Bird Products Corporation.

SERVICE MANUAL

VIP Gold and VIP Sterling Ventilators

Revisions

Revision	Summary of Changes	Pages	Date
A	Initial release.	All	March 2001

Warranty

THE V.I.P. BIRD GOLD AND V.I.P. BIRD STERLING SYSTEMS ARE WARRANTED TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP AND TO MEET THE PUBLISHED SPECIFICATIONS FOR TWO (2) YEARS OR 8,000 HOURS, WHICHEVER OCCURS FIRST.

The liability of Thermo Respiratory Group under this warranty is limited to replacing, repairing or issuing credit, at the discretion of Thermo Respiratory Group, for parts that become defective or fail to meet published specifications during the warranty period; Thermo Respiratory Group will not be liable under this warranty unless (A) Thermo Respiratory Group is promptly notified in writing by Buyer upon discovery of defects or failure to meet published specifications; (B) the defective unit or part is returned to Thermo Respiratory Group, transportation charges prepaid by Buyer; (C) the defective unit or part is received by Thermo Respiratory Group for adjustment no later than four weeks following the last day of the warranty period; and (D) Thermo Respiratory Group's examination of such unit or part shall disclose, to its satisfaction, that such defects or failures have not been caused by misuse, neglect, improper installation, unauthorized repair, alteration or accident.

Any authorization of Thermo Respiratory Group for repair or alteration by the Buyer must be in writing to prevent voiding the warranty. In no event shall Thermo Respiratory Group be liable to the Buyer for loss of profits, loss of use, consequential damage or damages of any kind based upon a claim for breach of warranty, other than the purchase price of any defective product covered hereunder.

Thermo Respiratory Group warranties as herein and above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of the rendering of technical advice or service by Thermo Respiratory Group or its agents in connection with the Buyer's order of the products furnished hereunder.

LIMITATIONS OF LIABILITIES

This warranty does not cover normal maintenance such as cleaning, adjustment or lubrication and updating of equipment parts. This warranty shall be void and shall not apply if the equipment is used with accessories or parts not manufactured by Thermo Respiratory Group or authorized for use in writing by Thermo Respiratory Group , or if the equipment is not maintained in accordance with a prescribed schedule of maintenance.

The warranty stated above shall extend for a period of two (2) years from date of shipment or 8,000 hours of use, whichever occurs first, with the following exceptions:

1. Components for monitoring of physical variables such as temperature, pressure, or flow are warranted for ninety (90) days from date of receipt.
2. Elastomeric components and other parts or components subject to deterioration, over which Thermo Respiratory Group has no control, are warranted for sixty (60) days from date of receipt.
3. Internal and optional external batteries are warranted for ninety (90) days from the date of receipt.

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Trademark Notices

Contact Information

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Contents

Safety Information

PLEASE read this entire manual before attempting to service the ventilator.

Attempting to service the ventilator without fully understanding its features and functions may result in unsafe operating conditions.

Intended Audience

This manual is written for Bird Products trained and authorized service personnel. It assumes you are familiar with Bird Products ventilators and have attended the V.I.P. Bird Gold and Sterling ventilator series training class.

Terms

WARNINGS	identify conditions or practices that could result in serious adverse reactions or potential safety hazards.
CAUTIONS	identify conditions or practices that could result in damage to the ventilator or other equipment.
NOTES	identify supplemental information to help you better understand how the ventilator works.

WARNING

If you are not authorized by Bird Products to work on the V.I.P. Bird Gold and Sterling ventilators, do not attempt to perform any of the procedures described in this manual. If you ignore this warning, you may create conditions that could be harmful to the patient, as well as void the warranty. **DO NOT SERVICE THE VENTILATOR UNLESS YOU HAVE BEEN TRAINED AND AUTHORIZED BY BIRD PRODUCTS TO DO SO.**

CAUTION

Refer to the V.I.P. Bird Gold and Sterling Operator's Manual for operator safety information and cautions. The following cautions apply any time you are servicing the ventilator:

Performing the 1,000 and 5,000 hour maintenance requires access to the interior of the ventilator. It is intended to be performed by a Bird Products Certified Service Technician. The technician should be familiar with appropriate ESD (Electro-Static Discharge) prevention techniques to avoid damage to electronic components.

Double check the Pneumatic connection to the gas transducer before applying pressure. If 25 PSI is inadvertently applied to the machine transducer it will be permanently damaged and require replacement.

CAUTION

Appropriate measures to prevent ESD damage to electronic components must be taken:

Wear a properly grounded and tested anti-static wrist strap when handling Printed Circuit Boards (PCBs).

Work on an anti-static surface.

Always use anti-static material for packaging PCB's.

Prior to cover removal, disconnect AC power from the wall source and ensure that the OFF/ON Switch is in the OFF Position.

Chapter 1 Introduction

What You Need To Service The Ventilator

This chapter describes what you will need to service the ventilator series. Please refer to the V.I.P. Bird Gold and Sterling Operator's Manual (P/N L1421) for complete information on the operation of the V.I.P. Bird Gold and Sterling ventilator series.

To service the ventilator, you need the following:

- Training or authorization from Bird Products Corporation.
- Required tools as specified in this manual.
- Power, oxygen and air sources.

Required Training Or Authorization

Only Bird Products Certified and authorized service personnel are permitted to service the ventilator. If you are not certified or authorized, please do not attempt to perform any of the service procedures listed in this manual.

Required Tools

All components of the V.I.P. Bird ventilator can be removed and replaced using the tools listed in Table 1-1. These tools can be acquired from your local hardware store or supplier, Bird Products Corporation does not sell these tools.

Table 1-1. Required Tools

TOOL	SIZE
Nutdrivers (deep socket):	11/32"
	9/32"
	1/4"
	3/8"
	5/16"
	7/16"
	1/2"
Open End Wrenches:	11/16"
	9/16"
	7/16"
	5/8"
	1/2"
Allen Hex Ball End 7" (18 cm) Shank Driver:	1/8"
	9/64"
	7/64"
	5/32"
	3/32"
	3/16"
Long thin needle nose pliers	
Diagonal Cutter	
Trimpot adjuster	
Common screwdriver	

Table 1-2. Special Tools ordered from Bird

P/N	Description
00066	90° elbow adapter
00077	inline pressure manometer
00631	lubricant
00673	flowmeter adapter
00822	hex nut
01233	22mmM X 15mmF, 2 each
02187	22mmF X 22mmM X 15mmF, 2each
06765	pressure regulator assy. 0 - 60 PSI
07525	oxygen sampling hose
09220	Bird flowmeter 0 - 15 LPM
09528	fiber optic cable gray/gray 6"
10188	exhalation valve body
10383	Infant test circuit and infant test lung.
20107	exhalation valve diaphragm

Table 1-3. Parts Ordered Separately or as Part of Kit (P/N 10289)

P/N	Description
03852	Microblender tool kit
10251	Microblender test kit
10284	Patient outlet sealing plate
10285	Safety valve sealing plate
10286	Relief valve sealing plate
10287	Regulator sealing plate
10288	Main sealing plate
10388	Transducer test harness
15137	Current measuring test fixture
33903	Syringe

Table 1-4. Special Test Equipment not ordered from Bird

Digital mulitimeter

Oxygen regulator (two stage adjustable 0 - 80 psi)

Air regulator (two stage adjustable 0 - 80)

Calibrated oxygen analyzer (read in tenths to ensure accuracy of calibration) or equivalent

Precision pressure manometer 0 - 30 psi(with accuracy of 0.05 and 0.2 increments) or equivalent

Flow tube 0 - 1 lpm (in increments os 0.1 lpm) or equivalent

Digital pressure transducer -20/+140 cmh2o (accuracy of +0.5 at 0 cmh2o to 2.0cmh2o) or equivalent

8 liter volume spirometer with temp compensation (± 2.0 % accuracy) or equivalent

Variable transformer 1 - 140 volts or 1 - 260 volts

12 - 16 vdc power supply with 5 amp. Minimum

Anti-static mats for table and floor

Anti static wrist strap

Anti static bags

Required Power and Gas Sources

To operate the ventilator you need a power source, oxygen source and air source as specified below:

- **Power Source.** The ventilator operates from a standard 100, 110, 220, or 240 VAC. power source.
- **Pressurized Oxygen.** The compressed oxygen source must provide clean, dry, medical grade oxygen at a line pressure of 40 to 60 PSIG (2.8 to 4.2 bar).
- **Pressurized Air.** The compressed air source must provide clean, dry medical grade air at line pressure of 40 to 60 PSIG (2.8 to 4.2 bar).

Chapter 2 Maintenance

Recommended Schedule of Maintenance

The V.I.P. Bird Gold and Sterling ventilator is designed to operate for long periods of time with very little maintenance. Table 2-1 gives a recommended schedule for maintaining the ventilator and describes the tasks that should be performed at each of the scheduled maintenance times.

Table 2-1. Recommended Maintenance

Routinely	Replace any damaged, leaking or worn tubing, adapters, and exhalation valve diaphragm.
Every 1000 hours	Replace air inlet water trap filter element (P/N 06146). Perform the preventive maintenance procedure.
Every 5000 hours	Check and *replace if necessary* the nylon cone filters (P/N 06804D ten pack) and the duck bill check valve (03895D ten pack). These parts are in the O_2 and Air inlet fittings. The Preventive Maintenance Procedure will need to be performed. This procedure must be performed by a Bird certified technician. If you are using a Bird reusable circuit, and the maximum allowable resistance exceeds the specification given below, replace the main flow filter and the proximal airway filter. Pediatrics: Main flow filter - 2 cmH_2O @ 60 LPM Infant: Main flow filter - 4 cmH_2O @ 20 LPM Proximal Airway filter - 1 cmH_2O
Every 20,000 hours	Complete machine maintenance service will be required at a minimum interval of 20,000 hours. Contact your Bird distributor or Bird Products Corporation to schedule.
Every Two Years	The blender will need to be overhauled. The overhaul kit P/N is 10003.

This schedule assumes the ventilator is operating in a typicalclinical setting. Adverse environmental conditions may necessitate more frequent maintenance.

CAUTION

Performing the 5,000 hour maintenance requires access to the interior of the ventilator. It is intended to be performed by a Bird factory trained technician. The technician should be familiar with appropriate ESD (Electro-Static Discharge) prevention techniques to avoid damage to electronic components.

Table 2-2 Overhaul Kit Parts

Part Number	Description	Quantity
00109	Washer	1
00114	O-Ring	9
00138	O-Ring	4
00328	O-Ring	1
01943	O-Ring	1
02013	O-Ring	1
03021	O-Ring	1
03373	O-Ring	1
03375	O-Ring	3
03808	O-Ring	2
04029	Tubing, 1/8" Silicone	2
05531	Retainer, Valve, Male	1
05532	Retainer, Valve, Female	1
05999	O-Ring	3
006146	Filter	1
06195	Housing & O-Ring	1
07849	O-Ring	1
08171	Orifice	3
08881	Flapper	1
08934	Tubing Assembly, Regulator Exhaust	1
09603	Elbow	1
09754	Safety Valve	1
09788	Tubing ¼" Reinforced	2
10003	Blender Overhaul Kit	1
15768	Flow Valve	1
30001	O-Ring	1
30002	O-Ring	1
30003	O-Ring	1
30004	O-Ring	1
30005	O-Ring	2
30006	O-Ring	1
80200	Label, Maintenance	1
33566	Regulator	1
15739	Exhalation valve	1
15661	Fan Assembly	1
15684	Sensor Receptacle	1
15683	Pneumatic Tubing	1
33564	3-Way Clippard Valve (Purge Manifold)	1
33600	3-Way Normally Closed, Man MT, Solenoid Valve (Purge Manifold)	2

Preventive Maintenance Procedures

Table 2-3 Equipment Required

Part Number	Description	Quantity
06804	Nylon Cone Filter	2
03895	Duckbill Check Valve	2
06146	Coalescing Filter	1
10383	Infant Flow/Volume Test Circuit	1
33754	Test Lung	1
15678	Infant Flow Sensor	1
15685	Pediatric Flow Sensor	1
20107	Exhalation Valve Diaphragm	1
10188	Exhalation Valve Body	1
00060	O2 Hose	1
02899	Air Hose	1
	Anti-static mat, covering worktable and grounded to earth.	1
	Anti-static wrist strap.	1
	9/64" Allen driver	1
	Air/oxygen source	1 ea
	Oxygen regulator (two stage adjustable 0 - 80 PSI)	1
	Air regulator (two stage adjustable 0 - 80)	1
	Calibrated oxygen analyzer (read in tenths to ensure accuracy of calibration) or equivalent	1
	Precision pressure manometer 0 - 30 PSI (with accuracy of 0.05 and increments of 0.2) or equivalent	1
	Leakage Current Tester	1
	Digital Multimeter (DMM)	1
	Flow Tube 0-50 LPM or Equivalent	1

Disassembly/Reassembly of O2 Inlet Fitting

1. Using a 3/4" open end wrench, remove the O_2 inlet fitting (P/N 03864L) from the Inlet Block Assembly (P/N 33519).

NOTE

This assembly threads into the block with a left-handed thread. A single groove on nut indicates left-hand thread.

2. Using a second 3/4" open-end wrench, separate the O_2 connector from the filter retainer.
3. Using a 3/4" open-end wrench to stabilize the filter retainer, remove the O_2 tail piece using a 1/8" Allen driver.
4. Carefully remove the filter and duckbill check valve
5. Inspect P/N 06804, cone filter, for dirt. If the filter is dirty then replace. Inspect the P/N 03895 Duckbill Check Valve and make sure it is still soft.
   If the valve is not soft, replace with a new one. Check off the Preventive Maintenance Check Sheet (PMCS) when you finish inspecting the filter and check valve.

6. Lightly lubricate o-ring (P/N 03808) with lubricant (P/N 00631) and assemble to O_2 connector (P/N 03834).
7. Insert duckbill check valve (P/N 03895) and washer (P/N 03897) into O_2 connector. Lightly lubricate o-rings (P/N 03808 & 00193) with lubricant (P/N 00631) and assemble to O_2 filter retainer (P/N 03835).
8. Using two ¾"open end wrenches, tighten the O_2 connector to the filter retainer.
9. Take a non-lubricated o-ring (P/N 00143) and install on the O_2 tailpiece (P/N 03832).
10. Insert O_2 tailpiece into the nut (P/N 00822) and using a 1/8 " Allen wrench, tighten O_2 connector. Using a ¾" open-end wrench install the O_2 fitting (P/N 03864) Check off the PMCS.

Disassembly/Reassemble of Air Inlet Fitting

1. With a ¾" open-end wrench, remove the air inlet assembly (P/N 10078) from the inlet block assembly (P/N 33519).
2. Using two (2) ¾" open-end wrenches, turn in a counterclockwise direction (CCW) and disassemble the air inlet assembly (P/N 10078).
3. Remove the filter, and duckbill check valve.
4. Inspect P/N 06804, cone filter for dirt. If the filter is dirty then replace the filter. Inspect the P/N 03895 duckbill check valve and make sure it is still soft. If the valve is not soft, replace with a new duckbill check valve. Check off the PMCS when you finish inspecting the filter and check valve.
5. Lightly lubricate o-ring (P/N 03808). Using two (2) ¾" open-end wrenches, assemble the air inlet fitting.
6. Using a ¾" open end wrench, install and secure the air inlet fitting (P/N 10078) to the inlet block assembly (P/N 33519).

Water Trap Filter

1. Turn the VIP so the rear panel is facing you.
2. Remove the water trap bowl located on the left-hand side of the unit, below the air and O_2 inlet.
3. Remove the filter from the unit. Turn the unit onto its right side (facing from rear). Remove the o-ring (P/N 06194) located on the water trap assembly.
4. Replace the o-ring (P/N 06194) with a new one. Replace water trap filter (P/N 06146) with a new one.
5. Re-Install the water trap bowl into place on the unit. Check off the PMCS.

Equipment Setup

1. Place the ventilator on a worktable covered with a grounded anti-static mat. Place the anti-static wrist strap around your wrist.
2. Make sure the ON/OFF switch is in the OFF position.
3. Locate dip switch SW504 on the Main PC Board. Turn switch 6 & 7 to the OFF position (See Test Figure 2.1).
4. Connect the pressure gauges to their respective regulators. Connect air and oxygen supply source regulator to their respective gas sources and make certain that pressure regulators are turned full counterclockwise OFF, CLOSED.

5. Connect O_2 supply hose, P/N 00060 and air supply hose, P/N 02899 to their respective input DISS fittings.
6. Open and adjust both supply source pressures to 50 PSIG. Set O_2% concentration selection knob to 60%.
7. Connect power cord to a properly grounded AC outlet.

