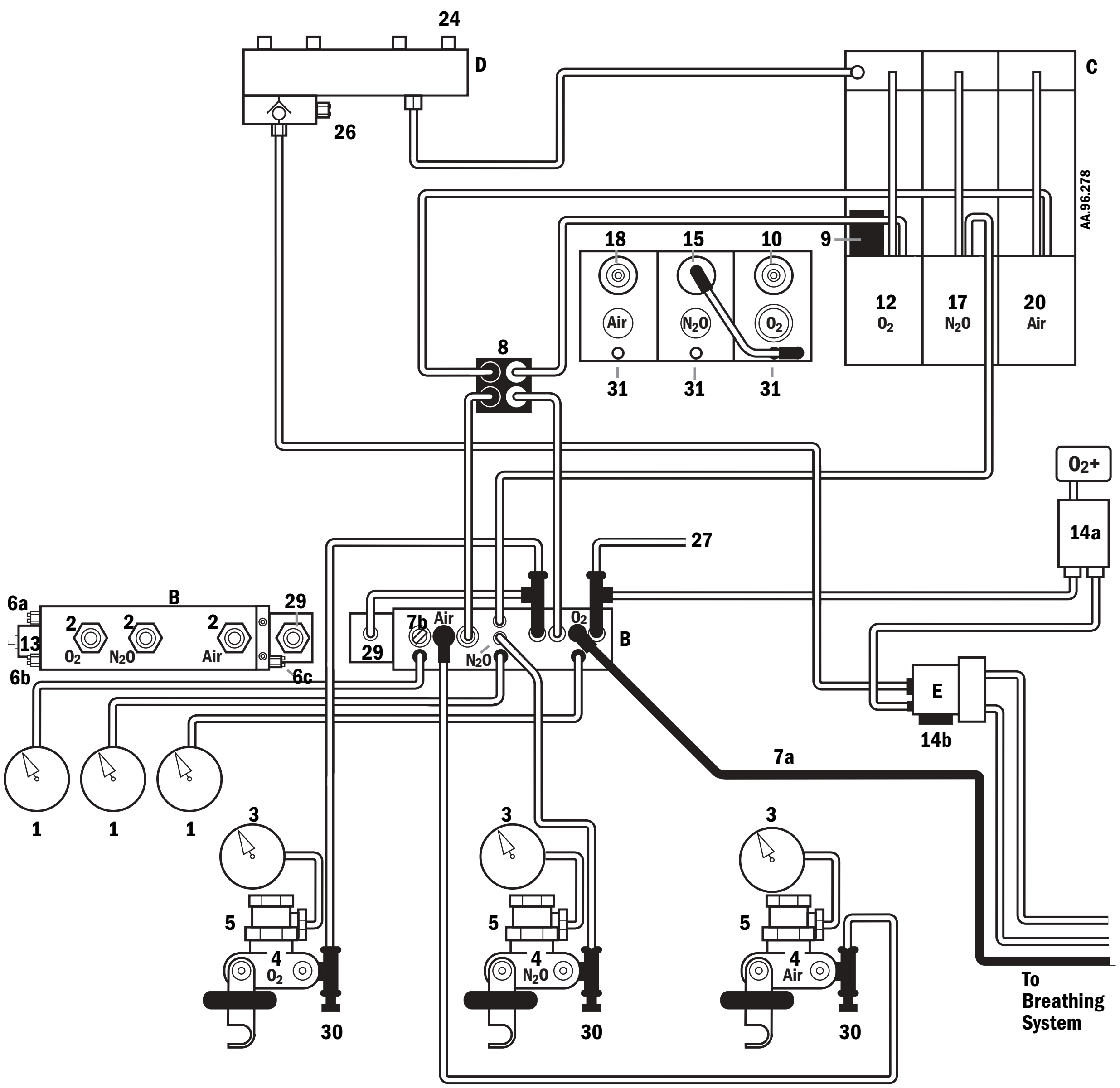
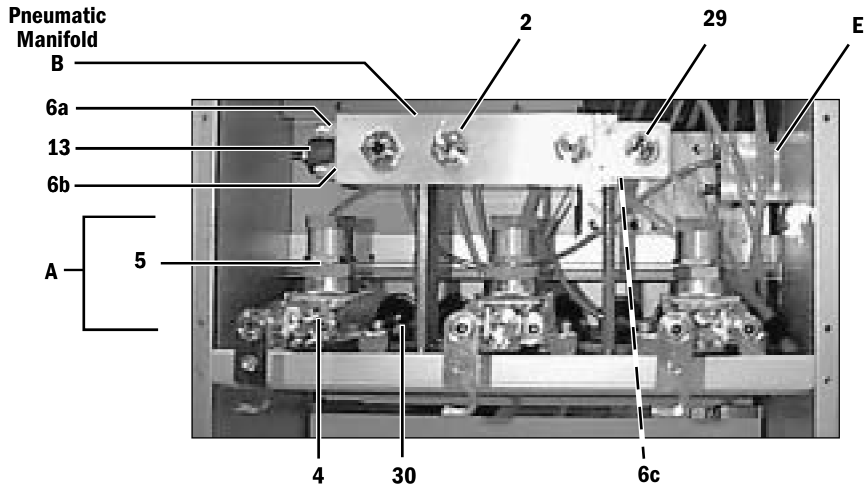
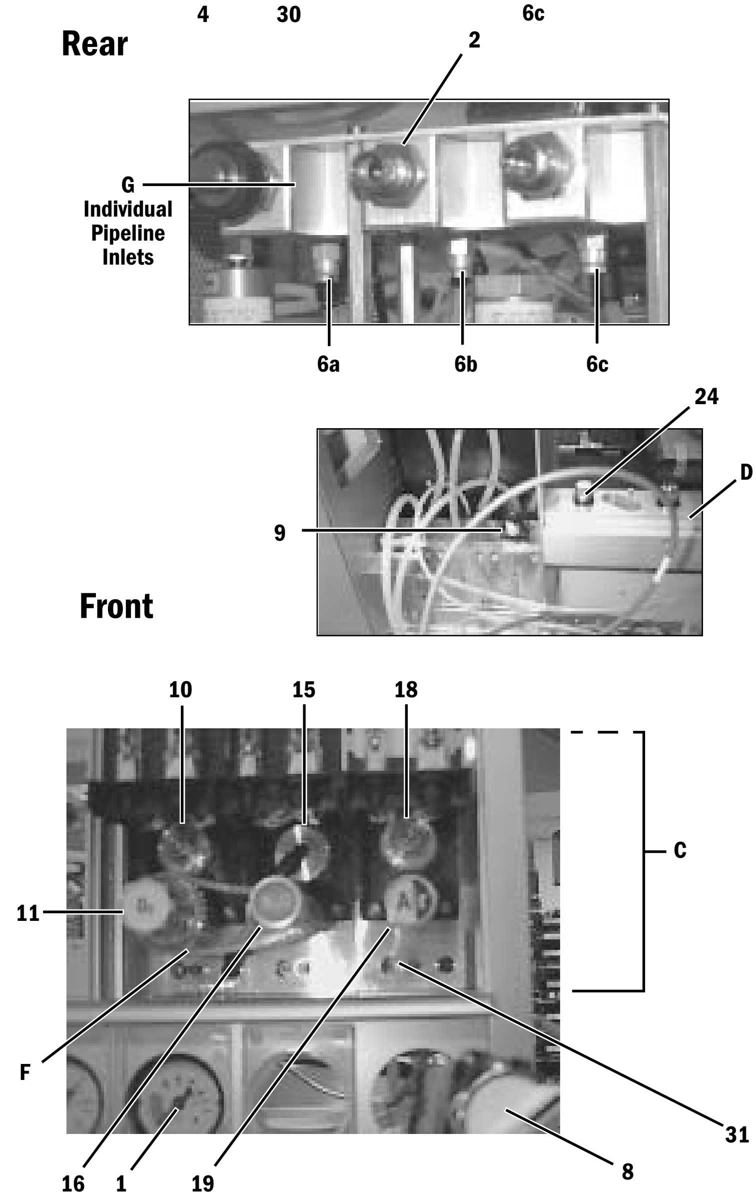


Figure 2-5 • Typical tubing connections - pictorial





1	Pipeline pressure gauge
2	Pipeline inlet
3	Cylinder pressure gauge
4	Cylinder inlet
5	Primary regulators (cylinder pressure)
6a	O_2 high-pressure relief valve
6b	N_2O high-pressure relief valve
6c	Air high-pressure relief valve
7a*	Vent drive gas (O_2)
7b*	Vent drive gas (Air)
8	System switch
9	Switch, low O_2 supply pressure alarm
10	O_2 secondary regulator
11	O_2 flow control valve
12	O_2 flowtubes
13	Flush regulator
14a*	O_2 Flush valve
14b*	O_2 Flush pressure switch (Vent feedback)
15	N_2O balance regulator
16	N_2O flow control valve
17*	N_2O flowtubes
18	Air secondary regulator
19	Air flow control valve
20*	Air flowtube
21**	Optional gas balance regulator
22**	Optional gas flow control valve
23**	Optional gas flowtubes
24	Vaporizer port valve
25**	Vaporizers
26	Low-pressure relief valve
27	To auxiliary O_2 Flowmeter
28**	Common gas outlet (CGO)
29	Pneumatic outlet (O_2)
30	Test ports (primary regulator)
31	Test ports (secondary/balance regulators)
A	Cylinder supplies
B	Pneumatic manifold
C	Flowhead
D	Vaporizer manifold
E	Common gas manifold
F	Chain link hypoxic guard (LINK-25)
G	Individual pipeline inlet manifolds
*	Not shown pictorially
**	Not shown

Figure 2-6 • Typical components

2.2.3 Induction machine

The Induction machine does not include a breathing system or a ventilator. Mixed gas and O_2 Flush output from the common gas manifold (**E**) flow directly to the Common Gas Outlet (**CGO**) at the front of the machine.

A pneumatic alarm assembly (**9**) taps into the O_2 supply at the pneumatic manifold (**B**) and sounds the O_2 Supply Failure alarm when O_2 pressure falls below the threshold.

The alarm assembly consists of three parts: a canister (**G**) that hold a volume of pressurized O_2, a pressure regulator (**H**), and a whistle (**I**) that sounds the alarm. The regulator keeps the canister pressurized as long as the supply pressure is higher than the alarm limit. When supply pressure falls below the alarm limit, the regulator releases the pressure from the canister through the whistle alarm.

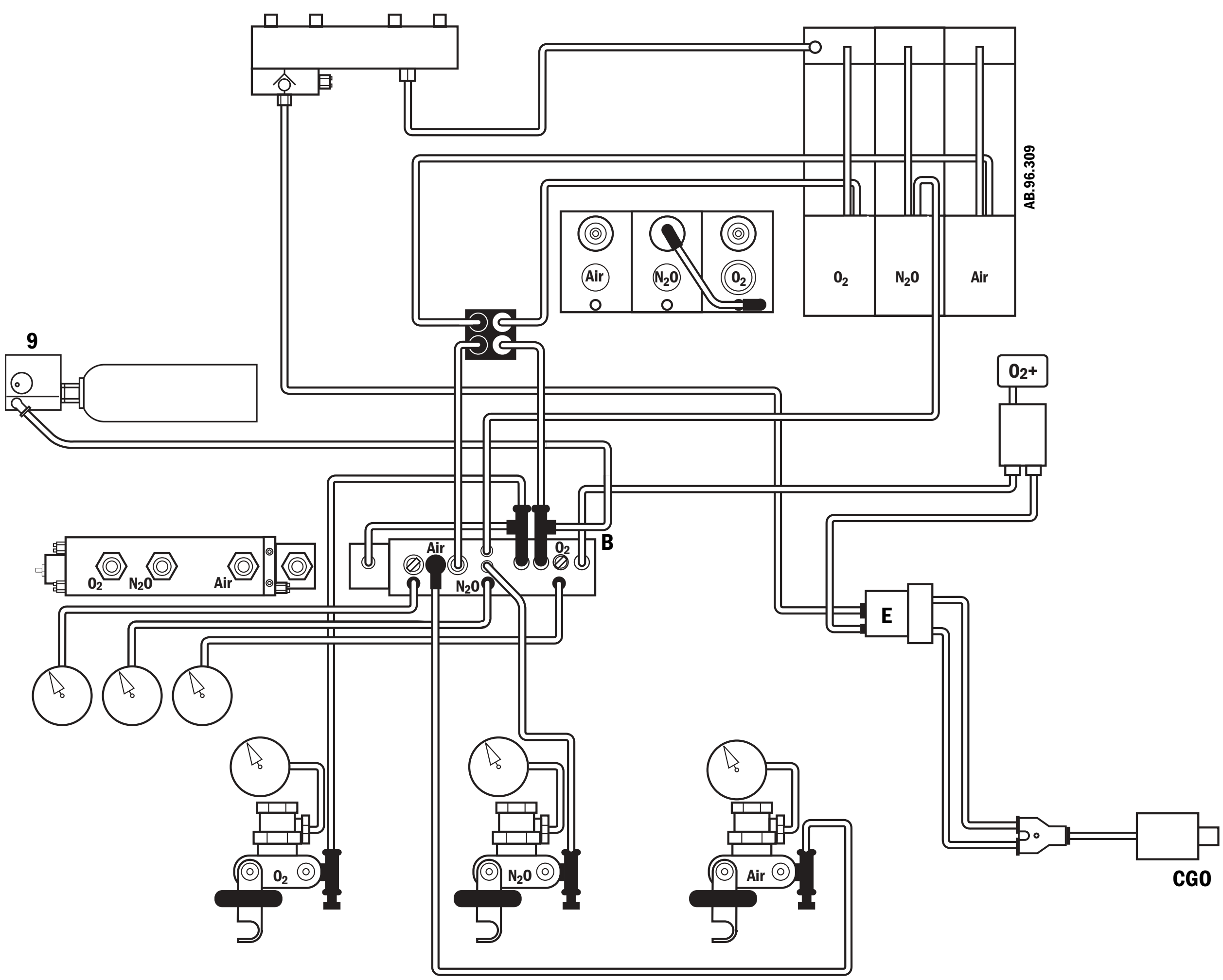
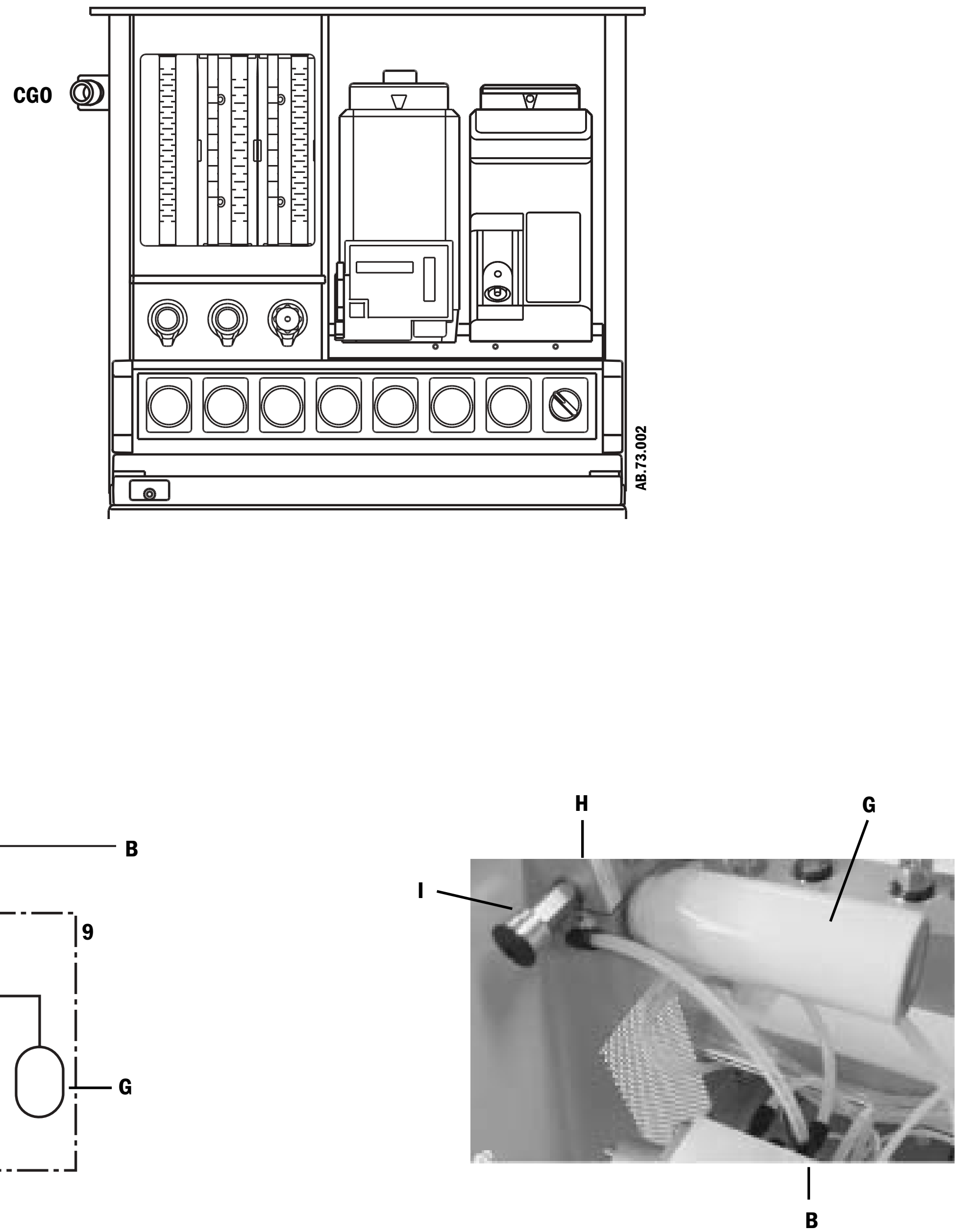


Figure 2-7 • Induction machine tubing



9 O_2 **Supply Failure alarm assembly**
B O_2 **supply pressure at pneumatic manifold**
CGO **Common gas outlet**
G **Canister, reservoir**
H **Alarm regulator**
I **Whistle**

Figure 2-8 • Induction machine components

2.2.4 Wall-rail mount machine

The wall-rail mount machine (Compact and Induction) includes:

- pipeline inlet connections (**A**) for O_2, N_2O, and Air (optional),
- an inlet connection for O_2 backup regulated cylinder supply (**B**),
- an optional backup regulated cylinder supply inlet connection for O_2, N_2O or Air (**C**),
- and an optional O_2 power outlet (**D**).

A regulated cylinder supply can be connected to the cylinder inlet for O_2, N_2O or Air with an optional Cylinder Regulator (**E**).

To use a backup cylinder for gases that do not have a cylinder inlet, the cylinder and pipeline supplies can be connected to the pipeline inlet using an optional checked Y-adapter (**F**).

Figure 2-9 shows the tubing connections for a wall-rail mount Induction machine. The Compact wall-rail mount machine does not include the pneumatic alarm assembly (**G**); it includes the standard pressure switches on the O_2 flowmeter module and the common gas manifold (**H**).

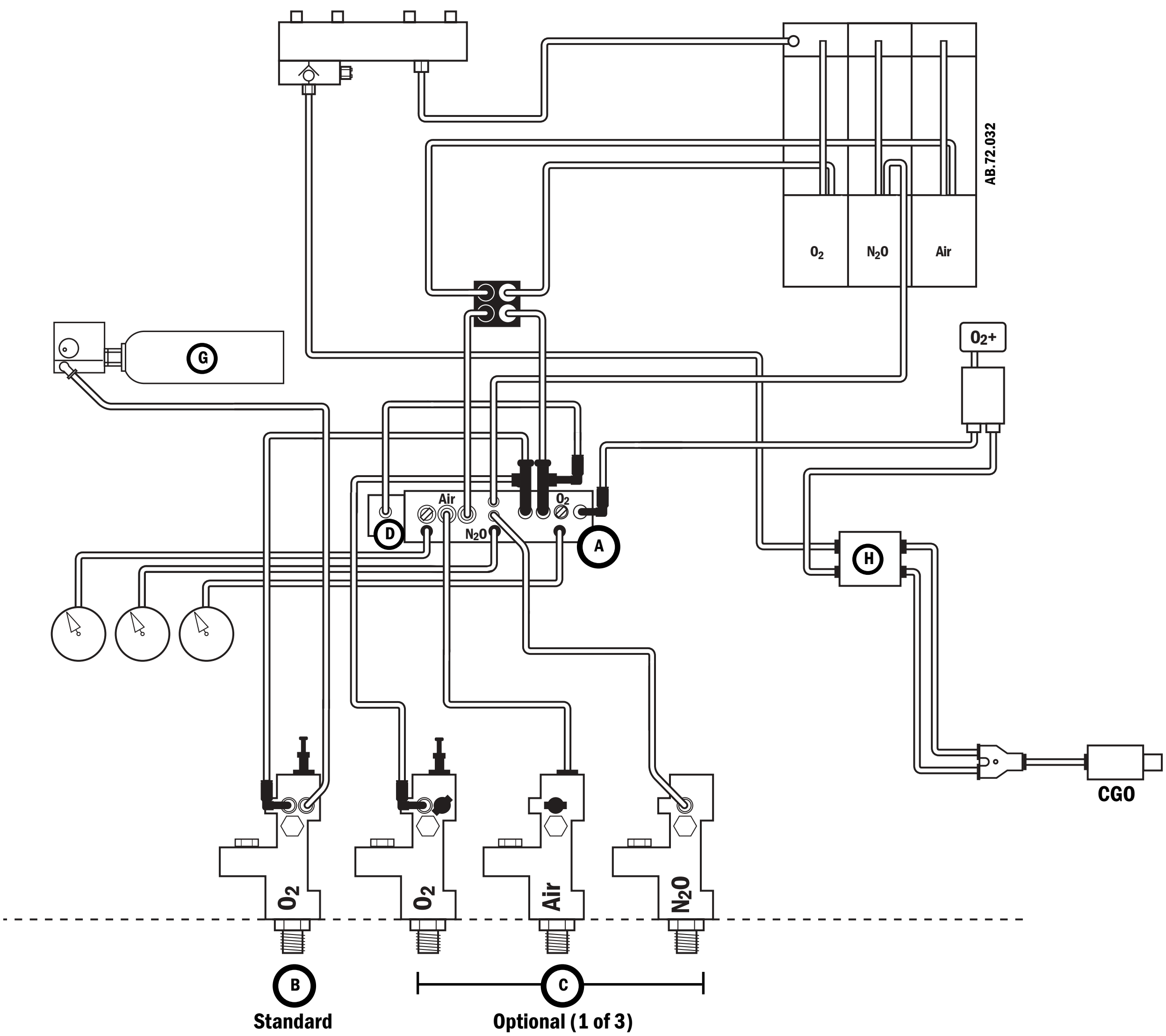


Figure 2-9 • Wall-rail mount machine tubing

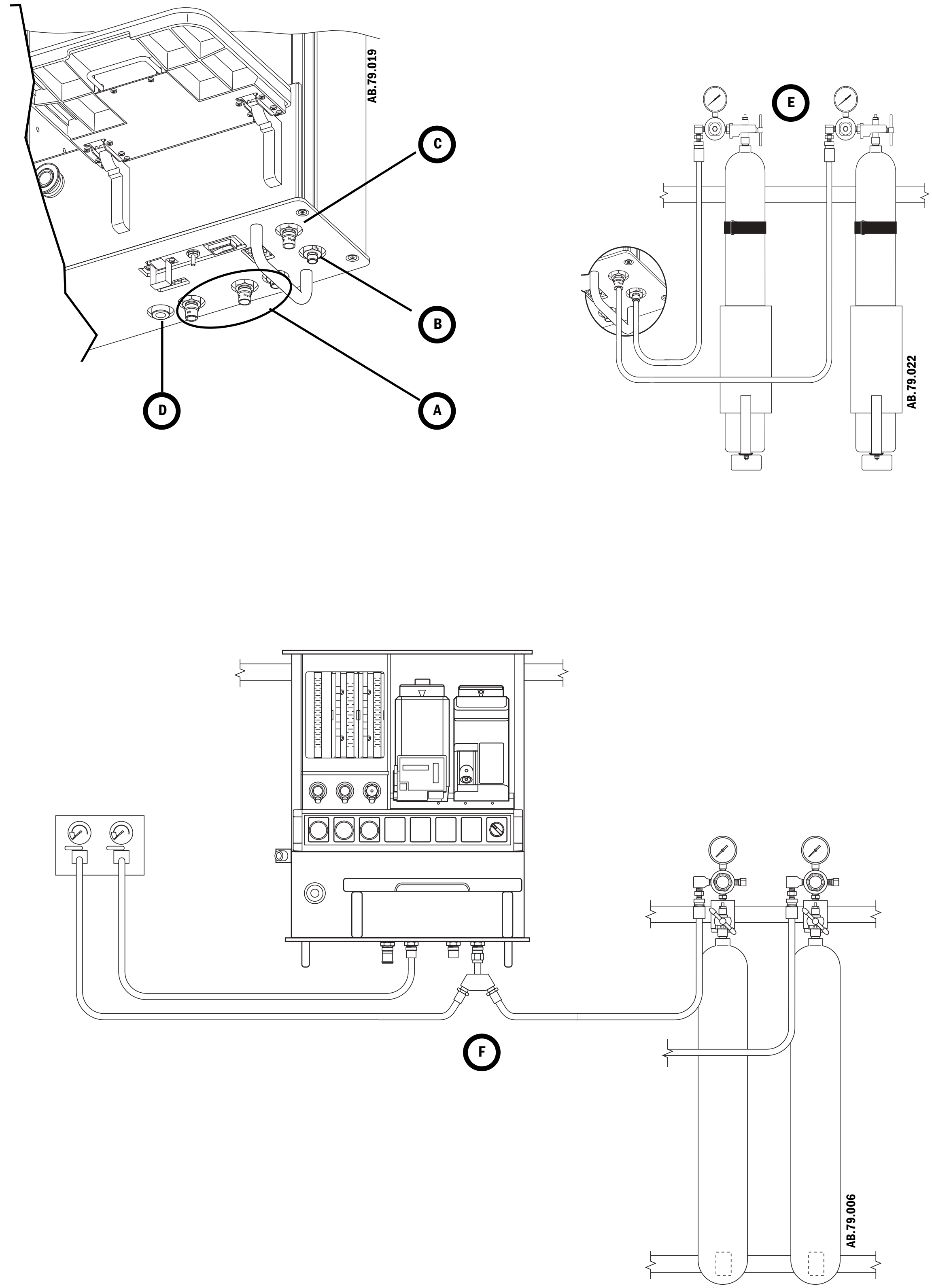


Figure 2-10 • Wall-rail mount machine components

2.2.5 System switch

The system switch has two positions: Standby and On.

In the Standby position — ⏻

The switch:

- Cuts off power to the ventilator (electrical).
- Stops O_2 and Air (pneumatic).
- Without O_2 pressure, the balance regulators stop N_2O, CO_2, and Heliox.

In the On position — I

The switch:

- Supplies power to the ventilator.
- Supplies O_2 and Air.
- Adequate O_2 pressure allows N_2O, CO_2, and Heliox gas flow.

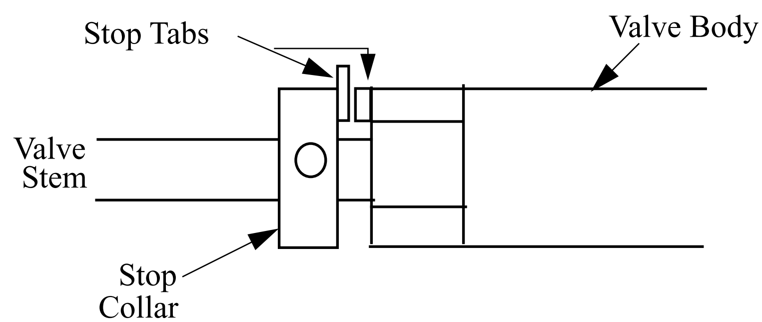
2.2.6 Flow control

Needle valves (one for each gas) adjust gas flows. Clockwise rotation decreases flow. Counterclockwise increases flow. Mechanical stops set minimum flows for all gases and maximum flows for CO_2 and Heliox. The link system sets the maximum ratio of N_2O to O_2.

⚠ WARNING The Link 25 Proportioning System sets a minimum O_2 concentration in the fresh gas stream when only O_2 and N_2O are used. Use of an absorber or another gas can still cause a hypoxic mixture to be delivered, especially at low O_2 flow rates.

Minimum flows

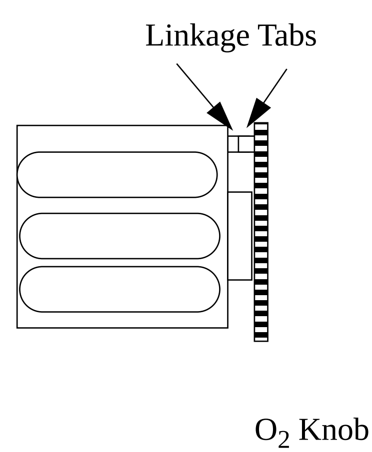
At minimum flow, two tabs prevent clockwise rotation of the valve stem. One tab is on the stop collar; the other is on the valve body.



Link system

The chain link system helps assure an approximate minimum 1 to 3 ratio of flow between O_2 and N_2O. When engaged (minimum O_2 concentration), a tab on the O_2 knob is in contact with a tab on the O_2 sprocket so that the O_2 and N_2O knobs turn together:

- an increase in N_2O flow causes an increase in O_2 flow,
- a decrease in O_2 flow causes a decrease in N_2O flow.



Higher concentrations of O_2 are possible when the link system is not engaged: either by reducing the N_2O flow below the point of engagement or by increasing O_2 flow above the point of engagement.

When the N_2O flow is below the point of engagement, increasing the N_2O flow turns the O_2 sprocket without changing the O_2 flow. At the point of engagement, the tab on the O_2 sprocket makes contact with the tab on the O_2 knob. Once the linkage is engaged, turning the N_2O flow control counterclockwise (increase in N_2O flow) also turns the O_2 knob counterclockwise (increase in O_2 flow) to maintain a nominal 25% minimum O_2 concentration.

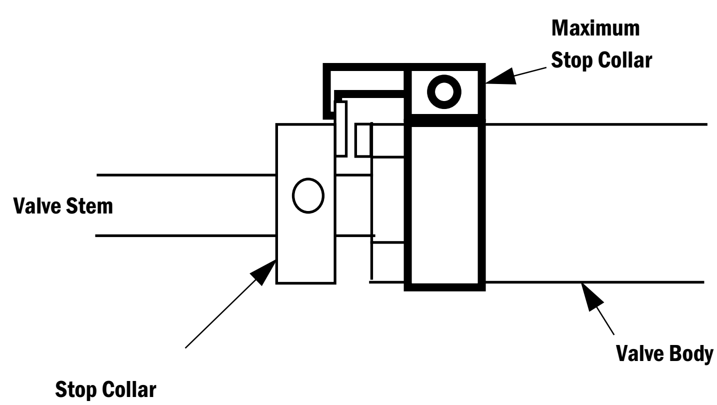
Decreasing the N_2O flow from the engagement point rotates the tab on the O_2 sprocket away from the tab on the O_2 knob. Increasing the O_2 flow rotates the knob tab away from the sprocket tab. Either action increases the O_2 concentration above 25%. Sufficiently decreasing O_2 flow or increasing the N_2O flow brings the two tabs back into contact and engages the linkage.

The kick-in point is defined as the N_2O flow at which the N_2O valve becomes engaged with the O_2 valve flowing at 200 mL/min. This engagement point is an arbitrary benchmark that assists in calibrating the proportioning system. The position of the kick-in is set in the factory. During field calibration, you set the O_2 flow to 200 mL/min and the N_2O flow to the kick-in flow (usually in the range of 400 to 700 mL/min) and then install the sprockets with the O_2 knob/sprocket engaged.

Maximum flows

A maximum stop collar on the body of the needle valve and a stop collar on the stem of the needle valve set the maximum CO_2 and Heliox flow.

At maximum flow, a tab on the stop collar hits the tab on the maximum stop collar and prevents you from turning the knob further counterclockwise. As you decrease the flow, the valve stem moves toward the needle valve assembly and clears the tab.



2.3 Flow through the breathing system

2.3.1 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 directly to the patient circuit (Bain/ Mapleson D), into the absorber through the common gas outlet, or directly to an external circuit through the optional auxiliary common gas outlet.
- **Breathing circuit paths:** The Aestiva has two breathing circuit modules—Circle and Bain/Mapleson D. Each breathing circuit handles fresh gas, recirculation, and exhaust flow differently.

2.3.2 Manual ventilation — Circle Module

Manual inspiration 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**).

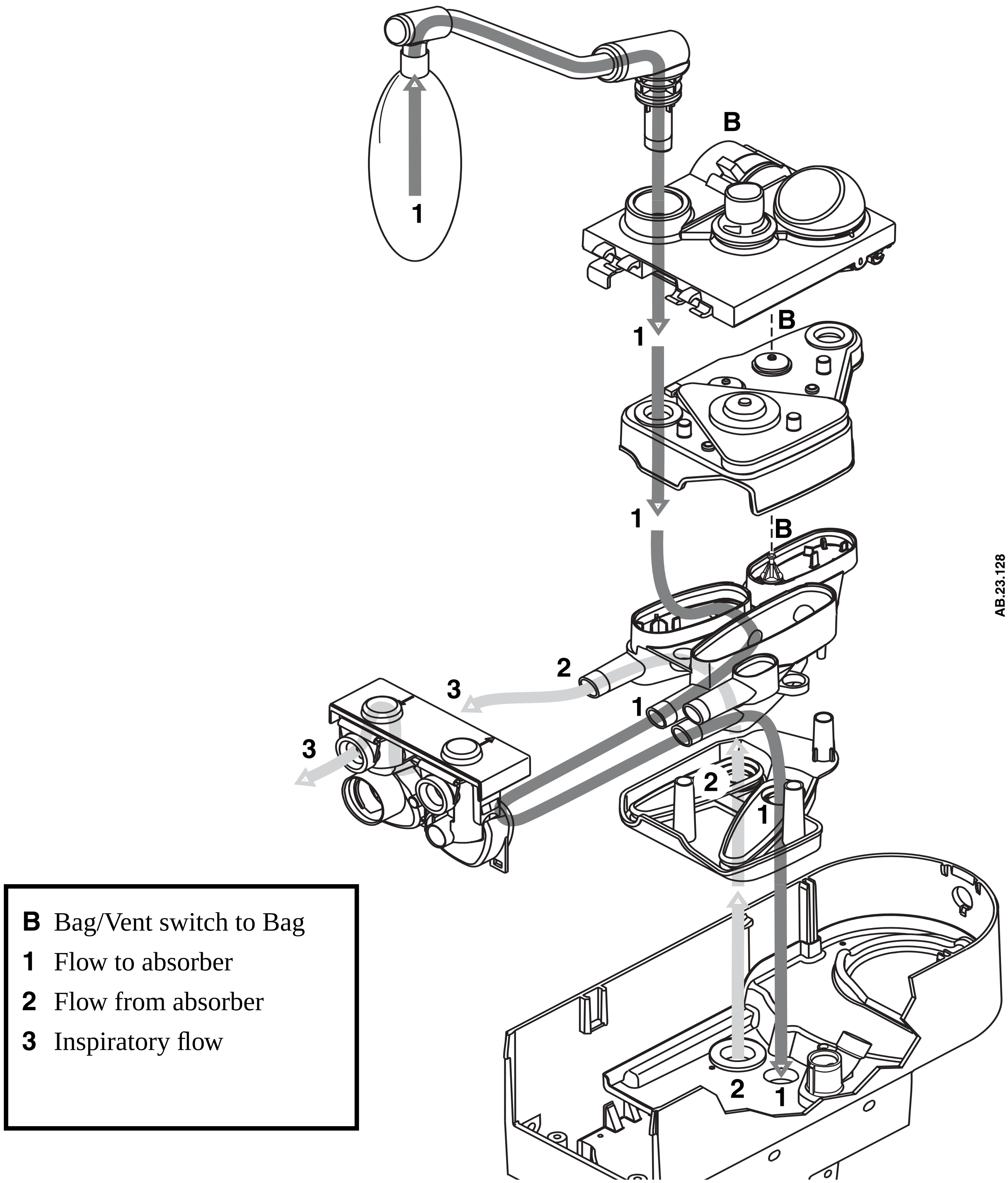
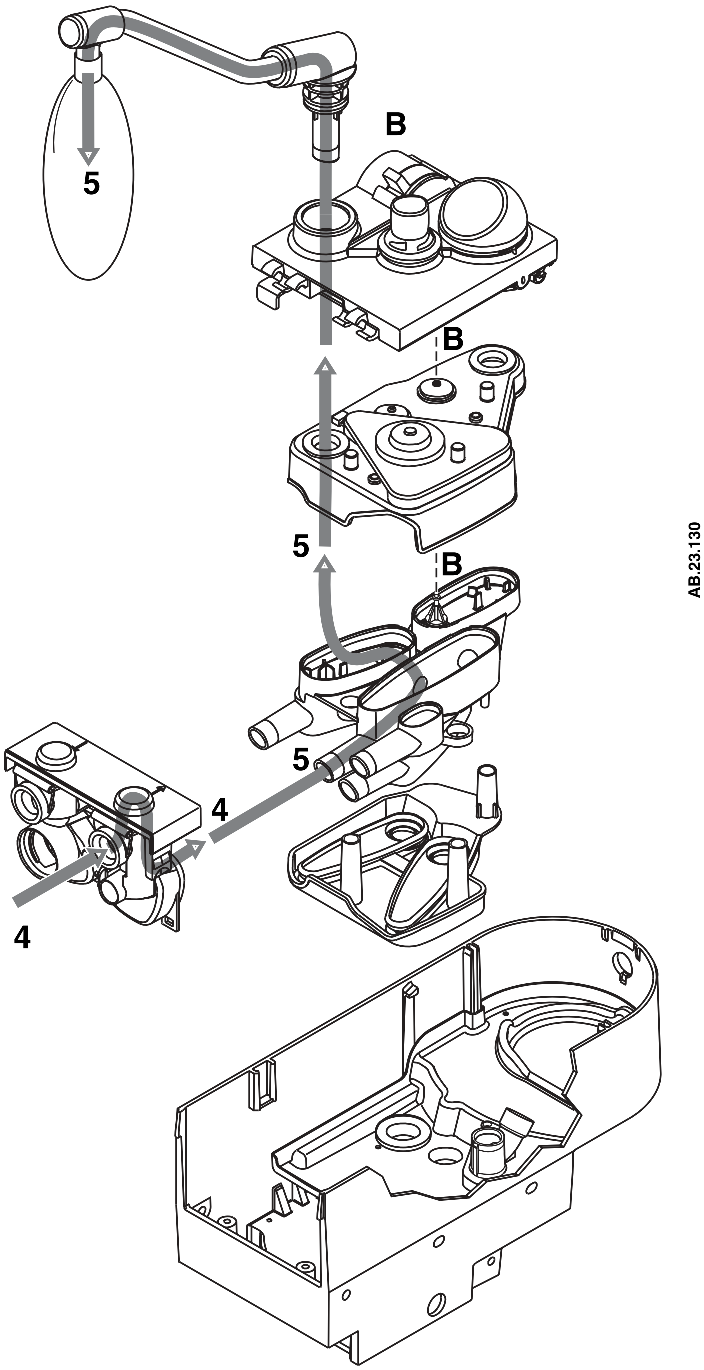


Figure 2-11 • Gas flow during manual inspiration

Manual expiration

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 arm (**5**).

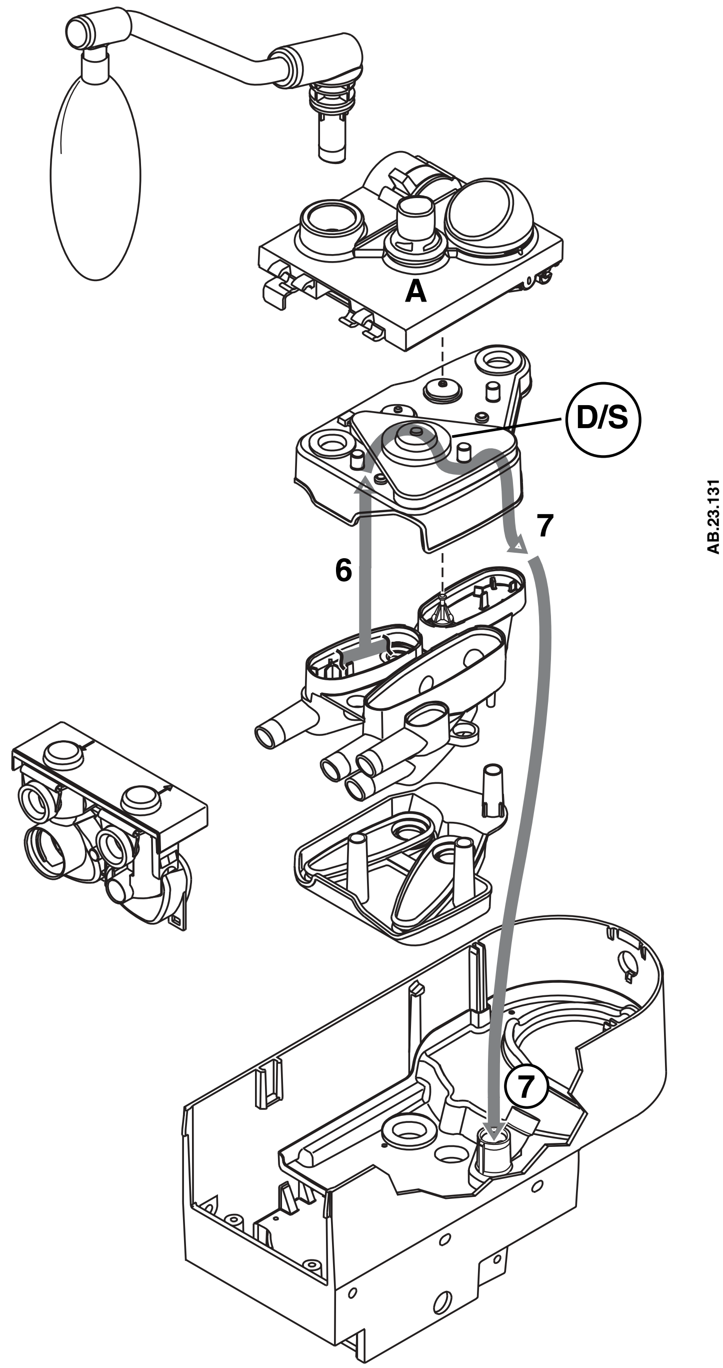


B Bag/Vent switch to Bag
4 Expiratory flow
5 Flow to bag

Figure 2-12 • Flow during manual expiration

APL Valve The APL valve (**A**) 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**).



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

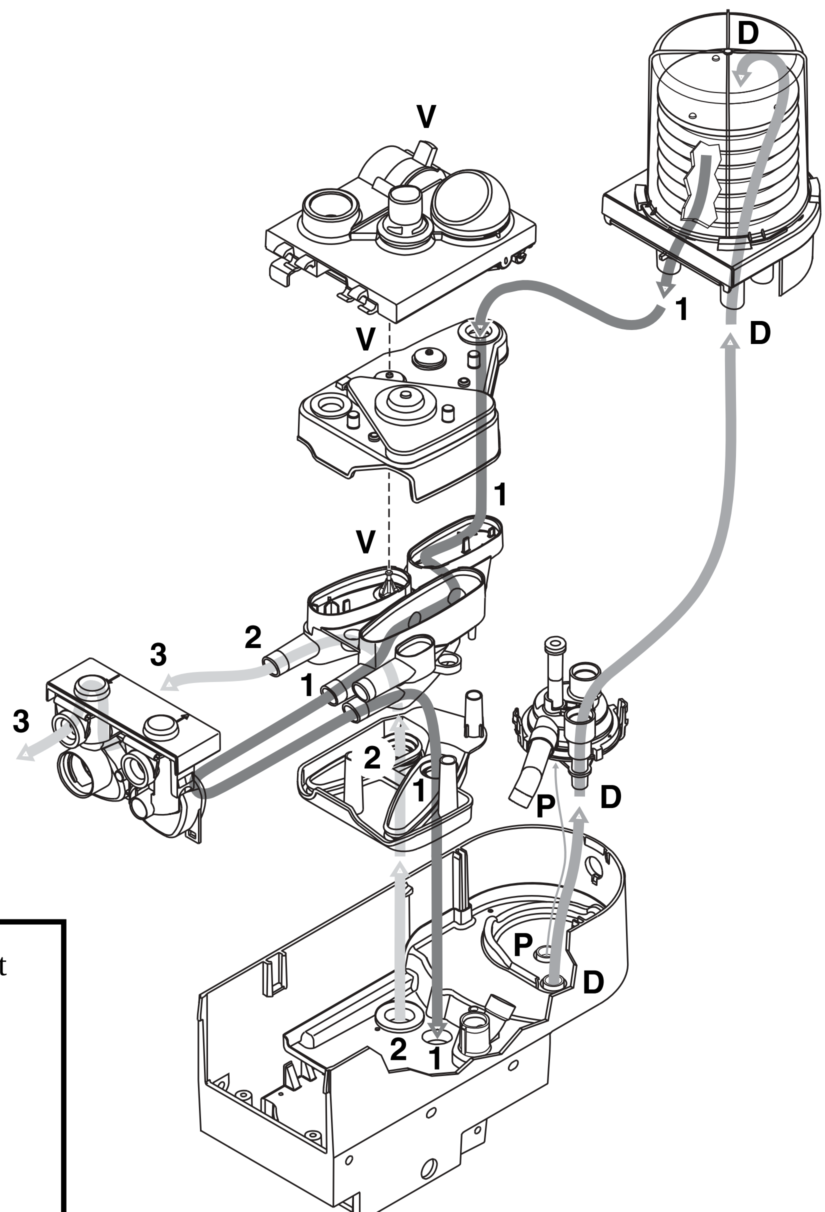
Figure 2-13 • Flow through the APL Valve

2.3.3 Mechanical ventilation — Circle Module

Mechanical inspiration

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**).



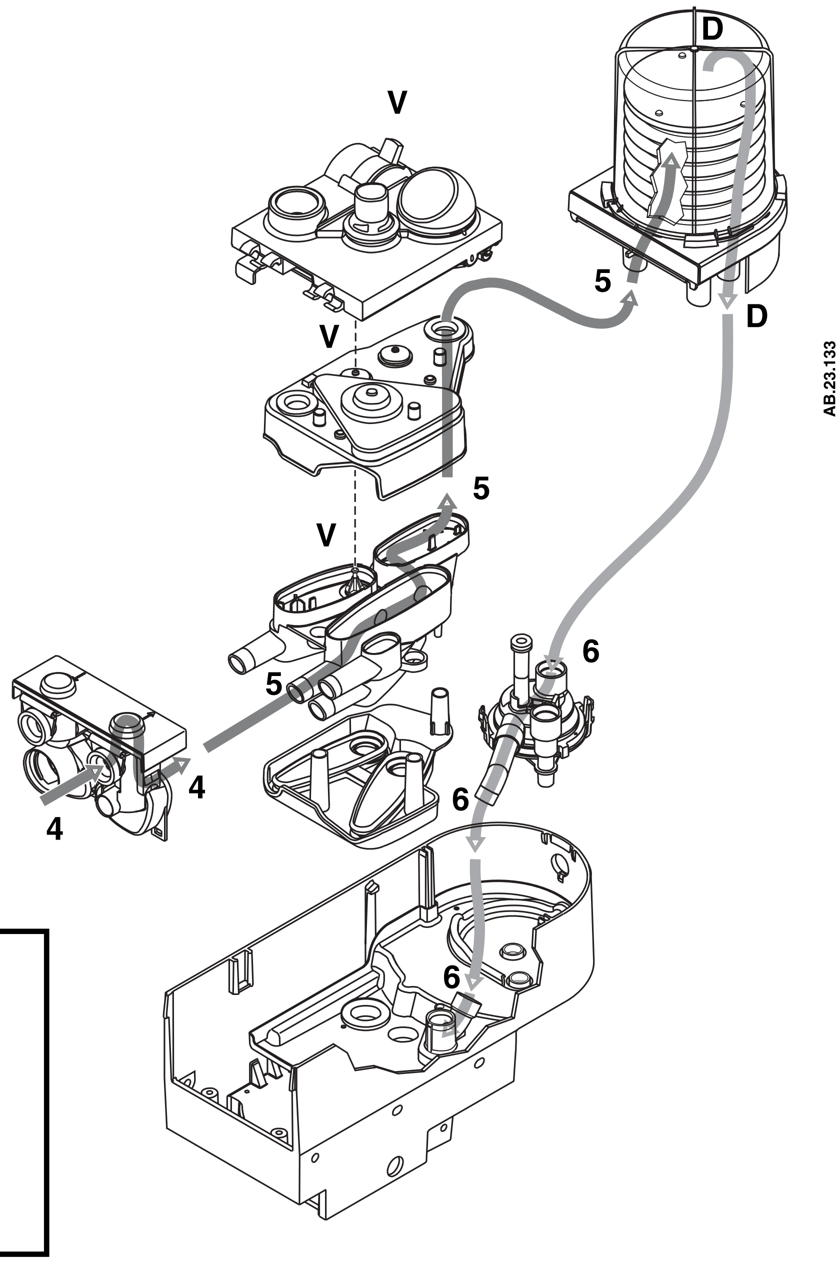
V Bag/Vent switch to Vent
P Pilot pressure
D Drive gas
1 Flow to absorber
2 Flow from absorber
3 Inspiratory flow

Figure 2-14 • Mechanical inspiration

Mechanical expiration

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.



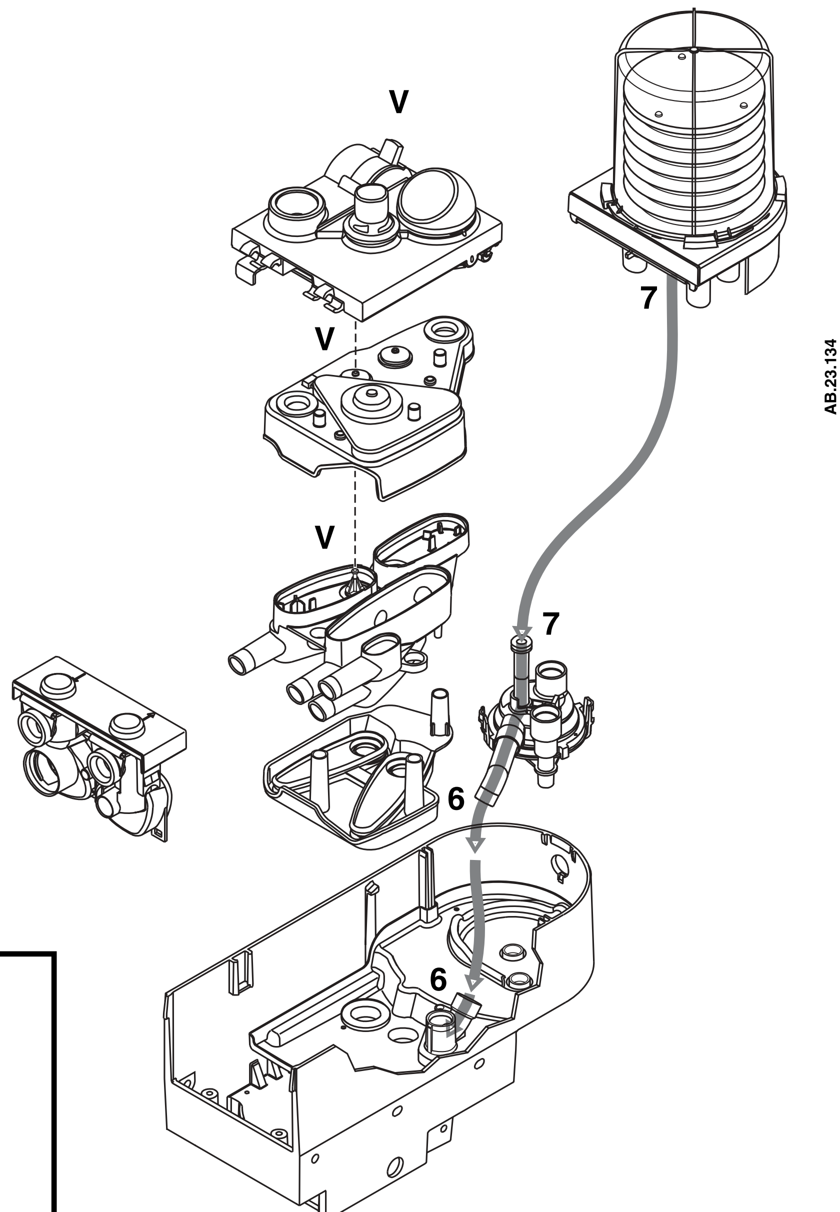
V Bag/Vent switch to Vent
D Drive gas
4 Expiratory flow
5 Flow to bellows
6 To scavenging

Figure 2-15 • Flow through the APL Valve

Pop-off valve

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



V Bag/Vent switch to Vent
6 To scavenging
7 Pop-off flow

Figure 2-16 • Flow through the pop-off valve

2.3.4 Fresh gas flow

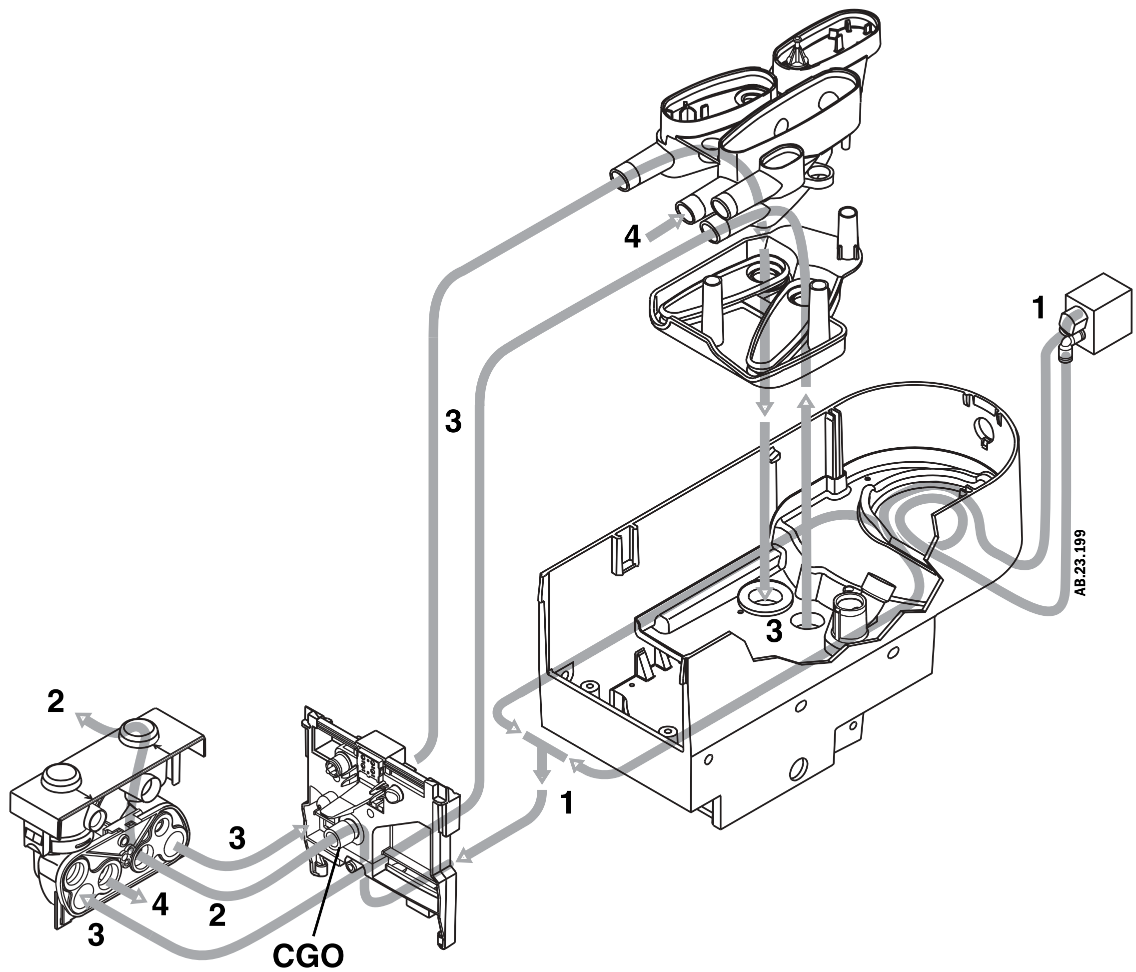
Common Gas Outlet only

Fresh gas (**1**) flows from the common gas manifold of the anesthesia machine and through the Common Gas Outlet (**CGO**) on the bulkhead.

During inspiration, fresh gas flows into the inspiratory limb (**2**) of the circle module; then, into the patient circuit.

During exhalation, fresh gas flows backwards through the absorber (**3**) into the expiratory limb of the circle module (**4**); then, out the scavenging system.

Note: There is no Fresh Gas Flow into the patient circuit during exhalation.



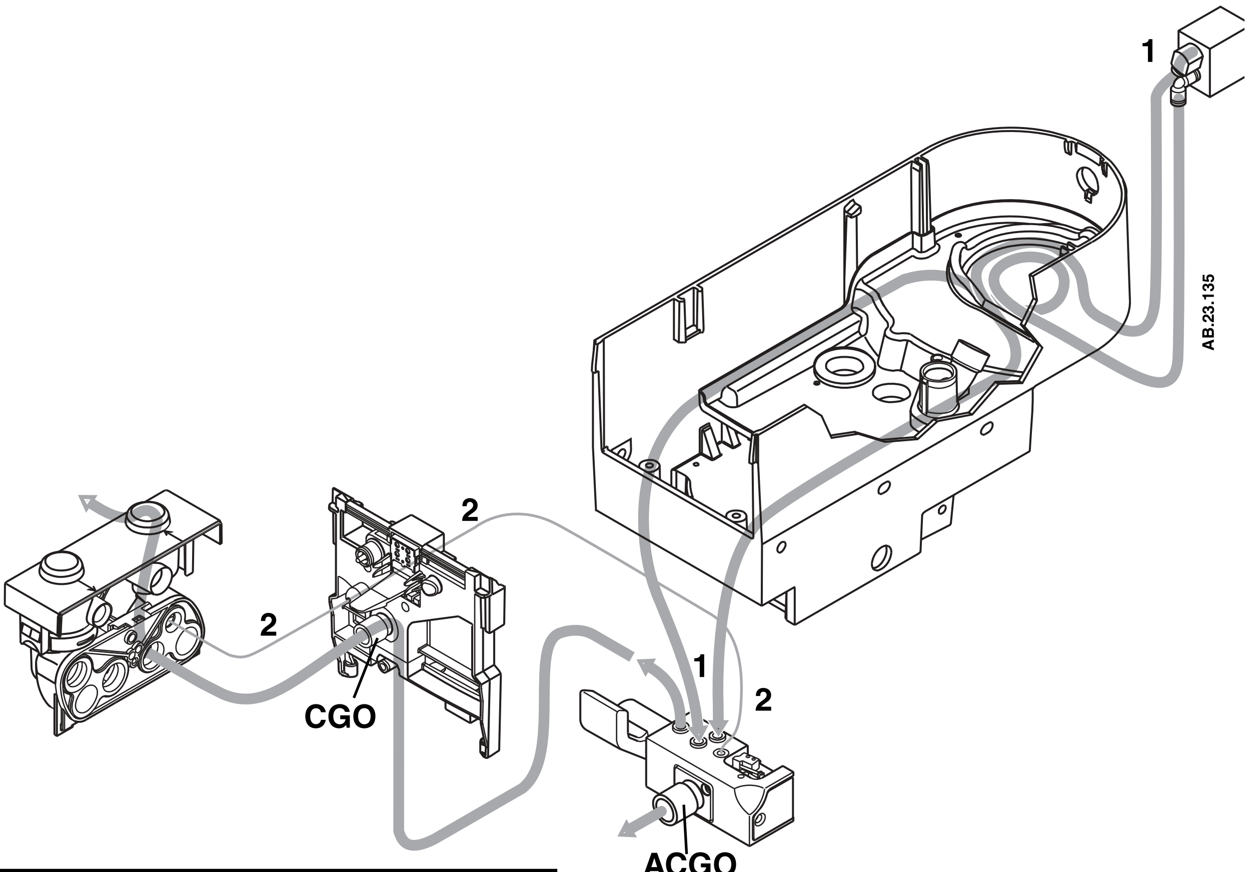
1 Fresh gas
CGO Comman Gas Outlet
2 Fresh gas flow during inspiration
3 Fresh gas flow during exhalation
4 Flow to scavenging system

Figure 2-17 • Fresh gas flow

Auxiliary Common Gas Outlet

In systems with an Auxiliary Common Gas Outlet (ACGO), the fresh gas (**1**) from the common gas outlet manifold of the anesthesia machine first flows to the ACGO. The ACGO switch directs the fresh gas flow either to the **CGO** outlet on the bulkhead of the Breathing System or to the **ACGO** outlet at the front of the Breathing System. The auxiliary outlet provides fresh gas to external circuits.

The O_2 sensor is located in the circuit modules. A restricted port on the bulkhead provides a fresh gas sample (**2**) for O_2 monitoring of the ACGO outlet.



1 Fresh gas
CGO Comman Gas Outlet
ACGO Auxiliary Comman Gas Outlet
2 ACGO sample to O_2 sensor

Figure 2-18 • Sampling and flow through the auxiliary fresh gas outlet

2.3.5 Different breathing circuit modules

The earlier figures show the Circle breathing circuit module. This is the standard module supplied with the system.

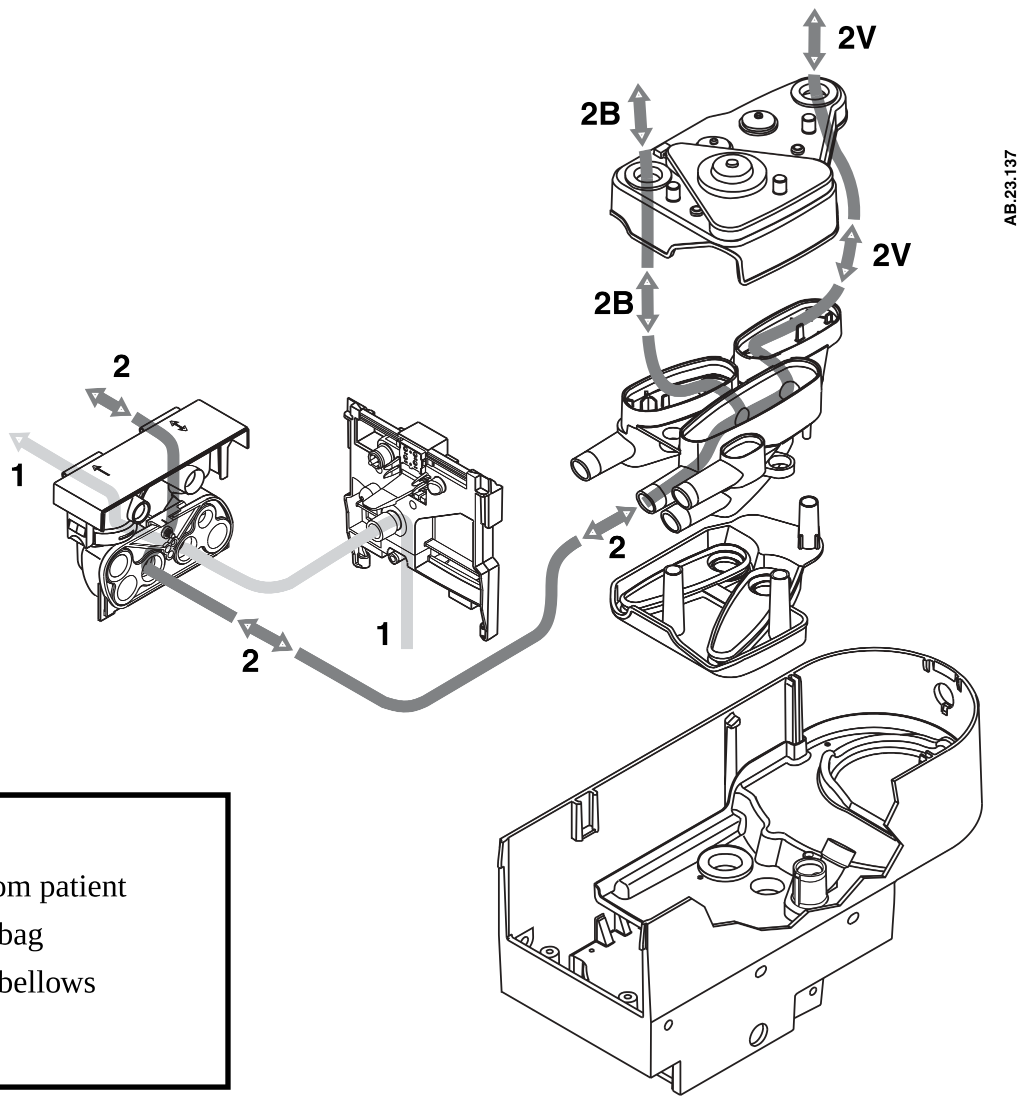
For specific needs, a Bain/Mapleson D breathing circuit module is also available.

Each module has identification tabs as detailed in Section 2.4.3.

Bain/Mapleson D

The Bain/Mapleson D module has:

- No check valves.
- Low compliance
- Passages that route the fresh gas (**1**) to the patient connection.
- Porting to the absorber is blocked (CO_2 monitor is recommended).



1 Fresh gas
2 Flow to/from patient
2B To/from bag
2V To/from bellows

Figure 2-19 • Bain/Mapleson D breathing circuit module

2.3.6 CO_2 Bypass

Note: The CO_2 Bypass is an option that is not available in all markets.

The CO_2 Bypass is a mechanical assembly that takes the place of the top dish of the absorber assembly. When in place, the upper housing of the bypass assembly presses against the activator of a microswitch that is located in the pan of the breathing system. This tells the ventilator that an absorber bypass is installed in the machine.

With absorber canisters locked in place, the bypass assembly is compressed. In the compressed state, valves inside the bypass assembly route the gas flow through the absorber canisters, as in machines that do not have a bypass installed.

When the absorber canisters are released, the bypass assembly expands. In the expanded state, the valves in the bypass assembly route the gas back into the main manifold, bypassing the canisters.

Additionally, when the bypass microswitch is activated (bypass installed) and the canister release microswitch is not (release open), the ventilator displays the “No CO_2 absorption” message.

Figure 2-20 ▪ CO_2 Bypass

2.3.7 Auxiliary Common Gas Outlet (ACGO)

When you pull the lever down (auxiliary position), a ramp in the lever pushes on the T end of a spring loaded actuator rod. Seals on the rod send Fresh gas and O_2 Flush gas to the auxiliary common gas outlet (ACGO). A portion of the gas is diverted to the O_2 sensor. A pin on the other end of the rod activates a microswitch.

When you pull the lever up, the spring pushes the rod back to its resting position, the seals send gas to the common gas outlet (CGO), and the pin releases the switch.

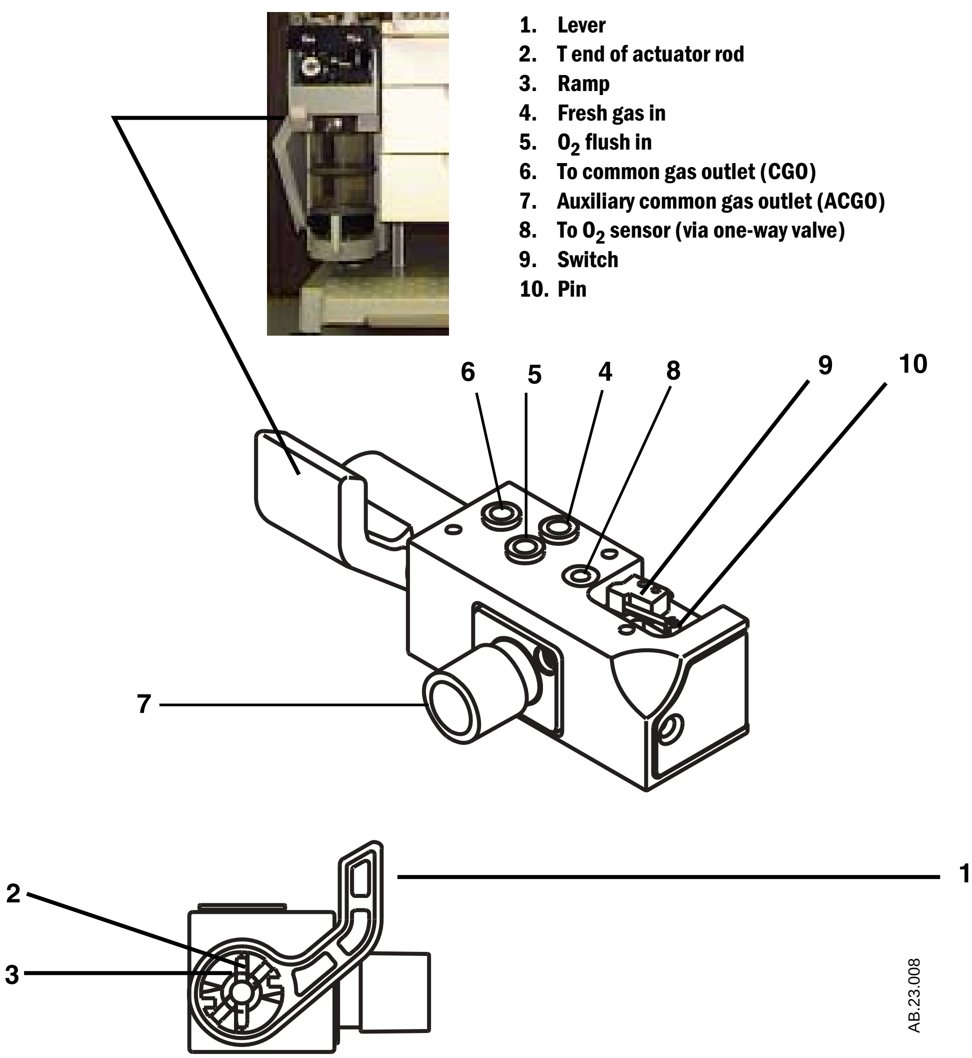


Figure 2-21 • Auxiliary Common Gas Outlet (ACGO) switch

2.4 Electrical and pneumatic signals

2.4.1 Summary of signals

Refer to the appropriate ventilator service manual for further details.

Machine switches:

- The mains inlet switch on the AC Inlet module controls AC power to the machine. The System switch on the front panel turns the machine On, or sets the machine into Standby mode.
- The O_2 Supply pressure switch on the flowhead module monitors the adequacy of the O_2 supply.
- The O_2 Flush pressure switch on the Common Gas Manifold monitors the activation of O_2 Flush flow.

Breathing system switches:

- Optical switches in the bulkhead look for the type of breathing circuit module or if the module is missing.
- A microswitch on the shaft of the canister release looks for open canisters (leak).
- A microswitch in the pan of the Breathing System tells the ventilator if the optional Absorber Bypass is installed. This permits operation with the canisters open.
- A microswitch on the back of the control panel tells the system if the panel is open (leak) or closed (APL and BTV functionality).
- A microswitch next to the Bag/Vent mechanism identifies the switch position. The system uses this to start and stop mechanical ventilation.
- A switch on top of the auxiliary common gas outlet tells the system which outlet is in use. With the auxiliary outlet in use, the ventilator is not operational; only O_2 monitoring of fresh gas is available.

7900 SmartVent

For machines with a 7900 SmartVent, the machine switches interface directly with the CPU board. The breathing system switches and the following pneumatic sample lines (refer to Figure 2-22) connect to the sensor interface board (SIB):

- Manifold Pressure Transducer,
- Drive Gas Pressure Limit Switch (DPLS),
- Expiratory Flow Pressure Transducer,
- Inspiratory Flow Pressure Transducer,
- Patient Airway Pressure Transducer.

7100 Ventilator

For machines with a 7100 Ventilator the machine switches interface with the CPU board through the Serial Adapter board. The breathing system switches and the following pneumatic sample lines (refer to Figure 2-23) connect to the monitoring interface assembly (MIA):

- Inspiratory Flow Pressure Transducer,
- Expiratory Flow Pressure Transducer.

The patient airway pressure transducer for the 7100 Ventilator is located on the pneumatic engine board.

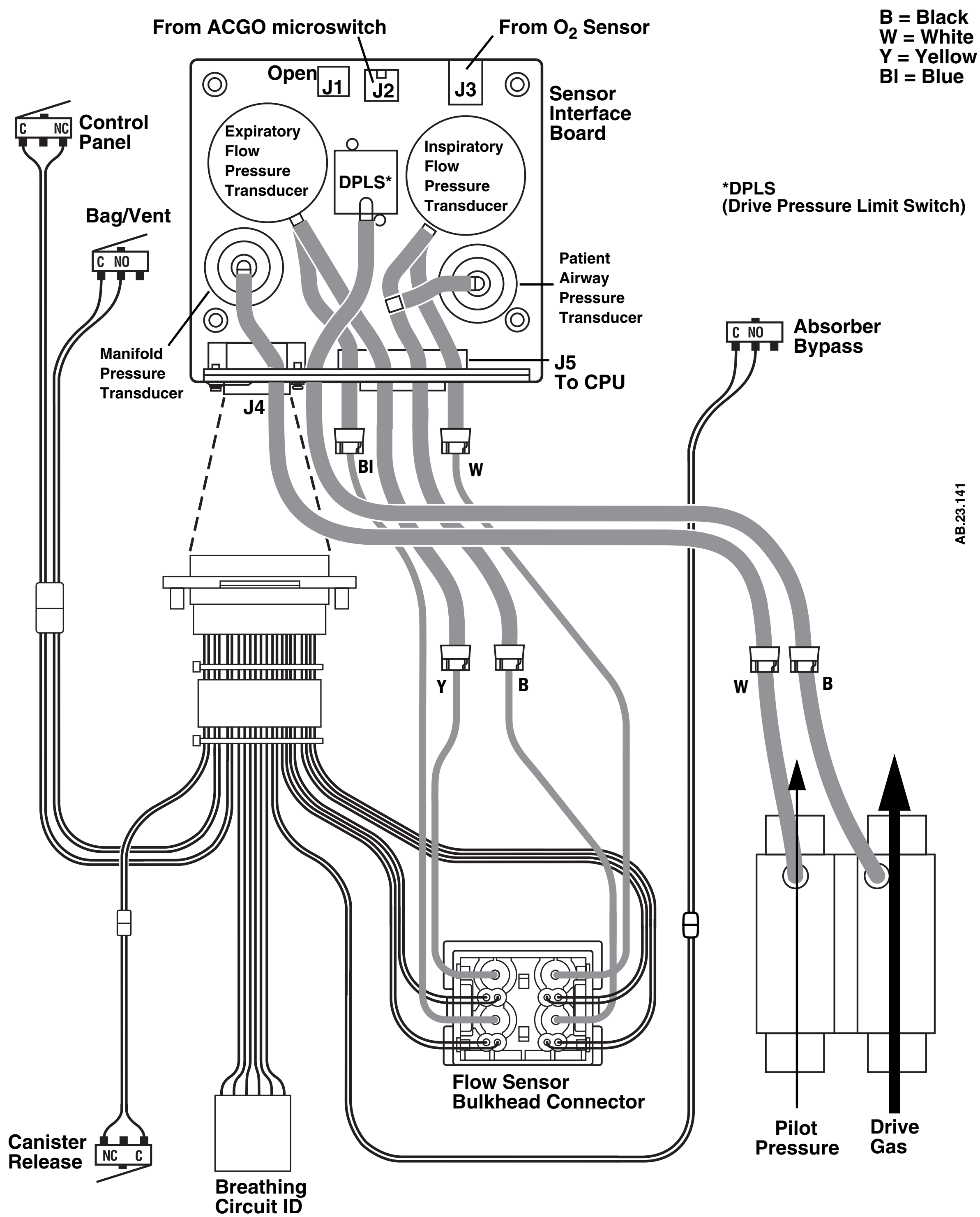


Figure 2-22 • Pneumatic and switch connections for machines with 7900 SmartVent

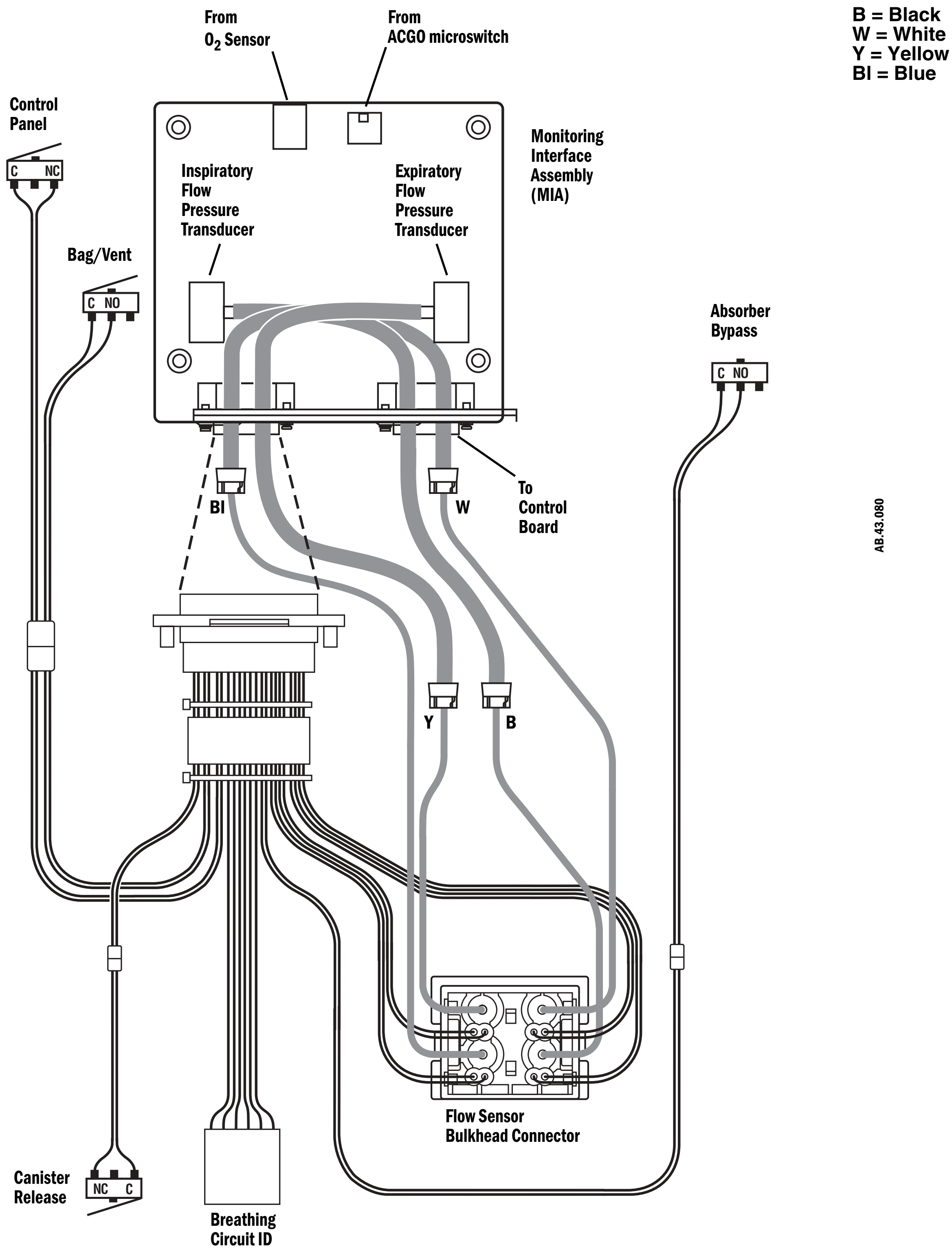
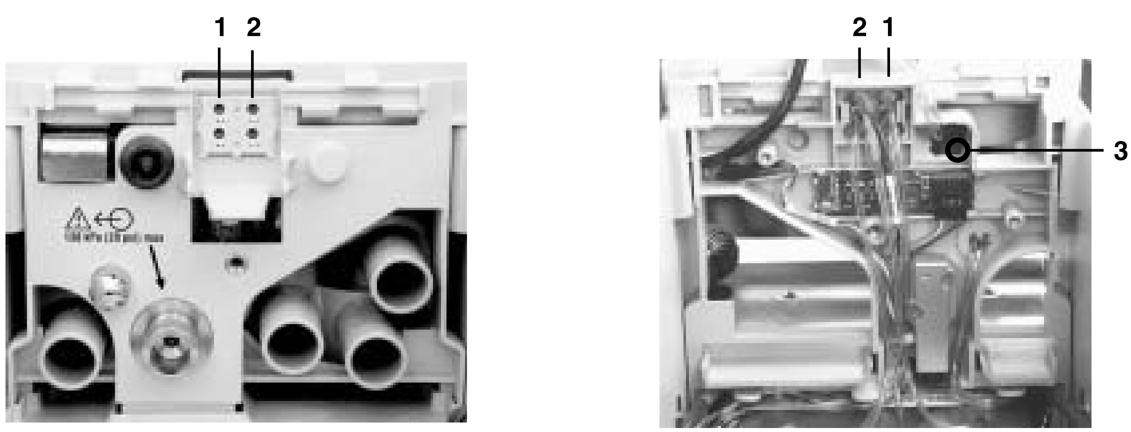


Figure 2-23 • Pneumatic and switch connections for machines with 7100 Ventilator

2.4.2 Subfloor tubing and wiring connections

Figure 2-24 has the rear subfloor and the bulkhead cover removed to show the tubing and the wiring.

Item	Color	Use with 7900 Ventilator	Use with 7100 Ventilator
6	Blue	Expiratory flow pressure transducer -	Expiratory flow pressure transducer -
7	Yellow	Expiratory flow pressure transducer +	Expiratory flow pressure transducer +
8	White	Inspiratory flow pressure transducer -	Inspiratory flow pressure transducer -
9	Black	Inspiratory flow pressure transducer +and patient airway pressure transducer	Inspiratory flow pressure transducer +
10	White	Ventilator manifold pressure	Not used
11	Black	Ventilator drive gas pressure	Not used



1. **Inspiratory flow senor connections**
2. **Expiratory flow sensor connections**
3. **Tube connection for airway pressure transducer (7100 only)**
4. **Sensor interface cable (Breathing Circuit ID board, Flow sensors, CO_2 Bypass switch, Canister switch, Bag/Vent switch, Cover switch)**
5. **Sensor interface board (SIB - 7900)Monitoring interface assembly (MIA - 7100)**

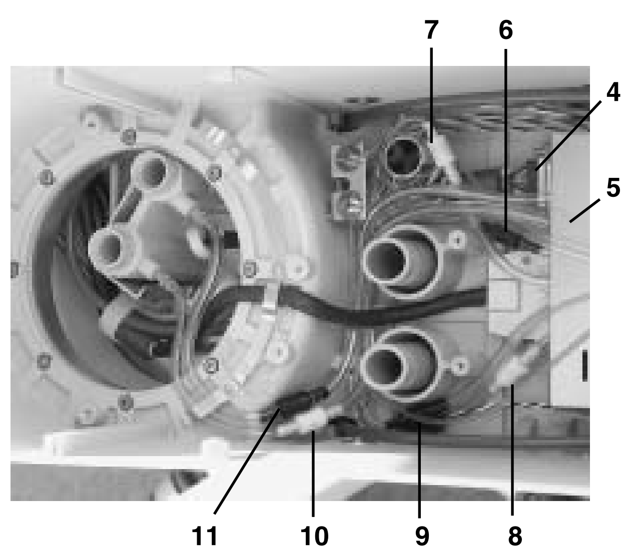
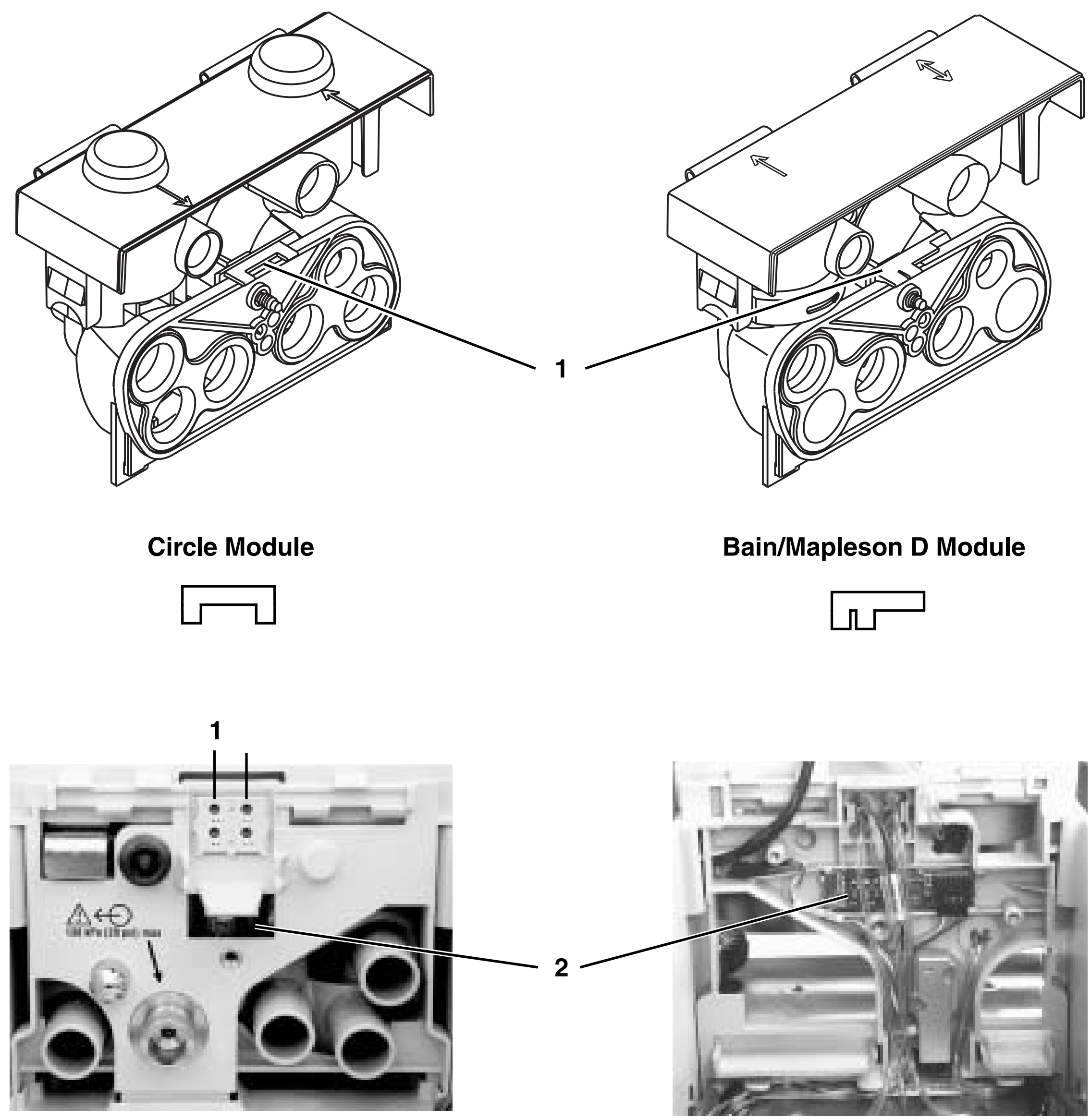


Figure 2-24 • Pneumatic tubing connections

2.4.3 Breathing circuit module ID

Tabs on the back of the breathing circuit module and optical sensors on the Module ID board tell the ventilator what type of module is connected.



1. **Tabs**
2. **Module ID Board**

Figure 2-25 • Module ID board

2.4.4 Control panel switches

Figure 2-26 shows the Bag/Vent switch (**1**) and the control panel switch (**2**).

When the Bag/Vent switch is set to Bag, the contact is closed. When it is set to Vent, the contact opens.

When you close the control panel the contact is closed. When you open the panel, the contract opens.

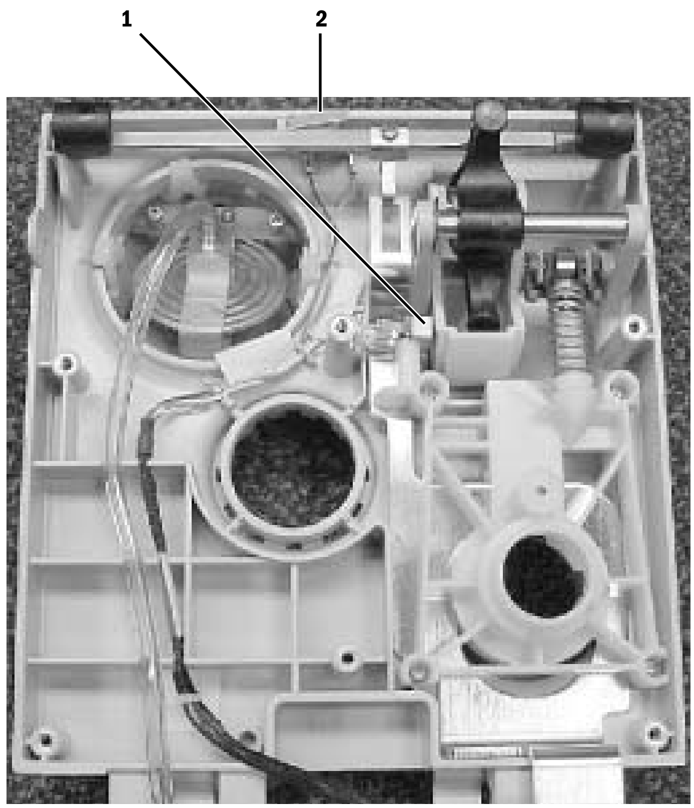


Figure 2-26 • Control panel switches

2.4.5 Canister switch

Figure 2-27 shows the canister switch. When the canister release is closed, a tongue pushes in the contact and an off-center cam pushes the canisters up. To open the release, pull it forward. When the collar clears the stop, turn the release clockwise. This moves the tongue away from the contact, which opens, and moves the cam away from the canisters.

1. **Canister release**
2. **Cam**
3. **Collar**
4. **Tongue**
5. **Switch**

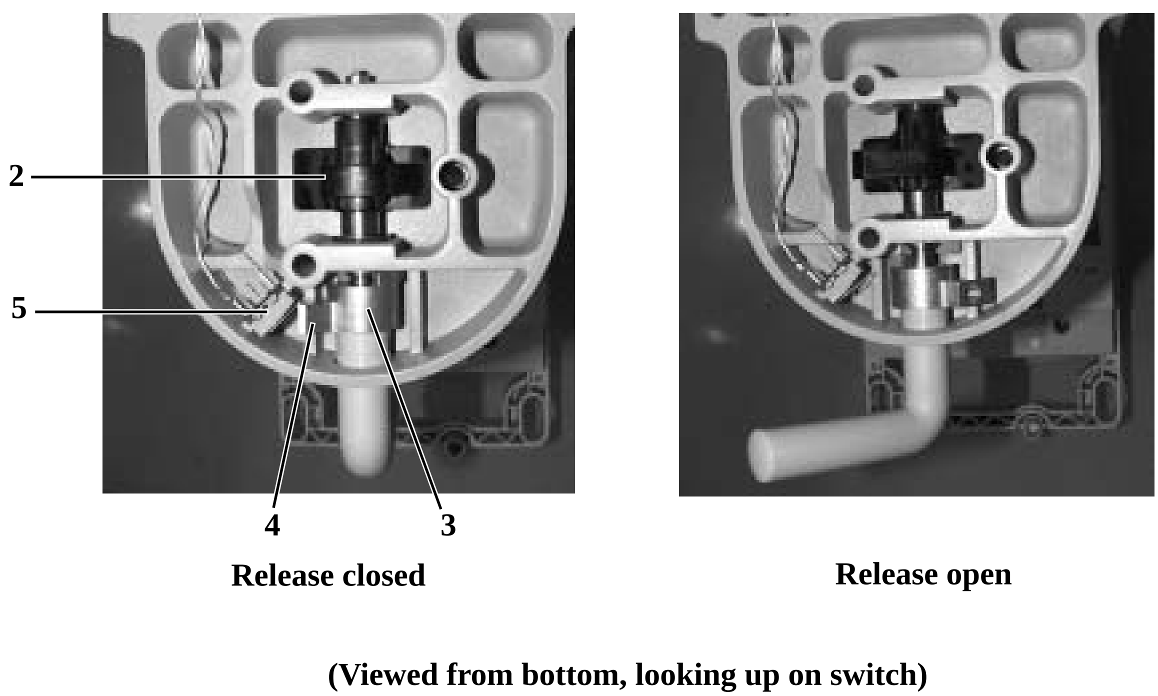


Figure 2-27 • Canister release switch

2.5 Ventilator monitoring and control

2.5.1 Summary of ventilator function

The Aestiva machine may contain either a model 7100 or 7900 Ventilator. The following explains the common controls and functions of these ventilators and their interaction with the Aestiva machine. See the specific Ventilator TRM for additional information.

Both models provide basic ventilator functions, plus optional advanced functions. This section covers the basic functions specific to the 7900 Ventilator. Some of these functions are optional on the 7100 Ventilator and may not be present on all machines. Basic functions on the 7900 include Volume Mode, Pressure Mode, PEEP, O_2 Monitoring, Volume Monitoring, Volume Compensation, and Pressure Waveform.

2.5.2 Volume Mode

Volume mode function (VCV) allows the user to select the desired tidal volume, respiratory rate, I:E ratio, airway pressure limit, and PEEP. The ventilator software uses the set rate and I:E ratio to determine the inhalation time period;

- for example, with Rate at 10/min and I:E ratio at 1:1, the inspiration time will be 3 seconds.

It then determines what velocity of drive gas must be delivered during the inspiratory time to deliver the set tidal volume;

- for example, with V_T at 500 ml, Rate at 10/min and I:E ratio at 1:1, 500ml / 3 seconds = 166.6 ml/sec or 10 L/min.

The amount of current required to open the flow valve enough to deliver the determined velocity is stored in a look-up table. In 7900 models, all flow valves are built to this table specification. (For 7100 - The table is established during the flow valve calibration based on the specific characteristics of the flow valve installed.)

2.5.3 Pressure Mode

Pressure mode function (PCV) allows the user to select the desired airway pressure, respiratory rate, I:E ratio, airway pressure limit, and PEEP. The software uses the rate and I:E ratio to determine the inspiratory time. It then opens the flow valve to a set flow of 80 LPM and monitors the airway pressure. When the set pressure plus PEEP is achieved, it reduces flow to a point that maintains the set pressure for the duration of the inspiratory time. The current to the flow valve required to maintain the reduced flow rate (Plateau) is set based on a look-up table created by the Bleed Resistor calibration (7900). The Plateau pressure is a controlled-loop process and the current to the flow valve is adjusted to maintain the target pressure. (The 7100 table is established during the PEEP valve calibration and uses open-loop control; therefore, the accuracy is based on the last calibration and can be affected by leaks and circuit characteristics.)

2.5.4 PEEP

PEEP (Positive End Expiratory Pressure) can be used in either VCV or PCV and is controlled by software in a similar function to the Plateau Phase, as described in the Pressure Mode section. This value is based on a look-up table created by the calibrations preformed in the Bleed Resistor calibration (7100 - PEEP valve calibration).

2.5.5 O_2 Monitoring

O_2 monitoring is standard on 7900 and optional on 7100 models. A galvanic O_2 cell located in the inspiratory side of the circuit monitors the concentration of oxygen in the breathing circuit. Calibration can be done from the users screens or from the service mode. Oxygen concentration is displayed on the ventilator screen. The O_2 value is also used in the formula to calculate tidal volumes. Inaccurate O_2 readings can result in inaccurate expired tidal volume readings.

2.5.6 Volume Monitoring

Volume monitoring is standard on 7900 and optional on 7100 models. A pressure differential transducer measures the pressure on each side of a Variable Flow Orifice (Flow Sensor) placed on the expiratory side of the absorber. This pressure differential equates to the velocity of the gas passing through the orifice. Measuring a “Volume of a gas” in a dynamic state is very complicated. Even volume displacement devices (such as water columns) have a calibrated scale that converts the displaced element (water) to an equivalent amount of the gas being measured. Volume of a gas changes with composition, temperature, pressure and saturation. The three most used constants for indicating gas volume are ATP (Atmospheric Temperature and Pressure), BTPS (Body Temperature, Pressure, Saturated), and STP (Standard Temperature and Pressure). Volume readings on Aestiva machines are displayed as ATP. Many respiratory gas monitors display volumes as BTPS. There can be as much as a 10% difference in these displayed values. It does not indicate a failure of either device, most likely the actual volume is somewhere between these two calculations.

2.5.7 Volume Compensation

Volume compensation is standard on 7900 and optional on 7100 models. It is only applicable in Volume Control Ventilation. A pressure differential transducer measures the pressure on each side of a Variable Flow Orifice (Flow Sensor) placed on the inspiratory side of the absorber. This pressure differential equates to the velocity of the gas passing through the orifice. This value is not displayed in the normal mode but can be viewed in service mode. During volume ventilation, the velocity of the gas passing through the inspiratory flow sensor is compared to the velocity of the gas coming from the flow valve. If there is a difference, the current to the flow valve will be modified to achieve the required output. If the volume compensation option is active, the first breath will be delivered based on flow valve calibration. Information from the inspiratory flow sensor is then used to verify the flow and adjust it if needed. The next delivered breath is adjusted by 50% of the difference between the set value and the value measured at the inspiratory flow sensor.

There are specific conditions that will trigger the compensation feature off, or locked, depending on the software revision.The ventilator will still deliver in volume mode based on the set value (or the last know correctly compensated value). The message “Vt comp off (locked) – pressure mode available” will be displayed. This is a medium level warning message indicating that the clinician should ensure the volume being delivered is acceptable; the deflection of the bellows gives an approximation of the volume delivered to the patient. Volume mode can be continued and any compensation necessary can be made manually by changing the set volume. It is not necessary to switch to pressure mode but pressure mode is available as an option.

Compensation will not resume until the reason it was disabled is corrected and the user re- selects volume mode as the ventilator option.

2.5.8 Pressure Waveform

Pressure wave form is standard on 7900 and optional on 7100 models. It allows the ventilator to display the airway pressure waveform.

3 Checkout Procedure

In this section

⚠ **WARNINGS**

After any repair or service of the Aestiva, 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 weight limit on each accessory shelf is 46 kg (100 lb).

Systems without accessory shelves have a weight limit on the top surface of 46 kg (100 lb).

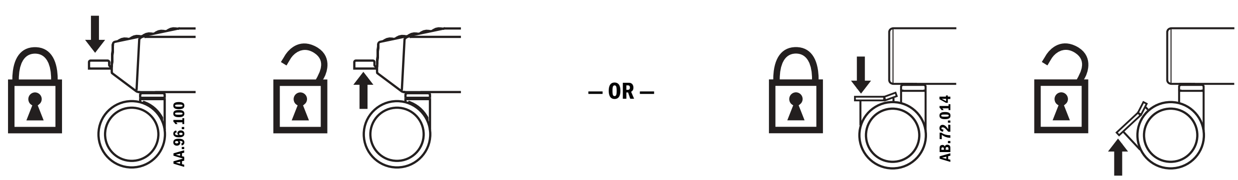
The folding side shelf has a weight limit of 23 kg (100 lb).

Make sure that:

1. The equipment is not damaged.
2. All components are correctly attached.
3. Pipeline gas supplies are connected.
4. Cylinder valves are closed on models with cylinder supplies.

⚠ 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.

5. Models with cylinder supplies have a cylinder wrench attached to the system.
6. On trolley model, make sure the casters are not loose and the brake is set and prevents movement.



3.2 Electrical safety tests

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

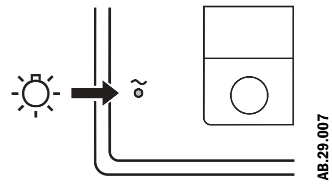
1. Connect an approved test device (e.g. UL, CSA, or AAMI) and verify that the leakage current is less than:

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.

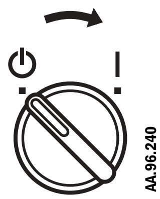
3.3 Power failure test

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



If the indicator is not on, the system does not have mains (electrical) power. Use a different outlet. Close the circuit breaker or replace or connect the power cable.

2. Set the system switch to On.



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 on the ventilator display:
   - “On Battery - Check Power” for 7900 ventilator,
   - “On Battery - Power OK?” for 7100 ventilator.
6. Connect the power cable again.
7. Make sure the alarm cancels.

3.4 Minimize alarms (optional)

Set the ventilator controls to decrease the number of alarms.

1. Control Keys:
   - Volume alarms: OFF
   - Plimit: 100 cm H_2O
2. Alarm menu:
   - Low O_2: 21%
   - High O_2: OFF
3. Bag/Vent switch: Bag

3.5 Pipeline and cylinder tests

⚠ **CAUTION** To prevent damage:

- Open the cylinder valves slowly.
- Do not force the flow controls.

If your system does not use cylinder supplies, do not do steps 2 and 3.

1. Disconnect the pipeline supplies and close all cylinder valves.If the pipeline and the cylinder pressure gauges are not at zero:
   a. Connect an O_2 supply.
   b. Turn On the system, if it is not already on.
   c. Set the flow controls to mid range.
   d. Make sure that all gauges but O_2 go to zero.
   e. Disconnect the O_2 supply.
   f. Make sure that the O_2 gauge goes to zero. As pressure decreases, alarms for low O_2 supply pressure should occur.
2. Make sure that the cylinders are full:
   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 one cylinder at a time for high pressure leaks:
   a. Set the system switch to Standby, which stops the O_2 flow.
   b. Disconnect all accessories from the pneumatic outlet.
   c. Turn OFF the auxiliary O_2 flowmeter.
   d. Open the cylinder.
   e. Record the cylinder pressure.
   f. Close the cylinder valve.
   g. Record the cylinder pressure after one minute. If the pressure decreases more than indicated below, there is a leak.

      690 kPa (100 psi) for machines with 7900 Ventilator

      5000 kPa (725 psi) for machines with 7100 Ventilator

      Install a new cylinder gasket and do this step again.
   h. Repeat step 3 for all cylinders.
   i. Close 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.

4. Connect one pipeline supply at a time.
   - Ensure that the appropriate gauge corresponds to the connected gas supply.
5. Use the chart below to check pipeline pressure:

ANSI (USA and Intl.), Australian, Canadian, French, Japanese	345 kPa (50 psig)
ISO, Italian, Scandinavian, South African, Spanish, Swiss	414 kPa (60 psig)
Austrian, German	500 kPa (75 psig)

3.6 Flow control and pressure relief tests

⚠ **WARNING** Nitrous oxide (N_2O) flows through the system during this test. Use a safe and approved procedure to collect and remove it.

1. Set up the gas scavenging system.
   a. Connect the AGSS to a gas scavenging system.
   b. Attach a patient circuit and plug the patient port.
   c. Attach a bag to the bag arm.
   d. Set the Bag/Vent switch to Bag.
   e. Adjust the APL valve to minimum.
2. Connect the pipeline supplies or slowly open the cylinder valves.
3. Turn all flow controls fully clockwise (minimum flow).
4. Turn on the system.
5. Confirm that the O_2 sensor measures 21% in room air and 100% in pure O_2. If not, calibrate the O_2 sensor.
6. Make sure the O_2 flowtube shows approximately 25 to 75 mL/min. The other flowtubes must show no gas flow.
7. Set the flow controls to mid range of each flowtube and make sure that the flowtube floats rotate and move smoothly.
8. Check the proportioning system concentration (increasing N_2O flow). Observe the following precautions:
   a. Start with all valves at the minimum setting.
   b. Adjust only the N_2O flow control.
   c. Increase the N_2O flow as specified in the following table and make sure the O_2 concentration is in range.

Note Allow the O_2 monitor to stabilize. At the lower flows, the O_2 monitor may take up to 90 seconds to stabilize.

   d. If you overshoot a setting, turn the O_2 flow control clockwise until the N_2O flow decreases to the previous setting before continuing the test.

Set the N_2O flow (L/min)	Measured O_2
0.15	21% minimum
0.5	21% minimum
0.8	21% to 30%
1.0	21% to 30%
3.0	21% to 30%
6.0	21% to 30%
9.0	21% to 30%

9. Check the proportioning system concentration (decreasing O_2 flow). Observe the following precautions:
   a. Start with N_2O valve at the maximum setting.
   b. Adjust only the O_2 flow control.
   c. Decrease the O_2 flow as specified in the table and make sure the O_2 concentration is in the allowed range.

Note Allow the O_2 monitor to stabilize. At the lower flows, the O_2 monitor may take up to 90 seconds to stabilize.

   d. If you overshoot a setting, turn the N_2O flow control counterclockwise until the O_2 flow increases to the previous setting before continuing the test.

Set the O_2 flow (L/min)	Measured O_2
3.0	21% to 30%
2.0	21% to 30%
1.0	21% to 30%
0.3	21% to 30%

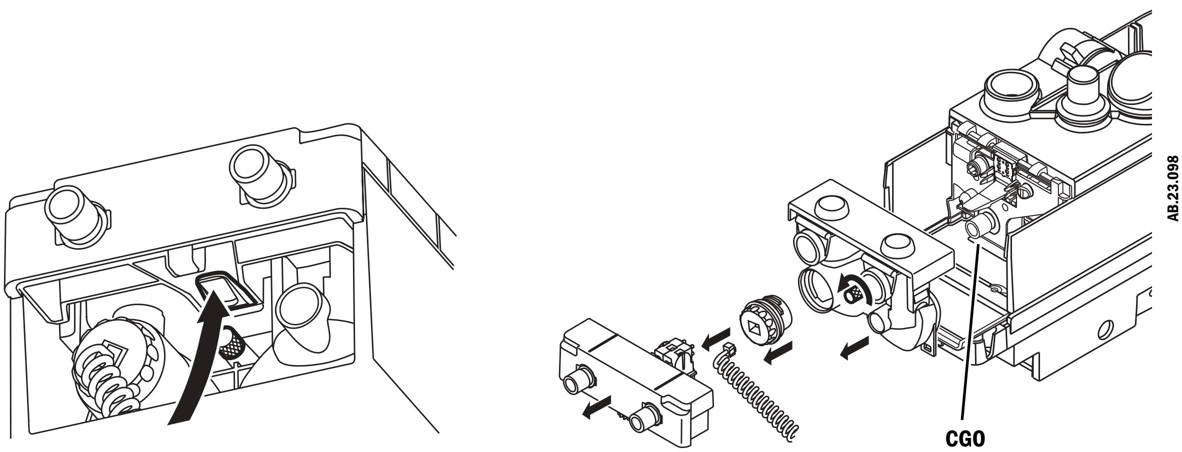
10. Check the linearity of the flow control for each additional gas. Use the appropriate table shown below.