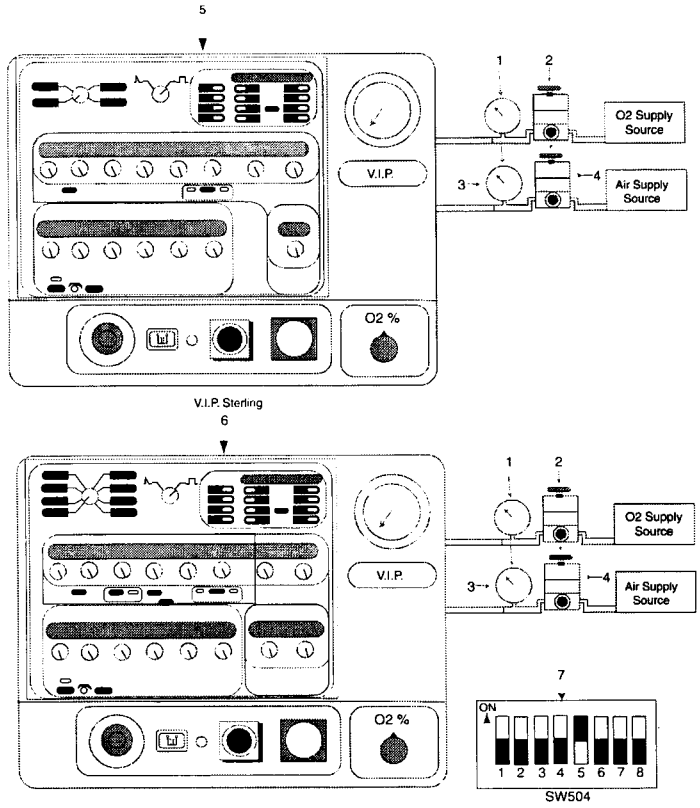


Figure 2.1 VIP Gold & Sterling set-up

1. O2 Pressure Gauge
2. O2 Regulator
3. Air Pressure Gauge
4. Air Regulator
5. V.I.P.Sterling (Top)
6. V.I.P.Gold (Bottom)
7. Dip Switch SW504 settings

Power Up Verification

Turn ON the ventilator. The display will go through the Power On Self Test (POST). Verify that the flow valve "Homes" within 5 seconds and does not move thereafter. Check off the Preventive Maintenance Check Sheet (PMCS).

NOTE

Remove the patient circuit and Exhalation Valve Body (P/N 10188) before continuing.

Transducer Verification

1. Set ventilator to the following settings:

Mode	Assist/Control Volume Cycle
Tidal Volume	400 mL
Inspiratory Time	—
Rate	10 bpm
Flow	40 lpm
Inspiratory Pressure	...
PEEP/CPAP	0 (zero) cmH20
Assist Sensitivity	OFF
Pressure Support	—
PS Time Limit	—
Low Peak Pressure	3 cmH2O
High Pressure	120 cmH20
High Breath Rate	300 bmp
High Tidal Volume	2.0 L
Low Min. Vol.	OFF
*Rise Time	—
Termination Sensitivity	—
Over Pressure Relief	Max.
02% Concentration	60%

**This control is for the V.I.P Gold only.*

2. The ventilator must run for 30 minutes before transducer calibration can be verified. Set Breath Rate to zero. Simultaneously press and hold the Silence, Reset, and Select buttons for one second.

3. The monitor window should read P 0.0 ± 1.00 cmH20. This is the Proximal transducer reading. Check off the Preventive Maintenance Checkout Sheet (PMCS). If the reading is out of specification, refer to the Operational Verification Procedure (Section 5) for calibration instructions
4. Press the Select button. The monitor window should read X 0.00 ± 1.00 cmH20. This is the Exhalation transducer reading. Check off the PMCS. If out of specification, refer to the Operational Verification Procedure (Section 5) for calibration instructions.
5. Press the Select button. The monitor window should read M 0.00 ± 2.00 cmH20. This is the Machine transducer reading. Check off the PMCS. If out of specification, refer to the Operational Verification Procedure (Section 5) for calibration instructions.
6. Press the Select button. The monitor window should read F XX. XX which is the current position for the flow valve. This value is not important for the PM procedure.
7. Press Select. The monitor window should read V 0.00 ± 0.028 cmH20. This is the Volume Monitor Flow Transducer Zero calibration. Check off the PMCS. If out of specification, refer to the Operational Verification Procedure (Section 5) for calibration instructions.
8. Press Select. The monitor window should read the letter T and the LED's for the monitor window parameter will all be lit. This is a self test only.
9. Press Select to repeat steps 3 through 8. Once the test is complete press the Silence and Reset buttons simultaneously to return to normal operation.

Software Revision Check

1. Turn the ventilator OFF. Depress and hold the Select button and turn ON the ventilator. Verify that the flow valve "Homes" within 5 seconds and does not move thereafter. Release the Select button when the monitor window reads 226.
2. The monitor window will flash "CAUTION REMOVE PATIENT PRESS SELECT TO BEGIN UVT". Activate the Select button: The monitor window will read "A: XX.XXX" with XX.XXX representing CPU A software revision level. Record the result on the PMCS.
3. Press the Select button. Monitor window will read "B: XX.XXX" with XX.XXX representing CPU B software revision level. Record the result on the PMCS.
4. Press the Select button. Monitor window will read "C: XX.XXX" with XX.XXX representing CPU C software revision level. Record the result on the PMCS.
5. Press the Select button. Monitor window will read "P: XX.XX" with XX.XX representing PAL (Watchdog Timer) revision level. Record the result on the PMCS.
6. Press the Select button: the monitor window will read "V:X.XX" with X.XX representing the software revision being used in the ventilator for the Volume Monitor Board. Record the result on the PMCS.
7. Press the Select button: the monitor display will read "PV:XX.XX" with XX.XX representing the Volume Monitor Pal (Watchdog Timer) software revision level. Record the result on the PMCS.

Ambient Pressure Test

1 Connect P/N 10383 test circuit to the VIP ventilator as shown in Test Figure 2.2. ***Do not attach the test lung to the circuit.***

2 Press the Select button. The monitor display will read "0 TST". The ventilator will test the three pressure transducers under a "no flow" condition. After 1 second, the results of the test can be obtained by pressing the Select button again. If the unit passes, the message "0 PASS" will

appear in the monitor window. If any transducer fails the test, one of the following messages will appear in the monitor window:

PRX FAIL

EXH FAIL

MCH FAIL

These messages are for the Proximal, Exhalation, and Machine transducers respectively. Check off the PMCS once the test is completed.

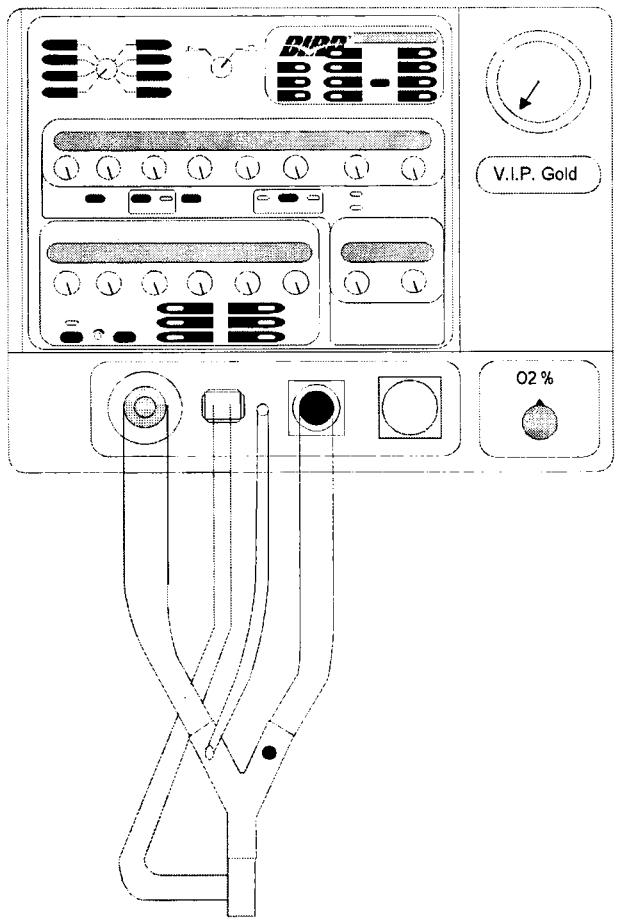


Figure 2.2

Pressurized Circuit Test

Press the Select button. The monitor window will flash "PRSR TST BLOCK PATIENT WYE PRESS SELECT". The patient wye must be blocked in order to close the patient circuit. Once this is done, press the Select button. The monitor window will read "TESTING". The ventilator will pressurize the circuit to a minimum of 55 to 65 cmH20. If this does not occur within five seconds, the message "LOW PRSR" will appear in the monitor window. If pressure is reached within five seconds, the ventilator will proceed to test the three transducers. After approximately eight seconds, the results will automatically be displayed. If the test passes, the message "PRS PASS" will appear in the monitor window. If any transducer fails the test, one of the following messages will appear in the monitor window.

PRX FAIL

EXH FAIL

MCH FAIL

MLT FAIL (this message indicates multiple transducer failure)

Check off the PMCS once the test is completed.

NOTE

If any portion of this test fails, the Pressure Test will automatically repeat. Press Select and the monitor window will read the message "PRSR TST BLOCK PATIENT WYE PRESS SELECT". The test will be continuously repeated until it either passes or the V.I.P. Sterling/Gold is reset. To reset unit, turn it OFF or press the Silence and Reset button at the same time.

Circuit Leak Test

Once the Pressurized Circuit Test indicates a pass, ("PRS PASS"), press the Select button. Using data collected during the previous test, the ventilator determines the amount of leakage in the patient circuit. If the ventilator passes, the message "LEAKPASS" will appear in the monitor window. If the test failed, the message "HIGHFLOW" or "LEAKFAIL" will be displayed. When the Select button is pressed, UVT will return to the beginning of the PRESSURIZED CIRCUIT TEST. The test will be continuously repeated until the instrument passes or you press Reset to terminate the UVT testing. Check off the PMCS once the test has been passed.

Language Select Setting

Press the Select button. The current setting of the language will be displayed in the monitor window. One of the following will appear:

English

Deutsche

Espanõl

Francais

Japanese

Italian

Illegal

Check off the PMCS, if the correct language is displayed.

NOTE

If the display reads Illegal then the language setting will default to English. At first available opportunity, Language select switch should be set to the correct setting. Refer to the Operational Verification Procedure (Section 5) for the switch settings.

Lamp Test

Activate the Select button. The monitor window will read "LAMP TST". All indicators, and all segments of the display will illuminate, except VENT INOP and EXTERNAL DC. EXTERNAL DC will only illuminate if the ventilator is powered by an external power source. Check off the PMCS.

Control Test

Press the Select button. Monitor window will read "CTRL TST". There are three parts to the Control Test.

A) **Mode Control Test:** Rotate the Mode control knob through all the positions. Monitor window will read the following messages as you check the positions:

(S)IMV/CPAP/PS	ASSIST CONTROL
VAPS: "VAPS IMV'	TCPL: "TIME A/C"
Volume: "VOL SIMV'	Pressure Control: "PCTL A/C"
Pressure Control: "PC SIMV'	Volume: "VOL A/C"
TCPL: "TIME IMV"	* VAPS: "VAPS A/C"

Turn the Volume Mode Waveform switch and the monitor window will read:

For  the display will read: "SQUARE"

For  the display will read : "DECTAPER"

B) **Push-Button Test:** Activate the following push-buttons and verify that the name is displayed in the monitor window:

BUTTONS PRESSED	MONITOR DISPLAY MESSAGE
Manual Breath	BREATH
* Insp	INSPPAUS
*Insp/Exp	I/E HOLD
	FLOW D/C
Silence	SILENCE
Reset	RESET

**This control is for the VIP Gold only.*

C) **Control Test:** Rotate each control knob on the ventilator verifying that the numbers on each display increment from minimum to maximum settings. See chart below for control ranges.

Variable CONTROL	Adjustment RANGE
Assist Sensitivity	OFF, 1 to 20 cmH2O (without flow sensor)
	OFF, 0.2 to 3.0 LPM (Infant flow sensor)
	OFF, 1.0 to 5.0 LPM (Pediatric flow sensor)
Breath Rate	0 to 150 BPM
Flow	3 to 40 LPM in TCPL
	3 to 120 in Vol., PC or VAPS
High Breath Rate Alarm	OFF, 1 to 300 BPM
High Pressure Alarm	3 to 120 cmH2O
High Tidal Volume Alarm	OFF, 2 ml to 2 L
Inspiratory Pressure	3 to 80 cmH2O
Inspiratory Time	0.10 to 3.0 sec.
Low Minute Volume Alarm	OFF, 0.05 to 30.0 L (No OFF in VAPS or Pressure Control)
Low Peak Pressure Alarm	OFF, 3 to 120 cmH2O
PEEP/CPAP	0 to 24 cmH2O
Pressure Support	OFF, 1 to 50 cm H2O
Pressure Support Time Limit	0.10 to 3.0 sec.
*Rise Time	1 to 7
Termination Sensitivity	OFF, 5% to 25% Peak Flow
Tidal Volume	10 to 1200 ml

**This control is for the VIP Gold only.*

Once you have completed all three parts of the test check off the PMCS.

Audible Alarm Test

Press the Select button. The Monitor window will read "AUDIBLE". Verify that the audible alarm is sounding before proceeding. Using a small flat head screw driver adjust the alarm loudness through its range. Make sure to set the alarm to an appropriate level. Check off the PMCS.

Volume Monitor Solenoid Leak Test

1. Press the Select button, the monitor display will read "PRESS SELECT TO START VM SL CK". Connect an Infant flow transducer, P/N 15678, to the V.I.P. Gold/Sterling.
2. Press the Select button. When the V.I.P. Gold/Sterling passes the test, the monitor display will read SL PASS. Check off the PMCS. Disconnect the Infant flow transducer from the V.I.P. Gold/Sterling.

Inspiratory Pressure (PIP)

1. Turn the ON/OFF switch to the OFF position. Wait 5 seconds and the turn the VIP ON again. Connect the P/N 10383 with test lung, to the ventilator as shown in Figure 2.2
2. Set the ventilator as follows:

CONTROL	VALUE
Mode	(S)IMV/CPAP/PS TCPL (Time Cycle Pressure Limited)
Tidal Volume	—
Inspiratory Time	3.00
Rate	5
Flow	10
Inspiratory Pressure	30
PEEP/CPAP	0
Assist Sensitivity	OFF
Pressure Support	—
PS Time Limit	—
Low Peak Pressure	3
High Pressure	120
High Breath Rate	300
High Tidal Volume	2.0L
* Rise Time	—
Low Min Volume	OFF
Termination Sensitivity	OFF
Over Pressure Relief	Max.
02% Concentration	60

**This control is for the VIP Gold only.*

3. Let the ventilator deliver 5 breaths. Verify that the PIP monitor window value is 30 +/- 2.0 cmH20 Check off the PMCS.

Blender Verification

Set ventilator as follows:

CONTROL	VALUE
Mode	(S) IMV/CPAP/PS TCPL
Tidal Volume	—
Inspiratory Time	3.00
Rate	10
Flow	10
Inspiratory Pressure	20

PEEP/CPAP	0
Assist Sensitivity	OFF
Pressure Support	—
PS Time Limit	—
Low Peak Pressure	3
High Pressure	120
High Breath Rate	300
High Tidal Volume	2.0L
Low Min Volume	—
* Rise Time	OFF
Termination Sensitivity	OFF
Over Pressure Relief	Max.
0_2% Concentration	60

**This control is for the VIP Gold only.*

2. Remove the test lung from the P/N10383 test circuit. Connect the patient circuit (the wye) to oxygen sampling hose. Put other end of sampling hose into a sampling container. Connect your Oxygen analyzer to the sampling container (See test figure 2.3). Your Oxygen analyzer should be calibrated to manufacture specification.
3. Set the 0_2% concentration knob to 30%. Wait for analyzer to stabilize. The analyzer should read 27.0% - 33.0%. Check off the Preventive Maintenance Check sheet (PMCS).
4. Set the 0_2% concentration knob to 60%. Wait for analyzer to stabilize. The analyzer should read 57.0% - 63.0%. Check off the PMCS.
5. Set the 0_2% concentration knob to 90%. Wait for analyzer to stabilizer. The analyzer should read 87.0% - 93.0%. Check off the PMCS.

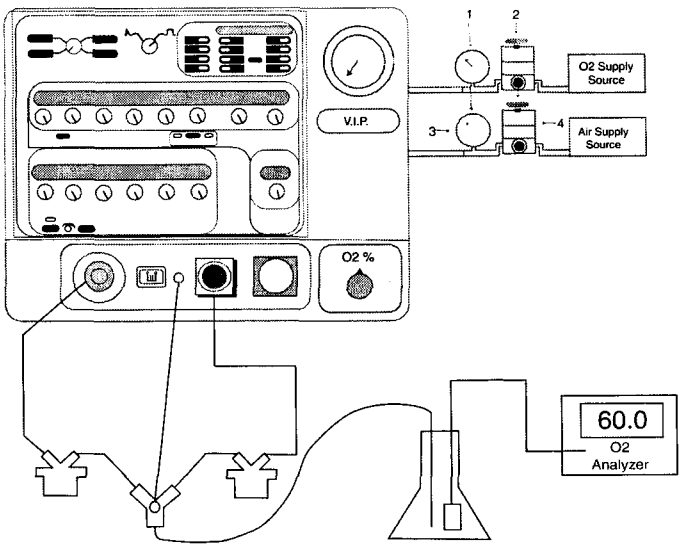


Figure 2.3

6. Turn the O_2% concentration knob to 60%. Set the Flow to 15, on the ventilator.
7. Reduce the air inlet pressure slowly. The blender should alarm at 30 +/- 2.0 PSIG. Slowly restore the pressure. Prior to reaching 50 PSI the alarm should stop. Check off the PMCS.
8. Reduce the oxygen inlet pressure slowly. The blender should alarm at 30 +/- 2.0 PSIG. Slowly restore the pressure. Prior to reaching 50 PSI the alarm should stop. Check off the PMCS.

Monitor Display Verification

1. Connect the Pediatric sensor P/N 15685 and test lung P/N 33754. Set the ventilator to the following settings:

NOTE

Turn the Bias Flow OFF before advancing to step 2.

CONTROL	VALUE
Mode	Assist/Control Volume Cycle
Tidal Volume	400
Inspiratory Time	—
Rate	10
Flow	40
Inspiratory Pressure	—
PEEP/CPAP	5
Assist Sensitivity	OFF
Pressure Support	—
PS Time Limit	—
Low Peak Pressure	OFF
High Pressure	120
High Breath Rate	300
High Tidal Volume	2.0 L
Low Min Volume	0.05
* Rise Time	—
Termination Sensitivity	—
Over Pressure Relief	Max.
02% Concentration	60

**This controls is for the VIP Gold only.*

2 Allow the ventilator to deliver about five breaths before checking the values. Press the Select button until Peak Inspiratory Pressure (PIP) LED is lit, the monitor window will read 25.0 cmH20 ± 10. Check off the PMCS.

3 Press Select. The Mean Airway Pressure (MAP) LED is lit and monitor window will read 9.0 cmH20 ± 2.0. Check off the PMCS.

4. Press Select. The PEEP LED is lit, monitor window will read 5.0 ± 2.0 cmH20, Check of the PMCS.

5. Press Select. The Rate LED is lit, monitor window will read 10 ± 2.0 BPM. Check off the PMCS.

6. Press Select. The Inspiratory Time (Ti) LED is lit, monitor window will read 0.6 +/- 0.08 seconds. Check off the PMCS.

7. Press Select. The I:E Ratio LED is lit, monitor window will read 1:6.5 to 1:9.0. Check off the PMCS.

8. Press Select. The Tidal Volume (VT) LED is lit and the monitor window will read 380 +/- 60 mL. Check off the PMCS.

9. Press Select. The Minute Volume (VE) LED is lit and the monitor window will read 3.8 +/- 0.6L. Check off the PMCS.

PEEP/CPAP/Sensitivity/Pressure Support

1. Change the following settings:

CONTROL	VALUE
Mode	(S)IMV/CPAP/PS Volume Cycle
Tidal Volume	Minimum
Rate	0 Bpm
Flow	Minimum
PEEP/CPAP	5 cmH20
Sensitivity	2 LPM

2. Squeeze the test lung to create a patient demand. The ventilator should deliver a breath once you have exceeded the Sensitivity setting. Watch the system manometer. It will read - 2.0 +/- 1.0 cmH20 and the patient demand indicator will light.

3. Set PEEP/CPAP =10, and the Pressure Support = 20. Squeeze the test lung until the ventilator delivers a breath. Watch the system manometer, it will read PEEP/ CPAP + Pressure Support = 30.0 +/- 2.0 cmH20.

4. Check off the PMCS.

Manual Over Pressure Relief Valve Verification

1 Change the following settings:

Tidal Volume	400
Rate	12
Flow	30

2. Remove the test lung and block the patient wye. While observing the excursion of the manometer, adjust the Over Pressure Relief Valve counterclockwise until 40.0 cmH20 is reached.

3. Then adjust the Over Pressure Relief Valve counterclockwise until 30.0 cmH20 is reached. Check off the PMCS. Readjust the Over Pressure Relief Valve full clockwise before continuing on to the next step.

APNEA Silence/Reset

1. Activate the Apnea switch on the rear of the unit. Set the volume monitor Apnea to 10 seconds.
2. Set the Rate to zero. Activate the Manual Breath button. With a stopwatch, measure the time interval
3. Between the Manual Breath activation and the audible and visual (indicator light) activation. The time must be 10 ±2 seconds.
4. Activate the Alarm Silence button. The elapsed time between the button activation and the alarm reinstatement must be 60 +/- 5 seconds.
5. Activate the Manual Breath button 3 times. The audible alarm must cancel. Activate the Reset button and the visual alarm must cancel. Set the Rate to 10. Check off the PMCS.

Low Peak Pressure Alarm

1. Note the value of the peak pressure on the system manometer during the inspiratory cycle of the ventilator.
2. Between machine breaths, increase Low Peak Pressure Limit above the noted peak pressure.
3. Verify audible and visual flashing display alarms activate. Set Low Peak Pressure Alarm to OFF. Press the Reset button. The audible and visual alarm should cancel. Check off the PMCS.

High Pressure Verification

1. Set the High Peak Pressure Alarm to 60.0 cmH20 and occlude (block) the exhalation valve outlet.
2. Press the Manual Breath button and verify that the High Pressure Limit audible and visual (flashing display) alarms occur at 60.0 +/-6.0 cmH20.
3. Measure the time from the initiation of the alarm to the initiation of the safety valve dump. The opening of the safety valve is noted by a fast decay of pressure on the system pressure gauge, a "rushing air" sound, and an illuminated "Circ Fault" LED. The time should be 3.0 +/- 0.5 seconds.
4. Verify that the system pressure gauge pressure drops from 60.0 to within 3.0 cmH20 of PEEP within 5 seconds. Remove the blockage from the exhalation valve body outlet.
5. Press Reset and verify "Circ Fault" LED cancels and that High Pressure Limit display stops flashing. Check off the PMCS.

High Breath Rate Alarm

1 Set the High Breath Rate control below the set Rate. The audible and visual High Breath Rate alarm should activate.

2 Set the High Breath Rate control to 300. The audible alarm should reset. Activate the Reset button and the visual alarm will reset. Check off the PMCS.

High Tidal Volume

1. Set the High Tidal Volume control to 300mL. The High Tidal Volume audible and visual alarm should activate.
2. Set the High Tidal Volume control to 2.0 L. The audible alarm should cancel. Activate the Reset button and the visual should cancel. Check off the PMCS.

Low Minute Volume

1. Set the Low Minute Volume control to 25.0 L. The Low Minute Volume audible and visual alarm should activate.
2. Set the Low Minute Volume control to OFF. The audible alarm should cancel. Activate the Reset button and the visual alarm should cancel. Check off the PMCS.

Low Inlet Gas Alarm

1. Reduce inlet pressure to 30 PSIG, on the in-line gauge.
2. Set Pressure Support to 10.0 cmH20 or above, and Sensitivity to 1.0 cmH20. Remove inspiratory hose from the patient output port on the ventilator.
3. Audible and Visible alarm for Low Inlet Gas will activate.
4. Reconnect inspiratory hose to the ventilator. Audible alarm will cancel. Press Reset and the LED will no longer be lit. Check off the PMCS.

Loss of Gas Supply

1. Remove gas supply pressure. Verify audible and visual Low Inlet Gas alarms activate.
2. Restore gas supply pressure. Verify ventilator returns to normal operation. Check off thePMCS.

Circuit Fault Alarm Verification

1. Remove the proximal pressure line located on the front of the unit. An audible and visual alarm must activate. Indicator light for Circuit Fault will be lit.
2. Reconnect the Proximal Pressure line to the ventilator and press Reset button. The ventilator must return to normal operation. Check off on the PMCS.

Electrical Power Disruption

1. Remove electrical power from the ventilator.
2. Verify audible and visual (Vent Inop. indictor will light) Vent Inop. alarms; also verify safety valve opens, flow valve closes and exhalation valve opens.
3. Restore electrical power to the ventilator. Verify the ventilator returns to normal operation (after power-up, self-test sequence) and Vent Inop. alarms cancel. Check off the PMCS.

Ground Continuity

1. Measure the ground continuity between the power cord ground and socket head cap screws on the bottom of the unit.
2. Verify ground resistance is less than 0.1 ohms. Record the result on the PMCS.

Leakage Current

1. Check for maximum leakage current by comparing Normal and Reverse Polarity in both Normally Open, and Normally Closed ground conditions.
2. Verify leakage current for Normal Polarity and Closed Ground.(N/C) is less then 100 microamps. Record the result on the PMCS.
3. Verify leakage current for Normal Polarity and Open Ground (N/O) is less then 100 microamps. Record the result on the PMCS.
4. Verify leakage current for Reverse Polarity and Closed Ground (R/C) is less then 100 microamps. Record the result on the PMCS.
5. Verify leakage current for Reverse Polarity and Open Ground (R/O) is less then 100 microamps. Record the result on the PMCS.
6. Turn the ON/OFF switch to the OFF position. Disconnect the 02 and air hose from the DISS inlet fittings.
7. Locate dip switch DW504. Turn switch 6 & 7 to the ON position (See Test Figure 1). Verify the switch 5 is in the ON position. Re-install top cover.

How to use the PMCS

1. Enter the Date of the testing.
2. Record the number of usage hours the unit has at the time of testing.
3. Enter the Model Number and Serial Number.
4. Check off the model type, Sterling or Gold.
5. Check off the tests performed as Pass when they are within specification. If unit fails any of the tests, perform the Operational Verification Procedure or follow the Troubleshooting guide in the Service Manual and fill out the Operational Verification Check Sheet.
6. Do a general inspection of the unit. Check and clean all exterior parts.
7. Record the corrective action taken for failed tests. You may mark the space "See the Operational Verification Check Sheet for corrective action."
8. Read, sign and date the Preventive Maintenance Check Sheet when the testing is completed. **The unit must be signed off before it can be returned to service.**

V.I.P. VENTILATOR PREVENTIVE MAINTENANCE CHECK SHEET

Date:_____ **Hours :**_____ **M/N:**_____ **S/N:**_____

☐ **VIP Sterling** ☐ **VIP Gold**

Air Filter Verification ☐ **O_2 Filter Verification** ☐
Air Duckbill Check Valve ☐ **O_2 Duckbill Check Valve** ☐

VERIFICATION CHECK	PASS	VERIFICATION CHECK	PASS
Power-up, homing of valves		**Monitor Display Verification:**	
Transducer Verification:		P.I.P. 25 ± 10.0 cmH20	
Prox Transducer		M.A.P. 9.0 ± 2.0 cmH20	
Exhalation Transducer		PEEP 5.0 ± 2.0 cmH20	
Machine Transducer		Rate 10.0 ± 1.0 BPM	
Volume Monitor Flow Transducer		Ti 0.6 to 0.8 seconds	
Software Revision Check		I:E Ratio 1:8.6 to 1:9.5	
Software CPU A Record:		VT 380 ± 60ml-	
Software CPU B Record:		VE 3.8 ± 0.61	
Software CPU C Record:		**PEEP/CPAP/Sensitivity/Press Sprt**	
Software PAL Record:		**Manual Over Pressure Relief Valve**	
Software Vol. Monitor CPU Record:		**Apnea/Silence /Reset**	
Software Vol. Monitor PAL Record:		**Low Peak Pressure Alarm**	
Ambient Pressure Test		**High Pressure Alarm Verification**	
Pressurized Circuit Test		**High Breath Rate Alarm**	
Circuit Leak Test		**High Tidal Volume Alarm**	
Language Select Setting		**Low Minute Volume Alarm**	
Lamp Test		**Low Inlet Gas Alarm**	
Control Test		**Loss of Gas Supply Alarm**	
Audible Alarm Test		**Circuit Fault Alarm**	
Vol. Monitor Solenoid Leak Test		**Electrical Power Disruption**	
Inspiratory Pressure (PIP)		**Ground Continuity**	
Blender Verification		**Leakage Current Checks**	
30% 02 Concentration		Leakage Current N/C	
60% 02 Concentration		Leakage Current N/O	
90% 02 Concentration		Leakage Current R/C	
Blender alarm for Low Air Pressure		Leakage Current R/O	
Blender Alarm for Low 02 Pressure			

General Inspection: Clean top cover, front panel, back panel, etc. Check for proper labels. Check the input voltage configuration to make sure it is set correctly for the unit model and type indicated.

Corrective Action Taken (If Needed)

I here by certify that the product with the above Serial Number has passed all operational specifications testing and is certified for clinical use. ***(The unit must be signed off before returning to clinical use).***

Signature:_____ Date:_____

Chapter 3 Disassembly

This section of the V.I.P. Bird Gold and Sterling Ventilator Series Service Manual describes the procedures for disassembling the ventilator.

The following **CAUTIONS** should be read and understood before accessing the interior of the ventilator:

> **CAUTION**
>
> The following measure to prevent ESD damage to electronic components must be taken:
>
> Wear a properly grounded and tested anti-static wrist strap when handling PCB's.
>
> Work on an anti-static surface.
>
> Always use anti-static material for packaging PCB's.

Ventilator Power Cord and Bracket Removal

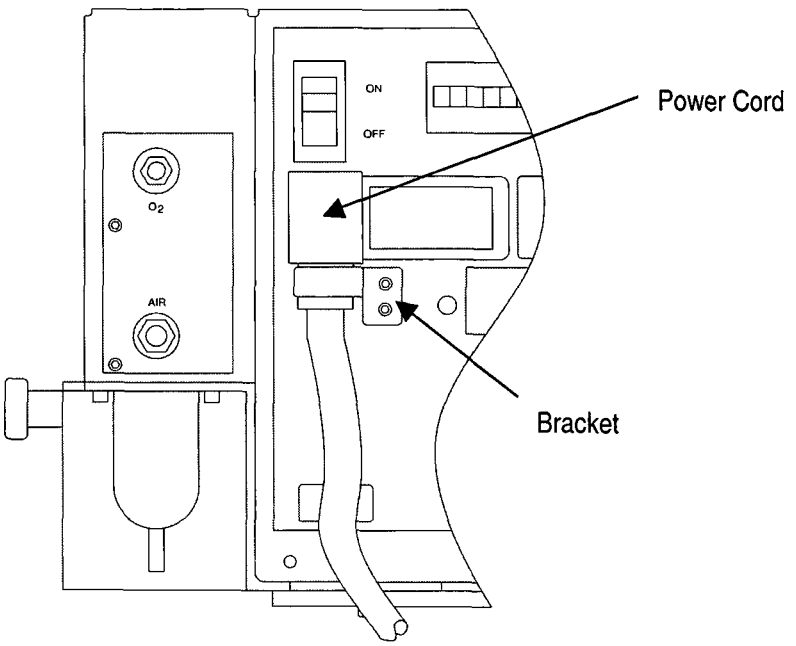


Figure 3.1 Ventilator Power Cord and Bracket Removal

1. Using a 9/64" Allen driver, remove the two (2) screws securing the power cord clamp. The clamp is located left side of the rear panel below the power entry module.
2. Remove power cord from the power entry module.

Rear Cover (P/N 20122)

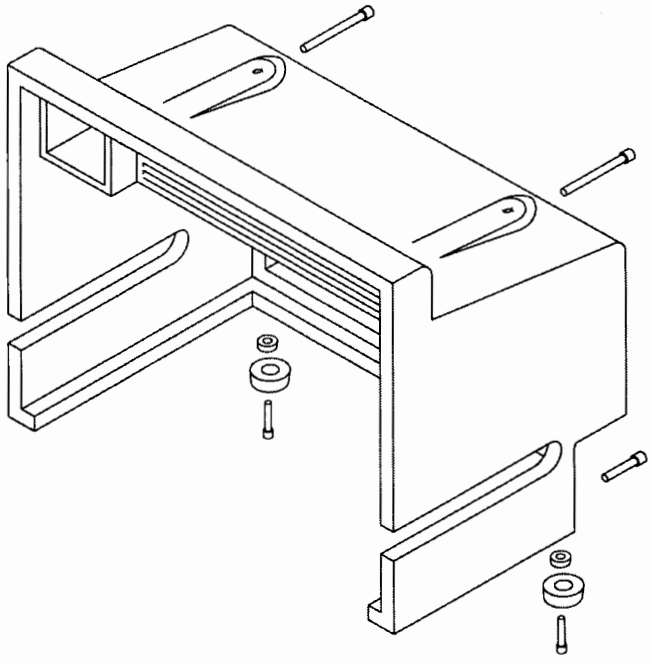


Figure 3.2 Rear Cover Assembly

1. Carefully lay ventilator on its front panel, exposing the sealing plate.
2. Using a 9/64" Allen driver, remove the four (4) screws securing the top cover. Two (2) screws are the longer screws and secure the upper part of the top cover. Two (2) screws are the shorter screws and secure the lower part of the top cover.
3. Carefully slide top cover up and away from the ventilator.