Set the O_2 flow (L/min)	Set the Air flow (L/min)	O_2 monitor range
4.0	3.0	61% to 71%
3.5	6.0	45% to 55%
1.5	8.0	28% to 38%

Set the O_2 flow (L/min)	Heliox —25% O_2, 75% He (L/min)	O_2 monitor range
4.0	3.0	63% to 73%
3.5	6.0	48% to 58%
1.5	8.0	32% to 42%

Set the O_2 flow (L/min)	CO_2 (L/min)	O_2 monitor range
2.0	0.2	86% to 96%
0.5	0.5	45% to 55%

11. Check the pressure relief valve (vaporizer manifold outlet).
    a. Turn all flow controls fully clockwise (minimum flow).
    b. Connect a gauge or a digital manometer to the Common Gas Outlet (CGO). Do not connect to the Auxiliary Common Gas Outlet (ACGO).
    c. Adjust the O_2 flow to 1 L/min.
    d. Verify that the test device reading stabilizes within the following range: **31–60 kPa**, **230–450 mm Hg**, **4.5–8.5 psi**.



12. Set all flow controls to 3 L/min.
13. Stop the O_2 supply. (Disconnect the pipeline supply or close the cylinder valve.)
14. Make sure that:
    a. The low O_2 supply alarm occurs.
    b. N_2O, CO_2, Heliox, and O_2 flows stop. The O_2 flow stops last.
    c. Air flow continues.
    d. Gas supply alarms occur on the ventilator if the ventilator uses O_2 as the drive gas.
15. Turn all of the flow controls fully clockwise (minimum flow).
16. Reconnect the pipeline supplies.

3.7 Vaporizer back pressure test

⚠ **WARNING** Anesthetic agent vapor comes out of the common gas outlet during this test. Use a safe, approved procedure to remove and collect the agent.

1. Set up the gas scavenging system.
   a. Connect the AGSS to a gas scavenging system.
   b. Attach a patient circuit and plug the patient port.
   c. Attach a bag to the bag arm.
   d. Set the Bag/Vent switch to Bag.
   e. Adjust the APL valve to minimum.
2. Turn the system on. Alarms can occur.
3. Set the O_2 flow to 6 L/min.
4. Make sure that the O_2 flow stays constant and the float moves freely.
5. Adjust the vaporizer concentration from 0 to 1% one click at a time. The O_2 flow must not decrease more than 1 L/min through the full range. If the O_2 flow decreases more than 1 L/min:
   a. Install a different vaporizer and try this step again.
   b. If the O_2 flow decreases less than 1 L/min with a different vaporizer, the malfunction is in the first vaporizer.
   c. If the O_2 flow also decreases more than 1 L/min with a different vaporizer, the malfunction is in the Aestiva. Do not use the Aestiva system until it is serviced (repair vaporizer manifold port valve).
6. Complete steps 3 through 5 for each vaporizer and vaporizer position.
7. Set the system switch to Standby.

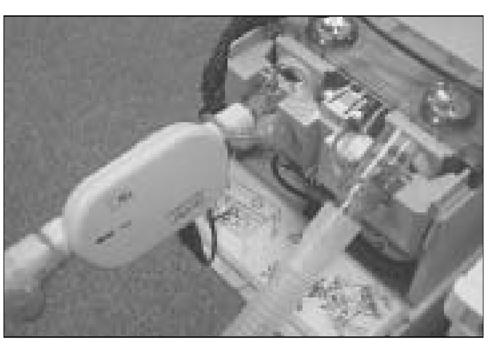
3.8 Flow sensor check

The test device used in the following procedure must have an accuracy to ± 2.5% or greater (refer to Section 8.1).

This procedure checks the raw velocity measurement made by the flow sensor; therefore, any error inherent in the conversion to volume is eliminated. This is true for both the ventilator flow sensors and the test device. The flow valve calibration is also verified.

1. Remove the bellows housing.
2. Remove and set aside the bellows assembly and the pressure relief valve.
3. Reinstall the bellows housing.

4. Remove the flow sensor module and take off the cover.
5. Remove the expiratory flow sensor from the flow sensor module.
6. Reinstall the flow sensor module with the expiratory flow sensor connected but not seated in the circuit module.
7. Ensure both sensors are plugged into the bulkhead connector.



8. Connect a test flow device in series with the inspiratory flow sensor (ensure the correct flow direction).
9. Connect a short piece of patient tubing between the inspiratory flow sensor and the removed expiratory flow sensor.

10. Go to the flow valve test tool screen in the service mode.
    - Follow the menu structure outline below to reach the adjustment for the inspiratory flow valve. Select and confirm at each step.

7900	7100
“Flow Valve Test Tool”	“Diagnostics Tests/Tools”
“Set Flow (LPM)”	“Valves - Test Tool”
	“Set Inspiratory Valve”

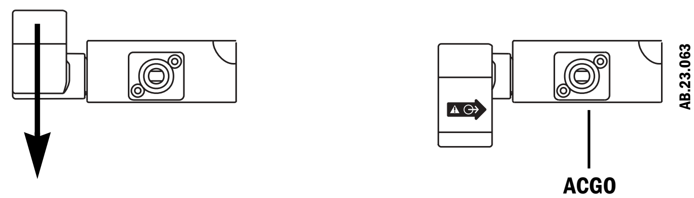
    - For the 7100:
        - “Set PEEP Safety Valve” to “Open”.
        - “Set PEEP Valve” to “100 cm H_2O”.
    - For the 7900:
        - Occlude the bleed resistor outlet.
11. Select flows of 10, 20, 30, and 50.
12. At each flow:
    Record the absolute value of the inspiratory and expiratory flow sensors. (*Inspiratory and Expiratory flows will have different signs (+ and -); these are flow direction indicators only.*)
    - The flow sensor readings should be within 10% of the test device.
13. If all flow sensors agree but are more than 10% from the set value:
    - check for leaks in the drive gas circuit,
    - perform all calibrations and recheck.
14. If no improvement,
    - For the 7100, calibrate the flow valve.
    - For the 7900, replace the flow valve.
15. Shut off the flow.
16. Switch the position of the inspiratory and expiratory flow sensors. (*This will reverse the flow through the sensors and give an indication of aging on the internal flapper. As the flapper gets older and is subjected to repeated cleaning, it tends to harden and lose its original shape.*)
17. Repeat step 11.
    - Compare the current expiratory flow to the recorded inspiratory flow without regard for the sign. If there is more than a 10% difference, replace the flow sensor currently on the expiratory side.
    - Compare the current inspiratory flow to the recorded expiratory flow without regard for the sign. If there is more than a 10% difference, replace the flow sensor currently on the inspiratory side.

3.9 Low-pressure leak test

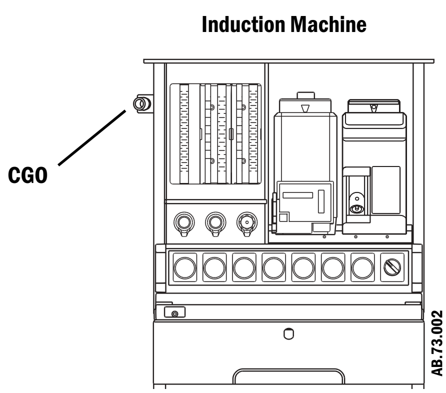
⚠ WARNING Do not use a system with a low-pressure leak. Anesthetic gas will go into the atmosphere, not into the breathing circuit.

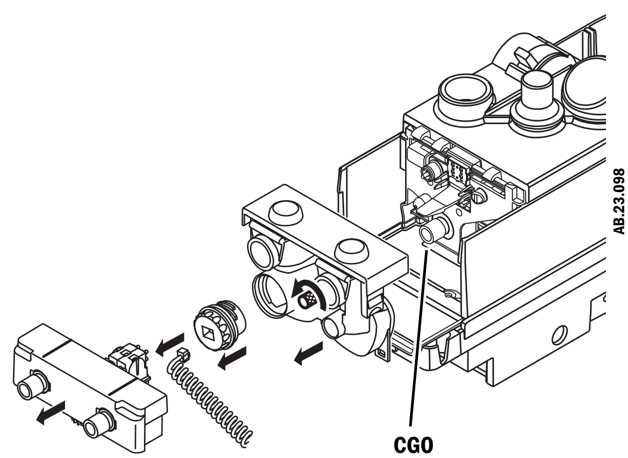
Negative low-pressure leak test

1. Turn on the auxiliary common gas outlet (ACGO — some models).

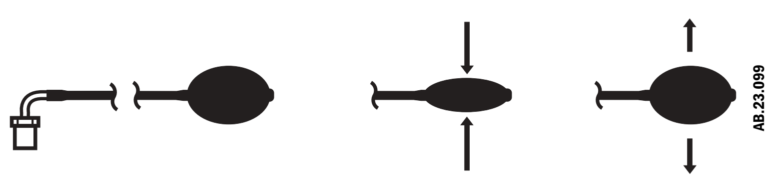


2. Or, access the common gas outlet (CGO).





3. Test the leak test device:
   a. Put your hand on the inlet of the leak test device. Push hard for a good seal.
   b. Squeeze the bulb to remove all air from the bulb.
   c. If the bulb completely inflates in less than 60 seconds, replace the leak test device.



4. Set the system switch to Standby.
5. Turn off all vaporizers.
6. Test the anesthesia machine for low-pressure leaks:
    a. Turn the flow controls one and a half turns counterclockwise (CO_2 to maximum flow).
    b. Connect the test device to the common or auxiliary gas outlet.
    c. Compress and release the bulb until it is empty.
    d. The vacuum causes the floats to move. This is usual. If the bulb completely inflates in 30 seconds or less, there is a leak in the low-pressure circuit.
7. Test each vaporizer for low-pressure leaks:
    a. Set the vaporizer to 1%.
    b. Repeat step 6.
    c. Set the vaporizer to OFF.
    d. Test the remaining vaporizers.
8. Disconnect the test device.
9. Turn all flow controls fully clockwise (minimum flow). Do not over tighten.

⚠ **WARNING** Agent mixtures from the low-pressure leak test stay in the system. Always flush the system with O_2 after the low-pressure leak test (1 L/min for one minute).

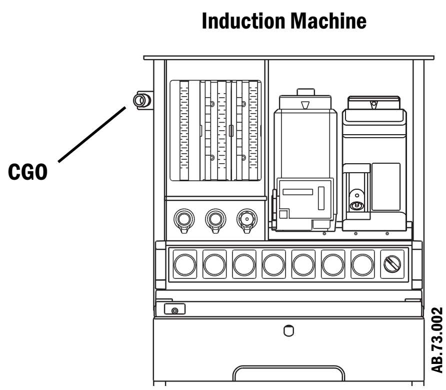
Turn off all vaporizers at the end of the low-pressure leak test.

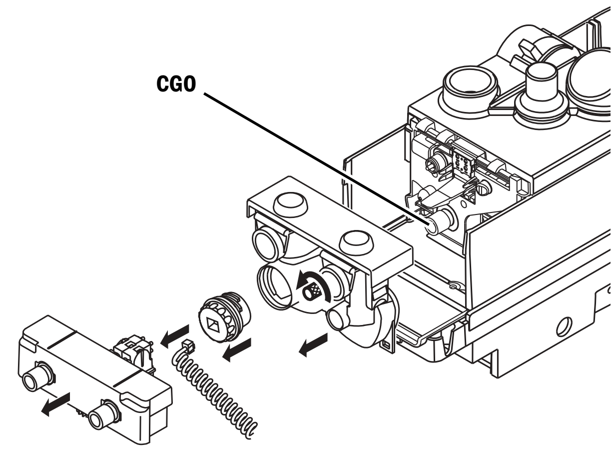
10. Remove all condensate from the breathing circuit module.
11. Assemble the breathing system (if previously disassembled).
12. Flush the system with O_2:
    a. Set the system switch to On.
    b. Set the O_2 flow to 1 L/min.
    c. Continue the O_2 flow for one minute.
    d. Turn the O_2 flow control fully clockwise (minimum flow).
    e. Set the system switch to Standby.

ISO or BSI standard low-pressure leak test

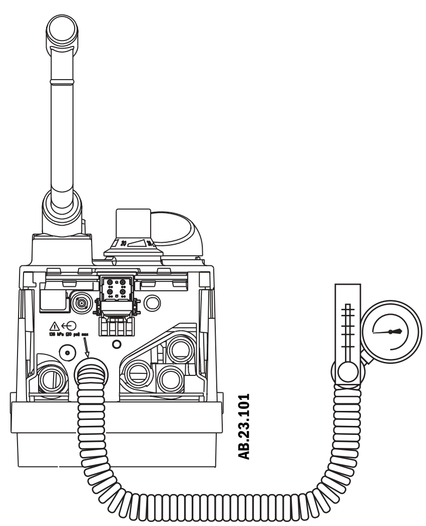
Note (for systems with an ACGO): The ACGO includes a one-way valve that directs a small sample of gas to the O2 sensor. Due to this, you cannot use positive-pressure to perform a low-pressure leak test through the auxiliary outlet.

1. If ACGO is present, set the Outlet switch to common gas outlet.
1. Access the common gas outlet (CGO).





2. Connect the leak test device to the common gas outlet with a section of tubing. For Induction Machines, connect the test device directly to the common gas outlet.



Note: Keep the flow tube vertical for accurate results.

3. Fully close all flow controls.
4. Fully open the needle valve on the test device.

⚠ CAUTION If the needle valve is not fully open, this test can damage the pressure gauge on the test device.

5. Open the Air or N_2O flow control and set a total flow of 0.4 L/min through the flowmeter on the test device.
6. Make sure that the pressure gauge on the test device reads zero and that all other flow controls are fully closed.
7. Close the needle valve on the test device until the test gauge reads:

ISO 5358	**3 kPa**
BSI 4272.3	**20 kPa**

8. If the flow through the test device is less than **0.35 L/min (ISO)** or **0.3 L/min (BSI)**, there is a low pressure leak in the anesthesia machine.
9. Test each vaporizer for low-pressure leaks:
   a. Set the vaporizer to 1%.
   b. Repeat steps 3 through 8.
   c. Fully open the needle valve on the test device to decrease the back pressure.
   d. Turn the vaporizer OFF.
   e. Test the remaining vaporizers.

⚠ **WARNING** Agent mixtures from the low-pressure leak test stay in the system. Always flush the system with O_2 after the low-pressure leak test (1 L/min for one minute).

Turn all vaporizers OFF at the end of the low-pressure leak test.

10. Remove all condensate from the breathing circuit module.
11. Assemble the breathing system.
12. Flush the system with O_2:
    a. Set the system switch to On.
    b. Set the O_2 flow to 1 L/min.
    c. Continue the O_2 flow for one minute.
    d. Turn the O_2 flow control fully clockwise (minimum flow).
    e. Set the system switch to Standby.

3.10 Alarm tests

1. Connect a test lung to the patient connection.
2. Set the Bag/Vent switch to Vent.
3. Set the system switch to On.
4. Set the controls:
   - Ventilation Mode: Volume control
   - Ventilator:
     Tidal Vol: 400 ml
     Rate: 12
     I:E Ratio: 1:2
     Plimit: 40 cm H_2O
     PEEP: OFF
   - Anesthesia Machine
     O_2 flow: minimum flow (25–75 mL/min)
     All other gases: OFF
5. Push O_2 Flush to fill the bellows.
6. Make sure that:
   a. Mechanical ventilation starts.
   b. A subatmospheric pressure alarm does not occur.
      Note: With active gas scavenging, too much scavenging flow can cause subatmospheric alarm.
   c. The ventilator displays the correct data.
   d. The bellows inflate and deflate during mechanical ventilation.
7. Set the O_2 flow control to 5 L/min.
8. Make sure that:
   a. The end expiratory pressure is approximately 0 cm H_2O.
      Note: Positive end expiratory pressure when PEEP is off may indicate that the scavenging system is not removing enough gas.
   b. The ventilator displays the correct data.
   c. The bellows inflate and deflate during mechanical ventilation.
9. Test the low minute volume alarm:
   a. Go to the alarms menu.
   b. Set the alarm limit for low minute volume to 6.0 L/min.
   c. Make sure that a low minute volume alarm occurs.
   d. Go to the alarms menu.
   e. Set the low minute volume alarm to OFF.

10. Test the high airway pressure alarm:
    a. Set P_{limit} to less than the peak airway pressure.
    b. Make sure that the high airway pressure alarm occurs.
    c. Set P_{limit} to correct level.
11. Test the low airway pressure alarm:
    a. Remove the test lung from the patient connection.
    b. Make sure that the low airway pressure alarm occurs.
        - Other alarms such as low minute volume can occur.
12. Test the sustained airway pressure alarm:
    a. Set the controls:

APL valve	Closed
Bag/Vent switch	Bag

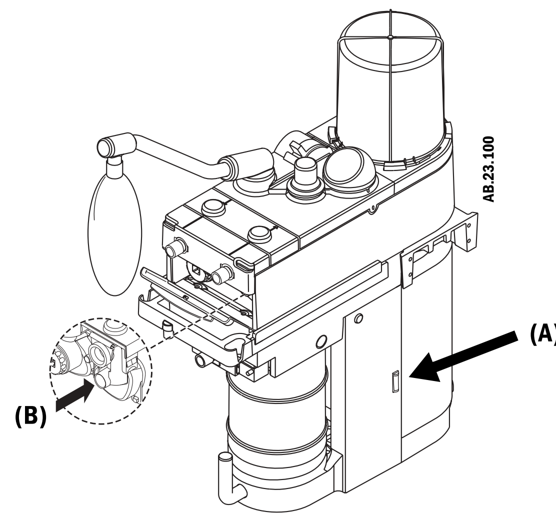
    b. Mechanical ventilation stops when the Bag/Vent switch is set to Bag.
    c. Close the patient connection and push the O_2 Flush button.
    d. Make sure that the sustained pressure alarm occurs after approximately 15 seconds at the sustained pressure limit (6-30 cm H_2O varies with pressure limit).
13. Test the apnea alarm:
    a. Remove the test lung from the patient connection.
    b. Make sure that the apnea alarm occurs (the apnea alarm occurs after 30 seconds).
        - Other alarms such as low minute volume can occur.
14. Test the O_2 monitor and alarms:
    a. Remove the O_2 sensor from the circuit module.
    b. Make sure the sensor measures approximately 21% O_2 in room air.
    c. Set the low O_2 alarm to 50%. Make sure a low O_2 alarm occurs.
    d. Set the low O_2 alarm back to 21% and make sure that alarm cancels.
    e. Put the O_2 sensor back in the circuit.
    f. Set the High O_2 alarm to 50%.
    g. Push the flush button to fill the breathing system.
    h. Make sure the high O_2 alarm comes On.
    i. Set the high O_2 alarm back to 100% and make sure that alarm cancels.
    j. After 2 minutes in pure O_2, the sensor measures approximately 100% O_2.
15. Set the system switch to Standby.

3.11 Breathing system tests

⚠ **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.

1. Verify that AGSS is operating. Breathing systems with active scavenging have a flow indicator **(A)** on the side. Make sure that the flow indicator shows a flow in the green (normal) region.
2. With a circle breathing module, push the drain button **(B)** for 10 seconds or more to drain condensate into the absorber.



3. Zero the pressure gauge (Section 6.6).

One-way Valves

4. Make sure that the one-way valves on the Circle breathing circuit module work correctly:
   a. The Inspiratory check valve rises during inspiration and falls at the start of expiration.
   b. The Expiratory check valve rises during expiration and falls at the start of inspiration.

   Note: The Bain/Mapleson D circuit module does not have one-way valves.

Ventilator Bellows

5. Ventilator bellows test:
   a. Set the system switch to Standby.
   b. Set the Bag/Vent switch to Ventilator.
   c. Set all flow controls to minimum.
   d. Close the breathing circuit at the patient connection. Use your hand or the test plug located in the handle of the breathing system.
   e. Push the O_2 flush button until the bellows is full.
   f. The pressure must not increase to more than 15 cm H_2O on the pressure gauge.
   g. Release the flush button. If the bellows falls more than 100 mL/min, it has a leak.

Service Mode Tests

6. Enter the Service Mode: Push and hold the adjustment knob on the ventilator's display and set the system switch to On.
   a. Select and confirm "Service Mode(s)."
   b. Follow the menu structure outline below to reach the adjustment for the inspiratory flow valve. Select and confirm at each step.

7100	7900 (4.X)	7900 (1.X/3.X)
"Diagnostics Tests/Tools"	"Breathing System Leak Test"	"Test for Leaks"
"Breathing System Leak Test"		

   c. Follow the instructions on the screen.

Bag Circuit

7. Test the Bag circuit for leaks:
   a. Set the system switch to On.
   b. Set the Bag/Ventilator switch to Bag.
   c. Plug the Bag port; use your hand or the approved test plug.
   d. Close the APL valve.
   e. Set the O_2 flow to 200 mL/min.
   f. Close the patient connection (using a hand or test plug on the breathing system handle) and pressurize the bag circuit with the O_2 flush button to approximately 30 cm H_2O.
   g. Release the flush button. The pressure must not decrease. A pressure decrease large enough to see on the gauge indicates a leak. Look for and repair the leak (open drain plug, open canister, breathing circuit assembly not pushed on completely).
   h. If your system has a CO_2 bypass, move the absorber canister release to the bypass position and repeat steps f and g to look for leaks in the bypass mode.

APL Valve

8. Test the APL valve:
   a. Check and zero the pressure gauge as required (Refer to section 6.6).
   b. Ensure that the AGSS is on and operational.
   c. Plug the patient connection by connecting it to the test port on the handle.
   d. Plug the bag arm with a test plug.
   e. Fully open the APL to MIN.
   f. Set the O_2 flow to 3 L/min. The pressure indicated on the pressure gauge should not exceed 3.0 cm H_2O.
   g. Adjust the total fresh gas flow to 30 L/min*. The pressure indicated on the pressure gauge should not exceed 4.0 cm H_2O.
   h. Check the valve at mid-range settings of about 20, 30, and 50 while flowing 30 L/min. Note that scale markings are only approximate. The pressure should stabilize at each setting; however, fluctuations within an 8 cm H_2O range (min to max) are acceptable**. Ensure that the APL valve exhibits a tactile detent feel when turning in the 30–70 cm H_2O range and that the knob does not rotate on its own.
   i. Set the APL to 70 while flowing 30 L/min. The pressure indicated on the pressure gauge should be between 60–85 cm H_2O, including any fluctuations**.
   j. Set the APL to MIN.
   k. Remove the plug from the bag arm and replace it with the bag. The bag should fully inflate.
   l. Reduce the O_2 flow to minimum and all other flow controls off.
   m. The bag should remain inflated.

* ***To achieve 30 L/min total fresh gas flow, set the O_2 flow to 15 L/min and the Air flow to 15 L/min. Alternatively, set the O_2 flow to 15 L/min and the N_2O flow to the maximum stop less approximately 1/2 turn.***

⚠ **WARNING** ***Nitrous oxide flows through the system during this test. Use a safe and approved procedure to collect and remove it.***

** ***Pressure fluctuations can occur with this test due to the steady high flow rate used. However, there should be no fluctuations or spikes outside of an 8 cm H_2O range (min to max) at any setting. This will not occur during normal bagging operation with lower fresh gas flow rates.***

9. Set the System switch to Standby

⚠ **WARNING** Make sure that there are no test plugs or other objects caught in the breathing system.

3.12 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.

3.13 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).

Notes

4 Repair Procedures

In this section This section covers the repair and replacement procedures for components of the Aestiva Anesthesia Machine.

⚠ **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.

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

Note All pictures and illustrations shown in Section 4 are from a left-hand machine. Orientation of pneumatic connections are reversed (rotated 180°) for right-hand machines.

4.1 Servicing the ventilator

The Aestiva Anesthesia Machine can be configured with either of two ventilators — the Aestiva 7900 SmartVent and the Aestiva 7100 Ventilator.

Service information for these ventilator is provided in separate service manuals as detailed in Section 1.2.2.

Ventilator components are located in four areas of the Aestiva machine.

- The Display/Control module.
- The Electrical Enclosure located behind the AC Inlet module.
- The Vent Engine Housing located in the rear portion of the Breathing System.
- The sensor interface (SIB—7900, MIA—7100) located under the rear subfloor of the Breathing System.

Common machine components such as switches and sensors which provide input to the ventilator and other Breathing System components that are common to both ventilators are covered in this manual.

The following components are associated with a particular ventilator and are covered in their respective service manuals.

Vent CPU

For the 7900 Ventilator the CPU board is located in the Electrical Enclosure.

For the 7100 Ventilator the CPU is part of the Control Board located in the Control Module.

Vent power supply

For the 7900 Ventilator the power supply and its related components are located in the Electrical Enclosure.

For the 7100 Ventilator the power supply is located in the Control Module.

Display/Control Module

The Display/Control Module is specific to each ventilator. Refer to the respective service manual for details.

Vent Engine

The Vent Engine is specific to each ventilator. Refer to the respective service manual for details.

SIB/MIA

The Sensor Interface Board (SIB) for the Aestiva 7900 Ventilator and the comparable assembly, the Monitoring Interface Assembly (MIA), for the Aestiva 7100 Ventilator are located in the Breathing System. With a few exceptions, the Breathing System components that interface with these assemblies are identical for each ventilator.

For the current revision levels of the service manuals, the replacement procedure for the 7900 SIB is covered in this manual (Section 4.12.16). The replacement procedure for the 7100 MIA is covered in the Aestiva 7100 Ventilator service manual.

Serial Adapter Board

For the 7100 Ventilator, the SAB is located in the Electrical Enclosure.

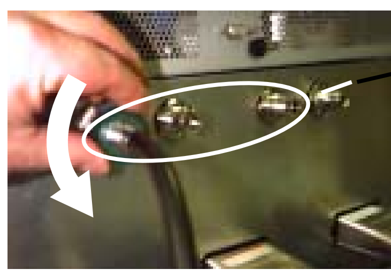
For the 7900 Ventilator, the serial data input/output functions are located on the CPU board.

4.2 How to bleed gas pressure from the machine

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

1. Set the system switch to On.
2. Close all cylinder valves.

   Note: If pipeline O_2 is not available, open the O_2 cylinder valve.
3. Disconnect all pipeline supplies (except for O_2) from the source.
4. Disconnect all pipeline supplies (except for O_2) from the rear of the machine.
5. Bleed all gas pressures from the machine:
   a. Turn the flow controls for all gases (except O_2) counterclockwise.
   b. Disconnect the O_2 pipeline supply from the source and from the machine (or close the O_2 cylinder valve).
   c. Press the O_2 flush button to bleed O_2 from the system.



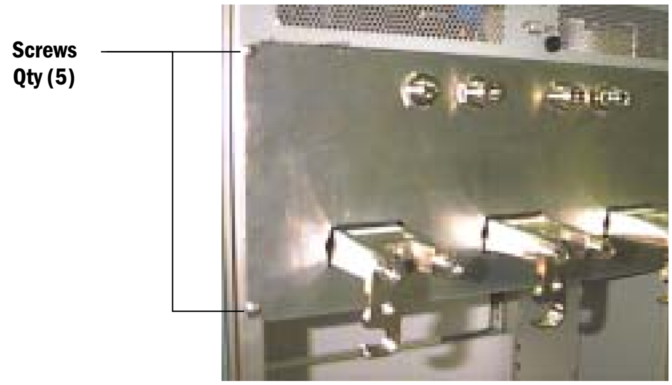
6. Set the system switch to Standby.

4.3 How to remove the rear panel

You must remove the rear panel to repair or replace many of the machine gas supply components. Before removing the rear panel,

1. Bleed all gas pressure from the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. Disconnect all electrical cables.
4. Remove all cylinders.
5. Remove the tee handles.

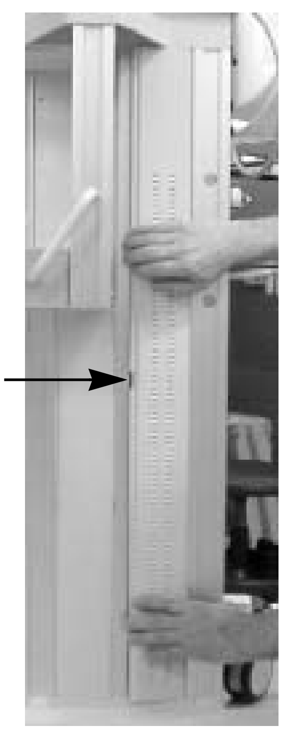
6. Remove the screws from the rear panel.



7. Remove the rear panel.
8. To reinstall the rear panel, perform the previous steps in reverse order.

Note: Before installing the rear panel, check the seals around the cylinder yokes. Replace any seal that is torn or cracked.

4.4 How to remove the side panels



There are clip springs in the rear frame uprights. To remove a side panel, you must move the panel towards the rear. Then you can pull the panel out of the front frame uprights.

1. Slide the side panel towards the rear.
2. Carefully insert a nonmetallic flat blade tool into the notch at the front side of the panel. A nonmetallic tool is recommended to prevent damage to the painted surface of the panel.
3. Pull the side panel from the frame.

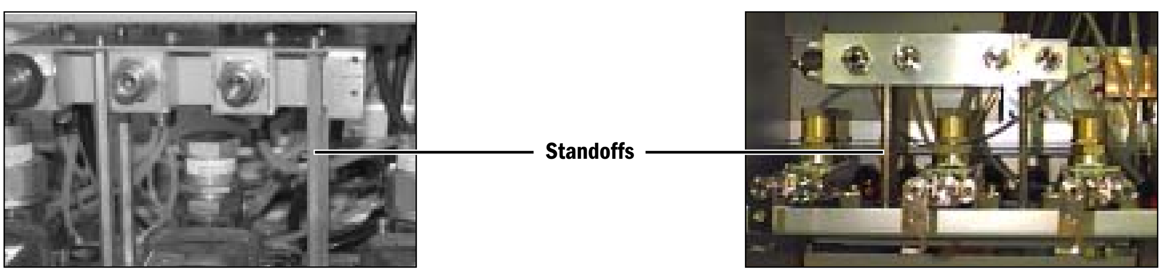
4.5 Service the pipeline inlet (pneumatic) manifold

Note Newer machine variants include individual pipeline inlet manifolds in place of the single pneumatic manifold used in previous production machines. Additionally, the common gas manifold has been redesigned and the secondary regulator has been eliminated.

4.5.1 Remove pneumatic manifold

You can move the pneumatic manifold, or the pipeline inlet assembly, to gain a less restricted access to its components by temporarily removing its mounting screws and in some cases its standoffs.

1. Remove the rear panel (Section 4.3).
2. Remove the four screws that hold the manifold assembly standoffs to the frame member (from below).



3. Pull the manifold assembly toward you. This frees (but does not totally remove) the pneumatic manifold to allow access to the front of the manifold.
4. For a less restricted access, remove the standoffs.

Replace pneumatic manifold or a pipeline inlet

To replace an individual pipeline inlet manifold:

Refer to Section 8.20 to identify parts.

1. Remove the manifold from the assembly.
2. Transfer the gauge adapter, pressure regulator, and pipeline inlet fitting (with filter and check valve) to the replacement inlet manifold.
3. Reassemble in reverse order.

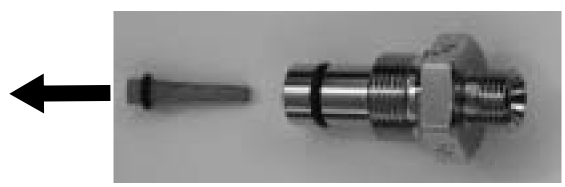
4.5.2 Replace pipeline inlet fitting

1. Remove the rear panel (Section 4.3).
2. Remove the pipeline inlet fitting.

3. Transfer the o-ring and inlet filter (or install new) to the new inlet fitting.
4. Install the new pipeline inlet fitting.
5. Install the rear panel.

4.5.3 Replace pipeline inlet filter

1. Remove the rear panel (Section 4.3).
2. Remove the pipeline inlet fitting (Section 4.5.2).
3. Pull the pipeline inlet filter out of the fitting. The o-ring should come out with the filter.

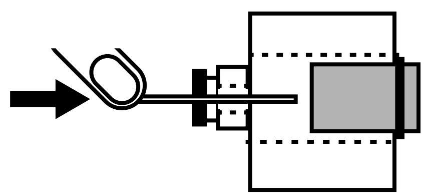


4. Install the new pipeline inlet filter in the pipeline inlet fitting. The new filter comes with an o-ring.
5. Install the pipeline inlet fitting.
6. Install the rear panel.

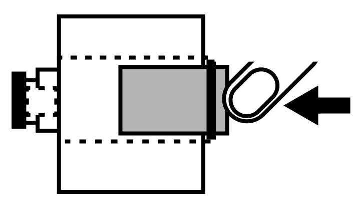
4.5.4 Replace pipeline inlet check valve

1. Remove the rear panel (Section 4.3).
2. From the front of the machine, remove the panel under the vaporizer manifold.
3. Remove the pipeline inlet fitting (Section 4.5.2).
4. The back of the pneumatic manifold has a tube connection for each inlet fitting. Find and remove the tube directly in line with the check valve that is being serviced.

   The individual O_2 or Air inlet manifolds include a drive gas connection at the back of the manifold. Remove the drive gas tube or plug to access the check valve.
5. From the back of the manifold, use a thin tool to push out the check valve. (For an individual 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,)



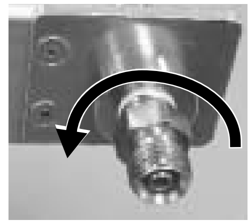
6. Push the new check valve into the opening, using the same thin tool. The new check valve includes an o-ring — orient it toward the pipeline inlet. **Note:** Make sure to push the new check valve all the way back into the opening until it bottoms out on the shoulder.



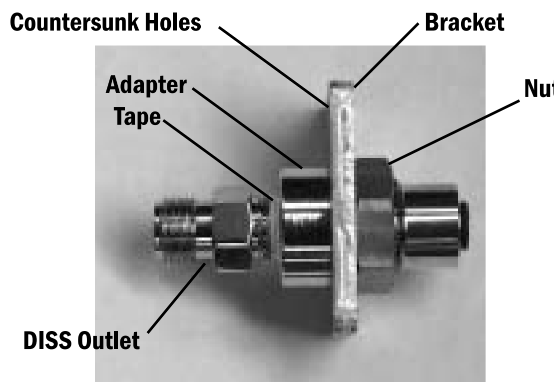
7. To assemble:
   a. Reconnect the tube to the pneumatic manifold (pull on the tube to ensure that it is locked into the fitting).
   b. Install the pipeline inlet fitting.
   c. Install the rear panel.
8. Perform the checkout procedure (Section 3).

4.5.5 Replace pneumatic O_2 power outlet

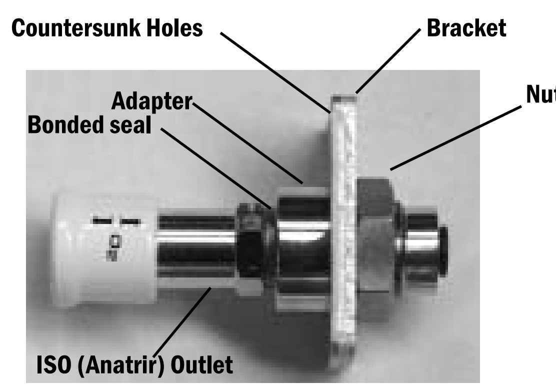
1. Remove the rear panel (Section 4.3).
2. Remove the O_2 power outlet fitting.



3. To assemble:
   a. **For DISS fittings**, apply teflon tape to the threads of the O_2 power outlet fitting.



For ISO fittings, do not use teflon tape. Use a bonded seal instead. Replace as necessary.

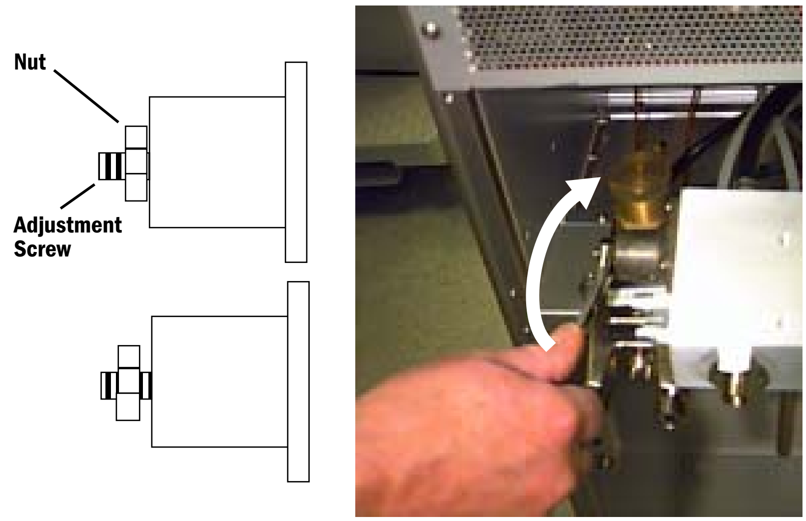


   b. Install the new O_2 power outlet fitting.
4. Install the rear panel.
5. Perform the checkout procedure (Section 3).

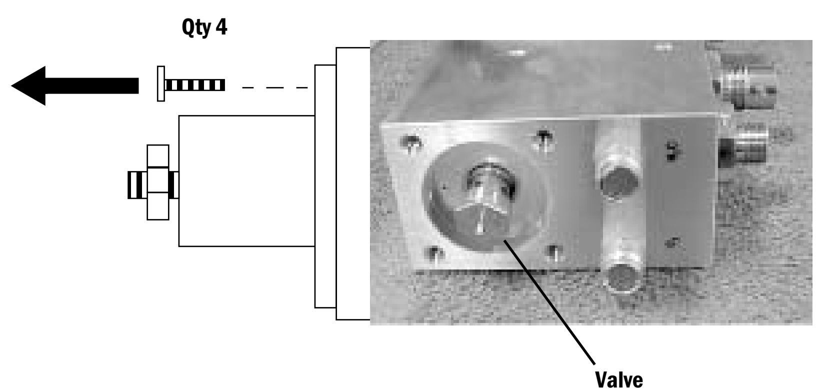
4.5.6 Rebuild flush regulator

1. Remove the rear panel (Section 4.3).
2. Remove the pneumatic manifold (Section 4.5.1).
3. Loosen the nut and turn the regulator adjustment screw counterclockwise to remove pressure from the spring.

.



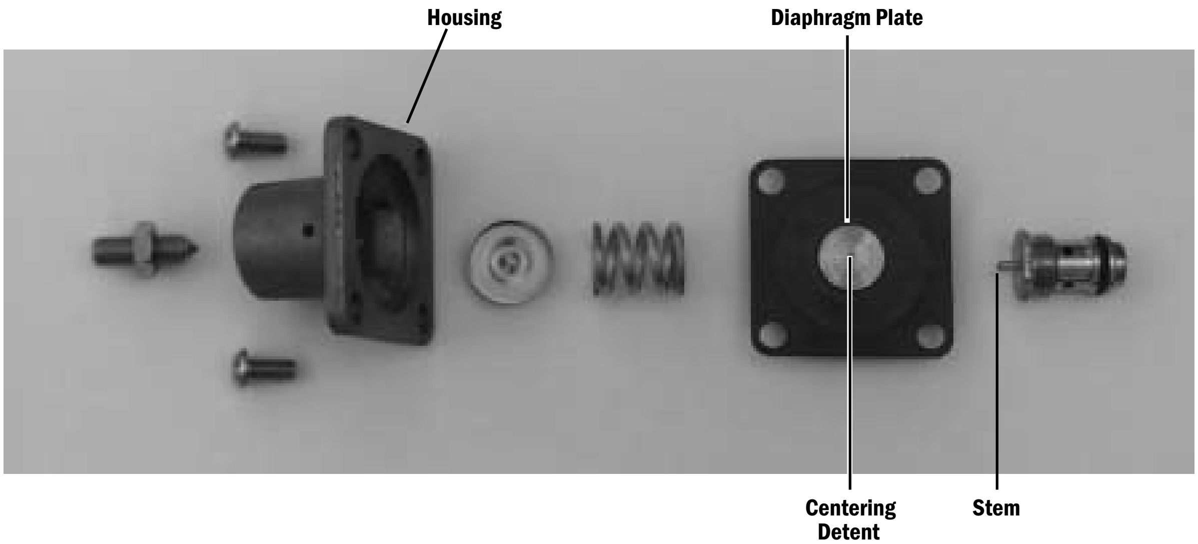
4. Remove the screws and disassemble the regulator.



5. Use a socket wrench to remove the regulator cartridge.
6. Check the condition of the o-ring on the valve body. Replace the o-ring if it is torn or cracked (lubricate sparingly with Krytox).

To reassemble

1. Install the valve body into the manifold.
2. Assemble the housing components into the housing.



3. Back out the adjustment screw to release spring pressure.
4. Install the housing loosely onto the manifold. Finger tighten the four mounting screws and then back off each screw one full turn.
5. Turn in the adjustment screw until the diaphragm plate just engages the valve stem (to the point where you first start to feel increased resistance) and then turn the screw in (tighten) one full turn.
6. Rotate the housing in a circular motion to ensure that the valve stem comes to rest in the centering detent of the diaphragm plate.
7. Using a x-cross pattern, securely tighten the regulator housing mounting screws.

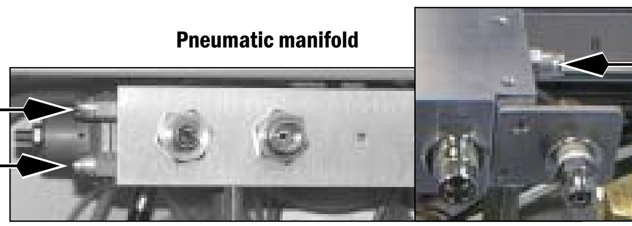
Adjust the regulator output

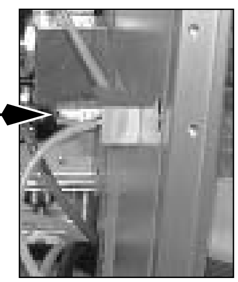
1. As an initial adjustment, turn the adjustment screw in four turns after it starts to compress the spring.
2. Check the output of the regulator (Section 6.5). Adjust if necessary.
3. Install the rear panel.
4. Perform the checkout procedure (Section 3).

4.5.7 Replace high-pressure relief valve

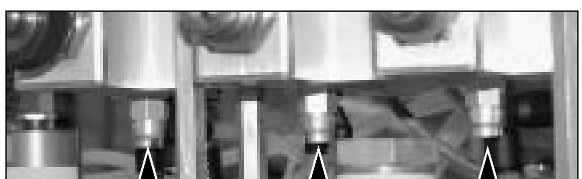
1. Remove the rear panel (Section 4.3).
2. Remove the high-pressure relief valve.
3. Install the new high-pressure relief valve.
   - Ensure the new valve includes an o-ring.

Pneumatic manifold





Individual pipeline inlets



4. Install the rear panel.
5. Perform the checkout procedure (Section 3).

4.5.8 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 respective ventilator service manual. If the drive gas selection and the actual drive gas do not agree, volumes will not be correct.

O_2 is the only monitored gas supply pressure. If Air is selected as the drive gas for the ventilator, there will be no specific alarm for loss of air supply. Performance alarms will still function.

1. Remove the rear panel (Section 4.3).
2. Remove the pneumatic manifold (Section 4.5.1).

Note: The pneumatic manifold has a connection for each drive gas marked "O_2 Vent" or "Air Vent." (The drive gas connection at the back of an individual pipeline manifold is not marked.) The connection not in use is blocked with a plug.

3. Remove the plug from the new connection.

Air Drive (equivalent) **View from Front (O_2 shown as drive gas)** **O_2 Drive**

4. Disconnect the drive gas hose from the present connection.
5. Install the plug in this connection (pull on the plug to ensure that it is locked into the fitting).
6. Reroute the drive gas hose so that it does not cause kinks in other tubing.
7. Connect the drive gas hose to the new connection (pull on the hose connector to ensure that it is locked into the fitting).
8. Do a high pressure leak test BEFORE you install the pneumatic manifold and the rear panel.
9. Enter the service mode and select the correct drive gas.
10. Test the primary regulator. Verify that it functions within specifications now that it will be supplying drive gas to the ventilator (Section 6.1).
11. To assemble:
    a. Install the pneumatic manifold.
    b. Install the rear panel.
12. Perform the checkout procedure (Section 3).

Drive gas connection for individual pipeline manifold

4.6 Service the cylinder supply modules

4.6.1 Tightening procedure for high-pressure tube fittings

The cylinder pressure gauge is connected to the cylinder supply through a copper tube with fittings at both ends. Use the following tightening procedure whenever you are replacing a cylinder supply or a cylinder pressure gauge.

1. Insert the tubing into the fitting until the ferrule seats in the fitting.
2. Tighten the nut by hand.
3. Continue tightening the nut with a wrench until it reaches the original position (about 1/4 turn). You will feel an increase in resistance at the original position.
4. After reaching the original position, tighten the nut just slightly.

Note If you are installing a new tube that has not been tightened before, tighten the nut 3/4 turns with a wrench after the nut is finger tight.

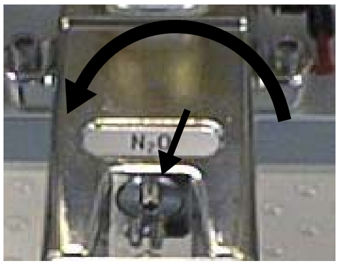
4.6.2 Replace primary regulator module (complete replacement)

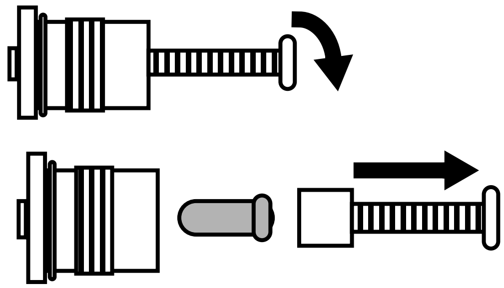
1. Remove the rear panel (Section 4.3).
2. Disconnect the cylinder pressure gauge fitting.
3. Remove the three mounting screws and lock washers.

4. Disconnect all other fittings.
5. To reassemble, perform the previous steps in reverse order.
   - Tighten the high-pressure fitting as detailed in Section 4.6.1
   - Pull on the cylinder output fitting to ensure it is locked in place.
6. Check the output of the regulator BEFORE you install the rear panel. Adjust if necessary (Section 6.1).
7. Perform the checkout procedure (Section 3).

4.6.3 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 into the brass retaining ring and pull it out.

⚠ **CAUTION** Make sure to screw the 6-mm screw in two turns only. Do not crush the filter.

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).

4.6.4 Replace cylinder check valve

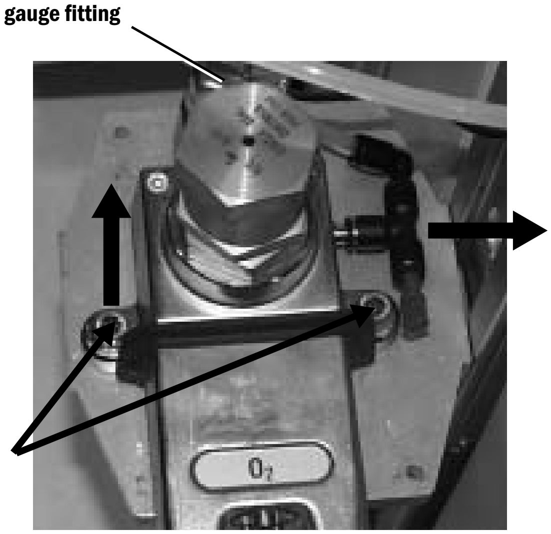
The cylinder check valve is not a replaceable item. If the check valve is defective, you must replace the complete cylinder supply module.

For instructions, see Section 4.6.2.

4.6.5 Replace 4th- and 5th-gas cylinder supply module

1. Bleed all gas pressure from the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. Remove the gas manifold cover (two screws from bottom of mounting plate.
4. Disconnect the cylinder pressure gauge fitting.
5. Disconnect the output tube fitting.
6. Remove the three mounting screws and lock washers.

Pressure gauge fitting

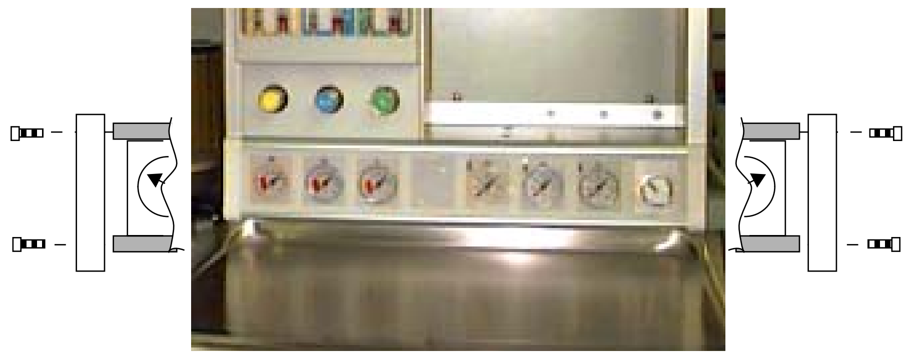


7. To reassemble, perform the previous steps in reverse order.
   - Tighten the high-pressure fitting as detailed in Section 4.6.1
   - Pull on the cylinder output fitting to ensure it is locked in place.
8. Check the output of the regulator BEFORE you install the manifold cover. Adjust if necessary (Section 6.1).
9. Perform the checkout procedure (Section 3).

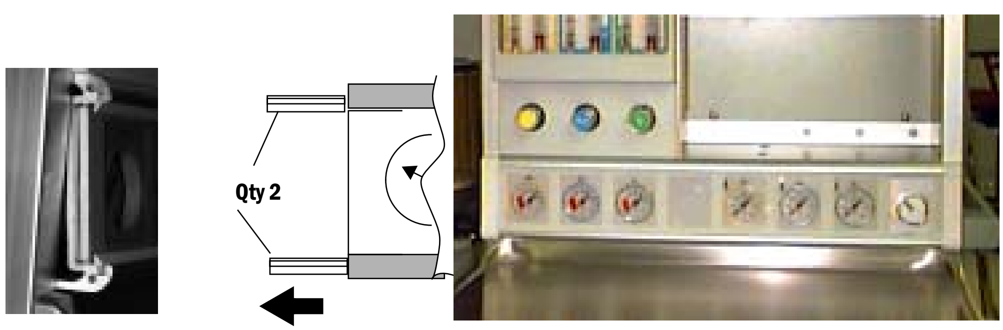
4.7 Service pipeline and cylinder pressure gauges

4.7.1 Remove gauge panel

1. Remove the end caps from both sides of the gauge panel (2 screws for each side).



2. Remove the vinyl seals from the top and bottom of the gauge panel (slide out). Note the position of the seals for proper reinstallation later.

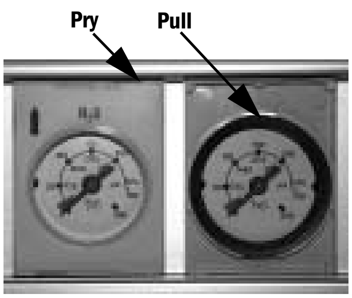


3. Pull the panel toward you. The system switch stays connected.
4. To reassemble, perform the previous steps in reverse order.

   Note: To prevent damage to a vinyl seal, keep the seal aligned with the mating groove in the aluminum extrusion. Then slowly insert.

5. Perform the checkout procedure (Section 3).

4.7.2 Replace pipeline or cylinder pressure gauges



1. Bleed all gas pressure from the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. Remove the gauge panel (Section 4.7.1).
4. Remove the gauge label (cover):
   a. Look for an indentation toward the top right side of the gauge's plastic cover.
   b. Put a thin tool in the indentation between the plastic cover and the metal frame.
   c. Lever the cover out.
5. Use a needle nose pliers to grab the gauge at the gap in the collar. Pull the gauge toward you (the gauge is held tightly; pull hard).
6. Disconnect the tube from the gauge.
   - Cylinder (high-pressure) gauges have copper tubing.
   - Pipeline (low-pressure) gauges have flexible nylon tubing.
7. To install the new gauge:
   a. Connect the tube on the new gauge.
      - For cylinder gauges, tighten the high-pressure fitting as detailed in Section 4.6.1.
      - For pipeline gauges, pull on the tube to ensure that it is locked in place.
   b. Align the gauge on the panel and push it into place.
   c. Install the gauge label.

⚠ **CAUTION** If installing multiple gauges, make sure to install the correct label for each gauge. The color ID front plate indicates the type of gas supply.

Note Low-pressure gauges for O_2, N_2O, and Air, and high-pressure gauges for Heliox and CO_2 follow the order of the flowhead and are mounted under the respective flowmeter module.

High-pressure gauges for O_2, N_2O, and Air follow the order of the cylinder supply modules and are mounted in order next to the system switch.

8. Install the gauge panel (Section 4.7.1).
9. Perform the checkout procedure (Section 3).

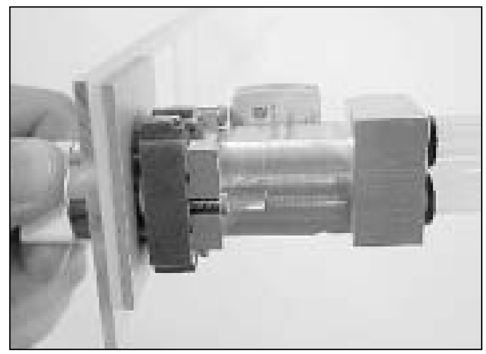
4.8 Replace system switch assembly

Current production machines use a Datex-Ohmeda designed system switch.

Earlier production machines can include a system switch from Telemechanique. These switches are no longer available. If service is required, replace these switches with a Datex-Ohmeda system switch.

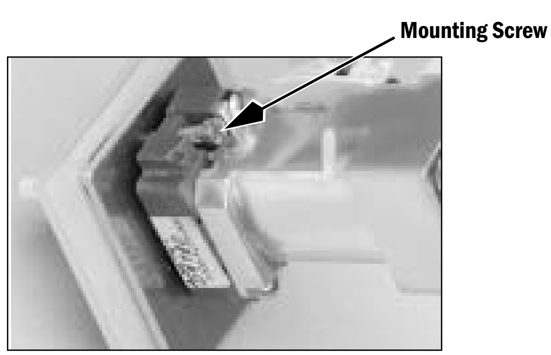
1. Bleed all gas pressure from the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. If present, remove the shroud from the switch collar (loosen three set screws).
4. Remove the gauge panel (Section 4.7.1).

System Switch
Telemechanique



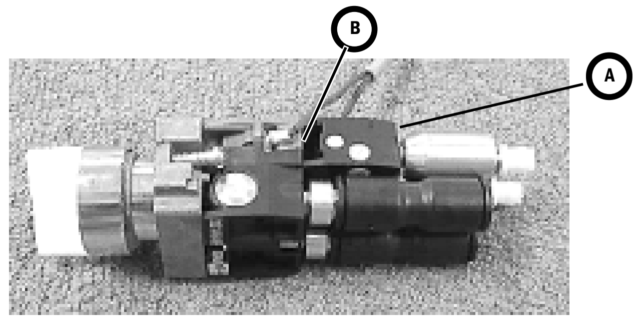
System Switch
Datex-Ohmeda

5. Note that switch assemblies can be on the left or right side of the system.
6. Back out the mounting screws just enough to allow the knob collar to be released.



7. While holding the switch assembly, push in the knob and turn it counterclockwise.
8. Pull the knob out from the front and remove the switch assembly.
9. Press in on the collar and pull the tubing out of the fittings.

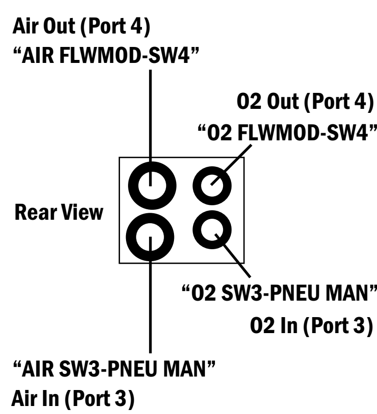
10. Disconnect the wires from the switch:
    a. For a Datex-Ohmeda switch, you have direct access to the wire terminals.
    b. For a Telemechanique switch:
        - Loosen the screw (**A**) at the back of the O_2 pneumatic module.
        - Remove the module.



        - Loosen the two outside screws (**B**) on the electrical module.
        - Pull the wires out of the electrical module.

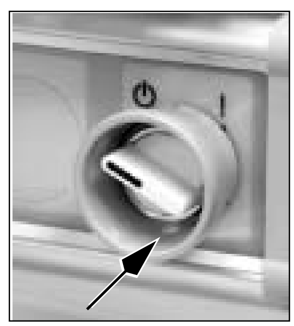
Install the replacement switch assembly:

11. Insert the wires in the electrical module and tighten the screws.
12. Pull the wires on the electrical module to ensure that there is a good connection.
13. Install the tubing on the pneumatic module following the labels on the tubing (pull on the tubing to ensure that it is locked into the module).



14. Turn back the mounting screws until their tips recede.
15. Orient the switch assembly with the Air fittings toward the right and the O_2 fittings toward the left, as viewed from the front of the machine.
16. Install the switch assembly through the mounting plate and through the rear of the gauge panel.

17. Push the knob collar in and turn it clockwise until it locks.
18. Tighten the mounting screws. Make sure that the top edge of the switch assembly and the top edge of the label plate are parallel to the top edge of the gauge panel.
19. Test the replacement switch assembly:
    a. Connect Air and O_2 supplies.
    b. Connect the power cable to an electrical outlet.
    c. Set the system switch to On.
    d. Increase the O_2 and Air flow. Make sure that gas flows.
    e. Make sure that you do not feel or hear any leaks.
    f. Make sure that the display comes On.
    g. Set the system switch to Standby.
    h. Make sure all gas flow stops and the display turns Off.
20. Reinstall the gauge panel (Section 4.7.1).
21. If applicable, replace the switch shroud.
    - Position the shroud on the switch collar so that the “drain” hole is at the lowest point.
    - Tighten three set screws to secure the shroud.

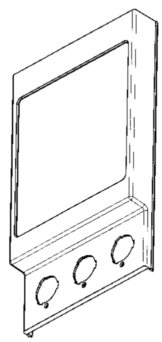


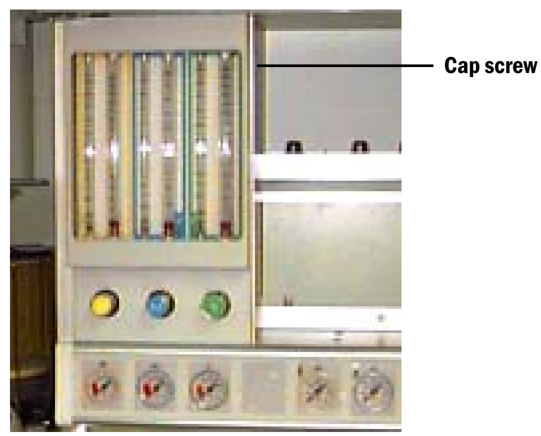
22. Perform the checkout procedure (Section 3).

4.9 Service the flowmeter module

4.9.1 Remove front flowmeter panel shield

1. Bleed all gas pressure from the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. Remove the gooseneck light if present.
4. Loosen, but do not remove the cap screw located in the vaporizer compartment side of the panel. To loosen, turn counterclockwise three times.
5. Grasp the panel at the sides and pull the panel off.

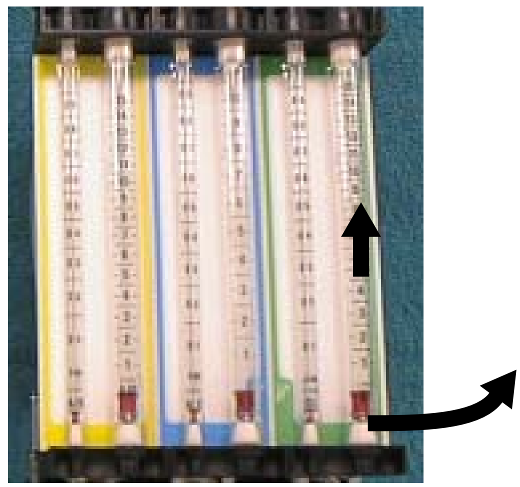




6. To reinstall the panel, perform the previous steps in reverse order.

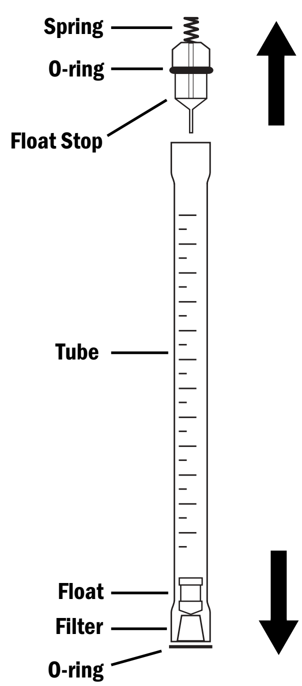
4.9.2 Remove flowtubes for cleaning or replacement

1. Remove the front flowmeter panel shield (Section 4.9.1).
2. To remove a flowtube assembly, push up on the tube just enough to clear the bottom seal, pull out from the bottom until the tube clears the flowtube module, then pull the down slowly to release it from the module.



⚠ WARNING Floats are calibrated to a specific tube. Keep each float with its tube. Replace tube and floats together. Interchanging floats can cause incorrect readings. Disassemble the flowtube assemblies only when service is required. Excessive cleaning can remove the antistatic coating from inside the tube. Damage to the float requires replacement of the entire flowtube.

3. Disassemble the flowtube assembly.



Float stops are indexed to flowtubes and to flowtube modules by gas.

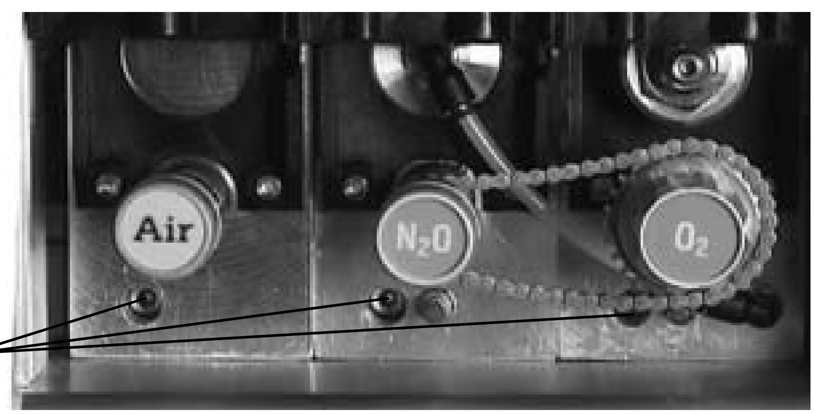
Tabs and slots at both connections must be aligned to install flowtubes.

4. Completely clean, rinse, and dry the flowtube. Use hospital grade alcohol and a flowtube brush.
5. Replace stops, filter and o-rings, as necessary. Lightly coat all o-rings with Krytox. Be careful to not get any Krytox on the bottom of small flowtube float stops.
6. Reassemble the flowtube assembly.
7. Insert the flowtube, spring side first, into the top of the module with the scale oriented forward.
8. Push up and slide the bottom of the flowtube into place on the bottom o-ring. It may be necessary to rotate the tube to engage the index tabs.

   Note: Be sure o-rings are inserted completely into the collar.
9. Push down on the tube to seat the bottom o-ring.
10. Reinstall the front flowmeter panel shield.
11. Perform the checkout procedure (Section 3).

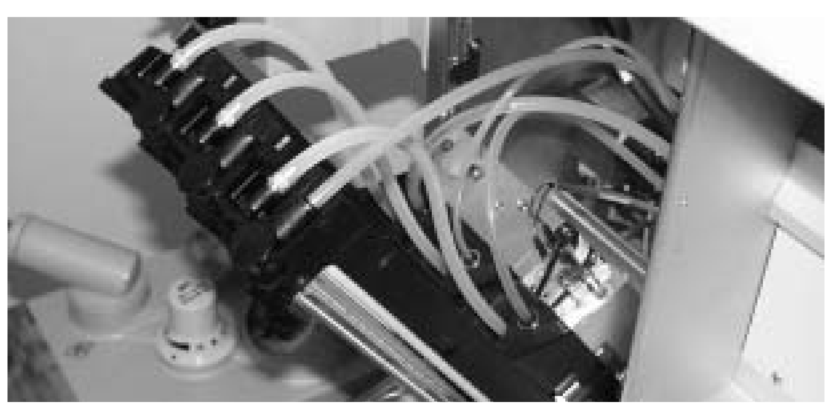
4.9.3 Remove complete flowmeter head

1. Remove the front flowmeter panel shield (Section 4.9.1).
2. Remove the mounting screw from each regulator manifold.

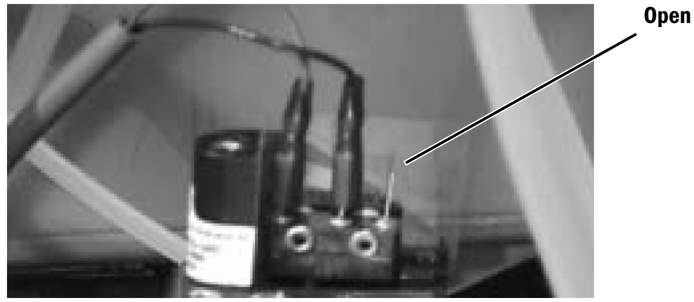


Mounting Screws

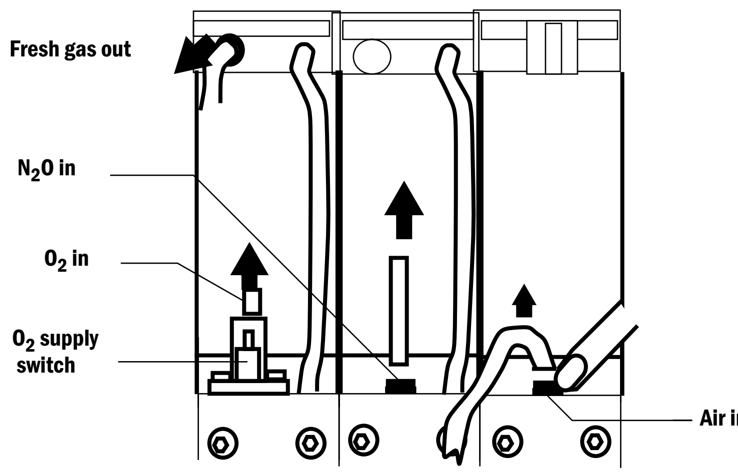
3. Pull forward, pulling first at the top of the flowmeter head, then from the bottom.



4. Disconnect the O_2 supply switch harness. Note position of switch connections so that you can reassemble correctly later.



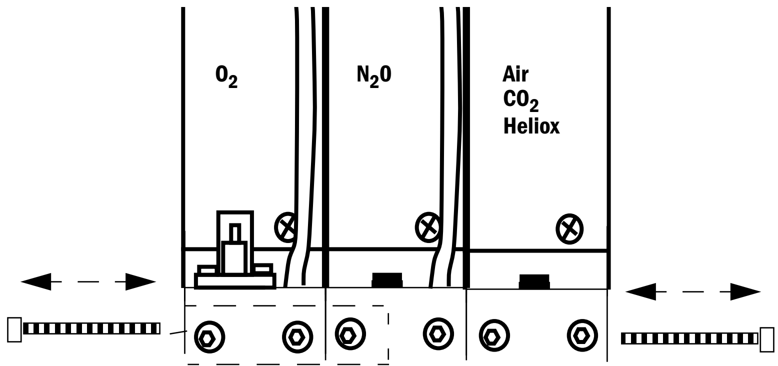
5. Disconnect the tubing at the rear of each gas module.The following example is a back view of the flowmeter head.

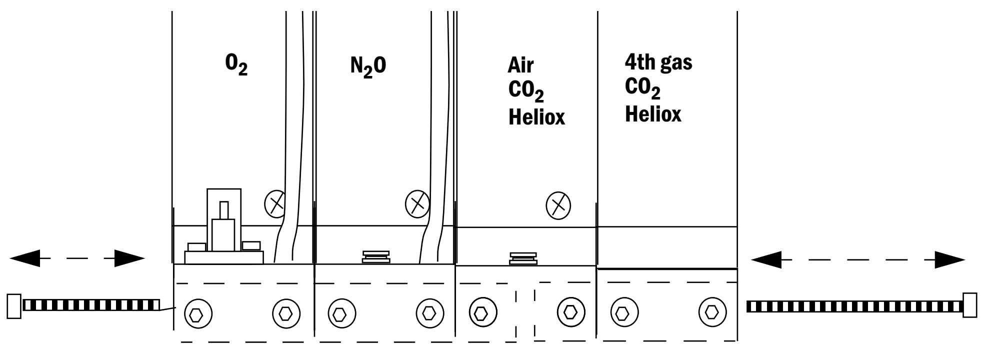


6. To reinstall, perform the previous steps in reverse order (pull on the tubing to ensure it is locked into the fittings).
7. Perform the checkout procedure (Section 3).

4.9.4 Replace flowmeter modules

1. Remove the front flowmeter panel shield (Section 4.9.1).
2. Remove the complete flowmeter head (Section 4.9.3).
3. Refer to the following illustrations of a three-gas or a four-gas flowhead. Note that these illustrations show ANSI flowmeter module positions. The order is reversed in ISO machines.

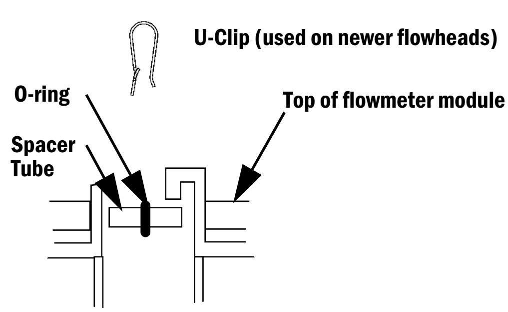




The flowmeter modules are held together by a single screw running through each regulator manifold (except N_2O).

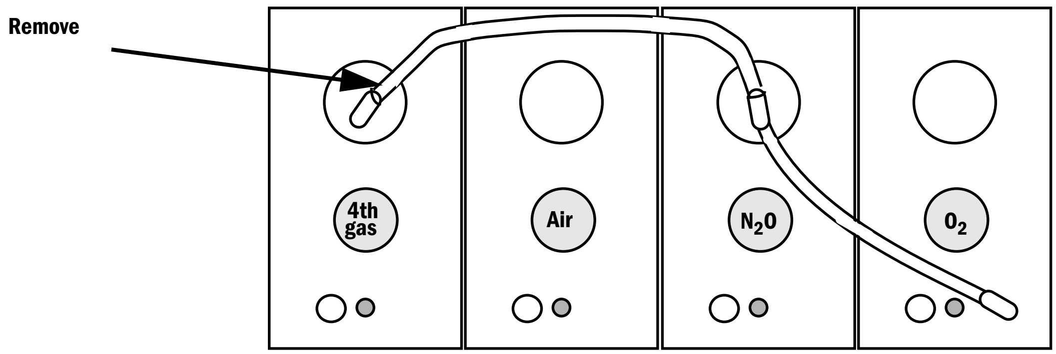
Note The flowmeter modules are hooked together at the top and may be held with a u-clip. To separate the modules, pivot the modules (front to back) 45 degree. The u-clip will disengage and allow the modules to separate.

The flowmeter modules are interconnected at the top by a spacer tube. The o-ring on the spacer tube makes a leak tight seal.



4. To remove the Air or 4th gas flowmeter module:

a. For a 4th gas head, remove the pilot tube going to the balance regulator.



b. Remove the screw located on the side of the Air or 4th gas flowmeter module.

c. Hold the flowmeter module with the flowtubes facing you.

d. Grasp the outer modules at the bottom of the regulator manifold and push the left module away from you until the u-clip pops off and the module separates from the other assemblies.

e. Pull the modules sideways to separate them at the top. Save the u-clip (if present), spacer tube, and the o-ring for reassembly.

5. To remove the O_2 or N_2O flowmeter module:

a. Set the O_2 and N_2O needle valves to their maximum position (CCW).

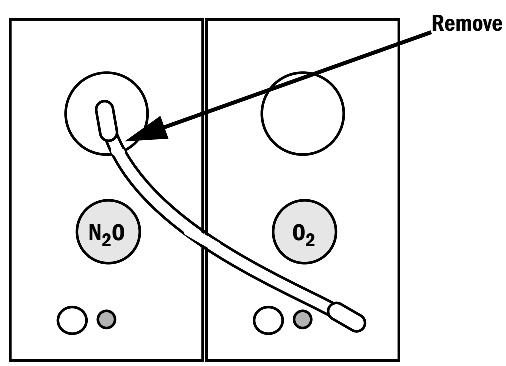
b. Loosen the set screws on the N_2O knob, then remove the knob.

c. Loosen the set screws on the N_2O sprocket and the O_2 knob.

d. To remove, grasp the O_2 knob/sprocket, N_2O sprocket, and chain as an assembly. Remove as an assembly.

e. Remove the spacer from the N_2O needle valve spindle.

f. Remove the pilot tube going to the balance regulator.



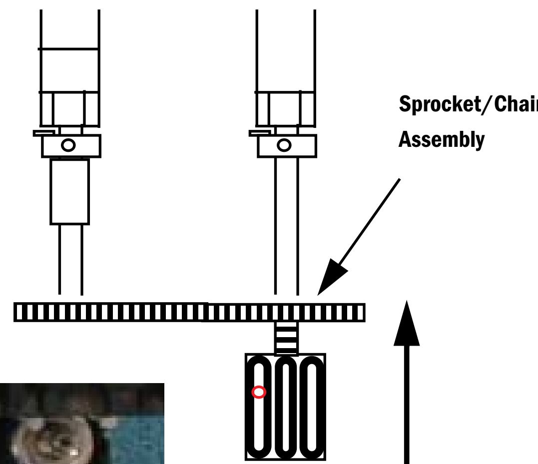
g. The O_2 and N_2O flowmeter modules are held together by a single screw. Remove the screw located on the side of the O_2 flowmeter module.

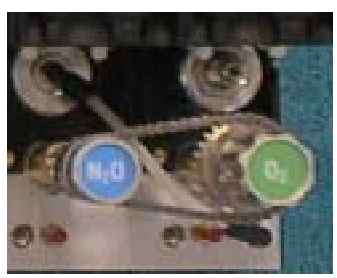
h. Hold the flowmeter modules with the flowtubes facing you.

i. Grasp the modules at the bottom of the regulator manifolds and push the left module away from you until the N_2O module separates from the O_2 module.

j. Pull the modules sideways to separate them at the top. Save the u-clip (if present), spacer tube, and the o-ring for reassembly.

6. To reassemble the flowmeter modules, perform the previous steps in reverse order.
7. Install the screw through the O_2 flowmeter module to locks the O_2 and N_2O flowmeter modules together.
8. Reattach the pilot tube that goes to the balance regulator.
9. Reassemble the flowhead.
10. Confirm needle valve calibration (Section 6.3).
11. Install the spacer on the N_2O needle valve stem.
12. Install the chain on the O_2 knob/sprocket assembly and the N_2O sprocket.
13. Install the chain and sprockets on the needle valve stems as an assembly. Do not tighten the set screws.

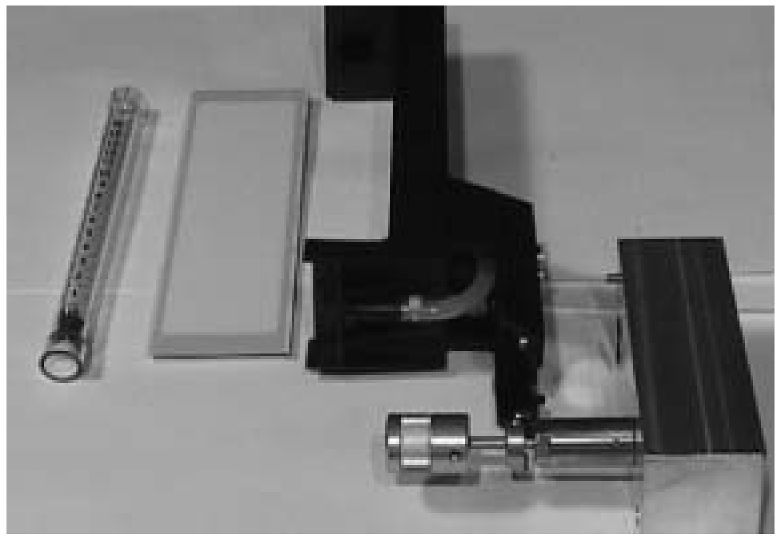




14. Install the N_2O knob. Snug one set screw to hold the knob in place.
15. Perform the link system calibration (Section 6.4).
16. Install the flowmeter panel shield.
17. Perform the checkout procedure (Section 3).

4.9.5 Replace flowmeter frame

1. Remove the front flowmeter panel shield (Section 4.9.1).
2. Remove the complete flowmeter head (Section 4.9.3).
3. Separate the flowmeter modules as required (Section 4.9.4).
4. Remove the flowtubes (Section 4.9.2). Keep all the parts for reassembly.
5. Remove the gas identification panel by removing the two screws at the back of the frame. Keep all the parts for reassembly.

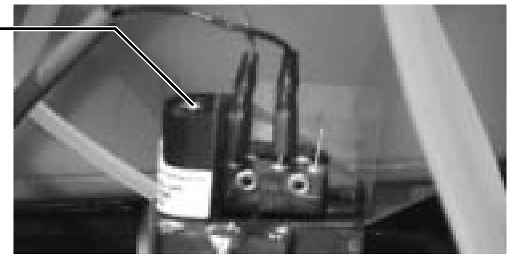


6. Remove the flowmeter frame by loosening the four mounting screws at the back of the regulator manifold.

   Note: There is a retainer in each screw location that keeps each screw within the manifold.
7. To reassemble, perform the previous steps in reverse order.
8. If replacing O_2 or N_2O frames, perform the link system calibration (Section 6.4).
9. Perform the checkout procedure (Section 3).

4.9.6 Replace O_2 supply switch

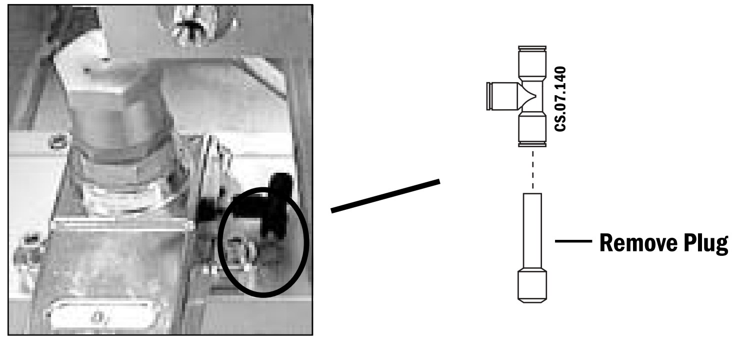
1. Remove the front flowmeter panel shield (Section 4.9.1).
2. Remove the complete flowmeter head (Section 4.9.3).
3. Remove the two mounting screws (and retaining plate, if present) from the O_2 supply switch.



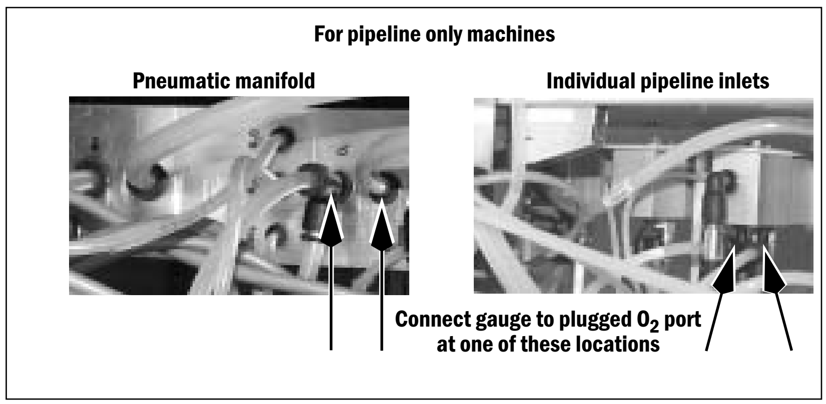
4. Pull the O_2 supply switch out of the regulator manifold.
5. Install the replacement O_2 supply switch.
6. Tighten the screws.
7. Disconnect the leads from the old switch and reconnect them to the new switch.
8. Adjust the alarm threshold for the new O_2 supply switch, as explained in the checkout procedure (Section 4.9.7).
9. Reinstall the flowmeter head.
10. Reinstall the front flowmeter panel shield.
11. Perform the checkout procedure (Section 3).

4.9.7 Checkout procedure for O_2 supply switch

1. Remove the rear panel (Section 4.3).
2. Attach a gauge to the O_2 primary regulator test port.



- On pipeline only machines, attach the gauge to a plugged 6-mm O_2 port at the front of the pneumatic manifold or to the O2 pipeline inlet manifold.



3. Adjust the O_2 flow control to minimum flow (clockwise).
4. Install an O_2 cylinder and open the cylinder valve (for pipeline only, connect O_2 pipeline source).
5. Turn the system on.
6. Close the cylinder valve (disconnect pipeline from source) and watch the test gauge as the O_2 pressure bleeds down slowly.

   Note: The “No O_2 pressure” alarm should occur between descending pressure of 221–193 kPa (32–28 psi).

   - With software version 3.4 or greater, an approximately 7 second delay was added to the alarm.
7. If adjustment is required, set the adjustment screw so that the “No O_2 pressure” alarm occurs at 207 ±7 kPa (30 ±1 psi).
8. Disconnect the gauge and plug the test port
9. To reassemble, perform the previous steps in reverse order.
10. Perform the checkout procedure (Section 3).

4.9.8 Replace secondary regulator manifold or balance regulator manifold

1. Remove the front flowmeter panel shield (Section 4.9.1).
2. Remove the complete flowmeter head (Section 4.9.3).
3. Separate the flowmeter modules (Section 4.9.4).
4. Remove the flowmeter frame from the regulator manifold by removing the four screws at the rear of the regulator manifold (no need to remove flowtubes).
5. Remove the needle valve from the regulator manifold:
   a. Unscrew the complete assembly together (stop collar, needle valve).
   b. Replace the o-ring if necessary.
6. Screw the flow control into the new regulator manifold.
7. Remove the plugs and balance regulator elbow or tee fitting (and O_2 supply switch if an O_2 module) from the old regulator manifold.
8. Install the plugs and balance regulator elbow or tee fitting (and O_2 supply switch if an O_2 module) into the new regulator manifold (pull on the plugs and fittings to ensure that they are locked into the manifold).
9. Reinstall the flowmeter frame to the regulator manifold.
10. Reinstall all the flowmeter modules to the flowmeter head.
11. Reinstall the flowmeter head (Section 4.9.4).
12. Do the necessary calibrations (Section 6).

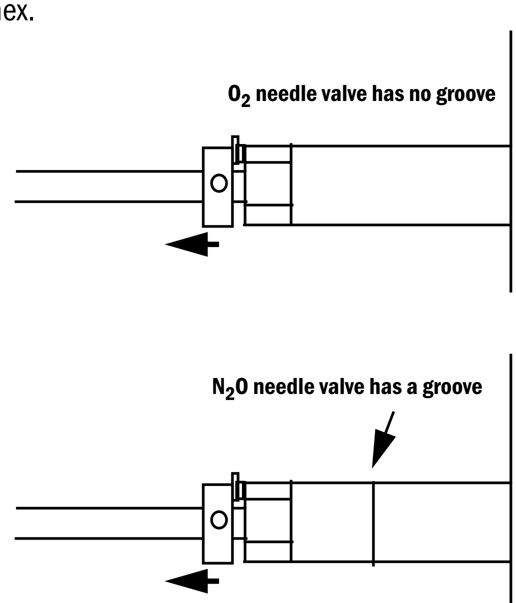
Necessary calibrations	Section
Secondary Regulator	6.2
O_2 minimum flow	6.3.2
Maximum flow	6.3.5
Link system	6.4

13. Reinstall the front flowmeter panel shield.
14. Perform the checkout procedure (Section 3).

4.9.9 Replace O_2 or N_2O needle valves

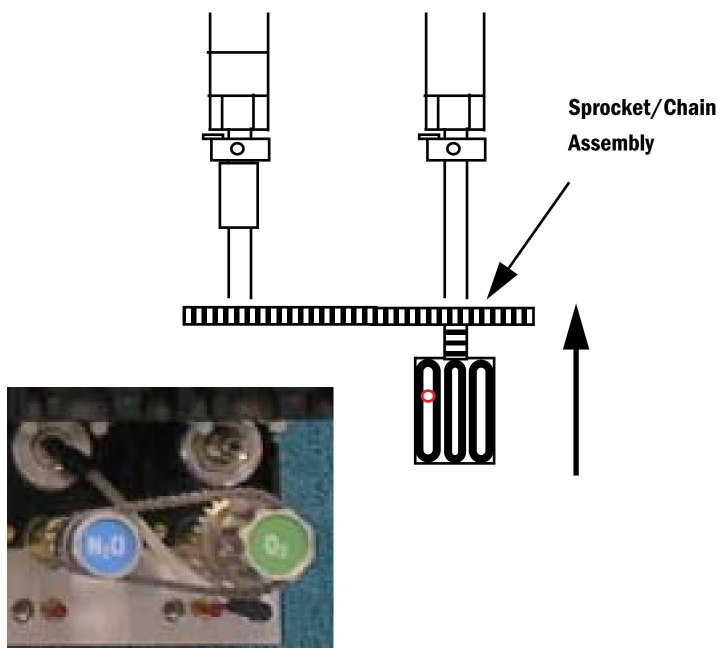
1. Bleed all gas pressure from the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. Remove the front flowmeter panel shield (Section 4.9.1).
4. Set the O_2 and N_2O needle valves to their minimum position.
5. Loosen the set screws on the N_2O knob, then remove the knob.
6. Loosen the set screws on the N_2O sprocket and the O_2 knob.
7. To remove, grasp the O_2 knob/sprocket, N_2O sprocket, and chain as an assembly. Remove as an assembly.
8. Remove the spacer from the N_2O needle valve spindle.
9. Loosen the set screws on the needle valve stop collar for the needle valve that is being replaced.
10. Remove the stop collar.
11. To remove the needle valve from the flowmeter block, turn the needle valve counterclockwise with a 16-mm wrench.
12. To install the new needle valve, turn it clockwise and tighten it with the wrench.

⚠ **WARNING** The O_2 and N_2O needle valves are not the same. Patient injury can result if the wrong needle valve is installed in the flowmeter block. You can identify the N_2O needle valve by a groove located just below the top brass hex.



13. Install the stop collar on the new needle valve. Do not tighten the set screws.
14. Perform the needle valve calibration (Section 6.3).
15. Put the spacer on the N_2O needle valve spindle.

16. Put the chain on the O_2 knob/sprocket assembly and the N_2O sprocket.
17. Install the chain and sprockets on the needle valve spindles as an assembly. Do not tighten the set screws.



18. Install the N_2O knob. Do not tighten the set screws.
19. Perform the link system calibration (Section 6.1).
20. Install the flowmeter panel shield.
21. Perform the checkout procedure (Section 3).

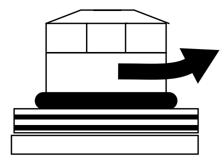
4.9.10 Replace 3rd or 4th gas needle valves

1. Bleed all gas pressure from the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. Remove the front flowmeter panel shield (Section 4.9.1).
4. Loosen the set screws on the flow control knob and remove the knob.
5. Loosen the set screws on the stop collar and remove the collar.
6. If equipped, remove the maximum flow stop collar.
7. Using a 16-mm wrench, remove the needle valve by turning it counterclockwise.
8. Install the new needle valve and tighten.
9. If equipped, install the maximum flow stop collar.
10. Install the stop collar. Do not tighten the screws.
11. Install the flow control knob on the shaft. Tighten one set screw to snug.
12. Reconnect the gas supplies.
13. Perform the flow control stop procedures explained in:
    - Section 6.3.4 for air.
    - Section 6.3.3 for 4th gas.
    - Section 6.3.5 for maximum flow.
14. Install the flowmeter panel shield.
15. Perform the checkout procedure (Section 3).

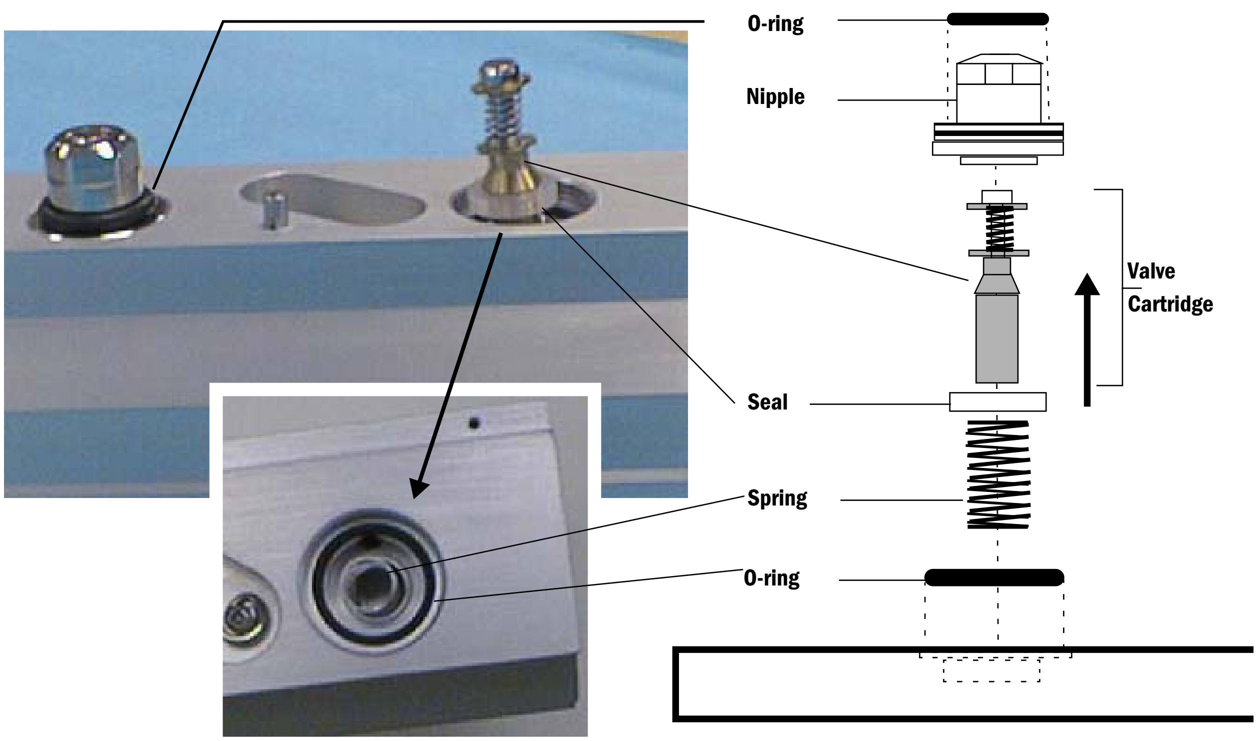
4.10 Service vaporizer manifold parts

4.10.1 Repair manifold port valve

1. Set the system switch to Standby.
2. Remove the vaporizers from the vaporizer manifold.
3. Using a 14-mm wrench, carefully remove the valve nipple (threaded).



4. Disassemble as necessary to replace parts. The following illustration shows the parts.



Note: The port valve replacement kit includes the valve cartridge assembly and the seal. The kit does not include o-rings.

5. When installing a new valve cartridge assembly into the vaporizer manifold, put a light coat of Krytox on the bottom portion of the cartridge. The bottom portion of the cartridge is defined as the brass surface that is inserted in the lower spring. **Note:** Do not apply Krytox to the valve seal.
6. Verify that the parts are free of dust and dirt.
7. To reassemble, perform the previous steps in reverse order.
8. Complete the port valve checkout procedure described below (Section 4.10.2).

4.10.2 Checkout procedure for manifold port valve

Use the Vaporizer Manifold Valve Test Tool to perform the checkout procedure for the manifold port valve. This tool and test procedure are intended for use only when the valve cartridge assembly is replaced.

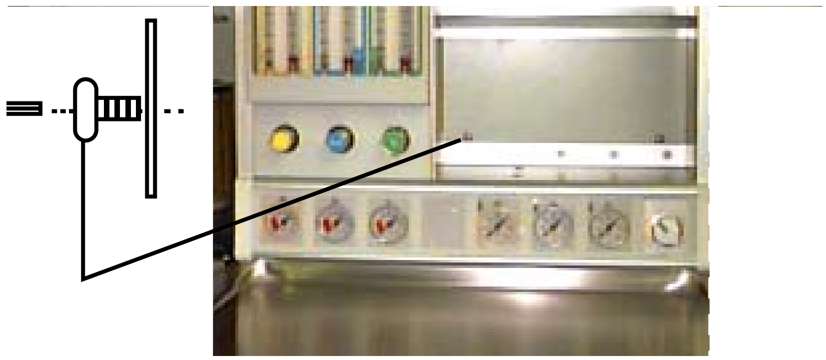
Note This replacement and test procedure is a service action and is not part of the maintenance program.

1. Set the system switch to Standby.
2. After replacing the valve cartridge assembly, remove the vaporizer port o-ring.
3. Attach the valve tester to the top of the valve by sliding the bottom of the tester onto the o-ring groove.
4. Tighten the tester screw down onto the valve until the screw bottoms out on the top of the valve. The tester o-ring should create a seal with the top of the valve.
5. Remove the panel under the vaporizer manifold.
6. Remove the inlet tube from the vaporizer manifold.
7. Test the leak-test device:
    a. Put you hand on the inlet of the leak-test device. Push hard for a good seal.
    b. Remove all air from the bulb.
    c. The bulb should not inflate in less than 60 seconds.
8. Attach the negative low-pressure leak-test device to the common gas outlet.
9. Remove all air from the bulb. The bulb should not inflate in less than 45 seconds.
10. Remove the valve tester.
11. Reassemble the inlet tube, vaporizer port o-ring, and the front panel.
12. Conduct a negative low-pressure leak test on the system (Section 3.9).

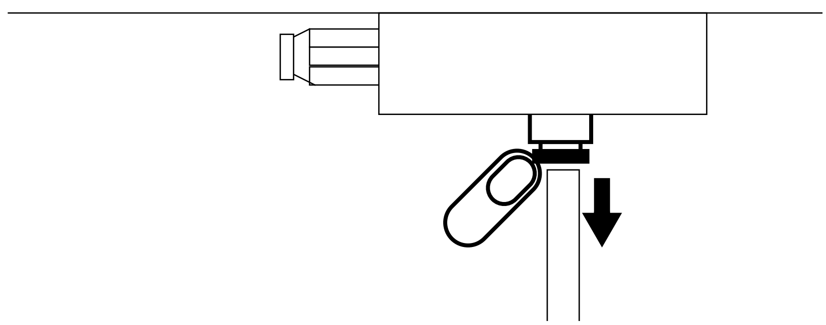
⚠ **WARNING** If the valve test tool is not removed before flowing gas through the system, pneumatic head damage could result.

4.10.3 Replace vaporizer manifold check valve

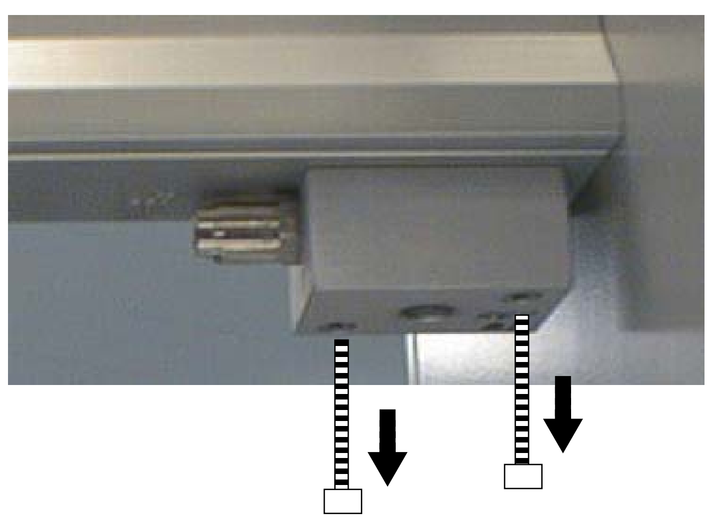
1. Set the system switch to Standby.
2. Remove the vaporizers from the vaporizer manifold.
3. Remove the panel under the vaporizer manifold.



4. Disconnect the tubing from the valve block.

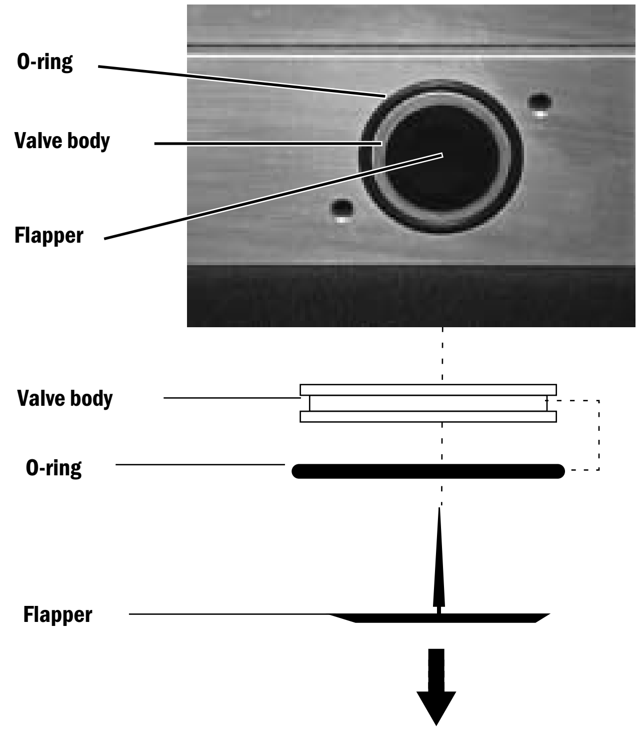


5. Remove the valve block.



Note The valve body, o-ring, and flapper do not come out with the block. They stay intact at the bottom of the vaporizer manifold.

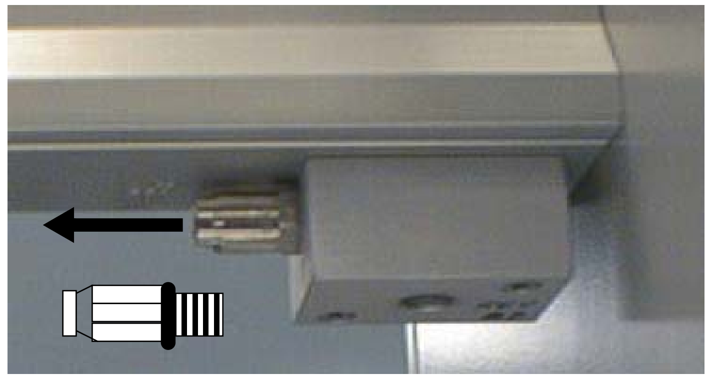
6. Pull the flapper out of the valve body.



7. Using a hex wrench, put the wrench through one of the holes of the valve body and pull down to remove the valve body and o-ring.
8. Verify that parts are free of dust and dirt.
9. Replace the flapper by inserting the flapper stem and gently pulling the stem until the flapper secures to the valve body.
10. Lightly lubricate the o-ring with Krytox.
11. Place the lubricated o-ring on the valve body port at the bottom of the manifold.
12. Gently install the valve body in the manifold:
    - Check that the o-ring makes a good seal between the manifold and the valve body.
    - Check that the flapper valve makes solid contact with the valve body.
13. Install the valve block.
14. Reconnect the tubing to the valve block. Pull on the tube to ensure that it is locked in the fitting.
15. Install the vaporizer front panel.
16. Perform the checkout procedure (Section 3).

4.10.4 Replace vaporizer pressure relief valve

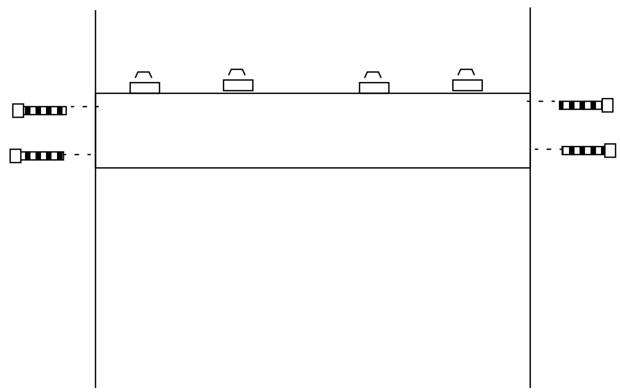
1. Set the system switch to Standby.
2. Remove the vaporizers from the vaporizer manifold.
3. Remove the panel under the vaporizers.
4. Using a 13mm open ended wrench, remove the vaporizer pressure relief valve by turning counterclockwise.



5. Verify that the parts are free of dust and dirt.
6. Install a new vaporizer pressure relief valve.
7. To reassemble, perform the previous steps in reverse order.
8. Reinstall the front panel.
9. Perform the checkout procedure (Section 3).

4.10.5 Replace vaporizer manifold (complete replacement)

1. Set the system switch to Standby.
2. Remove the vaporizers from the vaporizer manifold.
3. Remove the panel under the vaporizers.
4. Remove the inlet and outlet tubing on the vaporizer manifold.
5. Remove the flowmeter head assembly (Section 4.9.3).
6. Remove the outside side panel (Section 4.4).
7. For **2-Vap machines**, remove the mounting screws at each end of the vaporizer manifold.



   To access the outside mounting screws on a **3-Vap machine**,

   - Remove the wide extension cover. Refer to Section 8.4.
   - Remove the screw that holds the extension handle in the dovetail.
   - Slide the dovetail cover down to access the vaporizer manifold mounting screws.

8. Verify that parts are free of dust and dirt.
9. To reassemble, perform the previous steps in reverse order.
10. Reinstall the front panel.
11. Perform the checkout procedure (Section 3).

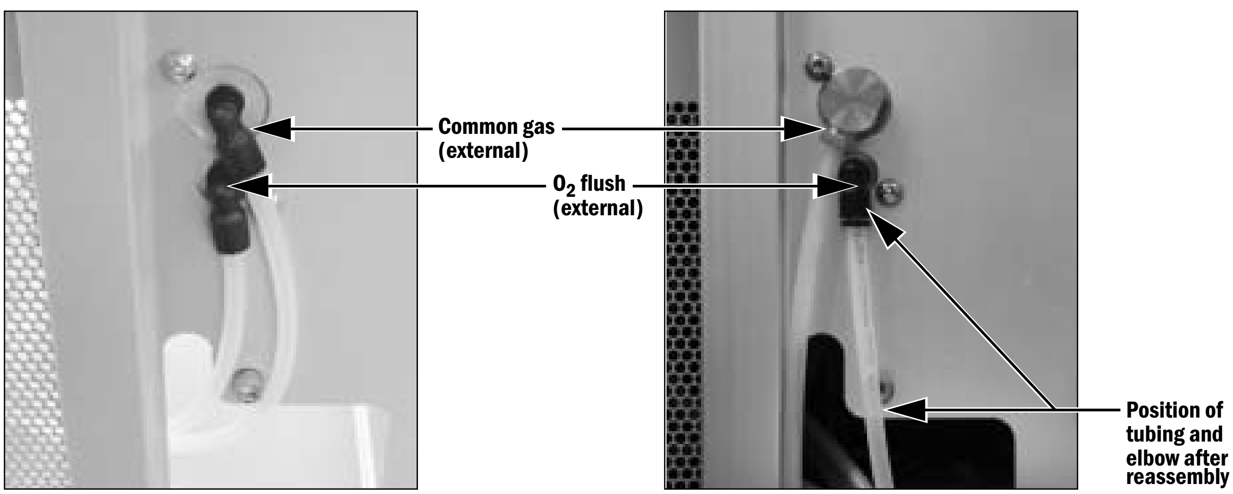
4.11 Service common gas manifold

Note Newer machine variants include individual pipeline inlet manifolds in place of the single pneumatic manifold used in previous production machines. The common gas manifold (CGM) used with the individual pipeline inlet manifolds does not include a check valve and the O_2 flush channel includes a greater flow restriction (smaller orifice) to compensate for the eliminated flush regulator.

4.11.1 Replace common gas manifold

1. Remove the front flowmeter panel shield (Section 4.9.1).
2. Remove the complete flowmeter head (Section 4.9.3).
3. Remove the upper side panel (Section 4.4).
4. From the side of the machine, remove the external common gas tubing and the external O_2 flush fitting from the manifold.

CGM used with individual pipeline inlet manifolds **CGM used with pneumatic manifold**

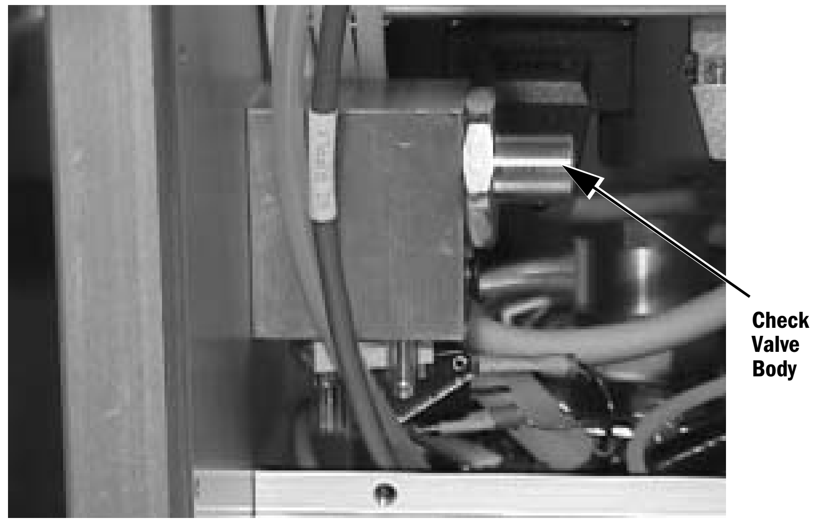


5. Remove the internal common gas tubing and the internal O_2 flush tubing on the manifold.
6. Disconnect the harness from the O_2 flush valve switch.
7. Using a hex wrench, remove the mounting screws (side of machine) and remove the manifold.
8. Remove the O_2 flush switch from the old manifold and install on the new manifold.
9. To reassemble, perform the previous steps in reverse order (pull on the fitting to ensure that it is locked into the manifold).

   Note: Position the O_2 flush elbow so that the tubing is routed straight down as shown above.
10. Perform the checkout procedure (Section 3).

4.11.2 Replace common gas manifold check valve

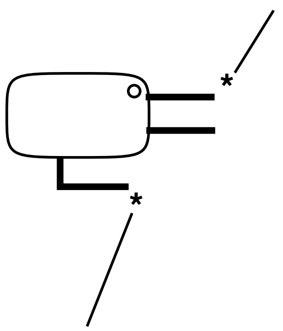
1. Remove the front panel shield (Section 4.9.1).
2. Remove the complete flowmeter head (Section 4.9.3).
3. Remove the internal common gas tubing (screw fitting).



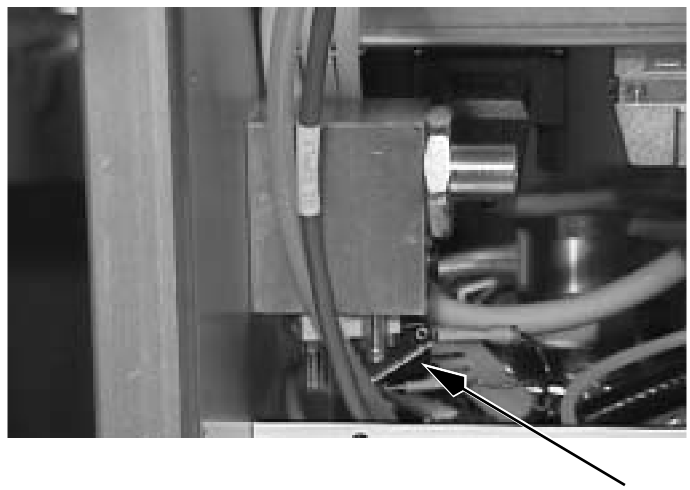
4. Using an open ended wrench, unscrew the check valve body, turning in a counterclockwise direction.
5. Remove the flapper from the check valve body by pinching the flapper and pulling it out.
6. Install the new flapper:
   a. Insert the stem of the flapper in the hole of the check valve body.
   b. Use a needle nose pliers or hemostats to grab the stem through the threaded port.
   c. Pull until the stem is seated on the valve body.
7. Install the check valve body into the block.
8. To reassemble, perform the previous steps in reverse order.
9. Perform the checkout procedure (Section 3).

4.11.3 Replace O_2 flush switch

1. Remove the front flowmeter panel shield (Section 4.9.1).
2. Remove the complete flowmeter head (Section 4.9.3).
3. Remove the side panel (Section 4.4).
4. From the side of the machine, remove the external common gas tubing and the external O_2 flush fitting from the manifold (Section 4.11.1).
5. Remove the internal common gas tubing and the internal O_2 flush fitting from the manifold.
6. Disconnect the harness from the O_2 flush valve switch.



*** Harness Connections**



O_2 flush switch

7. Using a hex wrench, remove the mounting screws (side of machine) and remove the manifold.
8. Remove the O_2 flush switch from the manifold.
9. Install the new switch (with o-ring).
10. To reassemble, perform the previous steps in reverse order (pull on the fittings to ensure that they are locked into the manifold).
11. Perform the checkout procedure (Section 3).

Note: *The pressure switch used with the new common gas manifold has a higher burst pressure specification than the pressure switch used with the original common gas manifold. The new pressure switch is backward compatible and can be used with either manifold.*

Caution: *Do not use the original pressure switch with the new manifold.*

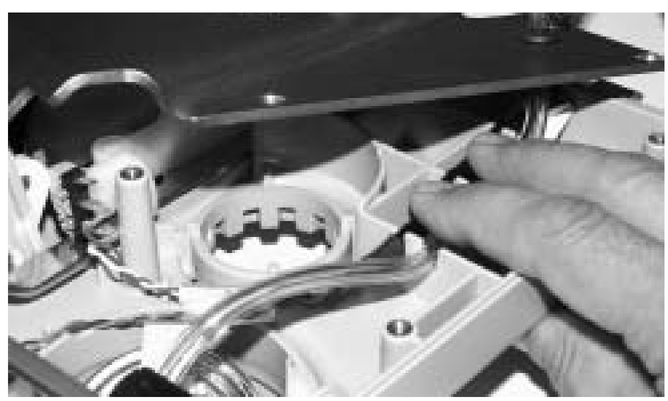
4.12 Service the breathing system

4.12.1 Replace control panel cover

To replace most of the components of the control panel, you must remove the cover (6 screws). When replacing the control panel's cover, make sure that the pressure gauge tube and the microswitch harnesses are properly seated in their retaining recesses.

1. Lay the cover over the control panel. Ensure that the tube and wiring harness pass through the cover with adequate length not to be strained when the cover is in place.
2. Route the hose and wiring harness into their recesses as shown.

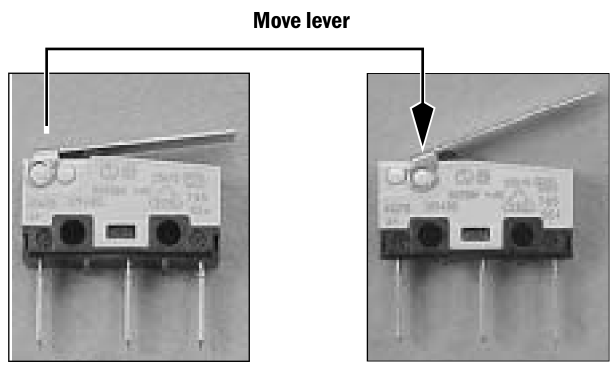
3. Hold the tube and the harness in place with your right hand as shown.



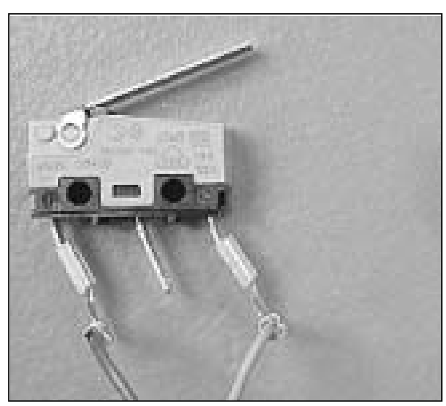
4. With your left hand guide the cover in to place.
5. Slide your fingers from under the cover as you position it over the tube and harness.
6. Ensure the tube and harness are not pinched under the cover.
7. Replace the screws.

4.12.2 Replace control panel microswitch

1. Open the front door of the breathing system.
2. Remove the flow sensor module.
3. Remove the circuit module.
4. Unlatch and remove the bag arm.
5. Unlatch and swing the control panel up from the rear.
6. Remove the control panel cover (six screws).
7. Remove the two screws from the control panel microswitch.
8. Remove the microswitch.
9. Remove the harness from the microswitch.
10. The new microswitch may have the lever positioned on the rear boss. Remove the lever and install the lever on the inside boss.



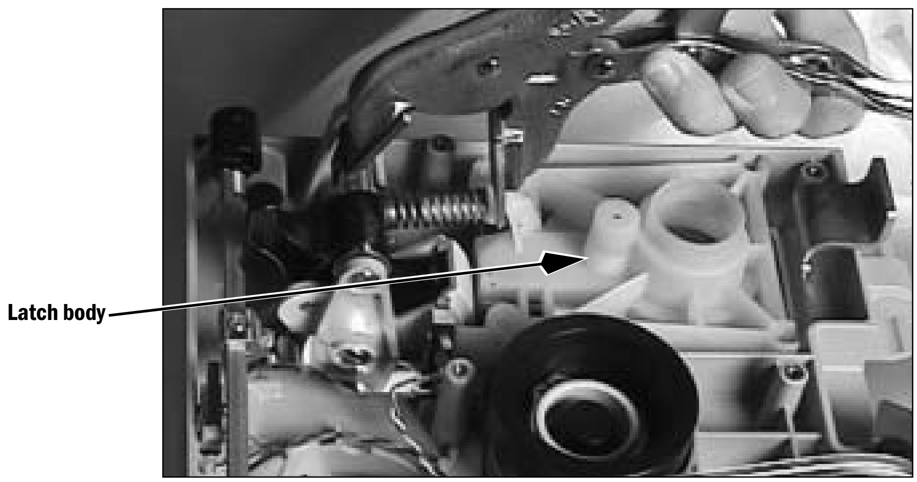
11. Install the harness to the new microswitch. Bend the connectors slightly as shown to provide clearance when mounted in the control panel.



12. Secure the microswitch to the control panel with the two screws.
13. Reassemble the control panel (Section 4.12.1).
14. Perform the checkout procedure (Section 3).

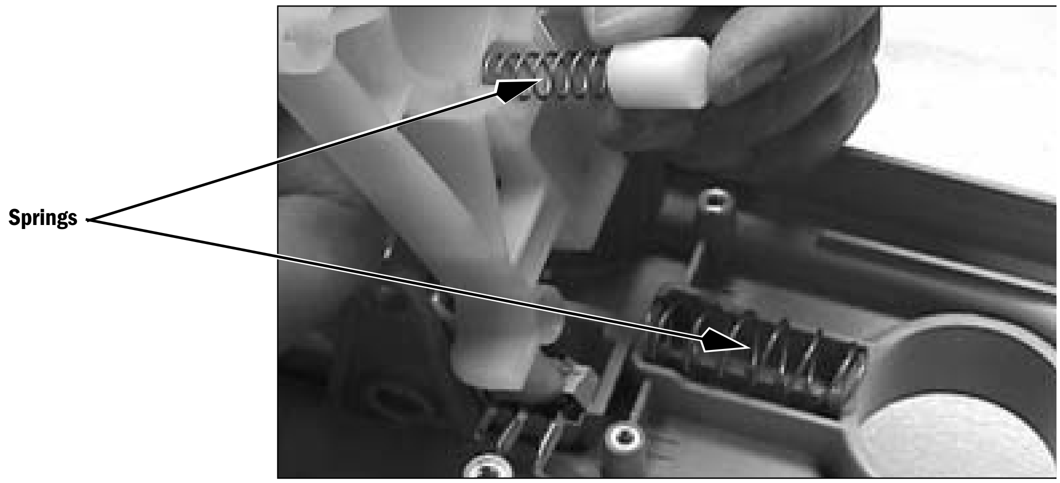
4.12.3 Replace Bag-to-Vent toggle or microswitch

1. Open the front door of the breathing system.
2. Remove the flow sensor module.
3. Remove the circuit module.
4. Unlatch and remove the bag arm.
5. Unlatch and swing the control panel up from the rear.
6. Remove the control panel cover (six screws).
7. To remove the pivot pin assembly, use special locking pliers to compress the spring. Pull the top sleeve back out of the socket to release the pivot pin assembly.



8. Remove the four screws that secure the latch body, then remove the latch body.

   Note: There are two springs at the bottom of the latch body. These springs may pop out when the latch body is removed.



To replace the microswitch, skip to Step 17;
to service the toggle assembly, continue with the following.

9. Remove the bag arm latch.
10. Remove the rocker shaft.
11. Remove the pivot bracket.
12. Remove the toggle shaft and lift out the bag to vent toggle assembly.
13. Disassemble the bag to vent toggle assembly:
    a. If the bag to vent toggle is being replaced:
       - Spread the mounting flanges on the old toggle and remove the rocker/toggle shaft. **NOTE**: Do not overstress the mounting flanges on the toggle by spreading them excessively.
       - Remove the E-ring retainer from the shaft.
    b. If the bag to vent toggle is not being replaced:
       - Remove the E-ring retainer.
       - Slide the shaft out and remove the rocker/toggle

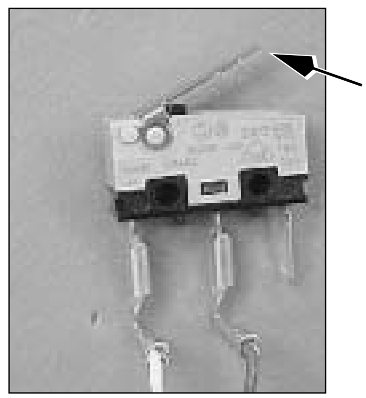
14. Reassemble the bag to vent toggle assembly:
    - Install the bag to vent rocker into the toggle.
    - Slide the shaft in part way.
    - Insert the Teflon washer on the side opposite the E-ring groove.
    - Slide the shaft through the washer and into the small hole in the mounting flange. Ensure the Teflon washer is not pinched between the shaft shoulder and the flange.
    - Use the edge of the bag arm latch as pictured to push the E-ring retainer into the groove on the shaft.

15. Install the toggle assembly
    - Replace the toggle shaft and toggle assembly.
    - Replace the pivot bracket.
    - Replace the rocker shaft.
    - Replace the bag arm latch.
16. Continue with the following.

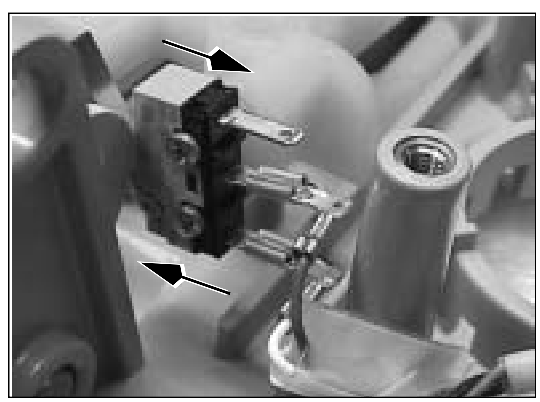
To replace the microswitch, continue with the following; otherwise, skip to Step 22 to reassemble the control panel.

To replace the microswitch:

17. Remove the screws that secure the microswitch.
18. Remove the microswitch.
19. Remove the harness from the microswitch.
20. Attach the harness to the new microswitch.
    (Note that the Bag/Vent microswitch has a shorter lever than the control panel microswitch.)



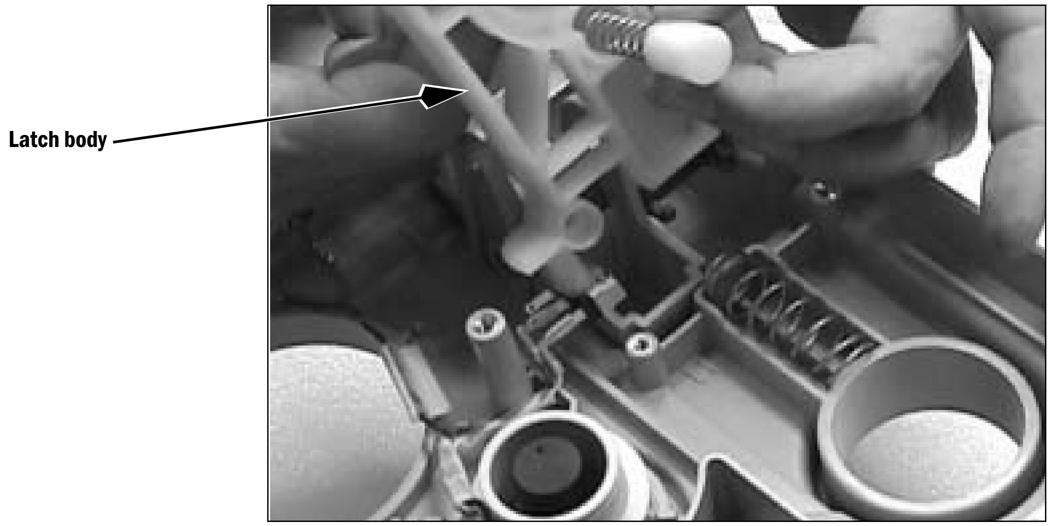
21. Mount the microswitch to the latch body. Before tightening the mounting screws, shift the switch assembly clockwise to take up all the free play in the mounting holes.



To reassemble the control panel:

22. Install the latch body:

    a. Place the small spring in the spring cavity of the latch body.



    b. Place the spring button on the end of the small spring.
    c. Place the large spring in the control panel cavity.
    d. Carefully position the latch body in place.

    Note: Make sure that the springs do not move out of their respective cavities.

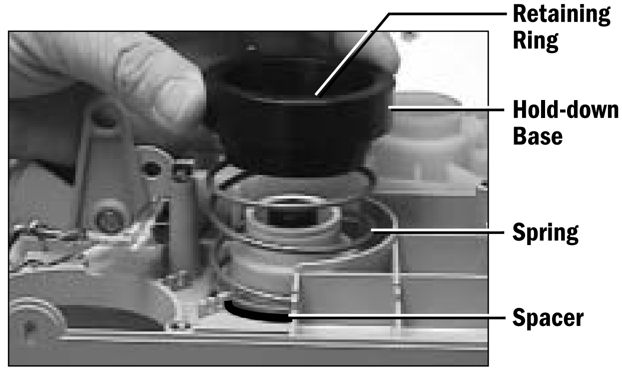
23. Once the latch body is in position, push the bag arm release lever in to allow the latch body to fall into place.
24. Install the four screws to secure the latch body to the control panel.
25. Reassemble the control panel by following the previous steps in reverse order.
26. Perform the checkout procedure (Section 3).

4.12.4 Replace adjustable pressure limiting (APL) knob assembly

1. Open the front door of the breathing system.
2. Remove the flow sensor module.
3. Remove the circuit module.
4. Unlatch and remove the bag arm.
5. Unlatch and swing the control panel up from the rear.

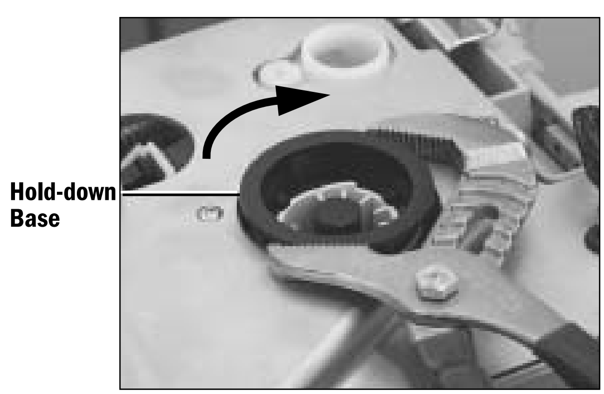
To Remove a "machined" APL Valve Actuator (knob)

- Hold the knob from underneath.
- Remove the retaining ring from the APL knob assembly.
- Pull out the hold-down base, the spring, and the spacer from the APL opening.
- Remove the APL knob assembly from the top side of the control panel.



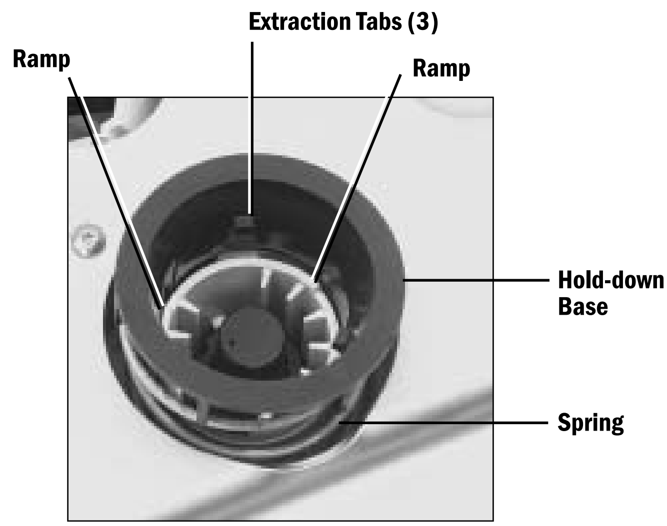
To Remove a "molded" APL Valve Actuator (knob)

- Expand the jaws of an adjustable pliers to accommodate the hold-down base.
- Hold the knob from underneath.
- Rotate the hold-down base clockwise half a turn to release the snaps holding the hold-down base to the body of the actuator.
- Remove the hold-down base and the spring from the control panel. If present, also remove the steel spring spacer (on older panels).
- Remove the APL knob assembly from the top side of the control panel.



Install the molded APL Valve Actuator

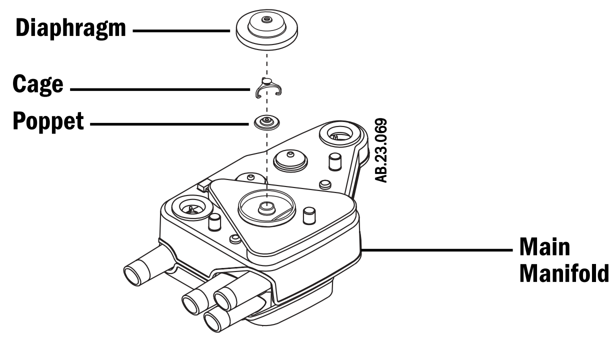
1. Set the APL Valve Actuator assembly to the MIN position.
2. From the top of the control panel, place the molded APL Valve Actuator into the control panel opening. Align the pointer on the base of the APL Valve Actuator so that it faces about 30 degrees toward the operator from a line parallel to the side of the breathing system (or to a customer preferred position).
3. While holding the APL Valve Actuator in place, swing the control panel to the fully open position.
4. Place the compression spring over the body of the actuator. For an older panel (not modified), also place the thin spacer (spiral ring) in the recess between the spring and body of the actuator.



5. Install the hold-down base:
   - Position the hold-down base over the actuator so that the extraction tabs are positioned between the ramps on the end of the actuator.
   - Place the heal of your palm over the hold-down base and apply a slight downward pressure.
   - Move your hand backward slightly so that the hold-down base tilts toward you.
   - While maintaining a downward pressure, push your hand forward to fully snap the hold-down base in place.

4.12.5 Replace APL disc or cage

1. Open the front door of the breathing system.
2. Remove the flow sensor module.
3. Remove the circuit module.
4. Unlatch and remove the bag arm.
5. Unlatch and swing the control panel up from the rear.
6. Remove the APL diaphragm from the main manifold.



7. Remove the APL poppet from the retainer by pulling out one of the cage legs far enough to remove the poppet. Note the orientation of the poppet so that you can correctly reinstall it later.
8. If replacing the cage, pull the cage from the diaphragm.
9. To reassemble, perform the previous steps in reverse order.
10. Perform the checkout procedure (Section 3).

4.12.6 Replace airway pressure gauge

1. Open the front door of the breathing system.
2. Remove the flow sensor module.
3. Remove the circuit module.
4. Unlatch and remove the bag arm.
5. Unlatch and swing the control panel up from the rear.
6. Remove the control panel rear cover (six screws).
7. Remove the tubing from the back of the airway pressure gauge.
8. If replacing the gauge cover, push in the three plastic locking levers on the gauge cover. The gauge and gauge cover will drop from the top of the control panel.

9. If replacing the gauge, use a 2.5-mm hex wrench to remove the two set screws from the gauge. Then remove the gauge from the gauge cover.
10. Install the new gauge into the cover by securing the two set screws.
11. Install the gauge cover (if removed) and secure by three plastic locking levers to the white plastic washer around the gauge opening.
12. Reassemble the control panel by following the previous steps in reverse order (also refer to Section 4.12.1).
13. Zero the pressure gauge (Section 6.6).
14. Perform the checkout procedure (Section 3).

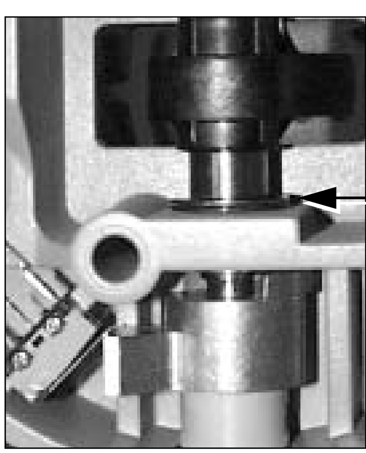
4.12.7 Remove or replace canister and dishes

1. Pull the release handle towards you.
2. Turn the release handle clockwise.

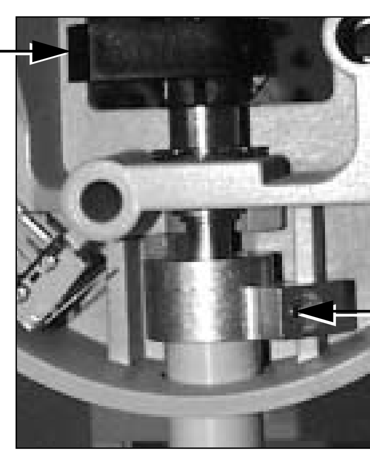
3. Remove the canisters.
4. Push in the buttons on each side of the housing. Pull down.
5. Remove the top canister dish.
6. Remove the drain dish.

4.12.8 Replace breathing system canister release handle and release mechanism

1. Remove the canisters and canister dishes (Section 4.7.1)
2. Turn the release handle counterclockwise to a 12 o'clock position (locked position).
3. From the underside, remove the larger retaining clip on the handle shaft (located near middle of shaft).
4. Turn the release handle clockwise to a 3 o'clock position.
5. Loosen the set screw on the indexer.
6. Slowly start to pull the handle out. **Note the position of the indexer for reinstallation.** Pull the handle the rest of the way out.
7. Remove the canister locking cam and the indexer as they slide off the shaft.



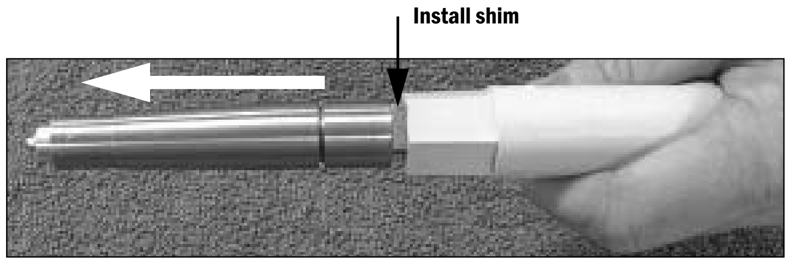
12 o'clock



3 o'clock

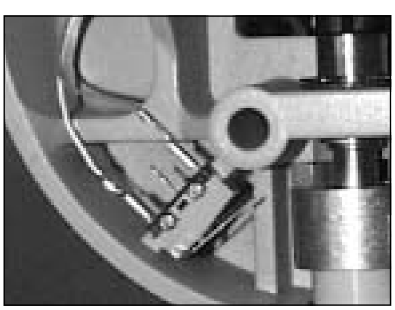
Re-assemble

8. The handle has an internal spring. Move the shaft back and install the shim between the shaft and the handle (included in the replacement kit). This positions the groove on the shaft for installing the large retaining clip.



9. To reinstall the release mechanism, slide the handle in at 3 o'clock position.
10. Align the indexer with the set screw facing down and the indexer at the position you noted in step 6.
11. Secure the indexer to the handle shaft by tightening the set screw.
12. Install the retaining clip into the groove in the shaft.
13. Pull the handle outward to remove the shim and make sure that the shaft is locked in place.
14. Reinstall the canister and the canister dishes.
15. Make sure the canister and dishes lock into place and that the canister microswitch engages.
16. Lubricate the release/locking mechanism (Section 5.3).
17. Perform the Breathing System Leak Tests (Section 7.2).

4.12.9 Replace canister microswitch



1. Place the canister release handle in the 3 o' clock position.

   Note: The microswitch is located beside the canister release locking cam.
2. Remove the two screws that secure the microswitch.
3. Remove the two wires from the microswitch.
4. Install wires to the new microswitch and tighten the screws.
5. Slowly turn the canister release handle to the 12 o' clock position (locked position).

   Note: As the handle moves to the 12 o'clock position, listen for a clicking sound. The click means that the microswitch engaged in the correct place.
6. If the microswitch did not engage, you can move it slightly with your hand.
7. Tighten the mounting screws.
8. Perform the checkout procedure (Section 3).

4.12.10 Remove the front and rear subfloors and the bulkhead cover

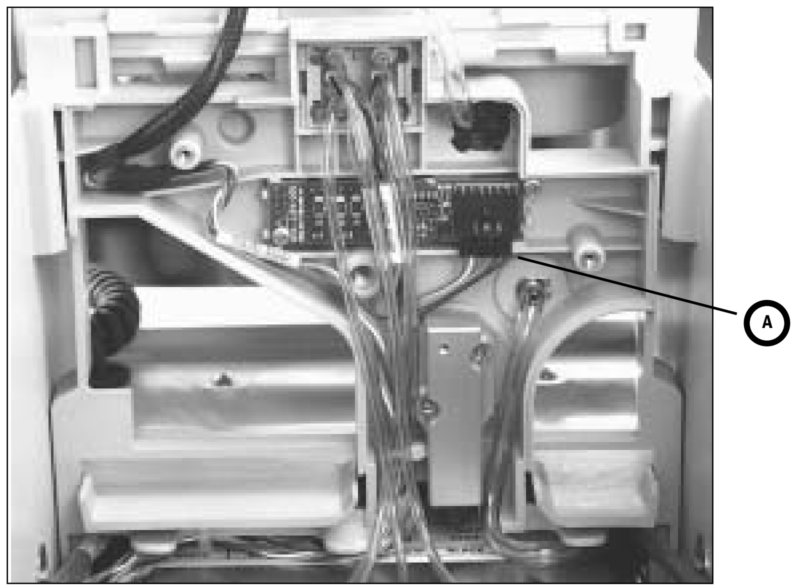
1. Open the front door of the breathing system.
2. Remove the flow sensor module.
3. Disconnect the O_2 sensor.
4. Remove the circuit module.
5. Remove the front subfloor:
   a. Remove the two screws on the top of the front subfloor.
   b. Pull out the front subfloor.

   Note: Do not damage the O_2 sensor cable when removing the front subfloor.

   c. To reassemble, perform the previous steps in reverse order.
   d. Perform the Breathing System Leak Tests (Section 7.2).
6. Unlatch and remove the bag arm.
7. Unlatch and swing the control panel up from the rear.
8. Remove the bellows assembly.
9. Remove the main manifold assembly.
10. Remove the exhalation valve assembly.
11. Remove the rear subfloor:
    a. Remove the six screws from the rear subfloor.
    b. Remove the rear subfloor.
    c. When replacing the rear subfloor, guide the front of the rear subfloor under the lip of the bulkhead cover and under the front subfloor.
    d. To reassemble, perform the previous steps in reverse order.
    e. Perform the Breathing System Leak Tests (Section 7.2).
12. For less restricted access, disconnect the Control Panel and put it aside
    a. Disconnect the tube from the pressure gauge port. From the front of the bulkhead, turn the pressure port counterclockwise to release it. Remove the tube.
    b. Disconnect the Control Panel harness.
    c. Swing the Control Panel to a vertical position and lift it straight up.
13. Remove the bulkhead cover.
14. To reassemble, perform the previous steps in reverse order.
15. Perform the Breathing System Leak Tests (Section 7.2).

4.12.11 Replace circuit module identification printed circuit board (ID PCB)

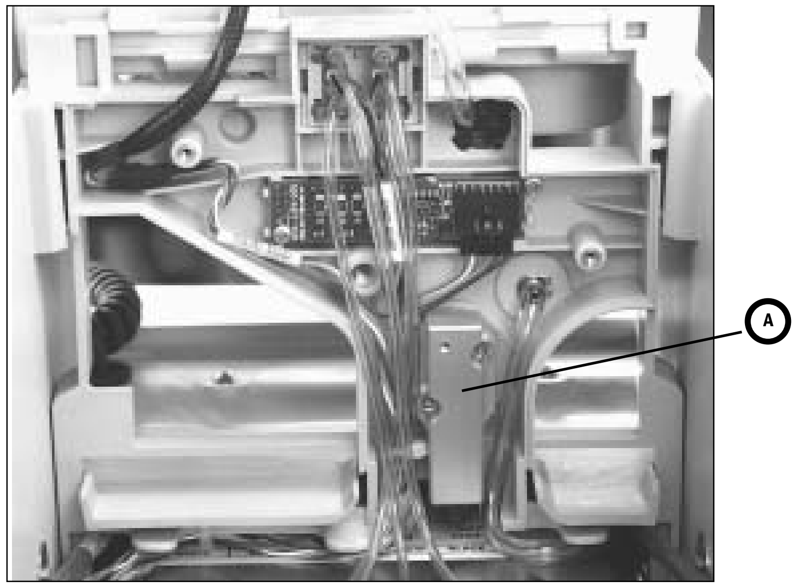
1. Follow the procedure in Section 4.12.10 to remove the bulkhead cover and gain access to the Circuit ID board. (Skip steps 5 and 11 that deal with removing the subfloors.)
2. Remove the bulkhead cover.
3. Remove the 6-conductor harness (**A**) from the printed circuit board.
4. Remove the two screws from the corners of the printed circuit board.
5. Remove the printed circuit board.



6. To reassemble, perform the previous steps in reverse order.
7. Perform the checkout procedure (Section 3).

4.12.12 Replace common gas outlet (CGO) assembly

1. Follow the procedure in Section 4.12.10 to gain access to the CGO.
2. Remove the tubing that is connected to the CGO assembly.
3. Remove the two screws that hold the CGO assembly (**A**) in the bulkhead.
4. Pull out the CGO assembly.



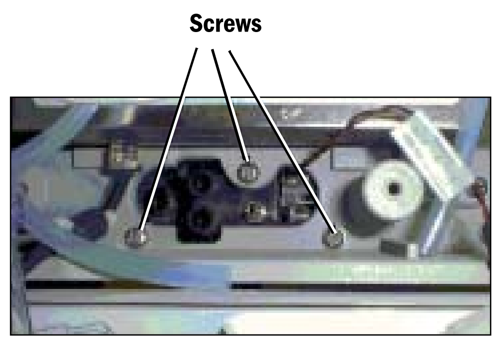
5. Reassemble by following the previous steps in reverse order.
6. Perform the checkout procedure (Section 3).

4.12.13 Remove the bulkhead

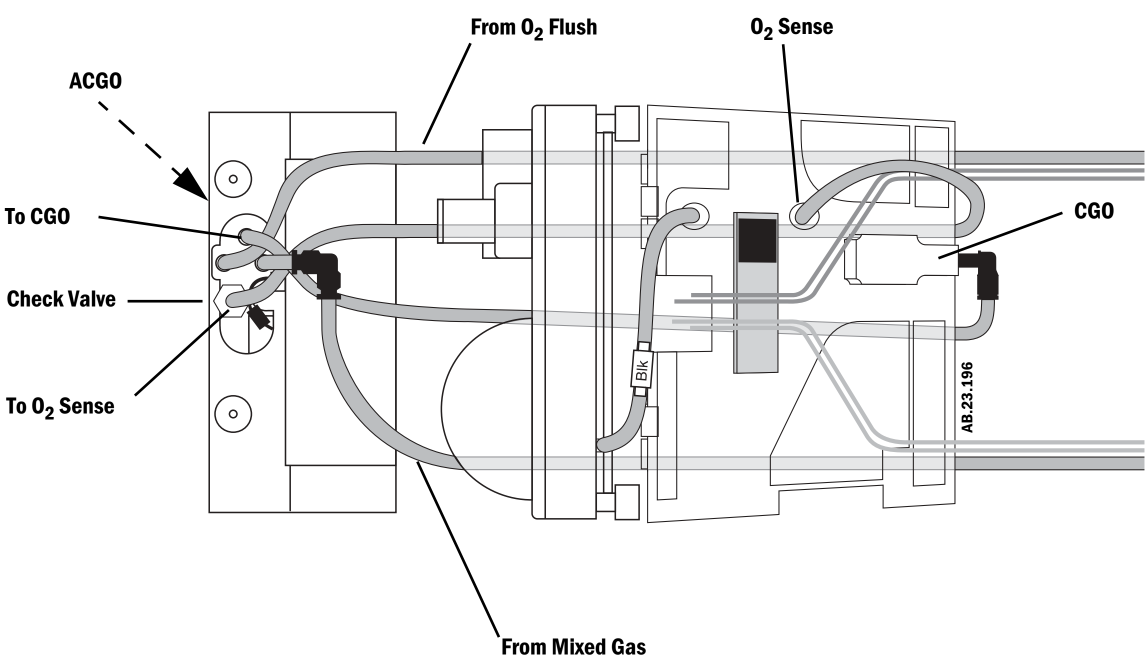
1. Follow the procedure in Section 4.12.10 to gain access to the bulkhead.
2. Remove the canisters and the top canister dish (Section 4.12.7).
3. From underneath, remove the two screws that secure the bulkhead assembly. (Screws are located near the holes for the upper canister dish release button.)
4. To reassemble, perform the previous steps in reverse order.
5. Perform the Breathing System Leak Tests (Section 7.2).

4.12.14 Replace ACGO or ACGO microswitch

1. Remove the front subfloor (Section 4.12.10).
2. Disconnect the tubing from the ACGO.
3. Disconnect the ACGO microswitch cable at the SIB connector.
4. Remove the O_2 sense check valve.
5. Remove the three screws that hold the ACGO to the breathing system chassis.



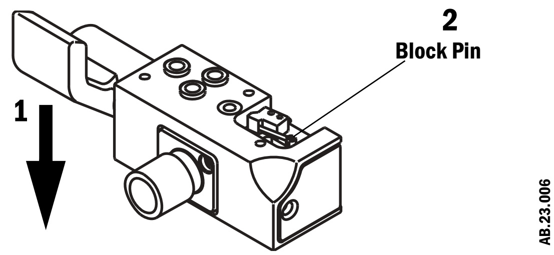
6. If required, replace the microswitch and harness assembly.
7. Reassemble by following the previous steps in reverse order.Reconnect the tubing as shown below.



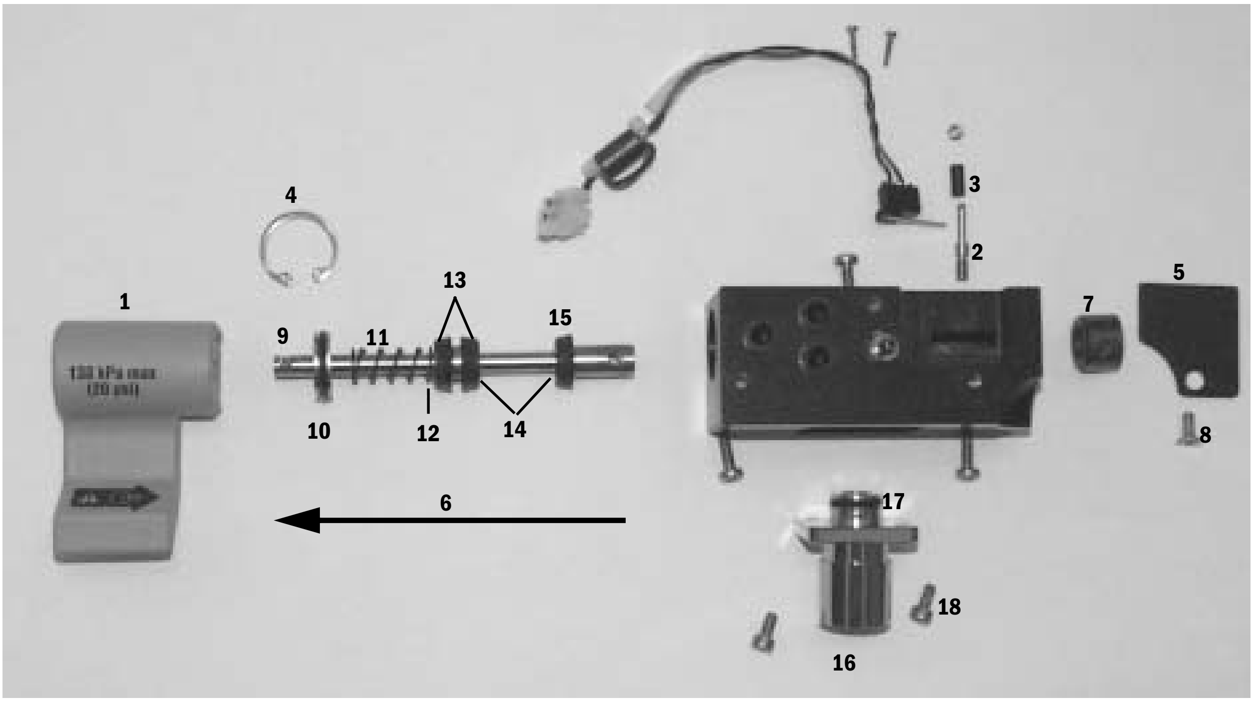
8. Perform the checkout procedure (Section 3).

4.12.15 Disassemble ACGO to replace seals

1. Remove the ACGO (Section 4.12.14).
2. Remove the switch lever (**1**) from the ACGO.
   a. Set the lever to the auxiliary outlet position (down).
   b. Block the microswitch activating pin (**2**) from returning to the rest position when the lever is set to the CGO position (up).
   c. Move the level to the CGO position and remove it from the ACGO assembly.



3. Disassemble the ACGO.
   a. Remove the nut, pin bearing (**3**), and pin (**2**) as an assembly.
   b. If the nut comes loose from the pin, remove the pin using locking pliers with aggressive-grip jaws.
   c. Remove retaining ring (**4**) at the lever end of the shaft.
   d. Remove the cover (**5**) at the opposite end.
   e. Pull the shaft assembly (**6**) out of the housing.
4. Disassemble the shaft assembly.
   a. Remove roll pin (**9**) from shaft.
   b. Slide off I-ring (**10**) and spring (**11**).
   c. Remove first e-clip (**12**) and slide off two cup seals and spacer (**13**).
   d. Remove remaining two e-clips (**14**) and slide off last cup seal (**15**).
   e. Reassemble the shaft assembly in reverse order noting the following.
      - The single cup seal (**15**) faces toward the outside.
      - The double cup seals (**13**) face toward each other.
5. Reassemble the ACGO in reverse order noting the following.
   a. Lubricate the following sparingly with Krytox:
      - The single cup seal (**15**).
      - The double cup seals (**13**).
      - The o-ring on I-ring (**10**).
   b. The beveled side of the shaft bearing (**7**) goes toward the shaft.
   c. Apply thread-lock compound to the retaining screw (**8**) for the bearing end cover.
   d. Apply thread-lock compound to the top threads of the pin (**2**) before replacing the pin bearing (**3**) and nut.



6. Remove the ACGO outlet (**16**) to replace the o-ring (**17**). Apply thread-lock compound to the mounting screws (**18**).
7. Reassemble the ACGO.
    a. Replace the pin (**2**) and pin bearing (**3**). Ensure that the microswitch lever is on the switch side of the pin.
    b. Pull the shaft away from the housing and block the pin to keep the shaft extended.
    c. Place the ACGO lever over the roll pin at the end of the shaft.
    d. Turn the lever to the auxiliary position.
    e. Release the pin.
    f. Turn the lever to the CGO position. It should now be locked in place.
8. Replace the ACGO assembly following the procedure (reverse) in the previous section (Section 4.12.14).
9. Perform the checkout procedure (Section 3).

4.12.16 Replace sensor interface board (SIB)

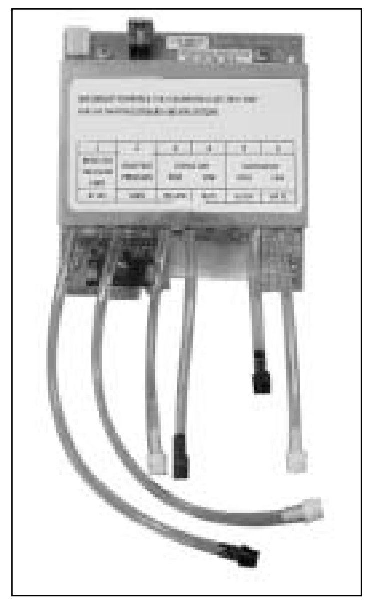
Note: This section deals only with the sensor interface board (SIB) that is used in machines with a 7900 Ventilator. The replacement procedure for the comparable component (monitoring interface assembly — MIA) used in machines with a 7100 Ventilator is covered in the service manual for the Aestiva 7100 Ventilator. The next revision of the Aestiva 7900 Ventilator service manual will include this procedure (and will be removed from subsequent revisions of this manual).

⚠ CAUTION Do not disconnect the hoses while the SIB is under pressure. This may damage the SIB components. Make sure the flow transducers are not pressurized by removing the breathing circuit before disconnecting any of the SIB interconnecting hoses.

Note Beginning in November 2004, the Enhanced SIB (ESIB) was introduced in the Aestiva/5 and Aestiva MRI machines. The ESIB replaces both previously used SIBs: the non-MRI and the MRI version.

SIB

ESIB



1. Follow the procedure in Section 4.12.10 to gain access to the SIB/ESIB.
2. Loosen the bulkhead and raise it slightly to free the SIB/ESIB for removal (Section 4.12.13).
3. Disconnect the two cables at the back of the SIB/ESIB:
   - Center connector J5, cable to processor board (press release tabs, pry gently with screwdriver);
   - Outside connector J4, interface harness connector.
4. Disconnect six color coded hose fittings.
5. Disconnect the O_2 sensor cable from the front of the SIB/ESIB.
6. For machines with an ACGO, disconnect the ACGO microswitch connector.

7. If present, remove the splash shield from the ESIB.
8. Remove the SIB/ESIB assembly from the system.

Note If the removed SIB was secured with Velcro on the bottom, remove the Velcro strips that remain on the chassis.

9. Replace new assembly (ESIB) into the chassis.
   - Make sure the board lays flat on the floor of the chassis between the alignment tabs.
10. Make all the connections in reverse order.
11. Replace the splash shield.
    - If installing a new splash shield, fold the four sides to form the splash shield
12. After all the connections are made, press down tubing and wiring harnesses so that they are at a level below the subfloor mounting studs.
13. See the following "Calibration instructions."

Calibration instructions

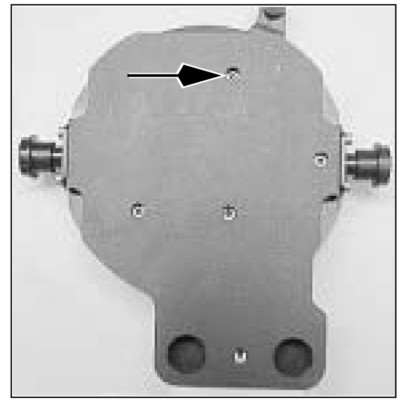
If the SIB is replaced, follow the "CPU board tests" in (Section 7.5.2 of the Aestiva 7900 Ventilator Technical Reference Manual).

Prior to placing the system in operation, all procedures in section 4 of the Aestiva 7900 Ventilator Service Manual and the Checkout Procedure (Section 3) in this manual must be completed.

4.13 CO_2 Bypass repair procedures

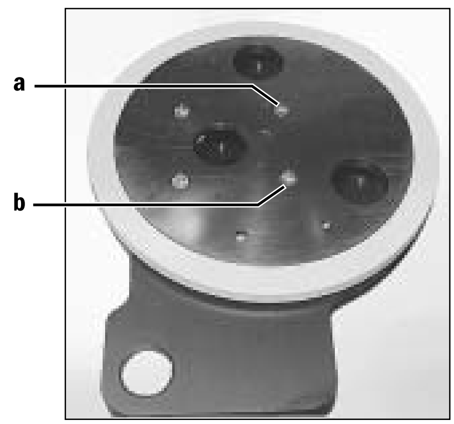
4.13.1 Disassembly

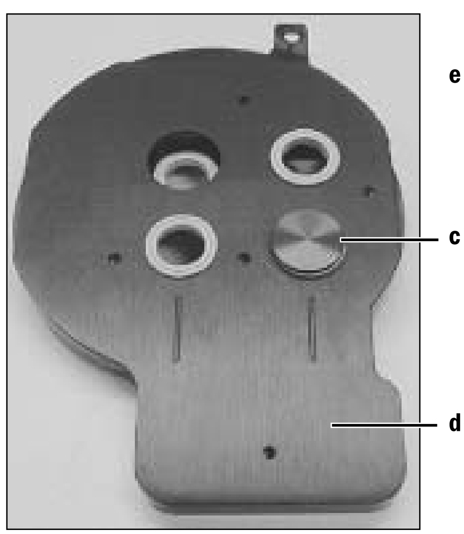
1. Remove the three tubes (two long and one short) from the Bypass assembly.
2. Fully loosen the five M4x12 screws that secure the upper manifold to the assembly.
3. While holding the assembly together, turn it over to remove the mounting screws from the upper manifold.

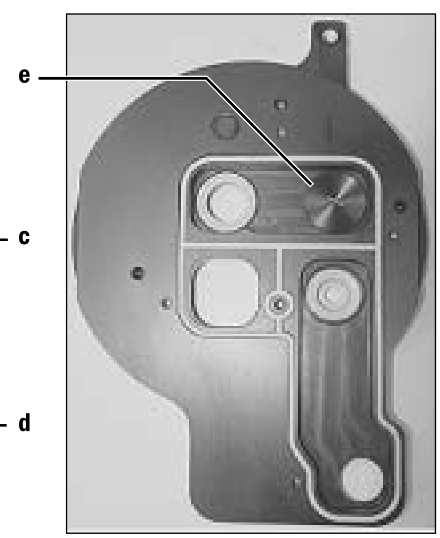


Note: *The actuator plate is spring loaded; hold the plate against the manifold while removing the mounting screws. As you remove the upper-right screw (**a**), the drain piston will fall into the upper manifold; as you remove the lower-right screw (**b**), an upper piston will fall into the upper manifold.*

4. Remove the four M4x8 screws that hold the actuator plate to the pistons.
5. Remove the actuator plate.
   - Set the three springs aside.
6. Remove the lower manifold and center plate as an assembly from the lower manifold
7. Remove the remaining upper piston (**c**).
8. Remove the center plate (**d**).
9. Remove the lower piston (**e**) from the lower manifold.







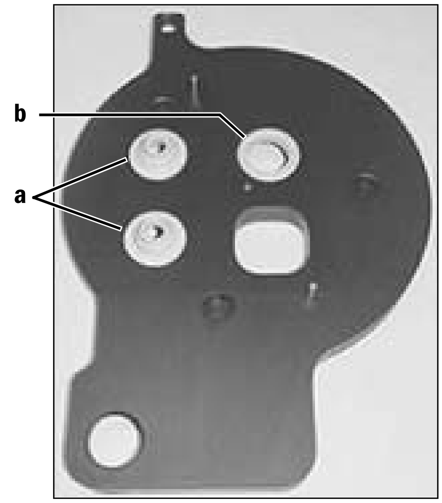
4.13.2 Replacement Procedure

Replace seals and components as necessary.

Refer to the parts section (Section 8.27.6) for replacement stock numbers.

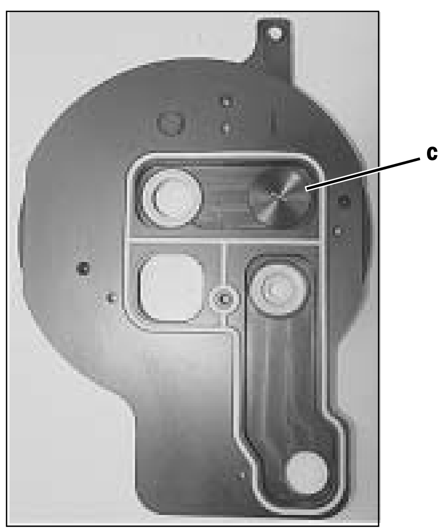
4.13.3 Assembly

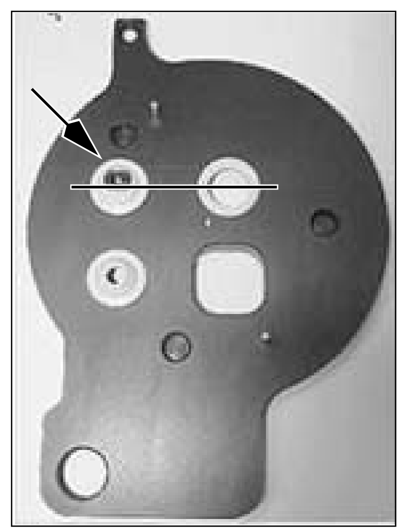
1. Ensure that two piston seals (**a**) and one “center plate” seal (**b**) are correctly installed in the lower manifold as shown.



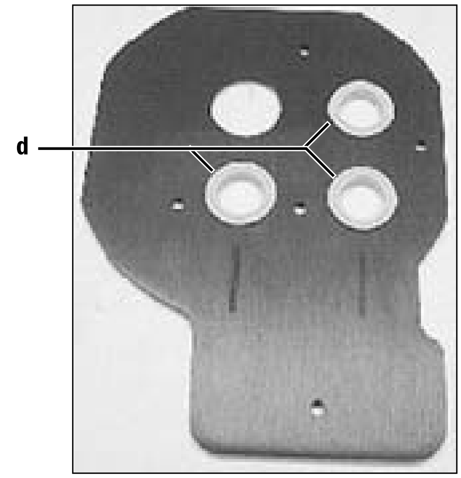
Note: *The lower piston is marked with a straight recess in the surface of the disk. After inserting the piston, verify that the piston seal fits properly into the* ***groove*** *at the end of the piston shaft by rotating the piston to make sure the rectangular head (alignment portion) does not bind with the seal.*

2. Install the lower piston (**c**) in the piston seal as shown. Align the rectangular head of the piston so that the long side of the head is parallel to the centerline between the two adjacent seals.

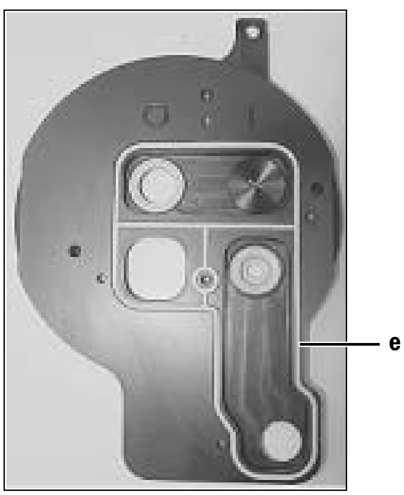


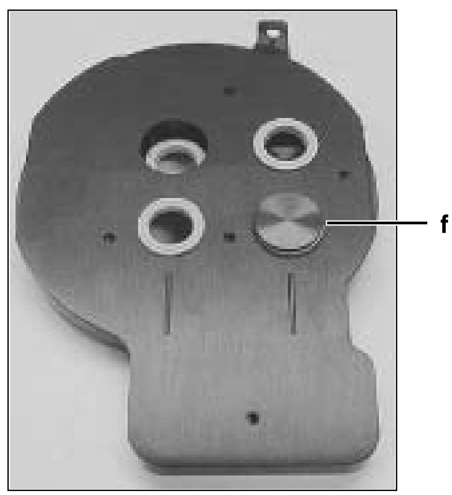


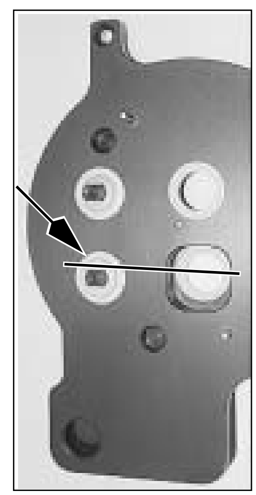
3. Ensure that three center plate seals (**d**) are correctly installed in the center plate as shown.



4. Ensure that the lower manifold seal (**e**) is correctly installed.





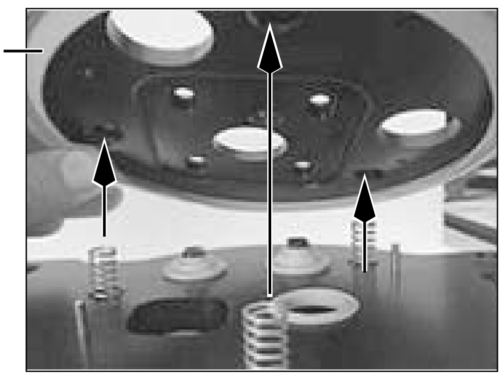


5. Place the center plate on top of the lower manifold assembly.
6. Install an upper piston (**f**) into the piston seal as shown.
7. Verify that the piston seal fits properly into the groove at the end of the piston shaft by rotating the piston to make sure the rectangular head (alignment portion) does not bind with the seal.
8. Align the rectangular head of the piston so that the long side of the head is parallel to the centerline between the two adjacent seals.

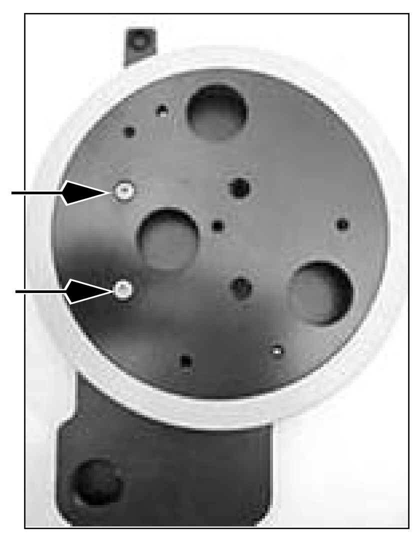
9. Place the three springs in the spring retaining holes on the bottom side of the assembly.

10. Install the actuator plate:
    - Ensure that the actuator plate seal (**g**) is correctly installed.
    - Place the Actuator Plate on the Manifold Assembly.
    - Align the three spring holes in the actuator plate directly over the three springs.

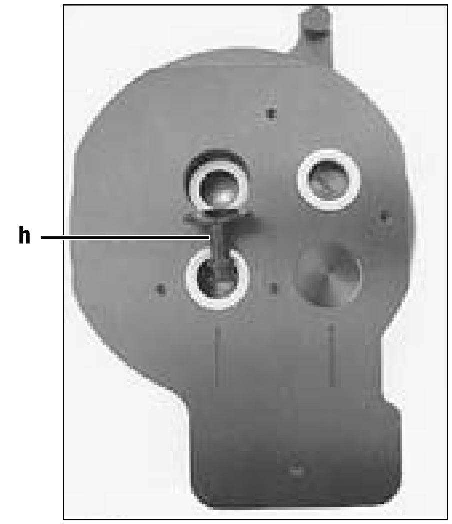
g



11. When aligned correctly, the rectangular heads of the two piston ends will fit into the rectangular recesses in the actuator plate.
    - Tighten the two screws that secure the pistons.

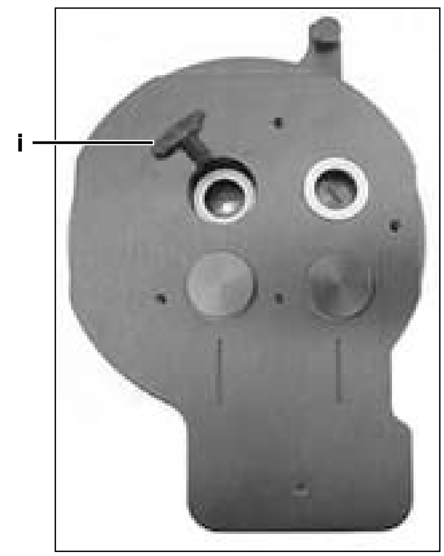


12. From the top side of the manifold assembly, insert the second upper piston (**h**) through the lower-left opening in the center plate.
    - Ensure the rectangular piston head aligns with the rectangular recess in the actuator plate.
    - Compress the actuator plate and tighten the screw to secure the piston.



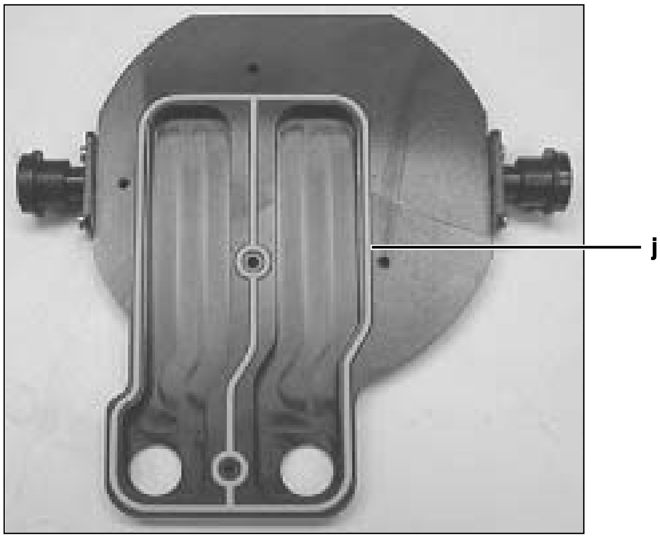
Note: *The drain piston is marked with a circular recess in the surface of the disk.*

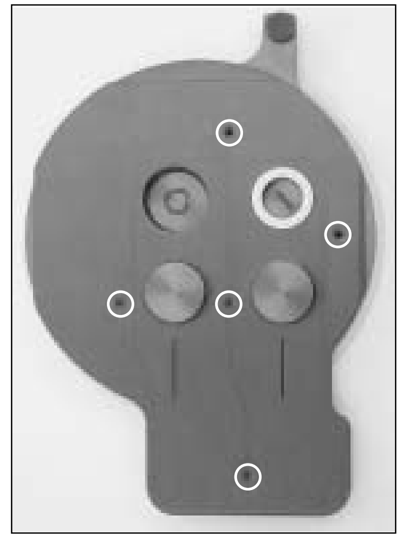
13. Drop the drain piston (**i**) through the actuator plate into position over the actuator plate.
    - Ensure the rectangular piston head aligns with the rectangular recess in the actuator plate.
    - Compress the actuator plate and tighten the screw to secure the piston.



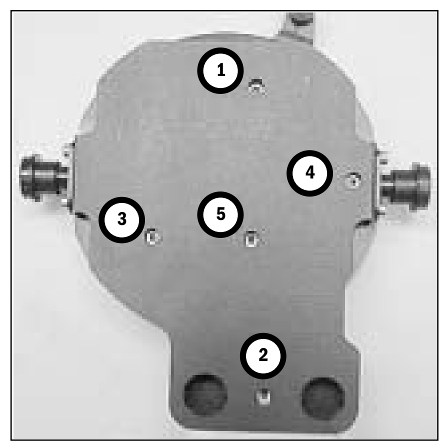
14. Compress the actuator plate several times and verify proper movement of all four pistons.

15. Ensure that the upper manifold seal (**j**) is correctly installed.





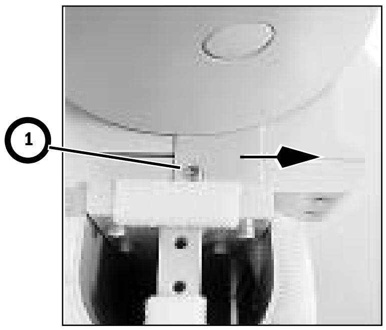
16. Adjust the center plate so that it aligns directly over the five threaded upper manifold mounting holes.
17. Place the upper manifold over the lower manifold assembly and start the five M4x12 screws.
18. Tighten the screws in the order sequence shown in the picture.



19. Ensure that the o-ring seals on the three tubes are correctly installed.
20. Install and securely tighten the two long tubes and one short tube.
21. Perform the Breathing System Leak Test (Section 7.2.3) with the CO_2 Bypass open and closed.

4.14 Service the breathing system with an articulating arm

4.14.1 Removing the rear panel

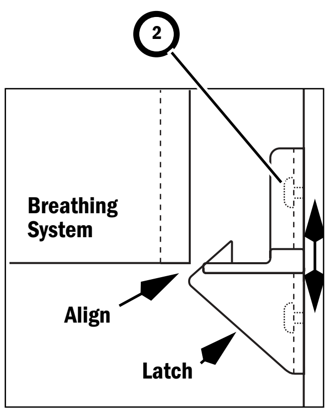


1. Remove the support column cap (attached with Velcro hook and loop).
2. Remove the screw (**1**) that secures the constrainer plate.
3. Remove the constraining plate by sliding it away from the breathing system.

   The absorber can now be extended and rotated so that the rear panel can be removed.
4. After servicing the breathing system, reinstall the constrainer plate and support column cap.

⚠ **CAUTION:** Failure to reinstall the constrainer plate could result in damage to the breathing system.

4.14.2 Latch adjustment



An improperly adjusted latch can result in breathing system movement during normal transport or difficulty in unlatching the breathing system from the machine. With a properly adjusted latch, the breathing system should engage the latch at the midpoint of the ramp, and in the closed position, should just rest on the latch flat beyond the ramp as shown in the illustration.

To adjust the latch:

Loosen the two mounting screws (**2**) slightly.

Move the latch up or down as needed for proper engagement.

Tighten the mounting screws securely.

Verify that the breathing system can be latched easily and that it must be raised slightly to move it from the latched position.

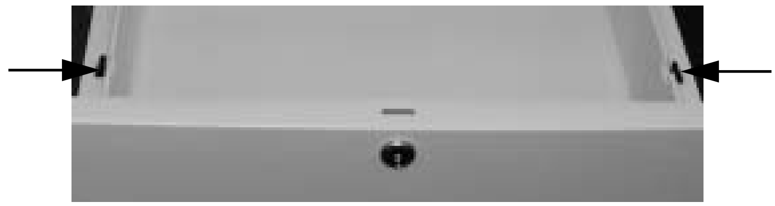
4.14.3 Check/adjust tension of absorber arm

It should take a slight effort to move the breathing system throughout its range of motion. The system should stop moving as soon at it is released.

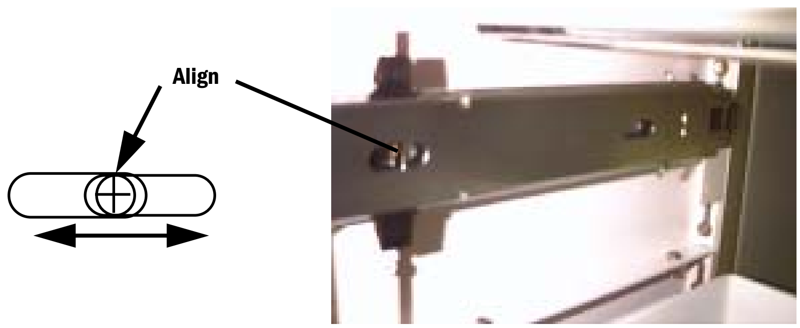
1. Check the movement of the breathing system.
2. If the system moves too easily, or wobbles, tighten the mounting nut associated with the affected movement: either under the support arm or under the support column (torque to 24 to 26 N-m).

4.15 Remove or replace drawer slides

1. Remove the drawer:
   a. Push in the tabs on each side of the drawer.
   b. Lift the drawer up and out, front first.



2. To remove the front screw, move the slide so its holes align over the front screw.



3. Remove the two screws.
4. Remove the slide.
5. Install the new slide. Apply Loctite 242 to the mounting screws.
   Push the slide toward the front of the machine as you tighten the screws.
   Tighten the front screw first.

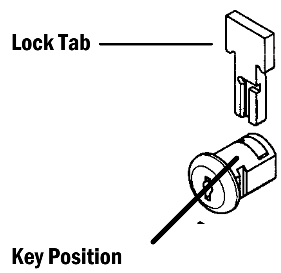
Note: *The new-style drawer slides have a longer rail than the original design. When installing a new-style drawer slide, position the slide as shown. The rear mounting screw attaches the slide to the support through the third slot.*

6. Push the back of the drawer into the slide hooks.

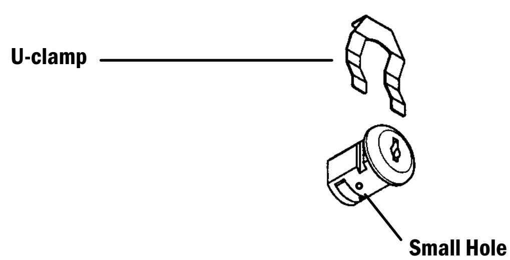
7. Push the front down to engage the tabs.

4.15.1 Replace drawer lock assembly

1. Remove the drawer (Section 4.15).
2. With the drawer in the upright position, insert the key and turn it to the locked position.
3. Turn the key back to approximately the "1 o'clock" position.



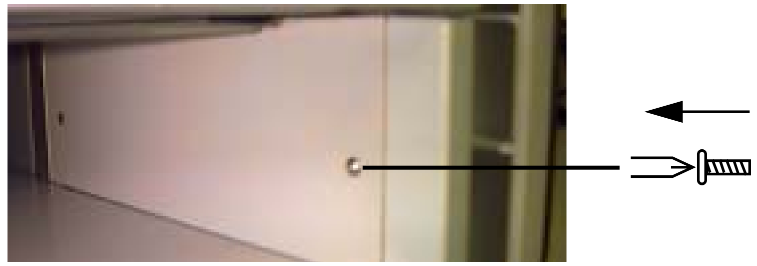
4. Insert a small pick in the hole in the back side of the lock assembly and depress the keeper spring.
5. Pull up and remove the lock tab. To ease the lock tab out of the lock assembly, you may have to release and depress the keeper spring several times as you continue to pull up on the lock tab.
6. With the drawer upside down, remove the u-clamp from the lock assembly:



7. The lock assembly now come out the front of the drawer.
8. When installing the lock, be sure the small hole in the cylinder of the lock is towards the top of the drawer and the spring keeper on the tab is toward the rear.

4.15.2 Remove or replace lower shelves

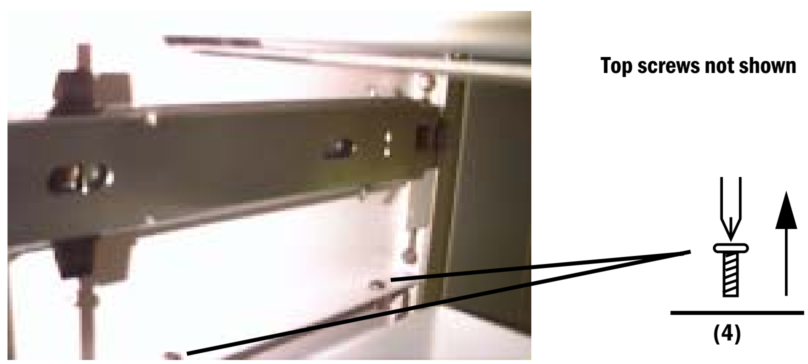
1. Remove the screws from the inner panels.



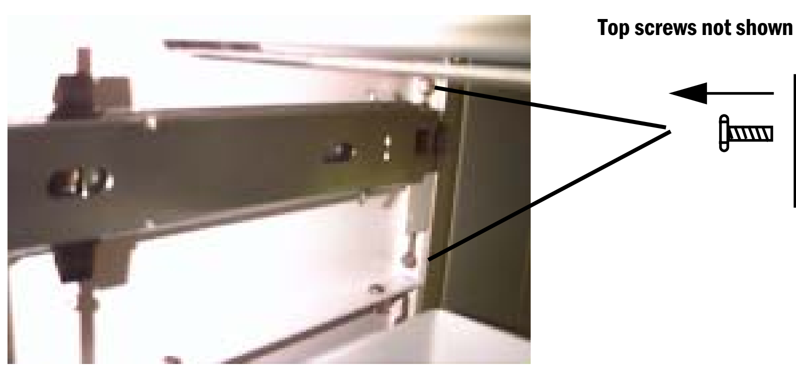
2. Remove the panels.
3. Remove the screws from the bottom of the shelf.
4. Lift the shelf out.
5. Install new shelf.
6. Reassemble in reverse order.

4.15.3 Replace side panel for drawer enclosure

1. Remove the drawer and drawer slide (Section 4.15) or the shelf (Section 4.15.2).
2. Remove the screws from the top and bottom of the panel (4).



3. Remove the mounting bolts at the back of the panel.



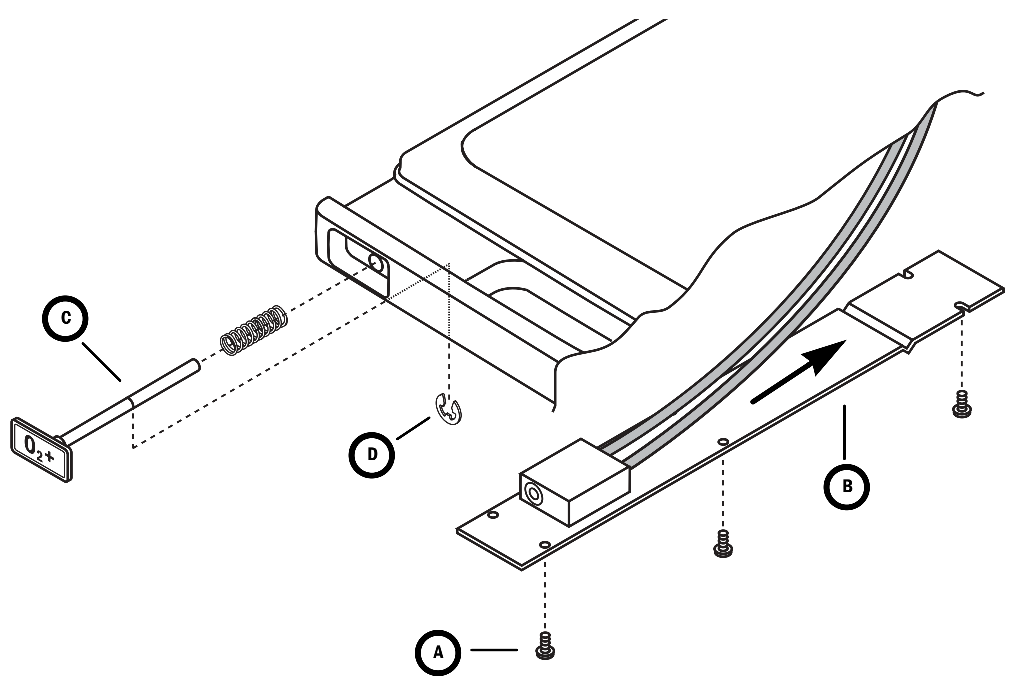
4. Remove the panel.
5. To reassemble, perform the previous steps in reverse order.

4.16 Replace O_2 Flush components

4.16.1 Replace O_2 flush button

Note: On some machines, the flush button control may be rotated 180° from position shown here.

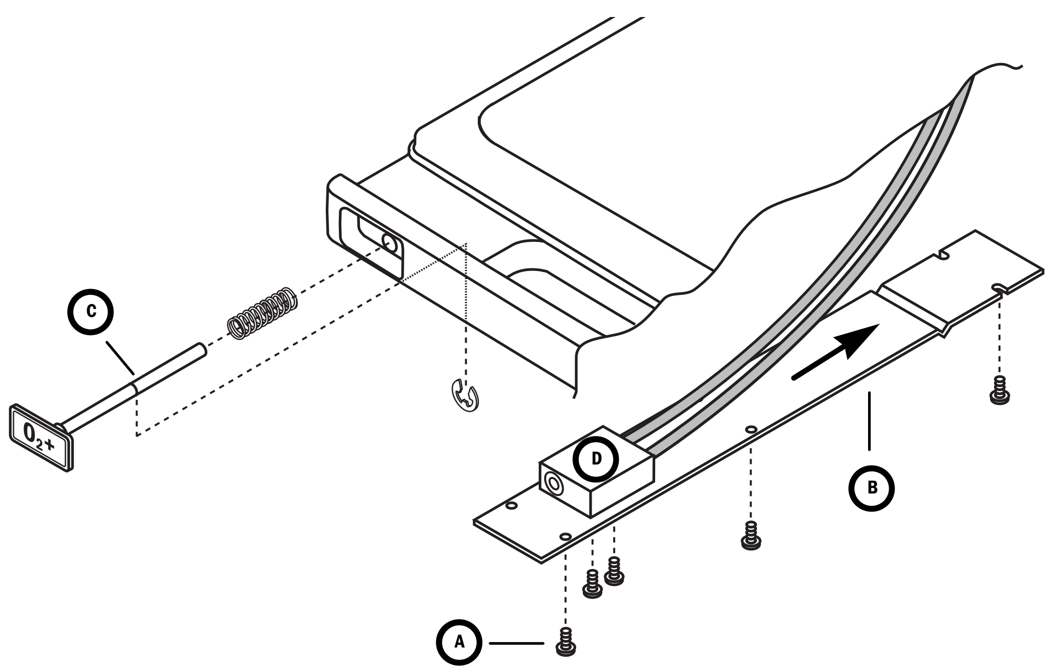
1. Remove the top two drawers (Section 4.15).
2. Remove the three screws (**A**) from the flush rod cover (**B**) under the tray top.
3. Push the flush control cover toward the back to disengage it from the flush rod (**C**).
4. Remove the retaining ring (**D**) from the flush rod.
5. Push the flush button out through the front.
6. Remove the spring.
7. Place the spring on the new rod.
8. Slide the rod in through the front.
9. Push the button all the way in.
10. Snap the retaining ring into the groove on the rod.
11. Position the cover so that the O_2 flush rod makes proper contact with the O_2 valve block.
12. Reinstall the cover screws.
13. Make sure that the O_2 flush is activated when the button is pushed.
14. Perform a low-pressure leak test (Section 3.9).
15. Perform the checkout procedure (Section 3).



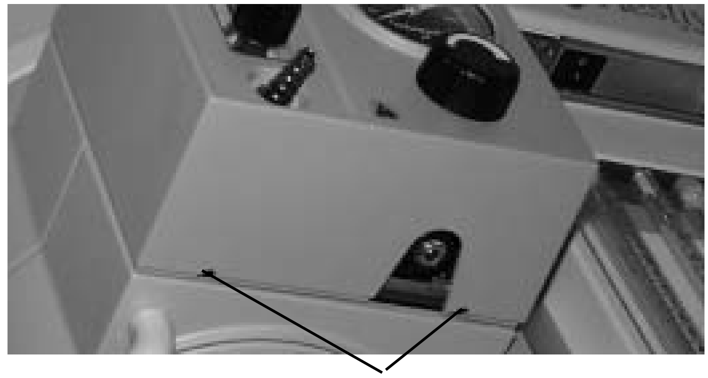
4.16.2 Replace O_2 flush valve block

Note: On some machines, the flush button control may be rotated 180° from position shown here.

1. Close all cylinder valves.
2. Disconnect the O_2 pipeline.
3. To bleed O_2 gas pressure from the machine, push the O_2 flush button.
4. Remove the top two drawers (Section 4.15).
5. Remove the three screws (**A**) from the flush rod cover (**B**) under the tray top.
6. Push the flush control cover toward the back to disengage it from the flush rod (**C**).
7. Remove valve block (**D**) from the cover.
8. Remove the O_2 tubes from the block.
9. Install the new block.
10. Reinstall the O_2 tubes. Pull on each tube to ensure it is locked into the fitting.
11. Position the cover so that the O_2 flush rod makes proper contact with the O_2 valve block.
12. Reinstall the cover screws.
13. Make sure that the O_2 flush is activated when the button is pushed.
14. Perform a low pressure leak test (Section 3.9).
15. Perform the checkout procedure (Section 3).



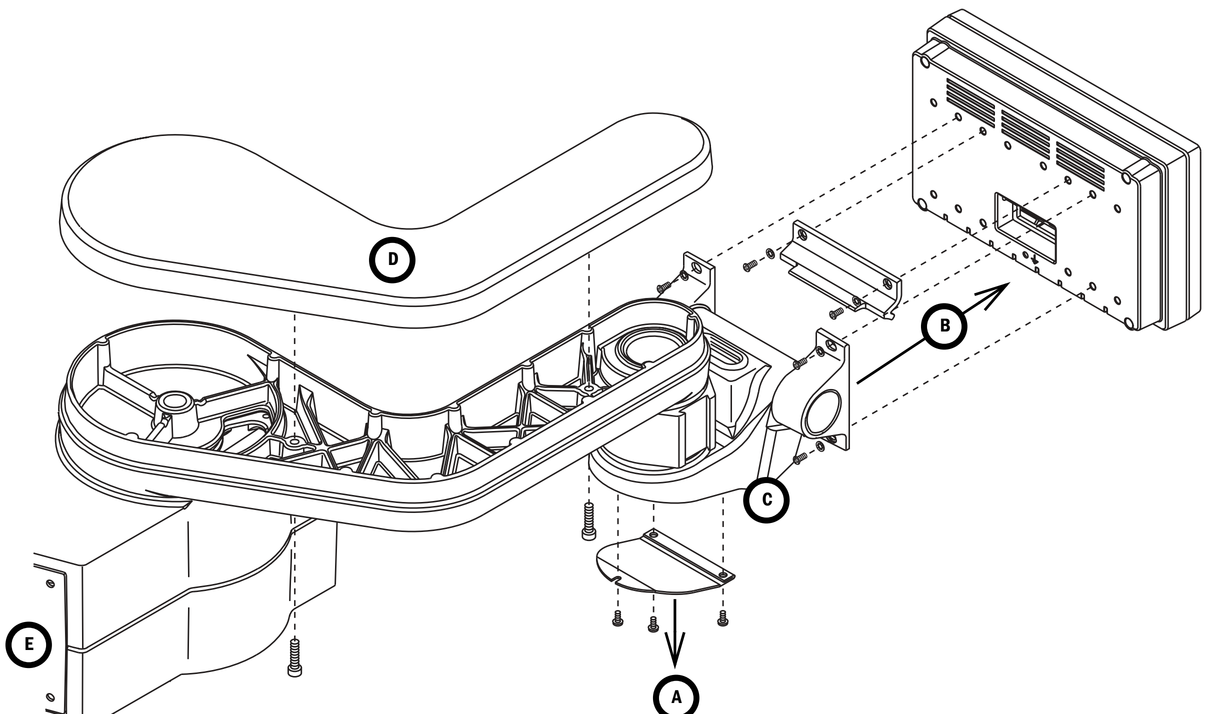
4.17 Replace auxiliary flowmeter or suction regulator



1. Loosen mounting screws to release retaining clips.
2. Push assembly up and swing bottom out.
3. Replace parts as necessary.
4. Reassemble in reverse order. Pull on tubing to ensure a tight fit.
5. Perform the checkout procedure (Section 3).

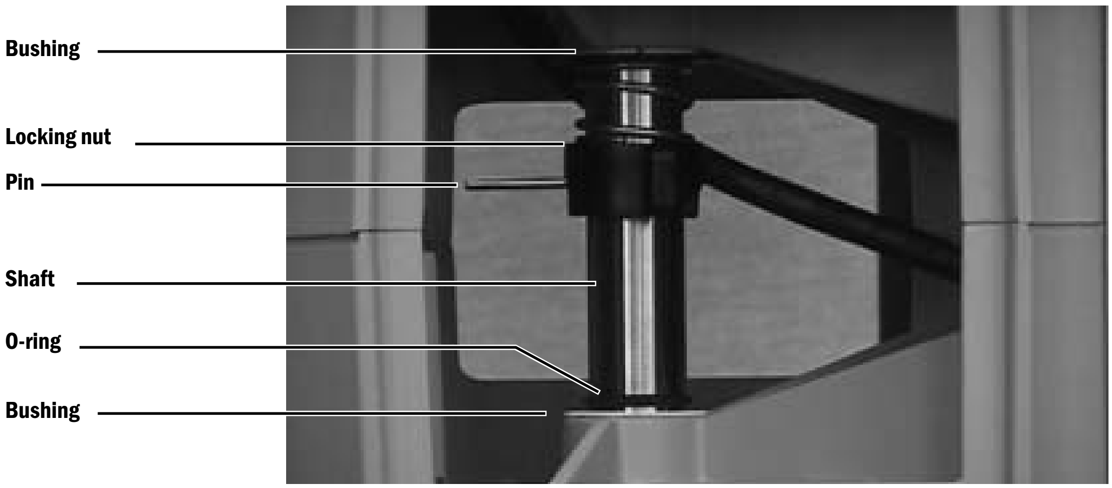
4.18 Repair or replace display arm

1. Remove the pivot arm cover (**A**).
2. Disconnect the cables from the ventilator display.
3. Remove the display from the pivot supports (**B**).
4. Remove the retainer ring (and stop washer) that holds the swivel wrist casting (**C**) to the arm.
5. Applying downward pressure, slowly rotate the wrist assembly back and forth until it comes loose from the pivot post.
6. Remove the display arm top cover (**D**) by removing the two screws located at the bottom of the arm.



7. Remove the shoulder cover **(E**) located at the rear of the arm shoulder.
8. Remove the auxiliary suction regulator (or front cover if regulator not present) at the front of the arm shoulder (Section 4.17).
9. Remove the display harness(es) from the arm assembly:
   a. Feed each harness one at a time through the pivot post.
   b. Route the harness into the shoulder at the top and then out of the shoulder through the back opening.

10. Remove the arm assembly:
    a. Turn the black plastic locking nut (located inside the arm shoulder) to relieve tension on the spring.
    b. Push up on the black locking nut.
    c. Slide the pin out of the arm mounting shaft.
    d. Keep the pin for reassembly.



11. Once the locking nut is released, pull up on the arm assembly and remove the o-ring at the bottom of the shaft.
12. Remove the arm from the shoulder.

Note: If the top or bottom display shaft bushings move from their locations, reinstall the bushings. The bushings have a notch at the top that aligns with the shoulder shaft openings.

13. Reinstall the replacement arm by performing the previous steps in reverse order.

Note: Inspect all o-rings associated with the arm and replace if necessary.

14. Perform the checkout procedure (Section 3).

4.19 Display mount adjustment

4.19.1 Standard mount

1. Verify proper orientation of the mounting hardware.
   - The dome of the two nested Belleville washers (**A**) should face the head of the mounting screw.

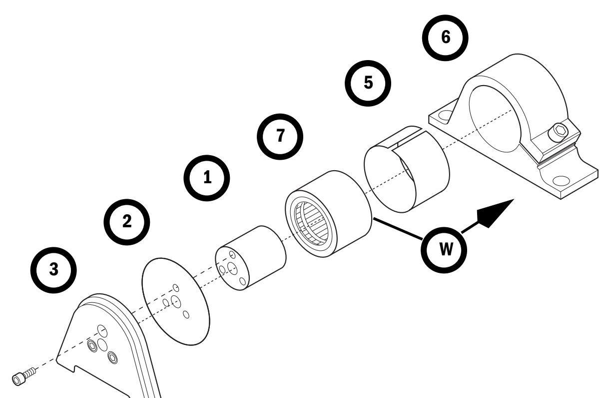
2. Tighten or loosen the mounting nut so that the display can be tilted without excessive force and remains in place when released.

Note: Do not exceed maximum torque (13.9 Nm). Upgrade to heavy duty mount if correct adjustment can not be achieved with standard mount.

4.19.2 Heavy duty mount

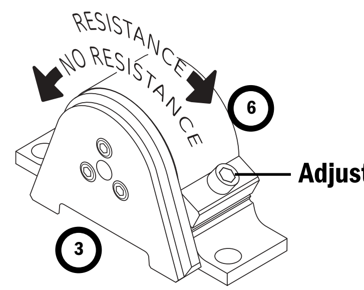
Refer to Section 8.17.4 to identify components.

Each bearing housing assembly must be assembled with the bearing installed in the housing so the writing on the side of the bearing (**W**) faces the same direction as shown.

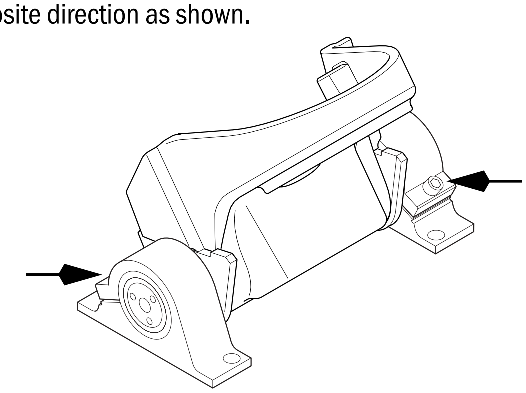


When properly assembled and adjusted, the bearing housing assembly offers resistance in one rotation and no resistance in the opposite rotation.

1. Before installing the bearing housing assemblies, verify that both assemblies are properly assembled as follows. If there is no resistance in either direction, tighten the resistance adjustment slightly.
   - While holding the housing (**6**), there should be resistance when the knuckle spacer (**3**) is rotated clockwise as shown and no resistance in the opposite direction.
   - If the resistance is not correct, reverse the position of the bearing in the assembly.



2. When mounted on the display arm knuckle, the adjustment screws will face in opposite direction as shown.



3. Initially tighten each resistance adjustment screw to 2 Nm. After the displays are mounted, the resistance can be readjusted as desired.
   - The adjustment screw oriented on top adjusts the resistance while tipping the displays upward.
   - The adjustment screw oriented on the bottom adjusts the resistance while tipping the displays downward.
4. Ensure that the downward adjustment is tight enough so the displays do not fall forward from their own weight.

4.20 Replace Front 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 Aestiva, close all gas cylinders, unplug the power cord, and set the system switch to standby.

⚠ **CAUTION:** Remove the vaporizers before tipping the machine. If a vaporizer is inverted, it must be set to 5% and purged for 30 minutes with a 5 L/min flow. The interlock system prevents purging more than one vaporizer at a time.

2. Remove the vaporizers, gas cylinders, drawers and all auxiliary equipment.

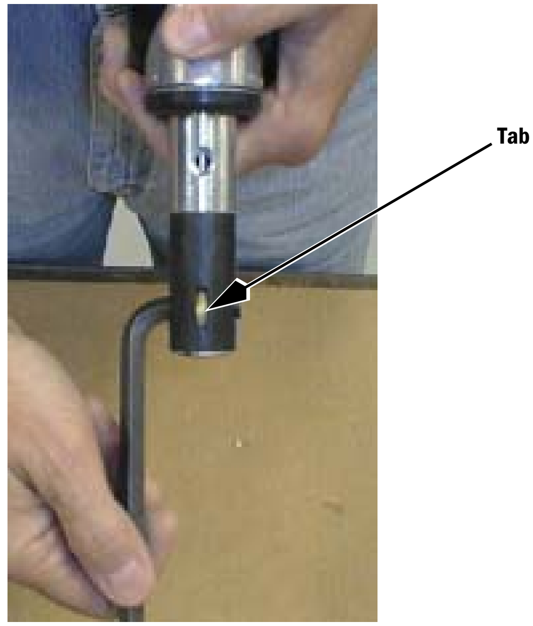
⚠ **CAUTION:** To prevent damage, do not tip Aestiva more than 10 degrees from vertical.

3. Block the rear wheels; then, block up the machine until there is enough room to remove the caster.

   To block up the machine, tip and slide blocks under the caster rails. Raise both sides evenly until the unit is high enough to remove the defective caster.

4. Release the brake.
5. Loosen screws and nuts on the brake pedal.
6. Remove one screw and nut, and turn screw into locator hole.
7. Slide brake rod for caster toward center of machine until it no longer engages caster.
8. Loosen screw that holds caster to frame.
9. Slide damaged caster out of bearing sleeve.

10. Make sure new caster is in locked position.



   a. Hold caster so locking tab faces away from you.
   b. Use a hex wrench to turn locking mechanism away from you.
   c. Make sure tab is down.

11. Hold the caster so the tab is facing toward the front of the machine.
12. Push the caster all the way into the bearing sleeve.
13. Insert screw and tighten to caster. Apply Loctite 242 to screw before you tighten it.
14. Make sure brake pedal is in locked position.
15. Slide brake rod through the caster until it hits the outer frame wall.
16. Release the brake. Make sure brake operates smoothly and casters turn freely with brake released.
17. Lock the brake. Make sure casters remain in place and do not turn.
    If a caster turns, use a 5-mm hex wrench to tighten the brake adjustment screw, located between the wheels on the trailing end of the caster.

Note: *Newer machines use pre-adjusted casters that do not include a brake adjustment screw.*

18. Remove the support blocks.
19. Carefully lower the unit to the floor.
20. Unblock the rear wheels.
21. Remount equipment.
22. Perform the checkout procedure (Section 3).

4.21 Replace Back 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 Aestiva, close all gas cylinders, unplug the power cord, and set the system switch to standby.

⚠ **CAUTION** Remove the vaporizers before tipping the machine. If a vaporizer is inverted, it must be set to 5% and purged for 30 minutes with a 5 L/min flow. The interlock system prevents purging more than one vaporizer at a time.

2. Remove the absorber, the vaporizers, gas cylinders, drawers and all auxiliary equipment.

⚠ **CAUTION** To prevent damage, do not tip Aestiva more than 10 degrees from vertical.

3. Block the front wheels; then, block up the machine until there is enough room to remove the defective caster.

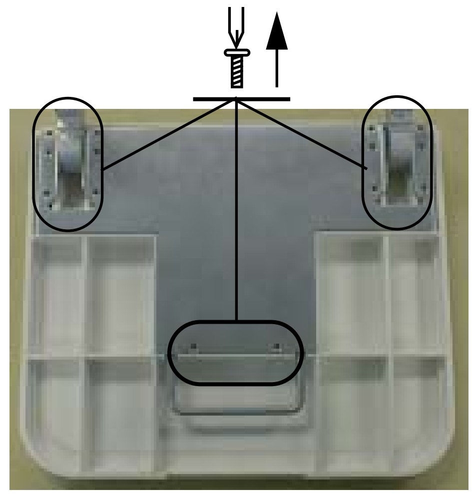
   To block up the machine, tip and slide blocks under the caster rails. Raise both sides evenly until the unit is high enough to remove the caster.

4. Loosen screw that holds caster to frame.
5. Slide damaged caster out of bearing sleeve.
6. Push the new caster all the way into the bearing sleeve.
7. Insert screw and tighten to caster. Apply Loctite 242 to screw before you tighten it.
8. Make sure the caster turns freely.
9. Remove the support blocks.
10. Carefully lower the unit to the floor.
11. Unblock the rear wheels.
12. Perform the checkout procedure (Section 3).

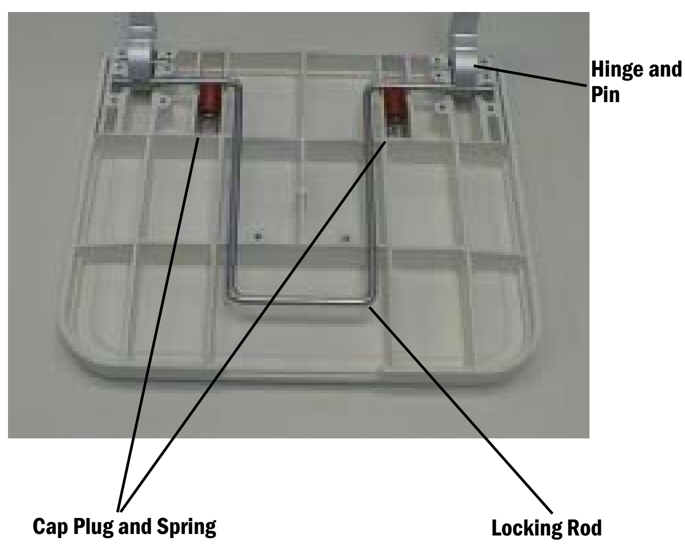
4.22 Replace flip-up shelf

Note Shelf shown upside down for clarity.

1. Remove the plate from the underside of the shelf (14 screws).



2. Remove the cap plug and spring assemblies from the slots in the shelf.



3. Remove the locking rod.
4. Remove the hinge and pin assemblies.
5. Insert the hinge and pin assembly into the new shelf.
6. Hold the locking rod in place and install the cap plug and spring assemblies on each side (plastic caps toward the rod).
7. Attach the plate to the underside of the shelf (14 screws).
8. Check that the locking rod operates smoothly.

4.23 Replace light package bulbs or panel

Note Newer machines use a task light board with LED lights; individual LEDs can not be replaced.

⚠ **WARNING** This lamp uses 2.4 watt bulbs. Higher wattage bulbs can get hot enough to burn you.

1. Remove the bezel by pulling it towards the front of the machine.

   Note: Use caution when removing the light package so that you do not damage the power connector.

2. Place your hands on the top of the light package assembly and push down. The light package is locked in by a locking post.
3. Remove the light package lens by pulling out on the end cap. The end cap is located on the opposite end of the light switch. The end cap is secured by two tabs.
4. Slide the lens out of the package.
5. To remove a bulb:
   a. Grasp a bulb.
   b. Pull the bulb to the side. The bulb slides out of the white socket.
6. Install a new bulb into the socket and push until the bulb locks.
7. Assemble and install the light package by performing the previous steps in reverse order.
8. Ensure that the light package is functional.

5 Installation and Maintenance

In this section

This section covers the regular maintenance procedures (minimum requirements) needed to make sure that the Aestiva Anesthesia Machine — including the ventilator — operates to specifications.

⚠ **WARNINGS**

Do not perform testing or maintenance on the Aestiva 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.

5.1 Aestiva/5 Installation Checklist

Serial Number:	Date: (YY/MM/DD) / /
Hospital:	Performed by:
☐ Induction Machine ☐ 7900 Ventilator ☐ 7100 Ventilator	

☐ 1. Unpack and assemble the Aestiva System.

If Induction Machine (not equipped with a ventilator), skip to Step 6.

☐ 2. If necessary, access the service mode Language Menu and select the correct language.

3. Access the service mode and perform the following:

☐ a. Enter the site altitude in increments of 100 meters.

☐ b. Select the correct ventilator drive gas (O_2 or Air).

☐ c. Enable/Disable Heliox Mode.

☐ d. Select the desired V_E Alarm Limits (Automatic or User Adjustable).

☐ e. Activate/Deactivate enabled monitoring and ventilation features as desired by the end customer (7100 only).

☐ f. Activate/Deactivate User Select Defaults as desired by the end customer (7900 only).

4. Access the service mode Calibrations menu and perform the following:

7900 Ventilator

☐ a. O2 Calibrations

☐ b. Cal Flow Sensors

☐ c. Adjust Drive Gas Regulator

☐ d. Pressure Sensitivity

☐ e. Cal Flow Valve

☐ f. Cal Bleed Resistor

7100 Ventilator

☐ a. O2 Calibrations

☐ b. Zero Flow and Airway Sensors

☐ c. Adjust Drive Gas Regulator

☐ d. PEEP Valve Calibration

☐ e. Inspiratory Valve Calibration

☐ f. Pressure Sensitivity

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

6. Perform System Checkout.

- ☐ a. Inspect the system (*Section 3.1*).
- ☐ b. Pipeline and cylinder tests (*Section 3.5*).
- ☐ c. Flow control and pressure relief tests (*Section 3.6*).
- ☐ d. Vaporizer back pressure test (*Section 3.7*).
- ☐ e. Low-pressure leak test (*Section 3.9*).
- ☐ f. Airway pressure gauge accuracy check (*Section 6.6.1*).
- ☐ g. Alarm tests (*Section 3.10*).
- ☐ h. Breathing systems tests (*Section 3.11*).
- ☐ i. Auxiliary O2 flowmeter tests, if equipped with option (*Section 3.12*).
- ☐ j. Integrated suction regulator tests, if equipped with option (*Section 3.13*).
- ☐ k. Power failure test (*Section 3.3*).
- ☐ l. Electrical safety tests (*Section 3.2*).

5.2 Aestiva/5 Planned Maintenance

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

5.2.1 Every six (6) months

Perform the following steps every six months:

Machine Checks and Tests

Refer to the Aestiva Operation Manual, Part 2.
Perform the following steps:

☐ 1. User maintenance listed below. Including disassembly, inspection, cleaning and parts replacement as required (*Section 4 and Section 2*).

- Manifold Maintenance

  Also: Sparingly lubricate Bag to Vent poppet o-rings with Krytox.
- Exhalation Valve Maintenance

  Also: Sparingly lubricate standpipe u-cup seal with Krytox.
- AGSS Receiver Maintenance

  Also: Empty any condensate from the receiver. Inspect, clean or replace filter on active AGSS.
- Breathing Circuit Maintenance
- Bellows Assembly Maintenance
- Bellows Assembly Tests
- O_2 Sensor Calibration
- Flow Sensor Calibration

Refer to listed sections in this manual. Perform the following steps:

☐ 2. Inspect the system (*Section 3.1*)

☐ 3. Pipeline and cylinder tests (*Section 3.5*)

☐ 4. Low-pressure leak test (*Section 3.9*)

☐ 5. Breathing systems tests (*Section 3.11*)

☐ 6. Power failure test (*Section 3.3*)

☐ 7. Electrical safety tests (*Section 3.2*)

5.2.2 Every twelve (12) months

Perform the following steps every 12 months. The six-month checks and tests are listed again in this section to allow for proper sequencing of steps.

Machine Parts Replacement

Refer to the listed section in this manual. Perform the following step:

☐ 1. Replace the vaporizer port o-rings (*Section 4.10.1*)
(Kit Stock Number 1102-3016-000)

Machine Checks and Tests

Refer to the Aestiva Operation Manual, Part 2.
Perform the following steps:

☐ 1. User maintenance listed below. Including disassembly, inspection, cleaning and parts replacement as required (*Section 4 and Section 2*).

- Manifold Maintenance
  Also: Sparingly lubricate Bag to Vent poppet o-rings with Krytox.
- Exhalation Valve Maintenance
  Also: Sparingly lubricate standpipe u-cup seal with Krytox.
- AGSS Receiver Maintenance
  Also: Empty any condensate from the receiver. Inspect, clean or replace filter on active AGSS.
- Breathing Circuit Maintenance
- Bellows Assembly Maintenance
- Bellows Assembly Tests
- O_2 Sensor Calibration
- Flow Sensor Calibration

Refer to listed sections in this manual. Perform the following steps:

☐ 2. Lubricate the absorber canister locking mechanism (*Section 5.3*)

☐ 3. Inspect the system (*Section 3.1*)

☐ 4. Inspect the Bag-to-Vent switch (*Section 5.7*)

☐ 5. Inspect the APL Valve for residue buildup, anomalies, defects, or wear.

☐ 6. Pipeline and cylinder tests (*Section 3.5*)

☐ 7. Flow control and pressure relief tests (*Section 3.6*)

☐ 8. Vaporizer back pressure test (*Section 3.7*)

☐ 9. Low-pressure leak test (*Section 3.9*)

☐ 10. Airway pressure gauge accuracy check (*Section 6.6.1*)

☐ 11. Alarm tests (*Section 3.10*)

☐ 12. Breathing systems tests (*Section 3.11*)

☐ 13. Auxiliary O_2 flowmeter tests, if equipped with option (*Section 5.5*)

☐ 14. Integrated suction regulator tests, if equipped with option (*Section 5.6*)

☐ 15. Power failure test (*Section 3.3*)

☐ 16. Electrical safety tests (*Section 3.2*)

(continued on next page)

(12-month maintenance continued from previous page)

7900 Ventilator Checks, Tests and Calibrations

Refer to the listed sections in the Aestiva 7900 Ventilator Technical Reference Manual (7900 TRM).
Perform the following steps:

☐ 1. Inspect the supply gas inlet filter. Replace if necessary (*7900 TRM - Section 6.1*)

☐ 2. Cycle both MOPV valves:
- MOPV Differential Relief Valve Test (*7900 TRM - Section 6.3*)
- MOPV Pressure Relief Valve Test (*7900 TRM - Section 6.4*)

☐ 3. From the Ventilator Service Mode menu
(Section 4a for 4.X software) or (Section 4b for 1.X/3.X software),
perform the following:
- Display I/O Signals (*4a.3.14*) or (*4b.5.2*).
  Verify proper operation of all switches.
- Display System Error Log (*4a.3.2*) or (*4b.5.4*).
  If any error codes have been logged,
  follow the appropriate troubleshooting procedures.
  Clear the error log.
- Adjust Drive Gas Regulator (*4a.3.18*) or (*4b.8*).
- Test Flow Valve (*4a.3.17*) or (*4b.4.8*).
- Test Gas Inlet Valve (*4a.3.7*) or (*4b.4.9*).
- Test Pressure Limit Switch (*4a.3.9*) or (*4b.4.10*).
- Calibrate Pressure Sensitivity (*4a.3.21*) or (*4b.9.3*).
- Calibrate Flow Valve (*4a.3.22*) or (*4b.9.4*).
- Calibrate Bleed Resistor (*4a.3.23*) or (*4b.9.5*).

7100 Ventilator Checks, Tests and Calibrations

Refer to the listed sections in the 7100 Ventilator Technical Reference Manual (7100 TRM).
Perform the following steps:

☐ 1. MOPV pressure relief valve test (*7100 TRM - Section 6.3*).

☐ 2. From the Ventilator Service Mode menu, perform the following:
- Display Discrete I/O Signals (*7100 TRM - Section 4.10.2*).
  Verify proper operation of all switches.
- Display Error Log (*7100 TRM - Section 4.5*).
  If any error codes have been logged,
  follow the appropriate troubleshooting procedures.
  Clear the error log.
- Adjust Drive Gas Regulator (*7100 TRM - Section 4.9.3*).
- Airway Sensor Span (*7100 TRM - Section 4.9.4*).
- PEEP Valve Calibration. (*7100 TRM - Section 4.9.5*)
- Inspiratory Valve Calibration (*7100 TRM - Section 4.9.6*).
- Pressure Sensitivity (*7100 TRM - Section 4.9.7*).

5.2.3 Every twenty-four (24) months

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

Machine Parts Replacement

Refer to the listed section in this manual.

Perform the following step:

☐ 1. Replace the top and bottom flowtube o-rings (*Section 4.9.2*) (Kit Stock Number 1006-8393-000).

7900 Ventilator Parts Replacement

Refer to the listed sections in the Aestiva 7900 Ventilator Technical Reference Manual (7900 TRM).

Perform the following steps:

☐ 1. Replace the internal backup battery (*7900 TRM - Section 7.5.6*) (Stock Number 1503-3045-000).

☐ 2. Replace the free breathing flapper valve (*7900 TRM - Section 6.2*) (Stock Number 0211-1454-100).

☐ 3. Replace the free breathing valve o-ring (*7900 TRM - Section 6.2*) (Stock Number 1503-3208-000).

7100 Ventilator Parts Replacement

Refer to the listed sections in the 7100 Ventilator Technical Reference Manual (7100 TRM).
Perform the following steps:

☐ 1. Replace the internal backup battery (*7100 TRM - Section 7.2.3*) (Stock Number 1504-3505-000).

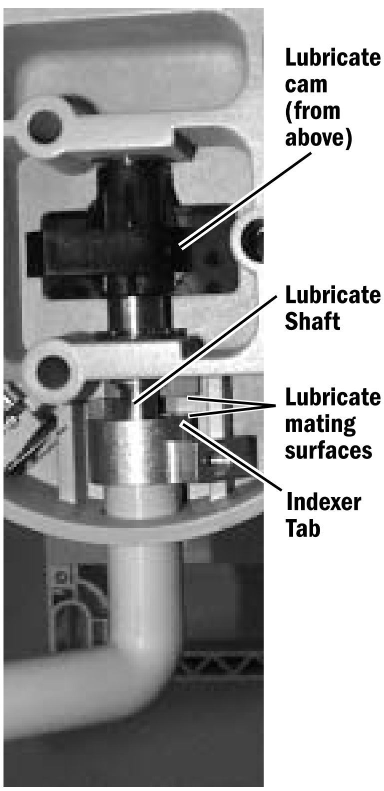
☐ 2. Replace the free breathing flapper valve (*7100 TRM - Section 6.2*) (Stock Number 0211-1454-100).

☐ 3. Replace the free breathing valve o-ring (*7100 TRM - Section 6.2*) (Stock Number 1503-3208-000).

5.3 Lubricate absorber canister locking mechanism

In order to ensure continued smooth operation, annual lubrication of the absorber locking mechanism is recommended. The use of an oxygen safe lubricant, such as Krytox, is advised but not required. Use a cotton swab or the like to apply a light coat of grease.

1. Remove the absorber canisters.
   - Pull out and rotate the locking lever clockwise.
   - Remove the canisters.
2. Remove the upper and lower absorber dish assembly (along with return tube).