Front Panel (P/N 15657)

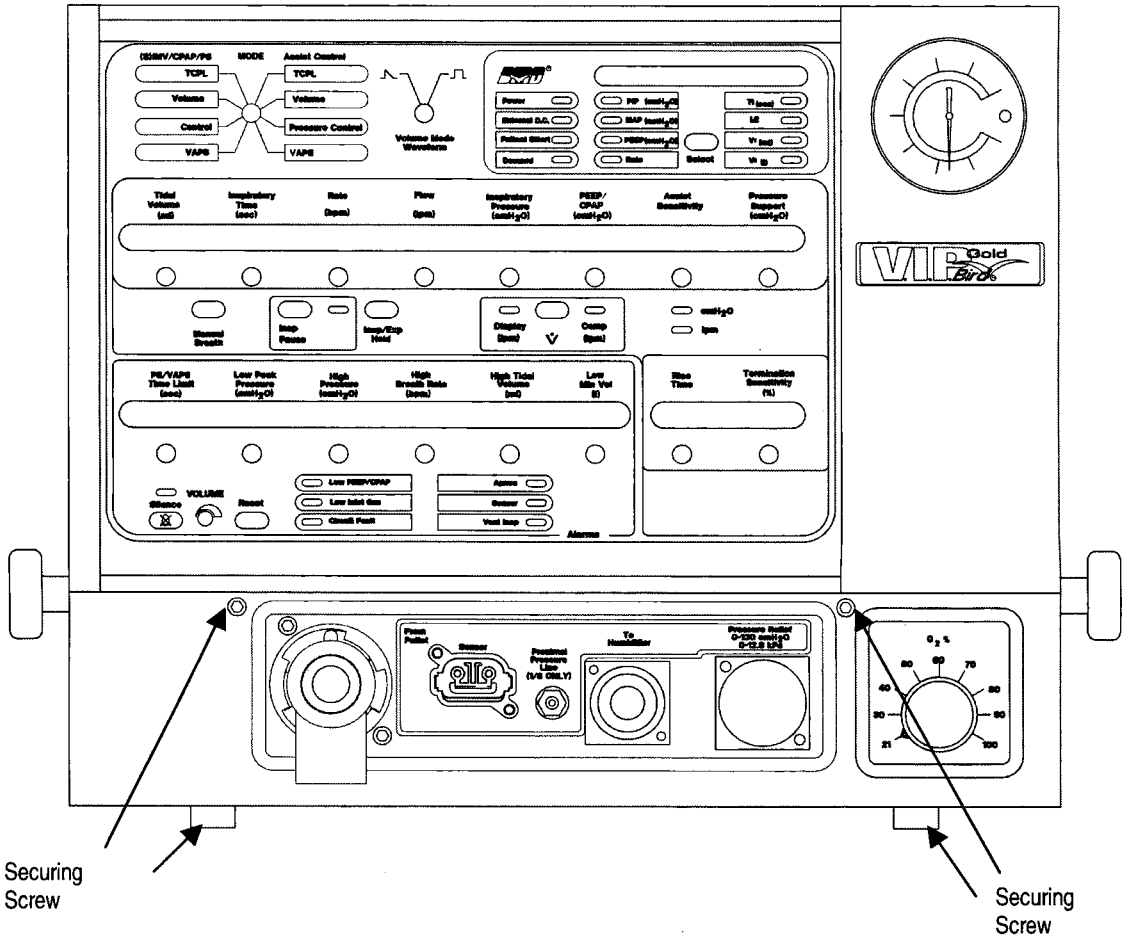


Figure 3.3 Front Panel

1. Carefully re-position the unit onto its base. Turn the unit so the front panel is facing forward. Refer to Schematic 90761 for the next 6 steps.
2. Unplug data cable from J2 on the Main PCB.
2. Unplug power cable from J3 on the Main PCB.
3. Unplug power cable from J1 on the Volume Monitor PCB.
4. Unplug the Zero/Purge cable from J2 on the Volume Monitor PCB.
5. Unplug apnea switch cable from J3 on the Volume Monitor PCB.
6. Unplug receptacle cable from J4 on the Volume Monitor PCB.
7. Refer to Schematic 90765 for the next 5 steps. Remove tube #3 from the manometer barb connector by pulling firmly on the tube.

Note:

To avoid damaging the transducers on the Main PCB, extreme care should be taken when removing tube assemblies. The proper method is to pull firmly straight back to avoid applying side load to the transducers

8. Remove tube #24 from the transducer labeled GAS PT401.
9. Remove tube #35 from the transducer labeled MACH PT302.
10. Locate tube #14, it is attached to Volume Monitor PCB transducer P2. **DO NOT detach the tubing from the transducer.** This is a calibrated tube and must be reused. Follow the tube from the transducer to the tee fitting. Detach the tube at the tee fitting.
11. Locate tube #17, it is attached to Volume Monitor PCB transducer P1. **DO NOT detach the tubing from the transducer.** This is a calibrated tube and must be reused. Follow the tube from the transducer to the tee fitting. Detach the tube at the tee fitting.

Note:

Tubes #14 and #17 are calibrated tubes. ***DO NOT DISCARD.*** *Leave the tubes attached to the Volume Monitor transducers for later re-assembly.*

12. Using a 9/64" Allen driver, remove the two screws securing the front panel.
13. Carefully place the V.I.P. Bird Gold/Sterling Ventilator on its left side. Using a 7/64" Allen driver, remove the two (2) bumper feet screws securing the bottom of the front panel
14. Carefully place the ventilator back on its base.
15. Pull the front panel slightly forward so your hand can reach the fiber optic cables. Disconnect the two (2) fiber optic link cables from the main PCB at U701 and U702.
16. Carefully pull the front panel away from the ventilator. Make sure to detach tubing #10 (exhalation transducer) and #11 (proximal transducer) from the Auto Zero Manifold as the front panel is pulled away from the unit.

Auxiliary Outlet (P/N 20221)

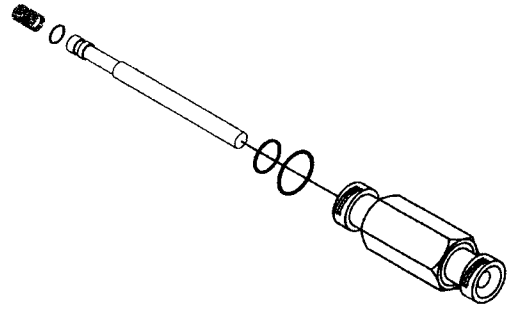


Figure 3.4. Auxiliary Outlet

1. Using an 11/16" open-end wrench, carefully remove auxiliary outlet.
2. Using a pair of thin needle nose pliers, carefully remove the poppet spring from inside the blender body.
3. Remove and discard the two o-rings from the auxiliary outlet assembly.
4. Remove and discard the o-ring from the poppet.

Volume Monitor PCB (P/N 50860) and Fan/Bracket (P/N 15661)

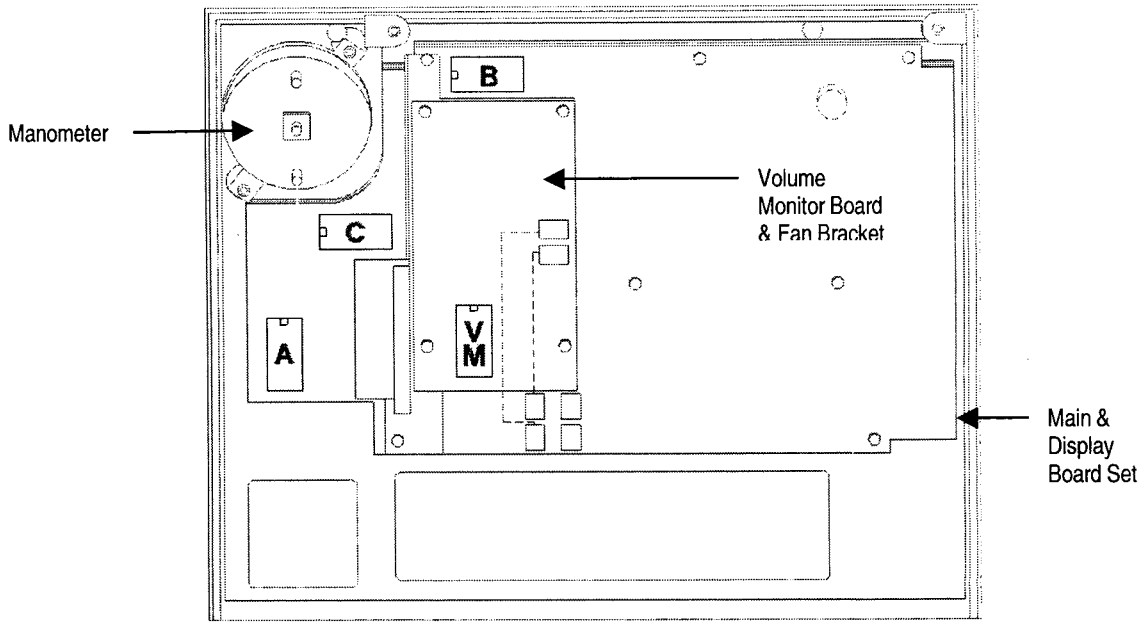


Figure 3.5 Volume Monitor PCB and Fan/Bracket

1. Place Front Panel Assembly (P/N 15657) on bench with the Main PCB (Gold P/N 50880 or Sterling P/N 50920) facing toward you.
2. Disconnect the fiber optic link cables (P/N 15647 QTY2) from U9 and U12 on the Volume Monitor PCB (P/N 50860).
3. Using a 7/64" Allen driver, remove the four (4) securing screws (P/N 40155) for the Volume Monitor PCB (P/N 50860).
4. Carefully remove the Volume Monitor PCB and place in an anti-static bag for later reassembly.
5. Using a 7/64" Allen driver remove the three screws (P/N 03220) securing the Fan/Bracket Assembly (P/N 15661).

Main (Gold P/N 50880 & Sterling P/N 50920) and Display (P/N 50870) PCBs

Note:

These only need to be removed if one of them is being replaced.

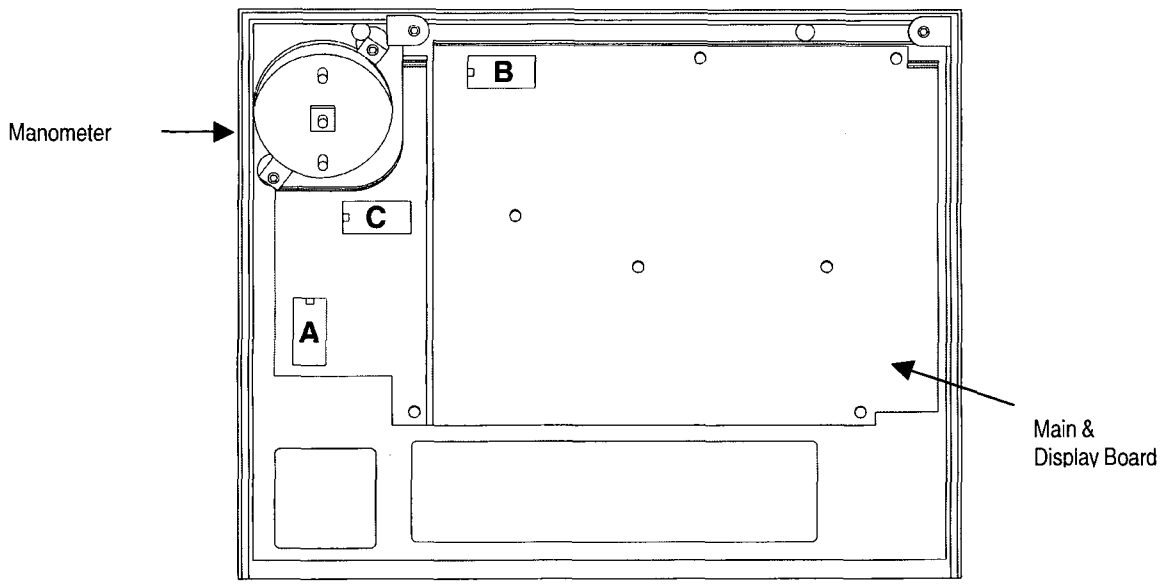


Figure 3.6 Main and Display PCBs

1. Turn the front panel assembly so the overlay is facing up. Remove the eighteen (18) control knobs (17 for V.I.P. Sterling)
2. Using a 5/16" nut driver, remove the sixteen (16) jamnuts (P/N 03281) and eighteen (18) lock nuts (17 for V.I.P. Sterling) from the control potentiometers.
3. Carefully turn the front panel so the circuit board is facing up. Using a 7/64" Allen driver, remove the five (5) securing screws for the Main and Display PCBs.
4. Place one hand on the Main PCB Assembly and turn the front panel upside down. Carefully remove the Main & Display PC boards from the front panel assembly. Place the PC boards in an anti-static bag.
5. Remove the ribbon cable that connects the Main and the Display PC boards **only if you are replacing one of them**.

Manometer (P/N 09799)

Note:

These only need to be removed if one of them is being replaced.

1. Turn the front panel so inside of panel is facing up. (Refer to Figure 4-6)
2. Using a 7/64" Allen driver, remove two (2) securing screws along with two (2) securing brackets.

Power Supply PCB (P/N 50160)

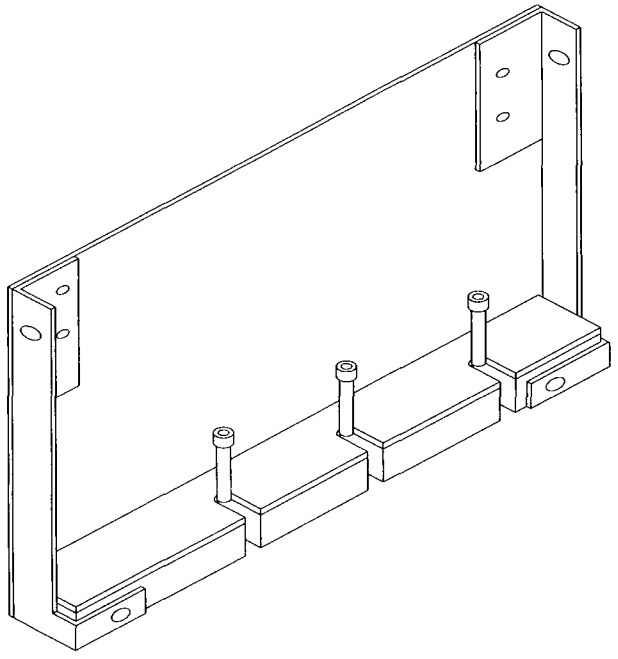


Figure 3.7 Power Supply PCB

1. Disconnect power Molex connector at J3 on Power Supply PCB.
2. Disconnect flow control valve connector at J201 on the Power Supply PCB.
3. Disconnect exhalation valve connector at J202 on the Power Supply PCB.
4. Disconnect data ribbon cable at J2 on the Power Supply PCB.
5. Disconnect power Molex connector at J401 on the Power Supply PCB.
6. Disconnect safety solenoid 2 pin connector at J303 on the Power Supply PCB.
7. Disconnect jet pump 2 pin (red) and auto zero manifold 3 pin (blue) connector at J301 on Power Supply PCB.
8. Disconnect I/E hold solenoid connector at J305 on Power Supply PCB.

9. Disconnect transformer 3 pin Molex connector at J9 on Power Supply PCB.
10. Disconnect 8 pin Molex connector at J8 on the Power Supply PCB.
11. Using 9/64" Allen driver, loosen the three (3) securing screws on the base of the Power Supply PCB. **DO NOT REMOVE SCREWS AT THIS TIME.**
12. Using 7/64" Allen driver, remove securing screw washer from rear panel assembly securing rear panel to Power Supply PCB bracket.
13. Remove Power Supply PCB assembly and place in anti-static bag.
14. Remove the three (3) securing screws from the casting where the Power Supply PCB is mounted.

Note:

Reference schematic 90765 Appendix A for wire locations

Power Transformer (P/N 15114)

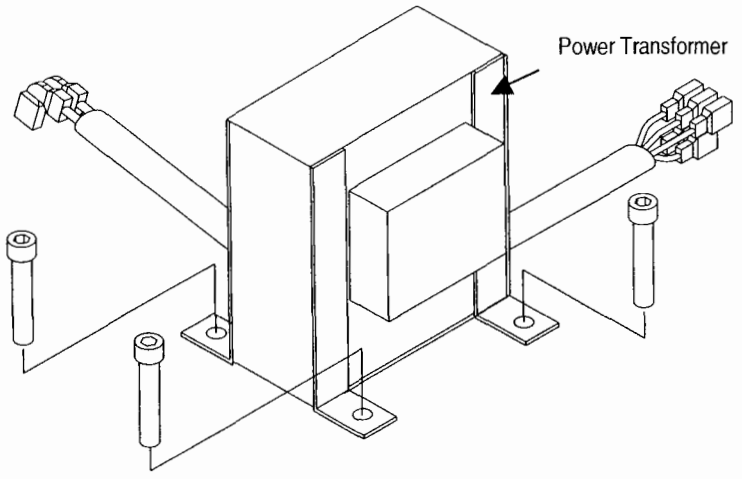


Figure 3.8 Power Transformer

1. Remove the primary wire terminals from the Power Entry Module located at the right side, inside the rear panel assembly.
2. Using a 7/64" Allen driver, remove two (2) securing screws from the left side, outside the rear panel next to the air and oxygen inlet fittings.
3. Using a 7/16" open-end wrench or 7/16" deep socket driver, remove nut securing the green ground wire terminal from ground lug located below Power Entry Module at inside of rear panel.
4. Using a 9/64" Allen driver, remove the four (4) securing screws from the mounting pad on the main accumulator and remove the Power Transformer.