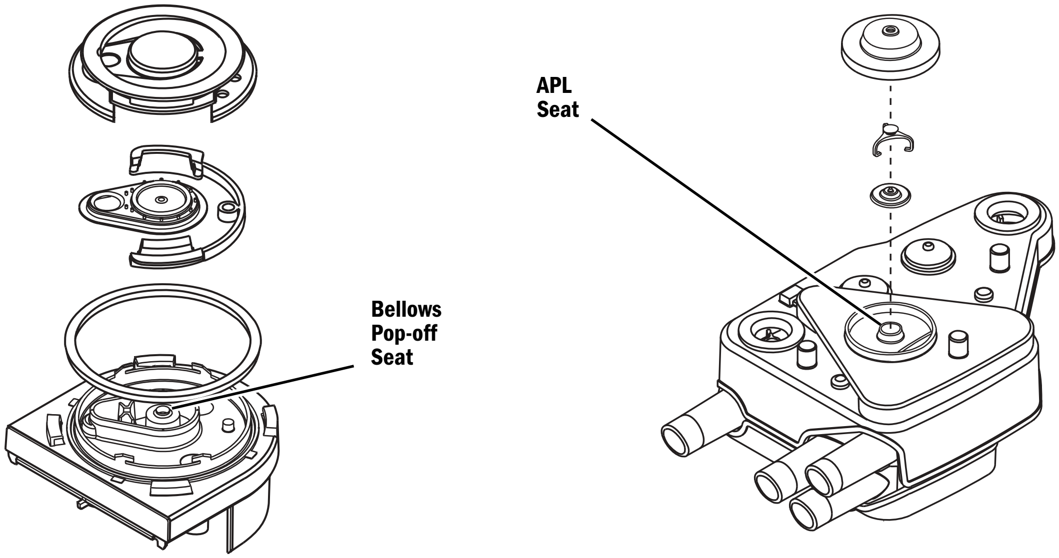
Bottom view of locking mechanism

3. Lubricate the locking mechanism:
   - Be sure to wear safety glasses.
   - Rotate the breathing system away from the machine.
   - Access the locking mechanism from below.
   - Ensure that the locking lever is in the released position.
   - Pull out the locking lever as far as possible and lubricate the indicated areas;
     - Lubricate the mating surfaces between the indexer and the base of the breathing system.
     - Lubricate the center shaft.
4. From above, lubricate the cam surface on the locking mechanism.
5. Lubricate the pin guides on the lower dish.
6. Lubricate the three holes (for pin guides) in the base of the breathing system.
7. Install the absorber dishes.
8. Install the absorber canisters
9. Cycle the release mechanism several times. Perform the BAG Mode Leak Test after each cycle.
10. Perform the preoperative checkout procedure.

5.4 Dressing leaky seats in bellows pop-off and APL valve

Leaks in the ventilator or bag modes can be caused by faulty seats in the bellows pop-off valve or in the APL valve in the main manifold.

Damaged seats should be replaced to eliminate the leak. If a replacement part is not at hand, minor nicks and scratches can be cleaned up by dressing the seats.



To dress the seats

1. Place a sheet of 600 grit or finer sandpaper on a flat, smooth surface such as a countertop. Tape or hold the sheet in place with one hand.
2. Invert the bellows base or APL manifold onto the sandpaper.
3. Slide the base/manifold across the sandpaper to resurface the seat:
   - Use circular or figure 8 strokes.
   - Use even pressure.
   - Five to ten strokes should be sufficient.
   - The oval/round wall around the seat is the same height as the seat to keep the diaphragm and seat on the same plane.
   - You will be resurfacing the seat and the wall at the same time.
4. Clean up the seat and wall with a soft cloth.
5. Reassemble the valve.
6. Test for leaks.

5.5 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 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 0–15 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	0.5	1.5
3	2.5	3.5
5	4.5	5.5
10	9.0	11.0
maximum (valve fully open)	12.0	-------

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

5.6 Integrated Suction Regulator tests

Note There are two types of integrated suction regulators for the Aestiva Anesthesia Machine:

- Continuous Vacuum (three-mode),
- Venturi (two-mode).

For the Continuous Vacuum Suction Regulator tests a vacuum source of at least 500 mm Hg (67 kPa or 20 in Hg) is required. The supply open flow must be a minimum of 50 L/min.

For the Venturi Vacuum Regulator Suction tests an O_2 or Air source of at least 282 kPa (41 psi) is required.

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 calibration.

Note To check gauge accuracy, be sure that the test gauge is capable of measuring 0–150 mm Hg for standard gauges, or 0–550 mm Hg for high vacuum gauges 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 gauge is in agreement with the vacuum test gauge:
   - ± 10 mm Hg/1.3 kPa for standard vacuum gauges
   - ± 38 mm Hg/5 kPa high vacuum gauges.

Test points for standard vacuum gauges

Test gauge	Suction gauge tolerance
40 mm Hg (5.3 kPa)	30–50 mm Hg (4–6.7 kPa)
80 mm Hg (10.7 kPa)	70–90 mm Hg (9.3–12 kPa)
140 mm Hg (18.7 kPa)	130-150 mm Hg (17.3–20) kPa)

Test points for high vacuum gauges

Test gauge	Suction 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 30 L/min for vacuum suction regulators,
   - at least 20 L/min for venturi suction systems.
4. Disconnect the test flowmeter.

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

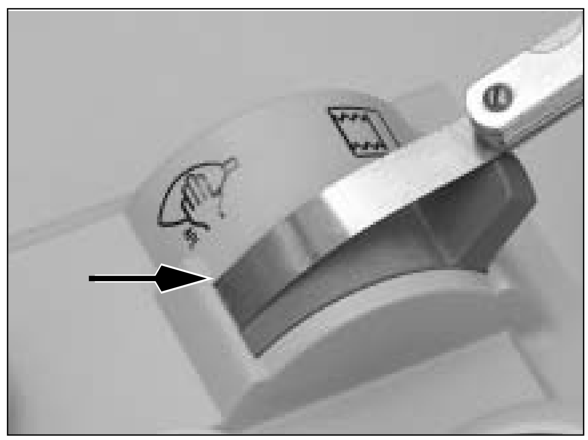
1. Turn the mode selector switch to O (OFF).
2. Rotate the suction control knob a minimum of two full turns in the clockwise direction (increase suction) to ensure its setting is not at the off position.
3. Occlude the patient port of the suction regulator.
4. Observe the suction gauge, the needle should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

5.7 Cleaning and inspecting the bag to ventilator toggle

Leaks between the bag and ventilator circuits may be caused by interference between the toggle and the control panel. This interference can be caused by debris trapped between the Bag to Vent toggle and control panel, buildup from cleaning agents, or wear in the switch parts.

Typically, this interference is found when the toggle is in the ventilator mode. Minor leaks may be reported by the user as a “puffing” breathing bag during mechanical ventilation. Significant leaks will be detected with the “Breathing system tests” portion of the preoperative checkout procedure.

1. Visually inspect the toggle for signs of interference or buildup.
   - Clean or replace as necessary.
2. If there is any indication of interference, check the clearance between the rounded surface of the toggle and the control panel with a 0.05mm (0.002 inch) feeler gauge.



   - Insert the gauge at a corner as shown and test all along the surface to the other corner.
   - Minor interference can be removed with extra fine sandpaper.
   - If the clearance cannot be achieved with light sanding, the toggle should be replaced.

Notes

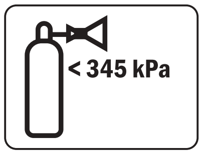
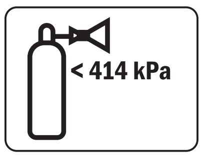
6 Calibration

In this section This section covers calibration procedures for components of the Aestiva Anesthesia Machine.

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

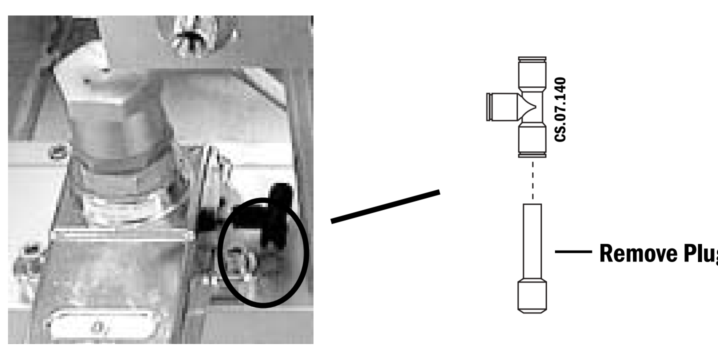
6.1 Primary Regulators

Follow the procedure in Section 6.1.1 to gain access to the regulators. Then, use the charts on the following page to select the test that is appropriate for the regulator you are testing:

	• This label on the rear cover indicates that the primary regulators are set to an output pressure slightly less than 345 kPa (50 psi), which is appropriate for all Pin Indexed cylinder supplies.
	• This label on the rear cover indicates that the primary regulators are set to an output pressure slightly less than 414 kPa (60 psi), which is appropriate for all DIN “Nut and Gland” and DIN High Pressure Hose cylinder supplies.
	• The primary regulators on machines that do not have either of these labels are set to an output pressure slightly less than 669 kPa (97 psi).

6.1.1 Test setup

1. Set the system switch to Standby.
2. Disconnect all accessories from the pneumatic outlet.
3. Remove the rear panel (Section 4.3). Do not reconnect pipeline supplies.
4. If equipped, turn OFF the auxiliary O_2 flowmeter.
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 and connect a test device capable of measuring 689 kPa (100 psi).



⚠ **WARNING** Wear safety glasses while test fixture is connected to this test port.

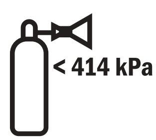
6.1.2 Testing Primary Regulators

There are five variations of the test procedure for the primary regulators. Use the following charts to select the test that is appropriate for the regulator/ pressure combination you are testing.

Chart 1: Diaphragm-style regulators

Diaphragm-Style Regulators	Regulator Setting	Vent Drive? (Gas Supply)	Test to perform
 	<669 kPa (<97 psi) DIN or Pin Indexed	Vent Drive (O_2/Air)	Test A(Page 6-4)
		Not Vent Drive (All gases)	Test B(Page 6-6)
	<414 kPa (<60 psi) DIN 	Vent Drive (O_2/Air)	Test A(Page 6-4)
		Not Vent Drive (All gases)	Test B(Page 6-6)
	<345 kPa (<50 psi) Pin Indexed 	Vent Drive (O_2/Air)	Test A(Page 6-4)
		Not Vent Drive (All gases)	Test B(Page 6-6)

Chart 2: Piston-style regulators

Piston-Style Regulator	Regulator Setting	Vent Drive? (Gas Supply)	Test to perform
	<669 kPa (<97 psi) DIN or Pin Indexed	Vent Drive (O_2/Air)	Test C(Page 6-8)
		Not Vent Drive (N_2O/O_2/Air)	Test D(Page 6-9)
		Not Vent Drive (CO_2/Heliox)	Test E(Page 6-10)
	<414 kPa (<60 psi) DIN 	Vent Drive (O_2/Air)	Test A(Page 6-4)
		Not Vent Drive (All gases)	Test B(Page 6-6)
	<345 kPa (<50 psi) Pin Indexed 	Vent Drive (O_2/Air)	Test A(Page 6-4)
		Not Vent Drive (All gases)	Test B(Page 6-6)

Test A **For primary regulators that supply drive gas to the ventilator (O_2 or Air), except (97) DIN or Pin Indexed piston-style.**

1. Remove the bellows assembly.
2. Slowly open the cylinder valve.
3. Set the system switch to On.
4. Set the fresh gas flow to 0.05 L/min (or minimum flow for O_2).When checking an Air regulator on systems that have a single Air flowtube, open the needle valve 1/8 turn from the minimum stop to achieve a flow close to 0.05 L/min.

5. **For diaphragm-style regulator:**
   - Close the cylinder valve and allow the pressure to decay to 2068 kPa (300 psi) as indicated on the cylinder gauge (upper limit of the red band). The flow may be temporarily increased to facilitate the decay.
   - At the time that the cylinder pressure reaches 2068 kPa (300 psi), set the system switch to Standby.
   - Within one minute, the test device must stabilize between:

     (97) DIN or Pin Indexed 655–669 kPa (95–97 psi)

     (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 6.1.3).

     Slowly open the cylinder valve.

5. **For piston-style regulator:**
   - Set the system switch to Standby.
   - At the end of 5 seconds, the test device should read:

     (60) DIN 372–400 kPa (54–58 psi)

     (50) Pin Indexed 310–341 kPa (45.0–49.5 psi).
   - If not, readjust the regulator (Section 6.1.3).

6. Set the Bag/Vent switch to Bag.
7. Enter the Service Mode: Push and hold the adjustment knob on the ventilator's display and set the system switch to On.
8. Select and confirm "Service Mode(s)."
9. Follow the menu structure outline below to reach the adjustment for the inspiratory flow valve. Select and confirm at each step.

7900	7100
"Flow Valve Test Tool"	"Diagnostics Tests/Tools"
"Set Flow (LPM)"	"Valves - Test Tool"
	"Set Inspiratory Valve"

10. Rotate adjustment knob clockwise to obtain 65 (L/min); confirm.
11. Set the flow control valve to minimum flow.
12. While watching the test device, flip the Bag/Vent switch to Vent for two seconds (return it to Bag after two seconds).The minimum test device reading observed must be greater than:

    (97) DIN or Pin Indexed 414 kPa (60 psi)

    (60) DIN 221 kPa (32 psi)

    (50) Pin Indexed 207 kPa (30 psi)

    Repeat this step three times.

    If the test device reading is less than specified, readjust the regulator per the applicable procedure in Section 6.1.3. However, set the regulated pressure higher by the difference you noted in this step plus 7 kPa (1 psi).

    If the regulator subsequently fails step 5 in this test because the reading is too high, replace the cylinder supply.
13. Set the system switch to Standby.
14. Close the cylinder valve.
15. Bleed the system of all pressure.
16. Disconnect the test device and plug the test port (pull on the plug to ensure it is locked in the fitting).
17. Replace the bellows assembly.
18. Replace the rear panel.
19. Perform the checkout procedure (Section 3).

Test B **For all gases not used to supply drive gas to the ventilator, except (97) DIN or Pin Indexed piston-style.**

1. If the cylinder supply being tested is N_2O, CO_2, or Heliox, connect a source of O_2 and set the O_2 flow control to the minimum stop (pilot pressure for secondary regulator).
2. Slowly open the cylinder valve for the regulator being tested.
3. Set the system switch to On.
4. Set the flow of the gas being tested to 0.05 L/min (or minimum flow for O_2).When checking an Air regulator on systems that have a single Air flowtube, open the needle valve 1/8 turn from the minimum stop to achieve a flow close to 0.05 L/min.

5. **For diaphragm-style regulator:**
   - Close the cylinder valve and allow the pressure to decay to 2068 kPa (300 psi) as indicated on the cylinder gauge (upper limit of the red band). The flow may be temporarily increased to facilitate the decay.
   - At the time that the cylinder pressure reaches 2068 kPa (300 psi), set the system switch to Standby.
   - Within one minute, the test device must stabilize between:

     (97) DIN or Pin Indexed 655–669 kPa (95–97 psi)

     (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 6.1.3).
     - Slowly open the cylinder valve.

5. **For piston-style regulator:**
   - Set the system switch to Standby.
   - At the end of 5 seconds, the test device should read:

     (60) DIN 372–400 kPa (54–58 psi)

     (50) Pin Indexed 310–341 kPa (45.0–49.5 psi).
   - If not, readjust the regulator (Section 6.1.3).

6. Set the system switch to On.
7. Set the flow control valve to the maximum indicated flow on the flow tube.
8. The test device reading must be greater than:

   (97) DIN or Pin Indexed 483 kPa (70 psi)

   (60) DIN 221 kPa (32 psi)

   (50) Pin Indexed 221 kPa (32 psi)

   If the test device reading is less than specified, readjust the regulator per the applicable procedure in Section 6.1.3. However, set the regulated pressure higher by the difference you noted in this step plus 7 kPa (1 psi).

   If the regulator subsequently fails step 5 in this test because the reading is too high, replace the cylinder supply.
9. Set the system switch to Standby.
10. Close the cylinder valve.
11. Bleed the system of all pressure.
12. Disconnect the test device and plug the test port (pull on the plug to ensure it is locked in the fitting).
13. Replace the rear panel.
14. Perform the checkout procedure (Section 3).

Test C **For piston-style primary regulators that supply drive gas to the ventilator (O_2 or Air) set to slightly less than 669 kPa/97 psi.**

1. Remove the bellows assembly.
2. Set the Bag/Vent switch to Bag.
3. Set the flow control to minimum stop.
4. Slowly open the cylinder valve.
5. Enter the Service Mode: Push and hold the adjustment knob on the ventilator's display and set the system switch to On.
6. Select and confirm "Service Mode(s)."
7. Follow the menu structure outline below to reach the adjustment for the inspiratory flow valve. Select and confirm at each step.

7900	7100
"Flow Valve Test Tool"	"Diagnostics Tests/Tools"
"Set Flow (LPM)"	"Valves - Test Tool"
	"Set Inspiratory Valve"

8. Rotate adjustment knob clockwise to obtain the following:
   - **for 7900** set to 120 (L/min); confirm.
   - **for 7100** set to 65 (L/min); confirm.
9. Set the Bag/Vent switch to the Vent position for 1 second, then return the Bag/Vent switch to the Bag position.
10. Within 5 seconds, record the pressure on the test device. The pressure shall not exceed 669 kPa (97 psi).
11. Adjust the flow to 50 mL/min (or to minimum flow for O_2).When checking an Air regulator on systems that have a single Air flowtube, open the needle valve 1/8 turn from the minimum stop to achieve a flow close to 0.05 L/min.
12. Close the cylinder valve and allow the pressure to decay to 2,068 kPa (300 psi) as indicated on the cylinder gauge (upper limit of red band). The flow may be temporarily increased to facilitate the decay.
13. When the cylinder gauge reaches the upper limit of the red band, the test device should read 607 to 669 KPa (88 to 97 psi).

    If the test device reading is less than specified, readjust the regulator per the applicable procedure in Section 6.1.3. However, set the regulated pressure higher by the difference you noted in this step plus 7 kPa (1 psi).

    If the regulator subsequently fails step 10 in this test because the reading is too high, replace the cylinder supply.
14. Reinstall the bellows assembly.
15. Bleed the system.
16. Set the system switch to Standby.
17. Disconnect the test device and plug the test port (pull on the plug to ensure it is locked in the fitting).
18. Replace the rear panel.
19. Perform the checkout procedure (Section 3).

Test D **For piston-style primary regulators that do not supply drive gas to the ventilator (O_2 or Air and N_2O) set to slightly less than 669 kPa/97 psi.**

1. If the cylinder supply being tested is N_2O, connect a source of O_2 and set the O_2 flow control to the minimum stop (pilot pressure for secondary regulator).
2. Slowly open the cylinder valve for the regulator being tested.
3. Set the system switch to On.
4. Adjust the flow of the gas being tested to full scale.
5. Rapidly reduce the flow to minimum flow.
6. Within 5 seconds, record the pressure on the test device. The pressure should not exceed 669 kPa (97 psi).
7. Adjust the flow to 50 mL/min (or to minimum flow for O_2).When checking an Air regulator on systems that have a single Air flowtube, open the needle valve 1/8 turn from the minimum stop to achieve a flow close to 0.05 L/min.
8. Close the cylinder valve and allow the pressure to decay to 2,068 kPa (300 psi) as indicated on the cylinder gauge (upper limit of red band). The flow may be temporarily increased to facilitate the decay.
9. When the cylinder gauge reaches the upper limit of the red band, the test device should read 607 to 669 KPa (88 to 97 psi).

   If the test device reading is less than specified, readjust the regulator per the applicable procedure in Section 6.1.3. However, set the regulated pressure higher by the difference you noted in this step plus 7 kPa (1 psi).

   If the regulator subsequently fails step 6 in this test because the reading is too high, replace the cylinder supply.
10. Bleed the system.
11. Set the system switch to Standby.
12. Disconnect the test device and plug the test port (pull on the plug to ensure it is locked in the fitting).
13. Replace the rear panel.
14. Perform the checkout procedure (Section 3).

Test E **For piston-style primary regulators that supply CO_2 or Heliox set to slightly less than 669 kPa/97 psi.**

1. Connect a source of O_2 and set the O_2 flow control to the minimum stop (pilot pressure for secondary regulator).
2. Slowly open the cylinder valve for the regulator being tested.
3. Set the system switch to On.
4. Adjust the flow of the gas being tested to full scale.
5. Rapidly reduce the flow to minimum flow.
6. After 5 seconds, record the pressure on the test device. The test device should read 607 to 669 KPa (88 to 97 psi).
7. If the regulated gas does not meet the above specifications, adjustment is required (Section 6.1.3).
8. Bleed the system.
9. Set the system switch to Standby.
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).

6.1.3 Adjusting Primary Regulators

Important: Cylinder supplies in an Aestiva machine must have all primary regulators set to the same pressure. If a regulator is replaced, the replacement regulator must be set (as required) to the same pressure 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.

If the cylinder supply being adjusted is N_2O, CO_2, or Heliox, connect a source of O_2 and set the O_2 flow control to the minimum stop (pilot pressure for secondary regulator).

To adjust the primary regulators, follow the procedure in Section 6.1.1 to gain access to the regulators. Then, select the procedure in this section that is appropriate for the regulator you are adjusting:

Procedure A (Page 6-12)

For all diaphragm-style regulators

Procedure B (Page 6-13)

For Piston-style regulators set to slightly less than:

(60) DIN 400 kPa (58 psi).

(50) Pin Indexed 341 kPa (49.5 psi).

Procedure C(Page 6-14)

For Piston-style regulators set to slightly less than:

(97) DIN or Pin Indexed 669 kPa (97 psi).

Procedure A **For all diaphragm-style regulators**

Do not attempt to adjust without flow.

1. Slowly open the cylinder valve.
2. Set the system switch to On.
3. Set and maintain the fresh gas flow of the gas being tested to 0.05 L/min (or minimum flow for O_2). When adjusting an Air or Heliox regulator on systems that have a single flowtube, open the needle valve 1/8 turn from the minimum stop to achieve a flow close to 0.05 L/min.
4. Close the cylinder valve and allow the pressure to decay to 2068 kPa (300 psi) as indicated on the cylinder gauge (upper limit of the red band). The flow may be temporarily increased to facilitate the decay.

5. When the cylinder gauge reaches the upper limit of the red band, adjust the regulator output pressure to:

   (97) DIN or Pin Indexed 655–669 kPa (95–97 psi)

   (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 4 and 5 a number of times to achieve the above setting.

6. Test the regulator settings per the appropriate test in Section 6.1.2:
   - **Test A (Page 6-4)**For primary regulators that supply drive gas to the ventilator (O_2 and Air).
   - **Test B (Page 6-6)**For all gases not used to supply drive gas to the ventilator.

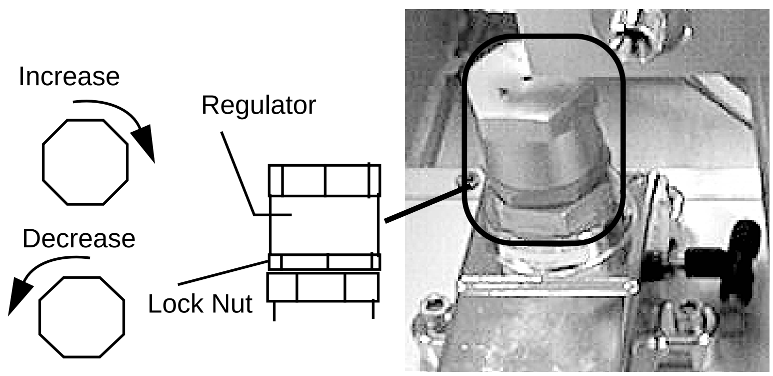
Procedure B **For Piston-style regulators set to slightly less than:**

- **(60) DIN** 400 kPa (58 psi).
- **(50) Pin Indexed** 341 kPa (49.5 psi).

⚠ **WARNING:** Piston-style regulators set to approximately 669 kPa (97 psi) should not be readjusted to a lower setting per this procedure without internal modification to the regulator and new user documentation. Contact Technical Support for details.

Do not attempt to adjust without flow.

1. Slowly open the cylinder valve.
2. Set the system switch to On.
3. Loosen the regulator adjustment lock nut (turn it clockwise as viewed from top).



4. Set and maintain the fresh gas flow to 0.05 L/min (or minimum flow for O_2). When adjusting an Air or Heliox regulator on systems that have a single flowtube, open the needle valve 1/8 turn from the minimum stop to achieve a flow close to 0.05 L/min.
5. Adjust the regulator output pressure to:

   (60) DIN 386–400 kPa (56–58 psi)

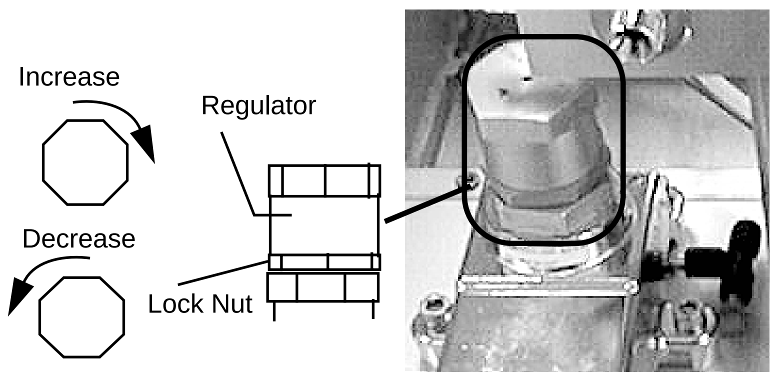
   (50) Pin Indexed 327–341 kPa (47.5–49.5 psi).
6. Tighten the regulator adjustment lock nut.
7. Confirm the setting in Step 5.
8. Test the regulator settings per the appropriate test in Section 6.1.2:
   - **Test A (Page 6-4)**For primary regulators that supply drive gas to the ventilator (O_2 and Air).
   - **Test B (Page 6-6)**For all gases not used to supply drive gas to the ventilator.

Procedure C **For Piston-style regulators set to slightly less than:**
- **(97) DIN or Pin Indexed** 669 kPa (97 psi).

Keep the following in mind as you adjust the regulator.

- Mark the regulator cap as a reference for adjustment.
- **Make adjustments only under flow conditions** (adjust flow to mid scale).
- Make adjustments in increasing steps (clockwise).
- If you overshoot a reading, decrease the adjustment cap one revolution (counterclockwise) so that adjustments are made while increasing the pressure setting.

1. Slowly open the cylinder valve.
2. Set the system switch to Standby.
3. Loosen the regulator adjustment lock nut (turn it clockwise as viewed from top).



4. Set the system switch to On.
5. Adjust the flow to 50 mL/min (or to minimum flow for O_2)When checking an Air regulator on systems that have a single Air flowtube, open the needle valve 1/8 turn from the minimum stop to achieve a flow close to 0.05 L/ min.
6. Close the cylinder valve and allow the pressure to decay to 2,068 kPa (300 psi) as indicated on the cylinder gauge (upper limit of red band). The flow may be temporarily increased to facilitate the decay.

   Note: If the current regulator output pressure it too high, decrease the adjustment cap one revolution (counterclockwise) and make adjustments by increasing the pressure setting.

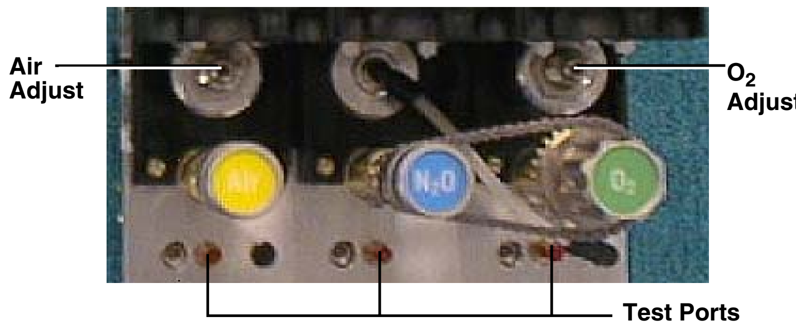
   - If this is an initial adjustment, adjust the regulator output pressure so that the test device reads 620–634 kPa (90–92 psi) when the cylinder gauge reaches the upper limit of the red band.
   - If this is a readjustment (the regulator is out of range as determined by the applicable test in step 8), increment the regulator setting within the range of 607–669 kPa (88–97 psi) and repeat the test.

7. Set the system switch to Standby.
8. Test the regulator settings per the appropriate test in Section 6.1.2:
   - **Test C (Page 6-8)**For piston-style primary regulators that supply drive gas to the ventilator (O_2 or Air) set to slightly less than 669 kPa/97 psi.
   - **Test D (Page 6-9)**For piston-style primary regulators that do not supply drive gas to the ventilator (O_2 or Air and N_2O) set to slightly less than 669 kPa/97 psi.
   - **Test E (Page 6-10)**For piston-style primary regulators that supply CO_2 or Heliox set to slightly less than 669 kPa/97 psi.
9. Repeat steps 3 through 7 until the regulated pressure readings are within specification.
10. Tighten the lock nut and verify the reading.

6.2 Secondary Regulators

6.2.1 Testing/Adjusting Secondary Regulators or Balance Regulators

1. Set the system switch to Standby.
2. Remove the flowmeter panel shield (Section 4.9.1).
3. Remove the plug from the test port and connect a test device capable of measuring 689 kPa (100 psi) using 1/8-inch nylon tubing.



4. Set the flow of the tested gas and of O_2 as detailed in the chart.
5. Verify that the output of the tested regulator is within the range listed in the chart.

Regulator	Output	Flow Regulated gas	Flow O_2
O_2	207 ±7 kPa(30 ±1 psi)	2 L/min	---------
Air	207 ±7 kPa(30 ±1 psi)	2 L/min	---------
N_2O	± 14 kPa (±2 psi) of O_2 reading	10 L/min	4 L/min
CO_2	117–138 kPa(17–20 psi)	0.5 L/min	2 L/min
Heliox	117–138 kPa(17–20 psi)	15 L/min	2 L/min

6. If required, adjust the O_2 and Air regulators to meet the above specifications. The other regulators are not adjustable.

   Note: The adjustment screws for these regulators are self-locking.
7. Disconnect the test device and plug the test port (pull on the plug to ensure it is locked in the fitting).
8. Perform the Flow Control Tests (Section 3.6).

6.3 Needle Valve Calibration

6.3.1 Summary

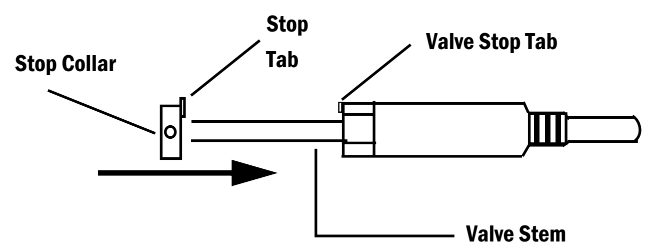
You need to calibrate a needle valve:

- if you install a new one,
- if minimum and maximum flows are not within specifications.

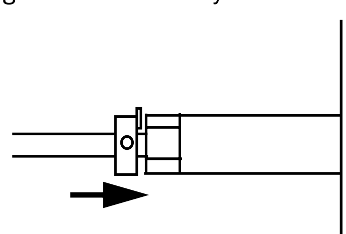
6.3.2 O_2 Needle Valve Calibration (Minimum Flow)

⚠ **CAUTION:** Do not force the needle valve against the seat. Overtightening the valve can cause the minimum flow setting to drift out of specifications.

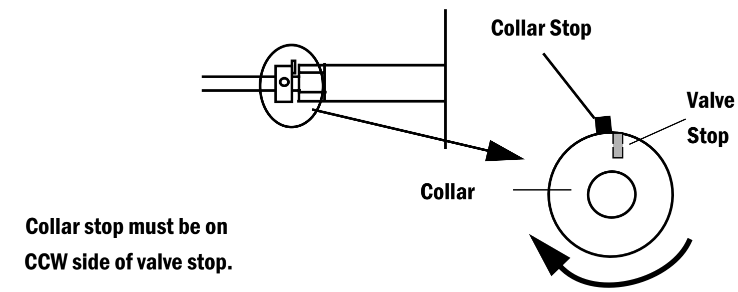
1. Set the system switch to Standby.
2. Remove the flowmeter panel shield (Section 4.9.1).
3. Slide a stop collar onto the valve stem with the stop tab toward the valve. Do not tighten setscrews.



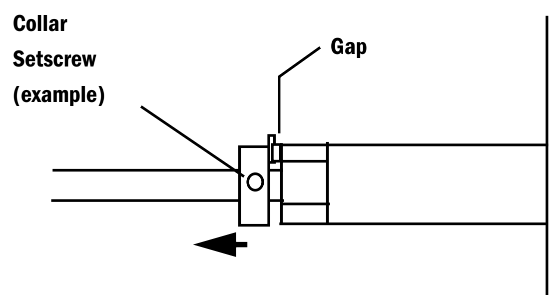
4. Set the system switch to On.
5. Adjust the O_2 needle valve to maintain a flow of 50 mL/min ±25 mL/min.
6. Push the stop collar against the valve body.



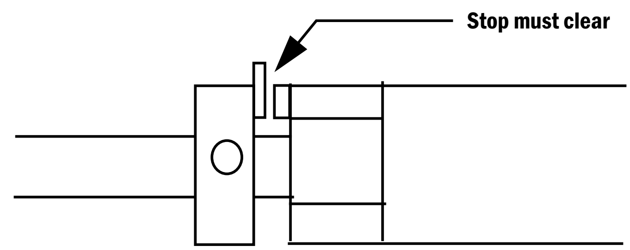
7. Turn the collar clockwise until the collar stop tab contacts the minimum stop tab on the valve body. *Do not turn the valve stem*.



8. Carefully pull the collar back so there is a slight gap between collar and the valve body (but still engages the valve stop).



9. Tighten the collar setscrews. Start with the one opposite the tab if possible.
10. Turn the valve stem counterclockwise at least one revolution to make sure the collar tab clears the valve stop.



If the stop does not clear:

a. Turn the valve stem back to minimum position.
b. Loosen the collar setscrews.
c. Repeat steps 9 through 11.

11. Turn the valve stem clockwise to the minimum stop.
12. Verify that the flow is within the 50 mL/min ±25 mL/min range.
13. Set the maximum stop collar if necessary (Section 6.3.5).

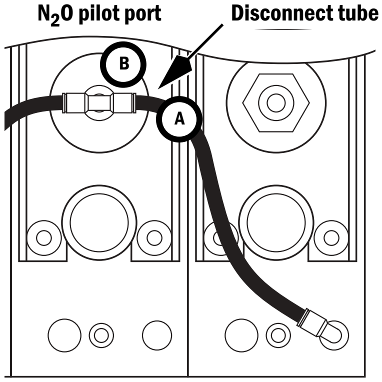
    Note: Maximum stop collars are required in Canada for all gas flow controls. In other areas, maximum stop collars are required for CO_2 and Heliox.

14. Calibrate the Link proportioning system (Section 6.4).

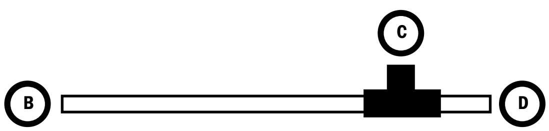
6.3.3 N_2O, CO_2, and Heliox Needle Valve Calibration (Minimum Flow)

⚠ WARNING You must be in a well ventilated room or use a gas evacuation device at this time. Anesthetic vapors exhausted into the room air can be harmful to your health.

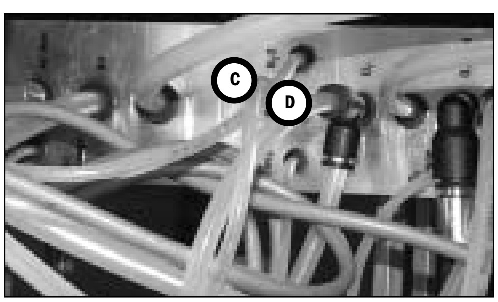
⚠ CAUTION: Do not force the needle valve against the seat. Overtightening the valve can cause the minimum flow setting to drift out of specifications.



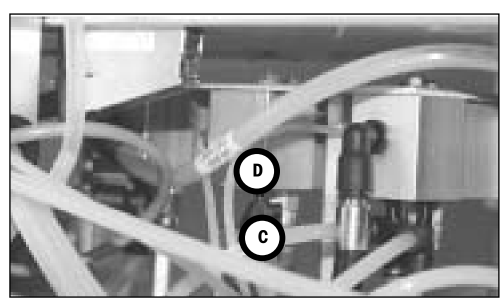
1. Disconnect all pipeline supplies and close all cylinder valves.
2. Remove the flowmeter panel shield (Section 4.9.1).
3. Remove the panel under the vaporizer manifold (2 or 3 screws).
4. Disconnect the tube (**A**) from the pilot port (**B**) on the N_2O regulator.
5. Disconnect a N2O supply tube (**C**) from the manifold outlet (**D**).
6. Using a 4-mm tube/tee fixture (see Service Tools - Section 8.1.1), connect the shorter tube (**D**) to the N_2O supply at the manifold. Connect the longer tube (**B**) to the N_2O pilot port. Connect the tube removed from the N_2O supply port to the open connection (**C**) on the tee connector of the fixture. This setup will pilot all pressure balancing regulators (N_2O, CO_2, and Heliox) during the minimum stop calibration.



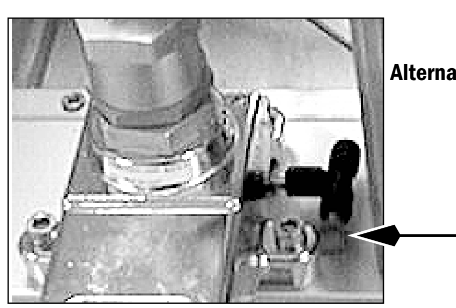
Pneumatic manifold



Individual pipeline inlets



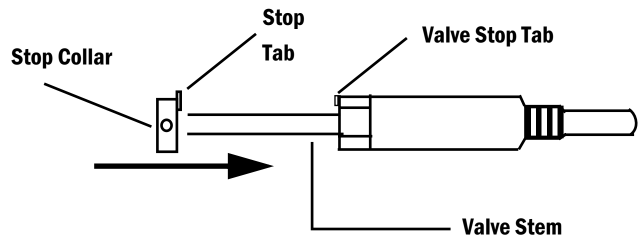
Note: As an alternate source of pilot pressure, you can connect a length of 4-mm tubing from the N_2O primary regulator test port tee to the N_2O pilot port. For this setup, you will have to remove the rear panel (Section 4.2).



Alternate source for pilot pressure

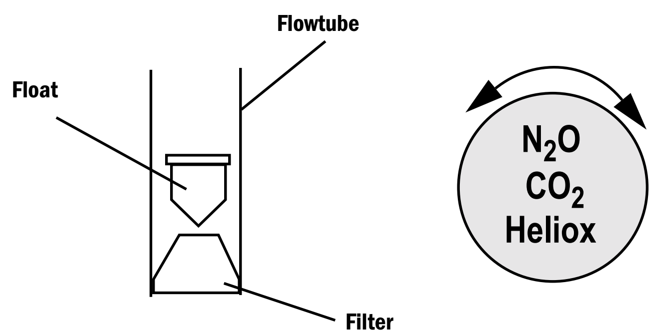
N_2O cylinder supply

7. Slide a stop collar onto the valve stem with the stop tab toward the valve. Do not tighten setscrews.

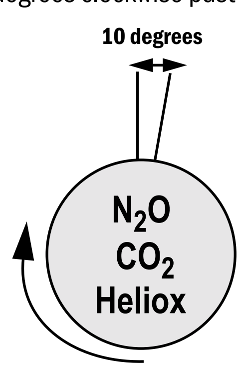


8. Connect either an N_2O pipeline or cylinder supply.
9. Slowly open the N_2O cylinder valve. (When calibrating CO_2 or Heliox, also open the respective gas cylinder valve.)

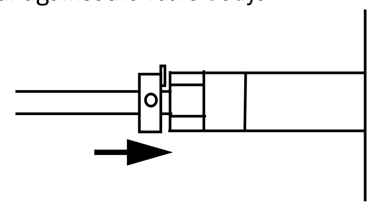
   Important: Do not connect the O_2 pipeline or open the O_2 cylinder valve.
10. Adjust the needle valve until the float is nearly touching the filter, but not quite.



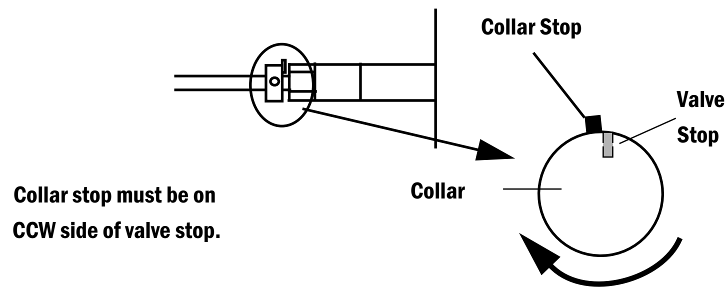
11. Disconnect the tubing from the inlet of the vaporizer manifold (left end of manifold).
12. If the machine has an air option, bleed down the air supply. Air can inflate the bubble (next step) if it is not shut off.
13. Apply a small amount of leak detection fluid (Snoop) to the end of the tube to form a bubble.
14. Turn the valve stem clockwise until the bubble no longer inflates. Do not turn more than 10 degrees clockwise past this point.



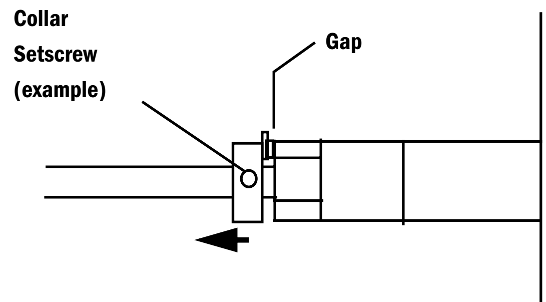
15. Push the stop collar against the valve body.



16. Turn the collar clockwise until the collar stop tab contacts the minimum stop tab on the valve body. *Do not turn the valve stem*.

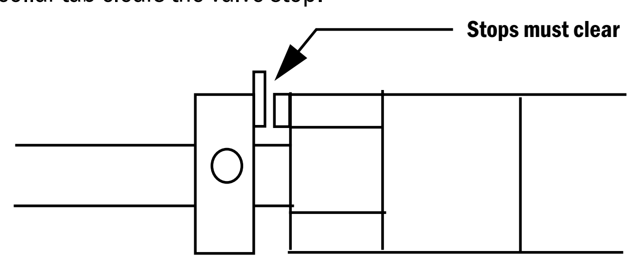


17. Carefully pull the collar back so there is a slight gap between collar and the valve body (but still engages the valve stop).



18. Tighten the collar setscrews. Start with the one opposite the tab if possible.

19. Turn the valve stem counterclockwise at least one revolution to make sure the collar tab clears the valve stop.



If the stops do not clear:

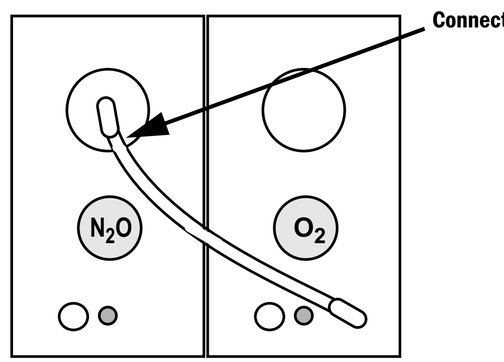
a. Turn the valve stem back to minimum position.

b. Loosen the collar setscrews.

c. Repeat steps 15 through17.

20. Turn the valve clockwise to the minimum stop.
21. Verify there is no flow at the end of the tube.
22. To calibrate minimum flow for CO_2 or Heliox, repeat steps 6 through 20.
23. Thoroughly clean the end of the nylon tube and reconnect it to the vaporizer manifold inlet.
24. Set the maximum stop collar if necessary (Section 6.3.5).

    Note: Maximum stop collars are required in Canada for all gas needle valves. In other areas, maximum stop collars are required for CO_2 and Heliox.
25. After calibrating minimum flow for all gases that include a pressure balancing regulator:
    a. Close the cylinder valve(s) and use the needle valve to bleed the remaining gas(es).
    b. Remove the nylon tube connecting the N_2O gas supply to pressure balance regulator pilot port.
    c. Reconnect the pilot tube to the N_2O pilot port. Pull on the tubing to ensure it is locked into the fitting.



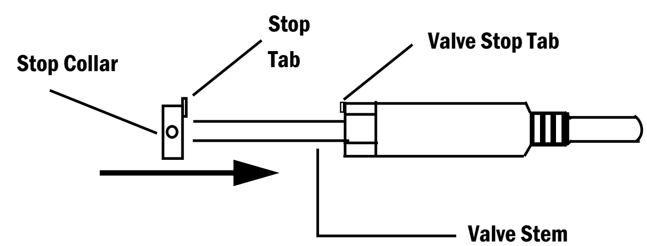
    d. Replace the plug for the test port tee at the N_2O gas supply regulator.
26. **For N_2O**, calibrate the Link proportioning system (Section 6.4).

    For CO_2 and Heliox, set the knob so that at minimum flow the label text is horizontal and the knob is on an even plane with the N_2O and O_2 knobs.
27. Replace the flowmeter panel shield and the vaporizer manifold panel.

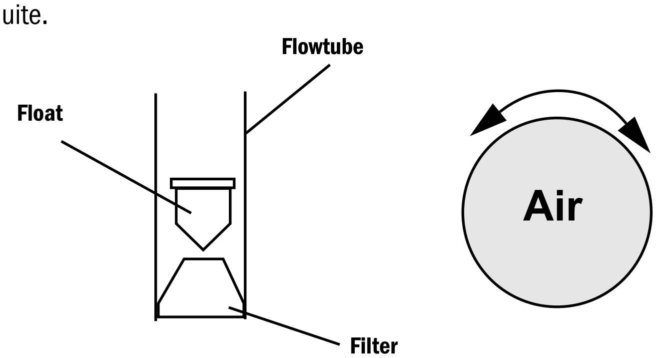
6.3.4 Air Needle Valve Calibration (Minimum Flow)

⚠ **CAUTION:** Do not force the needle valve against the seat. Overtightening the valve can cause the minimum flow setting to drift out of specifications.

1. Set the system switch to Standby.
2. Disconnect all pipeline hoses and close all cylinder valves except for air.
3. Remove the flowmeter panel shield (Section 4.9.1).
4. Remove the panel below the vaporizer manifold.
5. Slide a stop collar onto the valve stem with the stop tab toward the valve. Do not tighten setscrews.

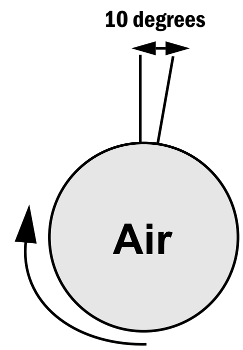


6. Set the system switch to On.
7. Adjust the needle valve until the float is nearly touching the filter, but not quite.

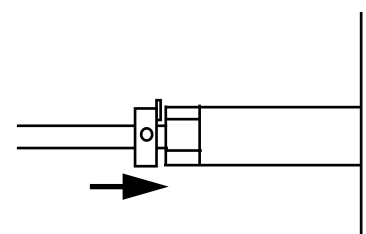


8. Disconnect the tubing from the inlet to the vaporizer manifold (left end of manifold).
9. Apply a small amount of leak detection fluid (Snoop) to the end of the tube to form a bubble.

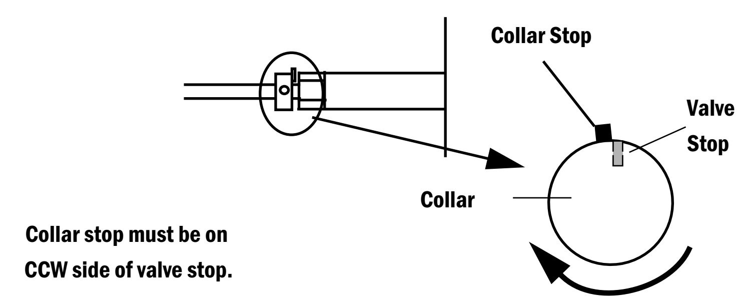
10. Turn the needle valve clockwise until the bubble no longer inflates. Do not turn more than 10 degrees clockwise past this point.



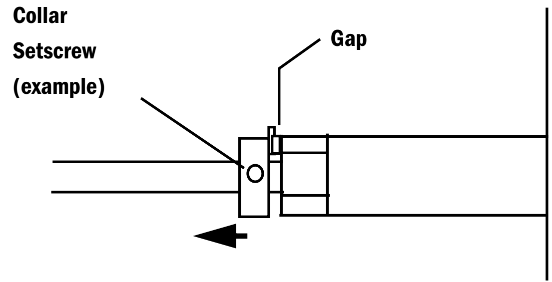
11. Push the stop collar against the valve body.



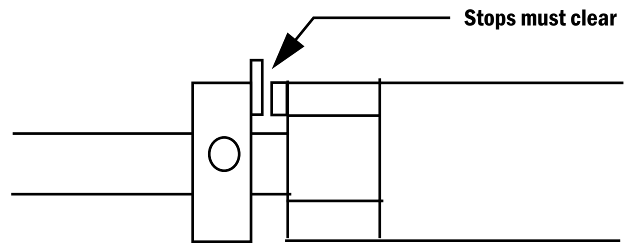
12. Turn the collar clockwise until the collar stop tab contacts the minimum stop tab on the valve body. *Do not turn the valve stem.*



13. Carefully pull the collar back so there is a slight gap between collar and the valve body (but still engages the valve stop).



14. Tighten the collar setscrews. Start with the one opposite the tab if possible.
15. Turn the valve stem counterclockwise at least one revolution to make sure the collar tab clears the valve stop.



If stops do not clear:

a. Turn the valve stem back to minimum position.
b. Loosen the collar setscrews.
c. Repeat steps 13 through 15.

16. Turn the valve stem clockwise to the minimum stop.
17. Verify there is no flow at the end of the tube.
18. If you will not be calibrating another non-oxygen valve, thoroughly clean the end of the nylon tube and reconnect it to the vaporizer manifold inlet.
19. Set the maximum stop collar if necessary (Section 6.3.5).

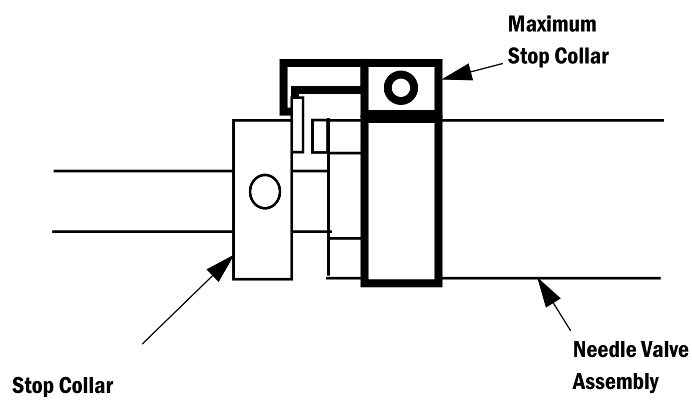
    Note: Maximum stop collars are required in Canada for all gas needle valves. In other areas, maximum stop collars are required for CO_2 and Heliox.

20. Set the knob so that at minimum flow the label text is horizontal and the knob is on an even plane with the N_2O and O_2 knobs.
21. Replace the flowmeter panel shield and the vaporizer manifold panel.

6.3.5 Needle Valve Calibration (Maximum Flow)

Note: Maximum stop collars are required for CO_2 and Heliox.

1. Calibrate the needle valve for minimum flow:
   - **Section 6.3.2** for O_2
   - **Section 6.3.3** for N_2O, CO_2 and Heliox
   - **Section 6.3.4** for Air
2. Turn the valve open 1/2 turn beyond the maximum indicated flow.
3. Position the maximum stop collar so that its hook contacts the stop collar tab on the counterclockwise side. The hook and tab should have overlapping contact of about 0.75 mm (about half the thickness of the stop collar tab).



   Note: This illustration shows the maximum stop collar in a vertical position. The actual position of the maximum stop collar may vary for each needle valve.

4. Tighten the setscrew on the maximum stop collar.
5. Turn the valve one full turn clockwise to make sure the hook does not contact the stop collar tab. If there is contact, move the maximum stop collar slightly forward.
6. Verify that you can turn the valve open 1/2 turn beyond the maximum indicated flow.
7. Turn the valve fully clockwise to the minimum stop.

6.4 Link system calibration

Before you start, make sure that:

- All parts are correctly installed.
- Stops on needle valves are set correctly.
- The machine meets leak check requirements.
- Confirm that the O_2 sensor measures 21% in room air and 100% in pure O_2. If not, calibrate the O_2 sensor.

⚠ **WARNING** You must be in a well ventilated room or use a gas evacuation device at this time. Anesthetic vapors exhausted into the room air can be harmful to your health.

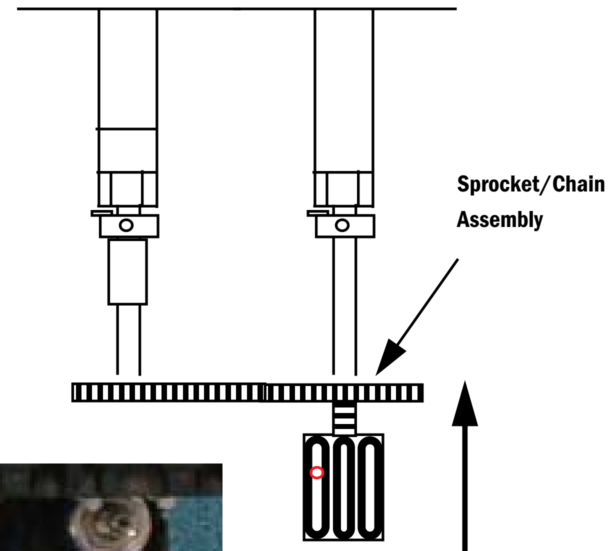
1. Set the system switch to Standby.
2. Remove the flowmeter panel shield (Section 4.9.1).
3. Put the plastic spacer on the N_2O needle valve spindle.
4. Turn the O_2 and the N_2O needle valves clockwise to their minimum stop position.

Spacer

5. Put the chain onto the O_2 knob/sprocket assembly and the N_2O sprocket.

   Note: The N_2O sprocket set screws should be away from the valve.

6. Install the chain and sprockets onto the needle valve stems as an assembly. Press the O_2 knob/sprocket against the O_2 minimum stop collar.

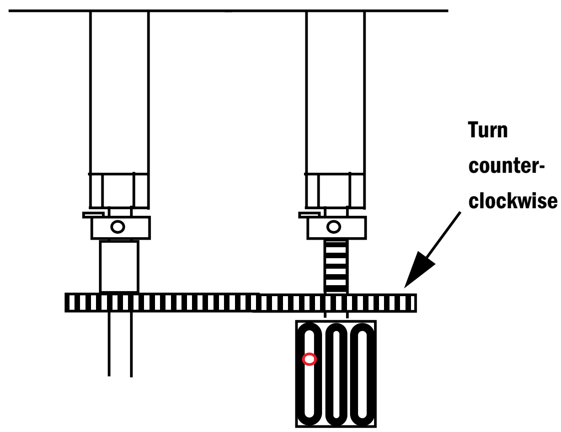


7. Tighten the setscrews in the O_2 knob. Do not tighten the N_2O sprocket setscrews.

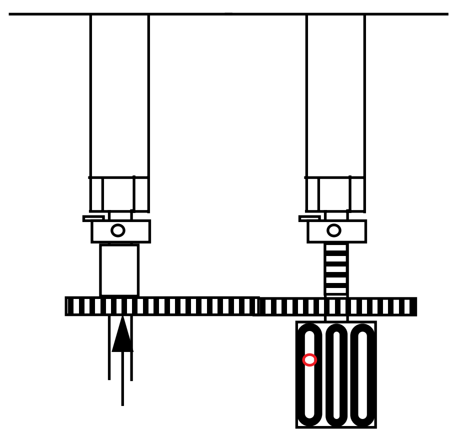
   Note: If O_2 label is on the knob, turn the knob so that the identification label is horizontal before tightening the setscrews.

8. Turn on the O_2 and the N_2O gas supplies (pipeline or cylinder).
9. Set the system switch to On.
10. Adjust the needle valves:
    - **O_2 needle valve:** 200 ±10 mL/min.
    - **N_2O needle valve:** 600 ±25 mL/min.

11. Turn the sprocket on the O_2 knob sprocket assembly counterclockwise until it stops against the tab on the O_2 knob. Do not allow the N_2O or O_2 valve stems to rotate.

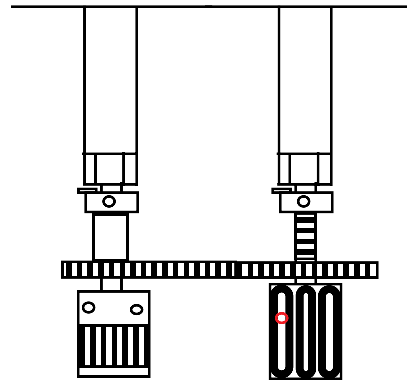


12. Push the N_2O sprocket against the plastic spacer.



13. Holding the O_2 knob, rotate the N_2O sprocket counterclockwise until all slack is removed from the chain.
14. Lightly tighten both N_2O sprocket setscrews.
15. Turn the N_2O needle valve clockwise to the minimum stop position.

16. Install the N_2O knob. Turn the knob so that the identification label is horizontal before tightening the setscrews.



17. Turn the N_2O needle valve counterclockwise, and check that the oxygen flow increases as N_2O flow increases.
18. Turn the O_2 needle valve clockwise, and check that the N_2O flow decreases as O_2 decreases.
19. Check the proportioning system concentration (increasing N_2O flow). Observe the following precautions:
    - Start with both valves at the minimum setting.
    - Adjust only the N_2O needle valve.
    - Increase the N_2O flow as specified in the table below and make sure the O_2 concentration is in the allowed range.

    Note: Allow the O_2 monitor to stabilize. At the lower flows, the O_2 monitor may take up to 90 seconds to stabilize.

    - If you overshoot a setting, turn the O_2 needle valve clockwise until the N_2O flow decreases to the previous setting before continuing the test.

Set the N_2O flow (L/min)	Measured O_2
0.8	22% to 29%
1	22% to 29%
3	22% to 29%
6	22% to 29%
9	22% to 29%

20. Check the proportioning system concentration (decreasing O_2 flow). Observe the following precautions:

    - Turn the N_2O needle valve to the maximum setting.
    - Adjust only the O_2 needle valve.
    - Decrease the O_2 flow as specified in the table and make sure the O_2 concentration is in the allowed range.

    Note: Allow the O_2 monitor to stabilize. At the lower flows, the O_2 monitor may take up to 90 seconds to stabilize.

    - If you overshoot a setting, turn the N_2O needle valve counterclockwise until the O_2 flow increases to the previous setting before continuing the test.

Set the O_2 flow (L/min)	Measured O_2
3	22% to 29%
2	22% to 29%
1	22% to 29%
0.3	22% to 29%

If both tests meet the criteria, calibration is complete (go to the next step). If either test fails to meet the criteria, return to step 10 and adjust N_2O to a lower or higher setting.**Note:** Adjusting the regulator pressure is not

If:	Then:
Concentration Low	Decrease N_2O
Concentration High	Increase N_2O

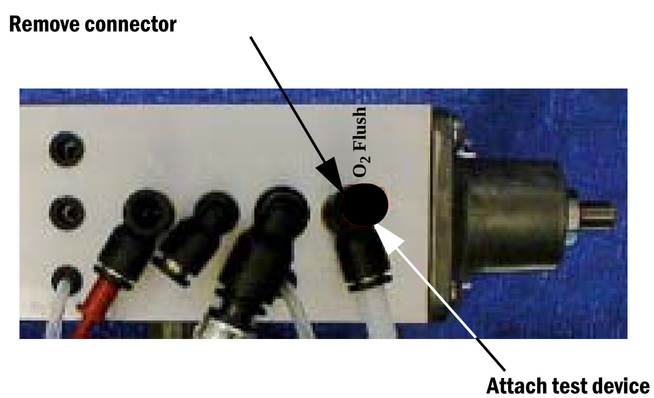
recommended. It has little effect on proportioning. If you have difficulty proportioning the system, you may need to replace either or both needle valves.

21. Tighten N_2O sprocket setscrews.
22. Set the system switch to Standby.
23. Turn off the O_2 and the N_2O gas supplies.
24. Check that all setscrews are tight.
25. Adjust all needle valves to minimum stop position.
26. Install flowmeter panel shield.

6.5 O_2 Flush Regulator

1. Bleed all gas pressure for the machine (Section 4.2).
2. Ensure that all cylinder and pipeline gauges read zero before proceeding.
3. Remove the rear panel (Section 4.3).
4. Remove the panel below the vaporizer manifold (2 or 3 screws).
5. Remove the connector from the O_2 Flush port. Attach a test device to the open port.

Note The flush regulator must be checked or adjusted with no flow.

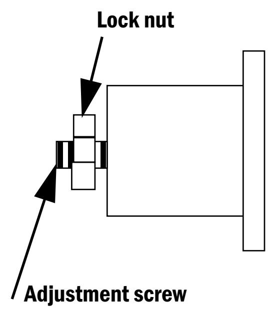


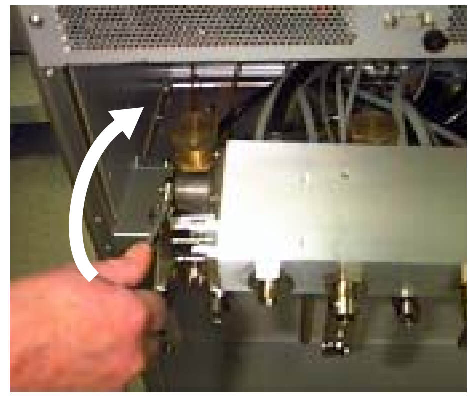
6. Connect an O_2 pipeline supply or slowly open the O_2 cylinder valve.
7. Read the pressure shown on the test device.

   The pressure should be 131 +0/-7 kPa (19 +0/-1.0 psi).

   If not, continue with the calibration on the next page.

8. If the pressure is not 131 +0/-7 kPa (19 +0/-1.0 psi),
   a. Loosen the adjustment screw's jam nut.
   b. Adjust the regulator (in small steps) to the above specification. If you overshoot the reading, bleed the pressure and repeat adjustment.
   c. Tighten the lock nut.
   d. Verify the reading.



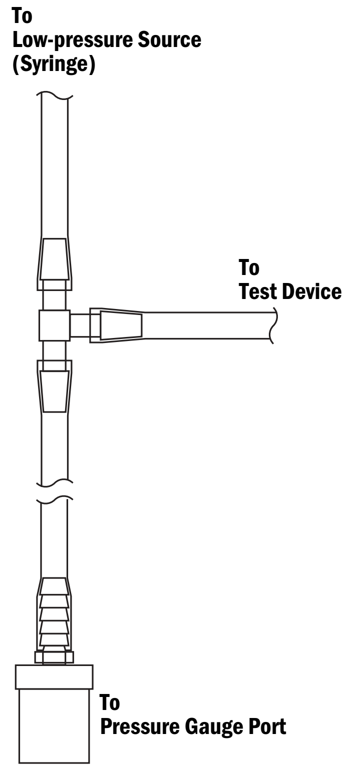


9. Disconnect the test device. Reattach the connector/tubing to the O_2 Flush port.
10. Replace the rear panel and the panel below the vaporizer manifold.

6.6 Zero the pressure gauge

1. Attach a patient circuit to the Breathing System. Leave the patient end open.
2. Set the Bag/Vent switch to Bag.
3. Adjust the APL valve to maximum.
4. Rotate the pressure gauge so that the indicator tabs align.
5. Insert a 2.5-mm hex wrench through the angled access hole in the control panel.
6. Adjust the pressure gauge to zero.
7. Plug the patient circuit.
8. Press and release the O_2 flush button to sweep the needle across the pressure gauge.
9. Remove the plug from the patient circuit to relieve the pressure in the circuit and recheck the zero setting of the pressure gauge.
10. If required, repeat zero and span procedure.

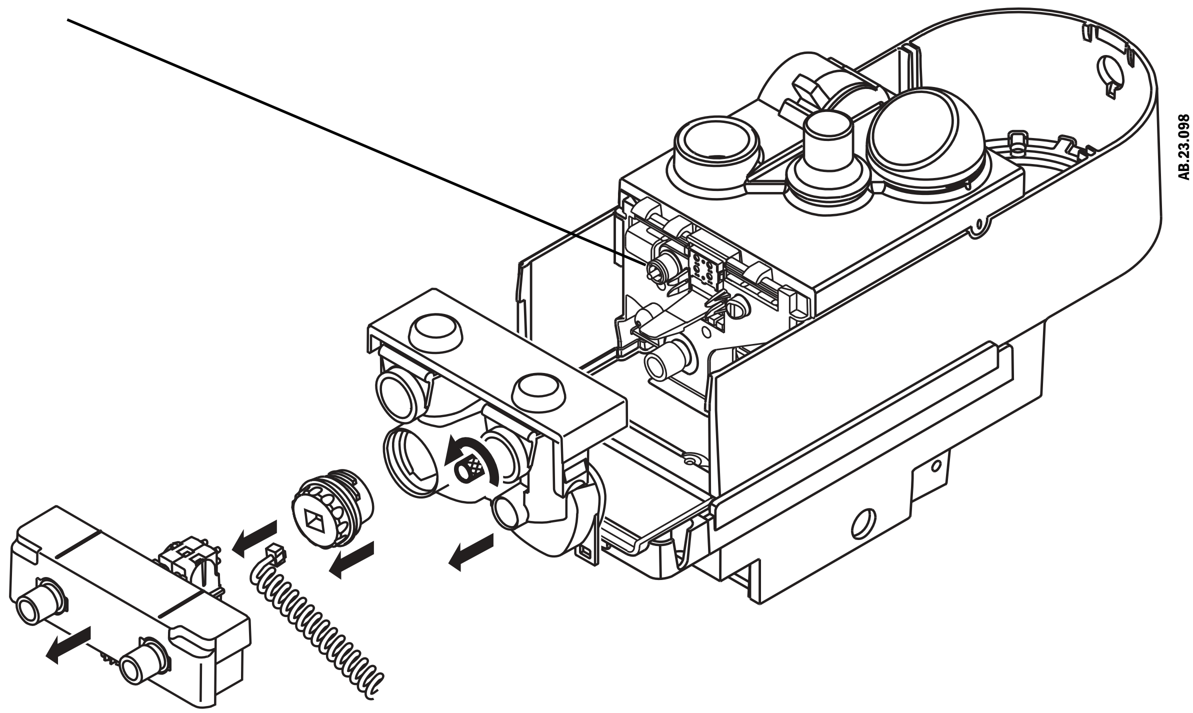
6.6.1 Checking the pressure gauge accuracy



The accuracy of the absorber airway pressure gauge can be checked by using a low-pressure test device (digital manometer or test gauge), a low-pressure supply source (typically a syringe) and an airway pressure gauge test adapter.

1. Ensure that the pressure gauge is zeroed (Section 6.6).
2. Connect a low-pressure supply source (syringe) to one of the open tubes of the test adapter.
3. Connect the test adapter plug to the pressure gauge port on the absorber bulkhead (the port with an o-ring on it).
4. Connect a low-pressure test device to the remaining open tube of the test adapter.
5. Adjust the pressure source to the following pressures as read on the test device. The airway pressure gauge should read within the values indicated.

Test Device	Aestiva Airway Pressure Gauge
0 cm H_2O	0 ±1 cm H_2O
40 cm H_2O	40 ±1 cm H_2O
-5 cm H_2O	-5 ±3 cm H_2O

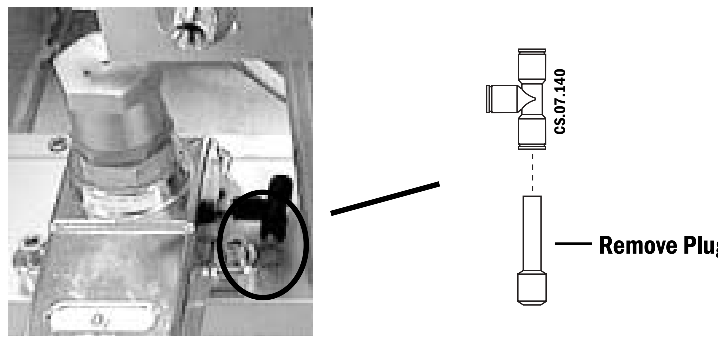


6.7 O_2 Supply Failure Alarm — Induction

The Induction machine includes a pneumatic alarm assembly that taps into the O_2 supply at the pneumatic manifold.

1. Remove the rear panel (Section 4.3).
2. Attach a gauge to the O_2 primary regulator test port.(On pipeline only machines, attach the gauge to a plugged 6-mm O_2 port at the front of the pneumatic manifold shown at left.)

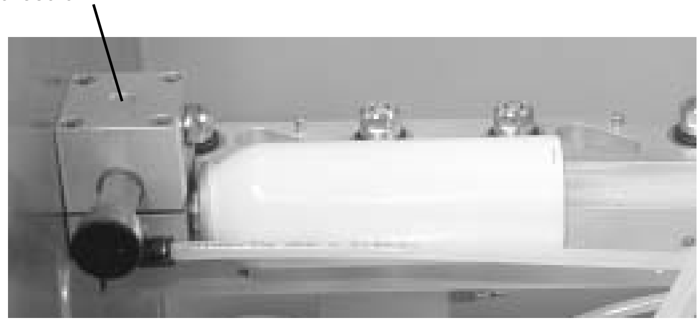
For pipeline only, attach gauge to plugged 6-mm O_2 port.



3. Adjust the O_2 flow control to minimum flow (clockwise).
4. Install an O_2 cylinder and open the cylinder valve (for pipeline only, connect O_2 pipeline source).
5. Turn the system on.
6. Close the cylinder valve (disconnect pipeline from source) and watch the test gauge as the O_2 pressure bleeds down slowly.

   Note: The "O_2 Supply Failure" alarm should sound for at least seven seconds between descending pressure of 234–267 kPa (39–34 psi).
7. If adjustment is required, set the adjustment screw so that the "O_2 Supply Failure" alarm sounds at 248 ±7 kPa (36 ±1 psi).

Adjustment Screw



8. Disconnect the gauge and plug the test port
9. To reassemble, perform the previous steps in reverse order.
10. Perform the checkout procedure (Section 3).

7 Troubleshooting

In this section This section covers the troubleshooting procedures for the Aestiva pneumatic systems. For troubleshooting electrical systems, refer to the appropriate Aestiva Ventilator service manual.

7.1 General Troubleshooting

⚠ **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.

Problem	**Possible Cause**	**Action**
High Pressure Leak	O_2 power outlet leak	Use a leak detector or Snoop to check for source of 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 gauges	Use a leak detector or Snoop to check for source of leak. Replace gauge 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(with vaporizer mounted)	Vaporizer not installed properly	Reseat vaporizer if not installed properly. Have vaporizer serviced at vaporizer center if vaporizer leaks.
	Missing or damaged o-ring on vaporizer manifold	Check condition of o-ring. Replace if missing or damaged.
	Loose fill port	Check fill port. Tighten if loose.
Low Pressure Leak (with or without vaporizer)	Leaking port valve on vaporizer manifold	Use the Vaporizer Manifold Valve Tester to check for leak. See Section 4.10.2 for instructions. If test fails, tighten, repair, or replace as needed.
	Leaking relief valve on vaporizer manifold	Remove relief valve. Occlude opening. Perform leak test. If test passes, replace valve.
	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.

Problem	Possible Cause	Action
Low Pressure Leak (with or without vaporizer) — continued —	Leak at flowmeter head	If vaporizer manifold passed previous tests: Remove tubing from input side of head and occlude port. Perform leak test. If test fails: • Check for damaged o-rings between flowmeter modules. Replace as needed. • Check for damaged o-rings at top and bottom of flow tubes. Replace as needed. • Check for cracked flow tube. Replace as needed.
		If secondary regulator leaks, replace the complete module.
		Note: An alternate method is to pressurize the system and use a leak detector or Snoop to check for source of leak.
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 drain open	Close drain.
	Absorber canisters open	Close canisters.
	Soda lime dust on canister seals	Clean three seals and mating surfaces.
	Patient circuit gas sample port open	Cap/plug the port.
	Misaligned absorber canisters	Open canisters, realign, close Check for latest version of top dish and main manifold seals. Follow Breathing System Troubleshooting Flowcharts (Section 7.2.2).
Breathing System Leak (Intermittent)	Misaligned absorber canisters	Check for latest version of top dish and main manifold seals.
	Main manifold seals open due to negative pressure from gas monitor or patient	Replace seals with newer version.
	ACGO O_2 sense check valve	Replace.
N_2O flow does not decrease with O_2 flow	Defective pilot regulator	Check pilot regulator. Replace if needed.
Unit displays low O_2 pressure with pipeline but not with cylinders	Low O_2 supply switch	Check switch. Calibrate or replace as appropriate.
Unable to begin mechanical ventilation	Absorber open	Close canister, or attach bypass device.
	Absorber top panel open	Close panel.
	No O_2 supply	Check O_2 supply.
	Defective Bag/Vent switch	Check Bag/Vent switch.

7.2 Breathing System Leak Tests

Note Always perform the low-pressure leak test (Section 3.8) on the machine before proceeding with these breathing system leak tests.

Make sure that the check valves on the breathing circuit module work correctly (Section 7.2.1).

Follow the troubleshooting flowcharts in Section 7.2.2 to determine the best sequence of tests for locating a breathing system leak.

The procedure in Section 7.2.3 helps you isolate the leak to Bag Mode components, Vent Mode components, or to components that are common to both modes.

- If you have a similar leak in both the bag mode and the ventilator mode, you must consider the Flow Sensor Module, the Circuit Module, the Absorber Canister area, and the bulkhead components (including CGO tubing). Carefully inspect the circuit module for damaged seals or misassembly, and the seating of the O_2 sensor.
- If you have a larger leak in one area than the other (Vent or Bag), the leak is most likely NOT in the Flow Sensor Module, the Circuit Module, the Absorber Canister area, or the bulkhead ports.

The procedures in Section 7.2.4 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.

7.2.1 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.

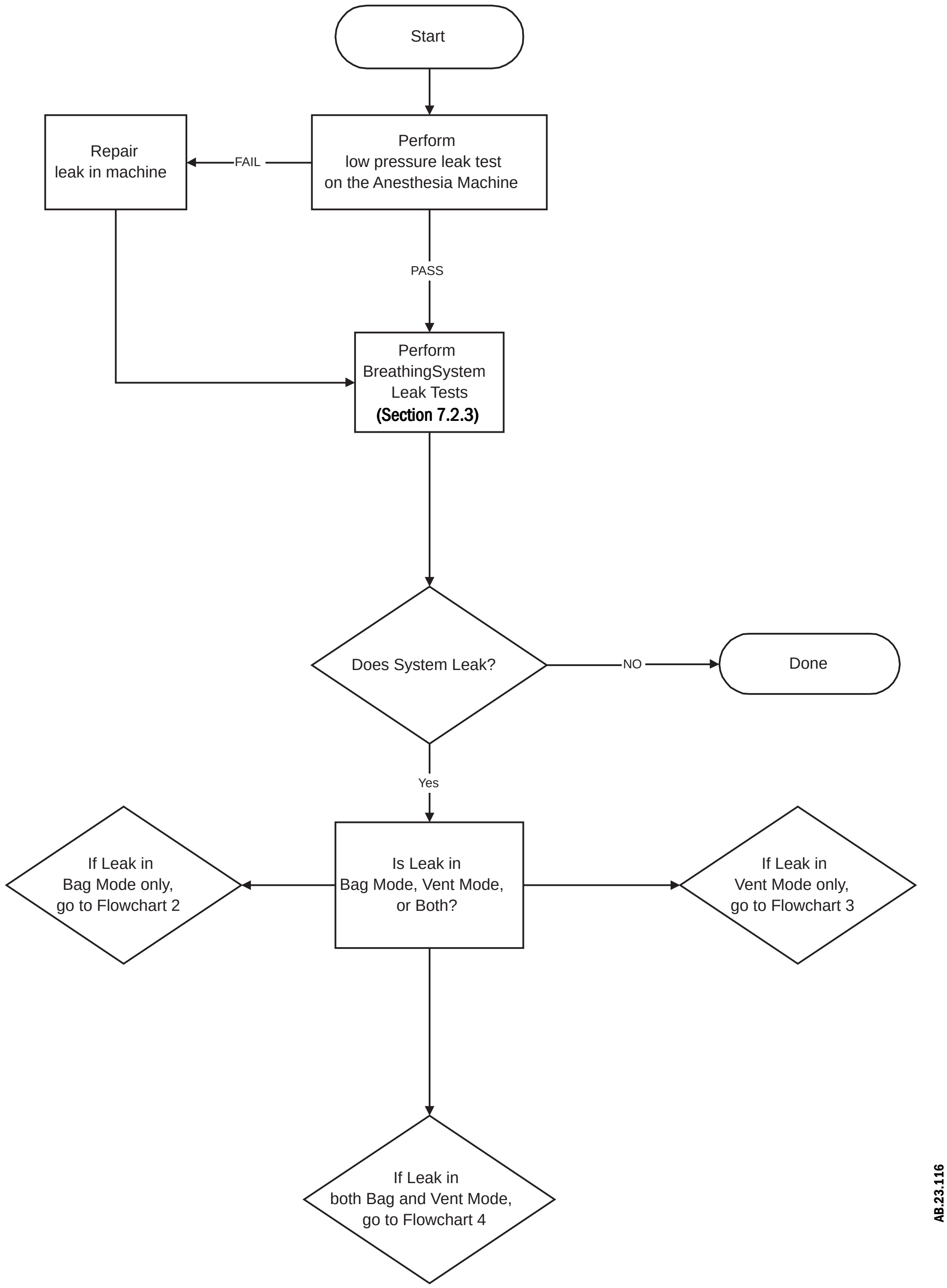
Inspiratory check valve

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, 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.

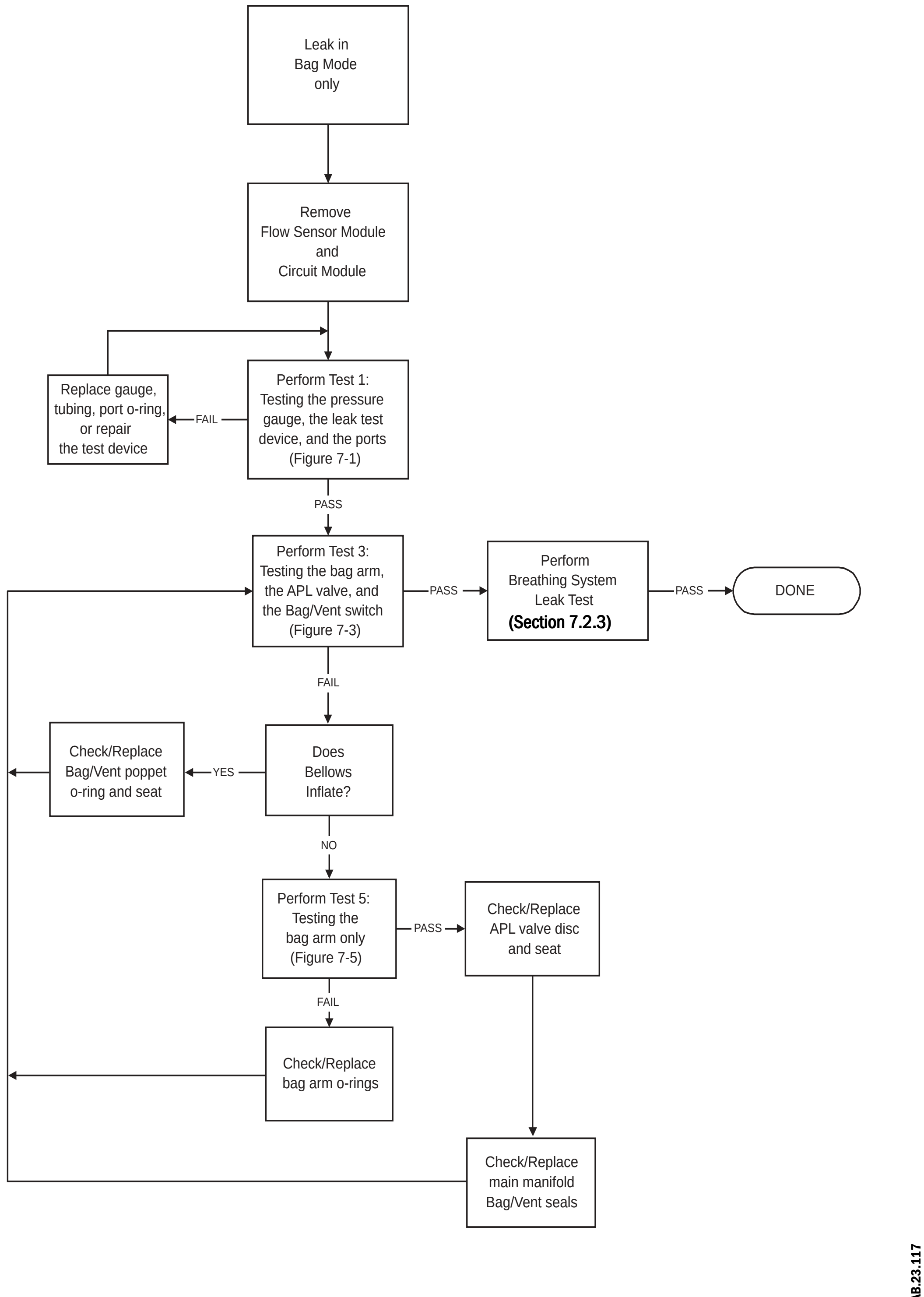
Expiratory check valve

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.

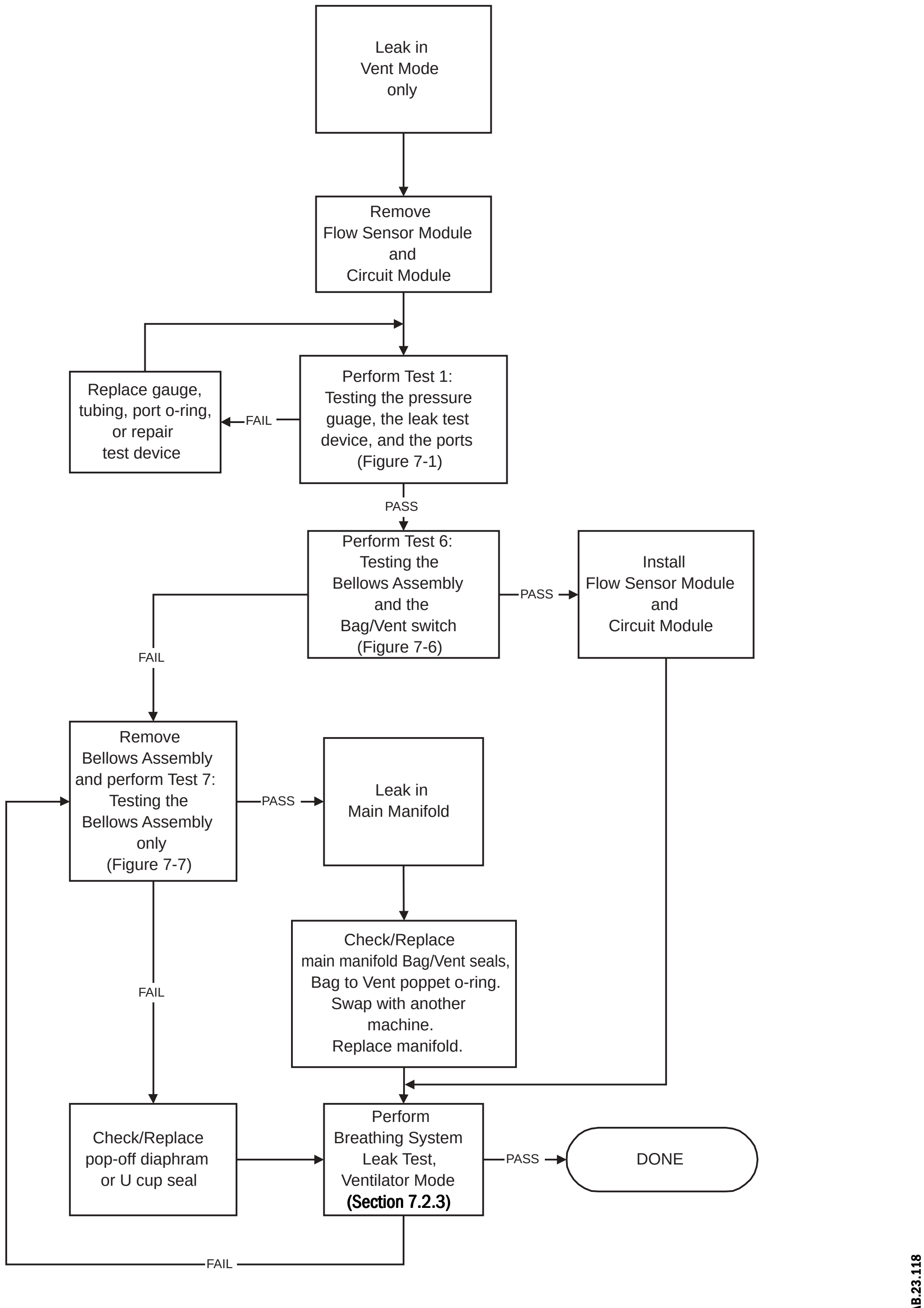
7.2.2 Breathing System Troubleshooting Flowcharts



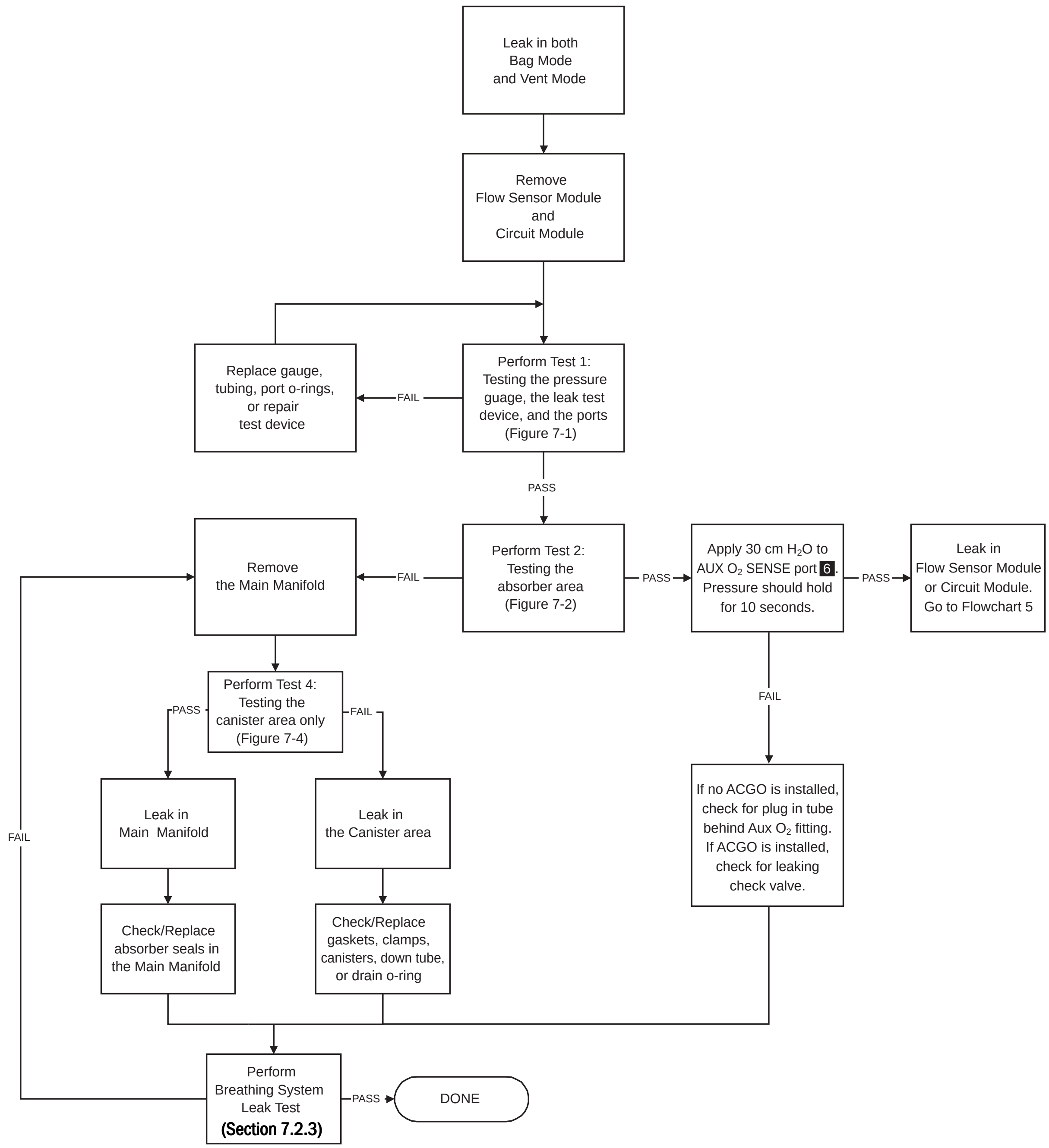
Flowchart **1**


Leak in Bag Mode only
Remove Flow Sensor Module and Circuit Module
Perform Test 1: Testing the pressure gauge, the leak test device, and the ports (Figure 7-1)
FAIL
Replace gauge, tubing, port o-ring, or repair the test device
PASS
Perform Test 3: Testing the bag arm, the APL valve, and the Bag/Vent switch (Figure 7-3)
PASS
Perform Breathing System Leak Test (Section 7.2.3)
PASS
DONE
FAIL
Does Bellows Inflate?
YES
Check/Replace Bag/Vent poppet o-ring and seat
NO
Perform Test 5: Testing the bag arm only (Figure 7-5)
PASS
Check/Replace APL valve disc and seat
FAIL
Check/Replace bag arm o-rings
Check/Replace main manifold Bag/Vent seals
AB.23.117

Flowchart 2

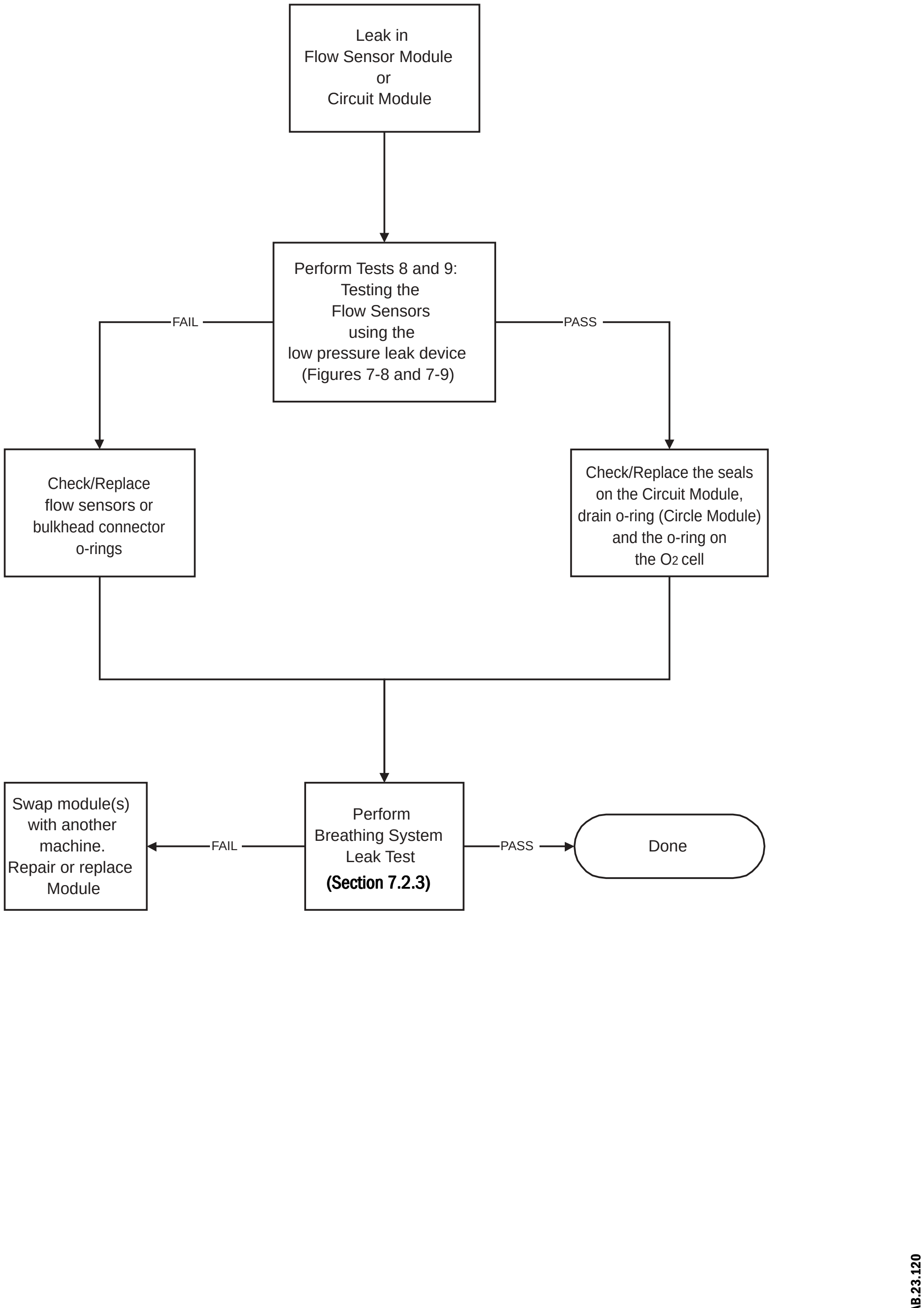

Leak in Vent Mode only
Remove Flow Sensor Module and Circuit Module
Perform Test 1: Testing the pressure guage, the leak test device, and the ports (Figure 7-1)
FAIL
Replace gauge, tubing, port o-ring, or repair test device
PASS
Perform Test 6: Testing the Bellows Assembly and the Bag/Vent switch (Figure 7-6)
PASS
Install Flow Sensor Module and Circuit Module
FAIL
Remove Bellows Assembly and perform Test 7: Testing the Bellows Assembly only (Figure 7-7)
PASS
Leak in Main Manifold
Check/Replace main manifold Bag/Vent seals, Bag to Vent poppet o-ring. Swap with another machine. Replace manifold.
FAIL
Check/Replace pop-off diaphram or U cup seal
Perform Breathing System Leak Test, Ventilator Mode (Section 7.2.3)
PASS
DONE
FAIL
AB.23.118

Flowchart **3**



AB.23.119

Flowchart **4**


Leak in
Flow Sensor Module
or
Circuit Module
Perform Tests 8 and 9:
Testing the
Flow Sensors
using the
low pressure leak device
(Figures 7-8 and 7-9)
FAIL
PASS
Check/Replace
flow sensors or
bulkhead connector
o-rings
Check/Replace the seals
on the Circuit Module,
drain o-ring (Circle Module)
and the o-ring on
the O_2 cell
Swap module(s)
with another
machine.
Repair or replace
Module
FAIL
Perform
Breathing System
Leak Test
(Section 7.2.3)
PASS
Done
AB.23.120

Flowchart ***5***

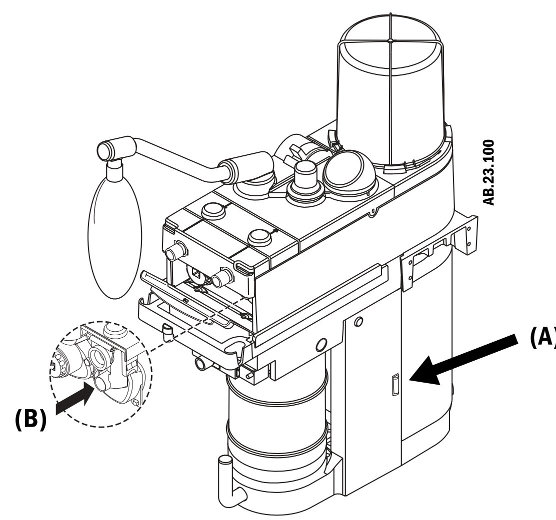
7.2.3 Breathing system leak test

This test checks for leaks in Vent Mode and Bag Mode components. It is part of the overall checkout procedure, Section 3.11 “Breathing system tests.” It is repeated here for testing convenience.

⚠ 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.

1. Verify that AGSS is operating. Breathing systems with active scavenging have a flow indicator **(A)** on the side. Make sure that the flow indicator shows a flow in the green (normal) region.
2. With a circle breathing module, push the drain button **(B)** for 10 seconds or more to drain condensate into the absorber.



3. Zero the pressure gauge (Section 6.6).

One-way Valves

4. Make sure that the one-way valves on the Circle breathing circuit module work correctly:
   a. The Inspiratory check valve rises during inspiration and falls at the start of expiration.
   b. The Expiratory check valve rises during expiration and falls at the start of inspiration.

   Note: The Bain/Mapleson D circuit module does not have one-way valves.

Ventilator Bellows

5. Ventilator bellows test:
   a. Set the system switch to Standby.
   b. Set the Bag/Vent switch to Ventilator.
   c. Set all flow controls to minimum.
   d. Close the breathing circuit at the patient connection. Use your hand or the test plug located in the handle of the breathing system.
   e. Push the O_2 flush button until the bellows is full.
   f. The pressure must not increase to more than 15 cm H_2O on the pressure gauge.
   g. If the bellows falls more than 100 mL/min, it has a leak.

Service Mode Tests

6. Enter the Service Mode: Push and hold the adjustment knob on the ventilator's display and set the system switch to On.
   a. Select and confirm "Service Mode(s)."
   b. Follow the menu structure outline below to reach the adjustment for the inspiratory flow valve. Select and confirm at each step.

7100	7900 (4.X)	7900 (1.X/3.X)
"Diagnostics Tests/Tools"	"Breathing System Leak Test"	"Test for Leaks"
"Breathing System Leak Test"		

   c. Follow the instructions on the screen.

Bag Circuit

7. Test the Bag circuit for leaks:
   a. Set the system switch to On.
   b. Set the Bag/Ventilator switch to Bag.
   c. Plug the Bag port; use your hand or the approved test plug.
   d. Close the APL valve.
   e. Set the O_2 flow to 200 mL/min.
   f. Close the patient connection (using a hand or test plug on the breathing system handle) and pressurize the bag circuit with the O_2 flush button to approximately 30 cm H_2O.
   g. Release the flush button. The pressure must not decrease. A pressure decrease large enough to see on the gauge indicates a leak. Look for and repair the leak (open drain plug, open canister, breathing circuit assembly not pushed on completely).
   h. If your system has a CO_2 bypass, move the absorber canister release to the bypass position and repeat steps f and g to look for leaks in the bypass mode.

7.2.4 Leak Isolation Tests

The previous flowcharts refer you to the following tests.

- Tests 1 through 7 require the breathing circuit leak test device (1406-8205-000).
- Tests 8 and 9 require the low pressure leak test device (0309-1318-800) and an 18-mm test plug (1407-8503-000).
- All tests require 1 or 2 test plugs (2900-0001-000).
- If the system includes an auxiliary common gas outlet (ACGO), set the switch to the common gas outlet position (lever up).

Note The diagrams on the following pages show a machine with a 7900 ventilator. These tests apply equally to machines with a 7100 ventilator.

- SIB is an acronym for Sensor Interface Board assembly used with 7900.
- MIA is an acronym for Monitoring Interface Assembly used with 7100.

⚠ 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.

Do not fully open the control panel with the breathing system leak test device connected. Equipment damage may result.

Test 1

Test 2

Test 3

Test 4

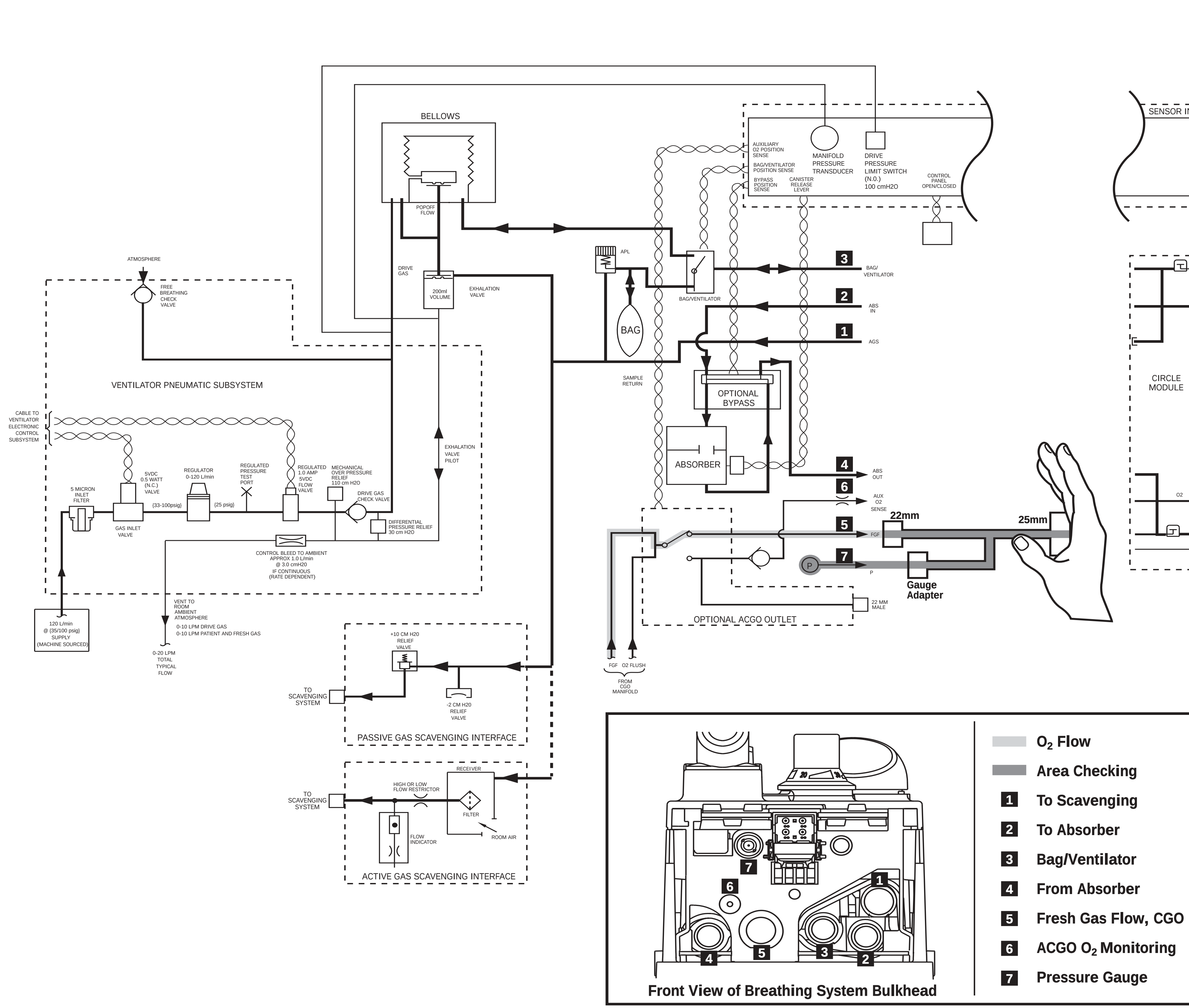
Test 5

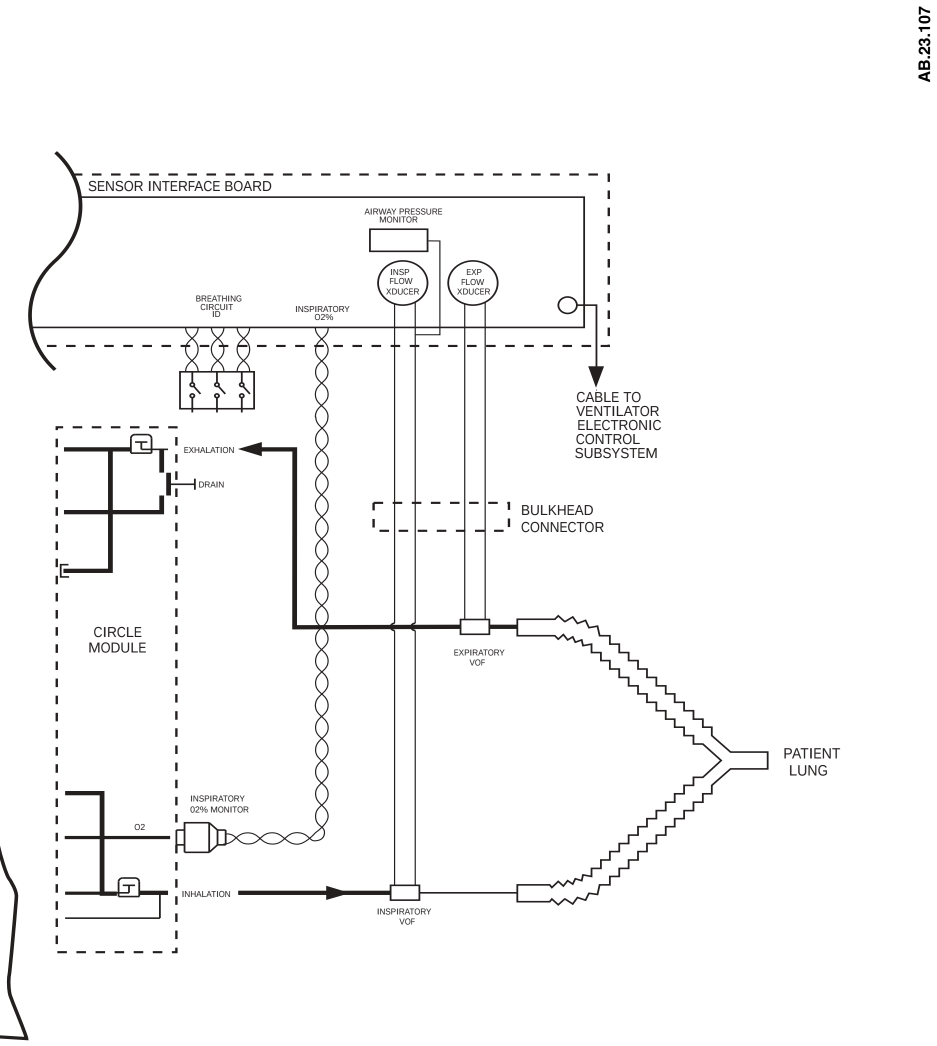
Test 6

Test 7

Test 8

Test 9

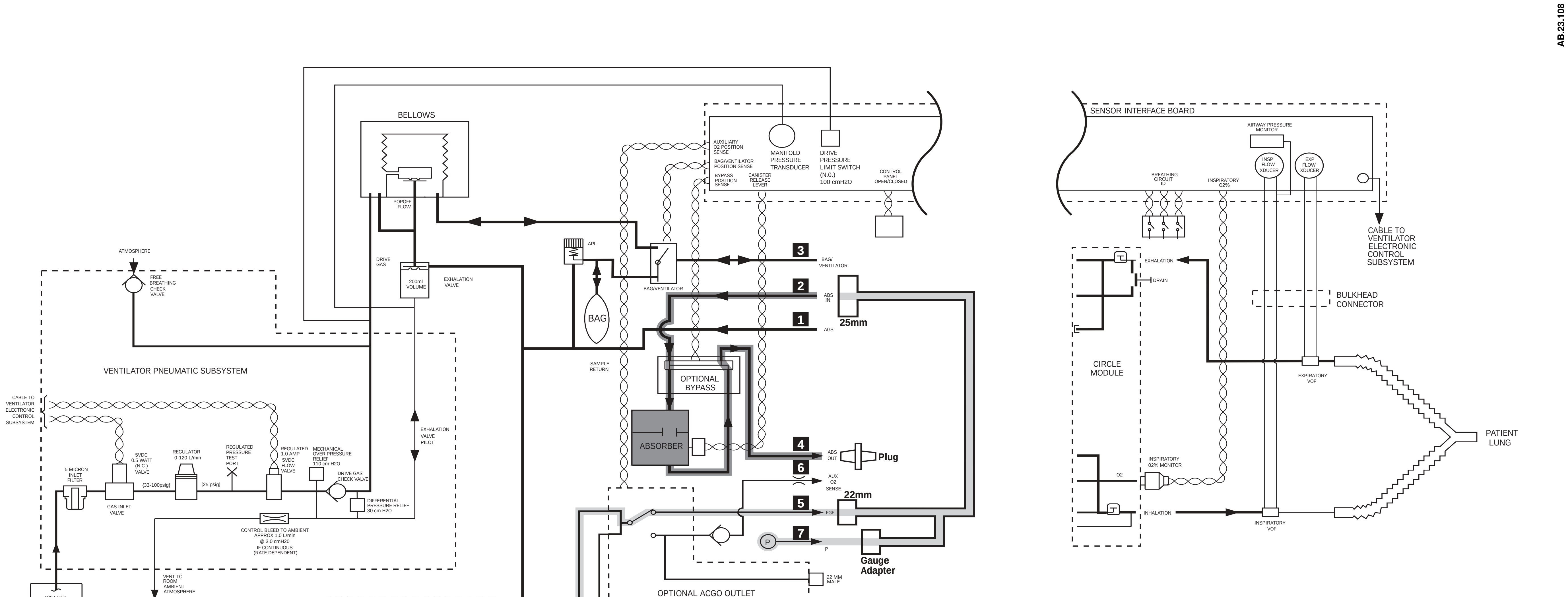


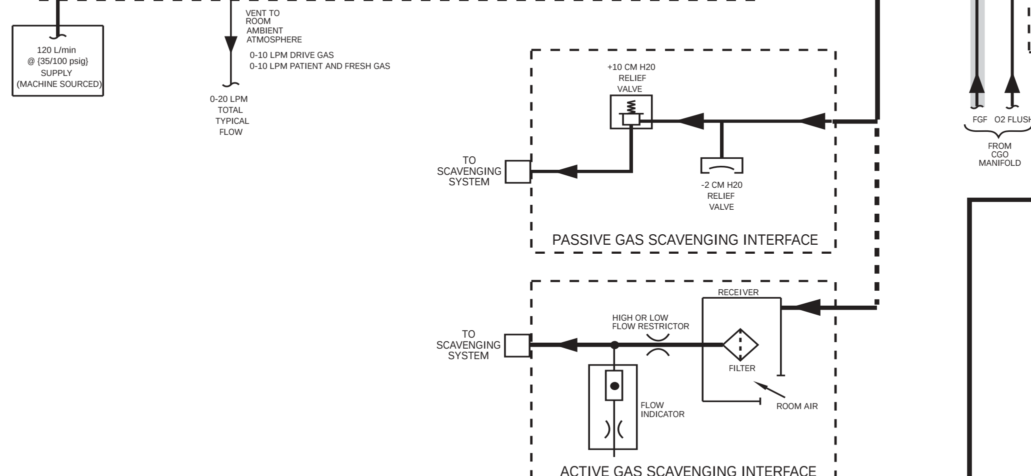


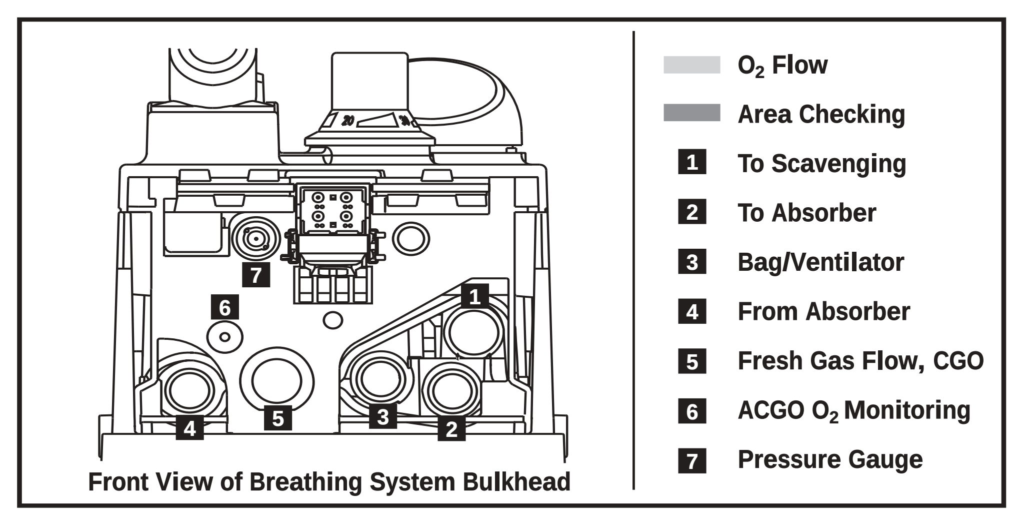
Test 1
Testing the pressure gauge, the leak test device and the ports

- Connect the leak test device to ports 5 and 7.
- Occlude the 25 mm connector with your hand.
- Slowly increase O_2 flow to achieve 30 cm H_2O.
- The leak rate is the O_2 flow needed to maintain 30 cm H_2O.
- Leak should be < 50 mL/min.

Figure 7-1 ▪ Testing the pressure gauge, the leak test device, and the ports





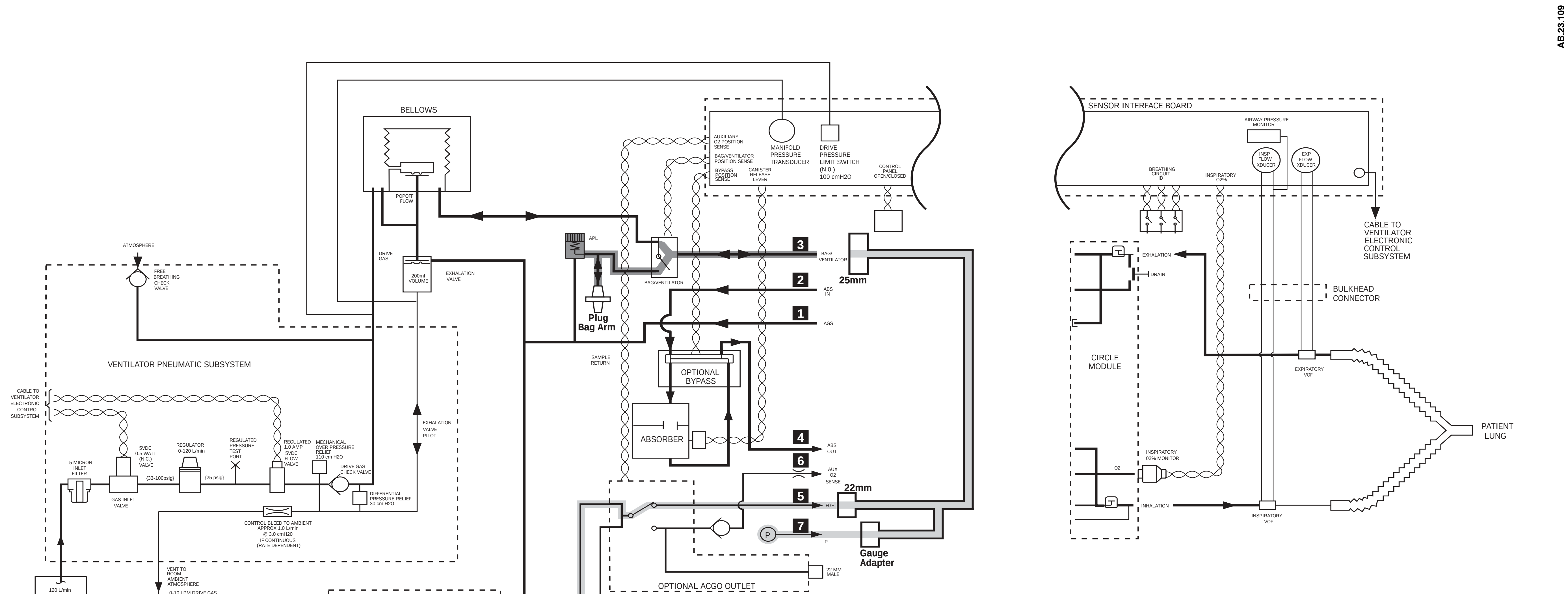


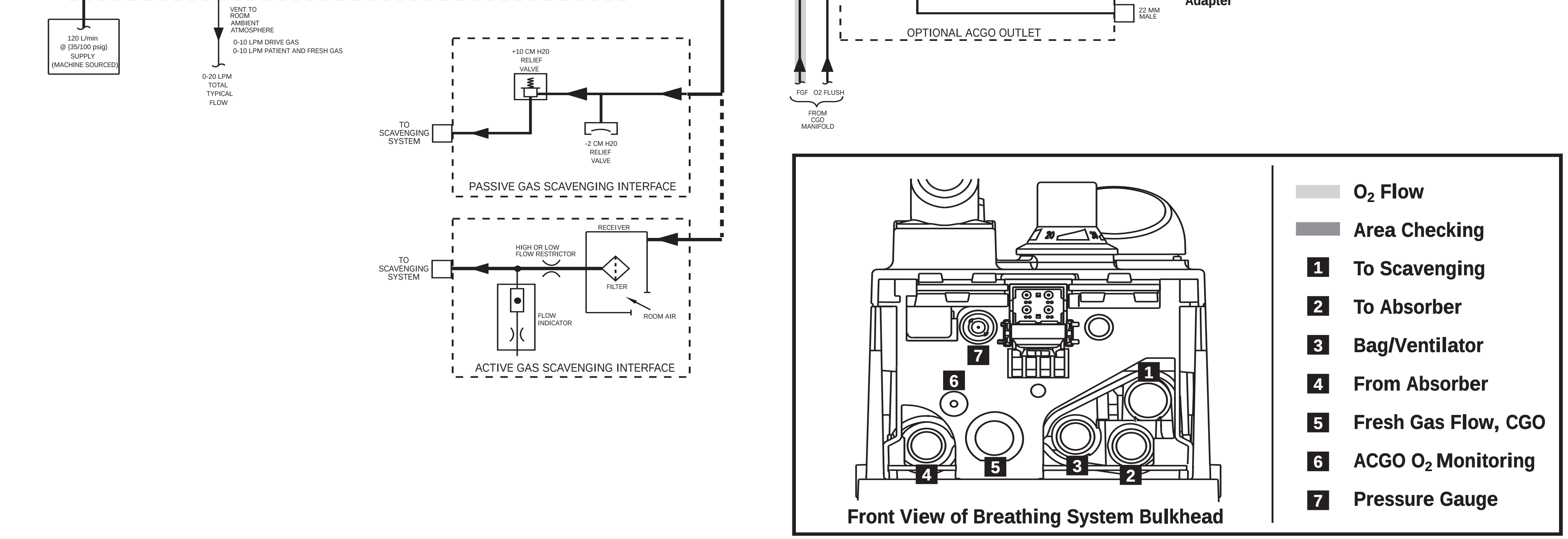
Test 2
Testing the absorber area

- Connect the test device to ports 5, 7, and 2.
- Plug port 4 with a test plug.
- Slowly increase O_2 flow to achieve 30 cm H_2O.
- The leak rate is the O_2 flow needed to maintain 30 cm H_2O.
- Leak should be < 75 mL/min.

If the optional absorber bypass is installed, repeat the test with the absorber canisters open.

Figure 7-2 ▪ Testing the absorber area

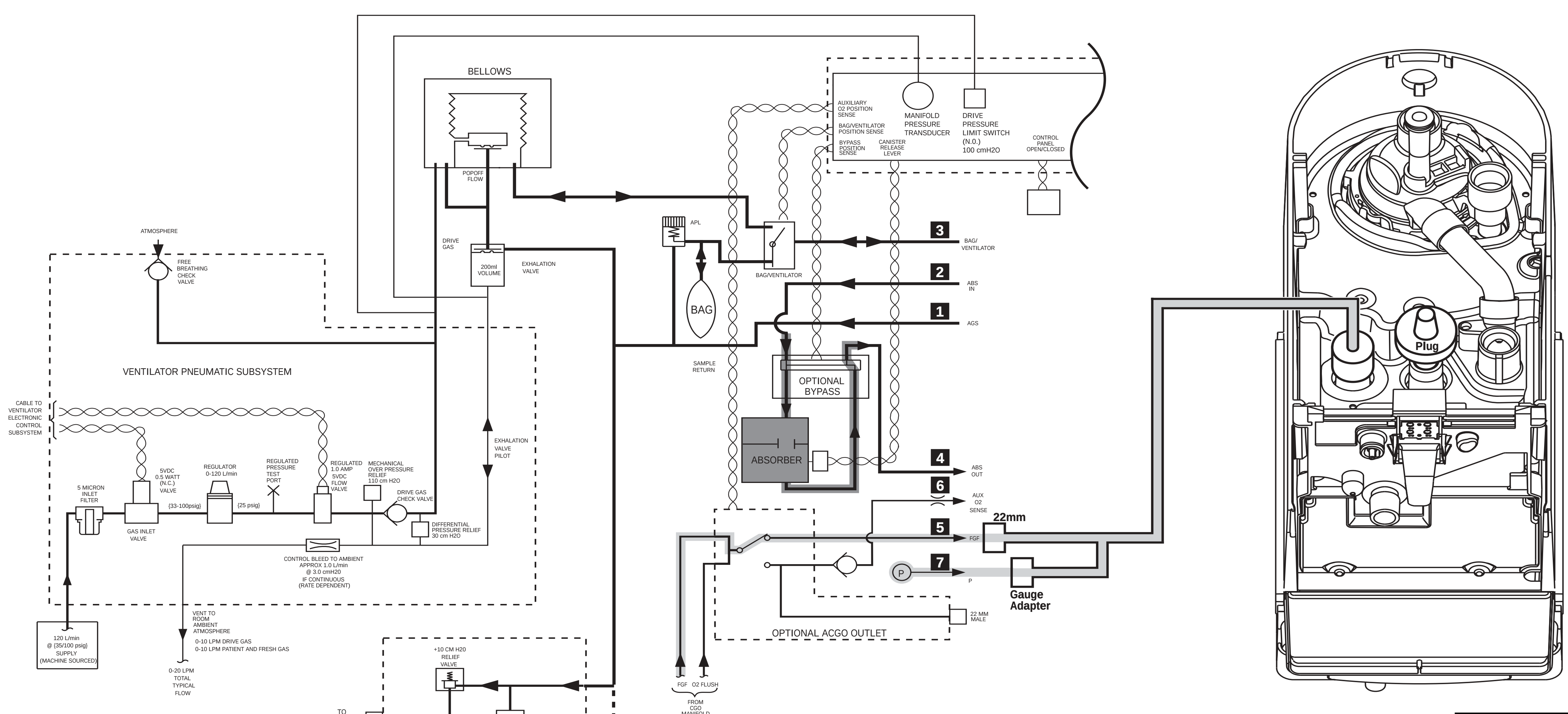




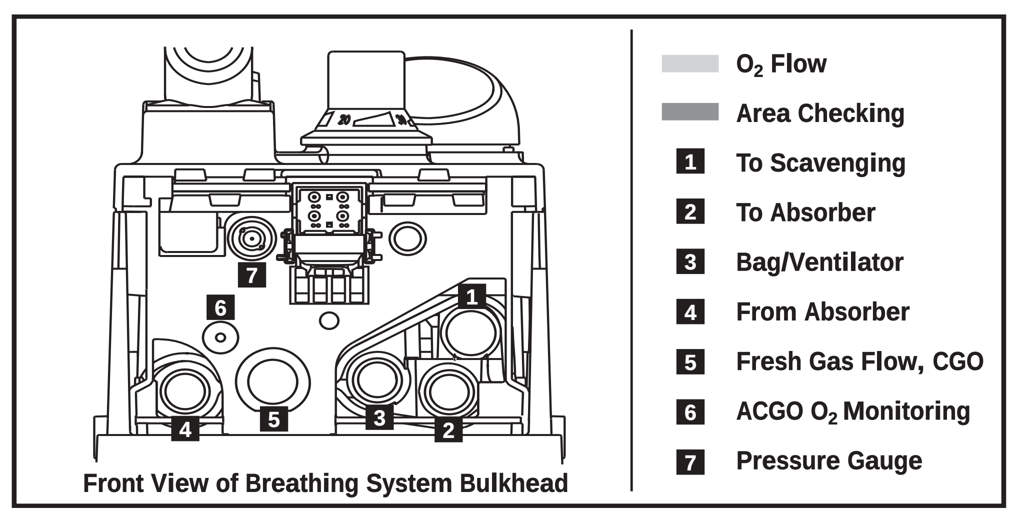
Test 3
Testing the bag arm, the APL valve, and Bag/Vent switch

- Connect the test device to ports 5, 7, and 3.
- Plug bag arm with a test plug.
- Close the APL valve.
- Set Bag/Vent switch to bag mode.
- Slowly increase O_2 flow to achieve 30 cm H_2O.
- The leak rate is the O_2 flow needed to maintain 30 cm H_2O.
- Leak should be < 100 mL/min.
- If bellows goes up, the switch is leaking.

Figure 7-3 ▪ Testing the bag arm, APL valve, and Bag/Vent switch



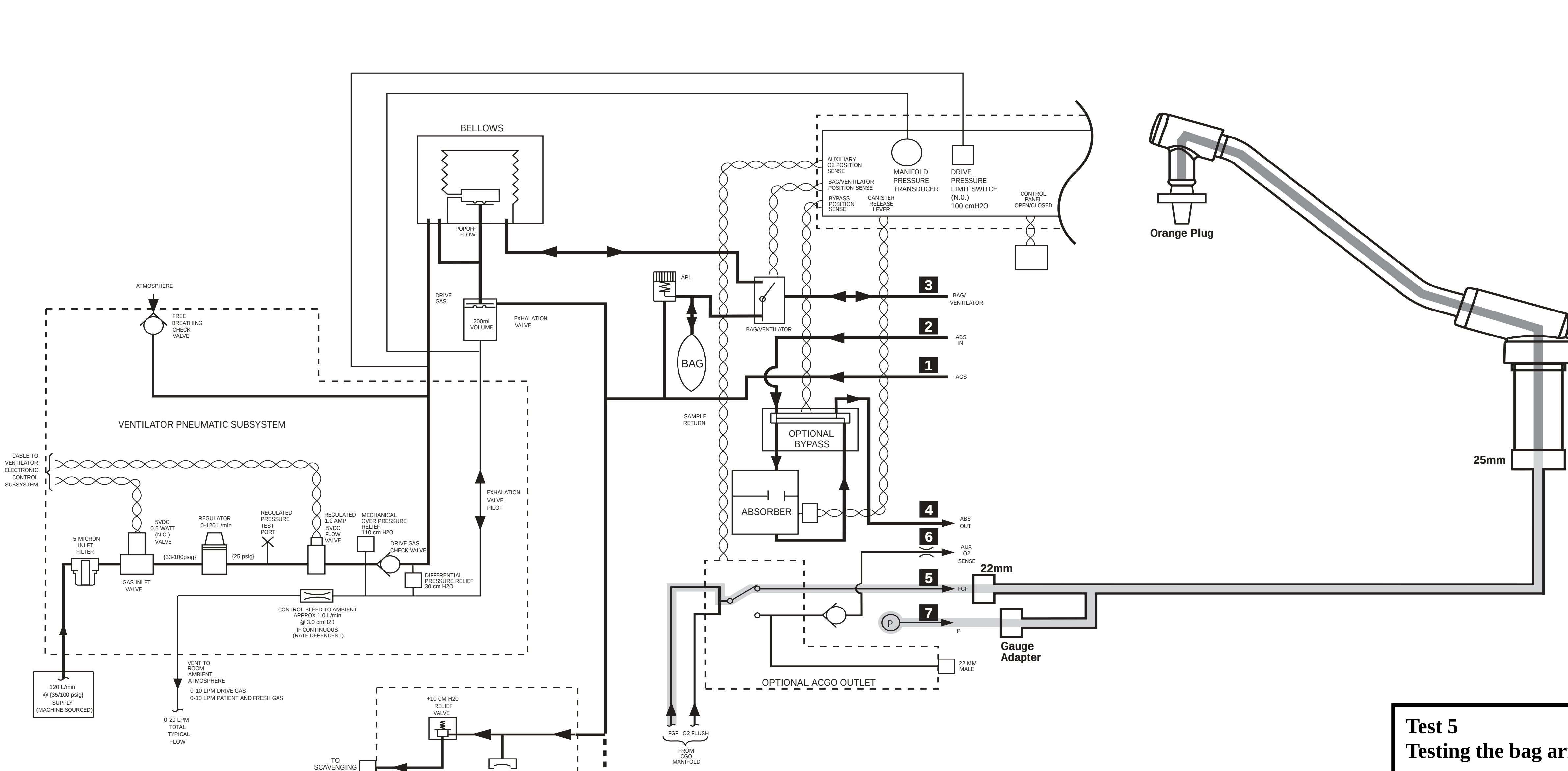
⚠ **CAUTION: Do not fully open the control panel with the breathing system leak test device connected. Equipment damage may result.**

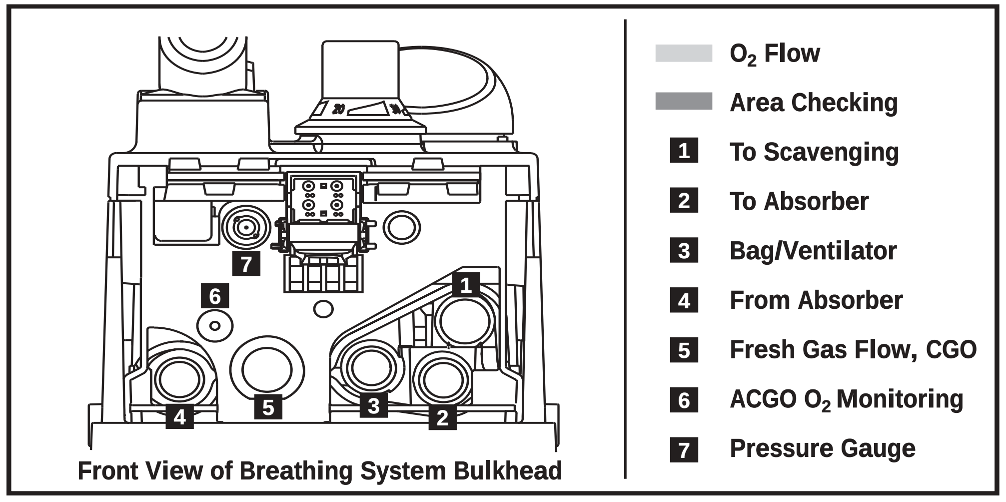


Test 4
Testing the canister area only

- Remove the main manifold.
- Connect the test device to ports 5 and 7.
- Connect the 25 mm connector to one of the ports that leads to the canisters
- Plug the other canister port with a test plug.
- Slowly increase O_2 flow to achieve 30 cm H_2O.
- The leak rate is the O_2 flow needed to maintain 30 cm H_2O.
- Leak should be < 50 mL/min.

Figure 7-4 • Testing the canister area only

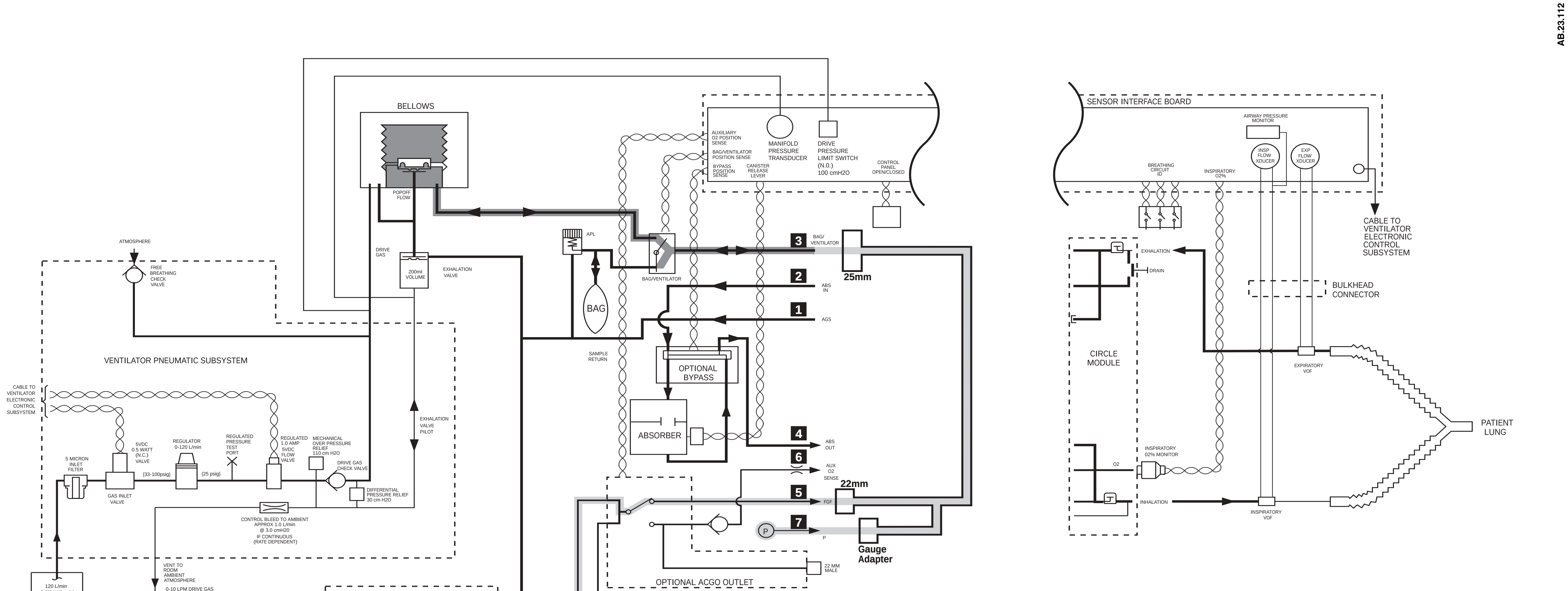


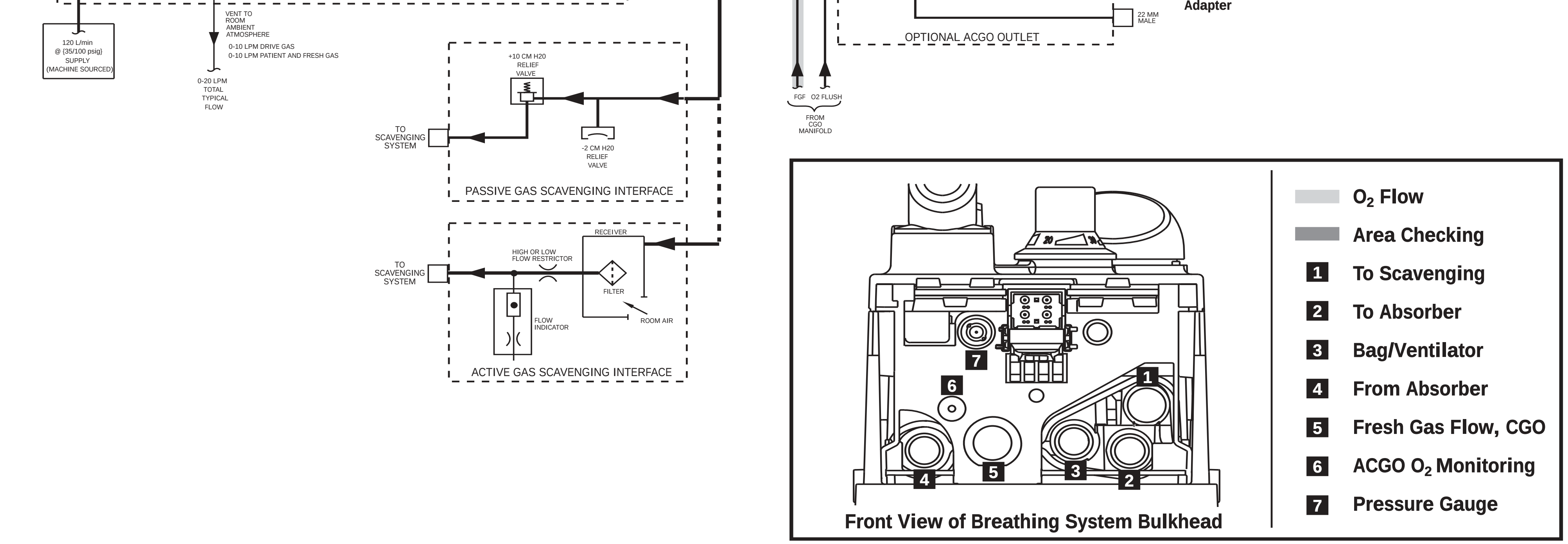


Test 5
Testing the bag arm only

- Connect the test device to ports 5 and 7.
- Plug the bag opening with a test plug.
- Connect the 25 mm connector to the other end.
- Slowly increase O_2 flow to achieve 30 cm H_2O.
- The leak rate is the O_2 flow needed to maintain 30 cm H_2O.
- Leak should be < 50 mL/min.

Figure 7-5 • Testing the bag arm only

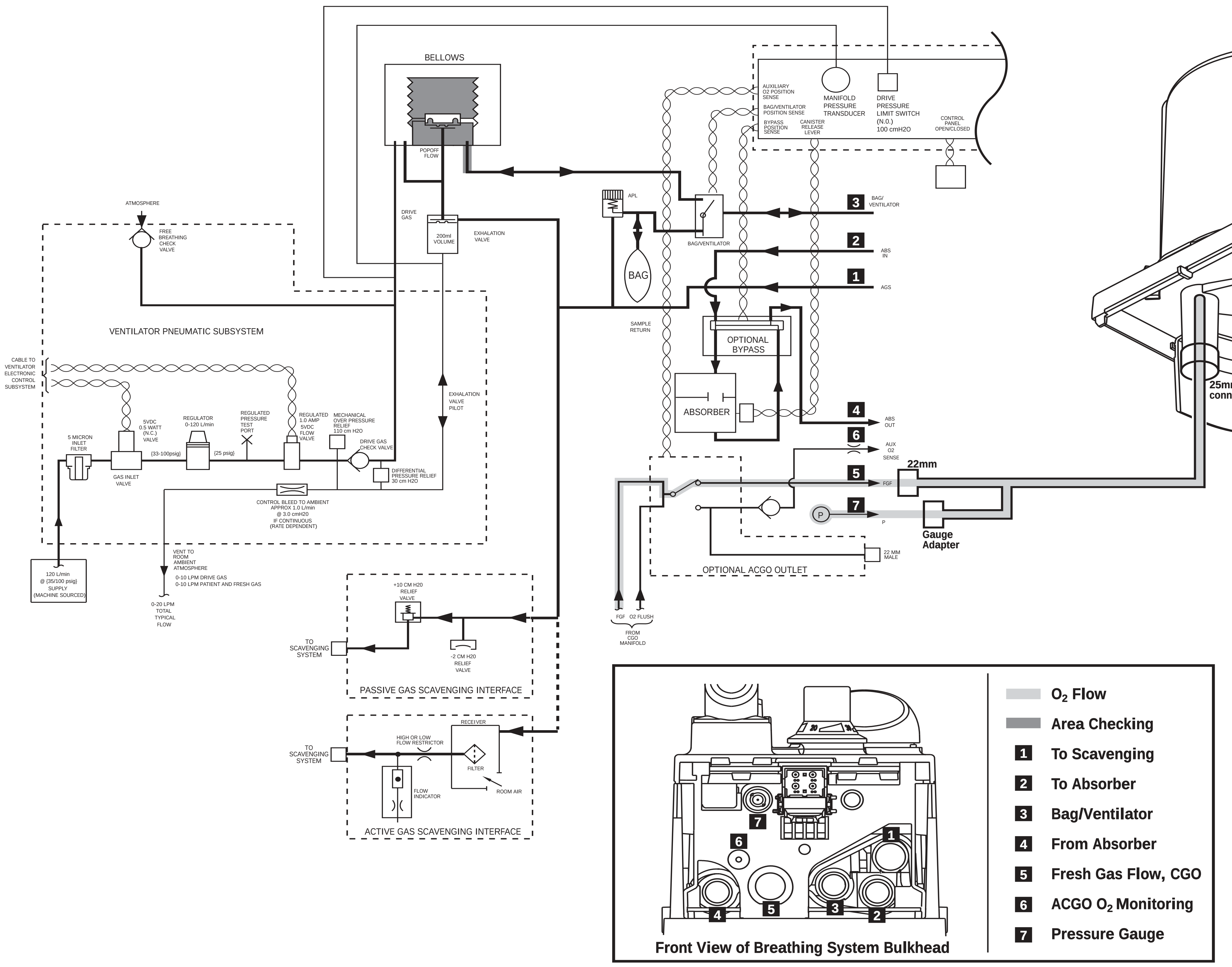


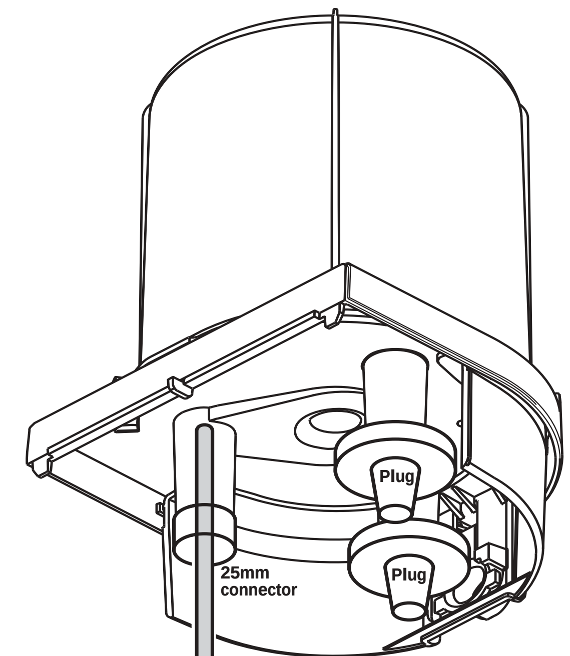


Test 6
Testing the bellows assembly and the Bag/ Vent switch

- Connect the test device to ports 5, 7, and 3.
- Turn the system On and go into the Service Mode.
- Select “Test for Leaks.”
- Follow the instructions on the Breathing System Leak Test screen.
- Leak should be < 150 mL/min.

Figure 7-6 • Testing the bellows assembly and the Bag/Vent switch



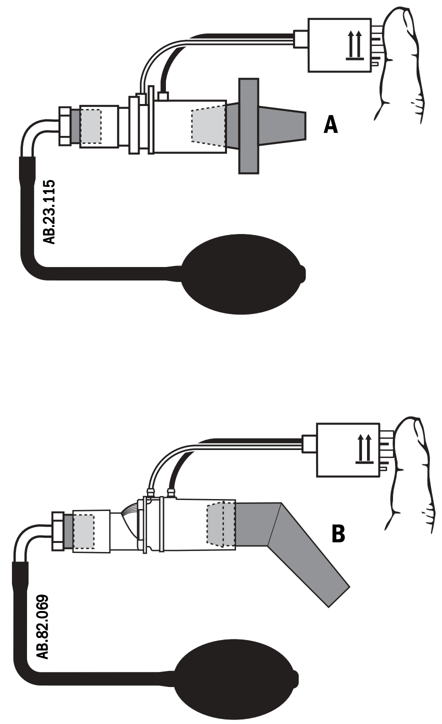


Test 7
Testing the Bellows Assembly only

- Connect the test device to ports 5 and 7.
- Connect the 25 mm connector to the bellows base port as shown.
- Plug the other two ports with a test plug as shown.
- Position the bellows assembly upright with the bellows collapsed.
- Slowly increase O_2 flow to achieve 30 cm H_2O.

  Note: The bellows will rise until the pressure equalizes.
- The leak rate is the O_2 flow needed to maintain 30 cm H_2O.
- Leak should be < 100 mL/min.

Figure 7-7 ▪ Testing the Bellows Assembly only

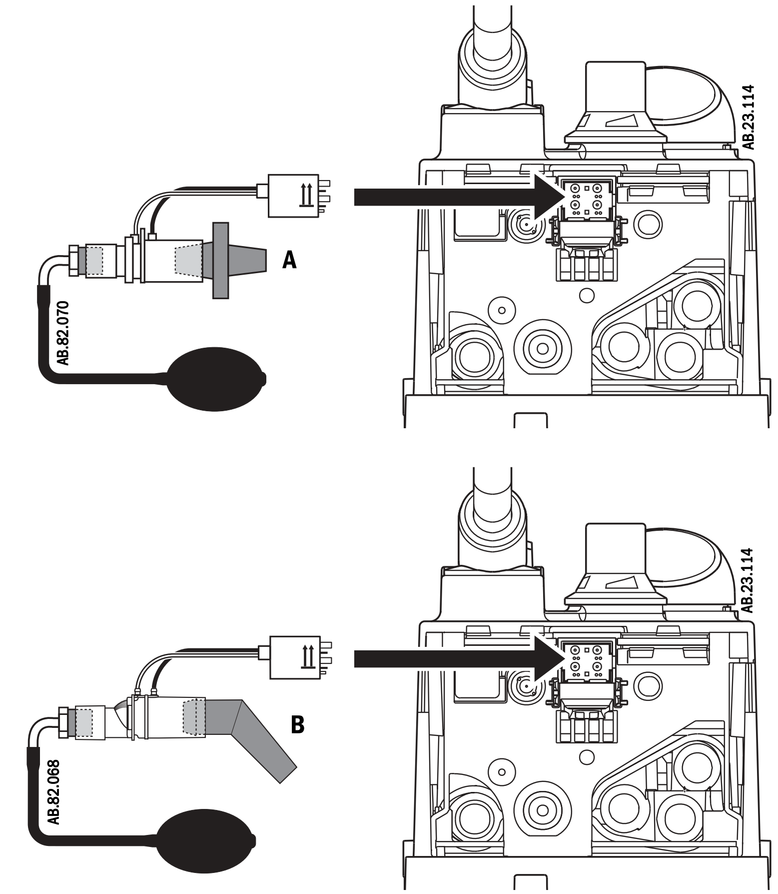


Test 8
Testing the Flow Sensors only

- Remove the Flow Sensor Module.
- Plug each Flow Sensor as shown.
- Connect the low pressure leak test device to the open end of the Flow Sensor.
- Block the connector end of the Flow Sensor with your hand.
- Compress and release the bulb until it is empty.
- If the bulb inflates in 30 seconds or less, there is a leak in the flow sensor.
- If there are no leaks in the flow sensors, go to Test 9.

Note: *To ensure a air-tight seal, use the corresponding plug as illustrated for the original flow sensor (**A**) or the new, moisture resistant (offset) flow sensor (**B**).*

Figure 7-8 ▪ Testing the Flow Sensors only



Test 9
Testing the Sensor module including SIB/MIA module and Breathing System components

- Remove the Circuit Module.
- Replace the Flow Sensor Module without the Curcuit Module in place.
- Plug each Flow Sensor as shown.
- Connect the low pressure leak test device to the open end of the Flow Sensor.
- Compress and release the bulb until it is empty.
- 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 tubing, or in the transducer on the SIB/MIA.

Note: *To ensure a air-tight seal, use the corresponding plug as illustrated for the original flow sensor (**A**) or the new, moisture resistant (offset) flow sensor (**B**).*

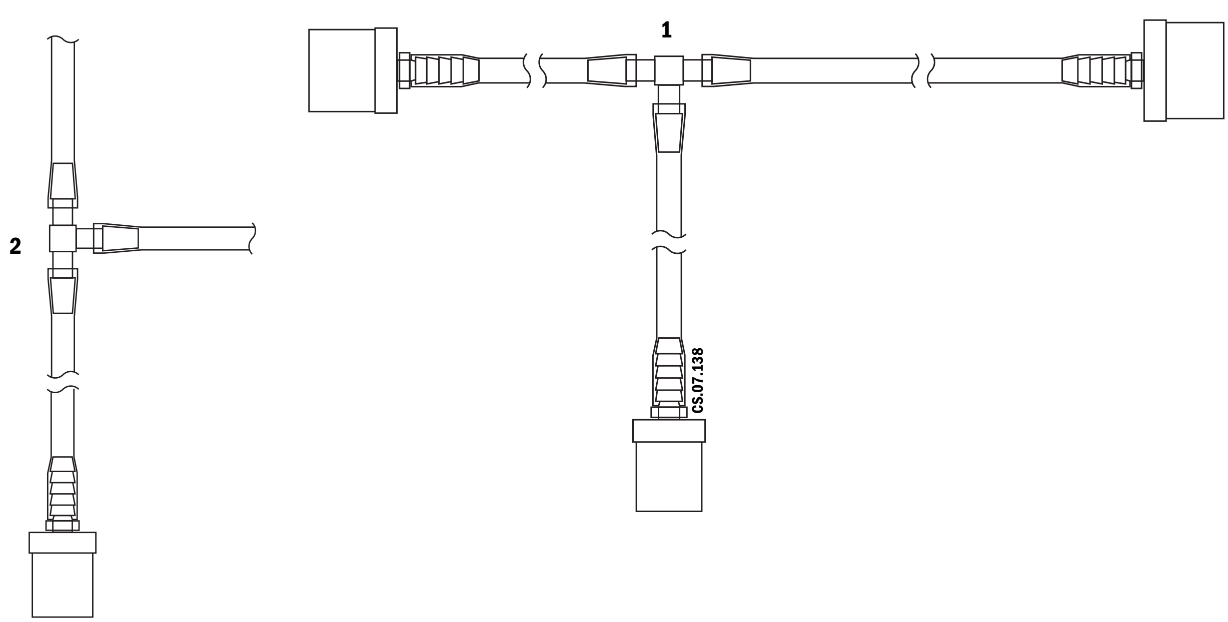
Figure 7-9 ▪ Testing the Sensor module including SIB/MIA module and Breathing System components

8 Illustrated Parts

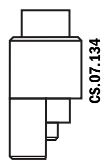
In this section

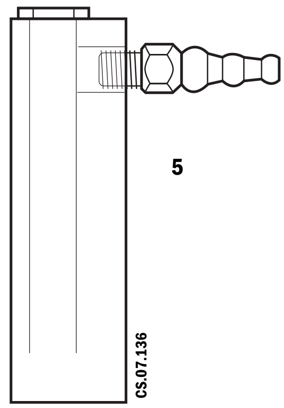
8.1 Service tools — Anesthesia machine

Item	Tool	Stock Number
1	Leak-check Kit, (Breathing System)	1406-8205-000
2	Airway Pressure Gauge test adapter	1406-8206-000
3	Vaporizer Manifold Valve Test Tool	1006-3967-000
4	Pliers, Spring Compression, Bag/Vent Switch	1406-8230-000
5	Test flowmeter, 6–50 L/min (Suction Flow Test)	1006-8431-000
6	Plug, stopper	2900-0001-000
7	Plug, 18 mm	1407-8503-000
	Tubing (for pressure measurement)	
	Tubing, 4 mm (N_2O, O_2 pilot)	1001-3060-000
	Tubing, 6 mm (O_2)	1001-3062-000
	Tubing, 8 mm (Air)	1001-3063-000
	Tubing, 1/8 inch, (all secondary regulator taps and pipeline gauges)	1006-3718-000
	Tubing, 1/4 inch, Fresh Gas (Vaporizer manifold, O_2 flush valve, CGO manifold)	1001-3064-000
	Tubing, 3/16 inch (CO_2, Heliox)	0994-6396-010



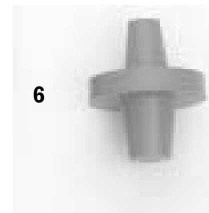
3

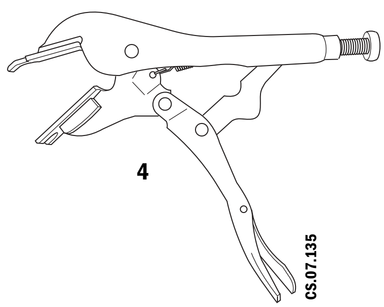




5

6





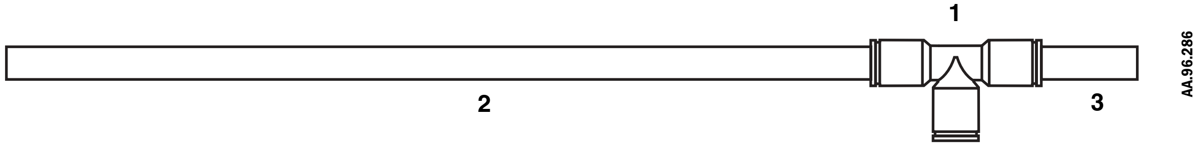
4

7

8.1.1 Secondary regulator pilot pressure tool

Assemble the secondary regulator pilot pressure tool using a 4-mm tee and tubing as shown. This tool is used with N_2O and 4th gas needle valve calibration.

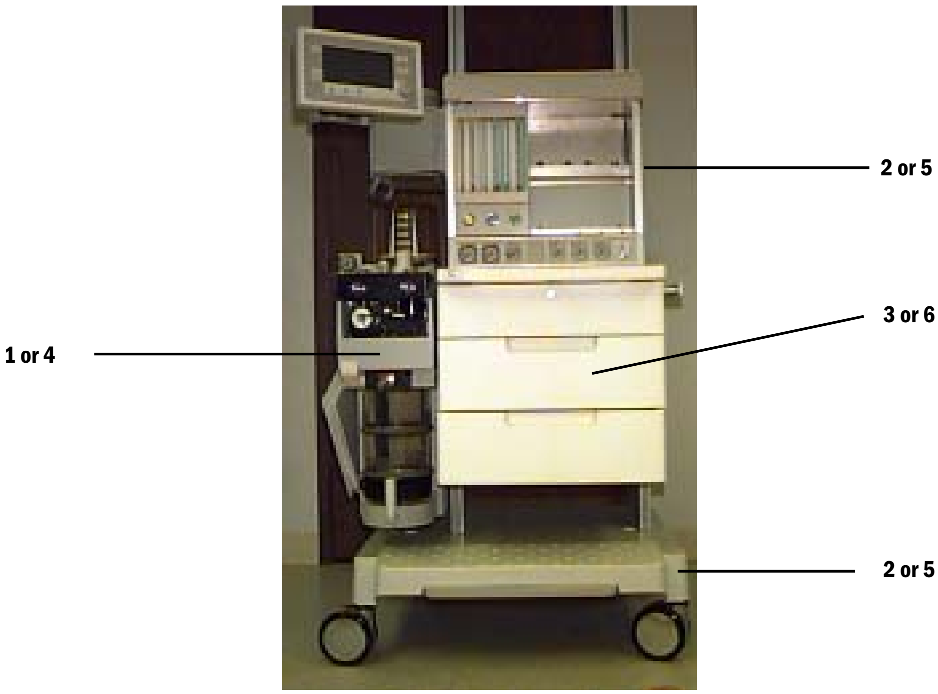
1



2 3

Item	Description	Stock Number
1	Tee, 4 mm, tube/tube/tube	1202-3653-000
2	Tubing, 4 mm (approximately 450 mm - 18 inches)	1001-3060-000
3	Tubing, 4 mm (approximately 50 mm - 2 inches)	1001-3060-000

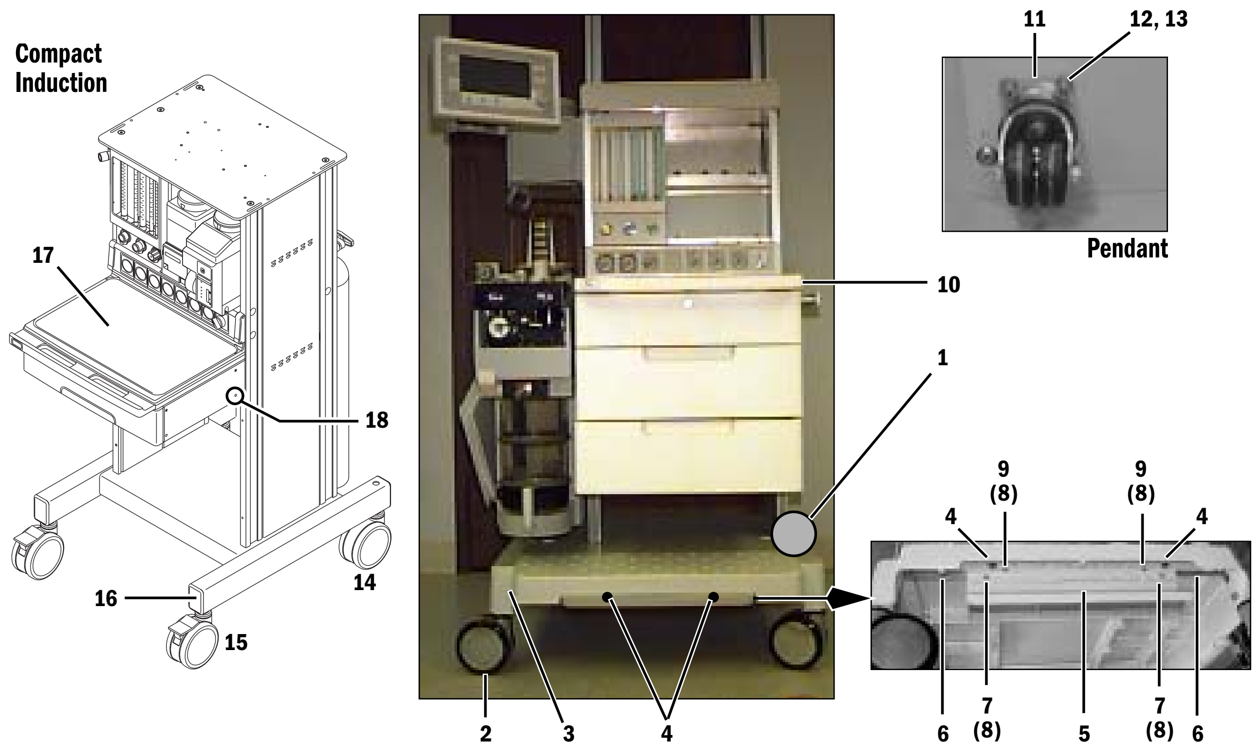
8.2 Touch-up paint



Item	Description	Stock Number
1*	Flint (medium) Gray, 18-mL bottle	1006-3851-000
2*	Quartz (light) Gray, 18-mL bottle	1006-3852-000
3*	Arctic-white, 18-mL bottle	1001-3363-000
4**	Neutral Gray N7 (medium dark), 18-mL bottle	1006-4198-000
5**	Neutral Gray N8 (medium), 18-mL bottle	1006-4199-000
6**	Neutral Gray N9 (light), 18-mL bottle	1006-4200-000

* Items 1 through 3 are from the original color palette.
** Items 4 through 6 are from the revised color palette.

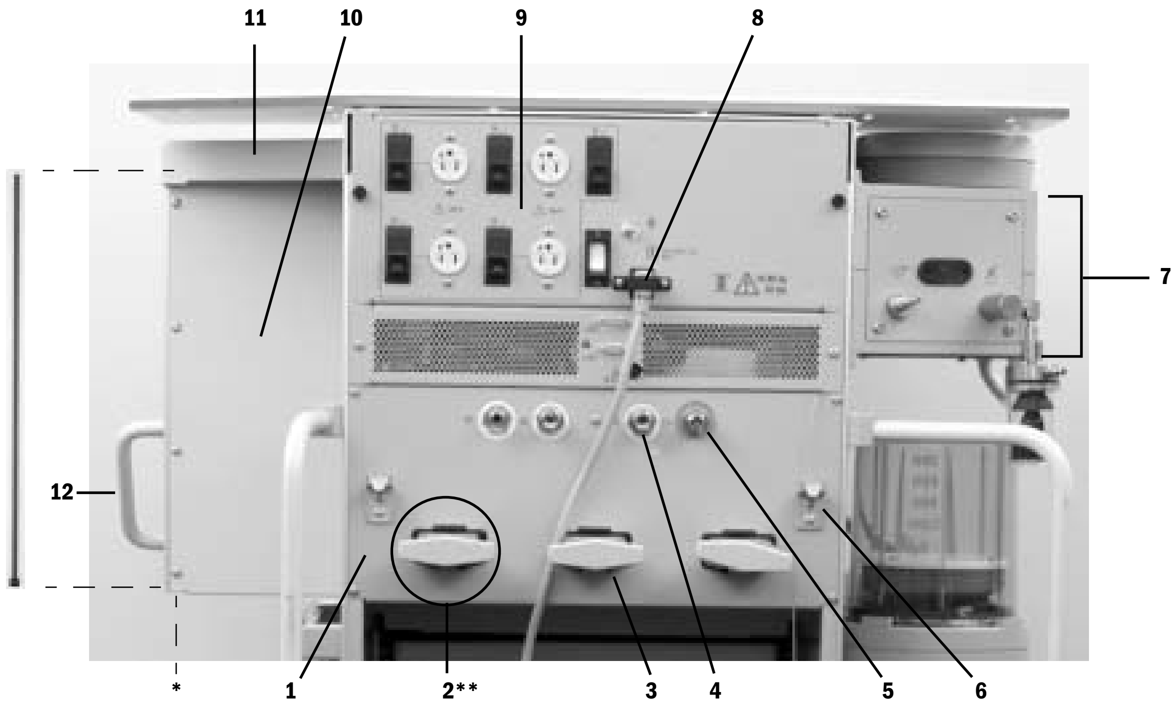
8.3 Casters, brake, and work surface



Item	Description		Stock Number
1	Caster, no brake (rear)		1202-3111-000
2	Caster, brake (front)		1202-3110-000
3**	Screw		1006-3647-000
4	Bumper, #6-32		1006-3226-000
5	Brake pedal		1006-1070-000
6	Rod, hex, brake (2)		1006-3227-000
7	Screw, M6x20, SKT HD CAP (2)		0144-2131-921
8	Nut, M6 Keps (4)	non-MRI	0144-3717-330
	Nut, Nyloc M6 (4)	MRI	9212-0360-006
9	Screw, M6x25, SKT HD CAP (2)		9211-0660-254
10	Work surface, with stainless steel top, O_2 flush left side		1006-8349-000
	Work surface, with stainless steel top, O_2 flush right side		1006-8348-000
11	Caster, Pendant		1006-4212-000
12**	Screw, M8x14		1006-3647-000
13	Washer, M8 flat		9213-0180-006
14*	Caster, no brake (Compact and Induction - rear)		1006-3071-000
15*	Caster, brake (Compact and Induction - front)		1006-3070-000
16	Plug, base		1006-4443-000
17	Work surface, without stainless steel top (Compact and Induction)		1006-1149-000
18	Plug		1006-3240-000
Not Shown	Parts to secure Compact/Induction casters to base assembly		
	* Nut, M12x1.75 SST Hex		0144-3132-140
	* Washer, flat M12 SST		0144-1029-165

** Apply Loctite 242

8.4 Rear panel — upper

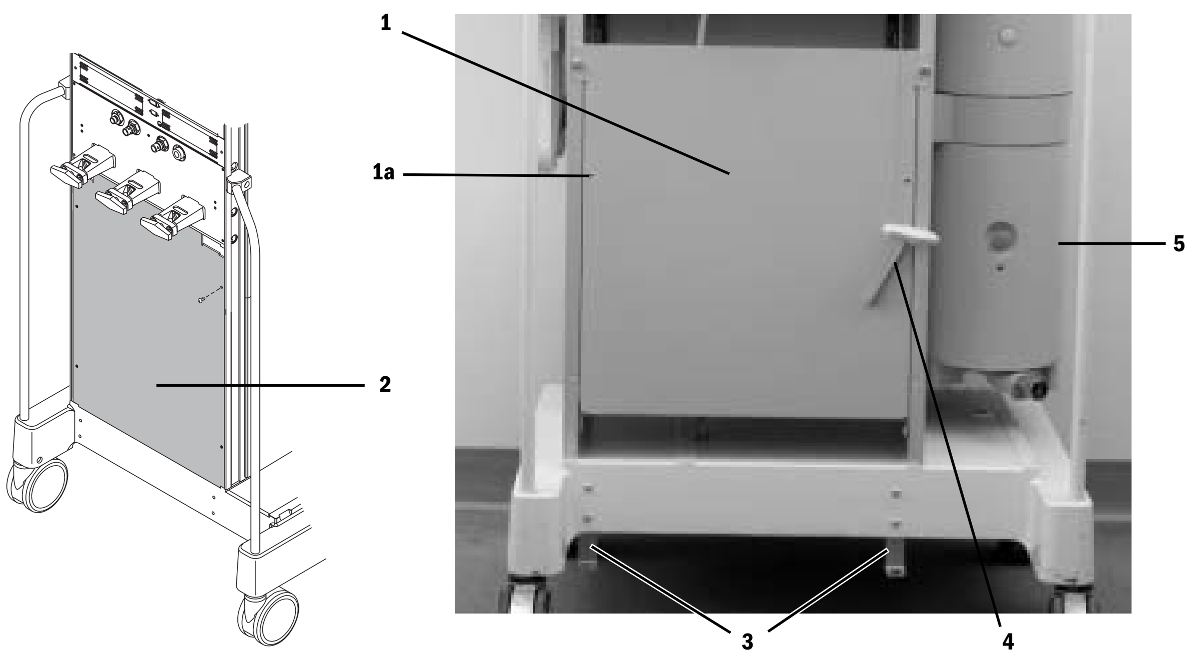


Item	Description	Stock Number
1	Panel, rear gas block (with pneumatic manifold)	1006-1350-000
Refer to Section 8.35 for applicable labeling	Panel, rear gas block (with individual manifolds)	M1057386
	Panel, Pendant machine (with pneumatic manifold)	1006-4204-000
	Panel, Pendant machine (with individual manifolds)	M1088104
	Screw, M5 x 8 button head (5)	0144-2531-911
2	Cylinder Gas Supplies	Refer to section 8.18
	**Cover, empty regulator position	1006-4655-000
	**Nuts, for empty regulator cover (2)	0144-3717-314
3	Gasket, cylinder supply	1006-3653-000
4	Pipeline Inlets	Refer to section 8.20.1
	Label, if no pipeline inlet (with pneumatic manifold)	1006-1368-000
	Label, if no pipeline inlet (with individual manifolds)	M1080906
5	Power Outlet	Refer to section 8.19
	Cap plug, if no power outlet	1006-1358-000
6	Bracket, cylinder cover, upper	1006-1042-000
	Nylon rivet (plug), if no cylinder cover	1006-3240-000
7	Suction items	Refer to section 8.38
	Shoulder items	Refer to section 8.17.2
8	Guard, power cord	0234-1004-510
	Screw, M4x8 Pozidriv (2)	1006-3178-000
	Power cord	Refer to section 8.14
9	AC inlets	Refer to section 8.14
	AC inlet components	Refer to section 8.14.1
10*	Panel, wide extension cover, 3-Vap	1006-5184-000
11*	Cover, wide extension, 3-Vap	1006-1425-000
12	Handle	1006-5216-000

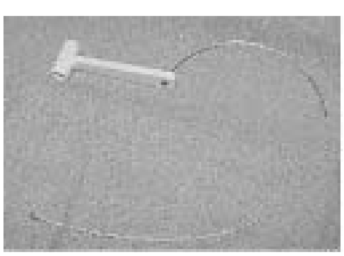
* To remove the panel (Item 10) for the 3-Vap extension, first loosen the two threaded rods that pass through the outside extrusion and hold the extension cover (Item 11) in place.

8.5 Rear panel — lower

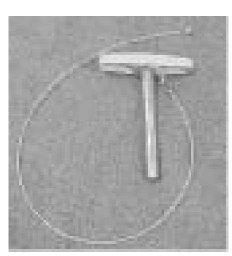
Item		Description	Stock Number
1		Rear Door Assembly	1006-8279-000
1a		Cable Assembly	1006-3721-000
2		Rear Cover	1006-8449-000
3		Bracket, cylinder cover, lower	1006-1509-000
4		Cylinder wrenches	-------------------
	4a	Cylinder wrench and cable	0219-3415-800
	4b	Cylinder wrench and cable, Tee-Handle (if cylinder cover installed)	0219-3412-800
	4c	Cylinder wrench (DIN) Cable, 530 mm Sleeve, chain bead	1202-3651-000 1010-3049-000 1001-3708-000
5		Breathing System	Refer to section 8.27



4a



4b



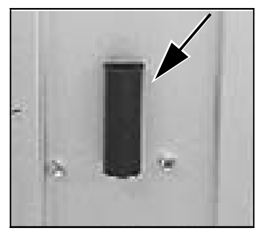
4c

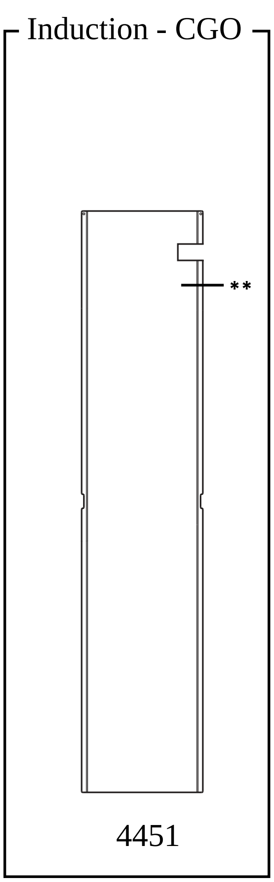
8.6 Side panels

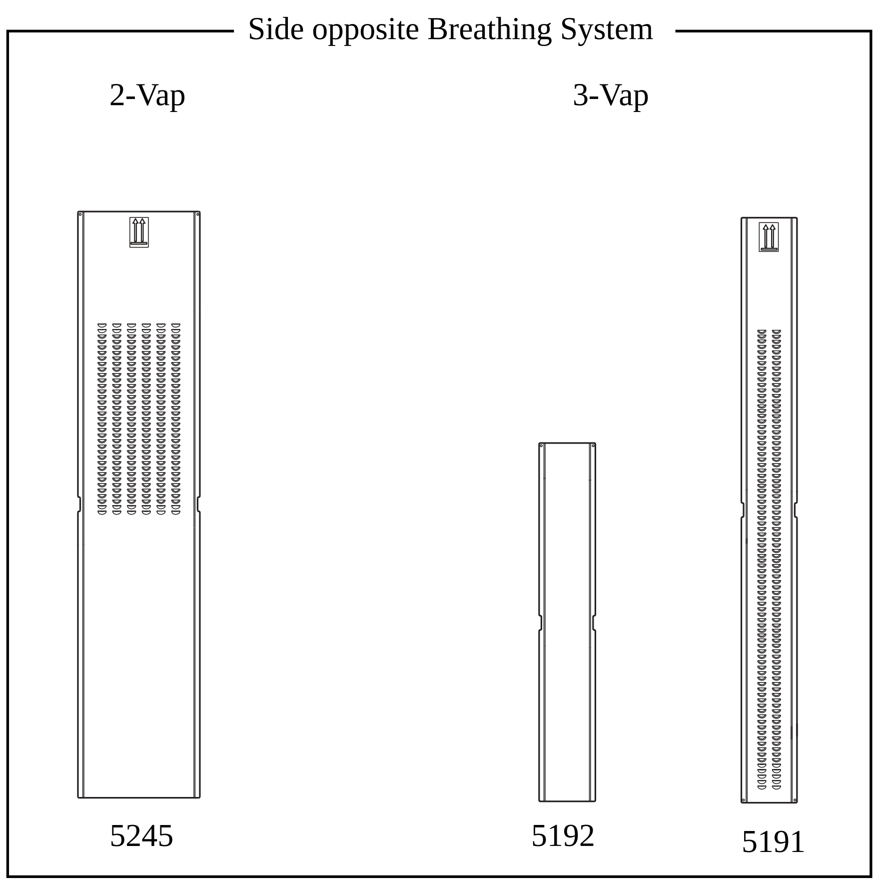
	Left-hand Machines						Right-hand Machines				Stock Number
	2-Vap				3-Vap		2-Vap		3-Vap		
	Ind*	Comp*	Arm	Lever	Arm	Lever	Arm	Lever	Arm	Lever	
Sideopposit eBreathingS ystem	X	X	X	X			X	X			1006-5245-000
					X	X			X	X	1006-5191-000
					X	X			X	X	1006-5192-000
BreathingSys temside		X	X		X		X		X		1006-5248-000
				X		X					1006-5246-000
								X		X	1006-5247-000
		X	X	X	X	X					1006-5190-000
							X	X	X	X	1006-5196-000
CGO side	X										1006-4451-000
										Seal	1006-4154-000

*Ind = Induction Comp = Compact

** Requires part "E" of label set (Refer to section 8.8).

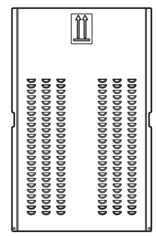






Breathing System side - Top

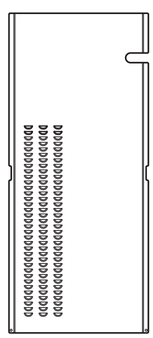
with Display Arm



5248

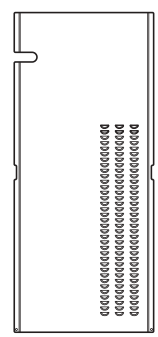
with Folding Display Mount

Left-hand machine



5246

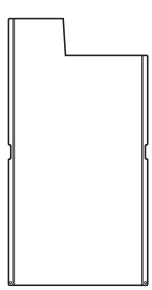
Right-hand machine



5247

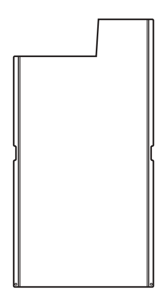
Breathing System side - Bottom

Left-hand machine



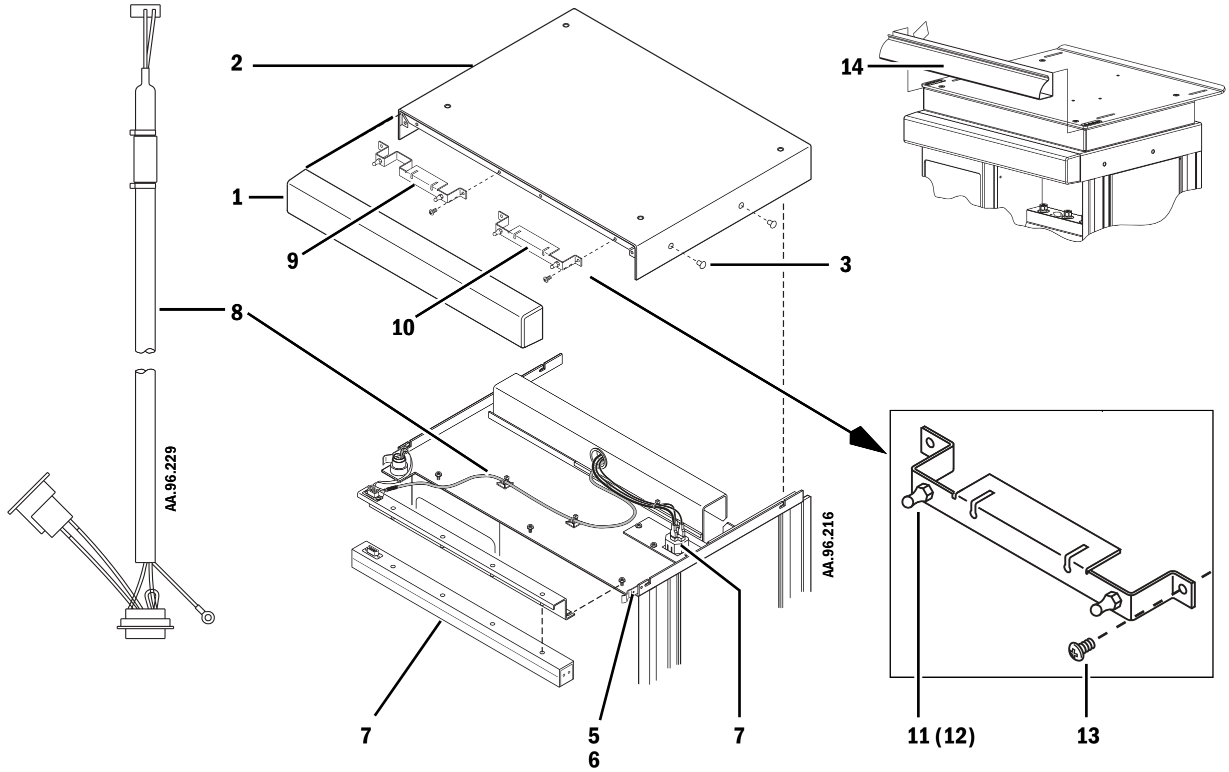
5190

Right-hand machine



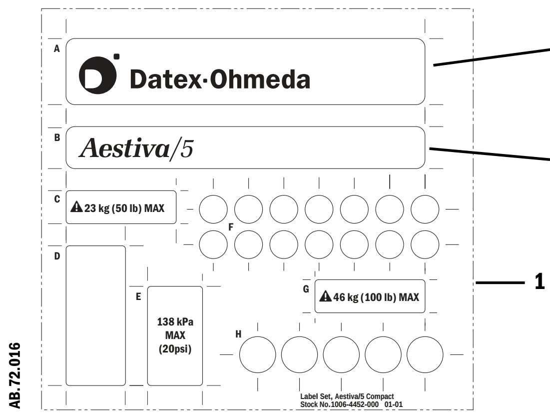
5196

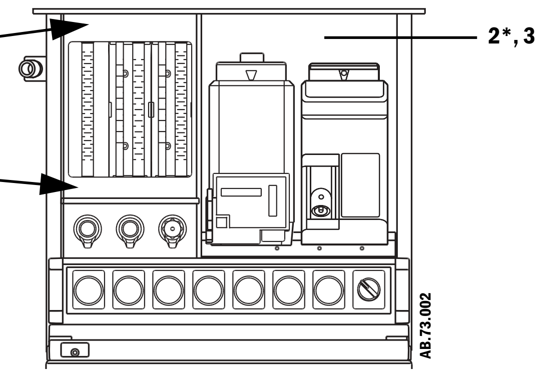
8.7 Upper shroud parts (lighting and bezel)



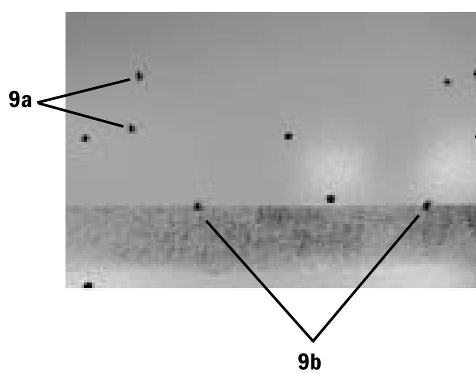
Item	Description	Stock Number
1	Bezel, Aestiva 3000	1006-3974-000
	Bezel, Aestiva/5	1006-4321-000
2	Shroud, upper enclosure	1006-1104-000
3	Plug, hole, plastic (4 per 2-Vap shroud; 2 per 3-Vap shroud)	1006-3199-000
4	Power Outlet, Tec 6	1006-3558-000
5	Clip, bezel	1006-1523-000
6	Nut, M4 Kep	0144-3717-314
7	Task Light (with LED lights)	1006-3025-000
	• Replacement board (with LED lights)	1006-4441-000
	• Bulb, task light strip (type 194) - for original design task light only	1006-3672-000
	• End Cap, for original design task light only	1006-8388-000
8	Light harness	1006-3802-000
9	Bracket, left-hand bezel support	1006-1462-000
10	Bracket, right-hand bezel support	1006-3197-000
11	Stud ball	1202-3272-000
12	Nut, M4 Keps	0144-3717-314
13	Screw, M4x8	1006-3178-000
14	Raceway, cable management 47.5 upper shelf	1006-4246-000
	Raceway, cable management 67.5 upper shelf	1006-4247-000
	Raceway, cable management 87.5 upper shelf	1006-4248-000
Not Shown:		
	Bulb, Gooseneck Light (type 1815) 2.4W	1006-3673-000
	Label, Gooseneck Light	1006-4797-000
	O-ring Kit, Gooseneck Light Hood	1006-1524-000

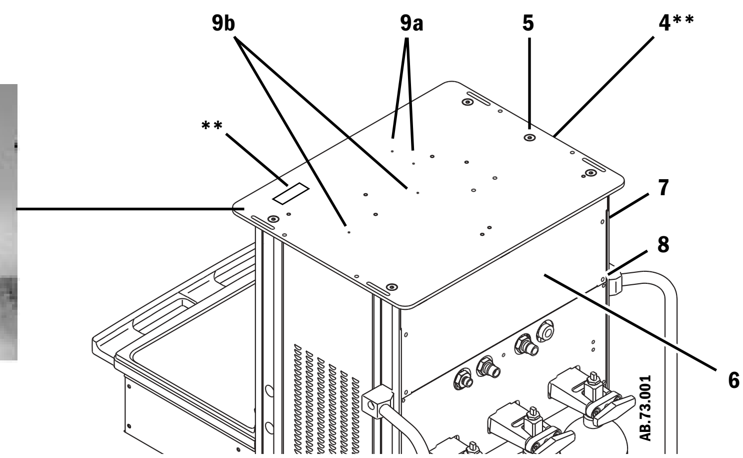
8.8 Compact/Induction Trolley label set and headframe parts





viewed from below

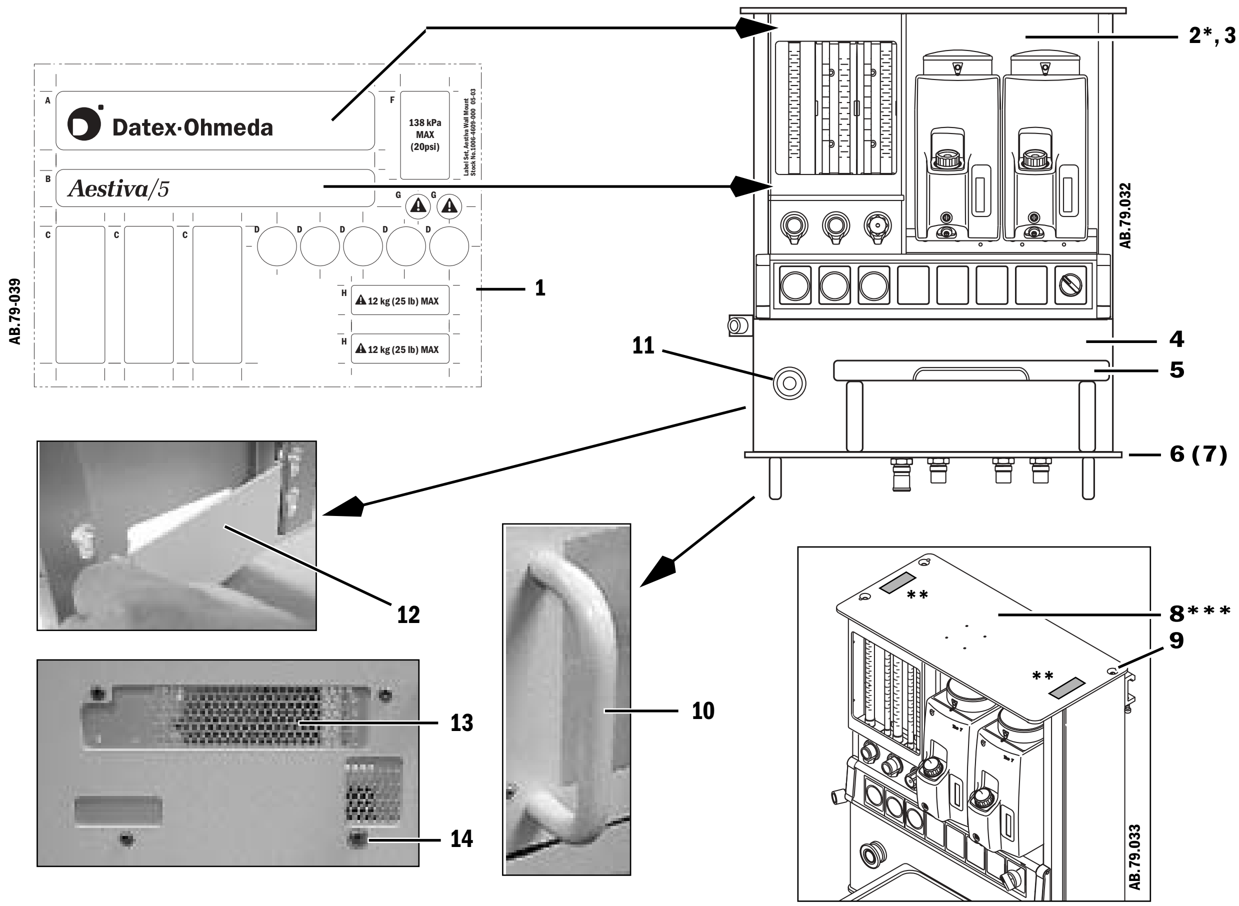




Item	Description	Stock Number
1	Label Set (Trolley)	1006-4452-000
2*	Panel, above vaporizer manifold	1006-4450-000
3	Screw, M4x10 CSK SKT HD	0140-6226-119
4**	Plate, machine top	1006-1338-000
5	Screw, M8x20 FL SKT HD	0144-2440-821
6	Cover, upper rear Induction	1006-3073-000
7	Screw, M4x8 BT SKT HD (2)	0140-6226-118
8	Screw, M5x8 BT SKT HD (2)	0144-2531-911
9***	Pin	0143-3208-506

* This panel is mounted to the back of the vaporizer manifold with two screws. The top of the panel is backed up by two pins in the top plate (item 9b).
** For Compact, apply label “G” — For Induction, apply label “C”.
*** These pins are inserted into the top plate from below. Compact machines require two pins (at location 9a); Induction machines require four pins (at location 9a and 9b).

8.9 Wall-rail mount label set and headframe parts



Item	Description	Stock Number
1	Label Set (wall-rail mount)	1006-4609-000
2*	Panel, above vaporizer manifold	1006-4450-000
3	Screw, M4x10 CSK SKT HD	0140-6226-119
4	Panel, front wall-rail mount	1006-4489-000
5	Flip-up Shelf	Refer to section 8.34
6	Plate, base	1006-4485-000
7**	Screw, M8x25 CAP CTSK SKT	0144-2440-820
8***	Plate, machine top (includes pins)	1006-4486-000
9	Screw, M8x20 FL SKT HD	0144-2440-821
10	Handle	1006-5216-000
	** Screw, M6x16	0144-2436-000
11	O_2 Flush	Refer to section 8.13
12	Cover	1006-4658-000
	Washer, flat 5.3 ID, 10.0 OD	1006-1459-000
	Nut, M4 Keps	0144-3717-314
13	Cover, base plate Induction	1006-4530-000
14	Screw, M4x8 DIN84	1006-3178-000

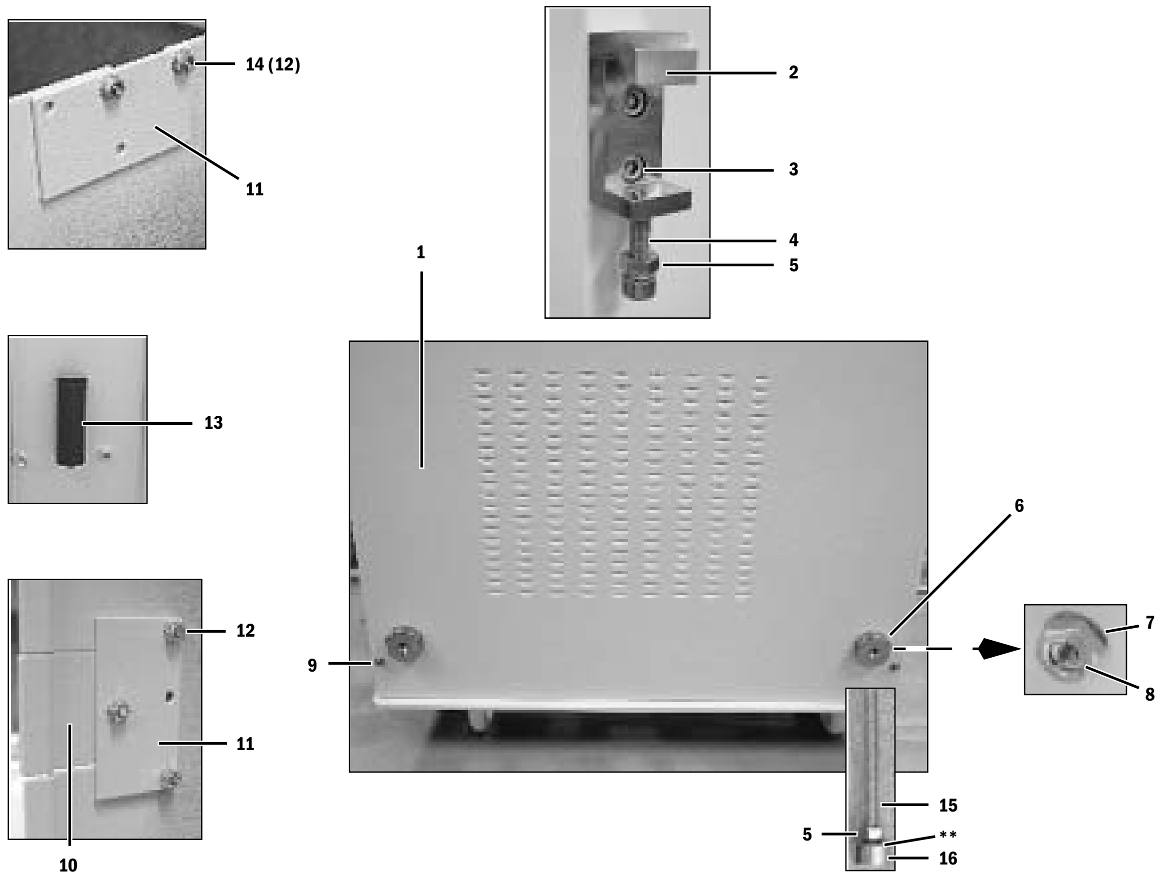
Refer to Section 8.35 for applicable base plate labeling

* This panel is mounted to the back of the vaporizer manifold with two screws. The top of the panel is backed up by two pins in the top plate.

** Apply Loctite 242.

*** Apply label "H" to top plate along each side.

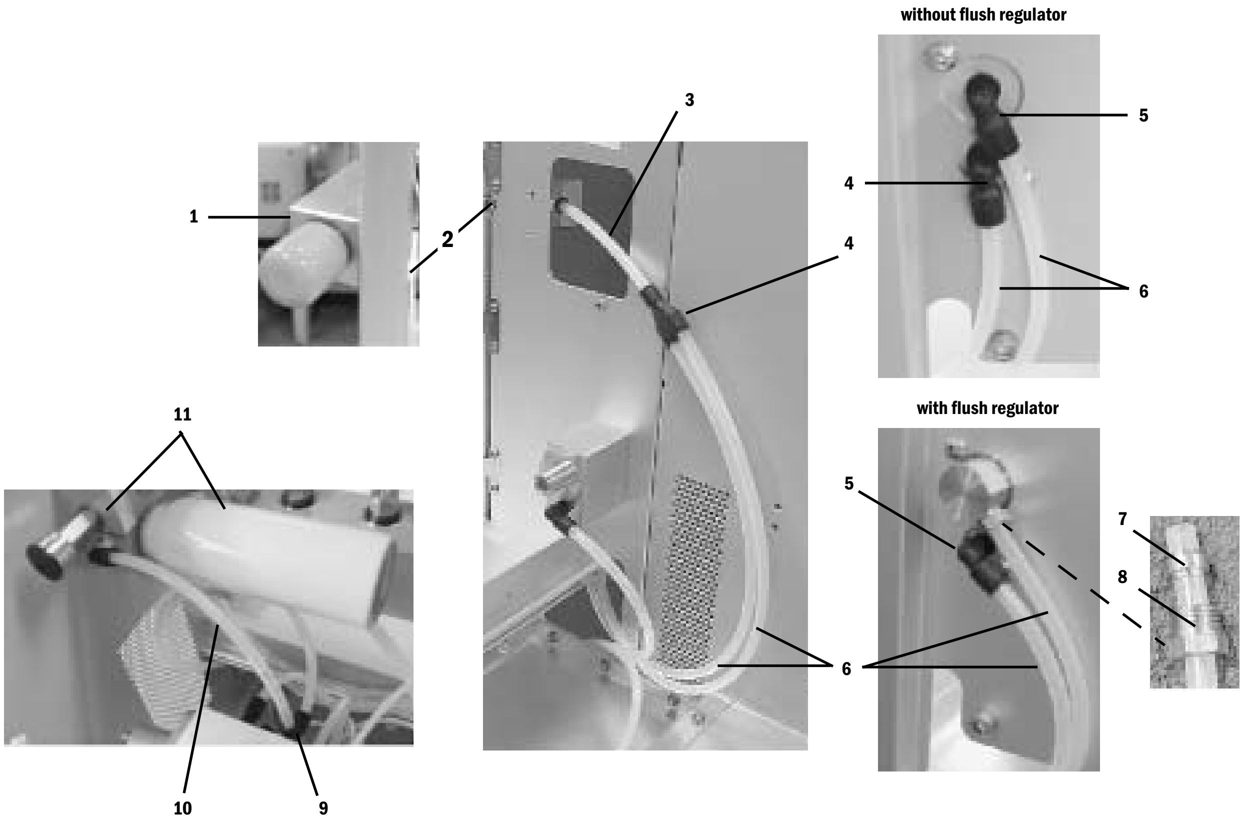
8.10 Wall-rail mount wrapper components



Item	Description	Stock Number
1	Wrapper, wall mount (does not include replacement serial number label)	1006-4487-000
2	Rail Clamp, wall mount	1006-4488-000
3*	Screw, M6x20 SKT HD CAP	0144-2131-921
4	Screw, M8x35 SKT HD CAP	0144-2148-245
5	Nut, M8	0144-3340-120
6	Bushing, threaded	1006-4496-000
7	Lockwasher, 1/2 inch internal	1010-3024-000
8	Nut, 1/2-20	0144-3356-113
9	Screw, M4x8 DIN84	1006-3178-000
10	Cover, CGO hole (for Compact)	1006-4532-000
11	Cover, cable cutout	1006-4543-000
12	Nut, M3 Keps	0144-3717-302
13	Seal	1006-4154-000
14	Screw, M3x8	1006-3242-000
15**	Rod, threaded M8x90	1006-4498-000
16**	Cap, standoff wall mount	1006-4497-000

* Apply Loctite 242.
** Apply Loctite 680 to retain cap (high strength retaining compound).

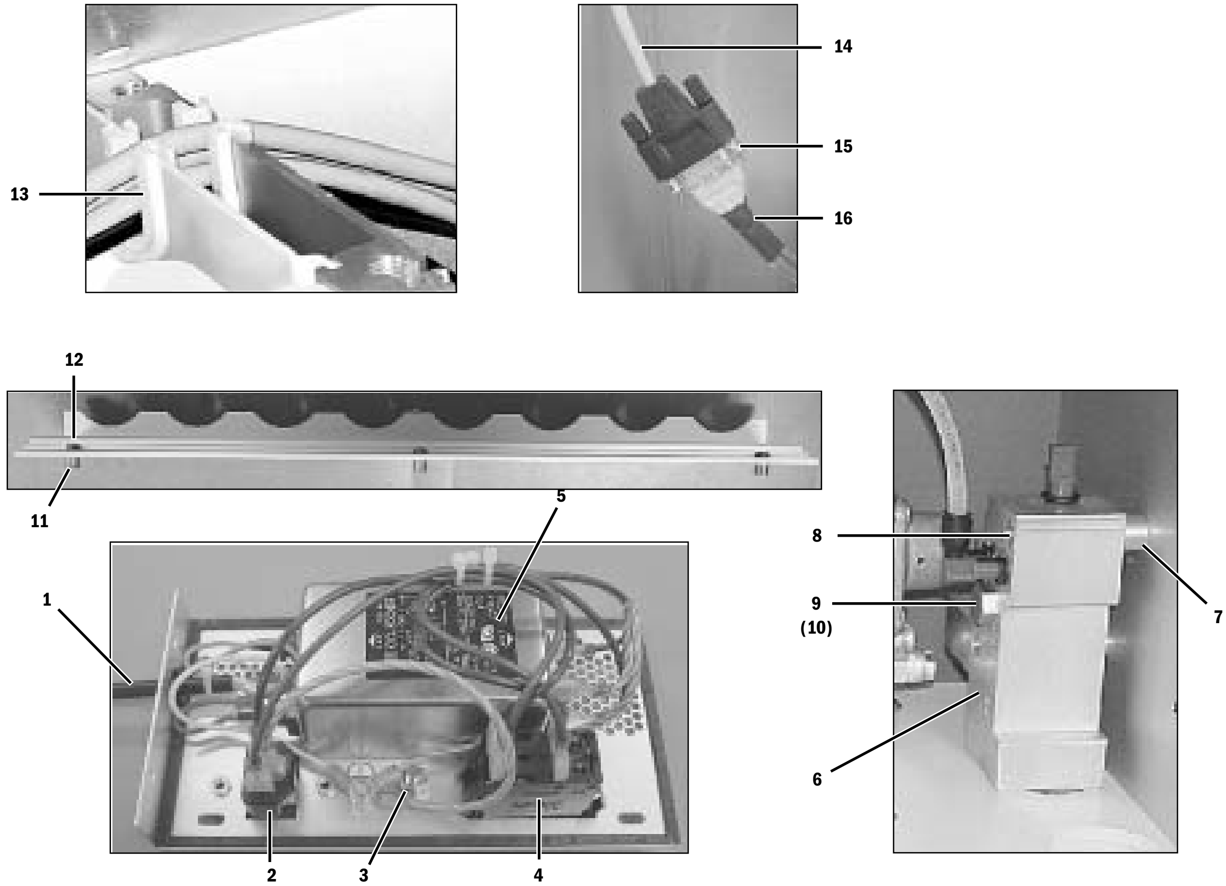
8.11 Induction machine pneumatic components



Item	Description	Length - Width	Stock Number
1	Common Gas Outlet, Induction		1006-8288-000
2*	Screw, M8x16 SKT LOW HEAD CAP		0144-2140-242
3	Tubing, 1/4 inch OD	120 mm - 1/4 in	1001-3064-000
4	Fitting, 1/4 inch Y		1006-3065-000
5	Fitting, 1/4 inch, plug-in elbow		1006-3737-000
6	Tubing, 1/4 inch OD (2)	500 mm - 1/4 in	1001-3064-000
7	Ferrule, enots 3/8 inch OD		9913-6562-700
8	Nut, enots		9913-6562-600
9	Fitting, Tee, 6-mm tube/tube/standpipe		1006-3862-000
10	Tubing, 6 mm	175 mm - 6 mm	1001-3062-000
11*	O_2 Alarm, pneumatic (with mounting screws)		1006-3719-000

* Apply Loctite 242

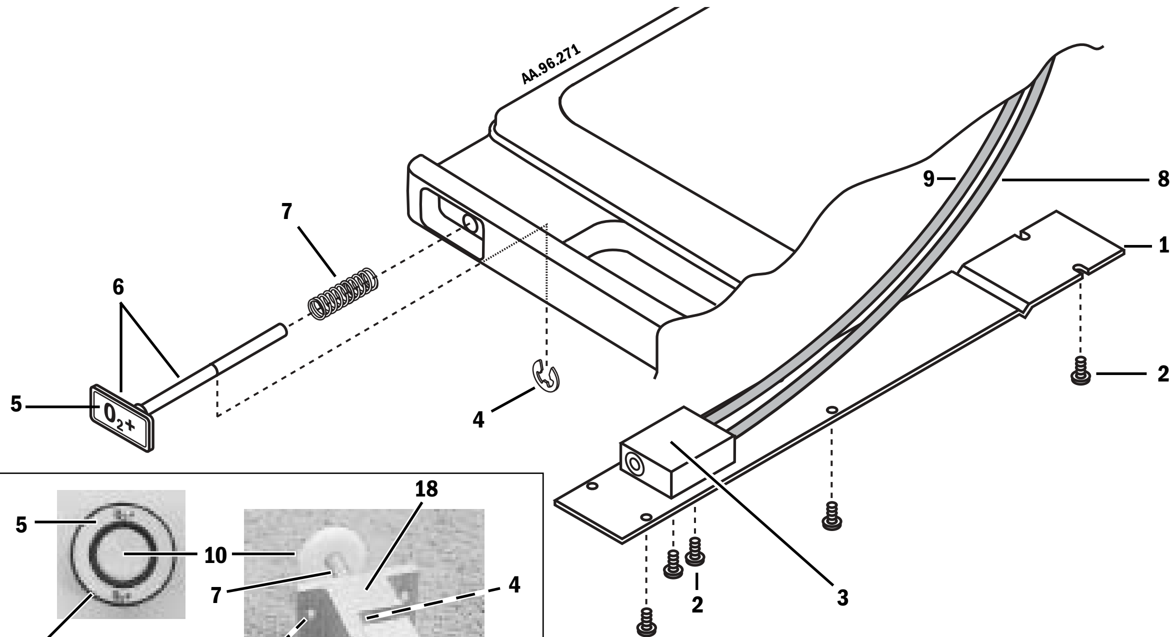
8.12 Compact/Induction wall-rail mount components

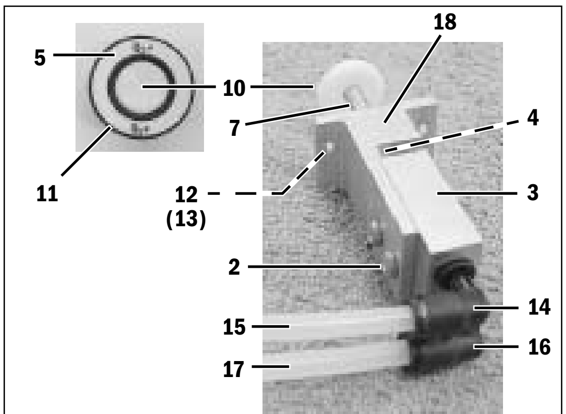


Item	Description		Stock Number
1	Power Cord, 7100 wall mount		1006-4529-000
2	Inlet, AC		1006-3554-000
3	Stud, Equal Potential, 6 mm		0208-0070-300
4	Circuit Breaker, 6A Rocker		1006-3773-000
5	Filter, AC Line, 100-240V		1504-5100-000
6	Gas Inlet Manifold (replacement)	O_2	1009-8066-000
		N_2O	1009-8067-000
		Air	1009-8068-000
7	Spacer		1006-4671-000
8*	Screw, M4x20		0144-2124-218
9	Plug, 7/16-20 M 12.7 HEX		1006-4672-000
10**	O-ring		0210-0579-300
11	Retainer, front panel		1006-4493-000
12*	Screw, M4x8 DIN84		1006-3178-000
13	Grommet (cut to size 33 mm)		1504-3529-000
14	Cable, to display control board		1504-5606-000
15	Jackpost, spacer (two included with hardware)		0402-0250-300
16	Cable, from machine switches		1006-4528-000

* Apply Loctite 242.
** Lubricate sparingly with Krytox.

8.13 Flush Button/Valve

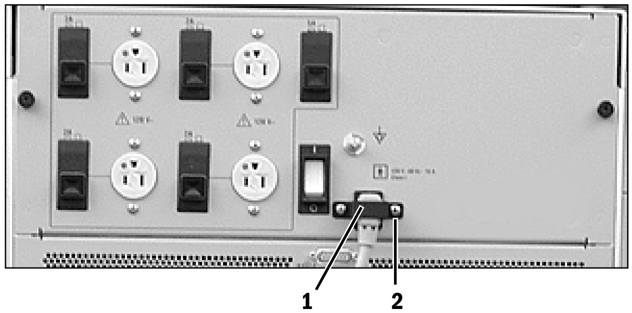




Wall-rail mount

Item	Description		Stock Number
1	Cover, flush rod		1006-1215-000
2	Screw, M4x8, DIN 84		1006-3178-000
3	Flush valve assembly		1006-8357-000
4	E-Ring		0203-5225-300
5	Label Set, O_2 flush	(Gray)	1006-1075-000
		(Green)	1006-4685-000
6	Flush button with rod		1006-1534-000
7	Spring, compression, square end		1006-3186-000
8	Flexible tubing, 1/4 inch x 610 mm, mixed gas		1001-3064-000
9	Flexible tubing, 6 mm x 915 mm, O_2		1001-3062-000
10	Flush button with rod		1006-4495-000
11	Shroud, O_2 flush		1001-4088-000
12	Screw, M3x10		0140-6719-101
13	Lockwasher, M3 internal		9213-0430-003
14	Elbow (tube/standpipe) 6 mm, O_2		1006-3534-000
15	Flexible tubing, 6 mm x 460 mm, O_2		1001-3062-000
16	Elbow (tube/standpipe) 1/4 inch, mixed gas		1006-3737-000
17	Flexible tubing, 1/4 inch x 360 mm, mixed gas		1001-3064-000
18	Bracket, flush valve mount		1006-4494-000

8.14 AC inlets and Power cords

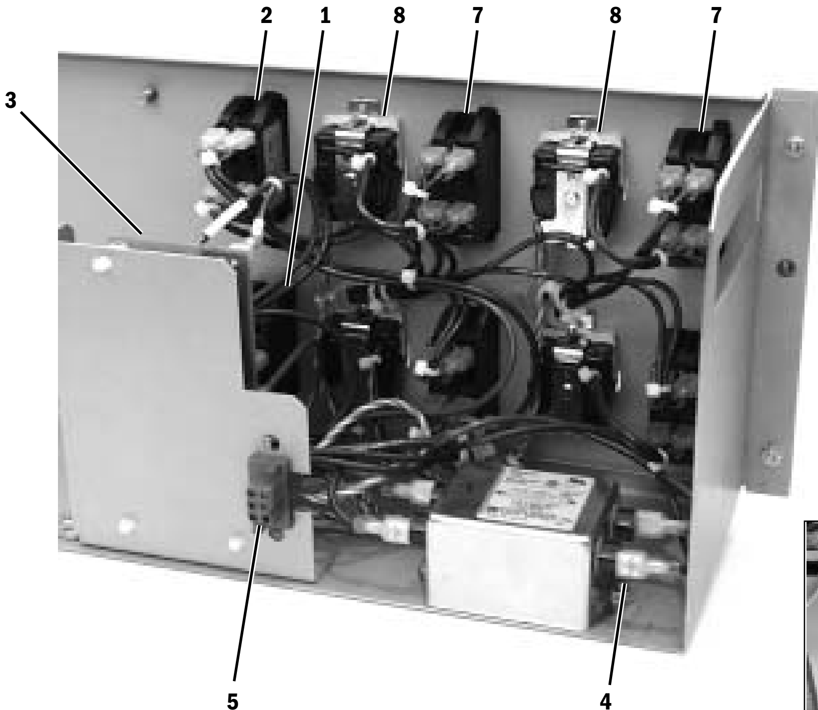


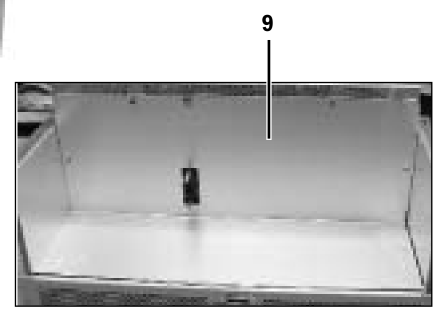
Item	Description	Stock Number with 7900	Stock Number with 7100
1	Cord retainer (all except China) Cord retainer (China)	0234-1004-510 M1054196	0234-1004-510 M1054196
2	Screw, M4x8 DIN84	1006-3178-000	1006-3178-000
	AC Inlet 100–120 VAC without outlets	1006-4326-000	1006-7087-000
	AC Inlet 220–240 VAC without outlets	1006-3732-000	1006-7088-000
	Australia, 220 VAC with four AS 3112 outlets Power Cord	1006-3818-000 1006-3888-000	1006-7052-000 1006-3888-000
	China Power Cord	Refer to section 8.14.1 M1053942	Refer to section 8.14.1 M1053942
	Danish, 220 VAC with four AFSNIT 107-2-01 outlets Power cord	1006-3819-000 1011-3696-000	1006-7054-000 1011-3696-000
	EURO, 220 VAC with four CEE 7/7 outlets Power Cord	1006-3726-000 1001-3380-000	1006-7048-000 1001-3380-000
	France, 220 VAC with four CEE 7/4 outlets Power Cord	1006-3728-000 1001-3380-000	1006-7049-000 1001-3380-000
	India and South Africa, 220 VAC with four BS546 outlets Power Cord	1006-3820-000 1006-3885-000	1006-7053-000 1006-3885-000
	Japan, 100 VAC with three Japanese outlets Power Cord	1006-3729-000 1006-3907-000	1006-7050-000 1006-3907-000
	NA, 120 VAC with four Nema 5-15 outlets Power Cord	1006-7067-000 1006-3907-000	1006-7047-000 1006-3907-000
	Swiss, 220 VAC with four SEV 1011 outlets Power Cord	1006-3822-000 1006-3889-000	1006-7055-000 1006-3889-000
	UK, 220 VAC with four BS1363 outlets Power Cord	1006-3730-000 1006-3884-000	1006-7051-000 1006-3884-000

8.14.1 AC Inlet Components

Item	Description	Stock Number	
1	Inlet, AC, Outlet Box	1006-3554-000	
2	Circuit Breaker, 3A, Rocker	1006-3785-000	
	Circuit Breaker, 5A Rocker	1006-3566-000	
	Circuit Breaker, 6A Rocker	1006-3773-000	
	Circuit Breaker, 10A Rocker	1006-3568-000	
3	Circuit board, Inrush, 100-120V	1006-3245-000	
	Circuit board, Inrush, 220-240V	1006-3246-000	
	Circuit board, Transient Suppression, 100-120V	1006-3788-000	
	Circuit board, Transient Suppression, 220-240V	1006-3789-000	
4	Filter, AC Line, 100-120/220-240V	1006-3724-000	— 7900 Vent
	Filter, AC Line, 100-240V	1504-5100-000	— 7100 Vent
5	Harness, Outlet, with output connector, 100-120V	1006-4015-000	— 7900 Vent
	Harness, Outlet, with output connector, 220-240V	1006-4016-000	— 7900 Vent
	Harness, Outlet, with output connector, 100-240V	1504-5707-000	— 7100 Vent
6	Screw, Snap-in Receptacle	1006-3200-000	
7	Circuit Breaker, 1A,	1006-3561-000	
	Circuit Breaker, 2A	1001-3312-000	
	Circuit Breaker, 3A	1006-3563-000	
	Circuit Breaker, 4A	1001-3203-000	
	Circuit Breaker, 5A	1006-3565-000	
			Stock Number for cover
8	Outlet Receptacle, Australia/China, AS 3112	1001-3305-000	NA*
	Outlet Receptacle, Danish, AFSNIT 107-2-D1	1011-3910-000	
	Outlet Receptacle, EURO, CEE 7/7	1202-3551-000	1009-4708-000 (shield)
	Outlet Receptacle, France, CEE 7/4 (**see Note**) Support Frame, snap in	1006-4421-000 1006-4422-000	NA*
	Outlet Receptacle, India and South Africa, BS 546	1006-3805-000	NA*
	Outlet Receptacle, Japanese	1006-3578-000	1009-3439-000 (plug)
	Outlet Receptacle, NA, Nema 5-15	1006-3555-000	1009-3439-000 (plug)
	Outlet Receptacle, Swiss, SEV 1011	1006-3807-000	1006-4709-000 (shield)
	Outlet Receptacle, UK, BS1363	1001-3309-000	NA*
9	Cover, electrical enclosure	1006-4299-000	
Not Shown:			
	Stud, Equal Potential, 6 mm	0208-0070-300	
	Toroid, 100-120V, with plate	1006-1516-000	
	Toroid, 220-240V, with plate	1006-1517-000	
	Nut, M6 Keps (to mount Toroid)	0144-3717-330	

* Not Applicable

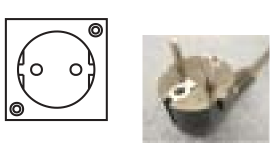




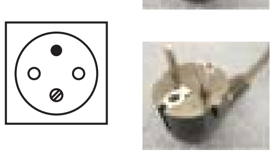
AA.96.228

AS 3112/GB2099
Australia/China

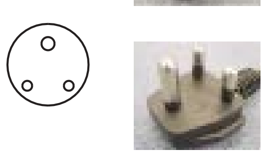
AFSNIT 107-2-D1
Danish,



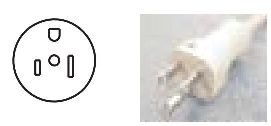
CEE 7/7
EURO



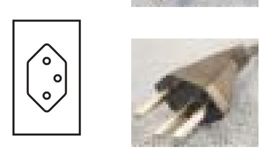
CEE 7/4
France (**see Note**)



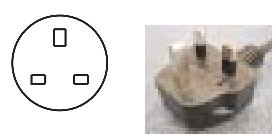
BS 546
India and South Africa



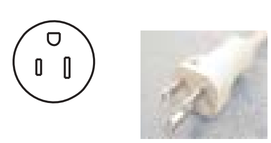
Nema 5-15
Japanese



SEV 1011
Swiss,



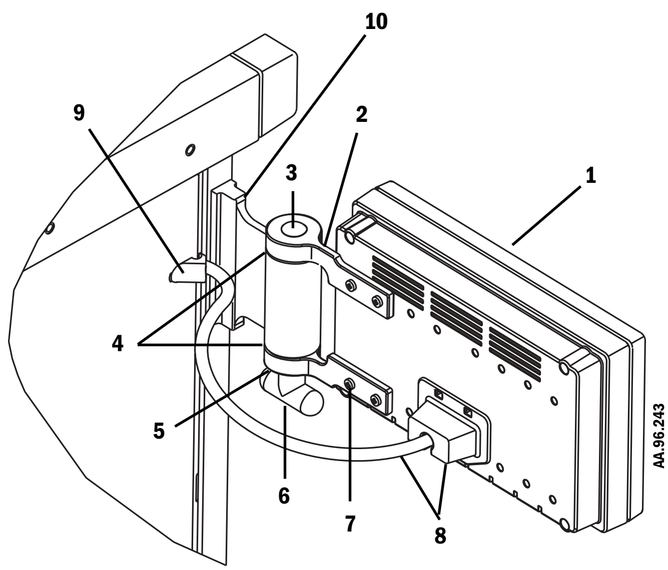
BS1363
UK



Nema 5-15
NA

Note: The shutter style French outlet (1006-4421-000) is not a direct replacement for older style French outlets. The older style French outlet (1006-3331-000) is no longer available. If an older style outlet is defective, the complete outlet box assembly must be ordered as a replacement.