Rear Panel (P/N 15004)

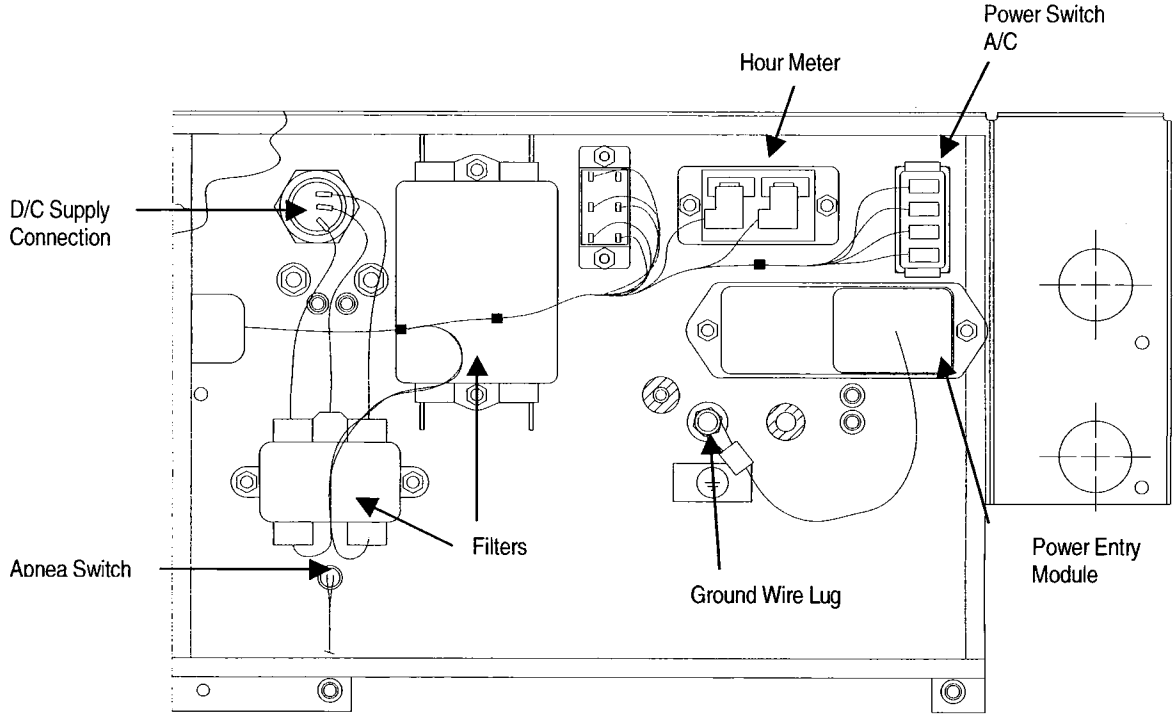


Figure 3.9 Rear Panel Assembly

1. Using a 5/8" open-ended wrench, loosen and remove the oxygen hose from the inlet block assembly inside the rear panel assembly.
2. Using a ¼" nut driver, loosen the hose clamp from the air outlet of the inlet block assembly inside the rear panel.
3. Remove the air hose from the connector on the inlet block assembly by pulling firmly back on the hose.
4. Remove the rear panel assembly from the casting and set aside for later re-assembly.

Note:

Pliers may be used to facilitate the removal of the air hose from the barb on the inlet block assembly.

Flow Control Valve (15768A)

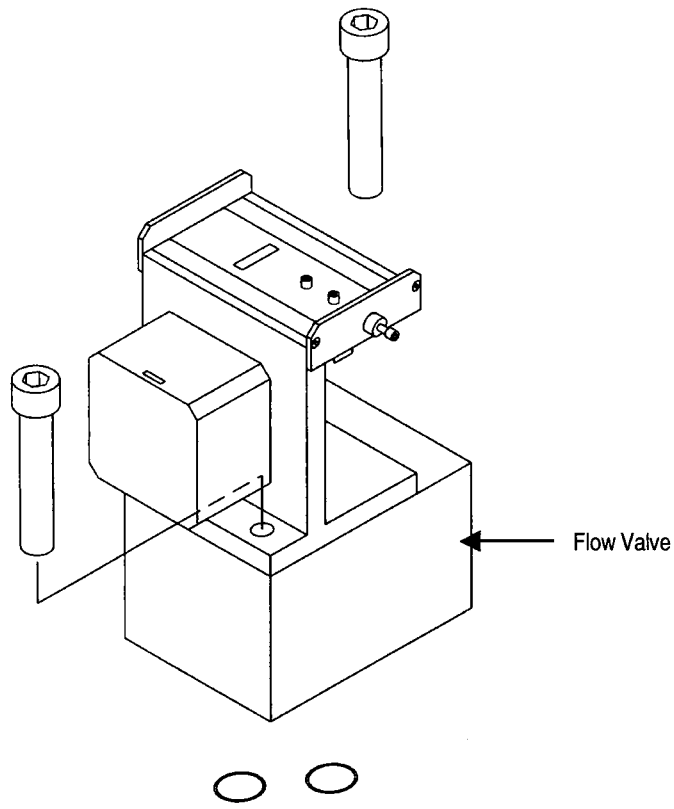


Figure 3.10 Flow Control Valve

1. Remove, if necessary, the plastic harness wraps securing the flow and exhalation valve wires harness assemblies.
2. Using a 9/64" Allen driver, remove the two (2) securing screws holding the flow control valve to the mounting pad on the casting.
3. Remove and discard the flow control valve, retain the screws for installation of the new flow control valve.

Exhalation Valve (P/N 15739) and Auto Zero Manifold (P/N 10278)

Note

Refer to schematic 90765 for tubing callouts

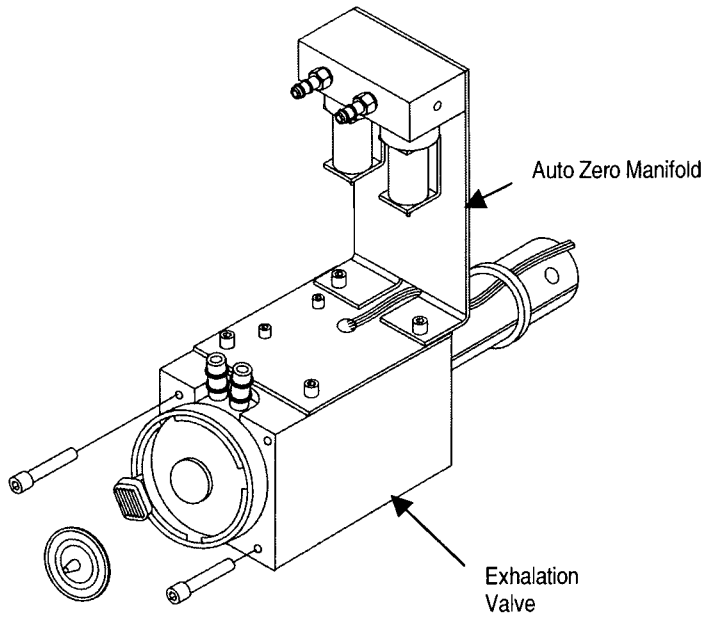


Figure 3.11 Exhalation Valve/Auto Zero Manifold

1. Remove the two tubes, #31 and #36, connected to the Exhalation Valve by pulling firmly in a straight upward motion.
2. Remove the two tubes, #5 and #12, connected to the auto zero manifold lower port.
3. Install the two (2) tubes #10 and #11 connected to the auto zero manifold upper port. Set aside for assembly later.
4. Using a 7/64" Allen driver, remove the two (2) securing screws securing the exhalation valve to the casting.
5. Remove the Exhalation Valve assembly from the casting. Place the Exhalation Valve on the bench.
6. Using a 3/32" Allen driver, remove the two (2) screws that secure the Auto Zero Manifold aside for later assembly. Discard the exhalation valve.

Safety Solenoid/Zero Purge (P/N 15652)

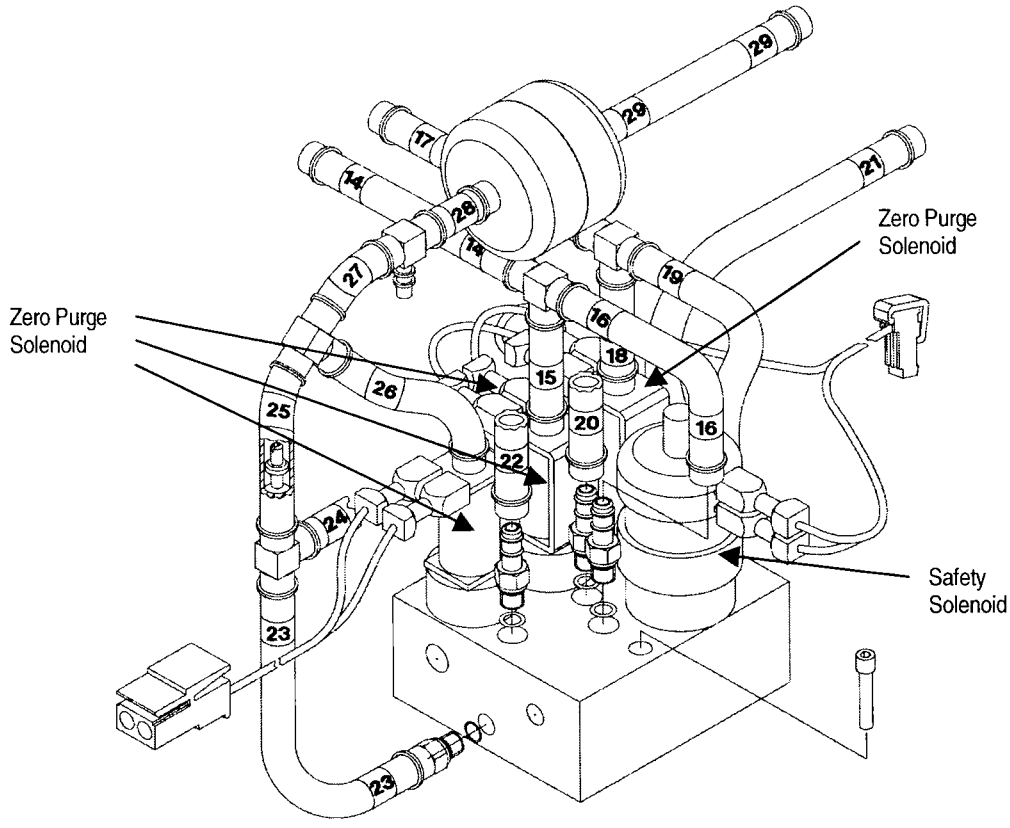


Figure 3.12 Safety Solenoid/Zero Purge Assembly

1. Remove the eight (8) tube assemblies, #15, #16, #18, #19, #20, #21, #22, #23 and #26 from the safety solenoid block by pulling firmly in a straight upward motion.
2. Using a 9/64" Allen driver, remove the two (2) securing screws and remove the Safety Solenoid/Zero Purge assembly from the mounting pad on the casting.
3. Remove and discard all o-rings from the counter bore holes on the base of Safety Solenoid/Zero Purge assembly manifold block assemblies.

Jet Pump/I/E Hold Block (P/N 15651)

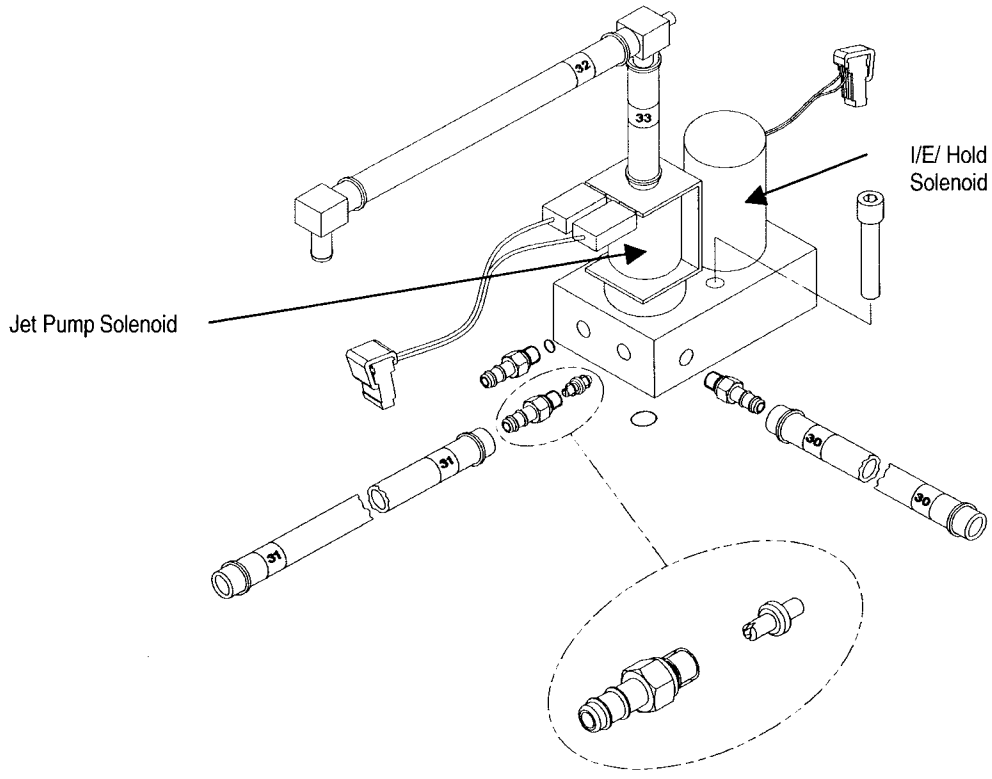


Figure 3.13 Jet Pump/I/E Hold Block

1. Remove tubes #8, #30, #31, and #33 from the Jet Pump/I/E Hold assembly by pulling firmly.
2. Using a 9/64: Allen driver, remove the two (2) securing screws and remove the Jet Pump/I/E Hold assembly from the mounting pad on the casting.
3. Remove and discard o-ring from the counter bore hole on the base of Jet Pump/I/E Hold assembly.

Tubing (P/N 15683)

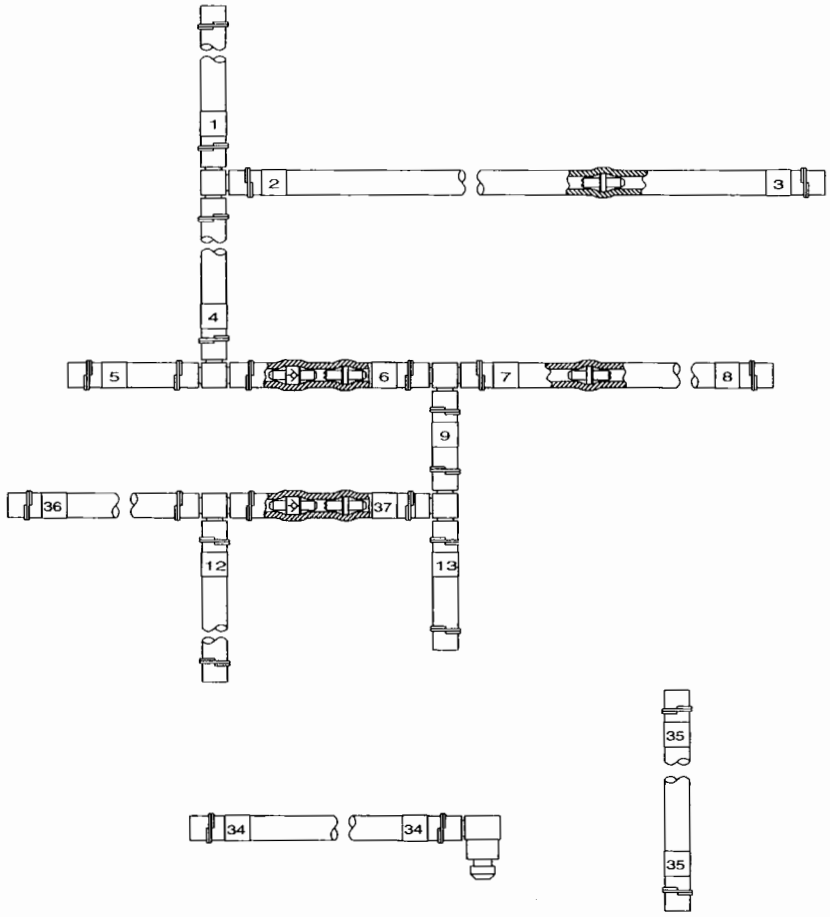


Figure 3-14 Tubing

1. Disconnect tube #29 from the barbed fitting behind the pressure regulator. Discard the tubing assembly.
2. Disconnect tube #34 from the pressure regulator. Disconnect the other end from the silicone elbow attached to the Safety Valve. Discard the tubing assembly.
3. Disconnect tube #32 from the Safety Valve assembly. Discard the tubing assembly.
4. Disconnect tube #20 and #21 from the Sensor Receptacle PCB. Discard the tubing assembly.