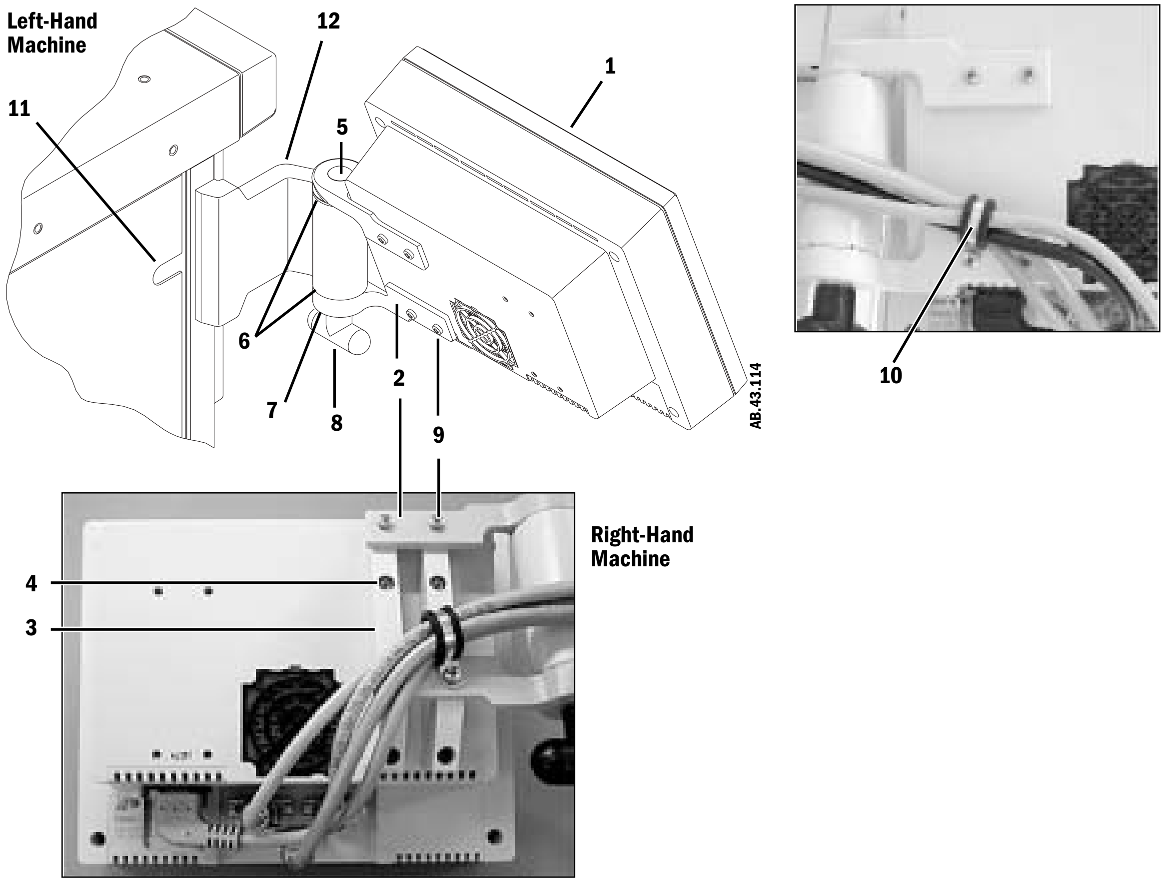
8.15 Display folding mount —7900



Item	Description	Stock Number
1	Display — 7900 Refer to Service Manual 1006-0453-000	
2	Casting, Vent Bracket (2)	1006-1533-000
3	Bolt, carriage	1006-1433-000
4	Bearing, white plastic (2)	1006-3228-000
5	Washer, flat	9213-0180-006
6	Handle, T-clamping	1301-3001-000
7	Screw, M4x16 (4) Lockwasher (4)	9211-0440-163 0144-1118-128
8	Harness, Vent CPU to display (Kit)	1006-8056-000
	- Cover (slotted), display connector	1006-1326-000
	- Washer, rectangular	1006-4287-000
	- Screw, M3x6 SST	9211-0430-063
	- Lockwasher, M3	9213-0430-003
9	Clip, cable outlet, screw head side Clip, cable outlet, nut side Screw, M4x8 (1) Nut Screw (mounting), M4x8 (2)*	1006-1470-000 1006-1471-000 9211-0640-083 0144-3536-115 9211-0640-083
10	Extrusion, Vent bracket mount * Screw, M8x16	1006-1431-000 0144-2140-242

* Apply Loctite 242

8.16 Display folding mount — 7100



Item	Description	Stock Number (LH-machine)	Stock Number (RH-machine)
1	Display — 7100 Refer to Service Manual 1006-0836-000		
2	Casting, LH Vent Bracket, 20 degree (2)	1504-3526-000	
	Casting, RH Vent Bracket (2)		1006-1533-000
3	Adapter, 20 degree (2)		1504-3522-000
4*	Screw, M4x20 SKT HD CAP (4)		0144-2124-218
5	Bolt, carriage	1006-1433-000	1006-1433-000
6	Bearing, white plastic (2)	1006-3228-000	1006-3228-000
7	Washer, flat	9213-0180-006	9213-0180-006
8	Handle, T-clamping	1301-3001-000	1301-3001-000
9	Screw, M4x16 (4)	9211-0440-163	9211-0440-163
	Lockwasher (4)	0144-1118-128	0144-1118-128
10	Clamp	1504-3527-000	1504-3527-000
11	Grommet	1504-3529-000	1504-3529-000
12	Extrusion, Vent bracket mount	1504-3514-000	1504-3514-000
	* Screw, M8x16	0144-2140-242	0144-2140-242

* Apply Loctite 242

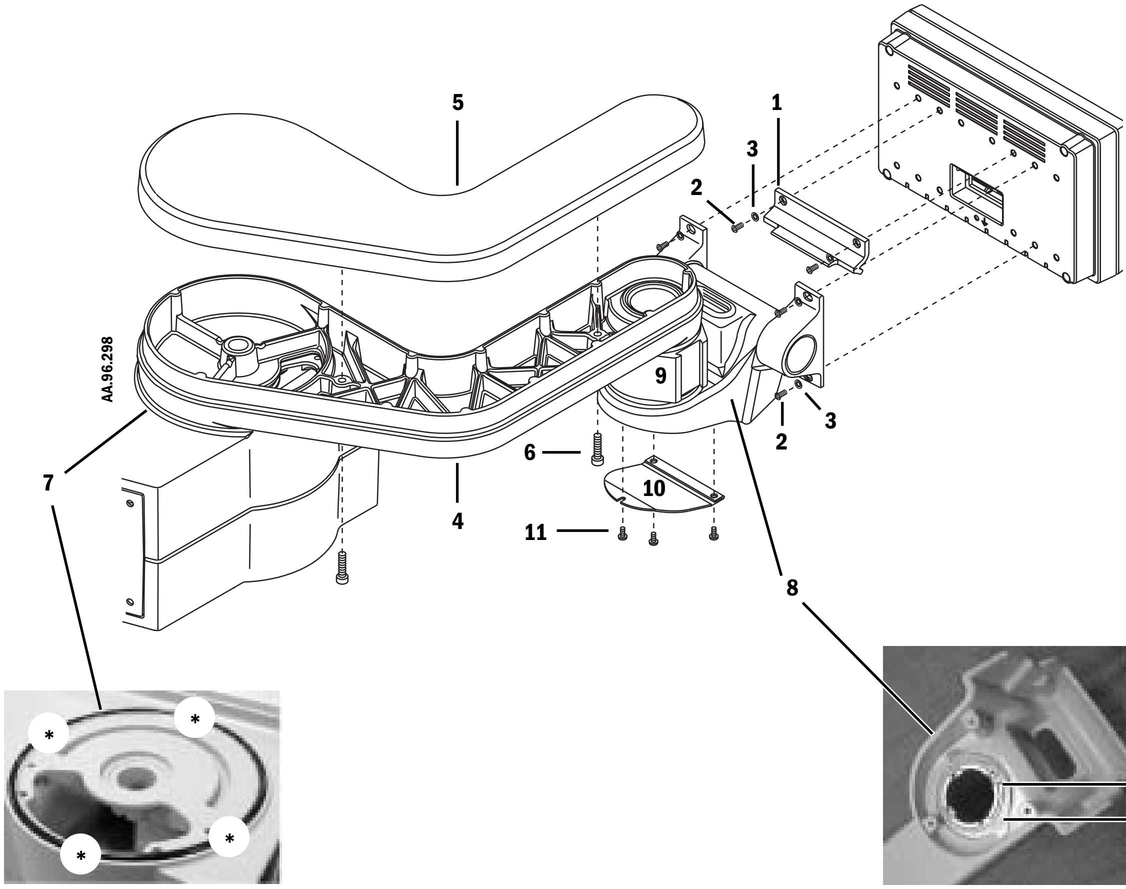
8.17 Display Arm

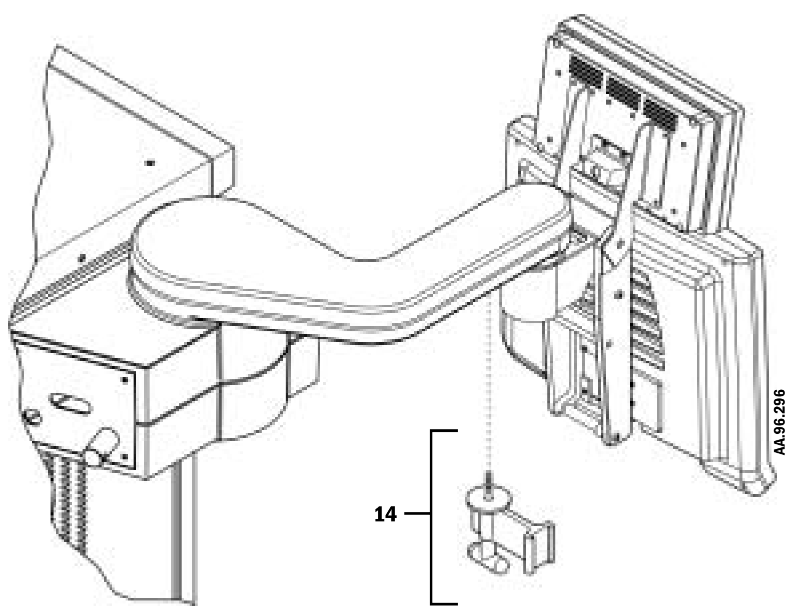
8.17.1 Arm parts list

Item	Description	Stock Number
1	Extrusion, tilt stop	1006-1323-000
2	Screw, M4x12 Pozidriv	0140-6226-111
3	Lockwasher, M4 internal	0144-1118-128
4	Display Arm, with mounting pins each end, display on left of machine	1006-8347-000
	Display Arm, with mounting pins each end, display on right of machine	1006-8419-000
5	Cover, display arm, left hand	1006-1169-000
	Cover, display arm, right hand	1006-1223-000
6	Screw, M6x25, SKT HD (2)	9211-0660-254
7*	O-ring, shoulder, 175.13 OD, 164.47 ID	1006-3229-000
8	Wrist Casting, with mid sleeve, pivot arm	Refer to section 8.17.3
9	Sleeve with dovetail groove ** O-ring	1006-1165-000 1006-1512-000
10	Cover, pivot arm, bottom	1006-1331-000
11	Screw, M4x8 Pozidriv (3)	1006-3178-000
12	Ring Retaining	1006-1162-000
13	Washer, wrist stop	1006-4232-000
14	Dovetail Bracket Kit (for use with Datex-Ohmeda AM mount)	1006-8286-000

* Lubricate sparingly with Krytox four areas of large o-ring, as shown in illustration.
** Lubricate sparingly with Krytox.

Arm parts



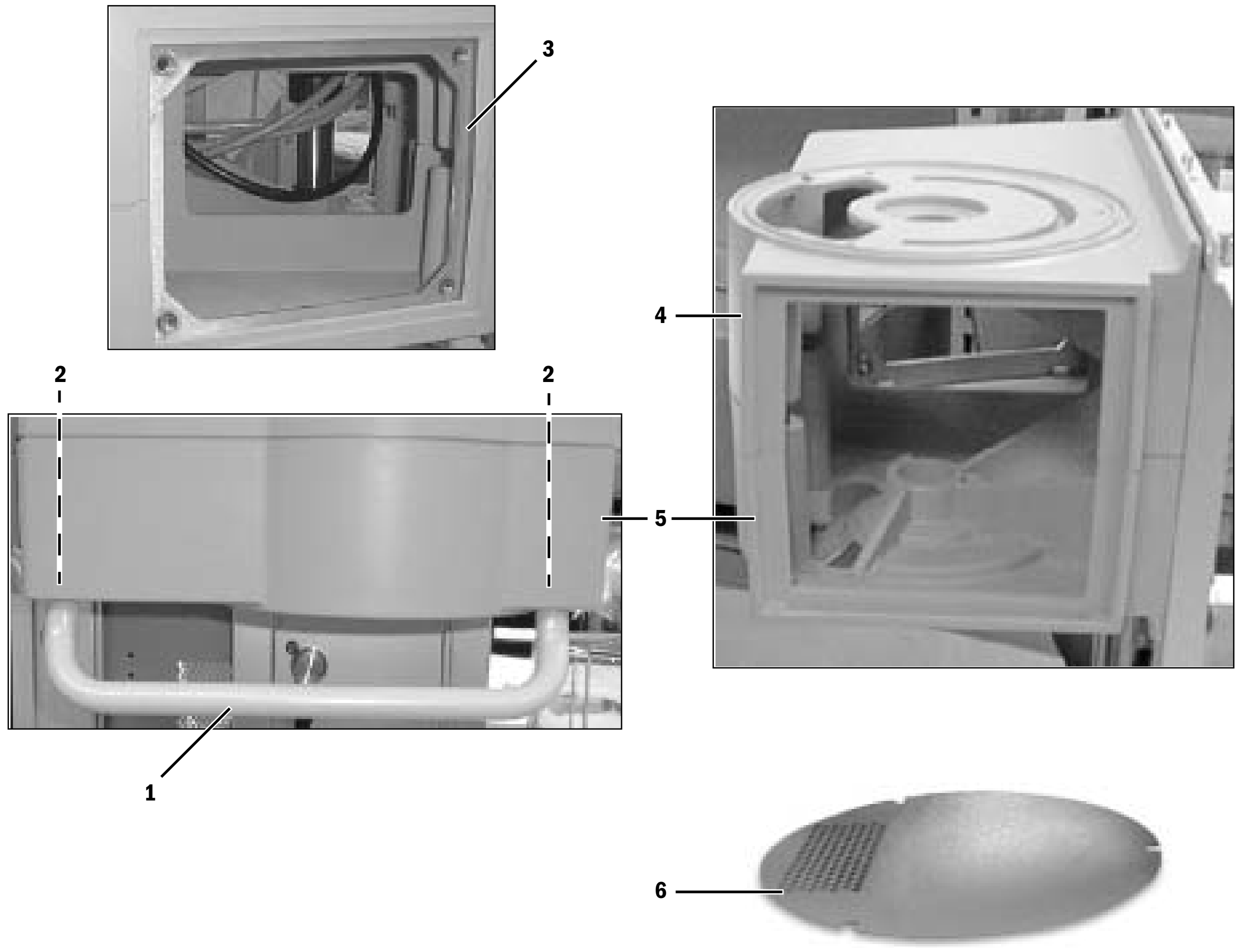


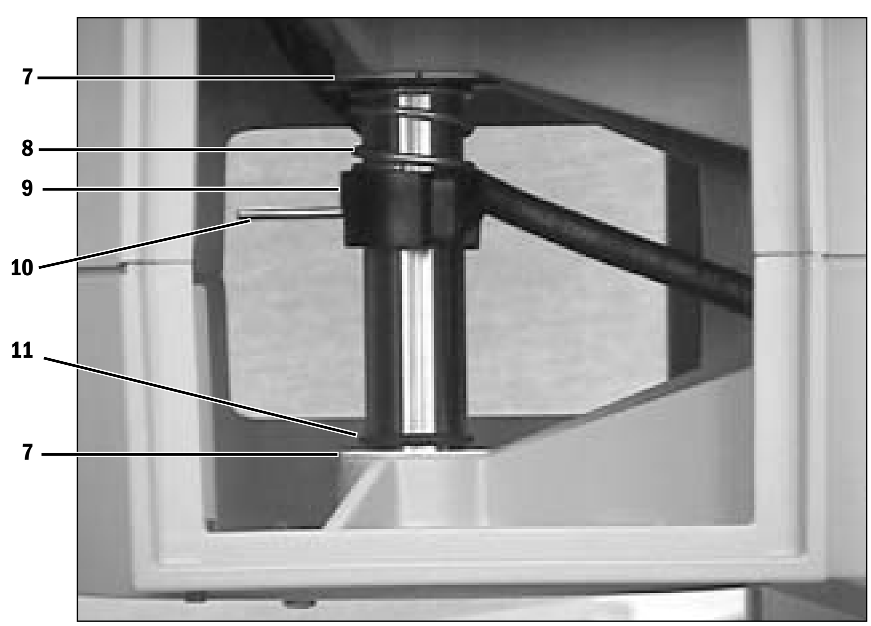
8.17.2 Shoulder parts list

Item	Description	Stock Number
1	Handle, shoulder	1006-3235-000
2	Screw, M6x16 Sems	0144-2436-109
3	Plate, backer pipeline outlet	1006-3234-000
4*	Cover, shoulder	1006-1146-000
5*	Cover, shoulder with lip	1006-1168-000
6	Cover, perforated	1006-3199-000
7	Bearing, Nyliner with key	1006-3228-000
8	Spring, Arm Tension	1006-3233-000
9	Nut, Spring Tension Lock	1006-3232-000
10	Pin, 0.125 inch x 1.5 inch	1006-3299-000
11	O-ring, 22.5 ID 28.5 OD	9221-3022-530

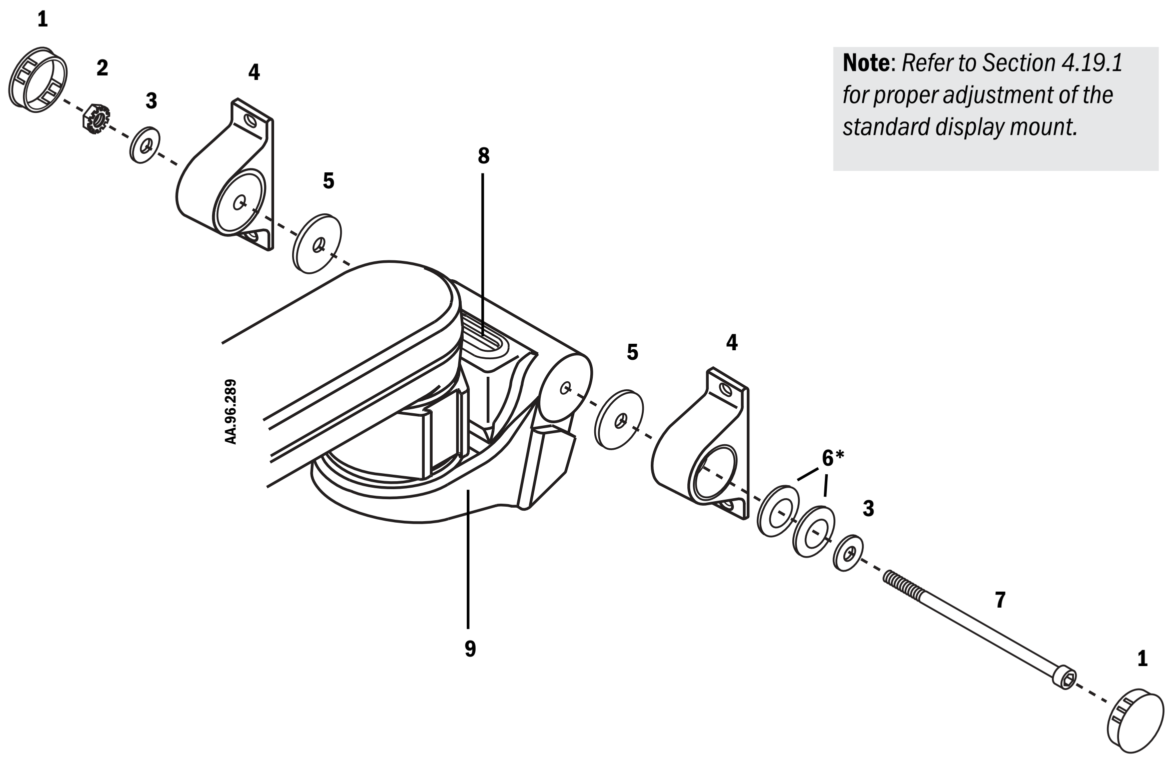
* **Note:** For right-hand machines, Item 4 is mounted in the lower position and Item 5 is mounted in the upper position.

Shoulder parts





8.17.3 Display mount parts (standard)

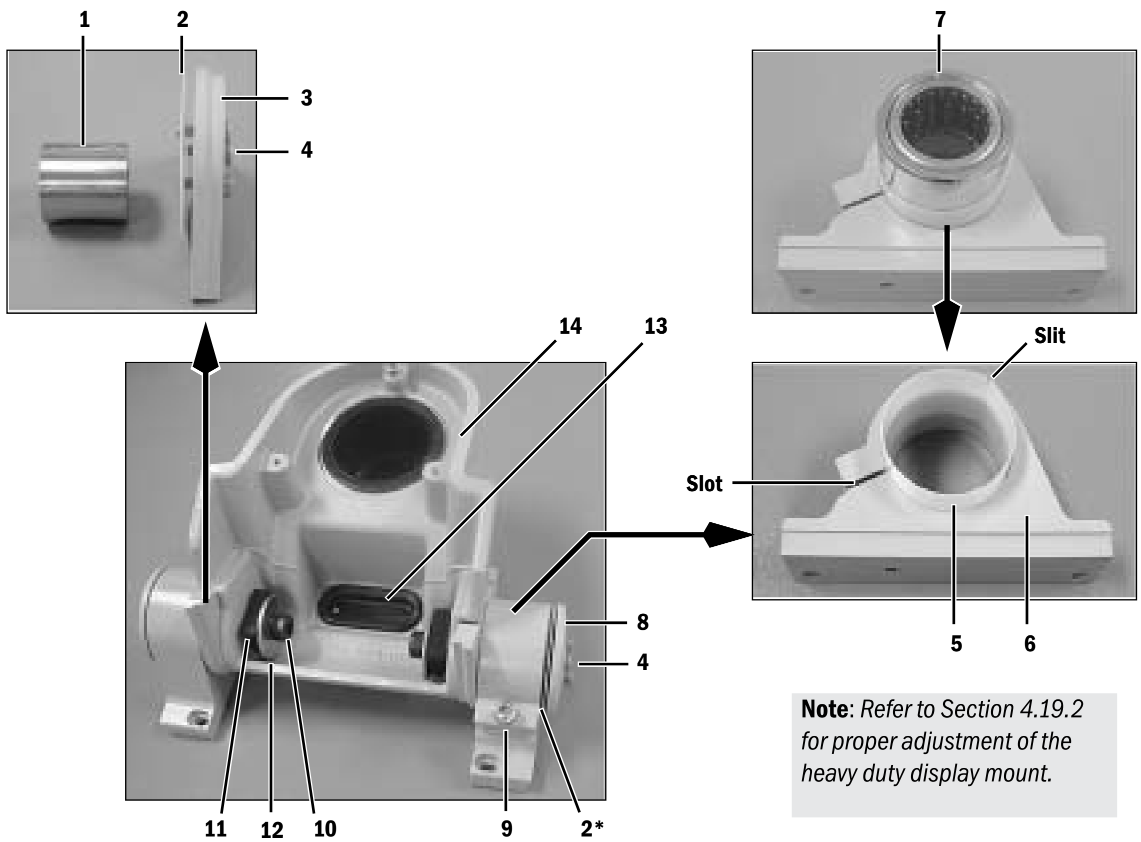


Note: *Refer to Section 4.19.1 for proper adjustment of the standard display mount.*

Item	Description	Stock Number
	Retrofit Display Arm Kit (includes Items 1 through 9)	1006-8074-000
1	Cap, Display Mount Support	1006-3036-000
2	Nut, M8 with external lockwasher	0144-3717-348
3	Washer, flat 0.3125 inch ID 1.0 inch OD	1006-3536-000
4	Housing, Display Mount Support	1006-1144-000
5	Washer, White Delrin	1006-4170-000
6*	Washer, Belleville (2)	1301-3000-000
7	Screw, M8-1.25x150 mm, Socket Head	0144-2140-248
8	Grommet, Pivot Arm	1006-3231-000
9	Wrist Casting, with mid sleeve, pivot arm	1006-7062-000
	** O-ring, wrist casting, 57.45 OD, 50.39 ID (2)	1006-3230-000

* Nest washers in each other. Place on screw with dome of washers facing head of screw.
** Lubricate sparingly with Krytox.

8.17.4 Display mount parts (heavy duty)

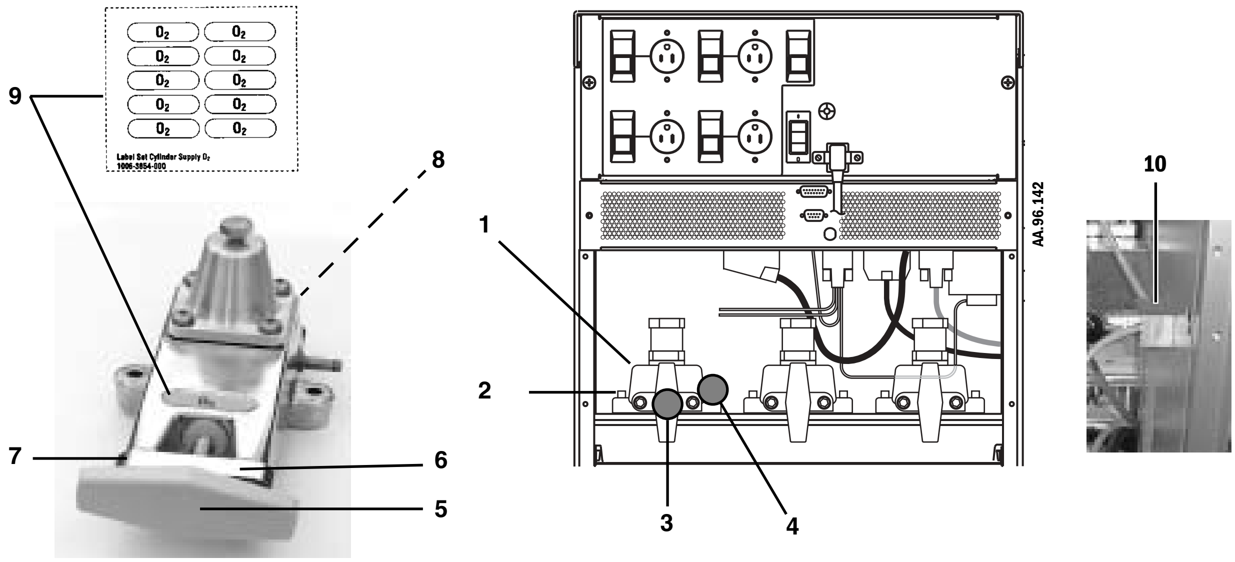


Note: *Refer to Section 4.19.2 for proper adjustment of the heavy duty display mount.*

Item	Description	Stock Number
	Heavy Duty Display Mount upgrade Kit, used to upgrade a standard single display mount to a multiple vertical 12" to 18" display.	M1072794
	Heavy Duty Display Mount retrofit Kit, used to upgrade a standard display mount to heavy duty, does not include display mounting hardware	M1055685
1	Axle	1602-3021-000
2	Washer, thrust plastic	1602-3017-000
3	Spacer, knuckle	1006-4728-000
4	Screw, M4x12 SKT HD CAP	1102-3006-000
5**	Spacer, slip plastic	1602-3015-000
6	Housing, bearing support	1006-4727-000
7***	Bearing assembly	M1055689
8	Cap, arm bearing	1011-3392-000
9	Screw, M6x20 SKT HD CAP	0144-2436-212
10	Screw, M8x25 SKT HD CAP	9211-0680-255
11	Spacer, counter draft	1006-4729-000
12	Washer, flat	1006-3536-000
13	Grommet, Pivot Arm	1006-3231-000
14	Wrist Casting, with mid sleeve, pivot arm	1006-7062-000
	* O-ring, wrist casting, 57.45 OD, 50.39 ID (2)	1006-3230-000

* Lubricate sparingly with Krytox.
** Position the slip spacer (**Item 7**) so that the split when the spacer is in position is opposite the slot in the housing (**Item 6**).
***With housing (**Item 6**) positioned as shown, place bearing (**Item 5**) in housing with writing on the side on the bearing facing up.

8.18 Cylinder Gas Supplies

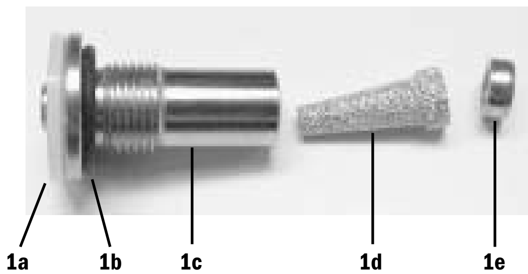


Item	Description	Pin Index	DIN	DIN, Large Cyl
1	Gas supply O_2	1006-3201-000	1006-3207-000	1006-3880-000
1	Gas supply N_2O	1006-3225-000	1006-3208-000	1006-3881-000
1	Gas supply Air	1006-3203-000	1006-3209-000	- - - - -
1	Gas supply CO_2	1006-3204-000	- - - - -	- - - - -
1	Gas supply Heliox	1006-3206-000	- - - - -	- - - - -

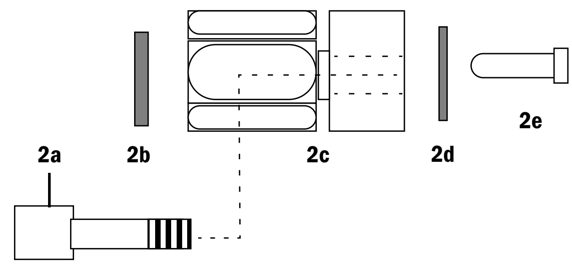
Item	Description	Stock Number
2	Screw M6x25 socket head cap/ 3 per supply	9211-0660-254
	Lockwasher (for above screw) Internal M6	0144-1118-130
3	Cylinder inlets (Pin Index or DIN for external cylinder)	Refer to section 8.18.1
4	Gas supply tee	Refer to section 8.37
5	Tee handle beige	0219-3372-600
6	Clamp, yoke	1001-4076-000
7	Spacer, gas block (2)	1001-4077-000
	Screw, M8 x 25 long socket head cap (2)	9211-0680-253
8	Elbow fitting for cylinder pressure gauge (copper tube connection of gas supply)	1006-3713-000
9	Label Set, cylinder supply, O_2	1006-3854-000
	Label Set, cylinder supply, N_2O	1006-3855-000
	Label Set, cylinder supply, Air	1006-3856-000
	Label Set, cylinder supply, CO_2	1006-3857-000
	Label Set, cylinder supply, Heliox	1006-3859-000
10	Block, includes relief valve - used with CO_2, Heliox (cylinder only) , 4th gas, 5th gas	1006-8354-000
	Pressure relief valve (with o-ring); 883 kPa (128 psi)	1006-3161-000

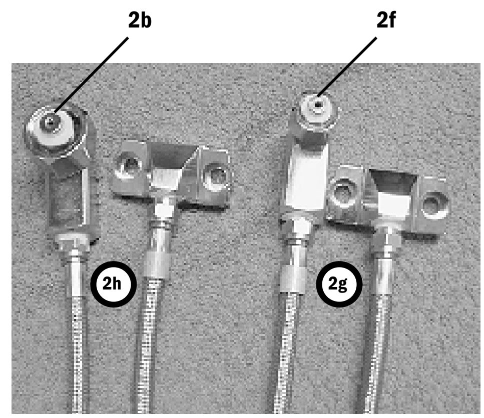
8.18.1 Cylinder inlet fittings

1 Pin Index



2 DIN (external cylinder)

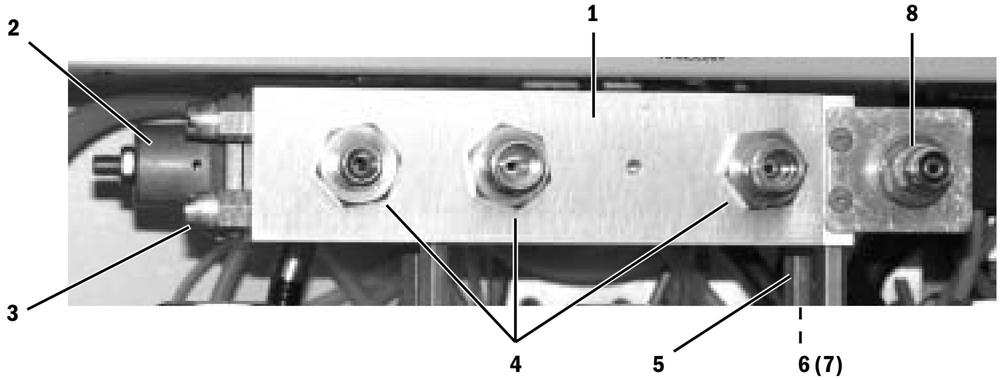




Item		Description	Stock Number
1		**Cylinder inlets (Pin Index)**	---------------------
	1a	Gasket	0210-5022-300
	1b*	O-ring	9221-3013-116
	1c	Adapter, inlet	1001-4075-000
	1d	Filter, sintered bronze	9914-6380-000
	1e	Retaining ring, filter	1001-5954-000
2		**Cylinder inlets (DIN)**	---------------------
	2a	Screw, M8x16	0144-2140-242
	2b	Sealing ring (DIN)	1009-3356-000
	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
	2f	Sealing ring, N_2O DIN Conn 11	1202-3641-000
	2g	Adapter, large cylinder N_2O	1006-4028-000
	2h	Adapter, large cylinder O_2	1006-4027-000

* Lubricate sparingly with Krytox

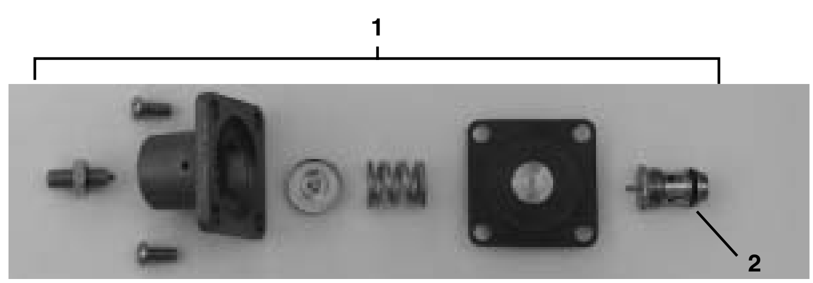
8.19 Main manifold



Item	Description	Stock Number
1	Manifold, interface/control (includes 2 and 3; does not include 4 or 5)	1006-8353-000
2	Flush valve regulator; “REV E” label indicates latest version	Refer to section 8.19.1
3	Pressure relief valve (with o-ring); 883 kPa (128 psi)	1006-3161-000
4	Pipeline inlets	Refer to section 8.20.1
5*	Standoff	1006-5147-000
6	Screw, M5x12 Screw, M5x16 (Pendant machines)	0144-2131-915 0144-2131-920
7	Lockwasher, M5 external	0144-1118-220
8	Power outlet or Heliox pipeline inlet	Refer to section 8.21

* Apply Loctite 242.

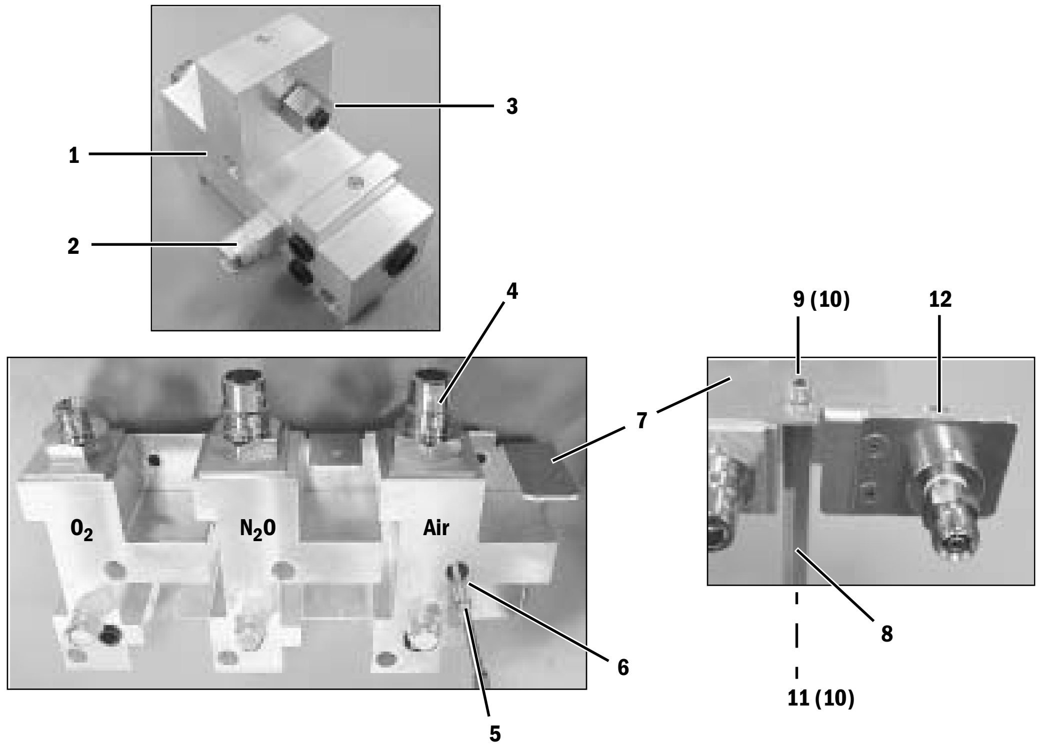
8.19.1 O_2 flush regulator



Item	Description	Stock Number
1	Flush Regulator Kit	1006-3211-000
2*	O-ring, regulator cartridge (included in kit)	0210-0479-300

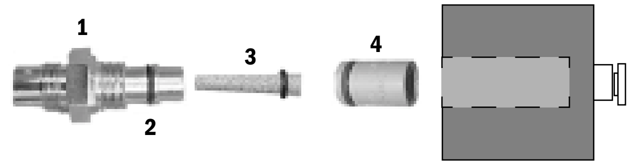
* Lubricate sparingly with Krytox

8.20 Pipeline inlet manifolds



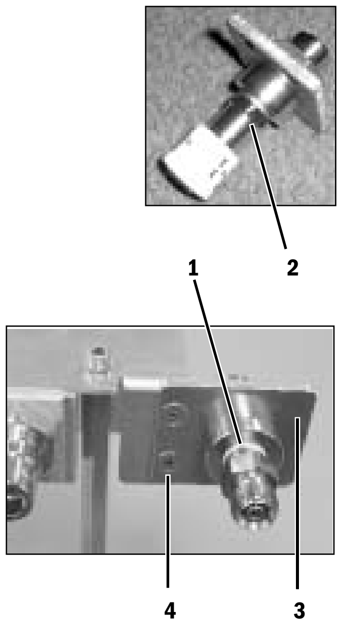
Item	Description		Stock Number
1	Gas Inlet Manifold (replacement)	O_2 N2O Air	1009-8066-000 1009-8067-000 1009-8068-000
2	Pressure relief valve and o-ring, 689/758 kPa (100/110 psi)		1011-3049-000
3	Adapter, pressure gauge (with o-ring) O-ring		M1082611 0210-0533-300
4	Pipeline inlets		Refer to section 8.20.1
5	Screw, M4x16		1011-3893-000
6	Lockwasher, M4 internal		0144-1118-128
7	Plate, manifold mounting		M1057385
8	Standoff		M1057387
9	Screw, M5x12		0144-2131-915
10	Lockwasher, M5 external		0144-1118-220
11	Screw, M5x12 Screw, M5x16 SKT HD CAP (Pendant machines)		0144-2131-915 0144-2131-920
12	Power outlet or Heliox pipeline inlet		Refer to section 8.21

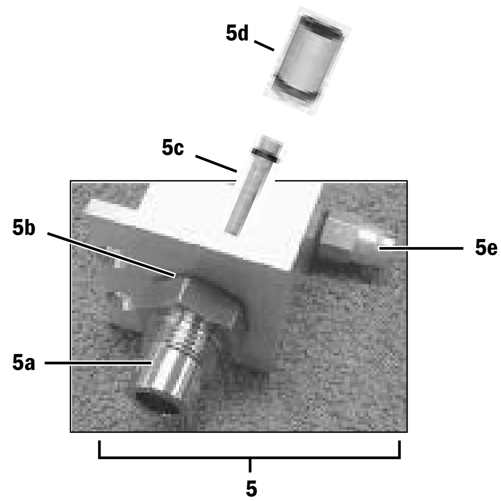
8.20.1 Pipeline inlet fittings



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 checkvalve with o-ring		1505-3273-000

8.21 Power outlets and Heliox pipeline inlet

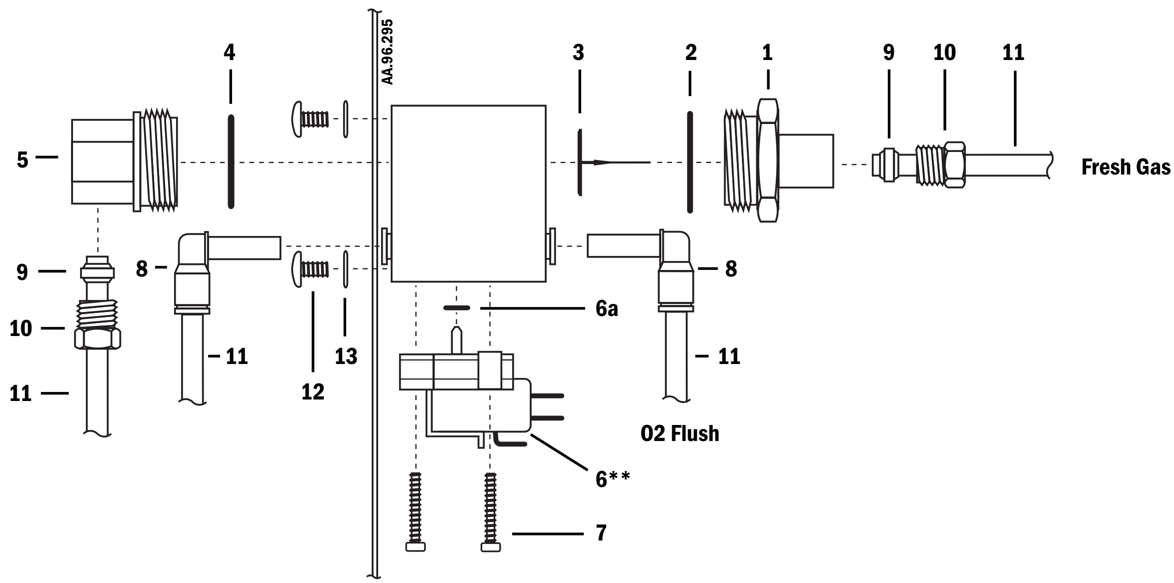




Item	Description	Stock Number
1*	Pneumatic power outlet, DISS, complete assembly	1006-8367-000
	Check Unit only (apply Teflon tape)	1001-3721-000
2*	Pneumatic power outlet, ISO (Anatrir) complete assembly	1006-8399-000
	Coupling only (use bonded seal)	1001-3765-000
	Seal, bonded	9947-0473-000
3	Bracket, power outlet	1006-5148-000
4**	Screw. M4x10 (2)	0140-6226-119
5	Heliox pipeline inlet , complete assembly	1006-8427-000
– 5a	Pipeline inlet fitting, Heliox	1006-3271-000
– 5b	Seal, bonded	9947-0473-000
– 5c	Sintered metal filter with o-ring	1006-8351-000
– 5d***	Pipeline checkvalve with o-ring	1006-3160-000
– 5e	Pressure relief valve and o-ring, 883 kPa (128 psi)	1006-3161-000

* These service kits do not include the mounting bracket.
** Apply Loctite 242
*** Lubricate o-ring sparingly with Krytox

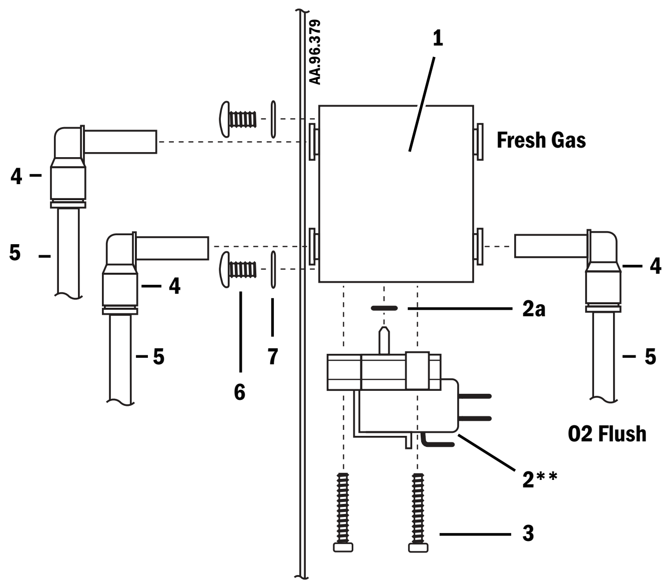
8.22 Common gas manifold — for units with O_2 Flush regulator



Item	Description	Stock Number
	Manifold (complete) - includes Items 1 through 7	1006-8352-000
1	Adapter, non-return	1001-4229-000
2*	O-ring, 28.3 OD, 25.1 ID, 1.6 W	9221-3025-116
3	Flapper valve EPR	0211-1451-100
4*	O-ring, 25.5 OD, 21.9 ID, 1.78 W	1006-3149-000
5	Outlet, common gas	1006-5144-000
6**	Switch, pressure 37 kPa (includes o-ring 6a)	1006-8395-000
6a*	O-ring, 7.24 OD, 3.68 ID, 1.78 W	1006-3213-000
7	Screw, M3 x 20 long socket head cap (2)	0144-2124-201
8	Fitting, 1/4 inch, plug-in elbow	1006-3737-000
9	Ferrule, enots 3/8 inch OD	9913-6562-700
10	Nut, enots	9913-6562-600
11	Flexible tubing, 1/4 inch OD, mixed gas, O_2 flush	1001-3064-000
12	Screw, M5x8 button head (2)	0144-2531-911
13	Lockwasher, M5 external	0144-1118-220

* Lubricate sparingly with Krytox
** Induction machines use a plug (1006-5227-000) and o-ring (1006-3213-000) in place of the pressure switch.

8.23 Common gas manifold — for units without O_2 Flush regulator



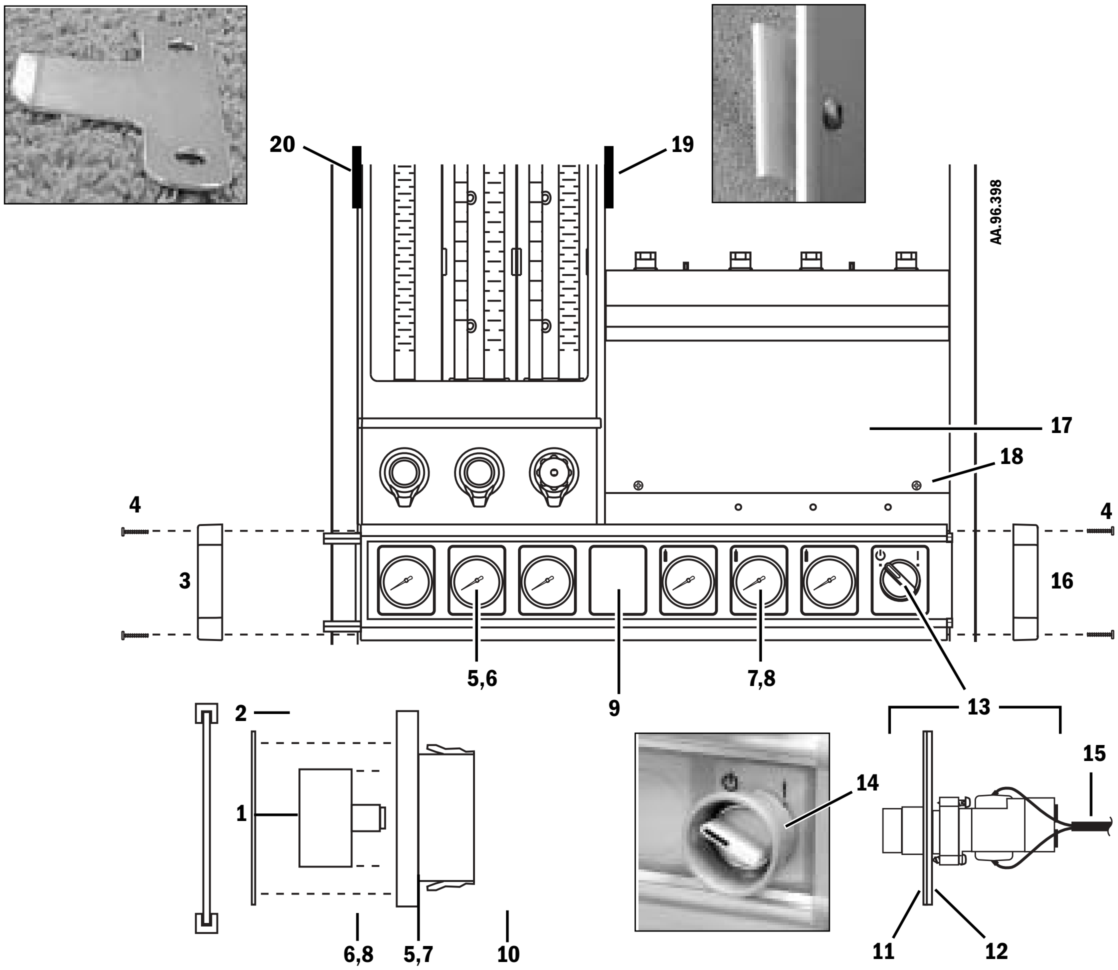
Item	Description	Stock Number
1	Manifold, common gas	M1078179
2**	Switch, pressure 55 kPa (includes o-ring 2a)	M1092740
2a*	O-ring, 7.24 OD, 3.68 ID, 1.78 W	1006-3213-000
3	Screw, M3 x 20 long socket head cap (2)	0144-2124-201
4	Fitting, 1/4 inch, plug-in elbow	1006-3737-000
5	Flexible tubing, 1/4 inch OD, mixed gas, O_2 flush	1001-3064-000
6	Screw, M5x8 button head (2)	0144-2531-911
7	Lockwasher, M5 external	0144-1118-220

* Lubricate sparingly with Krytox
** Induction machines use a plug (1006-5227-000) and o-ring (1006-3213-000) in place of the pressure switch.

Note: *The pressure switch* (**Item 2**) *used with the new common gas manifold for machines without an O_2 flush regulator has a higher burst pressure specification than the pressure switch used with the original common gas manifold. The new pressure switch is backward compatible and can be used with either manifold.*

Caution: *Do not use the original pressure switch with the new manifold.*

8.24 Pressure gauges and gauge panel



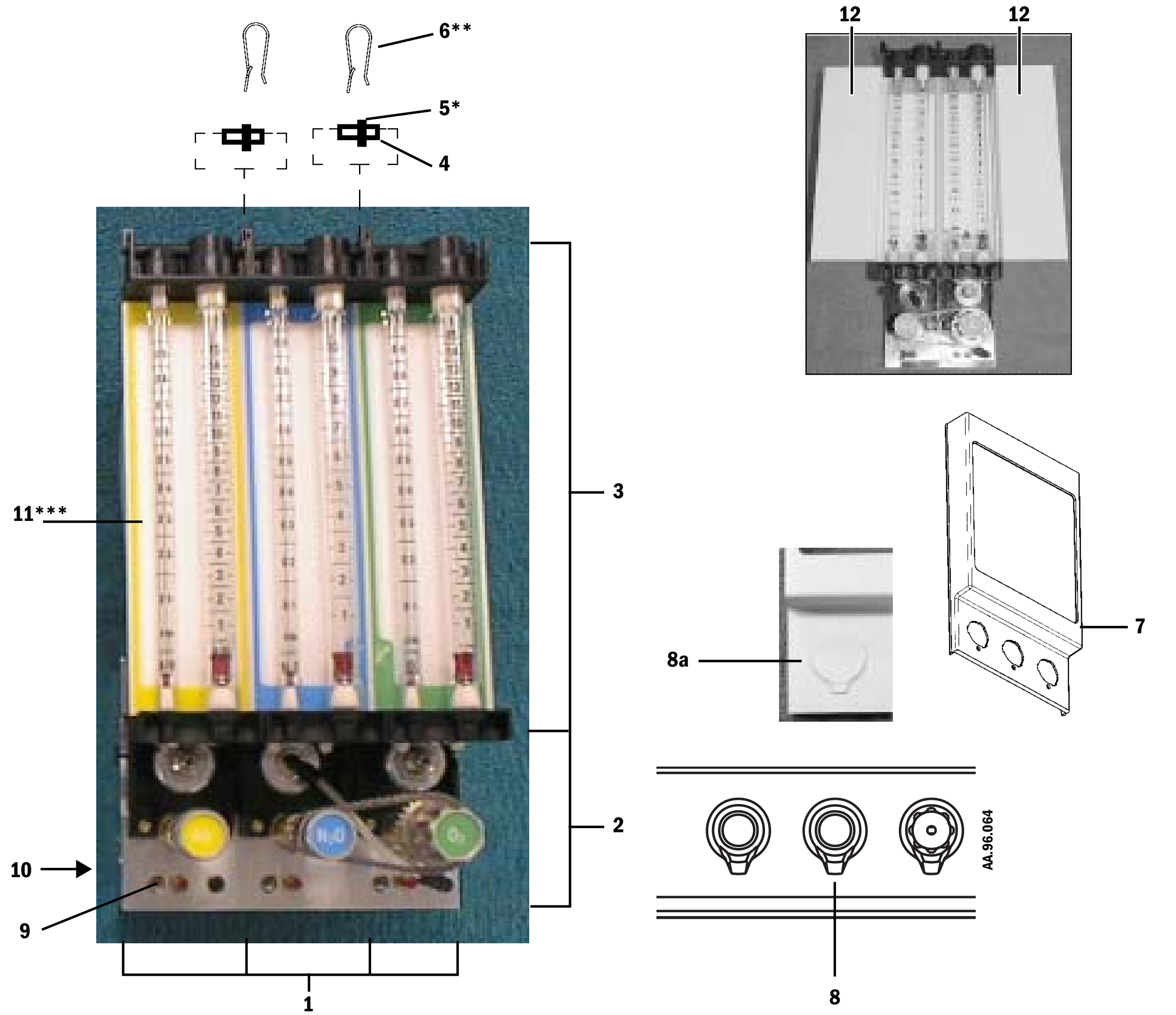
Item	Description	Stock Number
1	Window gauge panel	----------------------
	• 2-Vap, system switch on right (for left-hand machines)	1006-1394-000
	• 2-Vap, system switch on left (for right-hand machines)	1006-1395-000
	• 3-Vap, system switch on right (for left-hand machines)	1006-1397-000
	• 3-Vap, system switch on left (for right-hand machines)	1006-1396-000
2	Seal gauge panel	----------------------
	Seal wide	1006-1399-000
	Seal narrow	1006-1391-000
3	Cap, gauge panel extrusion, left	1006-1393-000
4	Screw, M3x20	0140-6719-103
5	Pipeline gauge	1006-3007-000
	Flexible tubing, 1/8 inch OD	1006-3718-000
	Connector, 10-32x1/8 inch tube	1006-3711-000
6	Label, pipeline gauge	Refer to section 8.24.1

Item	Description	Stock Number
7	Cylinder Gauge	1006-3006-000
	Connector, copper tubing, cylinder pressure gauge	1006-3712-000
	Tubing Assy, Copper, with connectors, 350mm	1006-8370-000
	Tubing Assy, Copper, with connectors, 450mm	1006-8371-000
	Tubing Assy, Copper, with connectors, 625mm	1006-8372-000
8	Label, cylinder gauge	Refer to section 8.24.1
9	Cover, gauge opening	1006-1398-000
10	Gauge support (narrow side down)	1006-1389-000
11	Label, system switch Standby/On	1006-1424-000
12	Plate, switch mounting	1006-5218-000
13	System switch, pneumatic/electric	1006-8452-000
14	Shroud Kit (includes set screws) Screw, M3x4 set HEX HD CUP PT	M1087232 0141-4227-102
15	Switch Harness (for all except Compact Wall/Rail mount) Switch Harness (for Compact Wall/Rail mount)	1006-3707-000 1006-4528-000
16	Cap, gauge panel extrusion, right	1006-1392-000
17	Panel, 2-Vap Panel, 3-Vap	1006-5181-000 1006-5182-000
18	Screw, M4x8 BT SKT HD SST	0140-6226-118
19	Clamp, flowtube cover secure Screw, M4x8 BT SKT HD SST	1006-1505-000 0140-6226-118
20	Clip, flowtube cover Screw, M3x8	1006-1428-000 1406-3242-000

8.24.1 Pressure gauge labels

Gas	Label Color	Stock Number Pipeline	Stock Number Cylinder
O_2	Green	1006-1417-000	1006-1405-000
O_2	White	1006-1418-000	1006-1406-000
O_2	Neutral	1406-4702-000	1006-4701-000
N_2O	Blue	1006-1416-000	1006-1404-000
N_2O	Gray	1006-1413-000	1006-1401-000
N_2O	Neutral	1006-4466-000	1006-4467-000
Air	Yellow	1006-1421-000	1006-1409-000
Air	White/Black	1006-1422-000	1006-1410-000
Air	Neutral	1006-4468-000	1006-4469-000
Heliox	White/Brown	-------------------	1006-1519-000
Heliox	Green/Brown	-------------------	1006-1400-000
CO_2	Gray	-------------------	1006-1412-000

8.25 Flowmeter components



Item	Description	Stock Number
1	**Flowhead Module:** includes regulator, flowtube module, flowtubes, needle valve, intermodule tube and associated o-ring, and label plate; does not include labels, link-25, or knobs (order separately).	-------------------
	O_2 flowhead module	1006-8380-000
	N_2O flowhead module	1006-8381-000
	Air flowhead module with double flowtube	1006-8383-000
	Air flowhead module with single flowtube	1006-8382-000
	CO_2 flowhead module	1006-8385-000
	Heliox flowhead module	1006-8384-000
2	Secondary regulators/Balance Regulators	-------------------
	Regulator Kit, O_2 (adjustable), without pressure switch	1006-8341-000
	Regulator Kit, N_2O (pressure balancing)	1006-8344-000
	Regulator Kit, Air (adjustable)	1006-8340-000
	Regulator Kit, CO_2 (pressure balancing)	1006-8343-000
	Regulator Kit, Heliox (pressure balancing)	1006-8342-000

Item	Description	Stock Number
3	**Flowtube Module:** includes housing, o-rings, and plug ball; does not include, flowtubes, label or label panel (order separately).	---------------------
	Flowtube module, O_2	1006-8338-000
	Flowtube module, N_2O	1006-8337-000
	Flowtube module, air, dual	1006-8333-000
	Flowtube module, air, single	1006-8334-000
	Flowtube module, CO_2	1006-8335-000
	Flowtube module, Heliox	1006-8336-000
4	Tube, intermodule connector	1006-3628-000
5*	O-ring, intermodule connector	1006-3613-000
6**	Clip, U-type self retaining	1006-4350-000
7	Cover, flowtubes, 3-gas (for Compact/Induction label set, refer to Section 8.8)	1006-1426-000
	Cover, flowtubes, 4-gas	1006-1427-000
8	Guard, flow control knob	1006-1500-000
	Screw, guard	1406-3242-000
8a	Plug, flowtube cover	1006-1501-000
9	Screw, M5-0.8x30 (module mounting)	1102-3049-000
10	Screw, M5-0.8x55 (O_2/N_2O/3rd gas module connect)	1006-3607-000
	Screw, M5-0.8x110 (4th gas module connect)	1006-3080-000
11***	Flowmeter labels	refer to chart below
	Label panel, flowmeter module	1006-1290-000
	Screw, label panel (2 required)	1006-3608-000
12	Plate, Flowtube blank	1006-1506-000

* Lubricate sparingly with Krytox.

** Note orientation of item 6; with flowmeter facing forward, the barbs should face to the left.

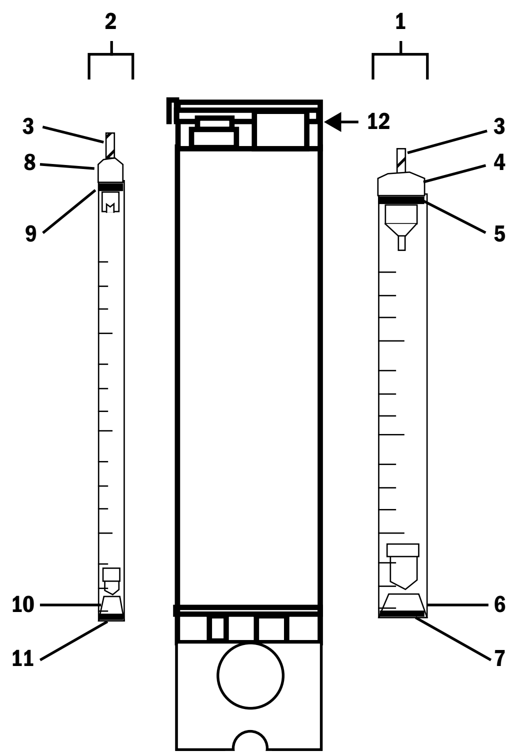
*** Position the label on the panel so that the right edge of the label is flush with the right edge of the panel. The left edge of the label will extend slightly beyond the left edge of the panel. When mounted in the flowmeter module, the flowmeter label on the right should slightly overlap the flowmeter label directly to its left.

Chart: Flowmeter Labels (include knob labels)

Label Color		Stock Number	Notes
O_2	**N_2O**		
Green	Blue	1006-0200-000	O_2 to right of N_2O
White	Blue	1006-0205-000	O_2 to right of N_2O
Neutral	Neutral	1006-4471-000	O_2 to left of N_2O
White	Blue	1006-0204-000	O_2 to left of N_2O
Blue	Gray	1006-0201-000	O_2 to left of N_2O
	Air		
	Yellow	1006-0209-000	
	White/Black	1006-0208-000	
	Neutral	1006-4470-000	
	Heliox		
	White/Brown	1006-0261-000	
	Green/Brown	1006-0210-000	
	CO_2		
	Gray	1006-0211-000	

8.25.1 Flowtube parts

Item	Description	Stock Number
1	**Large flowtube kits** (includes float, filter, o-rings, tube)	---------------------
	Flowtube kit, Air, large	1006-8325-000
	Flowtube kit, Heliox	1006-8328-000
	Flowtube kit, N_2O, large	1006-8329-000
	Flowtube kit, O_2, large	1006-8331-000
2	**Small flowtube kits** (includes float, filter, o-rings, tube)	---------------------
	Flowtube kit, Air, small	1006-8326-000
	Flowtube kit, CO_2	1006-8327-000
	Flowtube kit, N_2O, small	1006-8330-000
	Flowtube kit, O_2, small	1006-8332-000
3	Spring, top of flowtubes	1006-3624-000
4	Float stop, O_2 large	1006-1225-000
	Float stop, N_2O large	1006-1226-000
	Float stop, Air large	1006-1227-000
	Float stop, Heliox	1006-1228-000
5	O-ring, 17.6 OD, 12.37 ID, large flowtube, top	1006-3615-000
6	Filter, large flowtube	1006-3584-000
7	O-ring, 17.6 OD, 12.37 ID, large flowtube, bottom (red)	1006-3968-000
8	Float stop, O_2 small	1006-1233-000
	Float stop, N_2O small	1006-1234-000
	Float stop, Air small	1006-1235-000
	Float stop, CO_2	1006-1236-000
9	O-ring, 11.26 OD, 6.02 ID, small flowtube, top	1006-3617-000
10	Filter, small flowtube	1006-3583-000
11	O-ring, 11.26 OD, 6.02 ID, small flowtube, bottom (red)	1006-3969-000
12	Ball, 6 mm (plug fresh gas end)	1006-1353-000
Not Shown:		
	O-ring Kit, flowtubes (includes 4 each of top and bottom o-rings for large flowtube and 3 each of top and bottom o-rings for small flowtube).	1006-8393-000
	Silicon tube kit, long, including cable ties	1006-8378-000
	Silicon tube kit, short, including cable ties	1006-8379-000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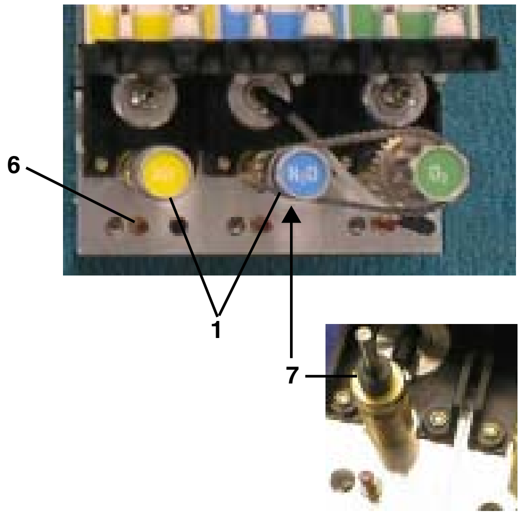
8.25.2 Secondary regulator components

Item	Description	Stock Number
1	Knob (N_2O) (Air) (CO_2) (Heliox) without label	1006-3633-000
2	O_2 Proportioning assembly (includes knob, sprocket, set screws, without knob label)	1006-8339-000
3	Set screw	0141-4227-105
4	O_2 Proportioner chain	1006-3610-000
5	Sprocket, N_2O	1006-3625-000
6	Plug, 1/8 inch	1006-3611-000
7	Spacer, link system, N_2O needle valve	1006-5140-000
8	Valve, needle (O_2) (Air) (CO_2) (Heliox)	1006-8346-000
8	Valve, needle N_2O (has notch around valve body)	1006-8345-000
9	O-ring, 10.1 ID 13.3 OD	9221-3010-116
10	O-ring, 0.250 inch ID 0.375 inch OD	0210-0687-300
11	Stop collar (all gases)	1006-3632-000
12	Maximum stop collar kit (includes item 13) *Maximum stop collars are required for CO_2 and Heliox.*	1006-8055-000
13	Mounting screw, M3x8, SKT HD CAP	1006-3865-000
14*	Pressure switch, O_2 supply alarm	1006-3623-000
15	O-ring, 0.250 inch ID 0.375 inch OD	0210-0687-300
16	Screws, M4x12 Pozidriv PAN	0140-6226-111
17	Plug, pressure switch cavity	1006-3665-000
18	Screws, M4x8 Pozidriv PAN	1006-3178-000
19	Fitting, O_2 pilot, plug-in elbow	1006-3533-000
20	Fitting, O_2 pilot, thread-in tee	1006-3664-000
21	Fitting, O_2 pilot, thread-in elbow	1006-3663-000
22	Tubing, 4-mm	1001-3060-000
23	Plate, switch retainer	M1082083
24	Screws, M4x16 Pozidriv PAN	9211-0440-163

* Induction machines use items 15, 17, and 18 in place of the pressure switch.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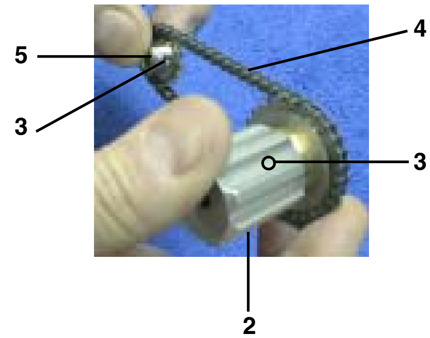
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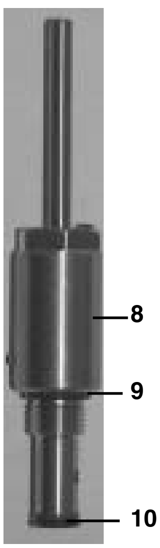
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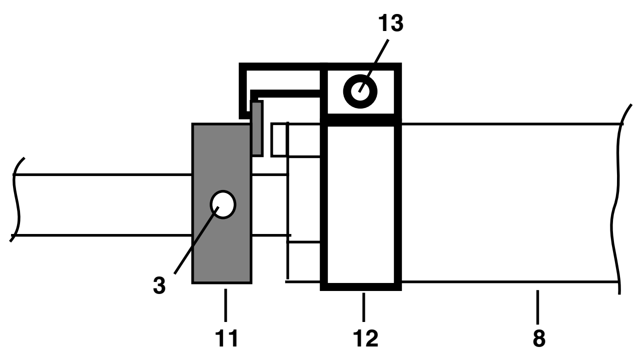
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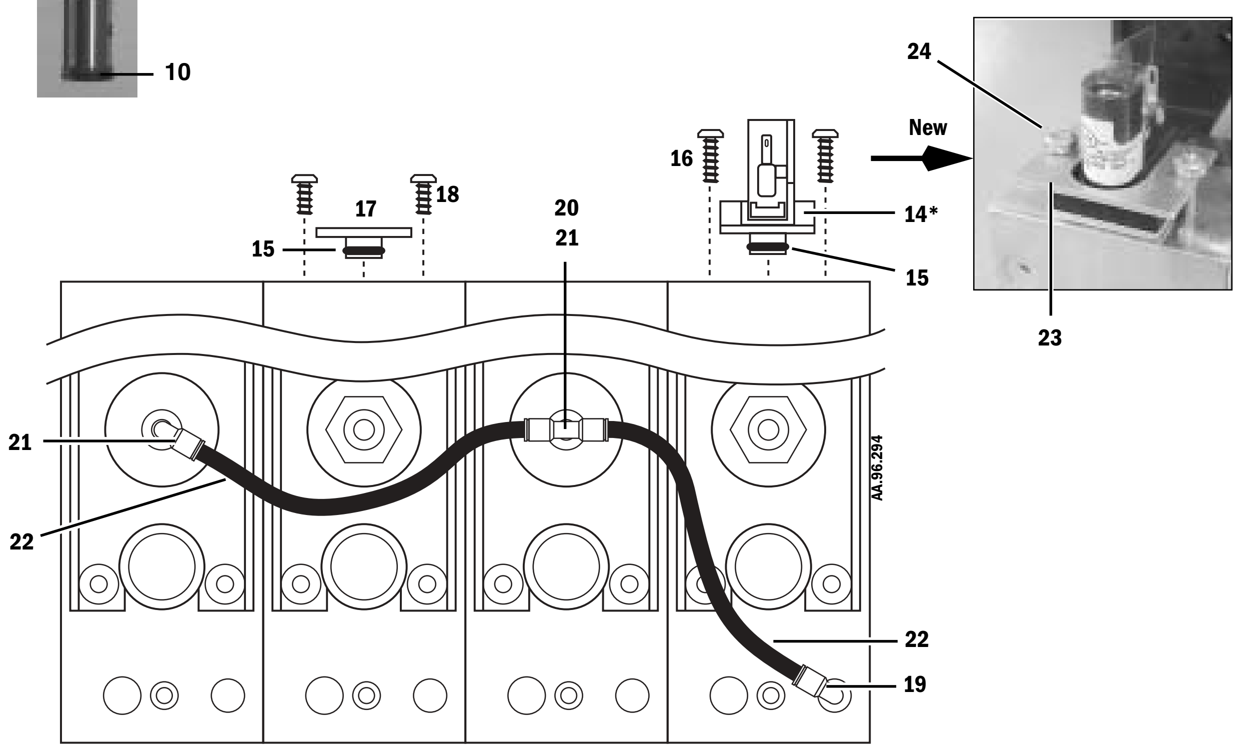
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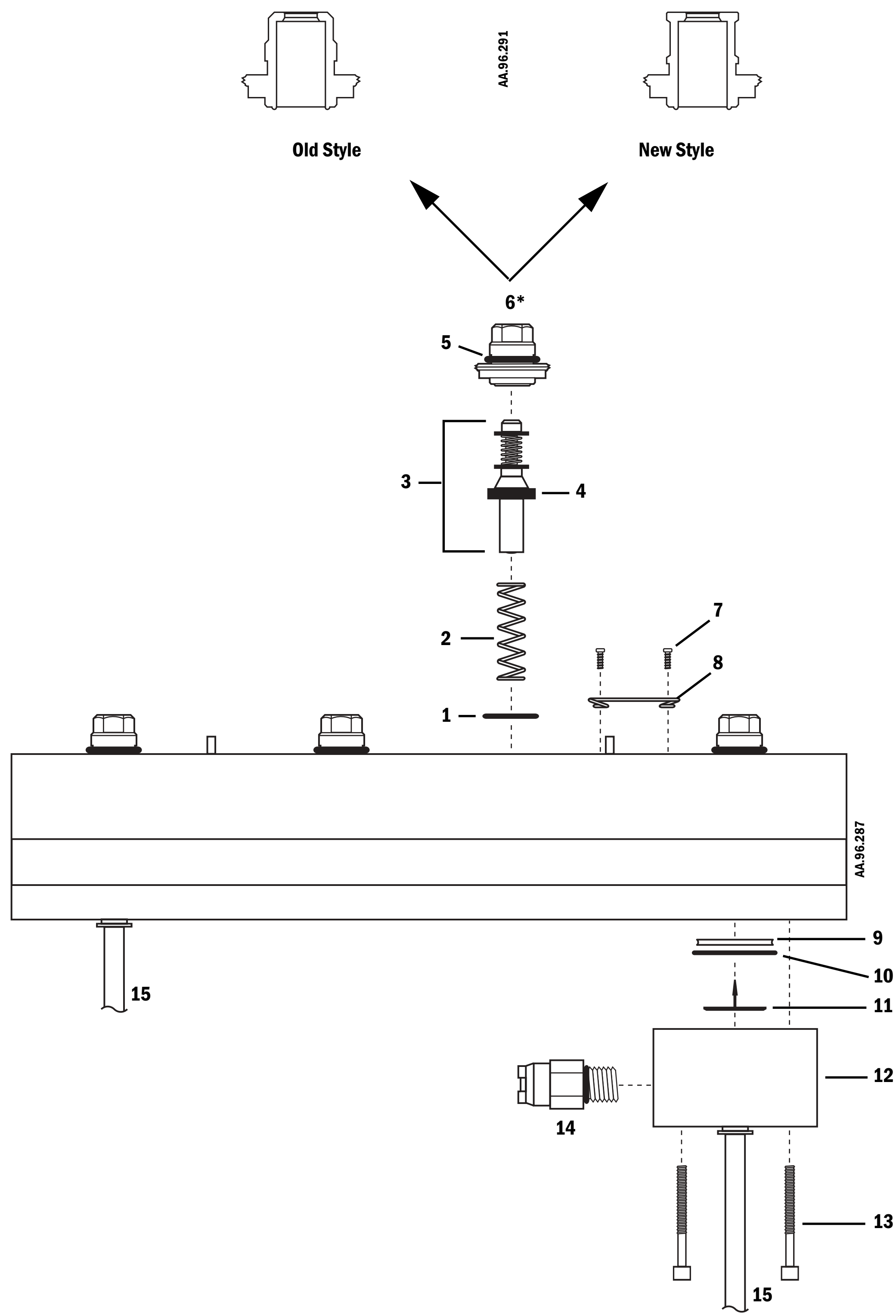
8.26 Vaporizer manifold

Item	Description	Stock Number
	Manifold assembly, complete, two position	1006-8355-000
	Manifold assembly, complete, three position	1006-8356-000
1	O-ring, 0.687 inch ID 0.812 inch OD	0210-0544-300
2	Spring, compression	1006-3736-000
3	Valve kit, includes seal	1006-8373-000
4	Seal	1006-3690-000
5	O-ring, 14.3 mm ID (Package of 6 o-rings)	1102-3043-000 1102-3016-000
6*	Nipple, vaporizer port (New Style)	1006-4215-000
7	Screw, M2.5 - 0.45x6 PAN, Pozidriv, SST	1006-3037-000
8	Spring, Dzus	1102-3056-000
9	Seat, check valve	1006-1352-000
10	O-ring 27.1 OD 21.89 mm ID	1006-3866-000
11	Flapper	0211-1451-100
12	Housing	1009-8477-000
13	Screw, M4 x 30, cap head	9211-0640-304
14	Valve, relief, 5.5 psi, 7/16-20 THD	1006-4128-000
15	Flexible tubing, 1/4 inch, mixed gas	1001-3064-000

* The “Old Style” vaporizer port nipple is no longer available. The “New Style” nipple is a direct replacement.

Not Shown (3-vaporizer manifold)	Stock Number
Slide, interlock left	1102-3010-000
Slide, interlock right	1102-3011-000
Spring, compression, interlock slide (2)	1102-3012-000
Plate, interlock slide	1006-1369-000
Screw, M3 x 6, SST (3)	9211-0430-063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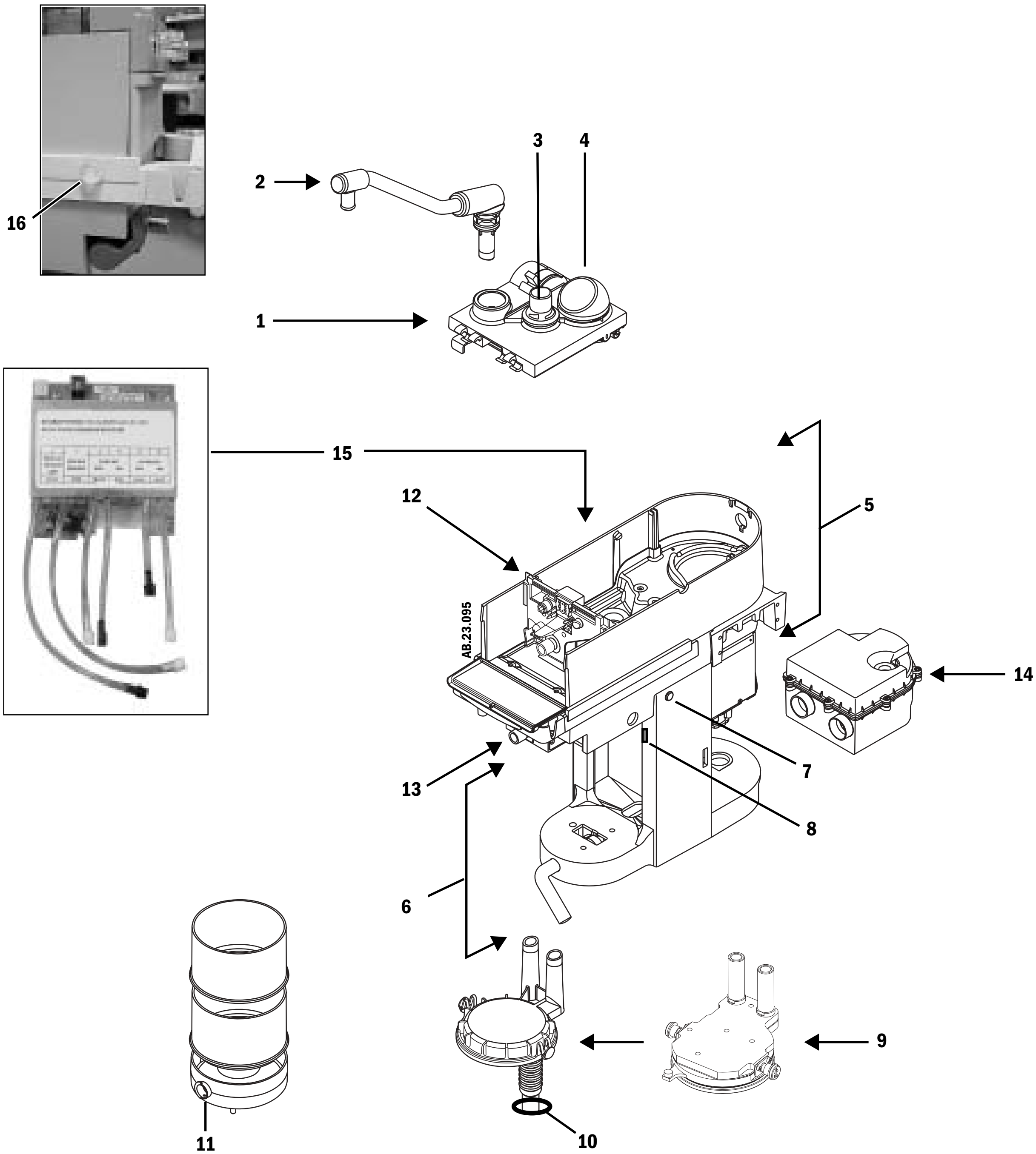
8.27 Breathing System - service parts

For additional, user serviceable, breathing system parts, refer to the following section.

Item	Description	Stock Number
1	Control panel assembly	Refer to section 8.27.2
2	Bag arm	Refer to section 8.27.7
3	APL Valve Kit (includes adjustment knob and main manifold components) (color changed to teal in 2001)	1406-8202-000
4	Pressure gauge, replacement kit (with housing and lens)	1406-8220-000
5	Upper chassis components	Refer to section 8.27.3
6	Lower chassis components	Refer to section 8.27.5
7	Shear pin, with textured head Cotter pin	1406-3205-000 1406-3206-000
8	Guide, absorber canister (Kit includes 2 with mounting hardware)	1406-8107-000
9	Absorber (CO_2) Bypass	Refer to section 8.27.6
10	Clamp, 1.031 – 1.188 OD hose (for canister corrugated tube)	0203-0531-300
11	Plug, sight glass-drain	0229-2080-100
	O-ring, plug	1406-3422-000
	Retaining ring, Spirolox 0.875 inch shaft (lower canister dish drain)	0203-5365-300
12	Bulkhead components	Refer to section 8.27.4
13	ACGO, Auxiliary Common Gas Outlet	Refer to section 8.27.8
14	AGSS, Anesthetic Gas Scavenging System	Refer to section 8.28
15	ESIB, Enhanced Sensor Interface Board (replaces previous 7900 SIB boards) MIA, Monitoring Interface Assembly (used in machines with 7100 ventilator)	1503-7014-000 1504-7000-000
16	Bumper (used on wall-rail mount machines)	1006-4665-000



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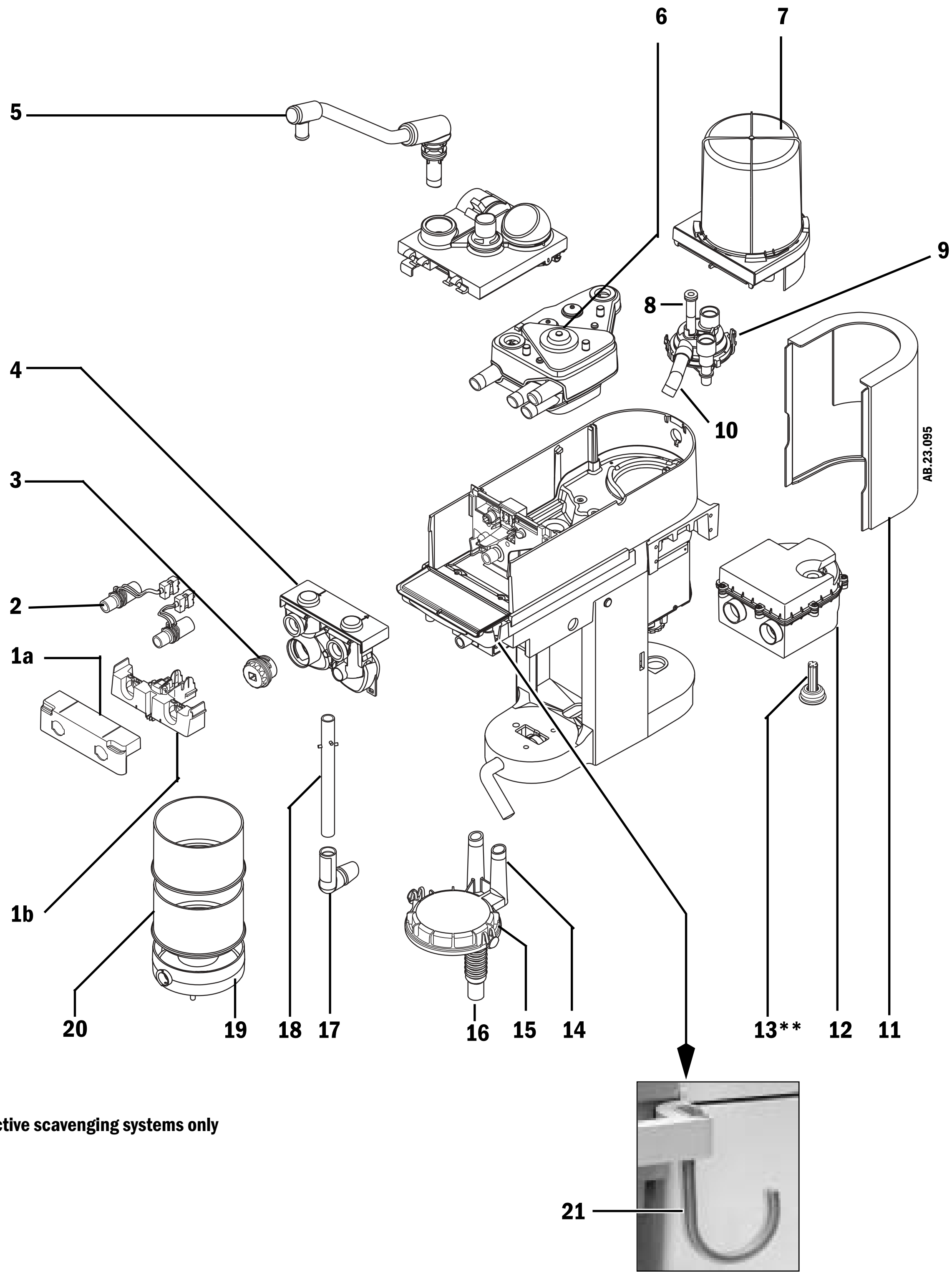
8.27.1 Breathing System - user replaceable parts

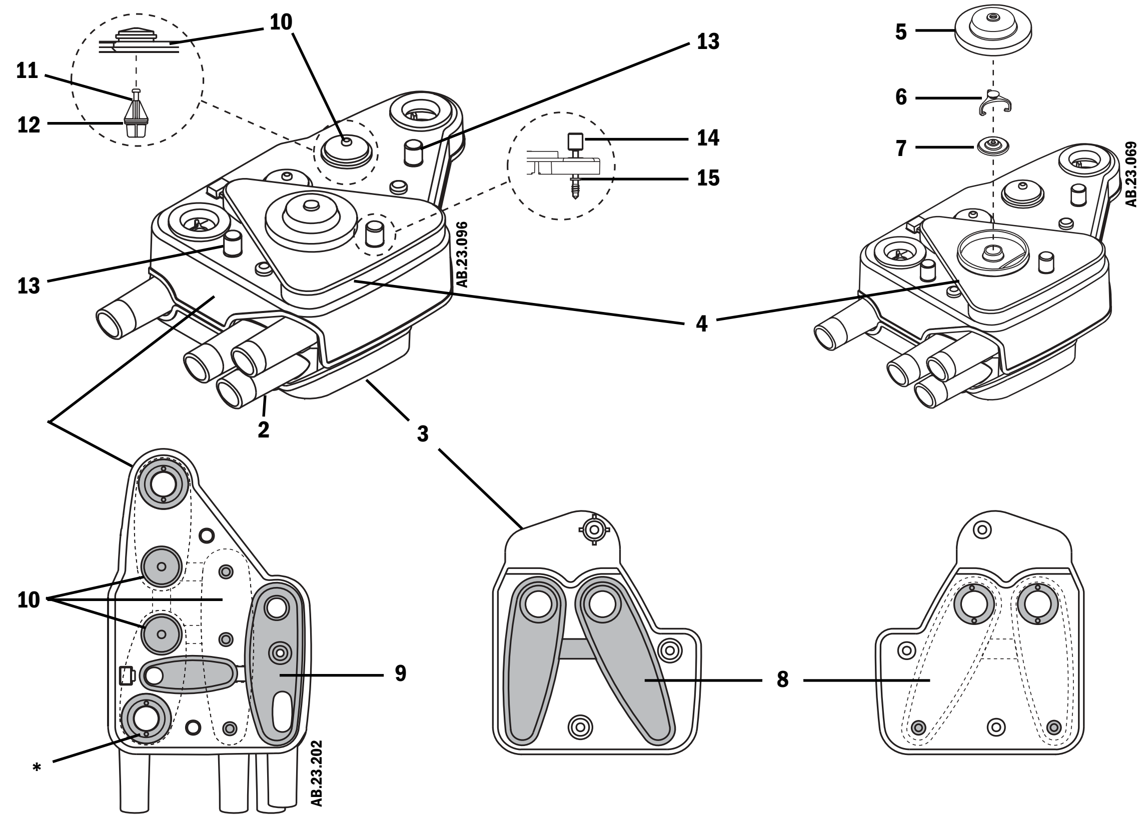
Top level

Item	Description		Stock Number
1	Flow sensor module (cover and holder) a. Cover only b. Holder only		1406-8208-000 1406-3401-000 1406-3400-000
2	Flow sensor (plastic - moisture resistant) Flow sensor (plastic) Flow sensor (metal - autoclavable) Flow port adapter (blank)	Not MRI compatible MRI compatible	1503-3858-000 1503-3856-000 1503-3244-000 1503-3849-000
3	O_2 sensor, cell O_2 port plug O-ring		6050-0004-110 1503-3857-000 1406-3466-000
4	Breathing circuit module, circle Breathing circuit module, Bain/Mapleson D	Refer to page 8-54 Refer to page 8-54	1406-8102-000 1406-8211-000
5	Bag arm long (adjustable) Bag arm short (not adjustable)		1406-3350-000 1406-3380-000
6	Main manifold assembly	Refer to page 8-52	1406-8209-000
7	Autoclavable bellows assembly	Refer to page 8-55	1406-8105-000
8	Tube, pop-off valve U-cup seal		1406-3240-000 1406-3241-000
9	Exhalation valve assembly	Refer to page 8-53	1503-8114-000
10	Tube, exhalation valve to gas scavenging		1406-3566-000
11	Rear column cover (includes retained thumbscrew)		1406-3455-000
12	Active AGSS, 6.35 mm (ANSI) Active AGSS, 30 mm threaded outlet Passive AGSS, 30 mm ISO taper Passive AGSS, 25 mm taper (DEU)	Refer to section 8.28.2 Refer to section 8.28.2 Refer to section 8.28.1 Refer to section 8.28.1	1406-8216-000 1406-8214-000 1406-8215-000 1406-8217-000
13**	AGSS nylon filter, 225 μ		1406-3521-000
14*	Upper dish absorber plastic (seal not included)		1406-3413-000
15*	Upper seal		1406-3414-000
16*	Tube corrugated 210 mm		1400-3009-000
17	Elbow transfer tube		1406-3576-000
18	Transfer tube		1406-3575-000
19*	Drain dish assembly		1406-8218-000
20*	Canister		0229-3015-800
21	Hook, mask		1406-3220-000
* Items 14, 15, 16, 19, and 20 (2 canisters) included in Kit.			1406-8207-000
** Active scavenging systems only			



** Active scavenging systems only

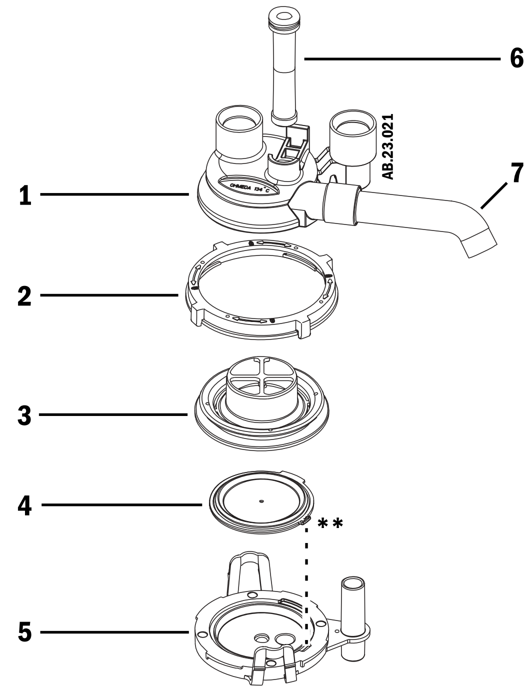
Main manifold



Top Plate (APL manifold removed) **Bottom Plate (Main body removed)** **Bottom Plate (Bottom view)**

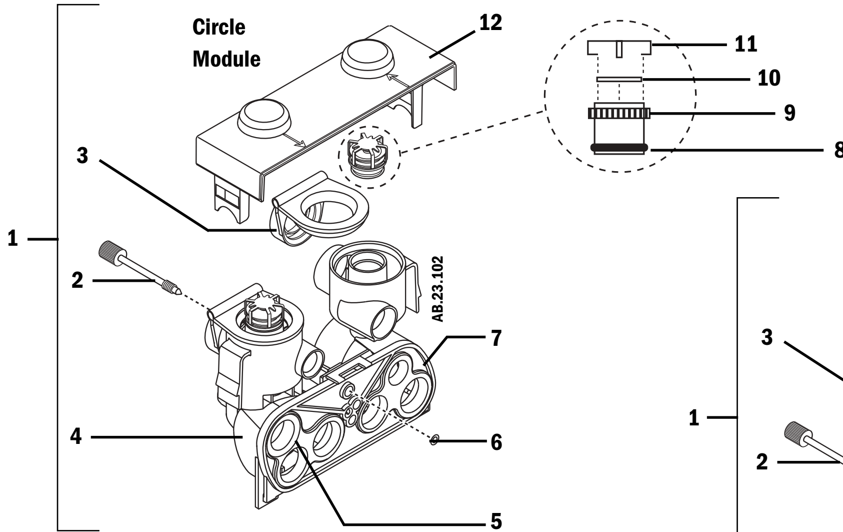
Item	Description	Stock Number
	Main Manifold, complete assembly	1406-8209-000
1	Plate, top, main manifold	1406-3300-000
2	Body, main manifold	1406-3301-000
3	Plate, bottom, main manifold	1406-3303-000
4	Manifold, APL/AGSS	1406-3302-000
5	Diaphragm, APL	1406-3331-000
6	Cage, APL	1406-3333-000
7	Poppet, APL	1406-3332-000
8*	Seal, main manifold – absorber	1406-3315-000
9	Seal, APL/AGSS	1406-3316-000
10*	Seal, Bag/Vent	1406-3314-000
11	Poppet, Bag/Vent (Qty 2)	1406-3279-000
12	O-ring (Qty 2)	1406-3278-000
13	Thumbscrew, M6 x28.5 mm (Qty 2)	1406-3305-000
14	Thumbscrew, M6x43 mm (with 10-mm head)	1406-3306-000
15	Ring, split (Qty 3)	1406-3319-000
* Newer versions have 2 raised bumps visible from the outside for identification.		
* Items 8 and 10 are available in Seal Kit - - - - - - - - - - - - - -		1006-8290-000

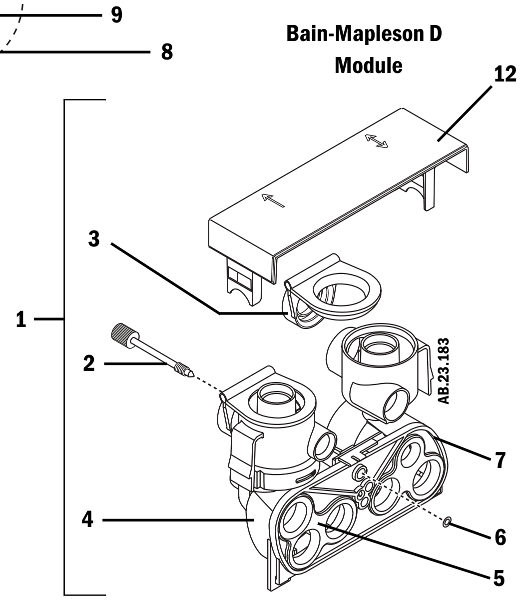
Exhalation valve

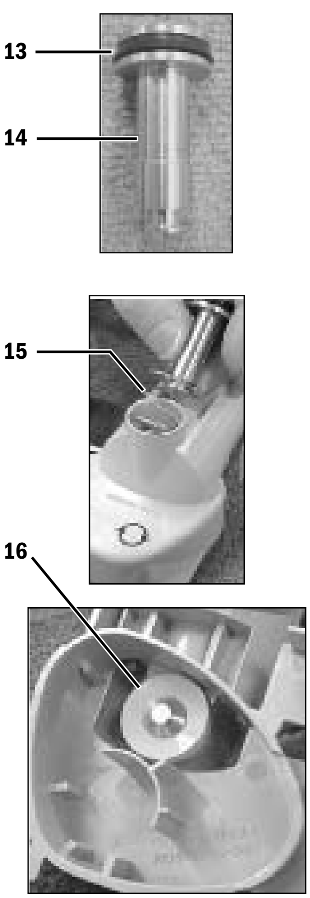


	Description	Stock Number
	Exhalation valve, complete assembly(* Includes Items 1 through 5)	1503-8114-000
1*	Exhalation valve cover	1503-3583-000
2*	Lock ring	1503-3588-000
3*	Seat exhalation valve	1503-3584-000
4*	Diaphragm assy	1503-8121-000
5*	Base, exhalation valve	1503-3585-000
6	Tube, pop-off valve U-cup seal	1406-3240-000 1406-3241-000
7	Tube exhalation valve	1406-3566-000
** Align tabs and cutouts.		