Purge Valve (P/N 10180) and Barbed Fittings

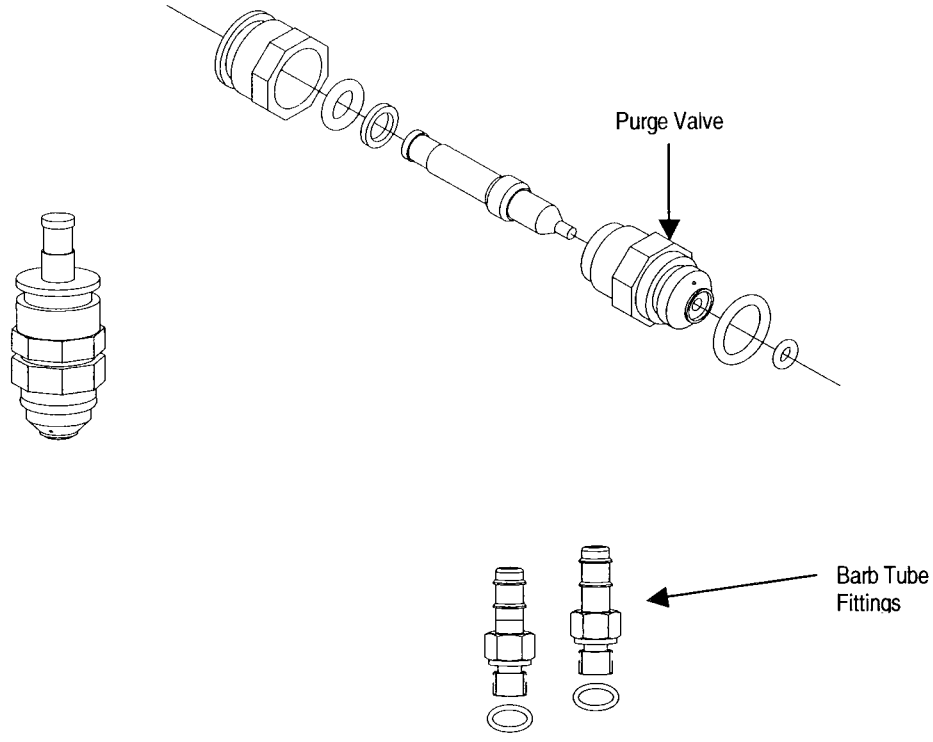


Figure 3-15 Purge Valve & Barb Fittings

1. Using a 1/2" open end wrench or a deep socket, remove Purge Valve assembly from the casting.
2. Using a 1/2" open end wrench and a 1/2" deep socket, disassemble the Purge Valve assembly.

   Discard the o-rings and nylon washer.
4. Using 1/4" deep socket driver, remove the barb tube fitting at the inlet port on the Pressure Relief Valve.
5. Using 1/4" deep socket driver, remove the barb tube fitting at the inlet port next to the Purge Valve.
6. Using 1/4" deep socket driver, remove the barb tube fitting behind the Pressure Regulator and alongside the main accumulator.
7. Remove and discard o-ring from each barb fitting.

Safety Valve (P/N 09754)

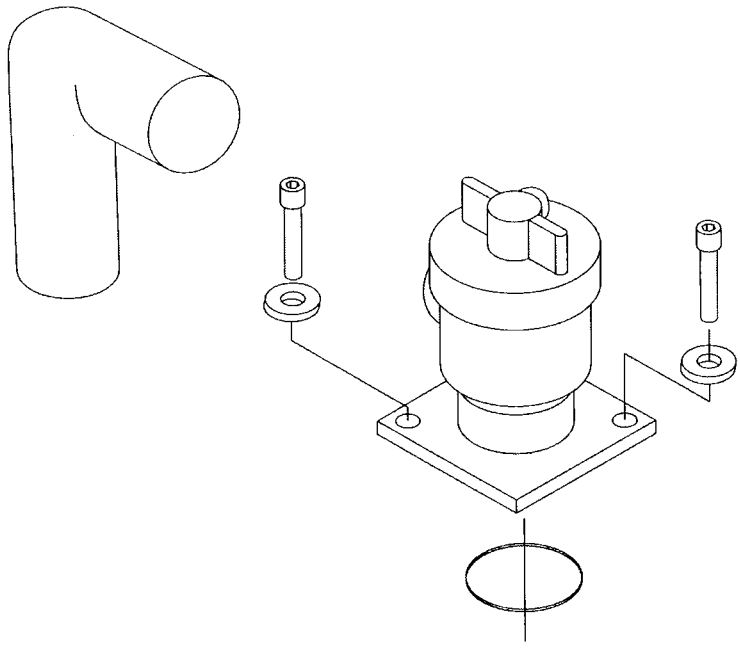


Figure 3-16 Safety Valve

1. Remove regulator purge line at regulator by pulling firmly on tube. Remove opposite end of Purge Tube from silicone elbow by pulling on elbow connector.
2. With fingers, pinch silicone tube and remove from casting base, and from the Safety Valve assembly.
3. Using a 7/64" Allen driver, remove the two (2) securing screws and two (2) washers holding the Safety Valve to mounting pad on the casting.
4. Remove and discard Safety Valve assembly.

Patient Outlet (P/N 10089)

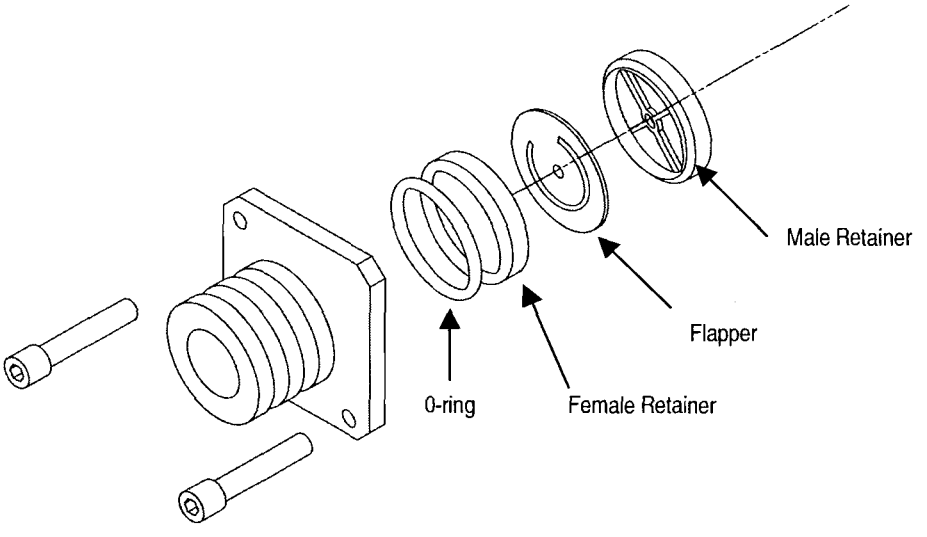


Figure 3-17 Patient Outlet

1. Using a 3/32" Allen driver, remove the two (2) securing screws and remove the outlet manifold from casting.
2. Remove and discard the o-ring from sealing groove on the outlet manifold.
3. Remove and discard female retainer, flapper, and male retainer.

Over Pressure Relief Valve (P/N 10092)

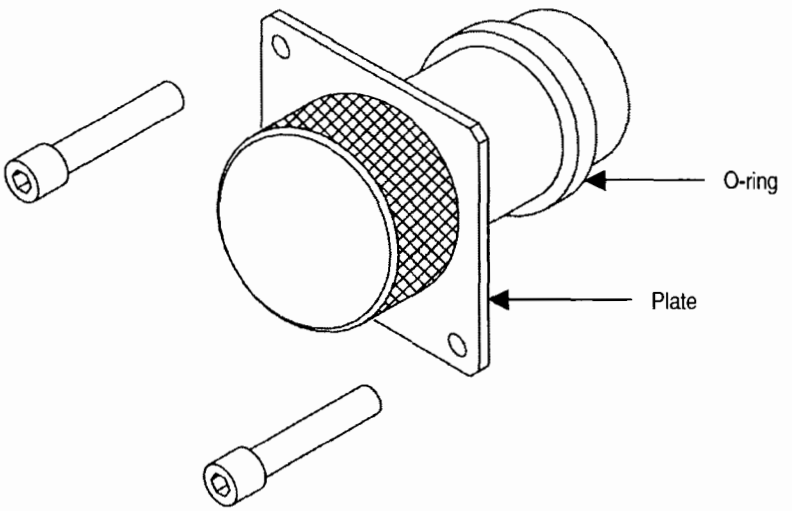


Figure 3-18 Over Pressure Relief Valve

1. Using a 7/64" Allen driver, remove the two (2) securing screws from the front of the Pressure Relief Valve.
2. Pull and twist firmly to remove the Over Pressure Relief Valve from the casting base.
3. Remove and discard the o-ring from the Over Pressure Relief Valve body.

Blender (P/N 10160)

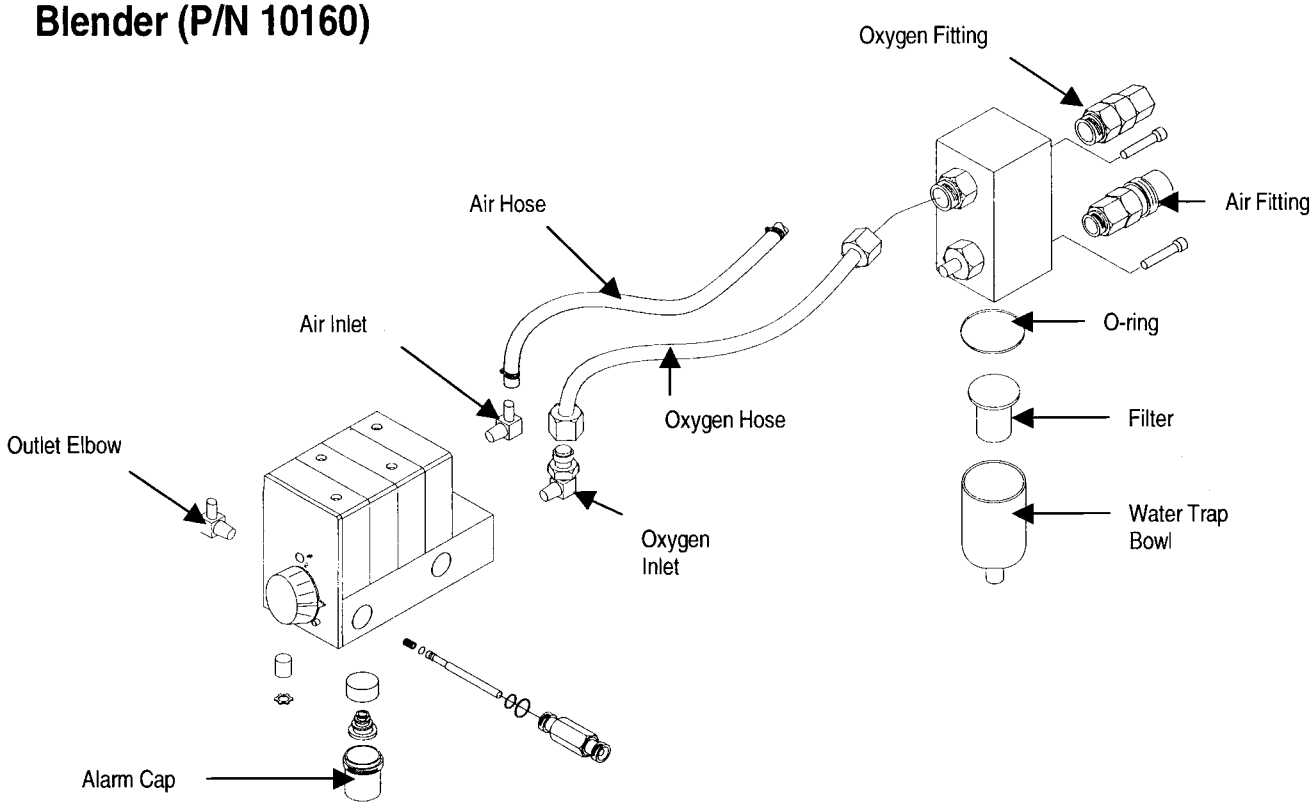


Figure 3-19 Blender

1. Position casting on its back to expose the base sealing plate.
2. Using a 1/8" Allen driver, remove two screws from the casting base securing the blender.
3. Turn the unit back onto its base. Lift the blender up from the casting.
4. Using a 1/4" deep socket, loosen the hose clamp at the elbow fitting on the blender**output.**
5. Pull firmly on the tube and remove from the elbow fitting. Discard the tubing assembly.
6. Using a 1/4" deep socket, loosen the hose clamp at the elbow fitting on the blender**input.**
7. Pull firmly on the tube and remove from the elbow fitting. Discard the tubing assembly.
8. Using a 9/16" open-ended wrench, loosen and remove the oxygen input hose from the oxygen inlet port on the blender.
9. Remove blender from casting and set aside for later reassembly.
10. See Section 7, Blender Service Manual for disassembly, reassembly and calibration of the blender.

Pressure Regulator (P/N 335661)

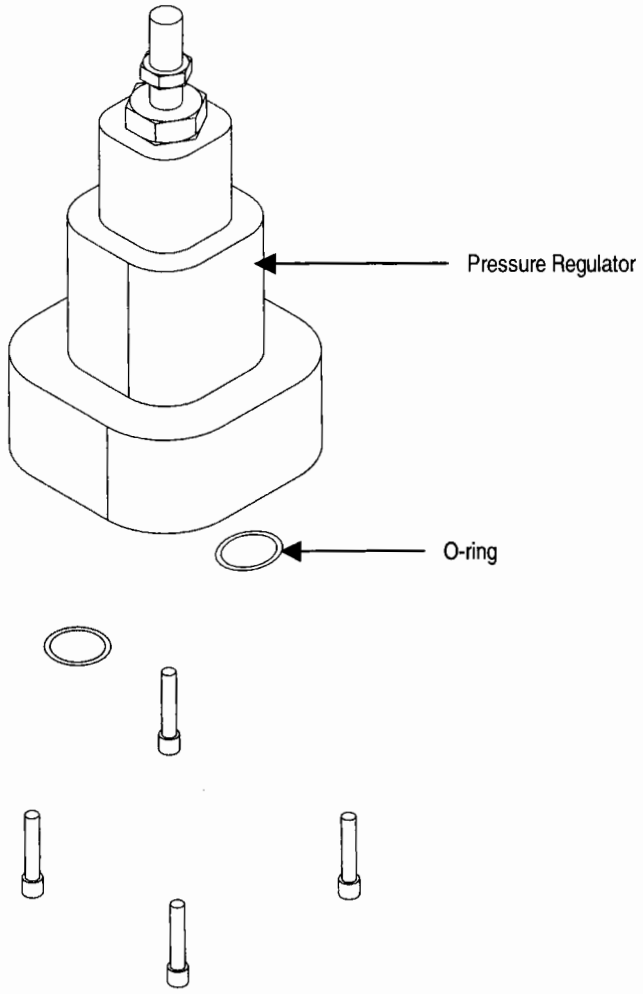


Figure 3-20 Pressure Regulator

1. Using a 9/67" Allen driver, remove four (4) screws securing the regulator to the castingbase

Note

Support the regulator with your hand to avoid putting stress on the screw or the threads.

2. Remove and discard the pressure regulator.

Sensor Receptacle (P/N 15684)

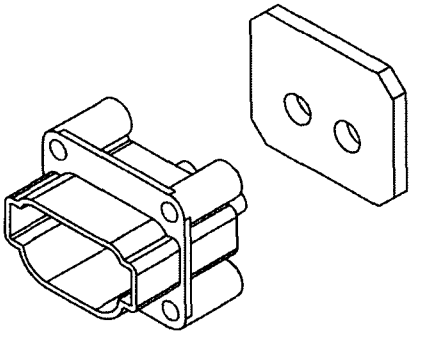


Figure 3-21 Sensor Receptacle

1. Using a 3/32 Allen driver, remove two screws securing the Sensor Receptacle to the V.I.P. Gold/Sterling Ventilator casting.
2. Discard the Sensor receptacle.

Inlet Block (P/N 33519)

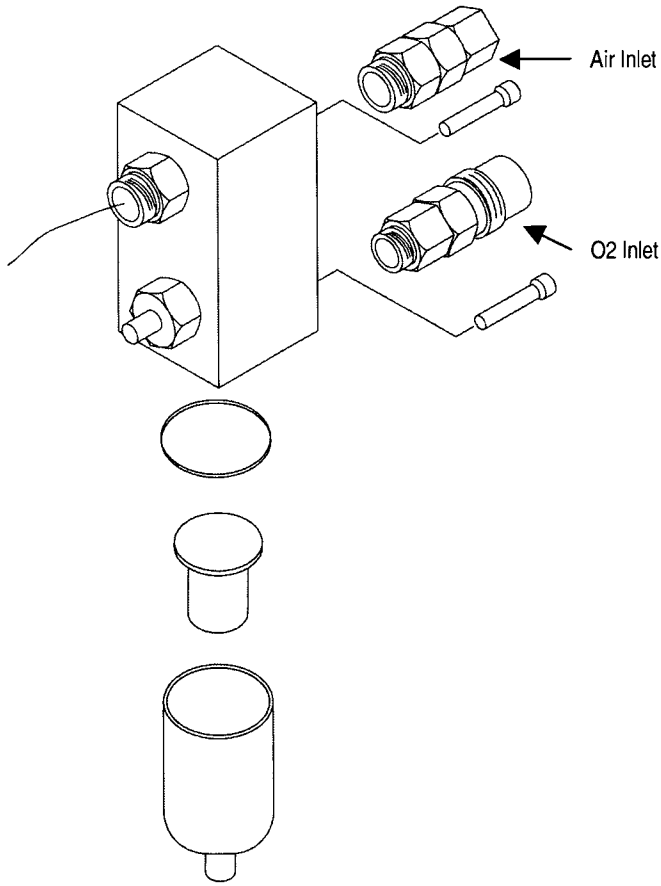


Figure 3-22 Inlet Block

1. Using a 9/16" open end wrench, loosen and remove O_2 hose from O_2 outlet port. Set tube aside for later assembly.
2. Using a 1/4" deep socket, loosen the hose clamp at the elbow fitting on the Inlet Block Assembly.
3. Pull firmly on the tube and remove from air output.
4. Using a 7/64" Allen driver, remove the three (3) screws securing the Inlet Block and coalescing filter bowl to the casting.
5. Remove the filter bowl.
6. Remove and discard coalescing filter.
7. Remove and discard sealing gasket.
8. Set inlet block aside for further disassembly later.

Casting Sealing Plate (P/N 20126)

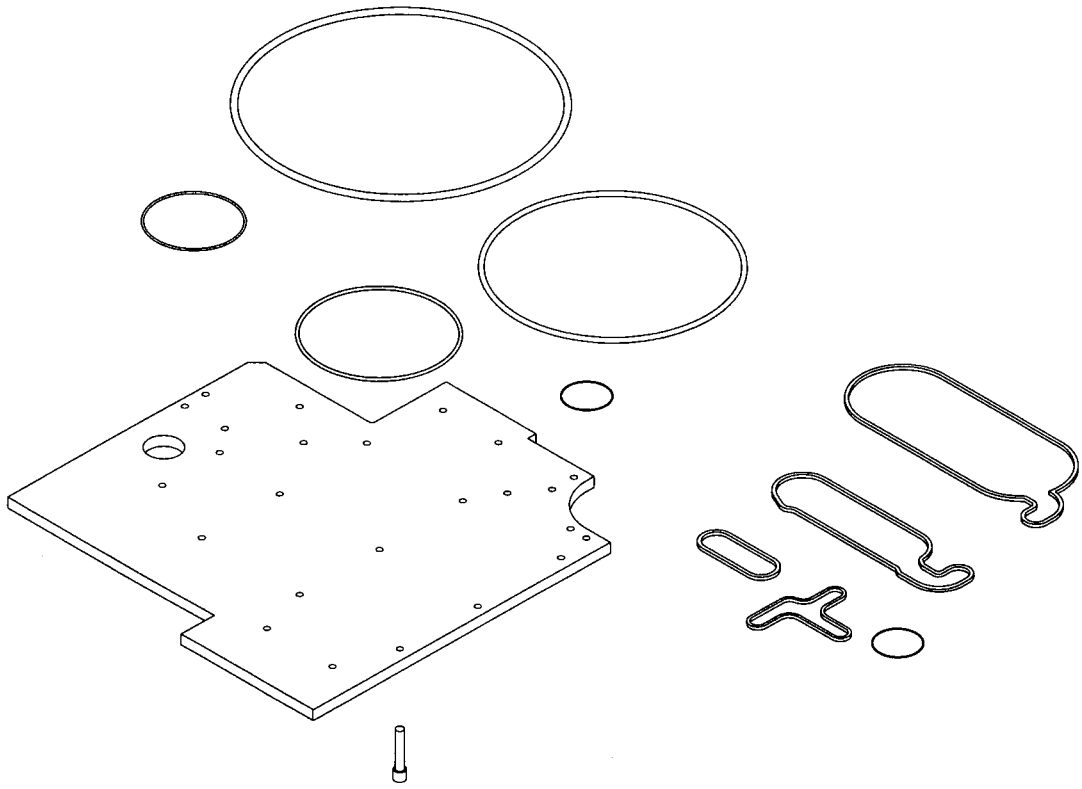


Figure 3-23 Sealing Plate and O-rings

1. Position casting exposing the Sealing Plate. The front of the unit should be facing you.
2. Using a 5/32" Allen driver, remove twenty-three (23) screws securing the sealing plate to the casting.
3. Remove the Sealing Plate being careful not to scratch the sealing surface.
4. Remove and discard the Sealing o-rings, Damping Chamber, Safety and Relief Port area, Flow Valve Port area, Purge Valve Port area.
5. Set sealing plate aside for cleaning and reassembly.

Safety Solenoid/Zero Purge Solenoid (P/N 15652)

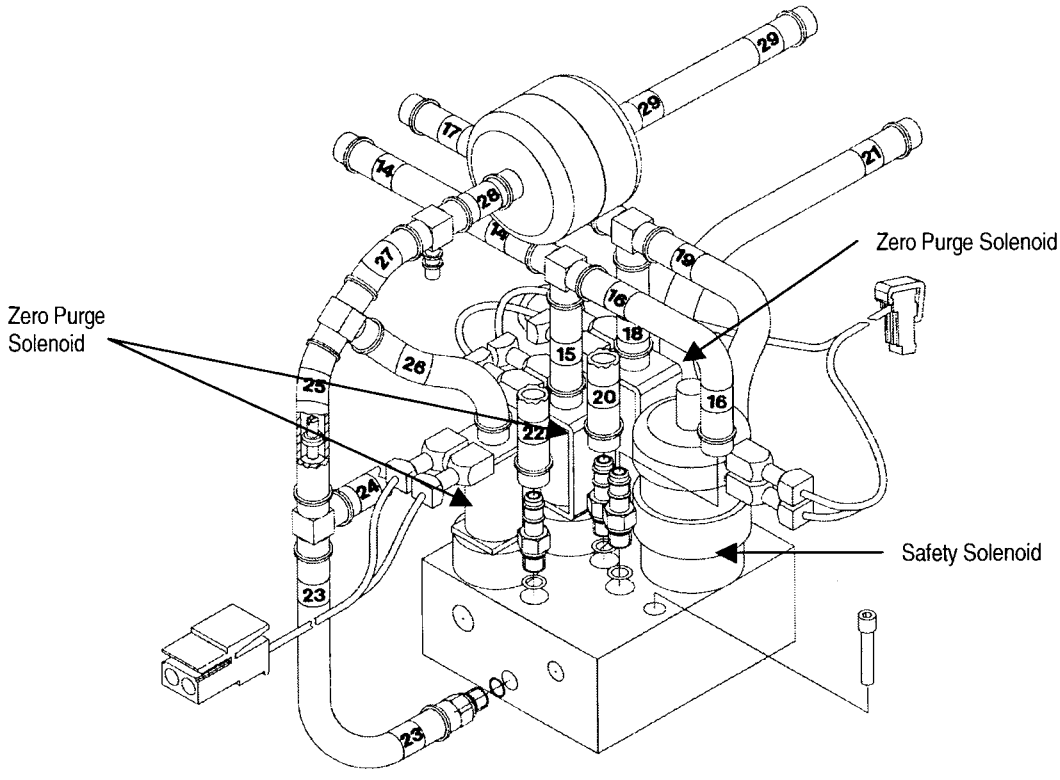


Figure 3-24 Safety Solenoid/Zero Purge Solenoid

1. Using a 1/4" deep socket driver, remove the six (6) Barb connectors.
2. Remove and discard the o-rings from the six (6) barb connectors.
3. Using a special Solenoid wrench, remove the Safety Solenoid from the Safety Solenoid/Zero Purge block.
4. Set the Solenoid and o-ring aside for later assembly.
5. Repeat step 3 and 4 until the three (3) Solenoids are removed from the Safety Solenoid/Zero Purge block. Discard the three (3) solenoids.
6. The block is now ready for cleaning the block can be soaked in mild soap and water or ultrasonic cleaner or scrubbed by hand.
7. Immediately after cleaning, rinse block using distilled or soft water, then blow-dry using medical grade compressed air.

Jet Pump/I/E Solenoid (P/N 15651)

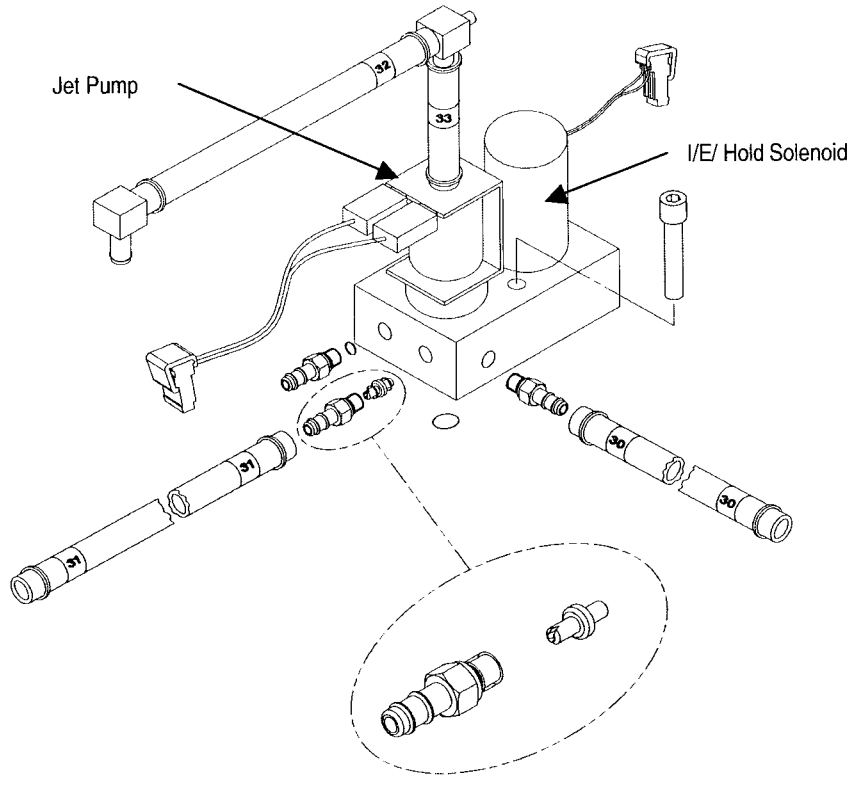


Figure 3-25 Jet Pump/I/E Solenoid

1. Using a 5/16" deep socket driver, remove the three (3) barb connectors from the Jet Pump/I/E Solenoid block.
2. Remove and discard the three (3) o-rings from the three (3) barb connectors.
3. Carefully, using a pair of thin needle nose pliers, remove and discard orifice from the right side port in the Jet Pump/I/E Hold block assembly.
4. Using a special solenoid wrench, remove the Jet Pump Solenoid from the Jet Pump/I/E Hold block.
5. Set the Jet Pump solenoid and o-ring aside for later reassembly.
6. Using a special solenoid wrench, remove the I/E Hold Solenoid from the Jet Pump/I/E Hold block.
7. Set I/E Hold Solenoid and o-ring aside for later assembly.
8. The block is now ready for cleaning. The block can be soaked in mild soap and water, ultrasonic cleaner, or scrubbed by hand.
9. Immediately after cleaning, rinse block using distilled or soft water, then blow dry using medical grade compressed air.

Oxygen Inlet (P/N 03864L)

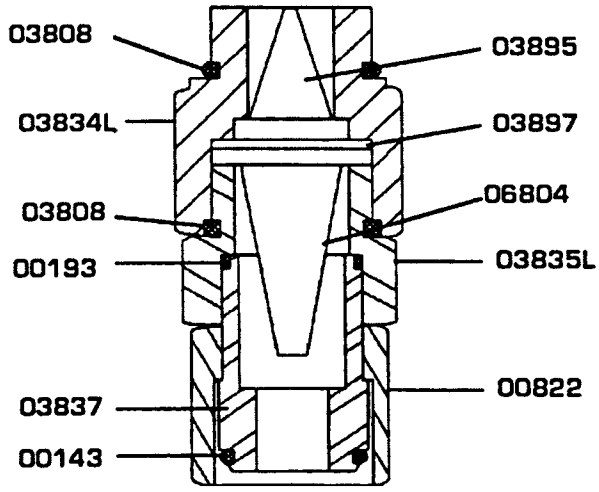


Figure 3-26 Oxygen Inlet

1. Using two (2) 3/4" open-end wrenches, turn in a clockwise direction (CW) and disassemble the inlet.
2. Using a 3/4" open-end wrench and a 1/8" Allen driver, remove the inlet nipple and nut.
3. Remove and discard two (2) o-ring, one (1) nylon cone filter, one (1) washer, one (1) duckbill check valve, one (1) o-ring, and one (1) o-ring.

Air Inlet (P/N 10078)

1. Using two (2) 3/4" open-end wrenches, turn in a counterclockwise direction (CCW) and disassemble the air inlet assembly.
2. Remove and discard two (2) o-rings, one (1) nylon cone filter, one (1) duckbill check valve and one (1) washer.

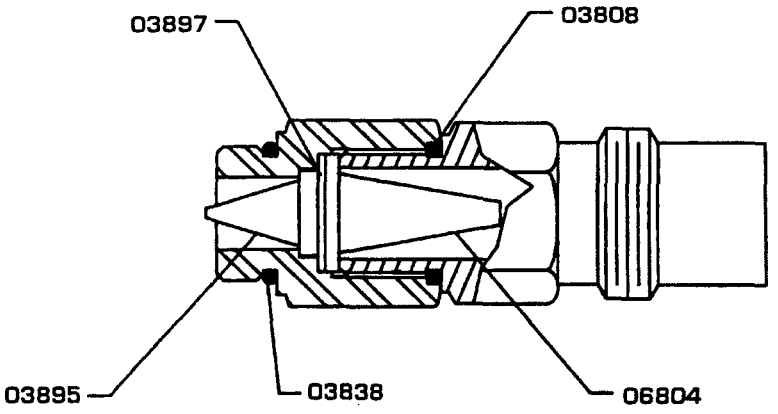


Figure 3-27 Air Inlet

Cleaning Casting Base (P/N 20125)

1. The base is now ready for cleaning. Casting may be scrubbed using a mild soap and water to remove any debris and traces of lubricant.
2. The casting should then be immediately rinsed with distilled or soft water and blown dry using clean, medical grade compressed air.

Chapter 4 Reassembly

This section of the V.I.P. Bird Gold and Sterling Ventilator SeriesService Manual describes the procedures for reassembling the ventilator.

Air Inlet (P/N 10078)

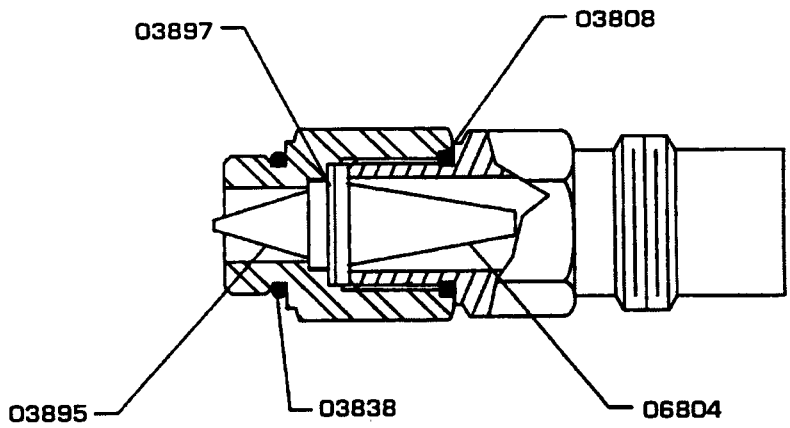


Figure 4-1. Air Inlet Assembly (P/N 10078)

1. Lightly lube two o-rings (P/N 03808) using Bird lubricant (P/N 00631) and install one onto the filter retainer (P/N 20034) and one on the air inlet (P/N 03833).
2. Insert Duckbill Check Valve (P/N 03895), washer (P/N 03897), and nylon cone filter (P/N 06804) onto the filter retainer (P/N 20034).
3. Using two 3/4" open wrenches, tighten the filter retainer (P/N 20034) on to the air inlet (P/N 03833) in a clockwise motion (CW).
4. Set the Air Inlet Assembly (P/N 10078) aside for the final assembly to the inlet block (P/N 33519).