Breathing Circuit Modules

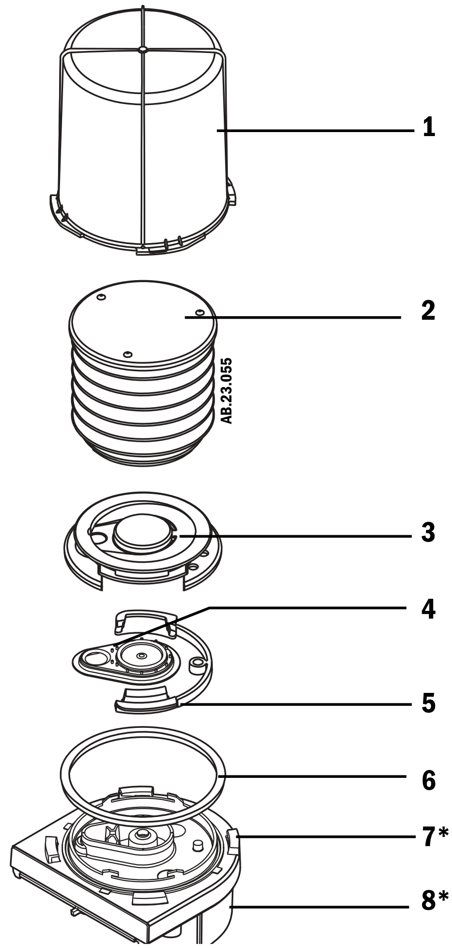






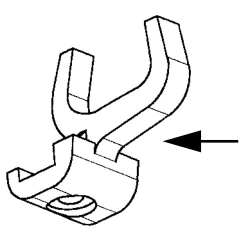
Item	Description	Circle Module	Bain-Mapleson D Module
1	Assembly (items 2-12)	1406-8102-000	--------
	Assembly (items 2-7, 12)	--------	1406-8211-000
2	M6-1x43 Thumbscrew	1406-3304-000	1406-3304-000
3	Seal lens, flow sensor	1406-3395-000	1406-3395-000
4	Module body	1406-3390-000	1406-3467-000
5	Seal module cover	1406-3317-000	1406-3463-000
6	Split ring	1406-3319-000	1406-3319-000
7	Back plate	1406-3391-000	1406-3391-000
8	O-Ring check valve	1406-3397-000	Not Used
9	Valve seat check valve	1406-3396-000	Not Used
10	Disc check valve	0210-5297-100	Not Used
11	Retainer check valve	1400-3017-000	Not Used
12	Lens	1406-3394-000	1406-3461-000
13*	Seal, u-cup	1406-3241-000	
14	Drain button	1406-3389-000	
15	Spring, compression	1406-3388-000	
16	Seal, drain	1406-3398-000	
* Lubricate sparingly with Krytox.			
Not shown:			
	Tube, fresh gas, Bain-Mapleson D Module		1406-3462-000

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	1406-3313-000
8*	Latch, bellows base	1406-3318-000
* Items 7 and 8 are available as assembly in Kit.		1406-8106-000

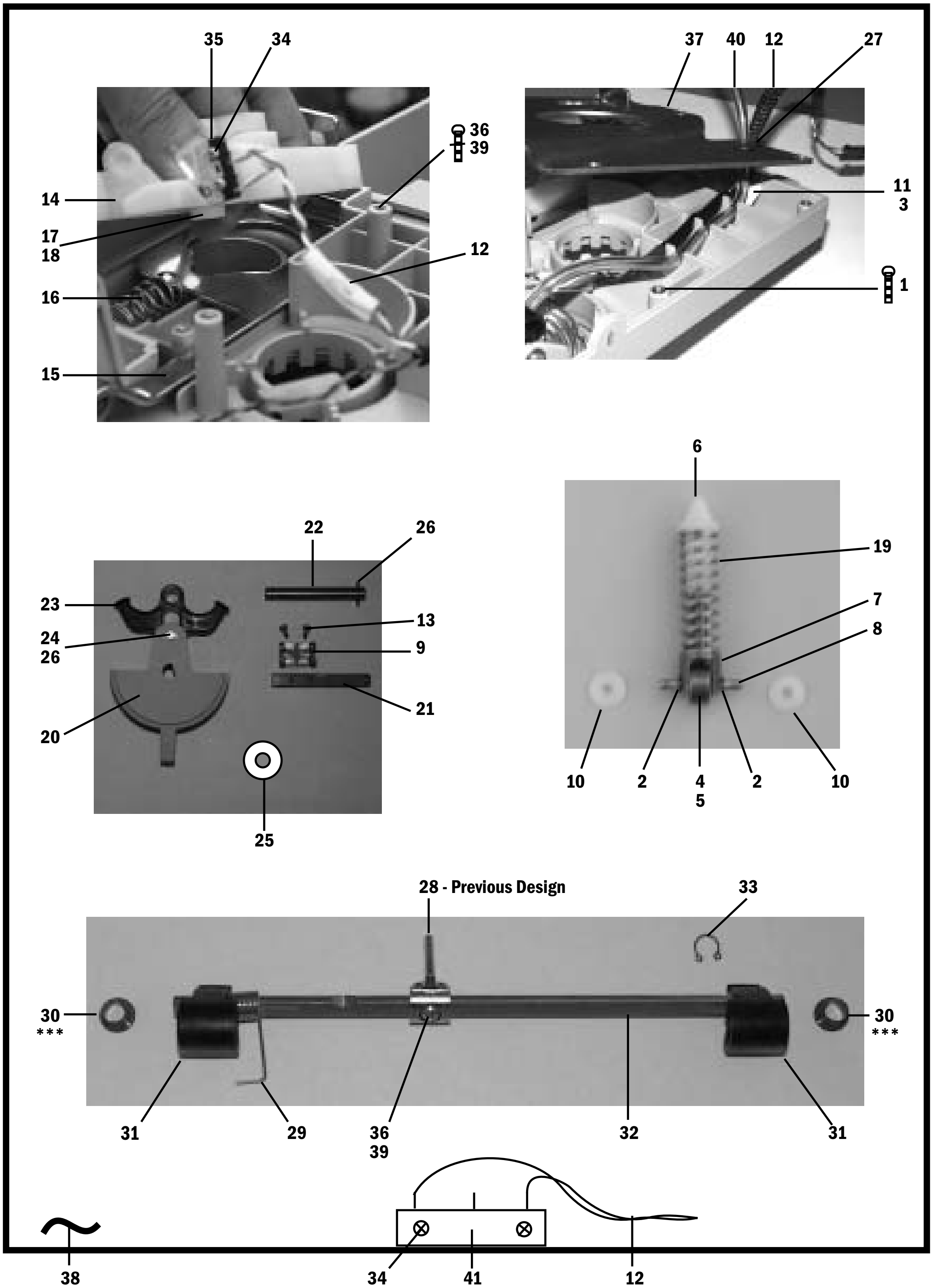
8.27.2 Control Panel



28 - New Design

Item	Description	Stock Number
	Control panel assembly (without APL Valve and Pressure Gauge)	1406-8201-000
1*	Screw, M4x8 BT SKT HD SST (6)	0140-6226-118
2	Ring, E retaining 0.125 inch shaft (2)	0203-5361-300
3	Cable tie	0203-5915-300
4	Bearing	0209-0081-300
5	Roller	0229-2056-500
6	Sleeve, pivot pin	0229-2057-500
7	Pin, pivot	0229-2059-500
8	Shaft	0229-2061-500
9	Bracket, pivot	0229-2085-200
10	Washer, Delrin (2)	0402-1044-500
11	Mount, cable tie	1001-3736-000
12	Harness, Control panel	1006-3800-000
13*	Screw, M3-0.5x8 SKT HD CAP (2)	1006-3865-000
14	Body, latch	1406-3251-000
15**	Latch, bag arm and control panel Latch (new design)	1406-3254-000 1406-3602-000
16	Spring	1406-3255-000
17	Pin, latch bag arm	1406-3256-000
18	Spring	1406-3257-000
19	Spring	1406-3270-000
20	Toggle, Bag to Vent (color changed to teal in 2001) Latest design has a raised bump on the underside	1406-3271-000
21	Shaft, toggle	1406-3272-000
22	Shaft, rocker	1406-3273-000
23	Rocker, Bag to Vent Valve	1406-3274-000
24	Shaft, rocker/toggle	1406-3275-000
25	Washer, Teflon	1406-3276-000
26	Ring, E retaining (2)	1406-3277-000
27	Grommet (2)	1406-3286-000
28**	Stop, latch Stop, latch (new design)	1406-3288-000 1406-3603-000
29	Spring, latch	1406-3289-000
30***	Bearing, flanged (2)	1406-3290-000
31	Latch (2)	1406-3291-000
32	Shaft, latch	1406-3292-000
33	Ring, retaining	1406-3294-000
34*	Screw, M2x10 Phillips PAN (4)	1406-3295-000
35	Microswitch, Bag/Vent	1406-3601-000
36	Screw,m3x8 BHSCS SST (5)	1406-3297-000
37	Cover	1406-3298-000
38	Control panel	1406-3299-000
39	Lockwasher, M3 internal (5)	9213-0430-003
40	Tubing, 350 mm - 1/4 inch	0994-6370-010
41	Microswitch, Control Panel	1406-3285-000

* Apply Loctite 242
** When replacing the previous design stop (Item 28) with a new design stop, you must also replace the latch (Item 15) with a new design latch.
*** Not used in new version control panel.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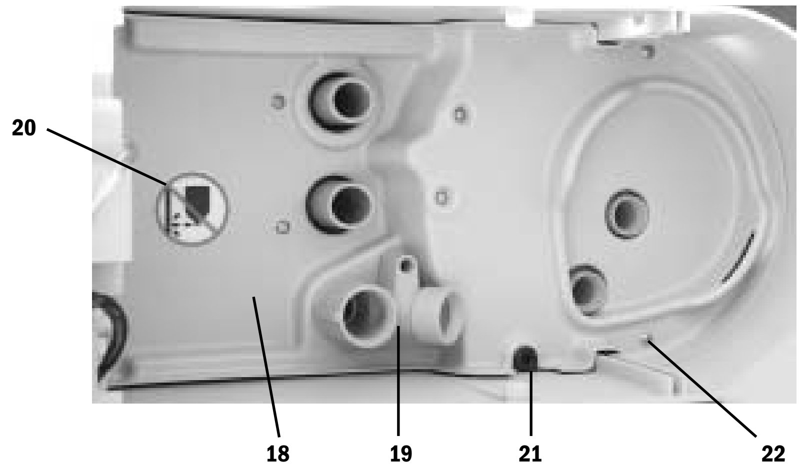
8.27.3 Chassis Upper

Item	Description	Stock Number
	Top chassis, with handle and door(includes items 1 through 9)	1406-8200-000
1	Chassis framework	1406-3200-000
2	Handle Support, right	1406-3212-000
3	Handle	1406-3213-000
4	Handle Support, left	1406-3211-000
5	Door	1406-3214-000
6	Label, door	1406-3215-000
7	Screw, M3x8 BHSCS SST (8)	1406-3297-000
8	Lockwasher, M3 internal (6)	9213-0430-003
9	Washer, flat 3.18 ID - 19.0 OD (8)	1406-3216-000
10	ACGO plate (if ACGO not installed)	1406-3238-000
11	Securing rivets, ACGO plate	1006-3199-000
12	Microswitch, Absorber Bypass, with harness	1006-4058-000
13	Blank, port seal	1406-3569-000
14	Subfloor, front	1406-3201-000
15	Cable, O_2 sensor	1006-3141-000
16	Grommet (cut)	1406-3203-000
17	Screw, M4x16 BT SKT HD SST (2)	0140-6226-115
18	Subfloor, rear	1406-3202-000
19	Manifold seal, AGSS, “Y”	1406-3565-000
20	Label, no spill	1406-3208-000
21	Grommet, horseshoe	no longer used
22	Screw, M4x8 BT SKT HD SST (6)	0140-6226-118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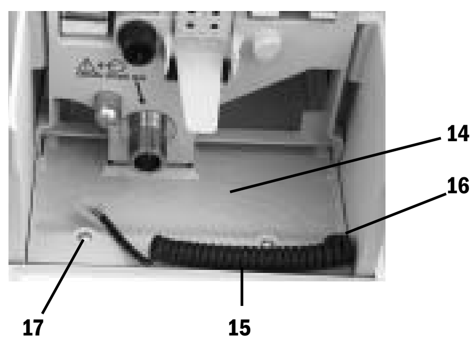
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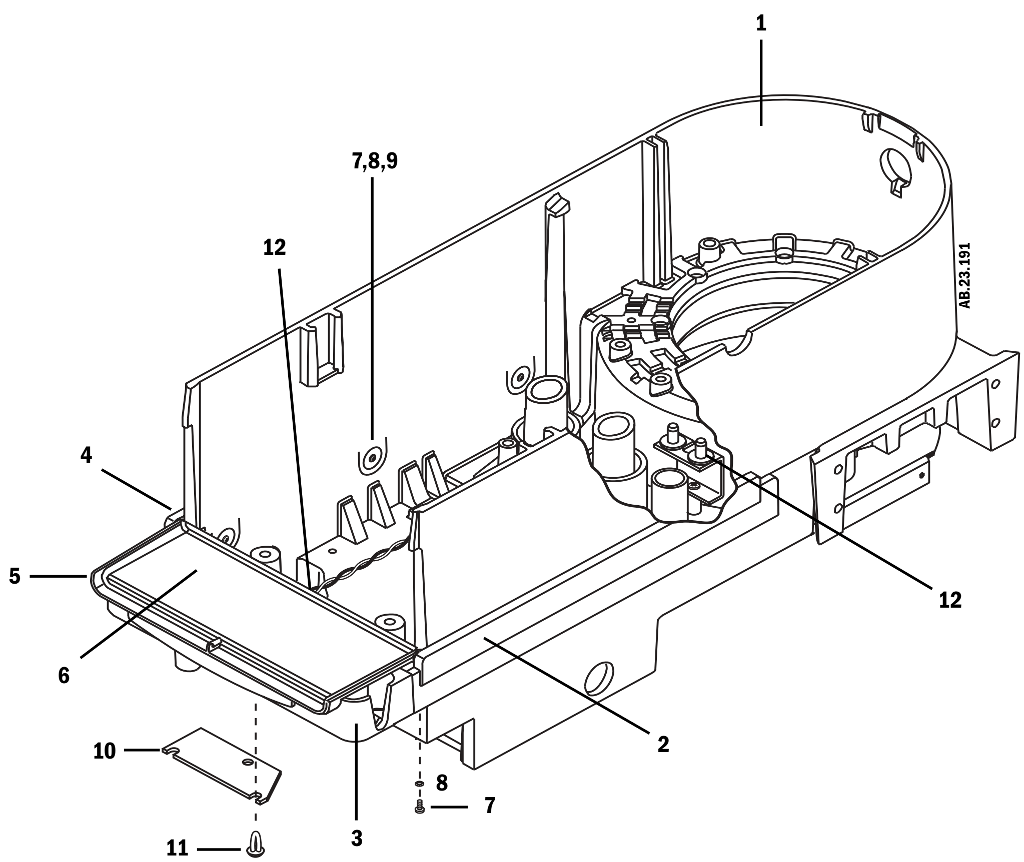
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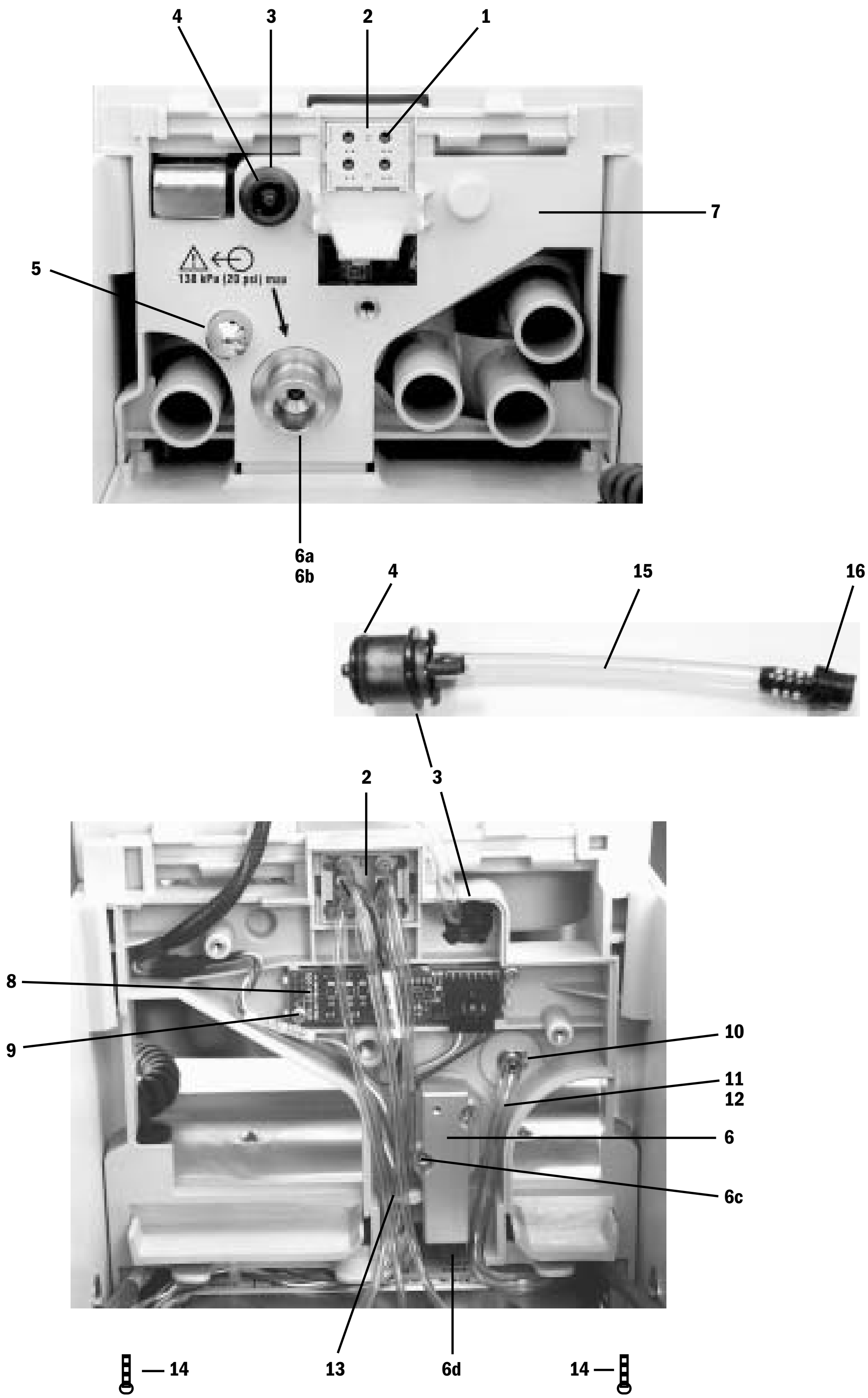
8.27.4 Bulkhead

Item	Description		Stock Number	Stock Number	
1	O-Ring Replacement Kit, Bulkhead Connector		1503-8115-000		
2	Complete connector with harness assembly and tubing/connectors		1503-3239-000		
	Complete connector with harness assembly (without tubing)		1006-3116-000		
	Tubing only, 500 mm - 1/8 inch, 4 each		1503-3123-000		
	Tubing connector, yellow	Insert half	1503-3131-000	1503-3132-000	Body half
	Tubing connector, blue	Insert half	1503-3129-000	1503-3130-000	Body half
	Tubing connector, black	Insert half	1503-3127-000	1503-3128-000	Body half
	Tubing connector, white	Insert half	1503-3118-000	1503-3119-000	Body half
3	Port Connector, pressure gauge — 7900		1406-3243-000		
	Port Connector, pressure gauge — 7100		1406-3245-000		
4	O-ring, port connector		1503-3240-000		
5	Port, ACGO O_2 sense		1406-3249-000		
6	Common gas outlet port assembly(Includes 6a through 6d)		1406-8204-000		
6a	Port, common gas outlet		1406-3248-000		
6b	O-ring, 0.5 OD - 0.375 ID		0210-0533-300		
6c	Screw, M4x12		1102-3006-000		
6d	Fitting, 1/4 inch elbow		1006-3737-000		
7	Bulkhead		1406-3247-000		
8	PCB, Breathing Circuit ID		1006-3052-000		
9	Screw, M3x8		1406-3242-000		
10	Retaining Ring		1202-3336-000		
11	Tubing, 1/4 inch (350 mm)		0994-6370-010		
12	Plug, 4 mm (for end of tube if no ACGO)		1006-3530-000		
13	Cable tie		0203-5915-300		
14	Screw, M4x8 Pozidriv (2)		1006-3178-000		
15	Tubing, 1/4 inch (100 mm) — 7900 and 7100		0994-6370-010		
	Tubing, 1/4 inch (320 mm) — 7100		0994-6370-010		
16	Coupling, inline (black) — 7900 and 7100	Body half	1503-3128-000	1503-3237-000	Insert half
	Coupling, inline (white) — 7100	Body half	1503-3119-000	1503-3236-000	Insert half
Not Shown:					
	Bulkhead cover		1406-3246-000		
	Screw, M3x8 (3)		1406-3297-000		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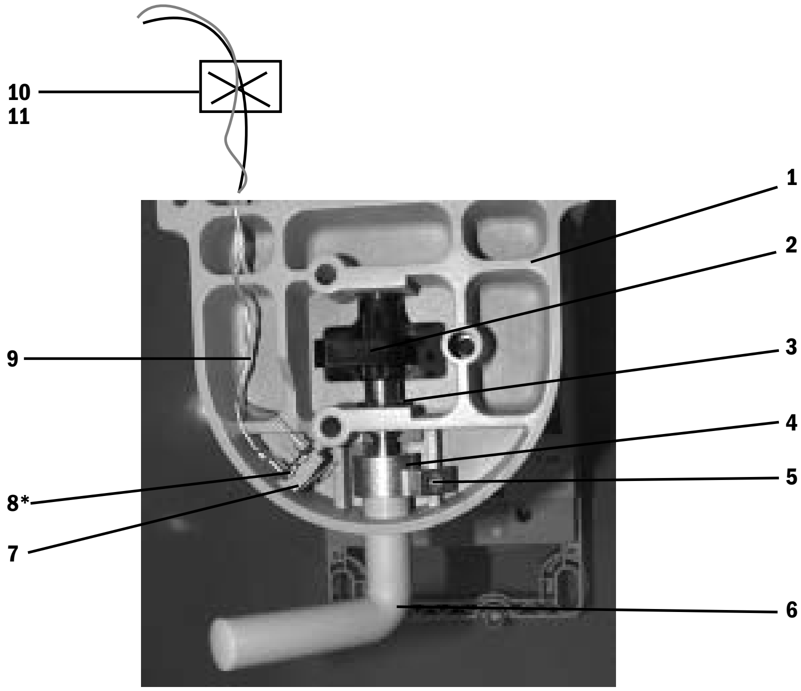
138 kPa (20 psi) max

8.27.5 Chassis Lower

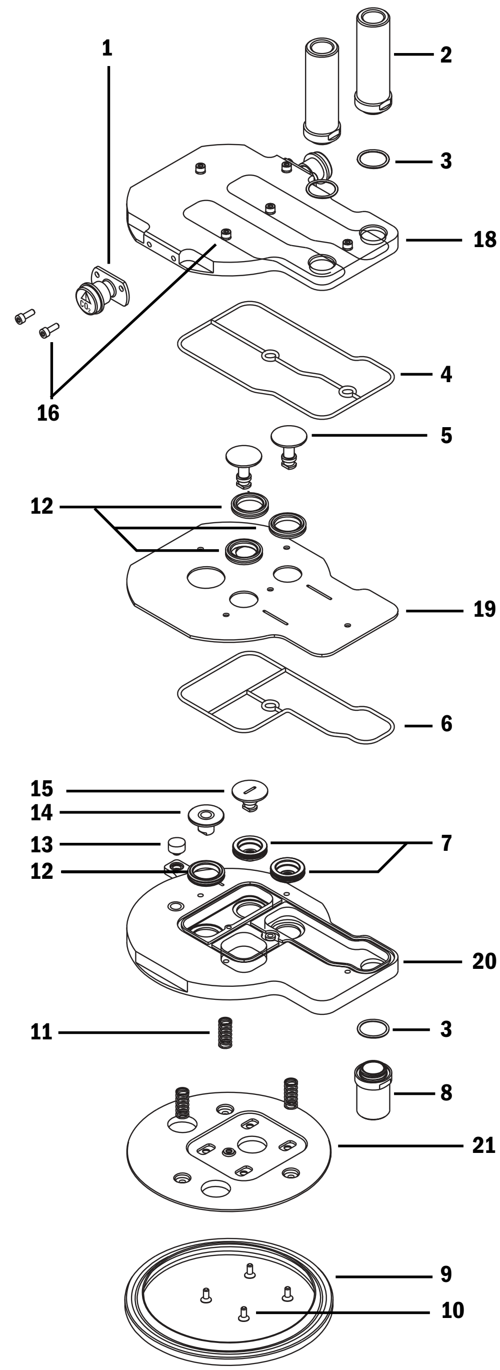


Item	Description	Stock Number
	Lower Housing Assembly, Kit(* Includes Item 1 and Items 7 through 11)	1406-8240-000
1*	Absorber bottom chassis	1406-3450-000
2	Cam, canister lock	1406-3445-000
3	Retaining ring	1406-3446-000
4	Indexer, canister lock	1406-3440-000
5	Screw	1102-3006-000
6	Canister lock handle assembly	1406-8222-000
7*	Switch, micro, canister release (no harness)	1406-3296-000
8**	Screw, M2x10 Pan Head	1406-3295-000
9*	Harness, Canister switch	1006-3801-000
10*	Cable-tie mount	1001-3736-000
11*	Cable-tie wrap	0203-5915-300

** Apply Loctite 242

8.27.6 Absorber (CO_2) bypass

Item	Description	Stock Number
	Absorber (CO_2) Bypass Assembly	1406-3500-000
1	Button Kit (2)	1406-8236-000
2	Tube, long (2)	1406-3518-000
3	O-ring (3)	1006-3614-000
4	Seal, upper manifold	1406-3516-000
5	Piston, upper (2)	1406-3505-000
6	Seal, lower manifold	1406-3517-000
7	Seal, piston (2)	1406-3508-000
8	Tube, short	1406-3519-000
9	Seal, actuator plate	1406-3510-000
10	Screw, M4x8 Flt HD (4)	0140-6226-107
11	Spring (3)	1406-3515-000
12	Seal, center plate (4)	1406-3503-000
13	Bumper	1406-3511-000
14	Piston, drain	1406-3504-000
15	Piston, lower	1406-3506-000
16	Screw, M4x12 SKT HD CAP	1102-3006-000
17	Label, absorber	1406-3456-000
18	Manifold, upper	1406-3501-000
19	Plate, center	1406-3507-000
20	Manifold, lower	1406-8235-000
21	Plate, actuator	1406-3509-000



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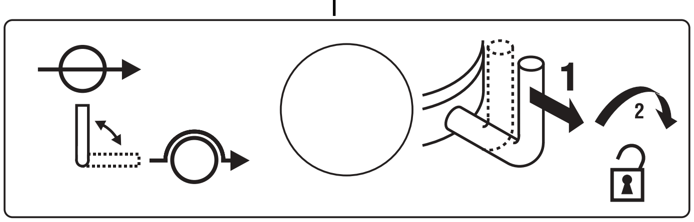
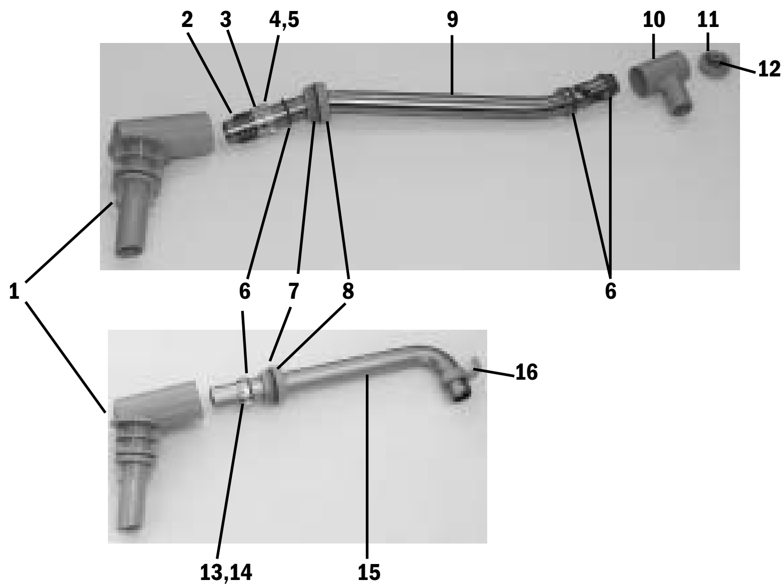


8.27.7 Bag Arms

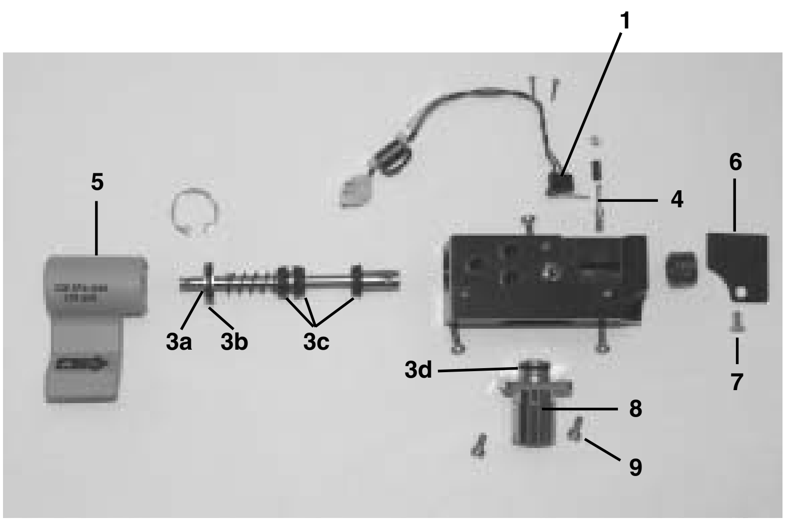


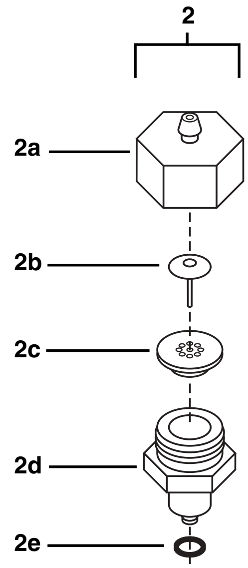
Item	Description	Stock Number
	Bag arm assembly, Long Arm	1406-3350-000
	Bag arm assembly, Short Arm	1406-3380-000
1	Base, bag arm	1406-3359-000
2	Spring	1406-3358-000
3	Ring, locking, arm side	1406-3356-000
4	Ring, locking, base side	1406-3355-000
5**	Set screw, M3x3 (see Note) Set screw, M3x4 (see Note)	1406-3357-000 0141-4227-102
6*	O-ring, 21.89 ID - 27.13 OD	1406-3345-000
7*	O-ring, 31.42 ID - 36.66 OD	1406-3346-000
8	Ring nut	1406-3354-000
9	Bag arm subassembly (see Note)	1406-3353-000
10	Port, bag arm	1406-3352-000
11	Cap, end bag arm	1406-3351-000
12*	O-ring, 7.59 ID - 12.83 OD	1406-3347-000
13	Adapter, bag arm short	1406-3382-000
14	Set screw, cup point hex (note dimple in arm)	9211-0830-055
15	Arm, short	1406-3381-000
16	Hook, short arm	1406-3385-000

* Lubricate sparingly with Krytox.
** Apply Loctite 242.

Note: If bag arm (Item 9) has counter bore, use the M3x4 set screw; otherwise, use M3x3 set screw.

8.27.8 Auxiliary common gas outlet (ACGO)





Item	Description	Stock Number
	Auxiliary common gas outlet assembly (ACGO)	1006-8037-000
1	Switch, micro, with harness (ACGO)	1006-3143-000
2	Check valve, O_2 sense	1406-8233-000
2a	Cap, ACGO check valve	1406-3599-000
2b	Flapper, ACGO check valve	1406-3600-000
2c	Disc, ACGO check valve	1406-3598-000
2d	Housing, ACGO check valve	1406-3537-000
2e	O-ring, 5.28 ID 7.82 OD	1406-3543-000
3	Seal Replacement Kit, ACGO	1406-8231-000
3a*	O-ring, 0.250 inch ID 0.375 inch OD	0210-0687-300
3b*	O-ring, 0.687 inch ID 0.812 inch OD	0210-0544-300
3c*	U-cup	1503-3089-000
3d*	O-ring, ACGO outlet	1406-3536-000
4	Pin	1406-3530-000
5	Lever, ACGO toggle (color changed to teal in 2001)	1406-3533-000
6	Plate, end cover	1406-3529-000
7	Screw, M4x10 CSK SKT HD SST	0140-6226-119
8	Outlet adapter, ACGO	1406-3535-000
9**	Screw, M4x8	9211-0640-083

* Lubricate sparingly with Krytox.
** Apply Loctite 242.

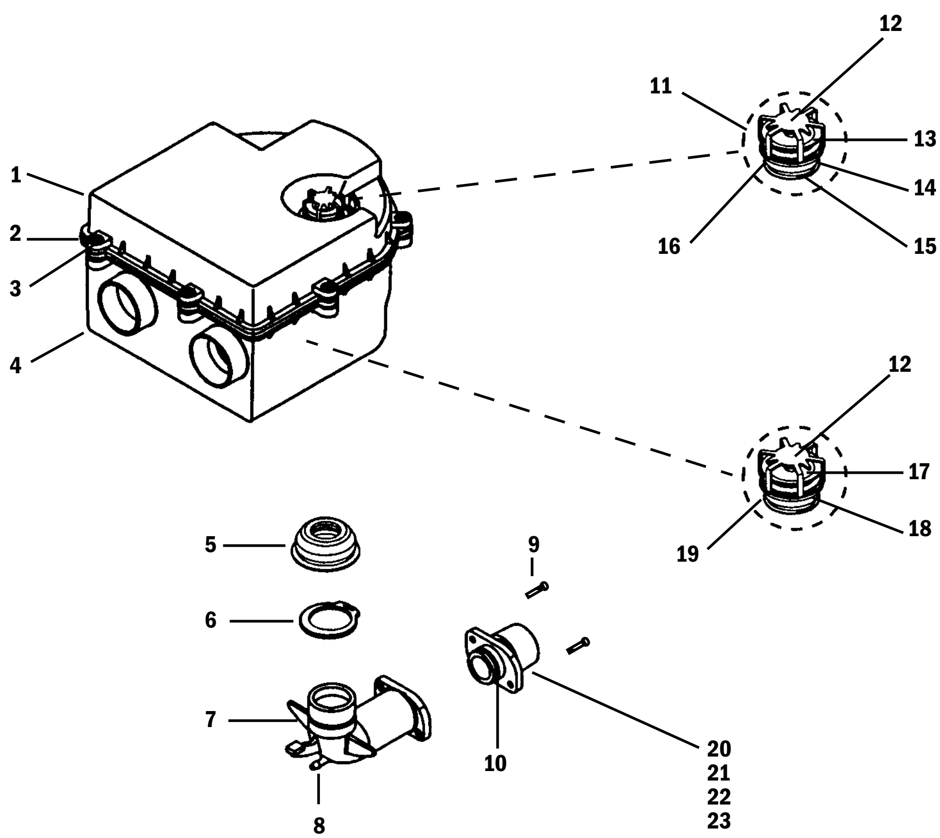
8.28 Anesthetic Gas Scavenging System — AGSS

8.28.1 Passive AGSS

Items 1 through 19 are included in all Passive AGSS kits listed below.

Item	Description, Common Parts	Stock Number
1	Receiver Body, Upper, Passive	1406-3525-000
2=	Seal, Receiver Body	1406-3552-000
3=	Screw, M4x12 Pozi (6 each required)	0140-6226-111
4=	Receiver Body, Lower	1406-3550-000
5=	Seal, Rotating Connector	1406-3520-000
6=	Retaining Ring, 31.7 SFT Diameter	1406-3554-000
7	Connector, Rotating	1406-3551-000
8	Cap, 3.18 Barb, Silicone	1406-3524-000
9=	Screw, M4x8 Socket Head (2)	9211-0640-083
10*=	O-ring, 21.95 ID, 25.51 OD	1406-3558-000
11	Ring, Locking Disc Retainer, 28.50 ID,	1400-3020-000
12	Retainer, Disc	1400-3017-000
13	Weight, Dead, 10 cm H_2O	1406-3572-000
14*	O-ring, 15.6 ID, 19.16 OD	1006-3616-000
15	Retaining Ring, 19.05 Shaft Diameter	1406-3577-000
16	Seat, Valve, Positive Pressure	1406-3571-000
17	Disc, Check Valve, Polypropylene	0210-5297-100
18*	O-ring, 37.82 ID, 41.38 OD	1406-3581-000
19	Seat, Valve, Negative Pressure	1406-3580-000
Passive AGSS, 30mm Taper ISO Male, Specific Parts		**1406-8215-000**
NS	Adapter, 30mm-19mm, Disposable	1500-3376-000
20	Connector, 30mm ISO, Male	1406-3555-000
Passive AGSS, 25mm Taper DEU Male w/Drager Hose and Probe, Specific Parts		**1406-8217-000**
21	Connector, 25mm Hose, German	1406-3573-000
NS	Hose, Suction, 5 meter long (Drager)	1001-3439-000
NS	Probe, Suction, 25mm (Drager)	1001-3440-000
Passive AGSS, Swedish, Specific Parts		**1406-8223-000**
22	Connector, Swedish	1406-3583-000
Passive AGSS, Danish, Specific Parts		**1406-8224-000**
23	Connector, Danish	1406-3584-000

* Lubricate sparingly with Krytox
= Common parts for both Active and Passive AGSS
NS Not shown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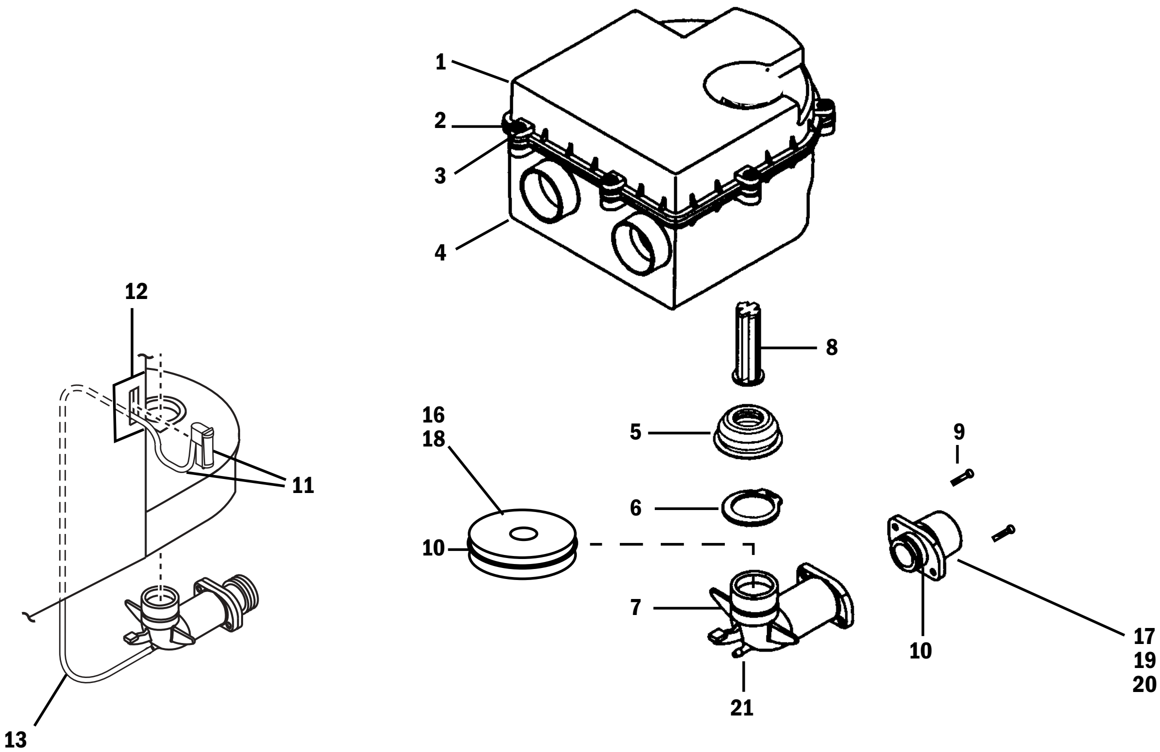
8.28.2 Active AGSS

Items 1 through 15 are included in all Active AGSS kits listed below.

Item	Description, Common Parts	Stock Number
1	Receiver Body, Upper, Active	1406-3559-000
2=	Seal, Receiver Body	1406-3552-000
3=	Screw, M4x12 Pozi (6ea. required)	0140-6226-111
4	Receiver Body, Lower, Active	1406-3550-000
5=	Seal, Rotating Connector	1406-3520-000
6=	Retaining Ring, 31.7 SFT Diameter	1406-3554-000
7=	Connector, Rotating	1406-3551-000
8	Filter, Air, 225 Micron, Nylon Screen	1406-3521-000
9=	Screw, M4x.07, 8mm Length, Socket Head (2)	9211-0640-083
10*=	O-ring, 21.95 ID, 25.51 OD	1406-3558-000
	AGSS Vacuum gauge replacement kit (includes Items 11, 12, and 13)	**1406-8221-000**
11	Gauge, Vacuum	1406-3560-000
12	Label, AGSS (mounts to side of absorber)	1406-3527-000
13	Tubing, 0.125 ID x 0.25 OD	0994-6370-010
14	Fitting, 19-mm male taper with hose barb	1406-8232-000
15	Tubing, 120 Length, Black Latex Conducting	0211-0185-500
Active AGSS, DISS EVAC Connector, Specific Parts(Low Flow — US Style)		**1406-8216-000**
16	Orifice, Low Flow	1406-3522-000
10*	O-ring, 21.95 ID, 25.51 OD	1406-3558-000
17	Connector, DISS EVAC	1406-3597-000
X	Hose Adapter Kit, DIA EVAC purple	1001-8887-000
X	Hose Adapter Kit, HIT DISS F EVAC purple	1001-8886-000
Active AGSS, 30-mm Male Thread Connector, Specific Parts(High Flow — UK Style)		**1406-8214-000**
18	Orifice, High Flow	1406-3523-000
10*	O-ring, 21.95 ID, 25.51 OD	1406-3558-000
19	Connector, M30 Thread	1406-3557-000
X	Hose with 30-mm (BSI) threaded fitting at both ends (5 meter)	1406-8227-000
X	Hose with 30-mm (BSI) threaded fitting at AGSS (machine) end and a BOC fitting at wall end (5 meter)	1406-8228-000
Active AGSS, 12.7-mm (1/2 inch) Hose Barb, Specific Parts(Low Flow — Japanese) Does not include flow gauge components (Items 11–13),		**1406-8225-000**
20	Connector, with 12.7-mm (1/2 inch) hose barb	1406-3574-000
21	Cap, 3.18 Barb, Silicone	1406-3524-000
Auxiliary Inlet Kit, for use with Active AGSS		**1406-8229-000**
22a	Retaining Ring	1406-3184-000
22b	Fitting, 10-32 x1/8-inch barb	1500-3116-000
22c	Plug, 10-32	1500-3272-000

* Lubricate sparingly with Krytox.
= Common parts for both Active and Passive AGSS.
X Not included in kit; order separately.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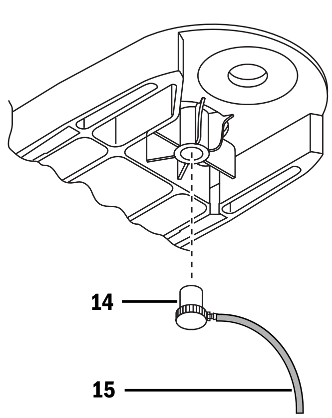
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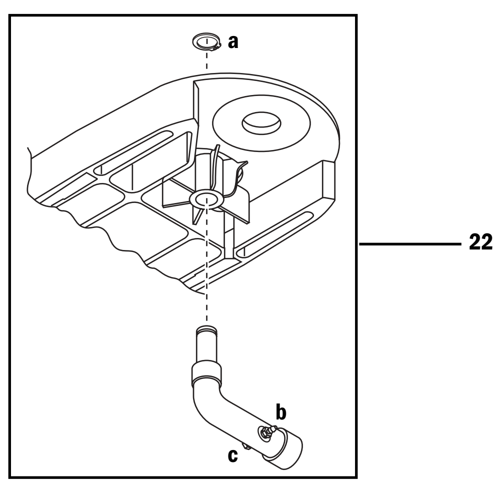
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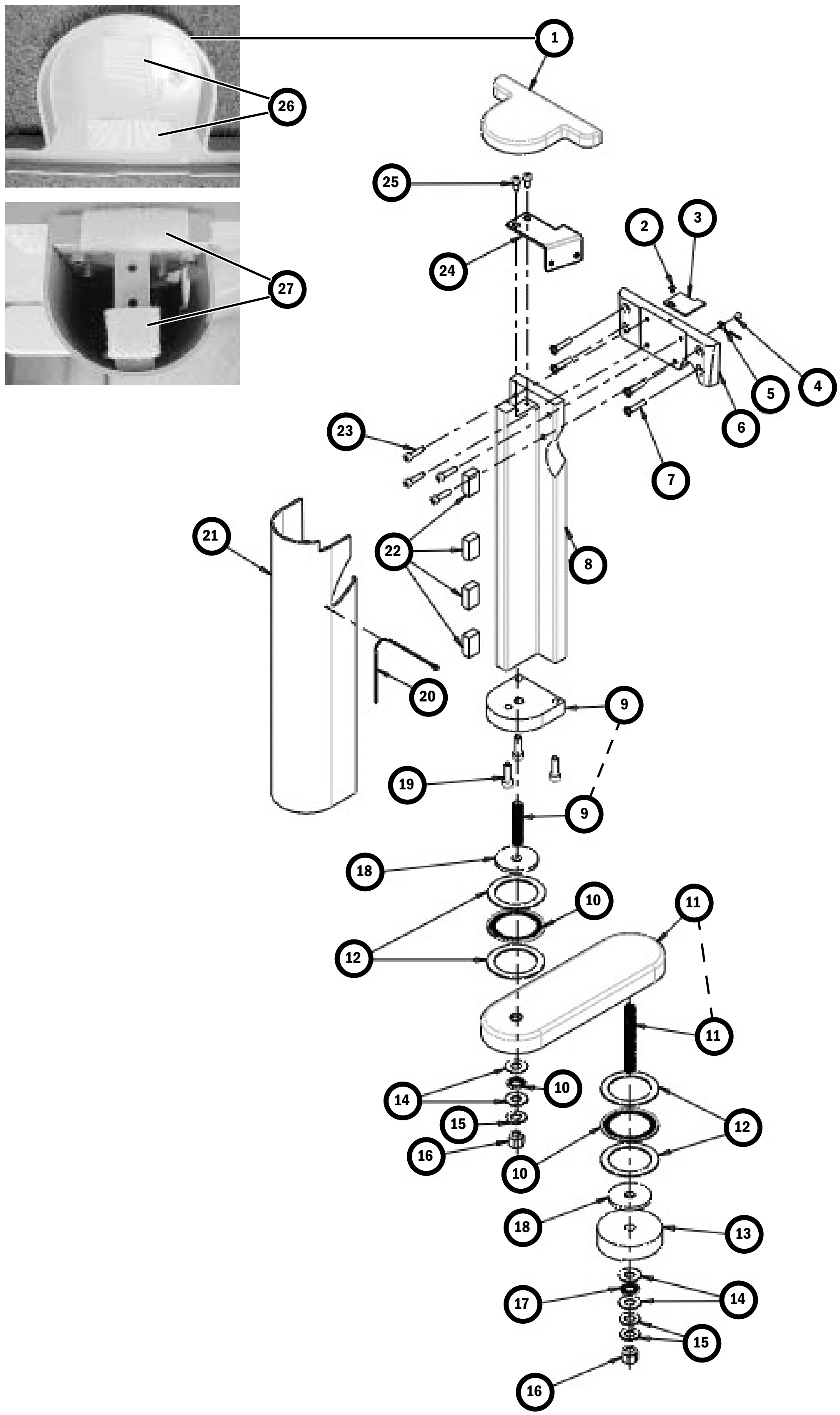
8.29 Articulating Arm

8.29.1 Support Column and Arm Assembly:

Item	Description	Stock Number
1	Cap, Support Column	1006-4591-000
2	Screw, M4x8	1006-3178-000
3	Plate, TNA Constrainer	1006-4619-000
4	Plate, Mounting TNA	1006-4586-000
4	Screw, M6x12	0144-2436-101
5	Clip, Cable Bundle	1006-4596-000
7	Screw, M6x25 CSK SKT HD	1009-3352-000
8	Support Column	1006-1550-000
9	Base (with threaded stud), Support Column	1006-4668-000
10	Bearing, Roller 2.125 inch ID	1006-4599-000
11	Support Arm (with threaded stud)	1006-4669-000
12	Washer, Bearing 2.125 inch ID	1006-4598-000
13	Spacer, Support	1006-4587-000
14	Washer, Bearing 0.5 inch ID	1006-4593-000
15	Washer, Flat 13.5 ID 25.4 OD	1006-3828-000
16	Nut, Nylock	1006-4595-000
17	Bearing, Roller 0.5 inch ID	1006-4594-000
18	Washer, Thrust Bearing	1006-4588-000
19	Screw, M8x25	9211-0680-253
20	Cable Tie	1006-4666-000
21	Cover, Support Column	1006-4590-000
22	Foam, Hold Down	1503-3238-000
23	Screw, M6x25	9211-0660-254
24	Bracket, Mount AGSS	1006-4620-000
25	Screw, M6x8	0144-2436-102
26	Velcro, hook	purchase locally
27	Velcro, loop	purchase locally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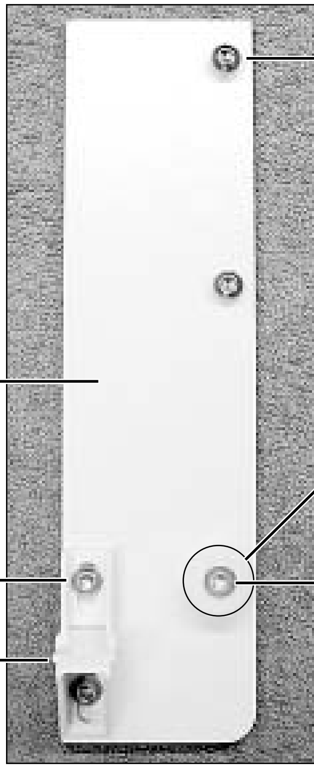
8.29.2 Articulating arm accessory items

Item	Description	Stock Number
1	Latch, TNA	1006-4624-000
2	Screw, M6x8	0144-2436-102
3	Bracket, TNA Latch	1006-4623-000
4	Bumper, TNA	1006-4641-000
5	Label, Transport Condition	1006-4667-000
6	Screw, M8x35	0144-2148-245
7	Wedge, Dovetail Lock	1006-1282-000
8	Label, ⚠	1006-0273-000
9	Plug	1202-3253-000
10*	Counterweight	1006-4589-000
11	Cover, Panel TNA	1006-4592-000
12	Ring ,Conduit Retainer	1006-4615-000
13	Cable Assembly, includes CPU cables and conduit	1006-4597-000
14	Hose Assy Vent Gas Supply	1503-3859-000
15	Tubing Nylon 0.25 inch OD (O2 Flush - 2275 mm)	1001-3064-000
16	Tubing Nylon 0.25 inch OD (Mixed Gas - 1840 mm)	1001-3064-000

* Machines that are equipped with the Articulating Absorber Arm include a counterbalance weight (**10**) on the right side of the machine to maintain stability when the breathing system is in the extended position.

⚠ **WARNING** Do not remove the counterbalance weight. Removing the weight will cause the machine to be unstable when the breathing system is extended.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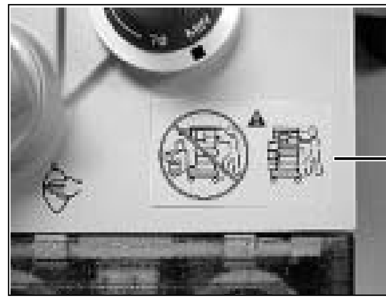
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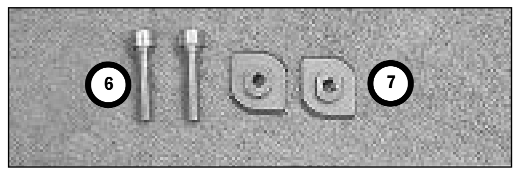
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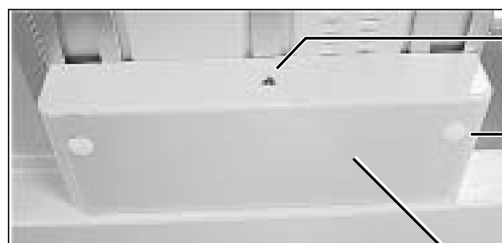
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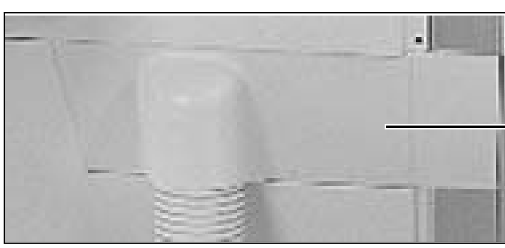
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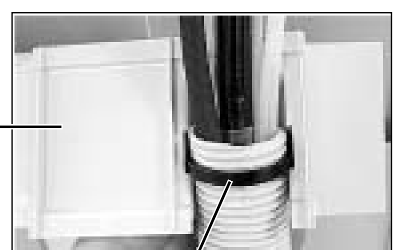
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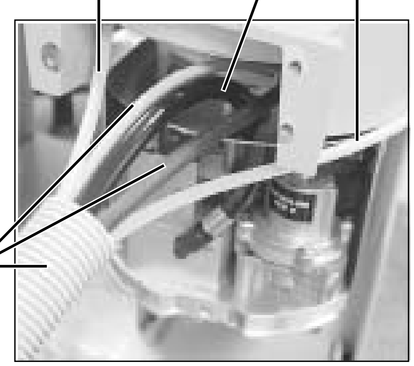
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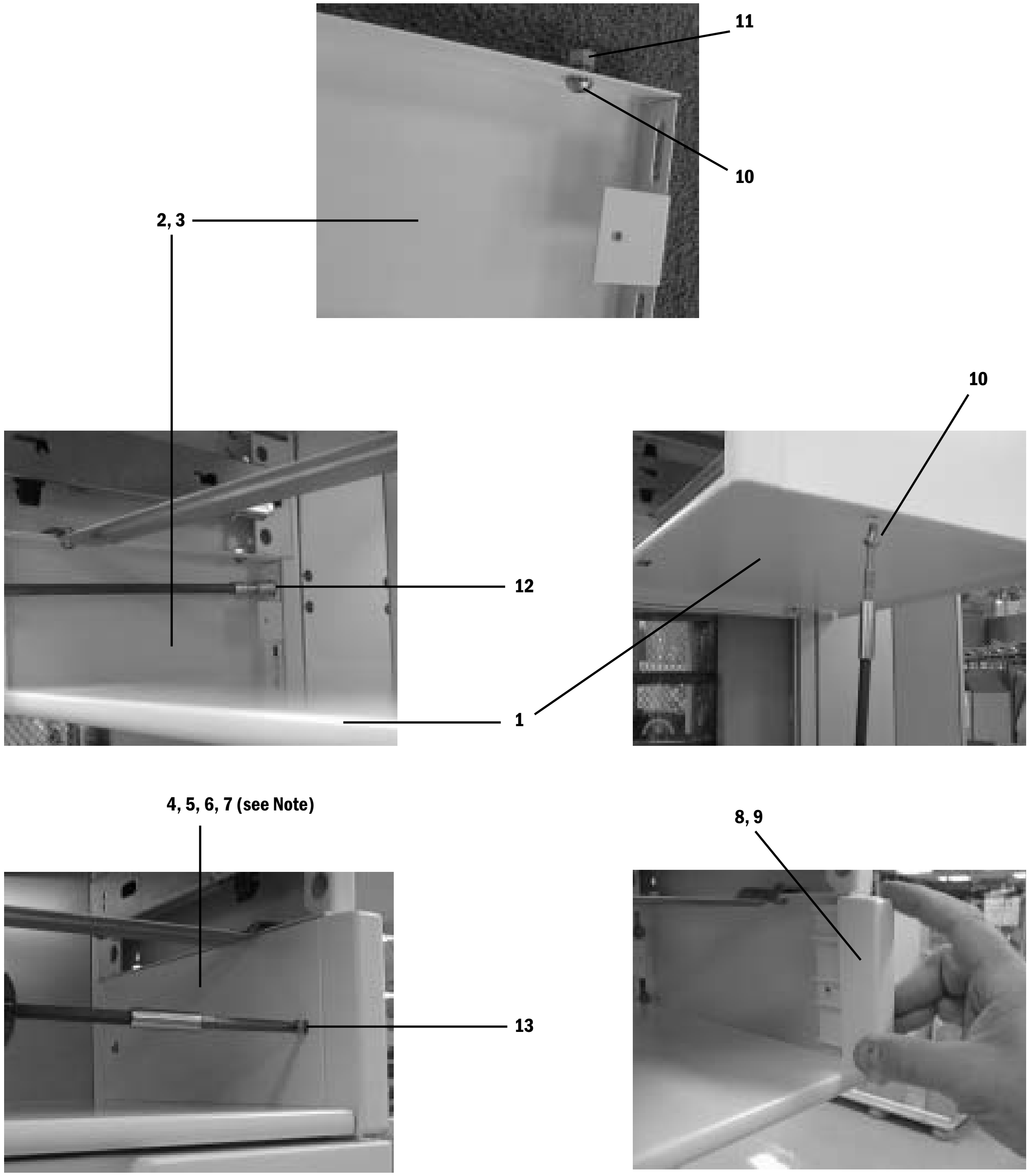
8.30 Lower Shelve Kits

Description	Stock Number
Shelf 9.2 cm (3.6 in) Opening	1006-8252-000
Shelf 13.2 cm (5.2 in) Opening	1006-8253-000
Shelf 20.6 cm (8.1 in) Opening	1006-8254-000
Shelf 24.6 cm (9.7 in) Opening	1006-8255-000
Shelf 28.6 cm (11.3 in) Opening	1006-8256-000
Shelf 32 cm (12.6 in) Opening	1006-8257-000
Shelf 36 cm (14.2 in) Opening	1006-8258-000

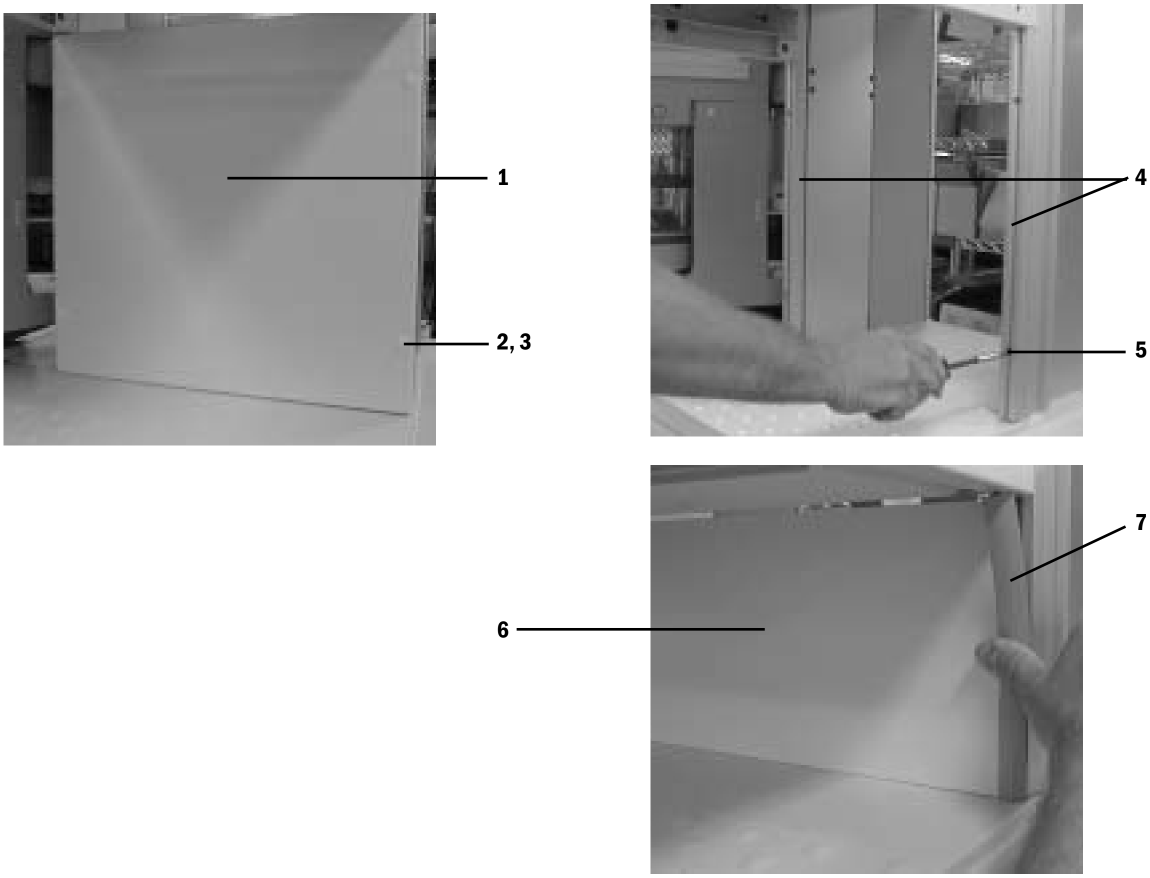
8.30.1 Parts List for Shelf Kits

			1006-8252-000 Shelf Kit 9.2 cm	1006-8253-000 Shelf Kit 13.2 cm	1006-8254-000 Shelf Kit 20.6 cm	1006-8255-000 Shelf Kit 24.6 cm	1006-8256-000 Shelf Kit 28.6 cm	1006-8257-000 Shelf Kit 32 cm	1006-8258-000 Shelf Kit 36 cm
Item	Description	Stock Number	Qty	Qty	Qty	Qty	Qty	Qty	Qty
1	Shelf	1006-1343-000	1	1	1	1	1	1	1
2	Side Support, 114 mm	1006-1346-000	2		4	2		6	4
3	Side Support, 154 mm	1006-1347-000		2		2	4		2
4	Cover, 114 mm (full width)	1006-1370-000			2	2		4	4
5	Cover, 114 mm (narrow)	1006-5213-000	2		2			2	
6	Cover, 154 mm (full width)	1006-1372-000					2		
7	Cover, 154 mm (narrow)	1006-1373-000		2		2	2		2
8	Bumper, 110 mm	1006-3733-000	2		4	2		6	4
9	Bumper, 150 mm	1006-3734-000		2		2	4		2
10	Screw, Sems M6x12	0144-2436-106	8	8	12	12	12	16	16
11	Nut, Keps M6	0144-3717-330	4	4	8	8	8	12	12
12	Screw, 1/4 inch x 0.37 inch long	1006-3741-000	4	4	8	8	8	12	12
13	Screw, M4x8	1006-3178-000	4	8	8	12	16	12	16



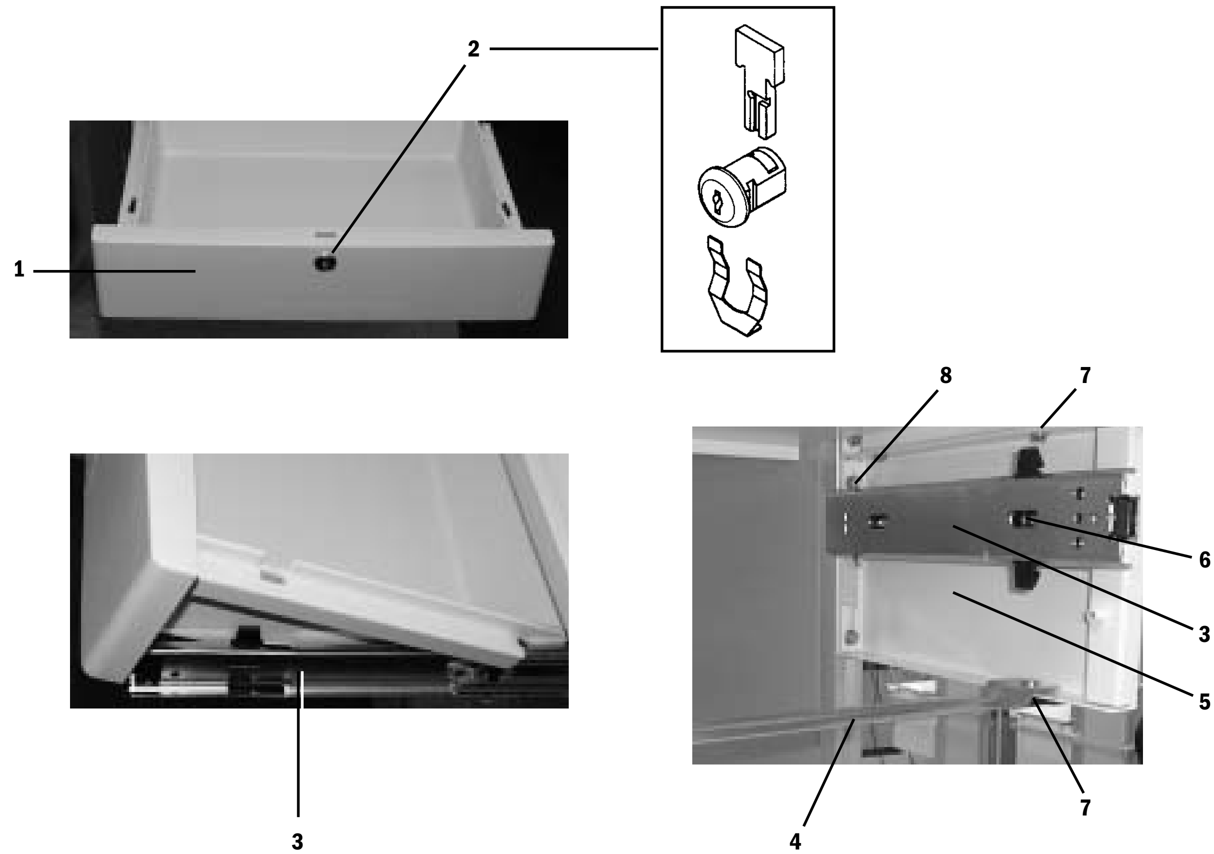
Note: For shelf heights 20.6 cm or greater, the side cover next to the shelf is a narrow cover (4 or 6). The covers above the narrow cover are the wide covers (5 or 7).

8.31 Drawer and Shelf Accessory Mounting Kit



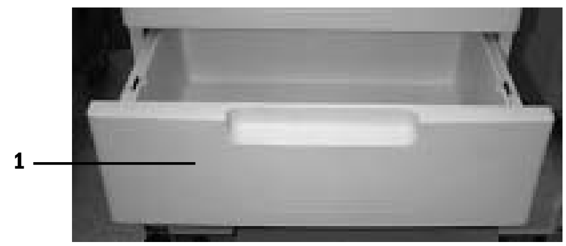
Item	Description	Stock Number
Note:	Items 1 through 3 are used on machines that only have the standard locking drawer. These items are removed when installing the accessory mounting kit.	
1	Front Panel, single drawer	1006-1360-000
2	Screw, Sems M6x12	0144-2436-106
3	Plug, hole	1006-3908-000
	Drawer and Shelf Accessory Mounting Kit (includes items below)	1006-8280-000
4	Extrusion, Aluminum Spacer	1006-1344-000
5	Screw, M6x8 BT SKT HD SST	0144-2436-102
6	Panel, Front Drawer (full size with break markings for custom fit)	1006-1359-000
7	Strip, Barbed Vinyl (356 mm length)	1006-1342-000

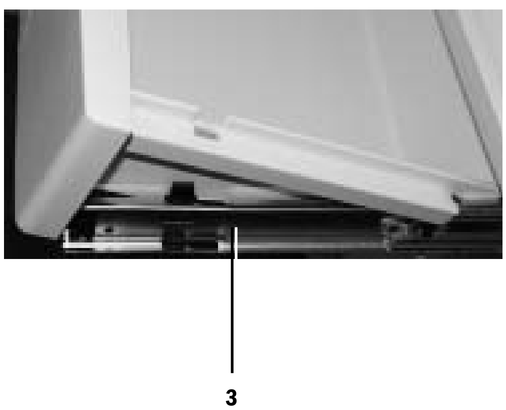
8.32 Drawer, Standard 11 cm Locking

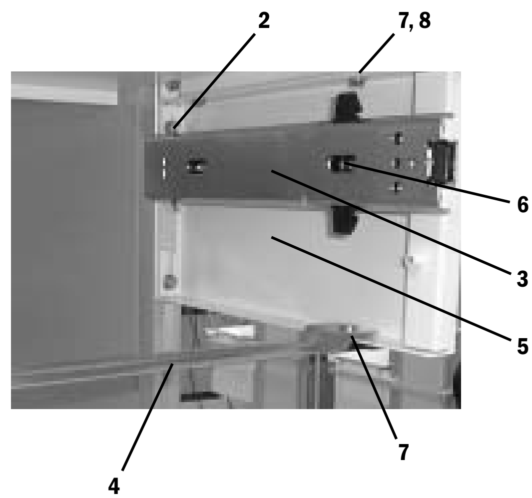


Item	Description	Stock Number
1	Drawer, 11 cm Locking (without lock) - (not MRI compatible)	1006-7009-000
2	Lock assembly (Refer to section 4.15.1)	1006-3184-000
3	Slide, drawer	1006-4549-000
4	Brace, drawer	1006-1184-000
5	Side Support, 110 mm wide (for standard drawer only)	1006-5236-000
6	Screw, M4x8 SKT HD SST	0140-6226-118
7	Screw, M6x12 SKT HD SEMS	0144-2436-106
8	Screw, M6x50 SKT HD CAP (Breathing System side) Screw, M6x60 SKT HD CAP (opposite Breathing System side)	9211-0660-504 0144-2131-914

8.33 Drawer, Optional 15 cm Non-locking

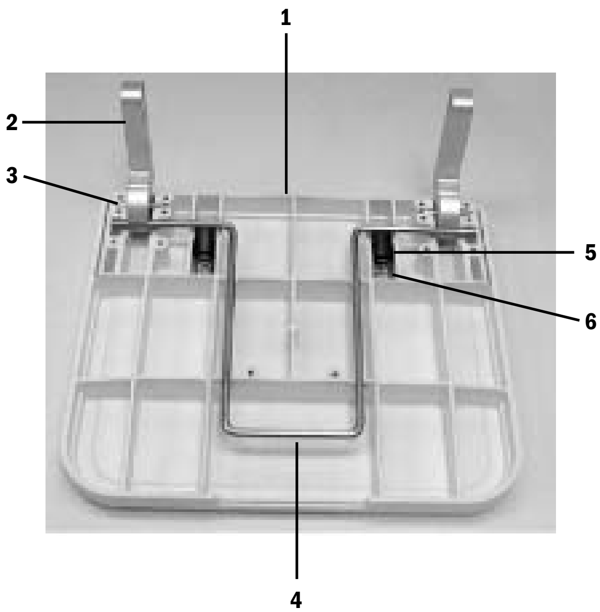


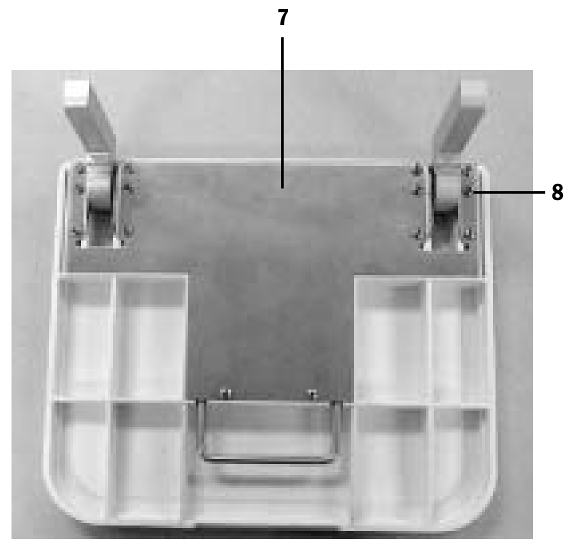




Item	Description	Stock Number	Qty
	Drawer Kit, includes all items listed below	1006-8250-000	
1	Drawer, 15 cm Non-locking	1006-7010-000	
2	Screw, 1/4 inch x 0.37 inch	1006-3741-000	(6)
3	Slide, drawer	1006-4549-000	(2)
4	Brace, drawer	1006-1184-000	(1)
5	Side Support, 154 mm wide	1006-1347-000	(2)
6	Screw, M4x8 SKT HD SST	0140-6226-118	(4)
7	Screw, M6x12 SKT HD Semsz	0144-2436-106	(6)
8	Nut, M6 Keps	0144-3717-330	(2)

8.34 Flip up shelf

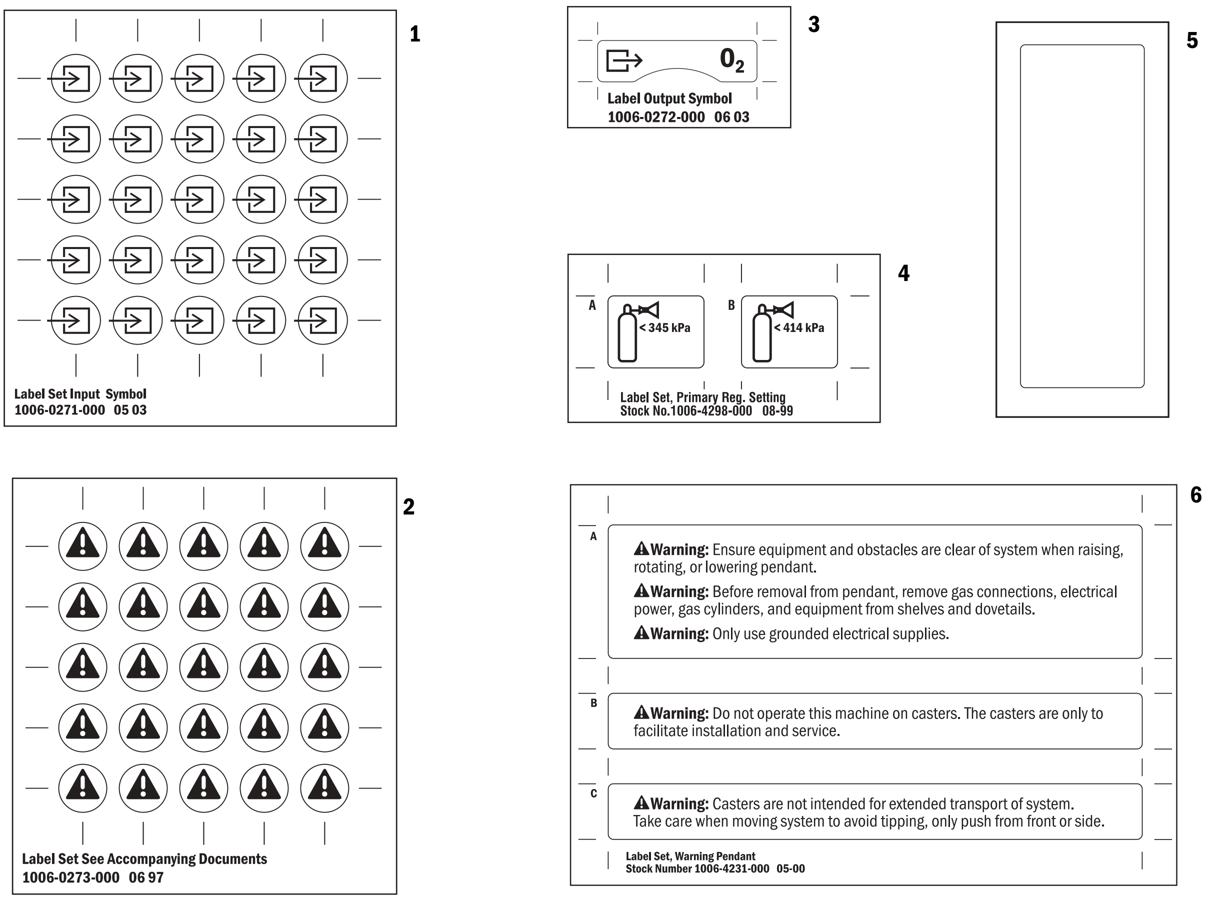




Item	Description	Stock Number
	Flip-Up Shelf (with stainless steel top), complete kit	1006-8026-000
	Flip-Up Shelf (without stainless steel top), complete kit	1006-8025-000
1	Shelf (with stainless steel top and weight limit labels)	1006-8350-000
	Shelf (without stainless steel top); also order two weight limit labels, see “Not Shown” below)	1006-3012-000
2	Mounting hinge	1006-1087-000
3	Pin, hinge	1006-5041-000
4	Rod, locking	1006-5040-000
5	Spring, 0.600 dia, 2.25 L	0203-3510-300
6	Cap 15.88 ID, 22.35 L	1006-3654-000
7	Plate, side shelf	1006-3013-000
8	Screw, 8x1 Pozidriv	1006-3243-000

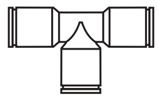
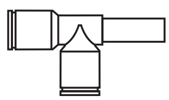
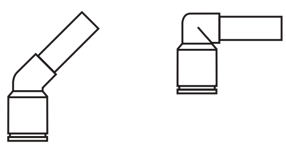
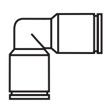
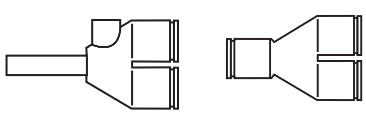
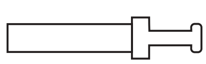
Not Shown		Stock Number
	Screw, M6x12 SKT HD Sems (to mount shelf)	0144-2436-106
	Label, shelf weight limit; 12 kg (25lb) MAX	1006-4656-000

8.35 Labels



Item	Description	Stock Number
1	Label Set, pneumatic input	1006-0271-000
2	Label Set, see accompanying documents	1006-0273-000
3	Label, pneumatic output – O_2	1006-0272-000
4	Label Set, primary regulator setting	1006-4298-000
5	Label, cover	1006-0347-000
6	Label Set, Pendant machine	1006-4231-000

8.36 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
	3/16 inch (CO_2 and Heliox)	0213-4727-300
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
	4 mm (N_2O)	1009-3040-000
	6 mm (O_2)	1009-3041=000
5 	**Y**	
	6 mm (O_2)	1009-3043-000
	8 mm (Air)	1009-3044-000
	8 mm Y with tailpiece	1009-3360-000
	1/4 inch (mixed gas)	1006-3065-000
6 	**Plug**	
	4 mm (N_2O)	1006-3530-000
	6 mm (O_2)	1006-3531-000
	8 mm (Air)	1006-3532-000
	3/16 inch (CO_2 and Heliox)	1006-3835-000

Note: Not every fitting is used in all machines.

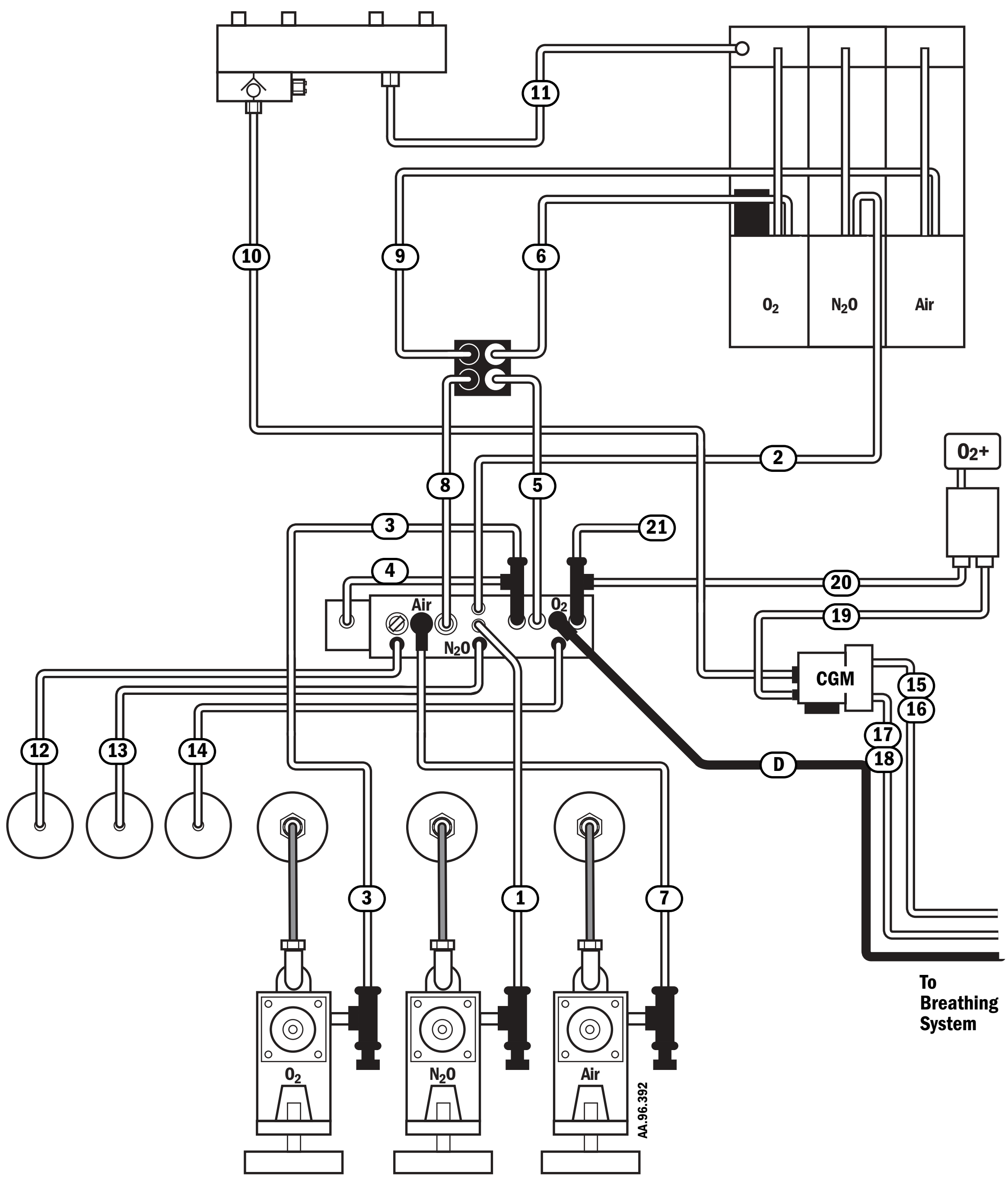
8.37 Tubing charts

8.37.1 Main manifold tubing

Except where specified otherwise:

- All tubing is a flexible nylon-type tube for use with quick-release fittings.
- Tube lengths may vary between machines - measure original.

Item	Description	Width	Stock Number
D	Hose Assembly, vent engine drive gas supply		1503-3219-000
1	N2O Cylinder to Main Manifold (305 mm, 320 mm, 400 mm, 650 mm)	4 mm	1001-3060-000
2	Main Manifold to N2O Flow Module (550 mm, 700 mm)	4 mm	1001-3060-000
3	O2 Cylinder to Main Manifold (280 mm, 320 mm, 550 mm, 600 mm, 650 mm)	6 mm	1001-3062-000
4	Main Manifold to O2 Power Outlet (315 mm)	6 mm	1001-3062-000
5	Main Manifold to System Switch - O2 (445 mm)	6 mm	1001-3062-000
6	System Switch (O2) to O2 Flow Module (750 mm)	6 mm	1001-3062-000
7	Air Cylinder to Main Manifold (205 mm, 300 mm, 510 mm)	8 mm	1001-3063-000
8	Main Manifold to System Switch - Air (520 mm)	8 mm	1001-3063-000
9	System Switch (Air) to Air Flow Module (775 mm)	8 mm	1001-3063-000
10	Vap Manifold Outlet to Common Gas Manifold (380 mm, 460 mm, 620 mm)	1/4 inch	1001-3064-000
11	Flow Module to Vap Manifold Inlet (550 mm, 750 mm, 850 mm)	1/4 inch	1001-3064-000
12	Main Manifold to Air Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
13	Main Manifold to N2O Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
14	Main Manifold to O2 Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
15	Refer to section 8.37.8		
16	Refer to section 8.37.8		
17	Refer to section 8.37.8		
18	Refer to section 8.37.8		
19	Flush Valve to Common Gas Manifold (360 mm, 610 mm)	1/4 inch	1001-3064-000
20	Main Manifold to Flush Valve (460 mm, 915 mm)	6 mm	1001-3062-000
21	Main Manifold to Aux O2 Flow Meter (800 mm)	6 mm	1001-3062-000

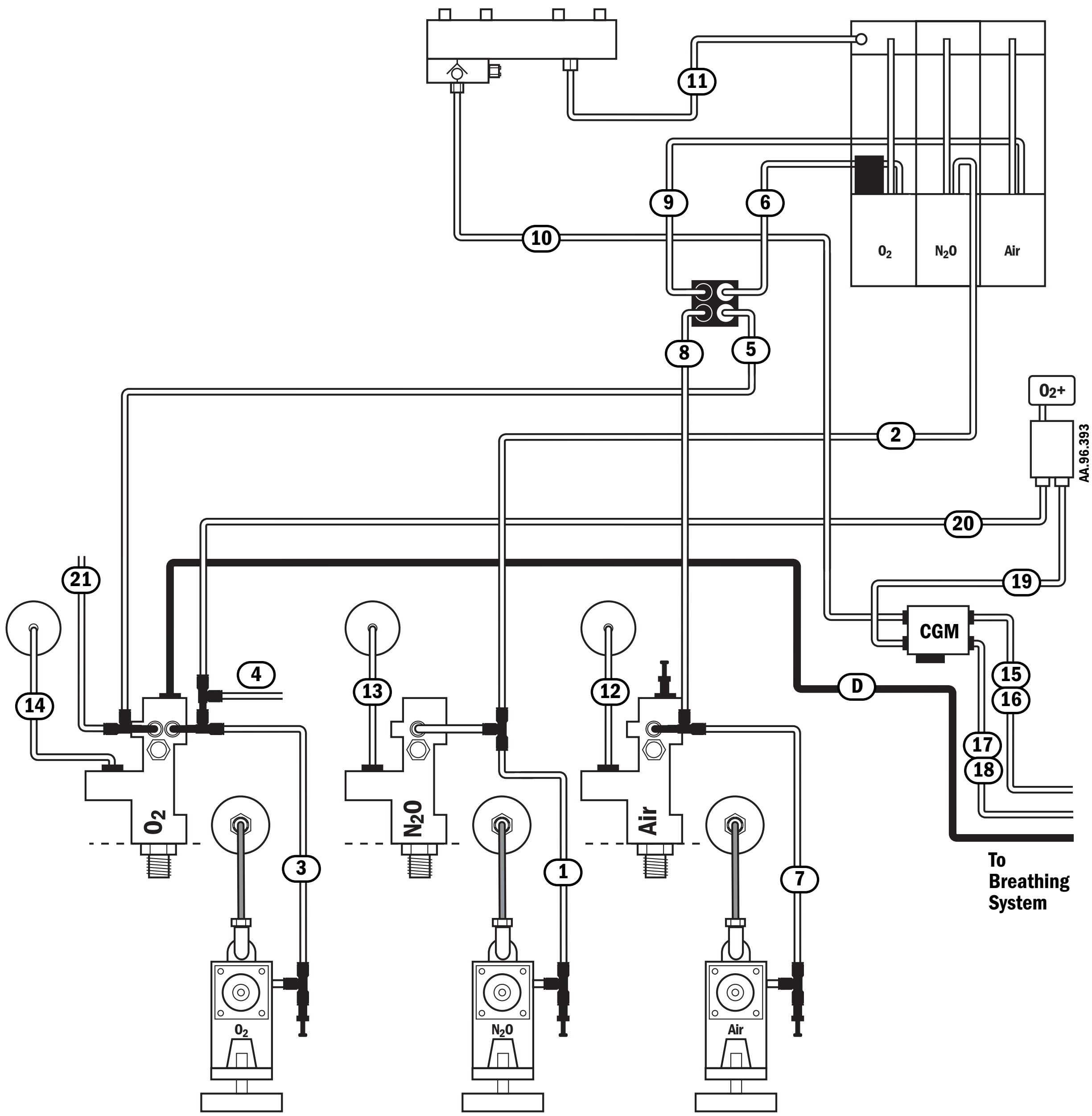

11
10
9
6
O_2
N_2O
Air
2
O_2+
8
5
3
21
4
20
Air
O_2
19
N_2O
CGM
15
16
17
12
13
14
D
18
3
1
7
To Breathing System
O_2
N_2O
Air
AA.96.392

8.37.2 Individual pipeline inlet manifold tubing

Except where specified otherwise:

- All tubing is a flexible nylon-type tube for use with quick-release fittings.
- The manifold tubing applies either to the pneumatic manifold or to an individual pipeline inlet manifold.
- Tube lengths may vary between machines - measure original.

Item	Description	Width	Stock Number
D	Hose Assembly, vent engine drive gas supply		1503-3219-000
1	N2O Cylinder to Manifold (305 mm, 320 mm, 400 mm, 650 mm)	4 mm	1001-3060-000
2	Manifold to N2O Flow Module (550 mm, 700 mm)	4 mm	1001-3060-000
3	O2 Cylinder to Manifold (280 mm, 320 mm, 550 mm, 600 mm, 650 mm)	6 mm	1001-3062-000
4	Manifold to O2 Power Outlet (315 mm)	6 mm	1001-3062-000
5	Manifold to System Switch - O2 (445 mm)	6 mm	1001-3062-000
6	System Switch (O2) to O2 Flow Module (750 mm)	6 mm	1001-3062-000
7	Air Cylinder to Manifold (205 mm, 300 mm, 510 mm)	8 mm	1001-3063-000
8	Manifold to System Switch - Air (520 mm)	8 mm	1001-3063-000
9	System Switch (Air) to Air Flow Module (775 mm)	8 mm	1001-3063-000
10	Vap Manifold Outlet to Common Gas Manifold (380 mm, 460 mm, 620 mm)	1/4 inch	1001-3064-000
11	Flow Module to Vap Manifold Inlet (550 mm, 750 mm, 850 mm)	1/4 inch	1001-3064-000
12	Manifold to Air Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
13	Manifold to N2O Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
14	Manifold to O2 Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
15	Refer to section 8.37.8		
16	Refer to section 8.37.8		
17	Refer to section 8.37.8		
18	Refer to section 8.37.8		
19	Flush Valve to Common Gas Manifold (360 mm, 610 mm)	1/4 inch	1001-3064-000
20	Manifold to Flush Valve (460 mm, 915 mm)	6 mm	1001-3062-000
21	Manifold to Aux O2 Flow Meter (800 mm)	6 mm	1001-3062-000

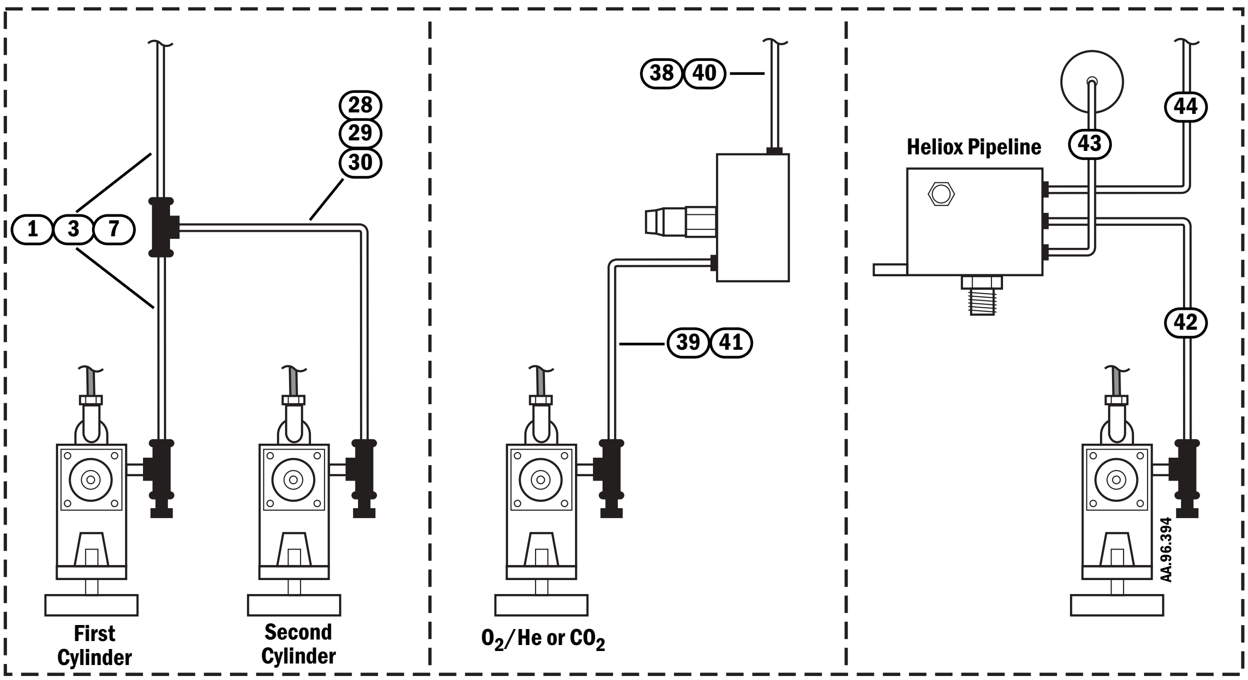


11
9
6
10
O2
N2O
Air
8
5
2
O2+
AA.96.393
20
19
21
CGM
4
14
13
12
D
15
16
17
18
O2
N2O
Air
3
1
7
To Breathing System
O2
N2O
Air

8.37.3 2nd Cylinder (Air, N_2O, O_2) and CO_2 or Heliox tubing

Except where specified otherwise:

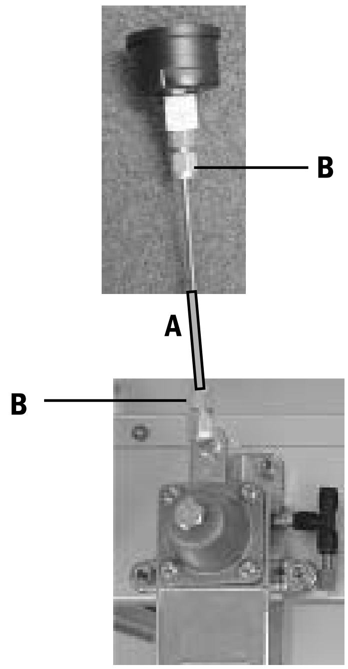
- All tubing is a flexible nylon-type tube for use with quick-release fittings.
- The manifold tubing applies either to the pneumatic manifold or to an individual pipeline inlet manifold; refer to Section 8.37.1 or Section 8.37.2 for connection points.
- Tube lengths may vary between machines - measure original.



Item	Description	Width	Stock Number
1	N_2O Cylinder to Manifold (305 mm, 320 mm, 400 mm, 650 mm)	4 mm	1001-3060-000
3	O_2 Cylinder to Manifold (280 mm, 320 mm, 550 mm, 600 mm, 650 mm)	6 mm	1001-3062-000
7	Air Cylinder to Manifold (205 mm, 300 mm, 510 mm)	8 mm	1001-3063-000
28	2nd Air Cylinder to Manifold (100 mm, 300 mm)	8 mm	1001-3063-000
29	2nd O_2 Cylinder to Manifold (220 mm, 500 mm, 600 mm)	6 mm	1001-3062-000
30	2nd N_2O Cylinder to Manifold (270 mm, 550 mm)	4 mm	1001-3060-000
38	Heliox (O_2/He) Pressure Relief Manifold to Helix Flowmeter (550 mm)	3/16 inch	0994-6396-010
39	Heliox (O_2/He) Gas Cylinder to Pressure Relief Manifold (375 mm)	3/16 inch	0994-6396-010
40	CO_2 Pressure Relief Manifold to CO_2 Flowmeter (550 mm)	3/16 inch	0994-6396-010
41	CO_2 Gas Cylinder to Pressure Relief Manifold (430 mm)	3/16 inch	0994-6396-010
42	Heliox (O_2/He) Gas Cylinder to Pressure Relief Manifold (375 mm)	3/16 inch	0994-6396-010
43	Manifold to Heliox (O_2/He) Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
44	Heliox (O_2/He) Pressure Relief Manifold to Helix Flowmeter (670 mm)	3/16 inch	0994-6396-010

8.37.4 Copper tubing kits

The cylinder gauges are connected to the cylinder gas supplies through a high-pressure copper tube. The copper tubing kits include a copper tube (**A**) of the indicated length and connectors (**B**) for each end.



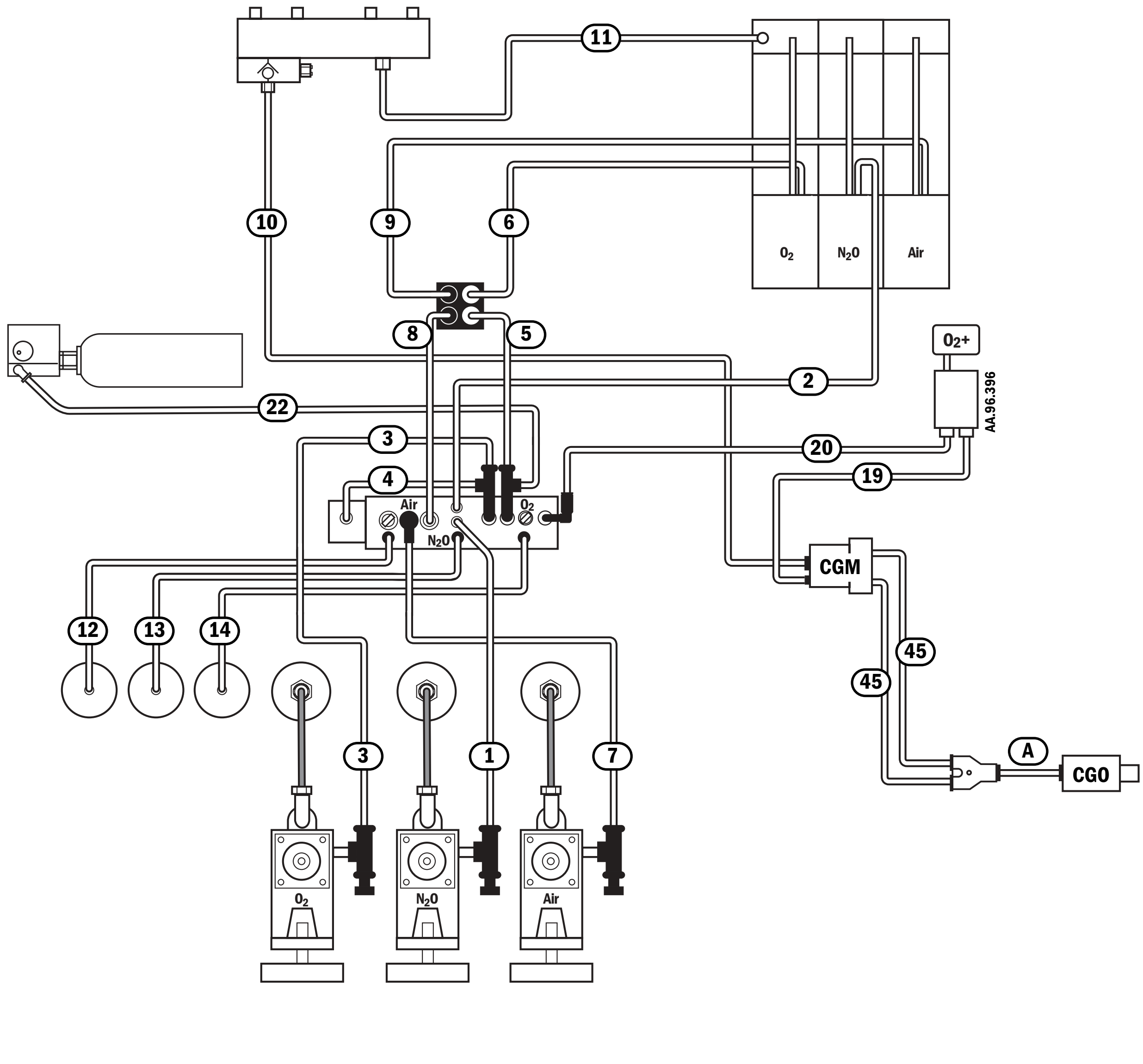
Item	Description	Length - Width	Kit Stock Number
	O_2 Cylinder to O_2 Cylinder Gauge	350 mm - 1/8 in	1006-8370-000
	N_2O Cylinder to N_2O Cylinder Gauge	350 mm - 1/8 in	1006-8370-000
	Air Cylinder to Air Cylinder Gauge	350 mm - 1/8 in	1006-8370-000
	CO_2 Cylinder to CO_2 Cylinder Gauge	450 mm - 1/8 in	1006-8371-000
	Heliox Cylinder to Heliox Cylinder Gauge	450 mm - 1/8 in	1006-8371-000
	Aux Cylinder to Aux Cylinder Gauge (in some cases could be length below—measure first)	450 mm - 1/8 in	1006-8371-000
	Aux Cylinder to Aux Cylinder Gauge (in some cases could be length above—measure first)	625 mm - 1/8 in	1006-8372-000

8.37.5 Induction machine with pneumatic manifold

Except where specified otherwise:

- All tubing is a flexible nylon-type tube for use with quick-release fittings.
- Tube lengths may vary between machines - measure original.

Item	Description	Width	Stock Number
1	N_2O Cylinder to Manifold (305 mm, 320 mm, 400 mm, 650 mm)	4 mm	1001-3060-000
2	Main Manifold to N2O Flow Module (550 mm, 700 mm)	4 mm	1001-3060-000
3	O_2 Cylinder to Manifold (280 mm, 320 mm, 550 mm, 600 mm, 650 mm)	6 mm	1001-3062-000
4	Main Manifold to O2 Power Outlet (315 mm)	6 mm	1001-3062-000
5	Main Manifold to System Switch - O2 (445 mm)	6 mm	1001-3062-000
6	System Switch (O2) to O2 Flow Module (750 mm)	6 mm	1001-3062-000
7	Air Cylinder to Manifold (205 mm, 300 mm, 510 mm)	8 mm	1001-3063-000
8	Main Manifold to System Switch - Air (520 mm)	8 mm	1001-3063-000
9	System Switch (Air) to Air Flow Module (775 mm)	8 mm	1001-3063-000
10	Vap Manifold Outlet to Common Gas Manifold (380 mm, 460 mm, 620 mm)	1/4 inch	1001-3064-000
11	Flow Module to Vap Manifold Inlet (550 mm, 750 mm, 850 mm)	1/4 inch	1001-3064-000
12	Main Manifold to Air Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
13	Main Manifold to N2O Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
14	Main Manifold to O2 Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
19	Flush Valve to Common Gas Manifold (360 mm, 610 mm)	1/4 inch	1001-3064-000
20	Main Manifold to Flush Valve (460 mm, 915 mm)	6 mm	1001-3062-000
22	O2 Supply to pneumatic low O2 alarm (225 mm)	6 mm	1001-3062-000
45	CGM to Y-connector (500 mm)	1/4 inch	1001-3064-000
A	Y-connector to CGO (120 mm)	1/4 inch	1001-3064-000

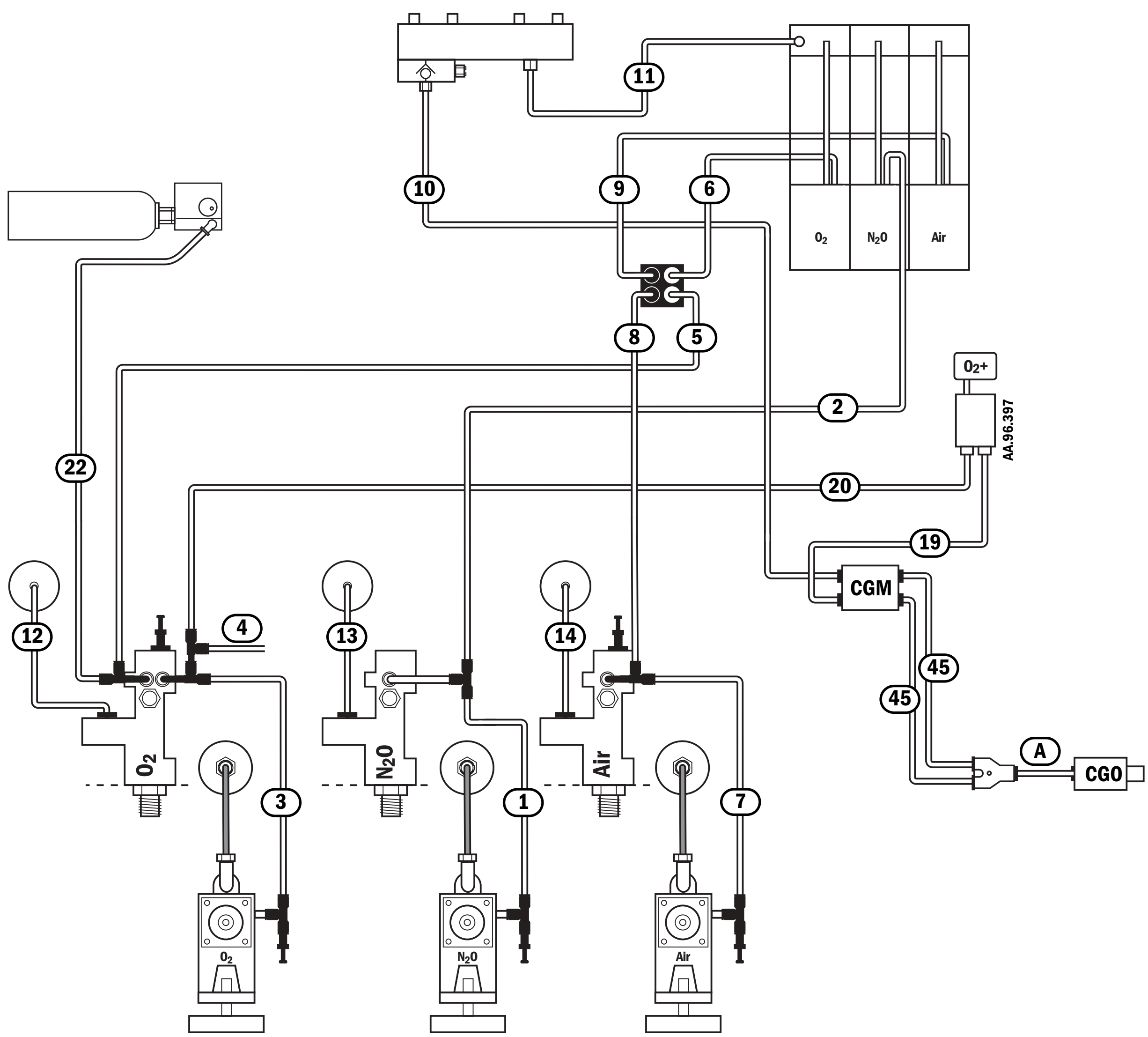

11
10
9
6
O2
N2O
Air
8
5
2
O2+
AA.96.396
22
3
20
4
19
Air
O2
N2O
CGM
12
13
14
45
45
3
1
7
A
CGO
O2
N2O
Air

8.37.6 Induction machine with individual pipeline inlets

Except where specified otherwise:

- All tubing is a flexible nylon-type tube for use with quick-release fittings.
- The manifold tubing applies either to the pneumatic manifold or to an individual pipeline inlet manifold.
- Tube lengths may vary between machines - measure original.

Item	Description	Width	Stock Number
1	N_2O Cylinder to Manifold (305 mm, 320 mm, 400 mm, 650 mm)	4 mm	1001-3060-000
2	Manifold to N2O Flow Module (550 mm, 700 mm)	4 mm	1001-3060-000
3	O_2 Cylinder to Manifold (280 mm, 320 mm, 550 mm, 600 mm, 650 mm)	6 mm	1001-3062-000
4	Manifold to O2 Power Outlet (315 mm)	6 mm	1001-3062-000
5	Manifold to System Switch - O2 (445 mm)	6 mm	1001-3062-000
6	System Switch (O2) to O2 Flow Module (750 mm)	6 mm	1001-3062-000
7	Air Cylinder to Manifold (205 mm, 300 mm, 510 mm)	8 mm	1001-3063-000
8	Manifold to System Switch - Air (520 mm)	8 mm	1001-3063-000
9	System Switch (Air) to Air Flow Module (775 mm)	8 mm	1001-3063-000
10	Vap Manifold Outlet to Common Gas Manifold (380 mm, 460 mm, 620 mm)	1/4 inch	1001-3064-000
11	Flow Module to Vap Manifold Inlet (550 mm, 750 mm, 850 mm)	1/4 inch	1001-3064-000
12	Manifold to Air Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
13	Manifold to N2O Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
14	Manifold to O2 Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
19	Flush Valve to Common Gas Manifold (360 mm, 610 mm)	1/4 inch	1001-3064-000
20	Manifold to Flush Valve (460 mm, 915 mm)	6 mm	1001-3062-000
22	O2 Supply to pneumatic low O2 alarm (225 mm)	6 mm	1001-3062-000
45	CGM to Y-connector (500 mm)	1/4 inch	1001-3064-000
A	Y-connector to CGO (120 mm)	1/4 inch	1001-3064-000

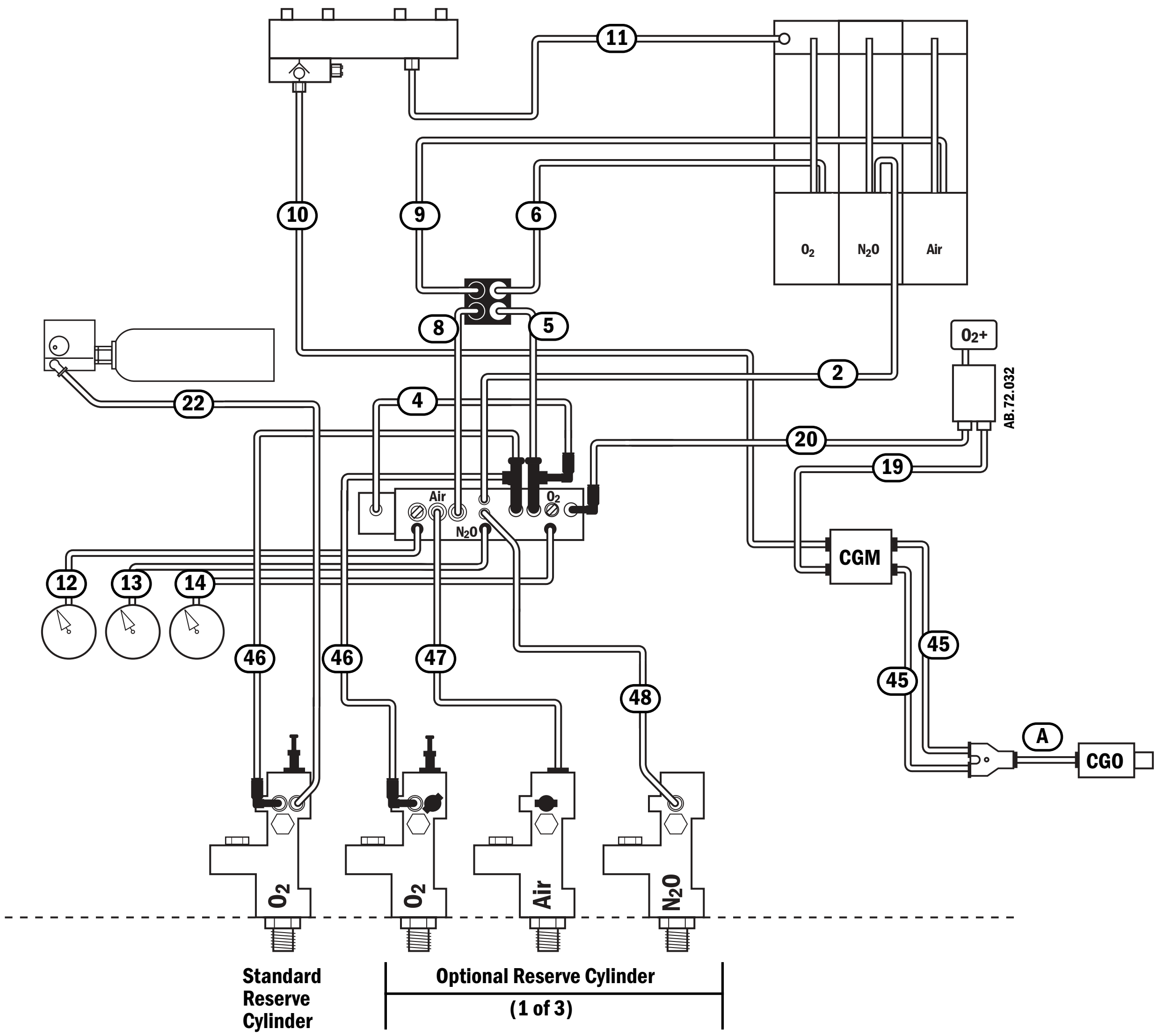

11
10
9
6
O_2
N_2O
Air
8
5
O_2+
2
AA.96.397
22
20
19
CGM
12
4
13
14
45
45
A
CGO
O_2
N_2O
Air
3
1
7
O_2
N_2O
Air

8.37.7 Wall mount machine

Except where specified otherwise:

- All tubing is a flexible nylon-type tube for use with quick-release fittings.
- Tube lengths may vary between machines - measure original.

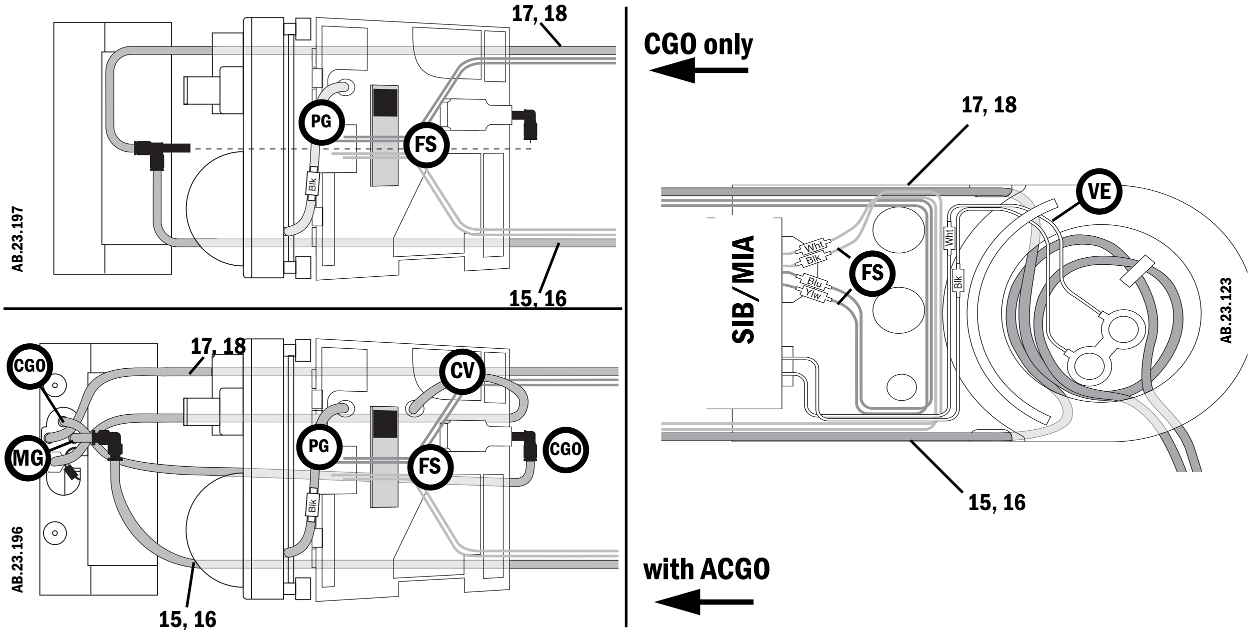
Item	Description	Width	Stock Number
2	Main Manifold to N2O Flow Module (550 mm, 700 mm)	4 mm	1001-3060-000
4	Main Manifold to O2 Power Outlet (315 mm)	6 mm	1001-3062-000
5	Main Manifold to System Switch - O2 (445 mm)	6 mm	1001-3062-000
6	System Switch (O2) to O2 Flow Module (750 mm)	6 mm	1001-3062-000
8	Main Manifold to System Switch - Air (520 mm)	8 mm	1001-3063-000
9	System Switch (Air) to Air Flow Module (775 mm)	8 mm	1001-3063-000
10	Vap Manifold Outlet to Common Gas Manifold (380 mm, 460 mm, 620 mm)	1/4 inch	1001-3064-000
11	Flow Module to Vap Manifold Inlet (550 mm, 750 mm, 850 mm)	1/4 inch	1001-3064-000
12	Main Manifold to Air Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
13	Main Manifold to N2O Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
14	Main Manifold to O2 Pipeline Gauge (470 mm)	1/8 inch	1006-3718-000
19	Flush Valve to Common Gas Manifold (360 mm, 610 mm)	1/4 inch	1001-3064-000
20	Main Manifold to Flush Valve (460 mm, 915 mm)	6 mm	1001-3062-000
22	O2 Reserve to pneumatic low O2 alarm (225 mm)	6 mm	1001-3062-000
45	CGM to Y-connector (360 mm)	1/4 inch	1001-3064-000
46	O2 Reserve to Main Manifold (220mm)	6 mm	1001-3062-000
47	Air Reserve to Main Manifold (380 mm)	8 mm	1001-3063-000
48	N2O Reserve to Main Manifold (300 mm)	4 mm	1001-3060-000
A	Y-connector to CGO (60 mm)	1/4 inch	1001-3064-000


11
10
9
6
O_2
N_2O
Air
8
5
2
O_2+
AB.72.032
22
4
20
19
Air
O_2
N_2O
CGM
12
13
14
46
46
47
48
45
45
A
CGO
O_2
O_2
Air
N_2O
Standard Reserve Cylinder
Optional Reserve Cylinder
(1 of 3)

8.37.8 Breathing System tubing

Except where specified otherwise:

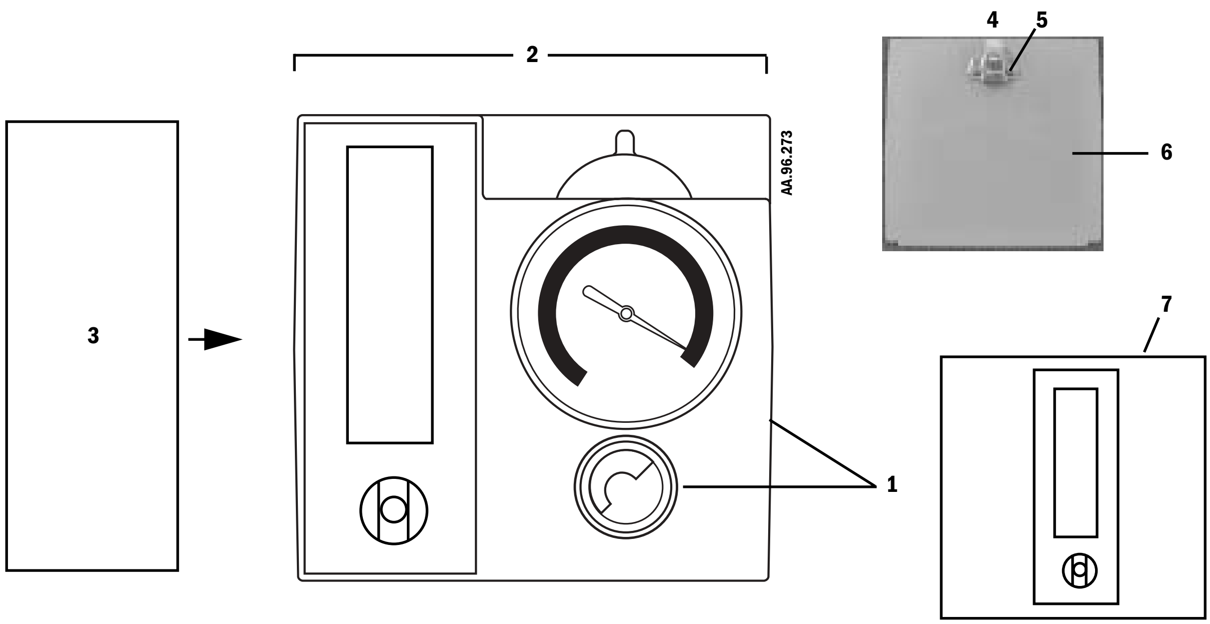
- All tubing is a flexible nylon-type tube for use with quick-release fittings.
- Tube lengths may vary between machines - measure original.
- Items marked with an asterisk (*) are flexible PVC-type clear hose.



Item	Description	Length - Width	Stock Number
15	Mixed Gas from Common Gas Manifold to Common Gas Outlet/ACGO (left hand machine)	1050 mm - 1/4 in (1840 articulating)	1001-3064-000
16	Mixed Gas from Common Gas Manifold to Common Gas Outlet/ ACGO(right hand machine)	970 mm - 1/4 in	1001-3064-000
17	O_2 Flush from Common Gas Manifold to Common Gas Outlet/ACGO (left hand machine)	1400 mm - 1/4 in (2275 articulating)	1001-3064-000
18	O_2 Flush from Common Gas Manifold to Common Gas Outlet/ACGO (right hand machine)	1250 mm - 1/4 in	1001-3064-000
CGO	ACGO Manifold to Fresh Gas Outlet (CGO)	120 mm - 1/4 in	1001-3064-000
CV*	ACGO Manifold External Check Valve to Absorber Bulkhead	350 mm - 1/4 in	0994-6370-010
FS*	Absorber Bulkhead Flow Sensor Connector to SIB Connector (4)	500 mm - 1/8 in	1503-3123-000
MG	Mixed Gas Elbow to ACGO Manifold	60 mm - 1/4 in	1001-3064-000
PG*	Absorber Bulkhead to Absorber Pressure Gauge (newer machines have inline connector)	350 mm - 1/4 in	0994-6370-010
VE*	Vent Drive Gas Seal (binoculars) to SIB Connector (2)(Not used with 7100 Ventilator)	150 mm - 1/4 in	0994-6370-010

8.38 Integrated Suction Regulator and Auxiliary O_2 Flowmeter

8.38.1 Major Components(vacuum suction)

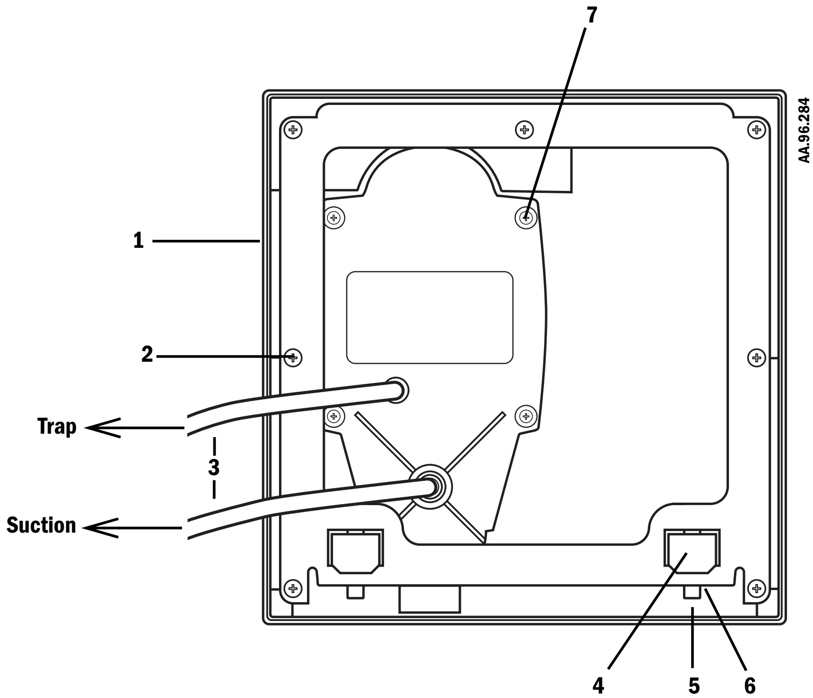


Item	Description	Stock Number
1*	Housing, with suction regulator knob (for vacuum or venturi)	1006-5250-000
2** (ANSI gauge)	Regulator Assembly; includes item 1 and suction regulator parts	1006-8412-000
2** (ISO gauge)	Regulator Assembly; includes item 1 and suction regulator parts	1006-8413-000
3	Panel, blank label	1006-0347-000
4	Latch, Roller (retains blank front panel for machines without Suction/Aux O_2)	1006-1499-000
5	Nut, M4 Keps	0144-3717-314
6	Plate, shoulder front cover	1006-1472-000
7	Housing only, Auxiliary O_2 (no suction)	1006-5253-000

Notes:

* The knob is an integral part of the housing. It cannot be removed from the housing and is not available separately.
** Item 2 does not include any Auxiliary O_2 Flowmeter parts. If present, they should be transferred to the new housing. If the machine does not include an Auxiliary O_2 Flowmeter, also order a blank panel label, item 3, to cover the open flowmeter area.

8.38.2 Suction Housing Components

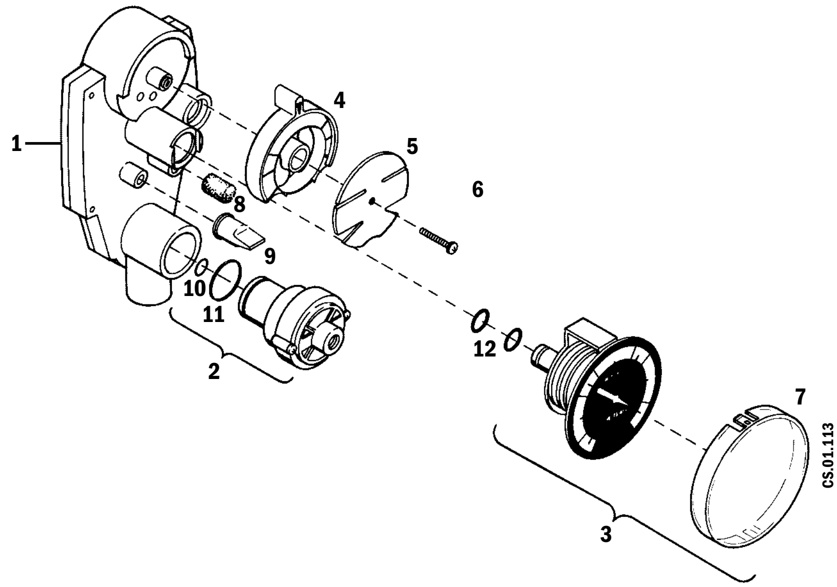


Item	Description	Stock Number
1	Mounting Bracket (mounts suction housing to Aestiva shoulder)	1006-5178-000
2	Screw, M3x10	0142-4254-112
3	Tygon Tubing (to rear-panel connections, 15 inches each)	6700-0005-300
4	Latch	1006-5179-000
5	Screw, M4x20	0144-2124-218
6*	Nut, M4 nylon insert	0144-3536-115
7	Screw, M3x8	0142-4254-106

Note:

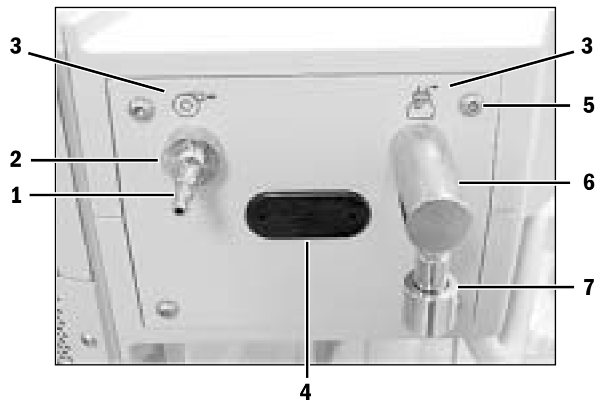
* Run nut all the way down to bracket edge; then, back off nut 1/2 turn.

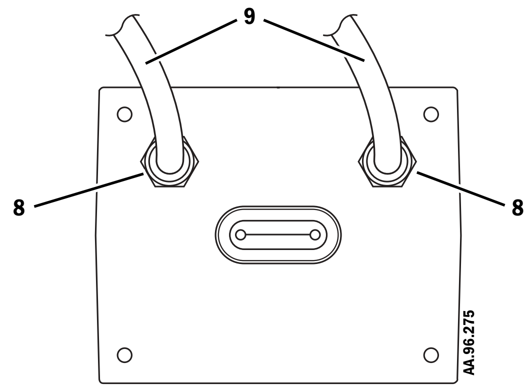
8.38.3 Regulator Assembly (3 mode)

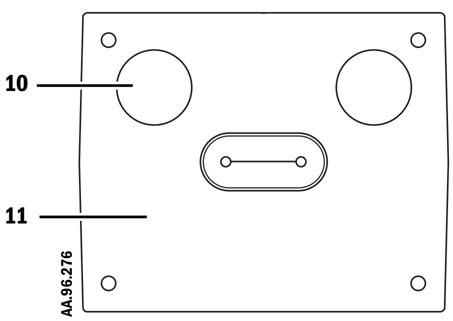


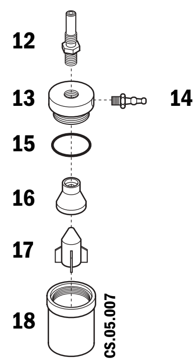
Item	Description	Stock Number
1	Base Assembly, without Gauge and Regulator Module	1006-5270-000
2	Regulator Module (plugs into base)	6700-1225-800
3	Gauge, Vacuum, 0-200 mmHg, ANSI	6700-0050-200
	Gauge, High Vacuum, CCW, ISO	6700-0050-205
4	Switch (lever)	6700-0078-500
5	Switch Plate	6700-0193-500
6	Screw (secures switch/switch plate)	6700-0152-400
7	Lens	6700-0087-500
8	Filter (fits into base assembly)	0206-5159-300
9	Valve, Relief, Positive Pressure	6700-0115-400
10	O-ring, Regulator Module, Stem (included with regulator module)	0210-0527-300
11	O-ring, Regulator Module, Large (included with regulator module)	6700-0136-500
12	O-ring, Gauge (included with gauge assy, 2ea. required)	6700-0130-500

8.38.4 Rear-Panel Fittings







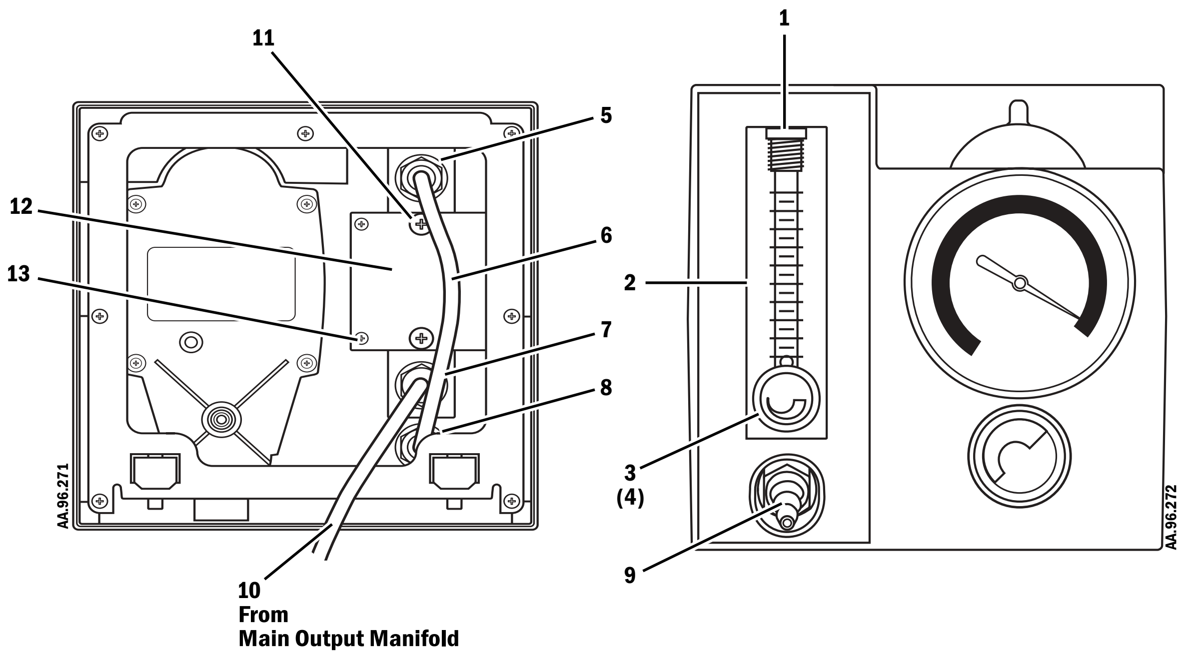


Item	Description	Stock Number
1*	Nipple, Tubing (screw into vacuum fitting)	0204-9018-535
2**	Fitting, Vacuum (mounts to rear panel), w/o Nut	1006-5068-000
3	Label Set, Vacuum Input/Suction Bottle (for rear panel)	1006-0275-000
4	Grommet, Oval (in middle of rear panel)	1006-3231-000
5	Screw, M6x16 Sems	0144-2436-109
6**	Fitting, Safety Trap (mounts to rear panel), w/o Nut	1006-5237-000
7*	Adapter, Locking Gland (bottle screws onto this)	6700-0144-700
8	Nut (for mounting fitting to rear panel)	1006-5065-000
9	Tygon Tubing (to rear-panel connection, 381 mm each)	6700-0005-300
10	Label, Blank (covers holes on rear panel)	1006-1368-000
11	Plate, Shoulder rear cover	1006-1492-000
- - -	Overflow Safety Trap (Items 12 through 18)	6700-0365-901
12	Locking Gland, male	0221-6264-535
13	Cap	0221-6315-535
14	Nipple, tubing	0204-9048-535
15	O-ring	0210-0528-300
16	Deflector, splash	0221-6317-100
17	Float	0221-6316-100
18	Jar, Lexan	0212-0463-100

* Apply Teflon tape to threads.

** Apply Loctite 242.

8.38.5 Auxiliary O_2 Flowmeter

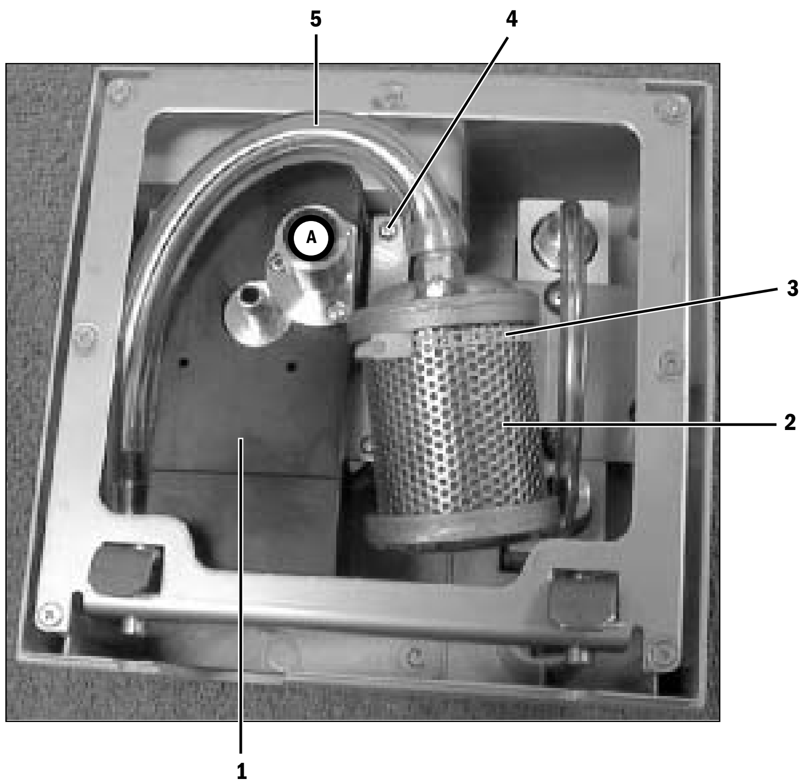


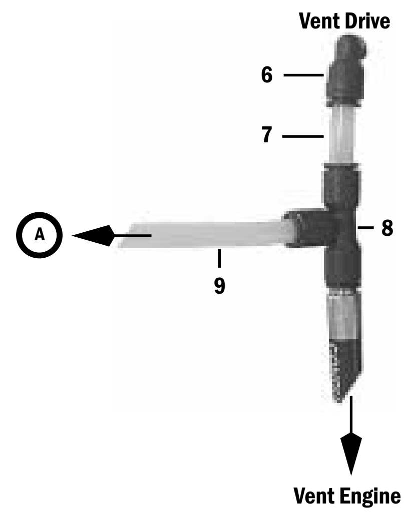
Item	Description	Stock Number
1	Flowmeter, 1-10 L/min, Complete with fittings installed	1006-8424-000
2	Flowmeter, 1-10 L/min, without fittings	1006-3841-000
3	Knob (gray)	1011-3471-000
4	Set screw	9211-0830-053
5*	Flowmeter Fitting, 1/8 NPTM Adapter	0204-8877-300
6	Tubing, clear 150 mm - 1/4 inch	0994-6370-010
7*	Flowmeter Fitting Assembly, 6-mm Tubing Adapter	1006-8423-000
8	Nut, M12x1.75, SST	0144-3132-140
9**	Nipple, Panel-Mount, Auxiliary O_2 Outlet	1006-5177-000
10	Tubing, Nylon 800 mm - 6 mm	1001-3062-000
11	Screw, 10-32 x 3/8	0140-6631-107
12	Plate, Flowmeter Mounting	1006-5180-000
13	Screw, M3x8, SST	0142-4254-106

Note:

* Apply Teflon tape to threads.
** Apply Loctite 242.

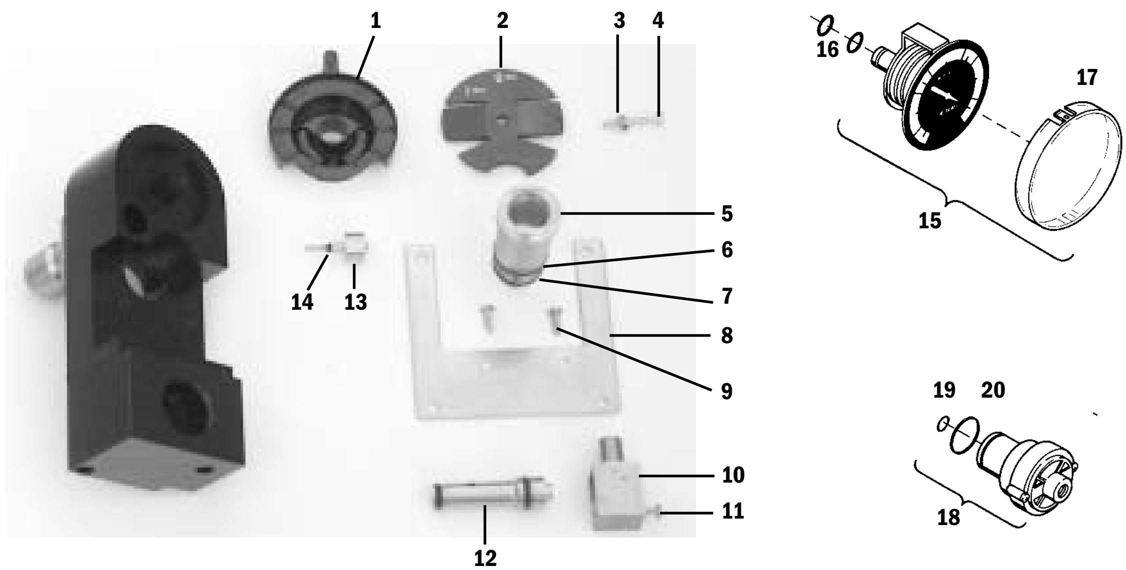
8.38.6 Venturi Suction Housing Components





Item	Description	Stock Number
1	Body, Complete (without gauge and regulator module)	1006-8425-000
2	Muffler, Venturi Suction	1006-4158-000
3	Cable Tie	0203-5917-300
4	Screw, M3x8, Stainless Steel	0142-4254-106
5	Tygon Tubing, 160 mm - 1/2 inch	6700-0005-300
6	Elbow, 8-mm tube/standpipe	1006-3535-000
7	Tubing, flexible nylon-type, 60 mm - 8 mm	1001-3063-000
8	Tee, 8 mm tube/tube/tube (Air)	1006-3545-000
9	Tubing, flexible nylon-type, 760 mm - 8 mm	1001-3063-000

8.38.7 Venturi Suction Regulator front view (2 mode)



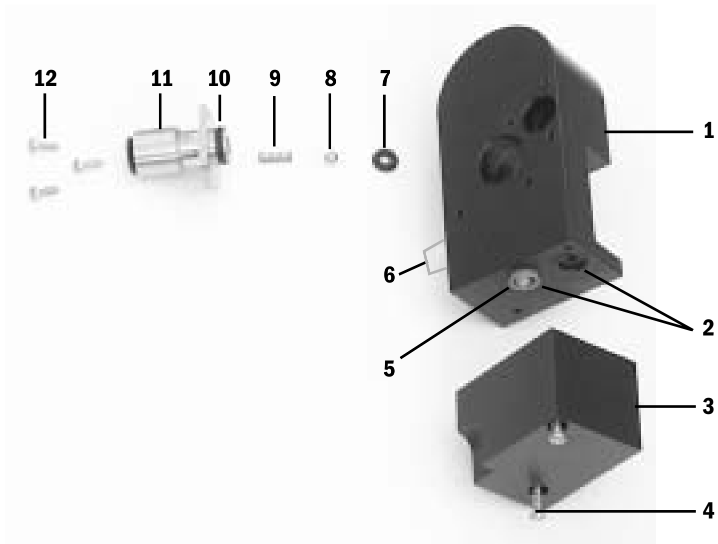
Item	Description	Stock Number
1	Switch	6700-0078-500
2	Switch Plate	6700-0194-500
3	Washer, Flat, Stainless Steel	0144-1003-132
4	Screw, M3x20, Stainless Steel	0142-4254-120
5	Adapter, Gauge	1006-5263-000
6*	O-ring, 19.16 OD, 15.6 ID	1006-3616-000
7*	O-ring, 17.55 OD, 14.00 ID	1503-3240-000
8	Plate	1006-5260-000
9	Screw, M3x8, Stainless Steel	0142-4254-106
10	Retainer, Venturi, with straight barb	1006-5264-000
11	Screw, M3x20, Stainless Steel	0142-4254-120
12**	Venturi, Vacuum, with 2 o-rings	1006-4160-000
13	Actuator valve	1006-5262-000
14*	O-ring, 3.61 OD, 1.07 ID	1006-4157-000
15	Gauge, Vacuum, 0-200 mmHg, ANSI	6700-0050-200
	Gauge, High Vacuum, CCW, ISO	6700-0050-205
16*	O-ring, Gauge (included with gauge assembly, 2 required)	6700-0130-500
17	Lens	6700-0087-500
18	Regulator Module (plugs into body)	6700-1225-800
19*	O-ring, Regulator Module, Stem (included with regulator module)	0210-0527-300
20*	O-ring, Regulator Module, Large (included with regulator module)	6700-0136-500

Notes:

* Lubricate o-rings sparingly with Krytox.

** O-rings not available separately.

8.38.8 Venturi Suction Regulator rear view (2 mode)



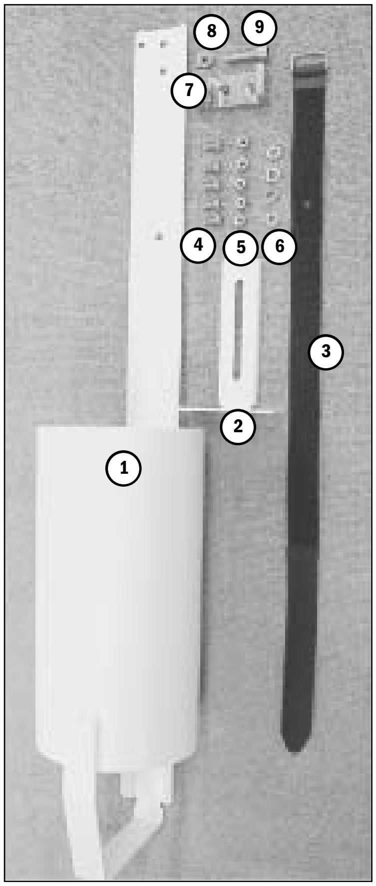
Item	Description	Stock Number
1	Body (upper); includes three of Item 6 and one of Item 2 (with cable tie for muffler)	1006-8422-000
2*	O-ring, 0.5 OD, 0.375 ID	0210-0533-300
3	Block (lower body)	1006-5265-000
4	Screw, M3x20, Stainless Steel	0142-4254-120
5**	Check valve	1006-4159-000
6	Filter, Foam	0206-5159-300
7*	O-ring, 8.871 OD, 3.63 ID	1006-4156-000
8	Ball, Stainless Steel	0409-1685-300
9	Spring, 3.76 OD, 11.1 L	1006-4155-000
10*	O-ring, 0.5 OD, 0.375 ID	0210-0533-300
11	Adapter Assembly, 8-mm Tubing	1006-8421-000
12	Screw, M3x8, Stainless Steel	0142-4254-106

Notes:

* Lubricate o-rings sparingly with Krytox.
** “Bullet” end out; “butterfly” end in.

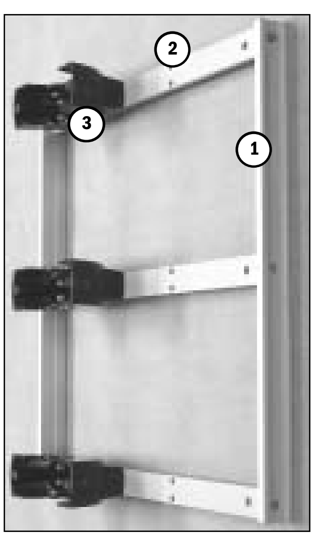
8.39 Service parts for optional kits

8.39.1 Wall-rail cylinder mounting kit 1006-4657-000



Item	Description	Stock Number
1	Holder, hanging cylinder	1006-4642-000
2	Bracket, standoff	1006-4643-000
3	Strap, Velcro with buckle	1001-3599-000
4	Screw, M6x12 BT SKT	0144-2436-101
5	Nut, M6 Nyloc	9212--360-006
6	Washer, M6 flat	9213-0160-006
7	Rail Clamp, wall mount	1006-4488-000
8	Nut, M8	0144-2148-120
9	Screw, M8x35 SKT HD CAP	0144-2148-245

8.39.2 ALM Pendant mounting kit 1006-8316-000 for wall-rail mount machines



Item	Description	Stock Number
1	Extrusion, dovetail ALM pendant	1006-4679-000
2	Bracket, wall mount ALM pendant	1006-4678-000
3	ALM Fix 89 clamps (not supplied by Datex-Ohmeda)	

Notes

9 Schematics and Diagrams

In this section

Schematics are subject to change without notice.

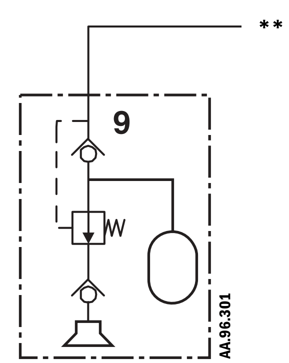
Circuit boards are available only as complete assemblies.

Key to Numbered Components

1. Pipeline pressure gauge
2. Pipeline inlet
3. Cylinder pressure gauge
4. Cylinder inlet
5. Primary regulator (cylinder pressure)
6. High-pressure relief valve (758 kPa / 110 psi)*
7. Supply connections for the ventilator
   a. O_2 drive gas
   b. Air drive gas
8. System switch
9. Switch for low O_2 supply pressure alarm (used with the ventilator)
10. O_2 secondary regulator (207 kPa / 30 psi)*
11. O_2 flow control valve
12. O_2 flow tubes

14. O_2 Flush
   a. Flush valve
   b. Pressure switch (used with the ventilator)
15. N_2O balance regulator
16. N_2O flow control valve
17. N_2O flow tubes
18. Air secondary regulator (207 kPa / 30 psi)*
19. Air flow control valve
20. Air flow tube
21. Optional gas balance regulator
22. Optional gas flow control valve
23. Optional gas flow tube
24. Vaporizer port valve
25. Vaporizer
26. Low-pressure relief valve (38 kPa / 5.5 psi)*
27. Auxiliary flowmeter (optional)
28. Common gas outlet (CGO)
29. Pneumatic outlet (O_2)
30. Test port (primary regulator)
31. Test port (secondary/balance regulator)

* Approximate values



Induction Machine O_2 Supply Failure Pneumatic Alarm

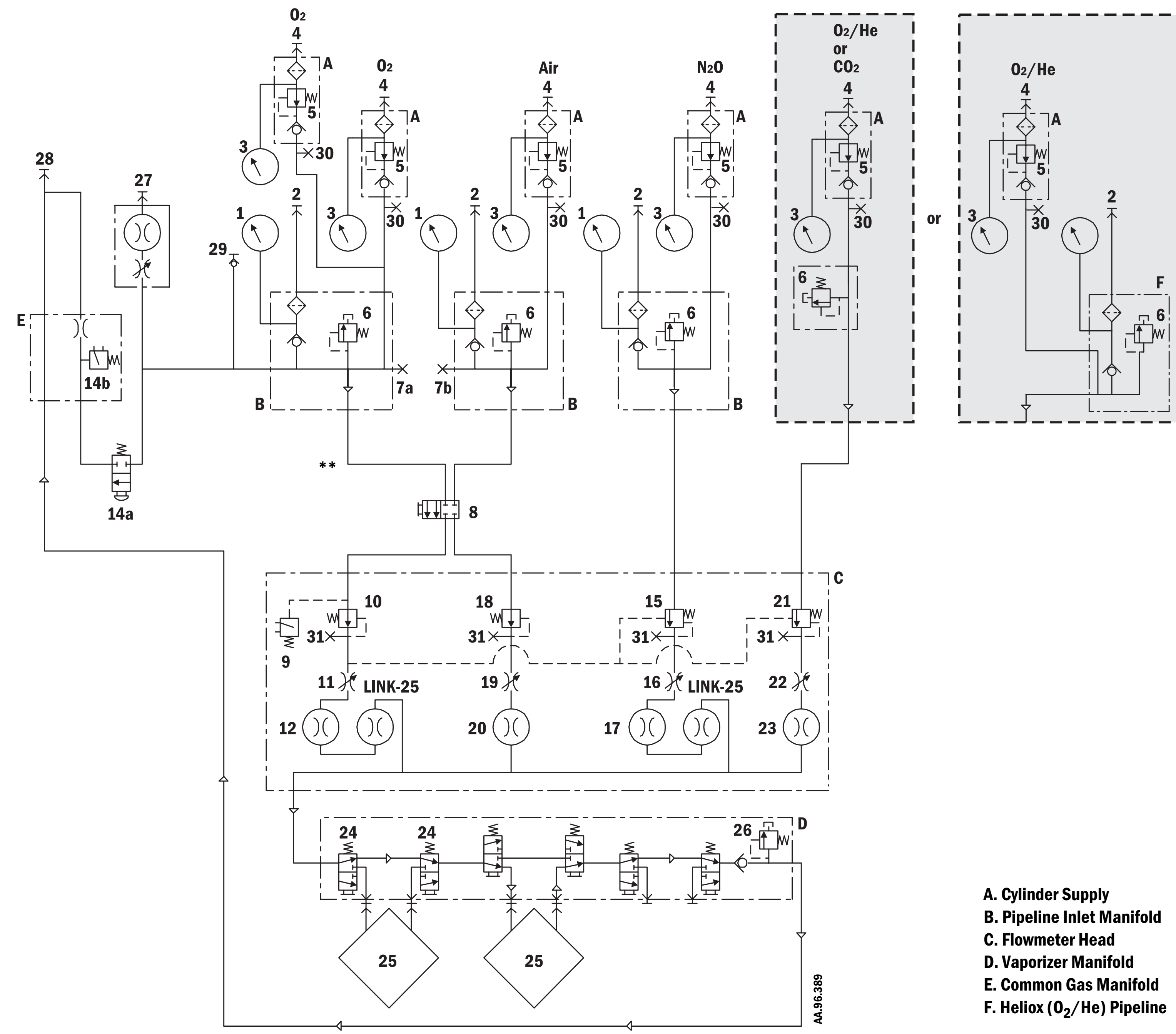


Figure 9-1 ▪ Pneumatic circuit diagram (machines with individual pipeline inlet manifolds)

Key to Symbols

Pneumatic Connection

Filter

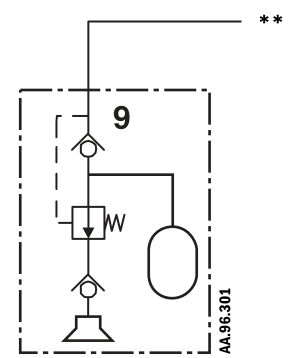
Direction of Flow

Check Valve

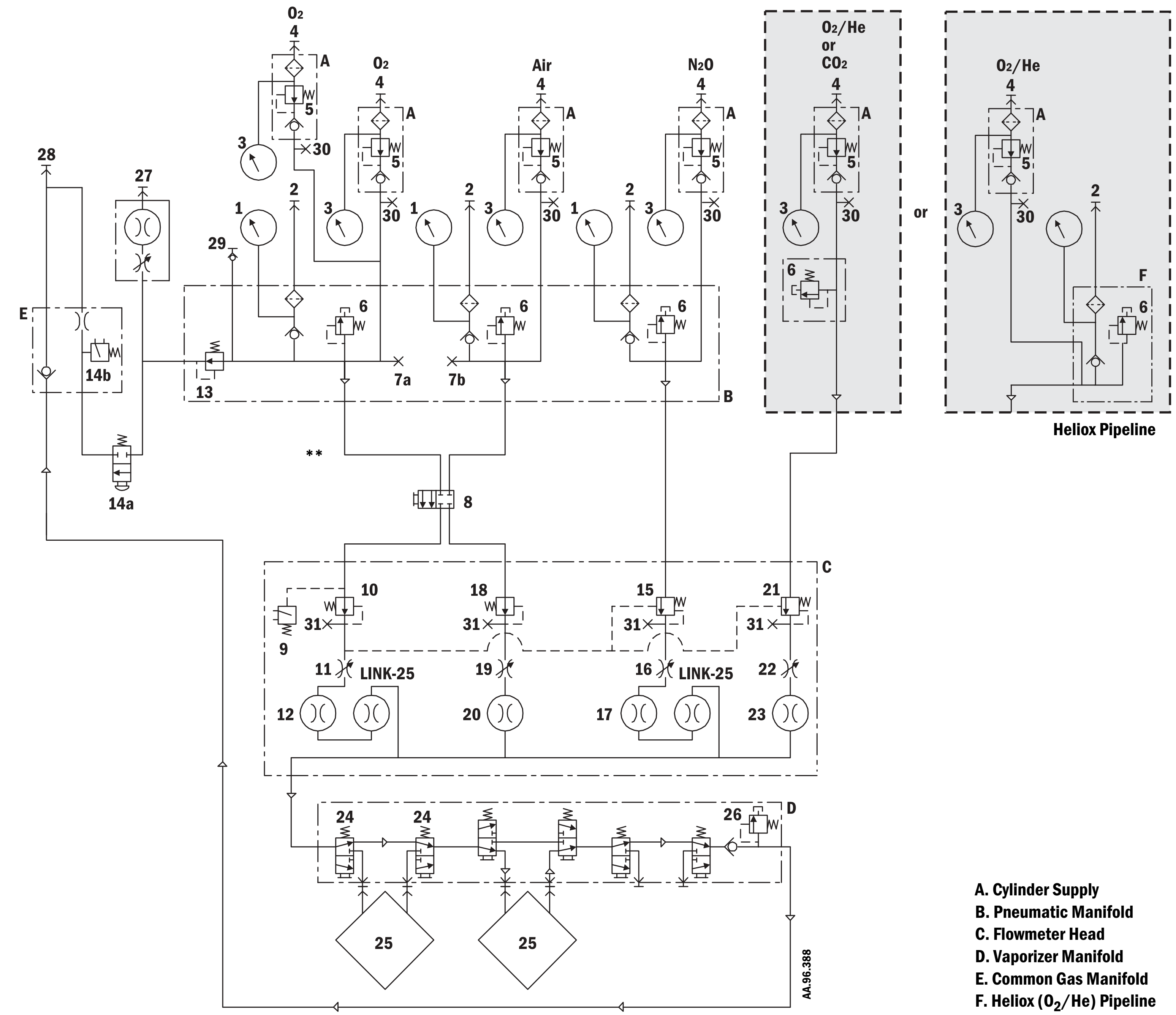
Key to Numbered Components

1. Pipeline pressure gauge
2. Pipeline inlet
3. Cylinder pressure gauge
4. Cylinder inlet
5. Primary regulator (cylinder pressure)
6. High-pressure relief valve (883 kPa / 128 psi)*
7. Supply connections for the ventilator
   a. O_2 drive gas
   b. Air drive gas
8. System switch
9. Switch for low O_2 supply pressure alarm (used with the ventilator)
10. O_2 secondary regulator (207 kPa / 30 psi)*
11. O_2 flow control valve
12. O_2 flow tubes
13. O_2 flush and auxiliary flowmeter regulator (131 kPa / 19 psi)*
14. O_2 Flush
    a. Flush valve
    b. Pressure switch (used with the ventilator)
15. N_2O balance regulator
16. N_2O flow control valve
17. N_2O flow tubes
18. Air secondary regulator (207 kPa / 30 psi)*
19. Air flow control valve
20. Air flow tube
21. Optional gas balance regulator
22. Optional gas flow control valve
23. Optional gas flow tube
24. Vaporizer port valve
25. Vaporizer
26. Low-pressure relief valve (38 kPa / 5.5 psi)*
27. Auxiliary flowmeter (optional)
28. Common gas outlet (CGO)
29. Pneumatic outlet (O_2)
30. Test port (primary regulator)
31. Test port (secondary/balance regulator)

* Approximate values



Induction Machine O_2 Supply Failure Pneumatic Alarm



Key to Symbols

- Pneumatic Connection
- Filter
- Direction of Flow
- Check Valve

Figure 9-2 ▪ Pneumatic circuit diagram (machines with a pneumatic manifold)

Key to Numbered Components

1. Pipeline pressure gauge
2. Pipeline connection
3. Reserve O_2 supply
4. Reserve Air supply (optional)
5. Reserve N_2O supply (optional)
6. High-pressure relief valve
   - For machines with Flush regulator (883 kPa / 128 psi)*
   - For machines without Flush regulator (758 kPa / 110 psi)*
7. Common gas outlet
8. System switch
9. Alarm for low O_2 supply pressure
10. Secondary O_2 regulator
11. O_2 flow control valve
12. O_2 flow tube
13. Flush regulator
14. O_2 Flush valve
15. N_2O balance regulator
16. N_2O flow control valve
17. N_2O flow tube
18. Air secondary regulator
19. Air flow control valve
20. Air flow tube
21. Vaporizer port valve
22. Vaporizer
23. Pressure relief, opens at approximately 38 kPa (5.5 psi)*
24. Pneumatic outlet (O_2)
25. Checked Y-adapter
26. Test Port (secondary/balance regulator)
27. Cylinder connection (Gas Pack)
28. Cylinder pressure gauge (Gas Pack)
29. Cylinder pressure regulator, 354 kPa / 52 psi (Gas Pack)
30. Pressure relief, opens at approximately 690 kPa/100 psi (Gas Pack)

* Approximate values

Note*: *Newer machine variants do not include the Flush regulator (Item 13) and the Common Gas Manifold (Item E) does not include the check valve.*

Key to Symbols

	Pneumatic Connection
	Filter
	Direction of Flow
	Check Valve

A. Gas Pack (Cylinder Regulator)
B. Pneumatic Manifold
C. Flowmeter Head
D. Vaporizer Manifold
E. Common Gas Manifold
F. Checked Y-adapter

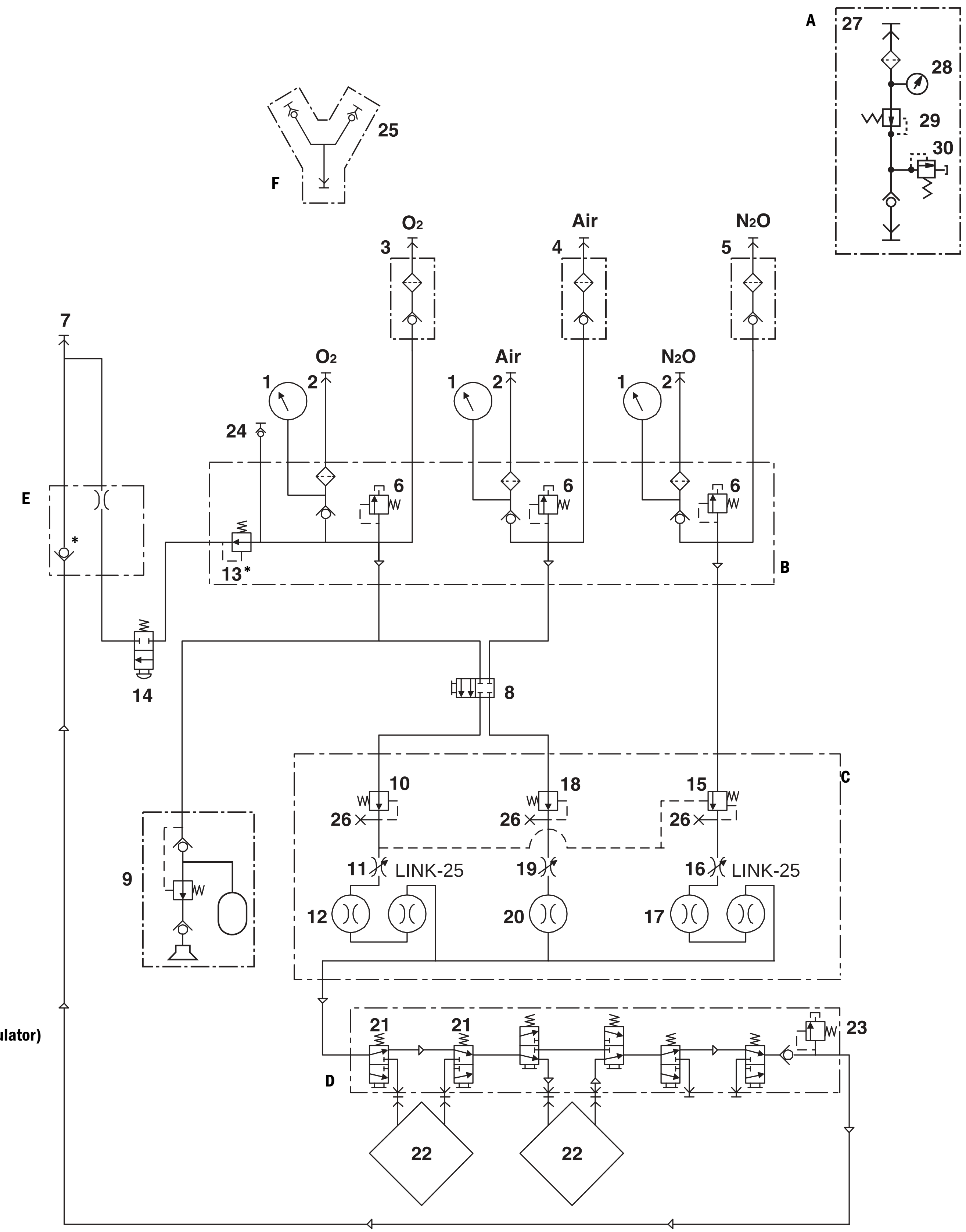
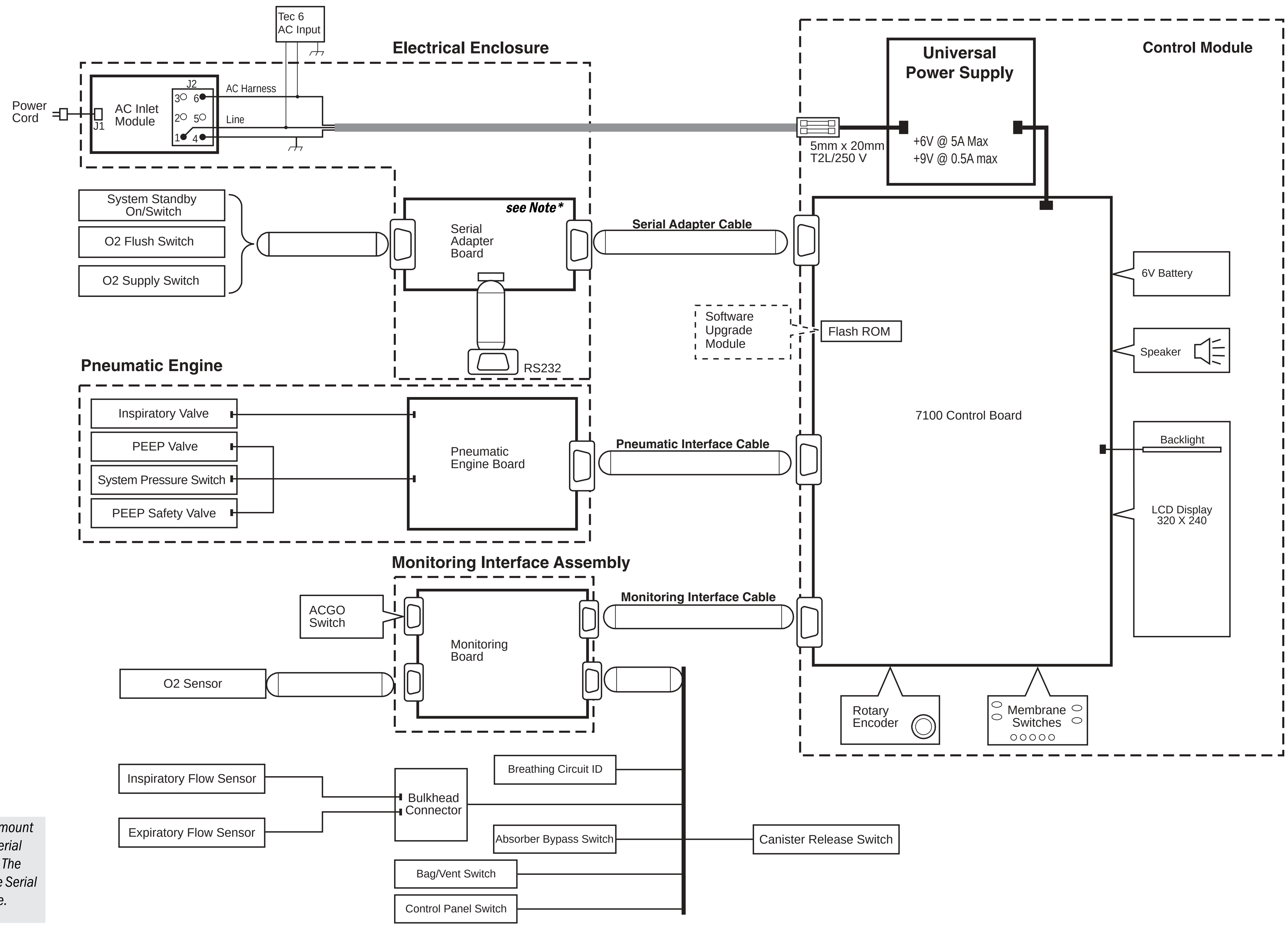


Figure 9-3 ▪ Pneumatic circuit diagram (wall-rail mount Induction machine)



Note*: *The Compact wall-rail mount machine does not include a Serial Adapter Board (no serial I/O). The system switch harness and the Serial Adapter Cable are joined inline.*

Figure 9-4 • Electrical cabling block diagram for machines with 7100 Ventilator

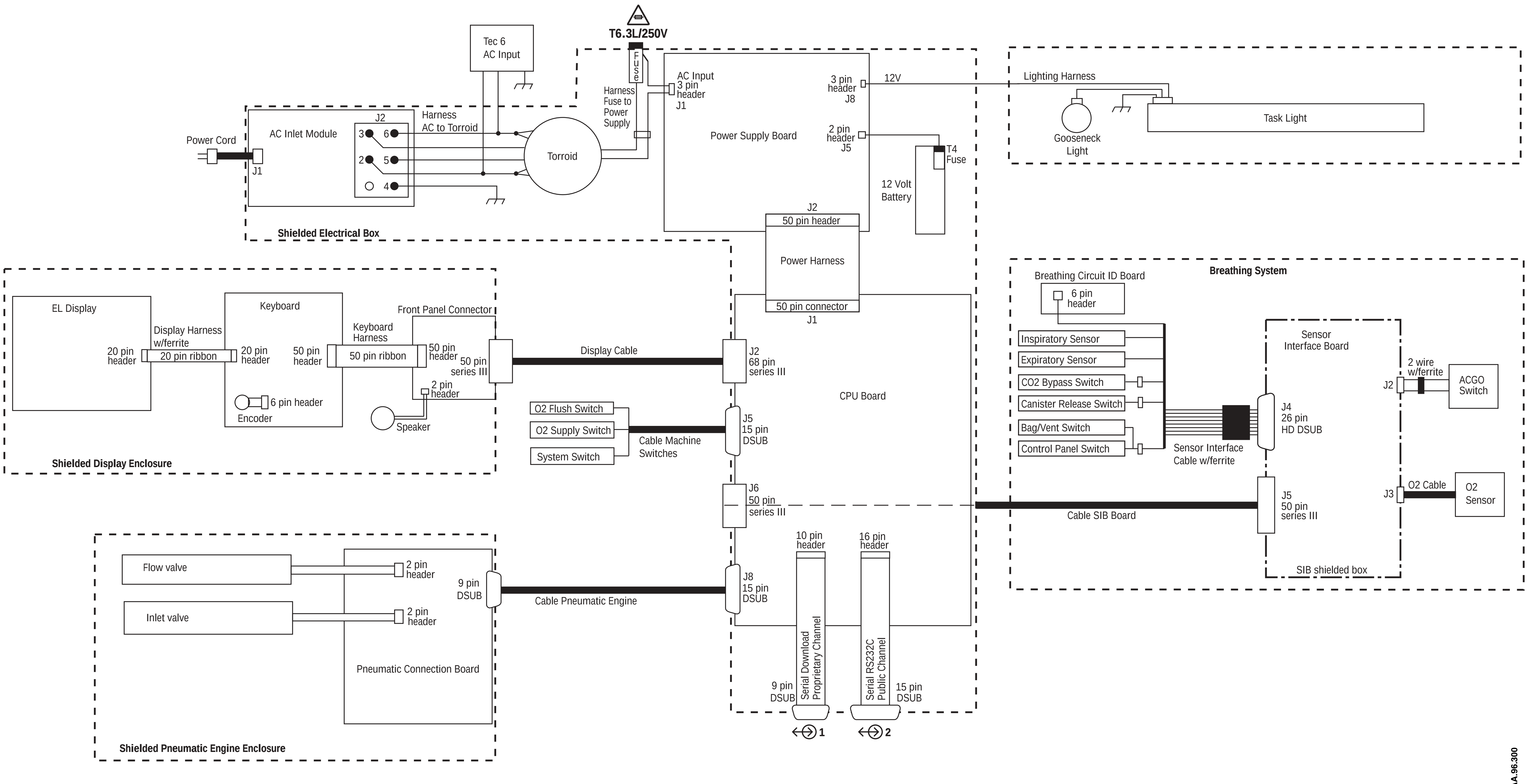


Figure 9-5 • Electrical cabling block diagram for machines with 7900 Ventilator (original)

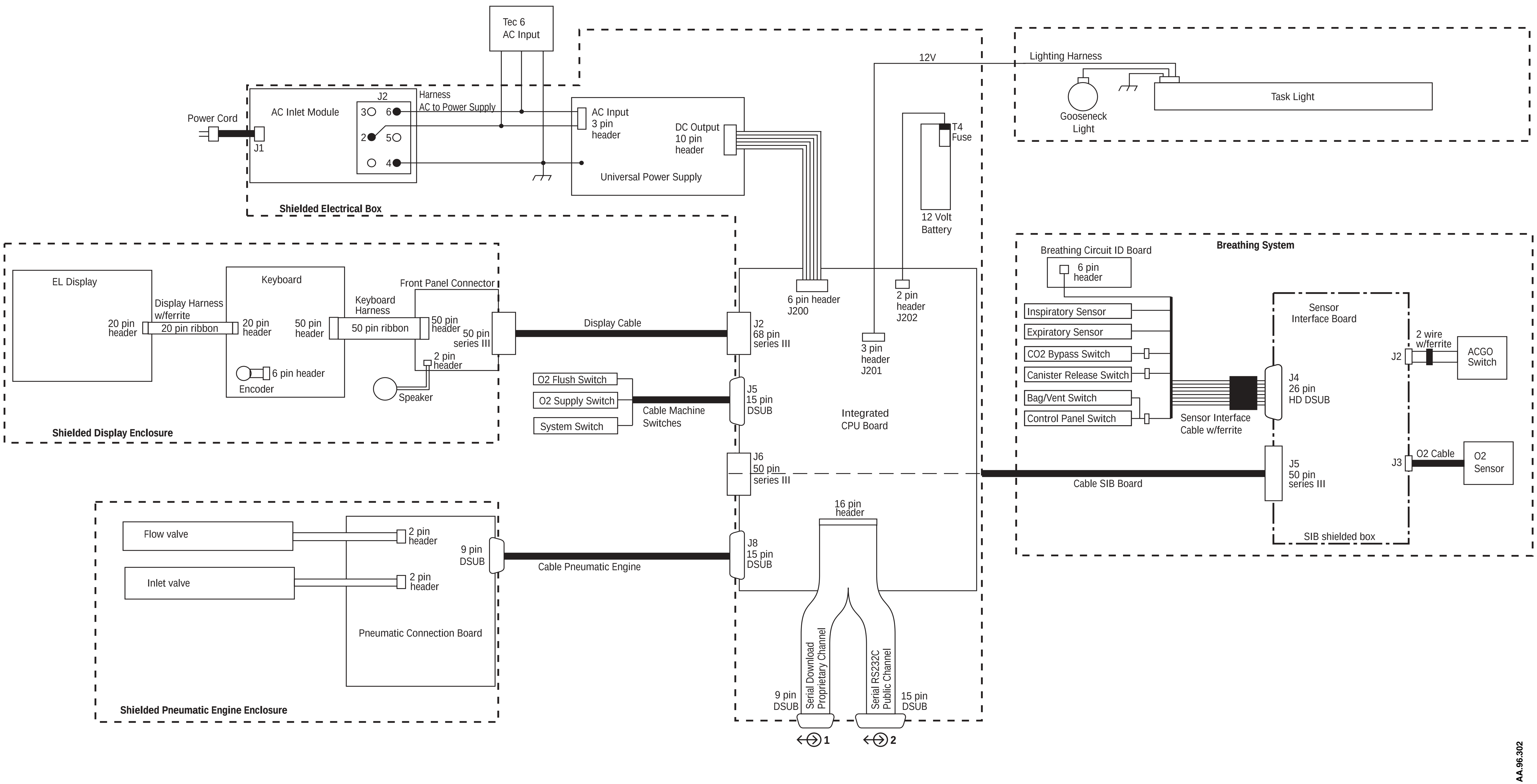


Figure 9-6 ▪ Electrical cabling block diagram for machines with 7900 Ventilator (Integrated CPU)

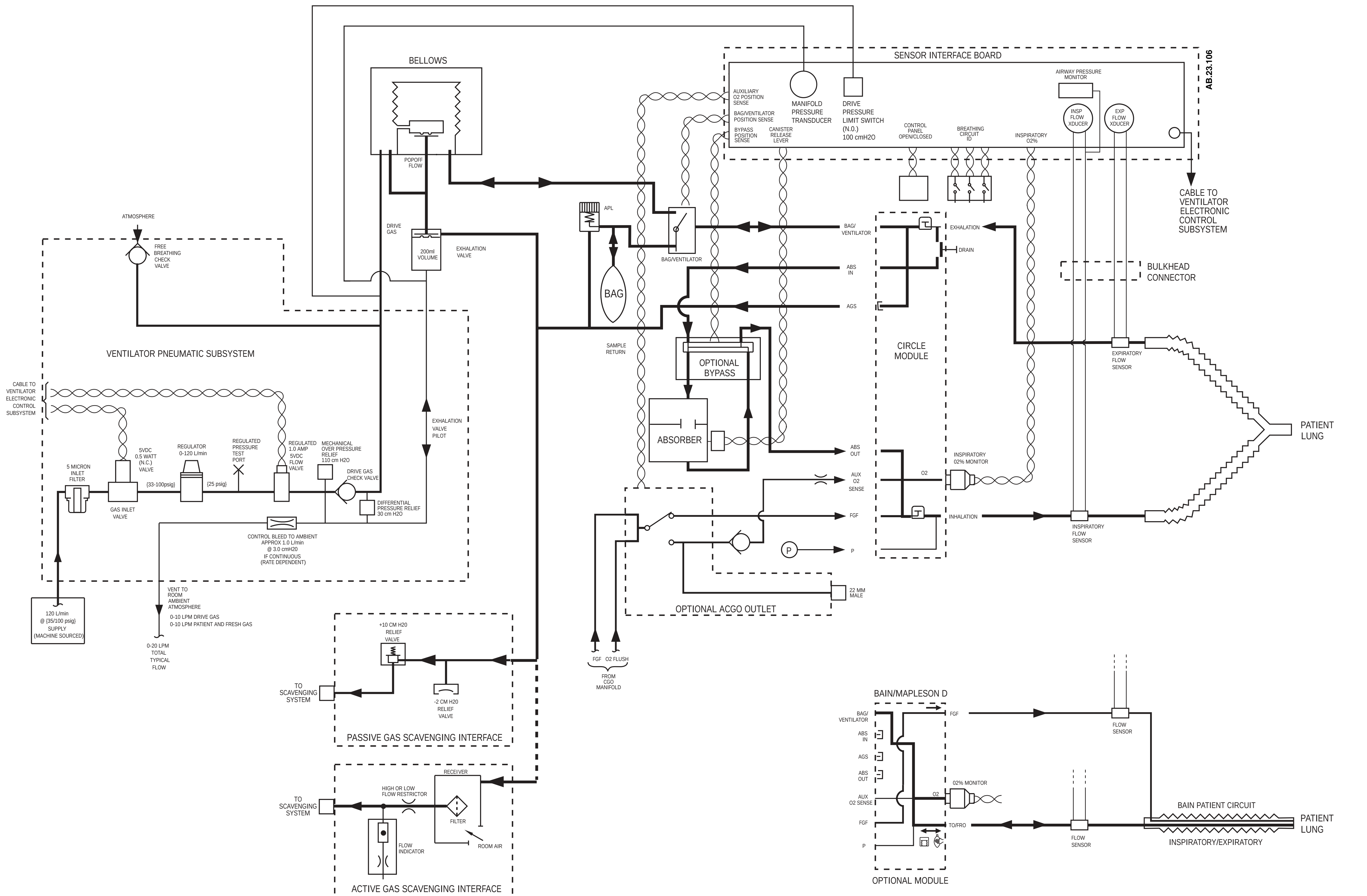


Figure 9-7 • System connection block diagram for machines with 7900 Ventilator

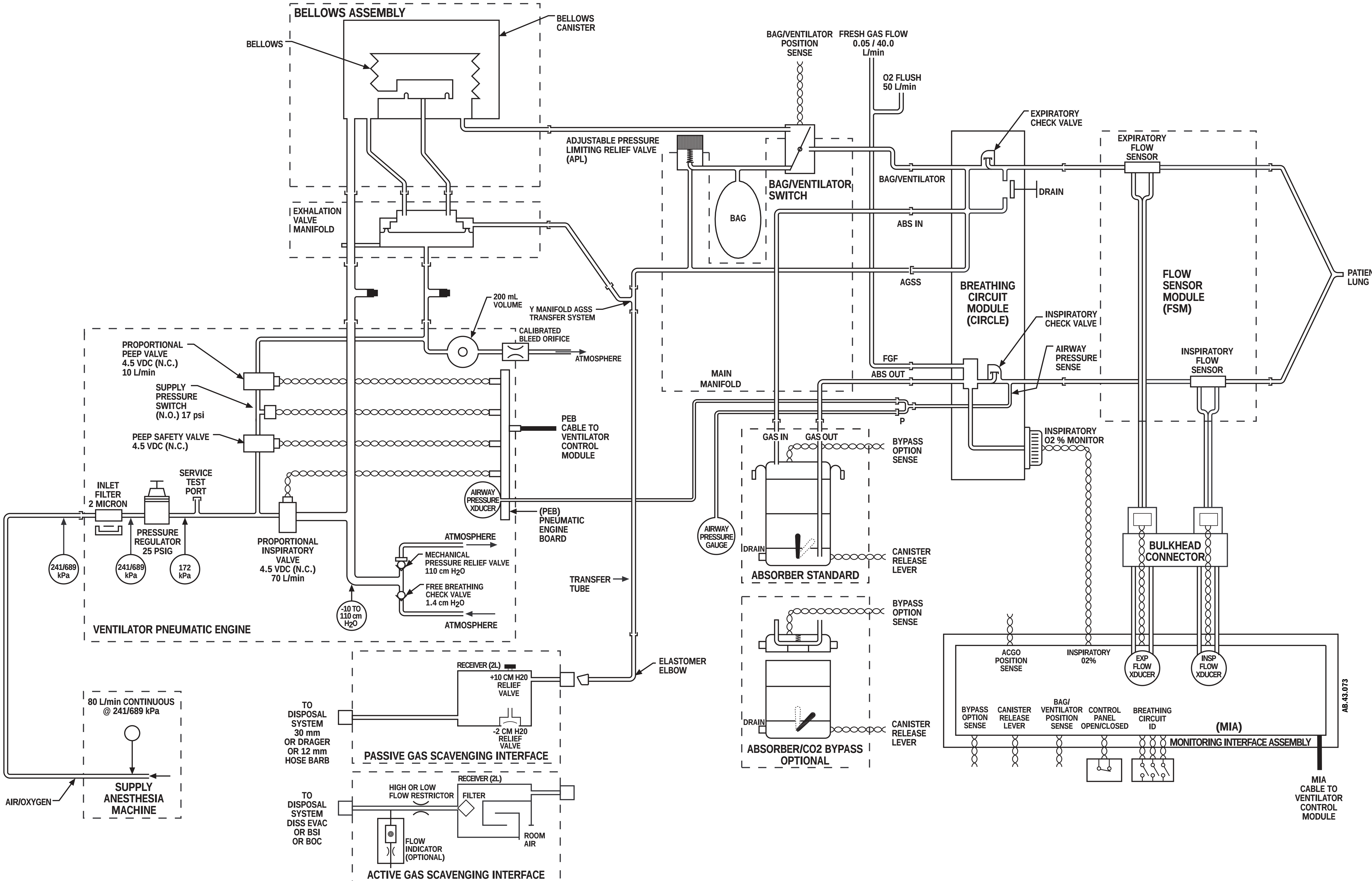


Figure 9-8 • System connection block diagram for machines with 7100 Ventilator

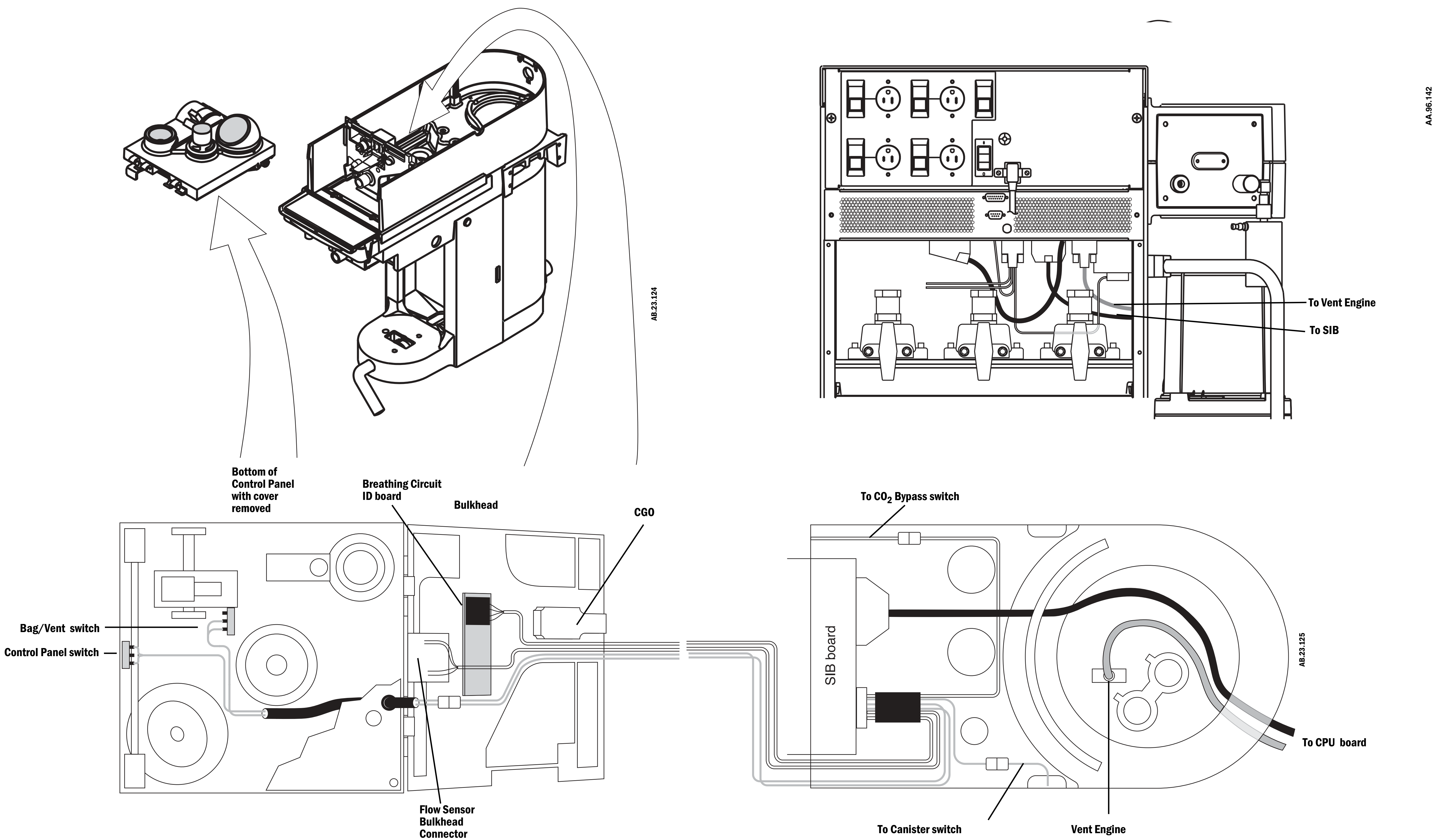


Figure 9-9 • Wiring harnesses for machines with 7900 Ventilator

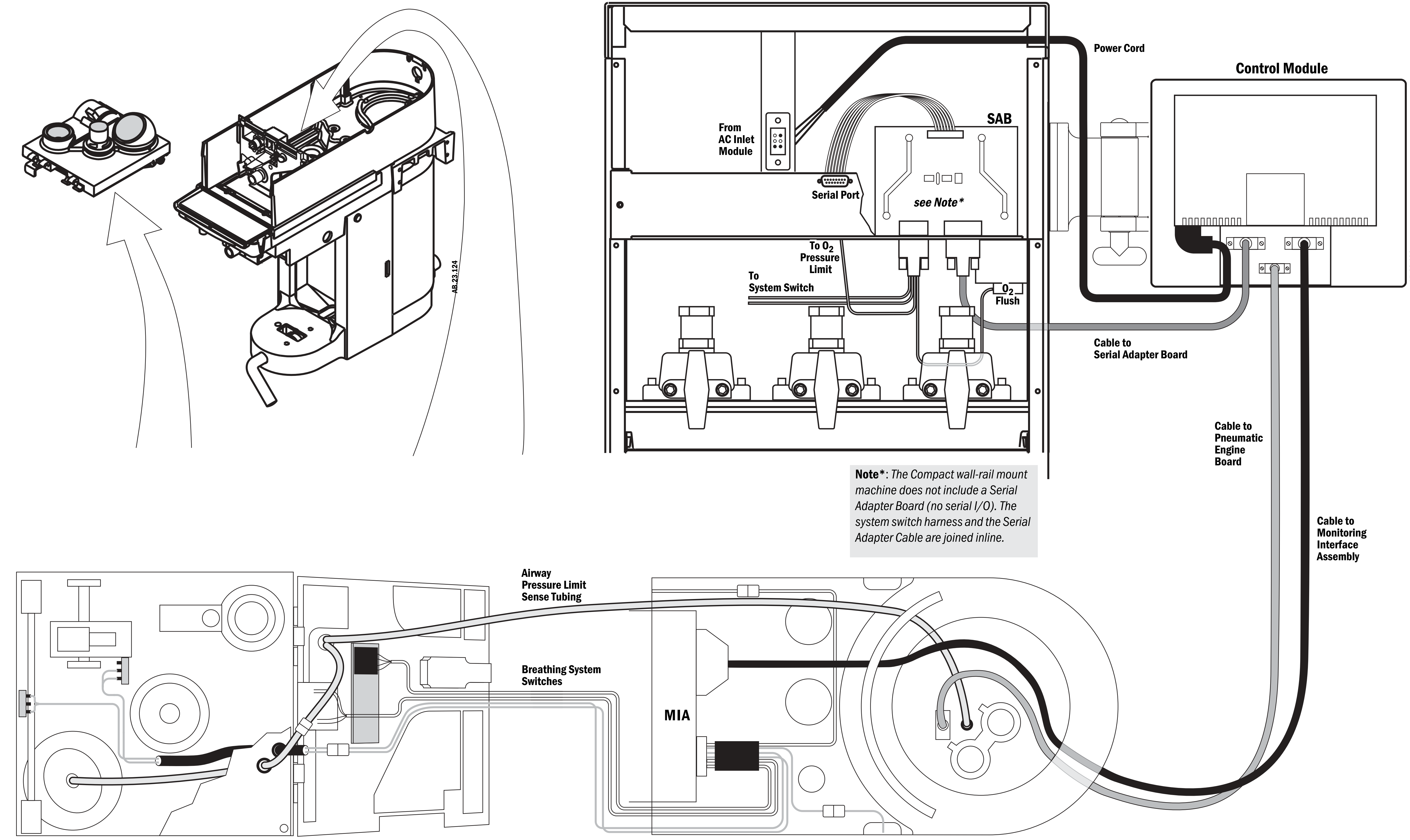


Figure 9-10 • Wiring harnesses for machines with 7100 Ventilator

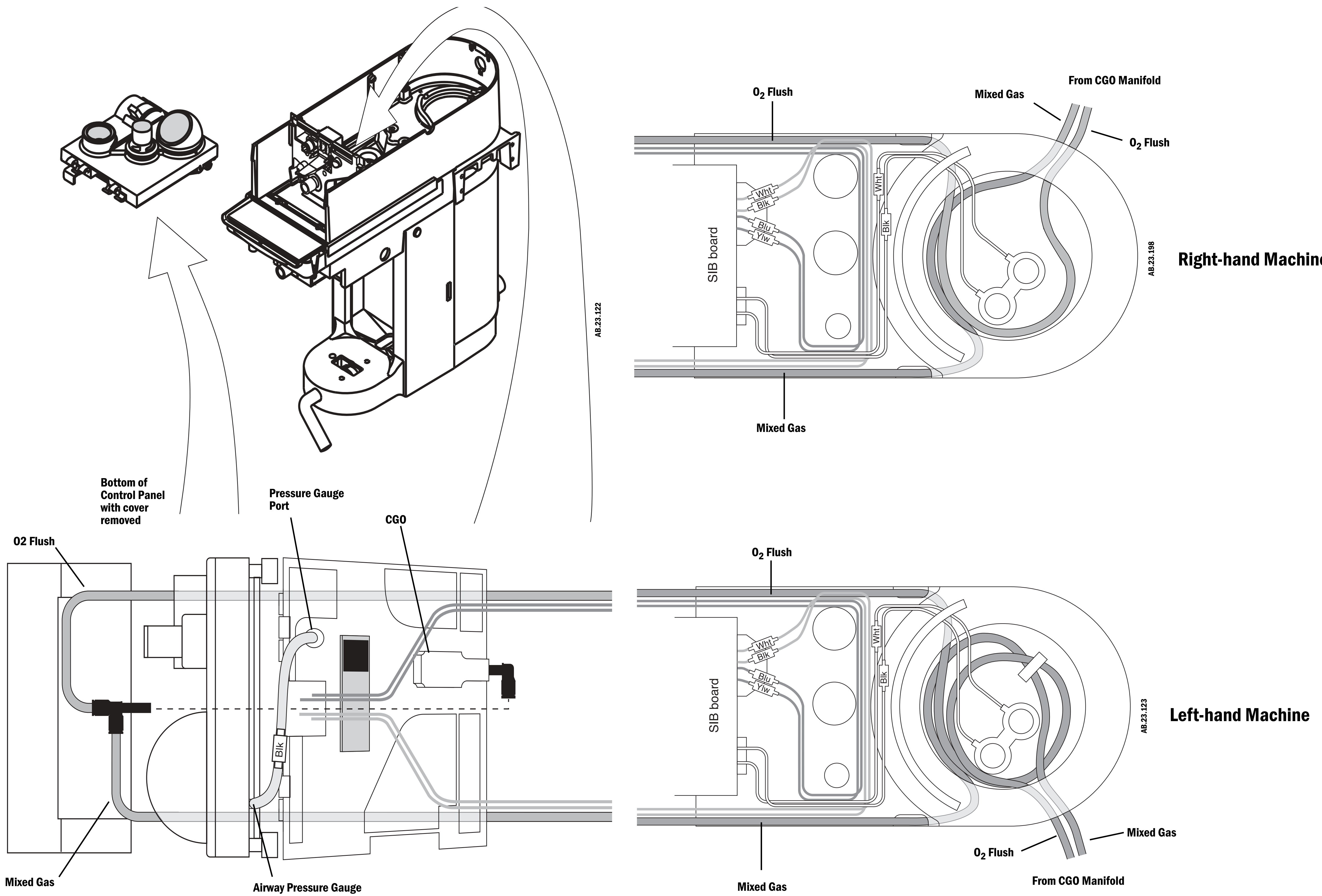


Figure 9-11 • Breathing System hose routing for machines without ACGO

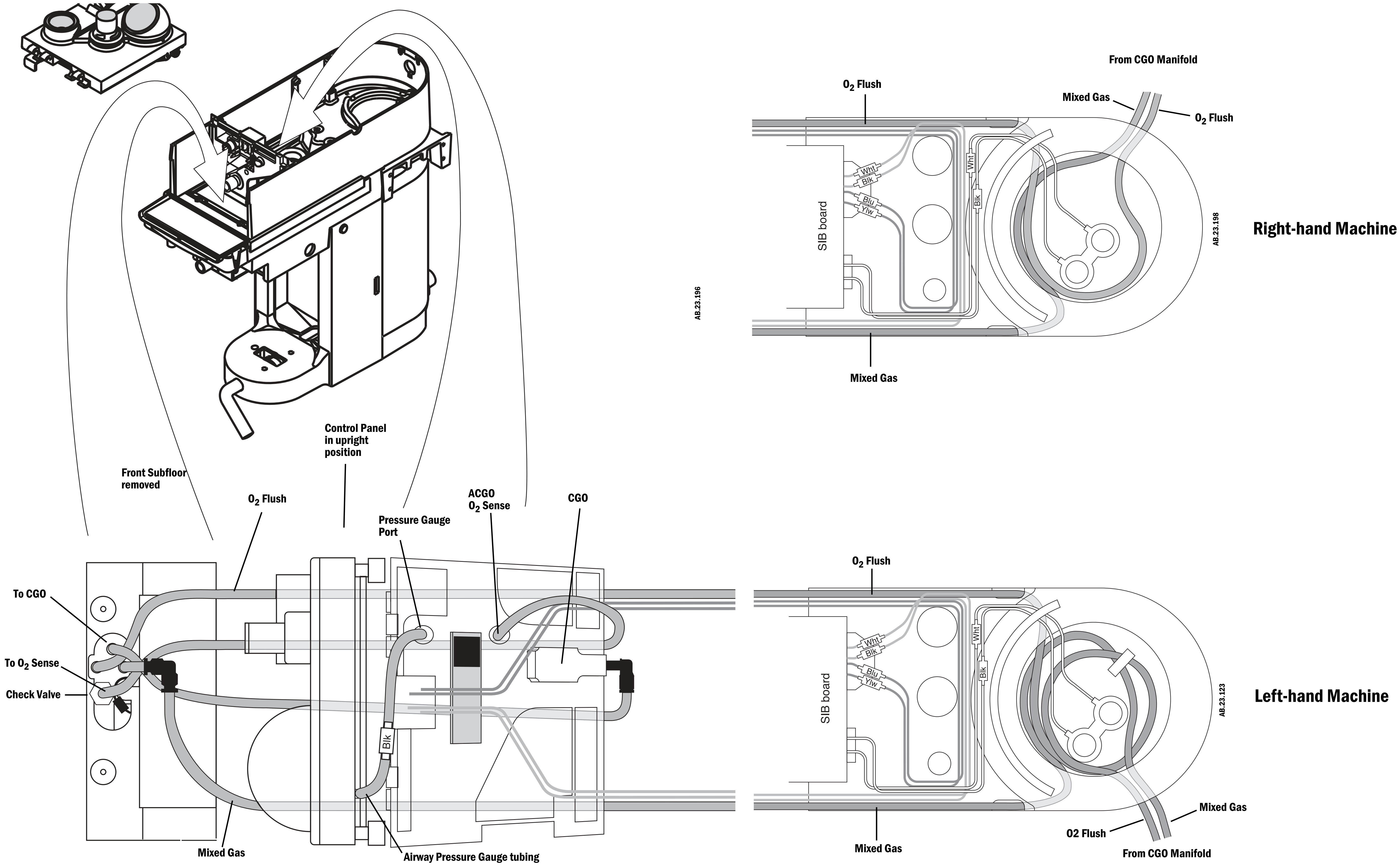


Figure 9-12 • Breathing System hose routing for machines with ACGO

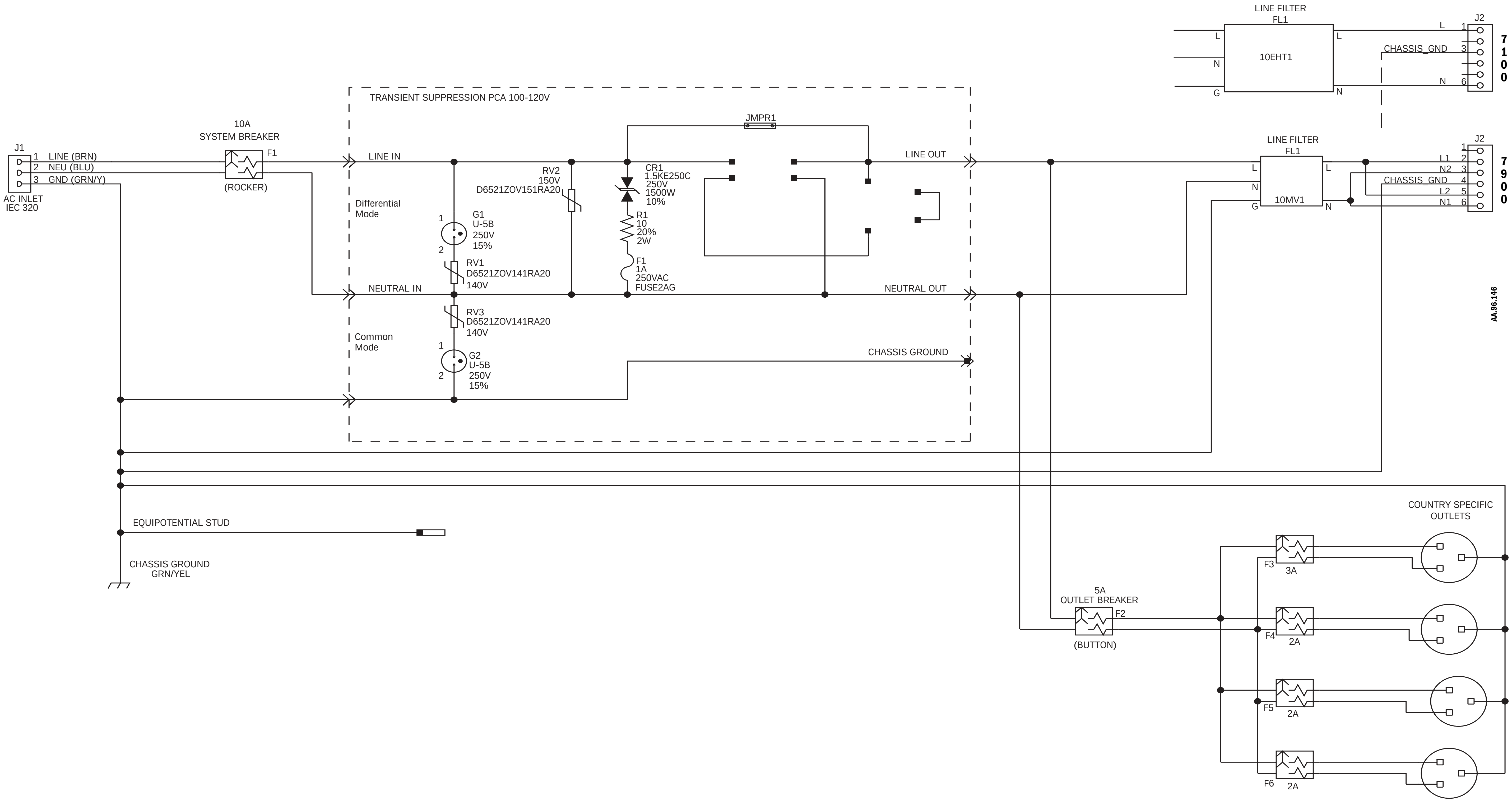


Figure 9-13 • Schematic, AC Inlet module; 100–120 V (Non-isolated outlets or no outlets)

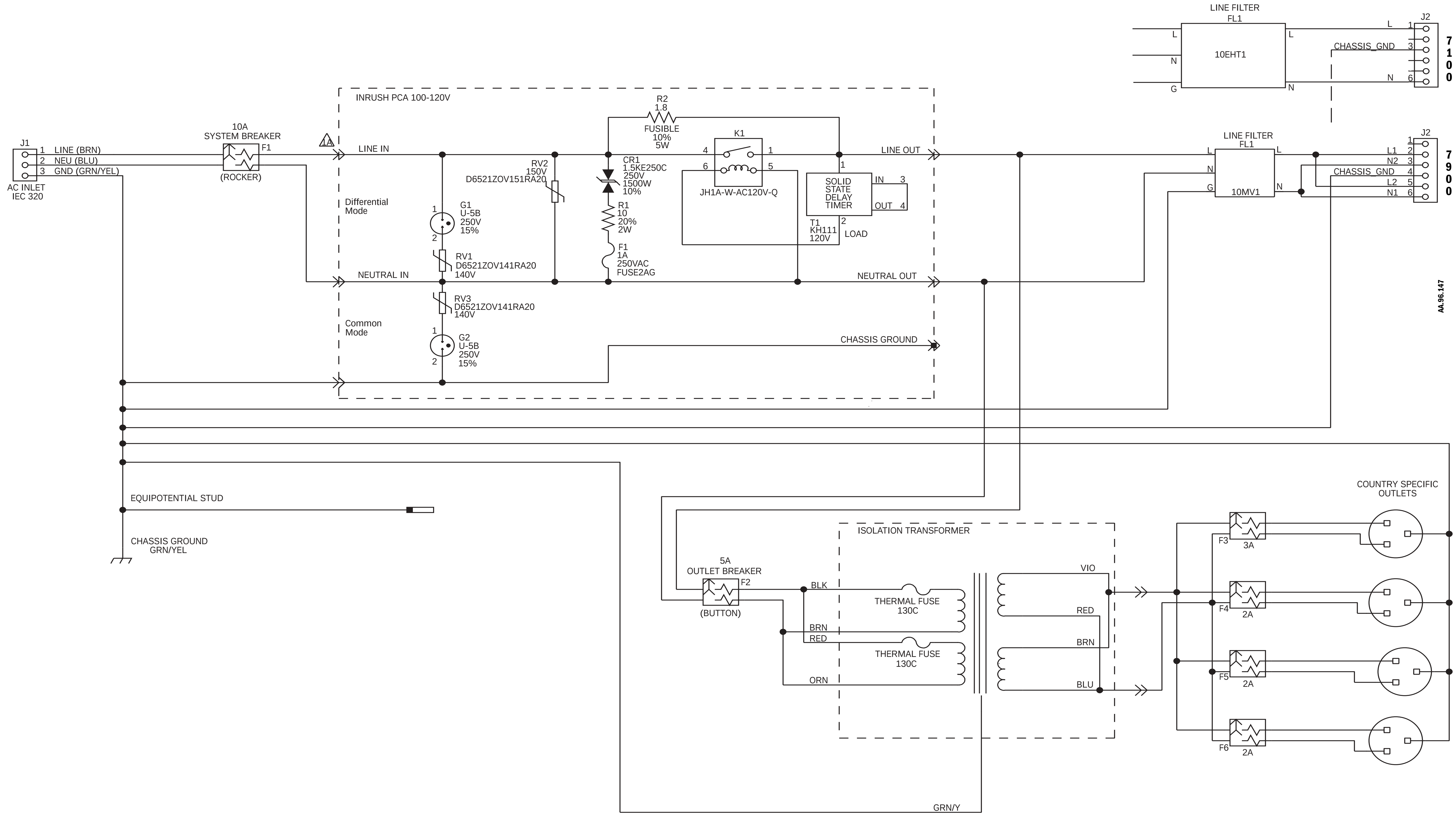


Figure 9-14 • Schematic, AC Inlet module; 100–120 V (Isolated outlets)

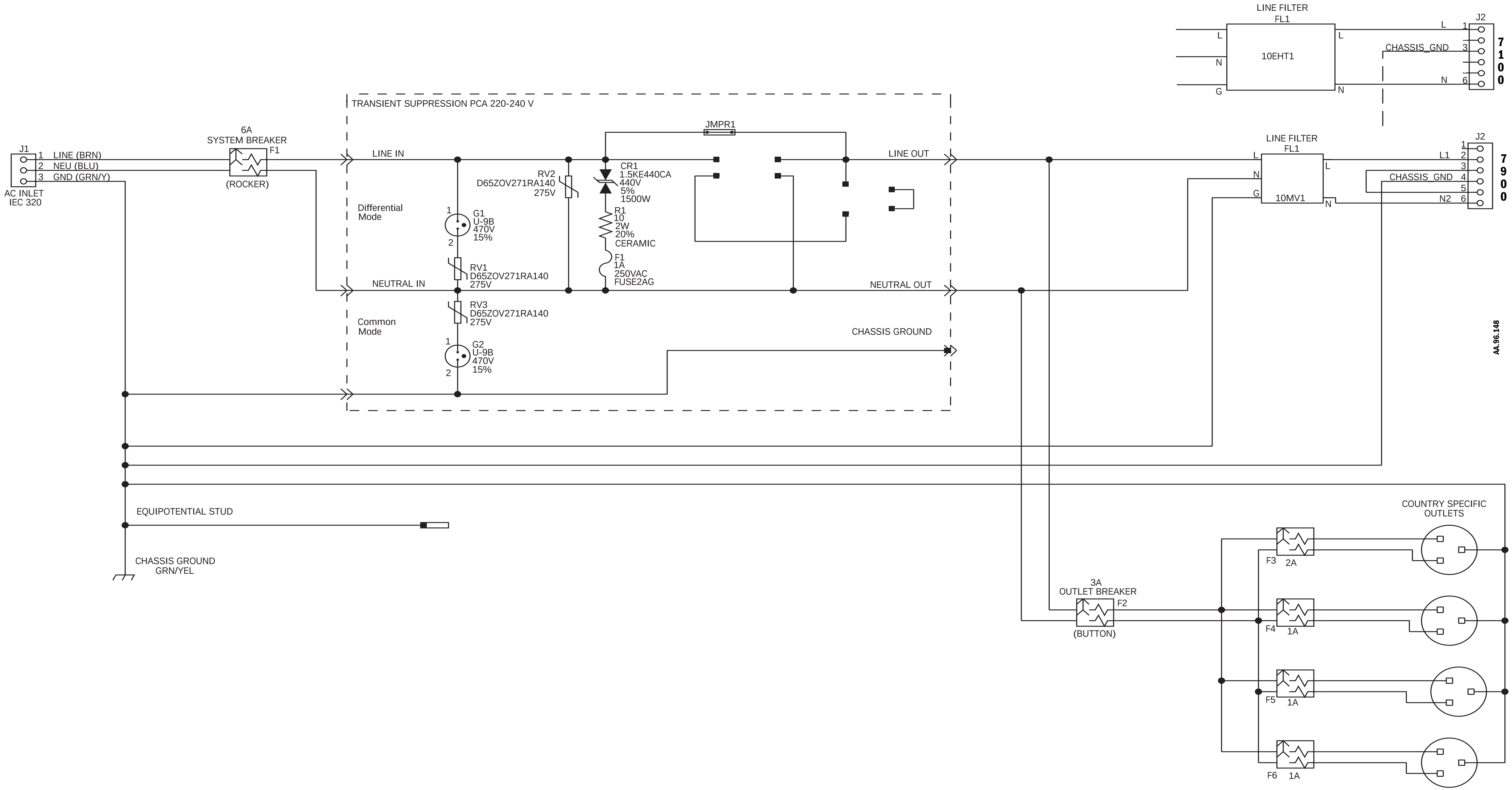


Figure 9-15 • Schematic, AC Inlet module; 220–240 V (Non-isolated outlets or no outlets)

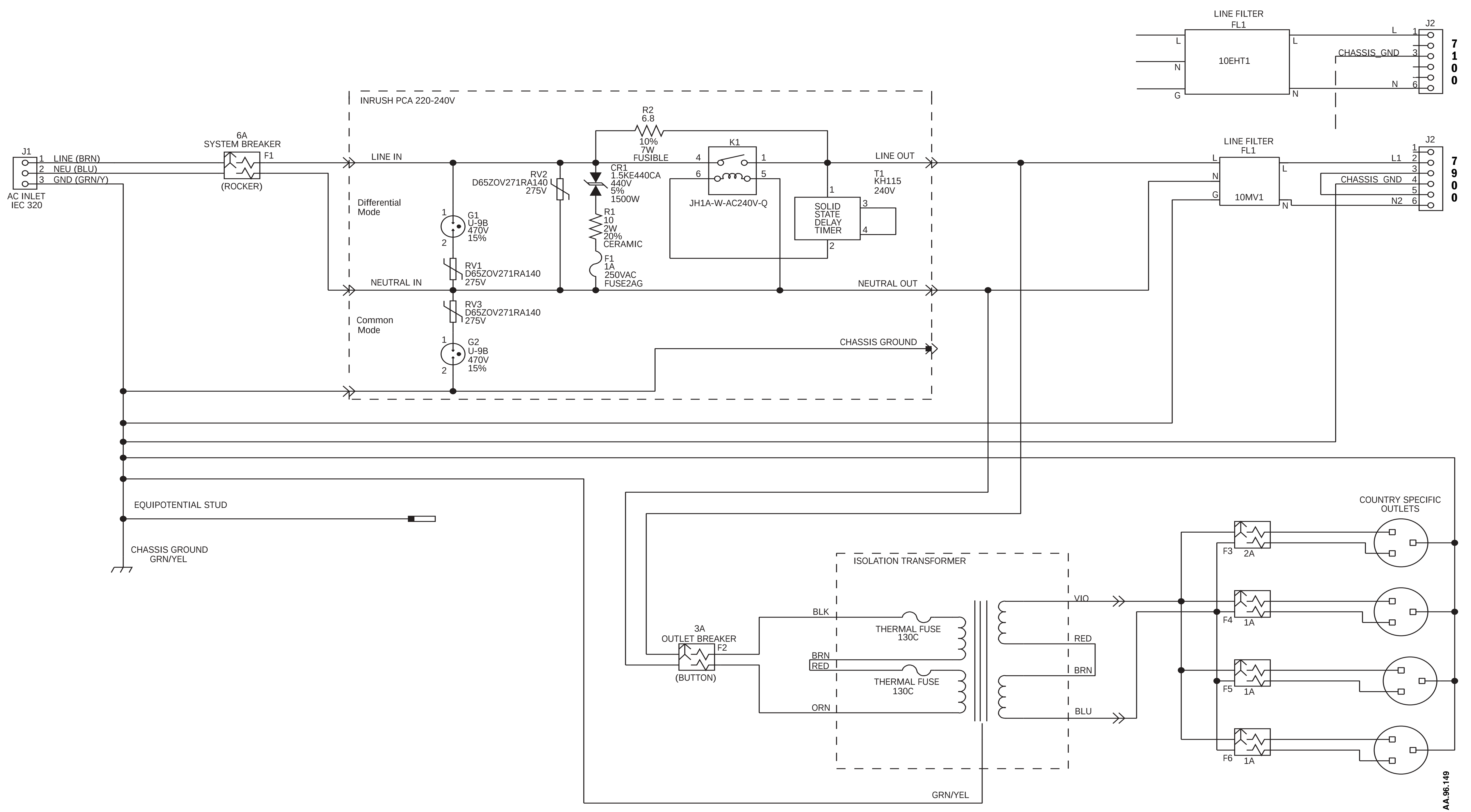


Figure 9-16 • Schematic, AC Inlet module; 220–240 V (Isolated outlets)

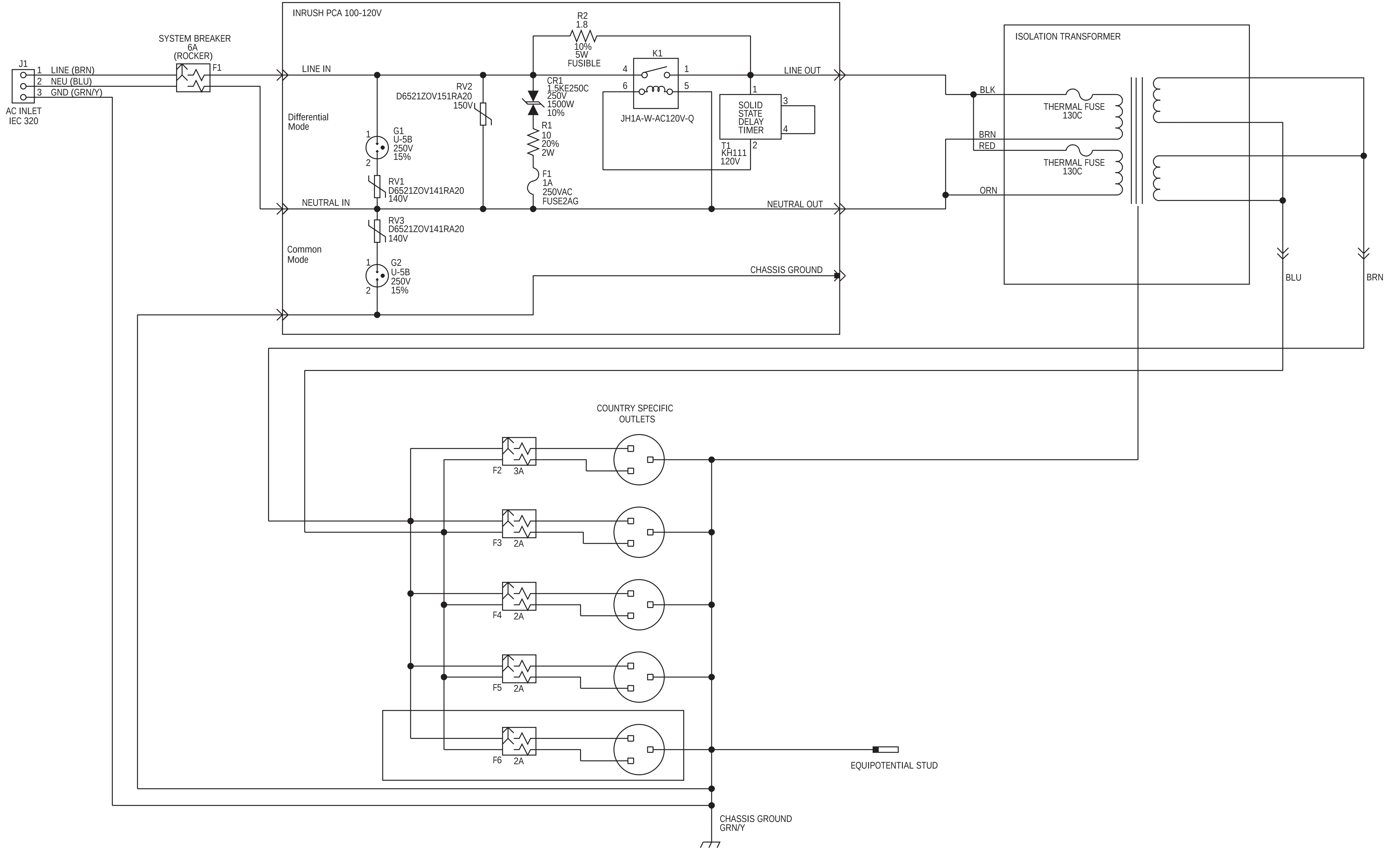


Figure 9-17 • Schematic, Auxiliary Outlet module; 100–120 V

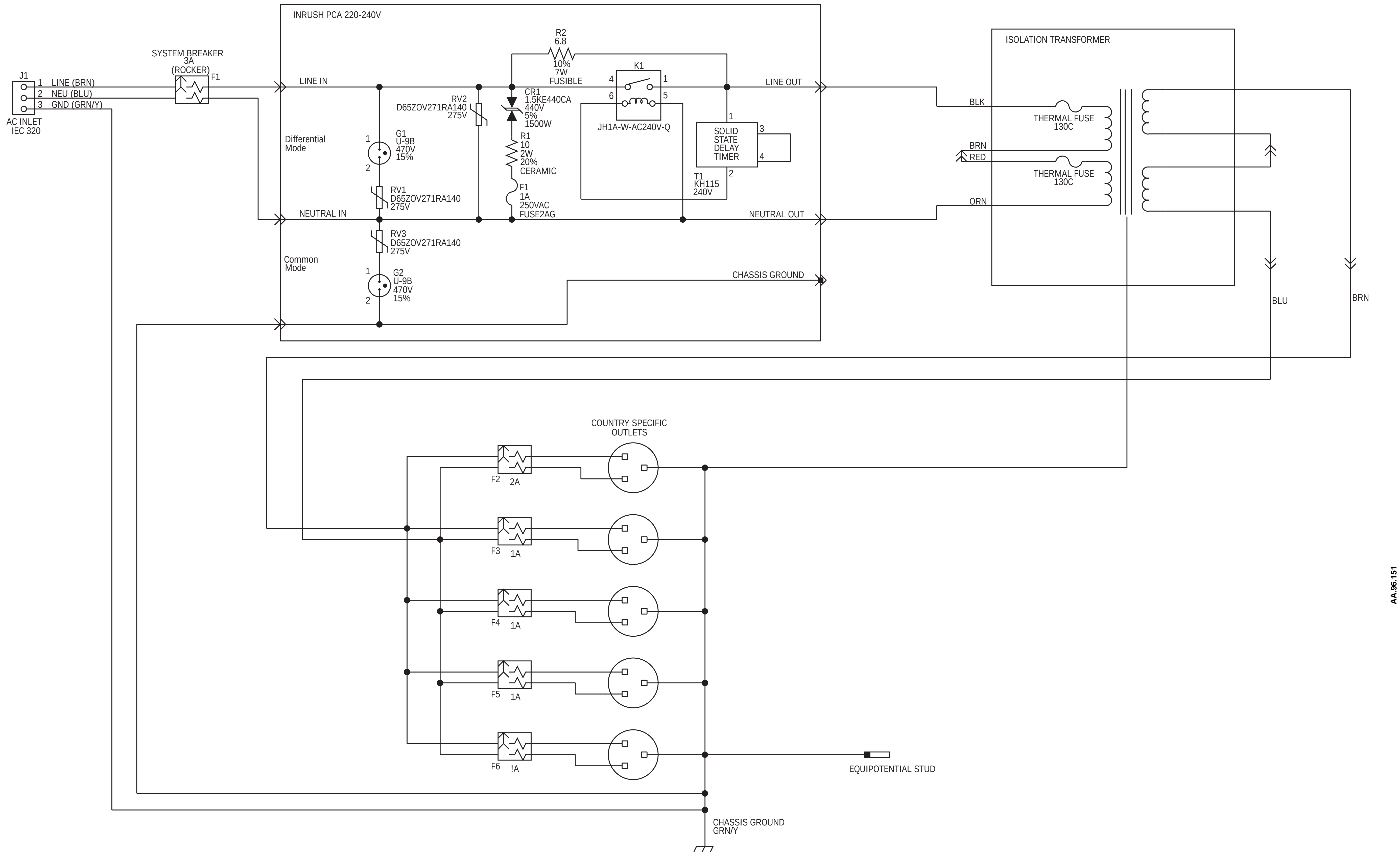


Figure 9-18 • Schematic, Auxiliary Outlet module; 220–240 V

Notes

Aestiva Anesthesia Machine
Technical Reference Manual

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