Oxygen Inlet (P/N 03864L)

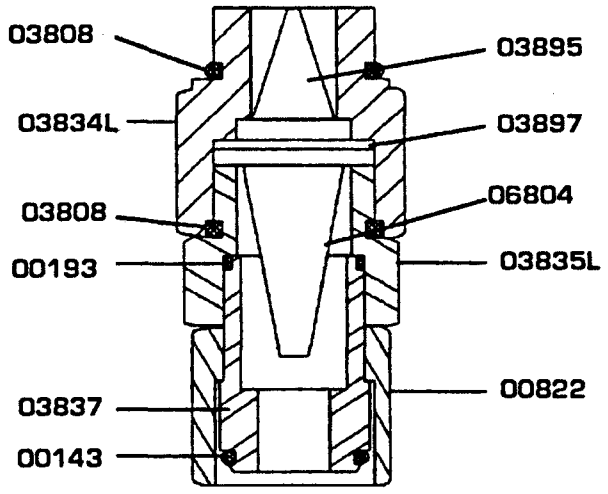


Figure 4-2. Oxygen Inlet Assembly (P/N 03864L)

1. Lightly lube two o-rings (P/N 03808) using Bird lubricant (P/N 00631) and install into the O_2 connector (P/N 03843L).
2. Insert Duckbill Check Valve (P/N 03895), washer (P/N 03897), and Nylon Cone Filter (P/N 06804) into the O_2 connector (P/N 03843L).
3. Lightly lube two o-rings (P/N 03808) using Bird lubricant (P/N 00631) and install on O_2 filter retainer (P/N 03835L).
4. Using two 3/4" open end wrenches, tighten the O_2 connector to the O_2 filter retainer using a counter clockwise motion (CW).
5. Install the o-ring (P/N 00143) onto the O_2 nipple (P/N 03837). Insert the O_2 nipple into the nut (P/N 00822).
6. Using a 3/4" pen end wrench and a 1/8" Allen driver, tighten the O_2 inlet nipple to the O_2 connector (P/N 03835L) in a clockwise motion (CW).
7. Set the O_2 inlet assembly (P/N 03864L) aside for final assembly to the inlet block (P/N 33519).

Inlet Block (P/N 33519)

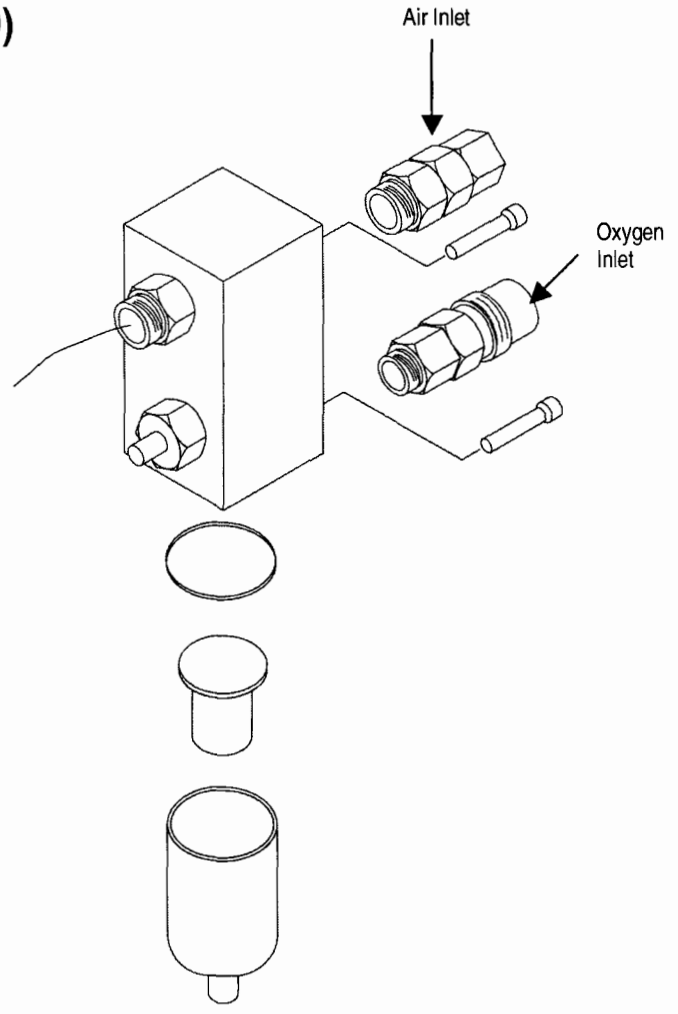


Figure 4-3. Inlet Block Assembly (P/N 33519)

1. Using a 9/16" open end wrench, install the O_2 inlet (P/N 03864L) into the upper port and tighten in a counter clockwise motion (CCW).
2. Using a 3/4" open end wrench, install the air inlet (P/N 10078) into the lower port and tighten in a clockwise motion (CW).
3. Set inlet block (P/N 33519) aside for final assembly to casting.

Jet Pump I/E Solenoid Assembly (P/N 15651)

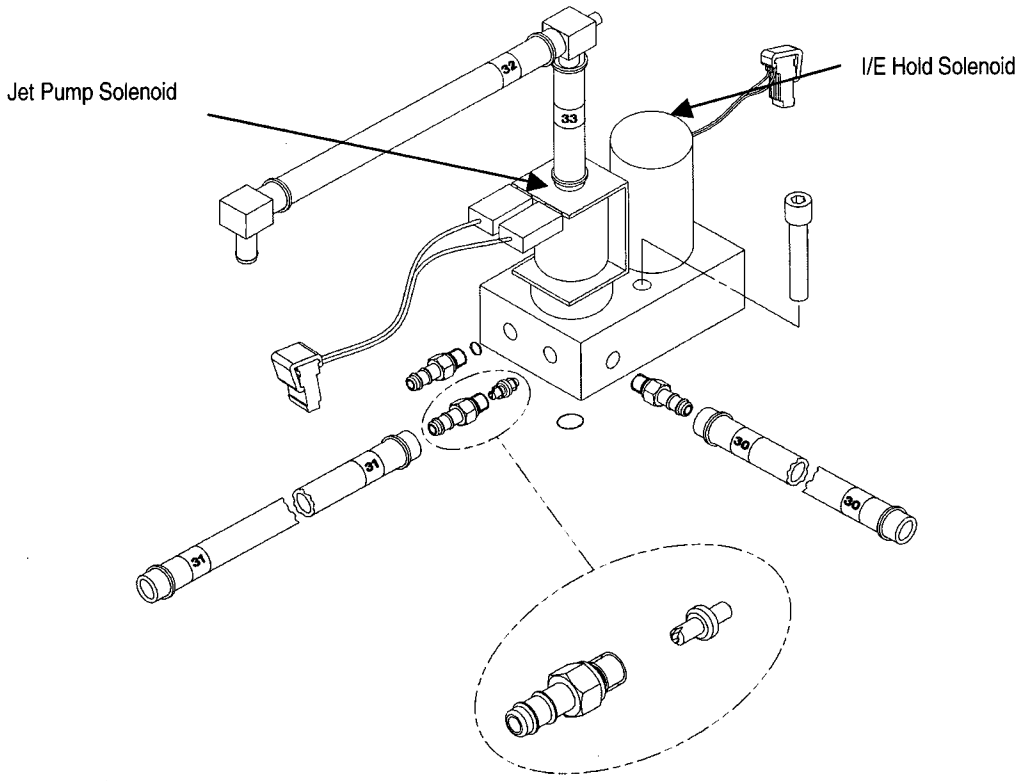


Figure 4-4. Jet Pump/I/E Solenoid Assembly (P/N 15651)

1. Carefully push orifice (P/N 08171) into the right side port on the Jet Pump/I/E hold block (P/N 21110).
2. Lightly lube three (3) o-rings (P/N 05999) and install one onto each of the three (3) barb connectors (P/N 04555).
3. Using a 5/16" deep socket driver, install and lighten the three (3) barb connectors (P/N 04555) to the Jet Pump/I/E hold block (P/N 21110).
4. Using a solenoid wrench (P/N 03426), install and tighten the Jet Pump Solenoid (P/N 15046) onto the Jet Pump/I/E hold block (P/N 21110).

Note

Before installing the solenoid verify that the o-rings are on the solenoid.

5. Using a Solenoid wrench (P/N 03426), install the I/E Hold Solenoid (P/N 33603) onto the Jet Pump/I/E hold block.
6. Set Jet Pump/I/E hold block assembly (P/N 15651) aside for final assembly.

Safety Valve/Zero Purge Assembly (P/N 15652)

1. Using a special Solenoid wrench (P/N 03426), install and tighten the Safety Solenoid (P/N 08940) onto the Safety Valve/Zero Purge assembly block (P/N 21111).

Note

Before installing the solenoid verify that the o-rings are on the solenoid.

2. Repeat step one (1) until all of the solenoids (Qty 2 P/N 33600 & Qty 1 P/N 335640 are installed onto Safety Valve/Zero Purge block (P/N 21111).
3. Lightly lube six (6) o-rings (P/N 00114) and install onto the six (6) barb connectors (P/N 00576).
4. Using a 1/4" deep socket driver, install and tighten the six (6) barb connectors (P/N 00576).
5. Set Safety Valve/Zero Purge assembly (P/N 15652) side for final assembly.

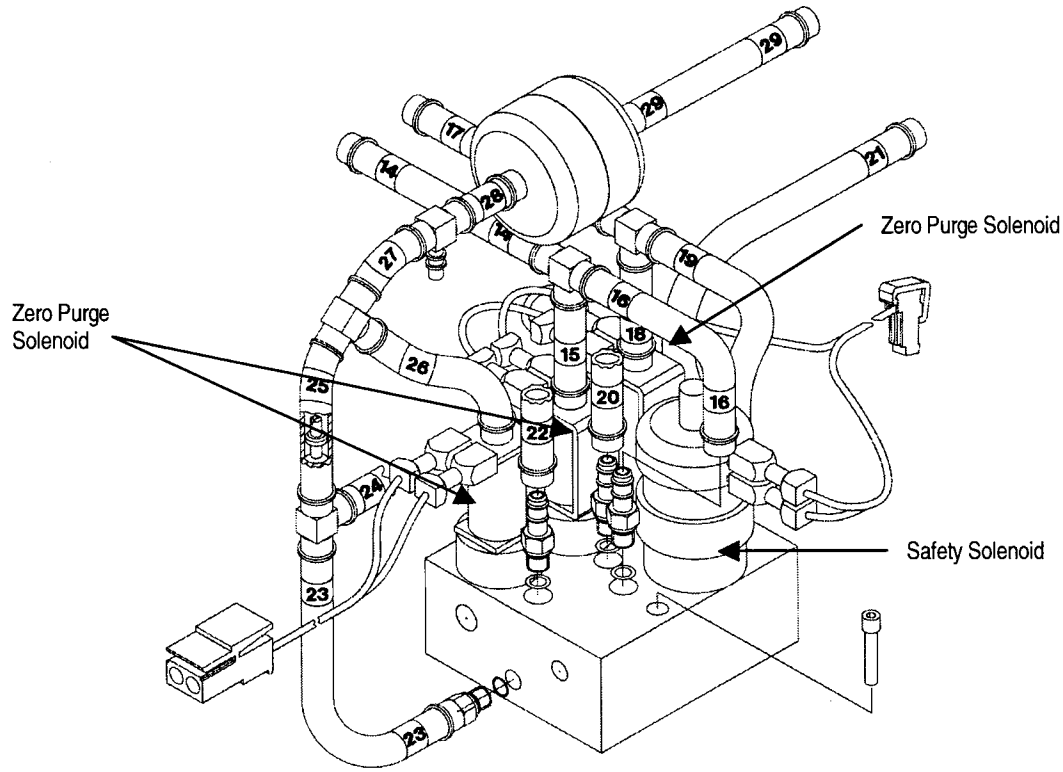


Figure 4-5 Safety Solenoid/Zero Purge Assembly (P/N 15652

Casting Sealing O-rings & Seal Plate (P/N 20126)

1. Make certain all o-rings are clean and free of dust.
2. Position o-ring (P/N 30001) into the groove around the main accumulator (Some stretching may be required).
3. Position o-ring (P/N 30002) into the groove around the damping chamber.
4. Position o-ring (P/N 30003) into the groove around the purge valve port area.
5. Position o-ring (P/N 30004) into the groove around the safety and relief port area.
6. Position o-ring (P/N 30005) into the groove around flow valve.
7. Very carefully position sealing plate over sealing area. Take care not to disturb the sealing o-rings.
8. Install two (2) screws (P/N 40002) finger tight to hold sealing plate in place.

Note

Make sure to align the holes for the pressure regulator.

9. Install the remaining twenty one (21) screws into the sealing plate finger tight.
10. Using a 5/32" Allen driver, tighten screws down just until screw head meets the sealing plate.
11. For the final tighten sequences, work in an outward motion. Begin with the inner most screws and work out to the edge of the sealing plate.

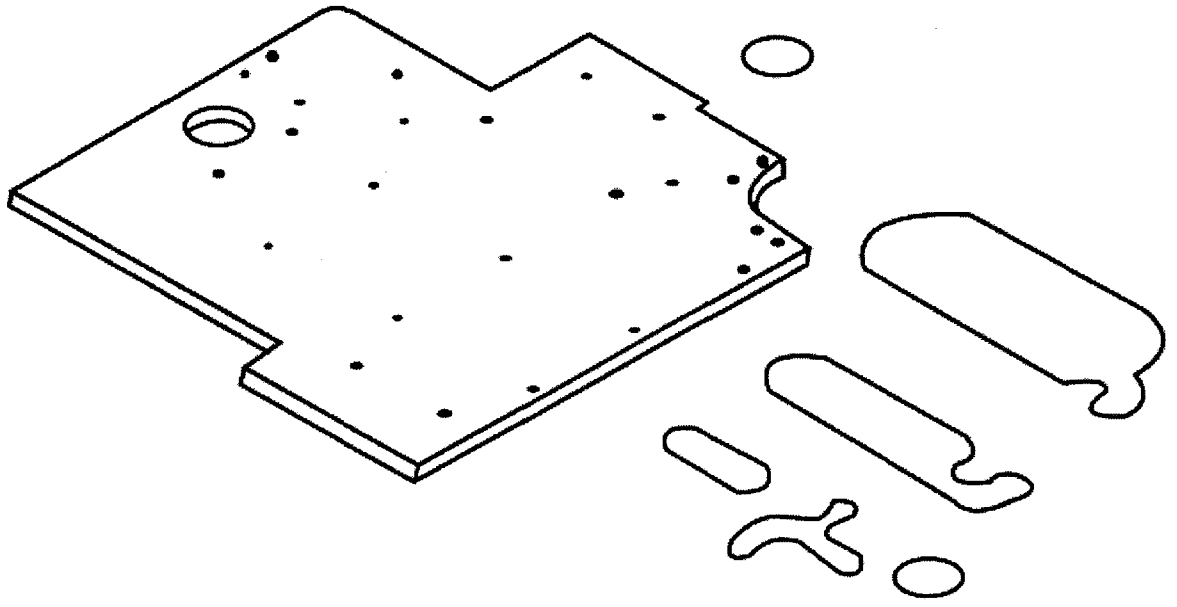


Figure 4-6 Casting Sealing O-rings & Seal Plate (P/N 20126)

Casting Leak Test

1. Turn casting over the front label facing you.
2. Attach regulator bypass fixture (P/N 10287) to pressure regulator mounting pad and secure with four 9/64" Allen screws (P/N 03217), insert screw from bottom through sealing plate.
3. Attach accumulator test fixture (P/N 10288) onto the Flow Control, Jet Pump/I/E Hold and Safety Solenoid/Volume monitor manifold mounting pads, evenly and secure using the three knuckled fastening screws on the fixture.
4. Attach and secure test fixture (P/N 10285) onto the Safety Valve mounting pad using two (2) 7/64" Allen screws (P/N 03219).
5. Install and secure the out patient port plug (P/N 10284) using two (2) 3/32" Allen screws (P/N 40013).
6. Install and secure brass plug (P/N 01470) onto mounting pad located at the Pressure Relief inlet port.
7. Install 0-60 PSI (0-4.2 $kgcm^2$) pressure test harness to supply source making certain that the pressure regulator is turned off full counter clockwise (CCW) to prevent damaging thegauge.
8. Install and secure with hose clamp, (P/N 09787) test harness hose to inlet elbow on main accumulator.

Note

Turn the rotary ON/OFF valve to OFF position.

9. Turn gas supply ON. Turn rotary ON/OFF valve to ON position.
10. Slowly turn test harness regulator clockwise (CW) to read 50 PSI (3.5 $kgcm^2$) on test harness gauge.
11. Turn rotary ON/OFF valve to OFF and observe pressure behavior on the test harness gauge. If pressure decays more then two (2) PSI per minute, check for leak. If pressure remains stable, system is leak tight. Relieve gas pressure from casting.

Note

Leak Troubleshooting:

- *Check for leaks at all test fixture sealing areas.*
- *Check for leaks in pressure test harness.*
- *Check and re-tighten if necessary all sealing plate screws.*
- *If leaks still persists, remove sealing plate and check all o-rings. Replace any damaged o-rings.*
- *Repeat leak test after reattaching the seal plate.*

Figure 4-7 Casting Leak Test

Sensor Receptacle

1. Install Volume Monitor Receptacle PCB (P/N 15684) into the casting from the inside.
2. Using a 3/32" Allen driver, install and secure Volume Monitor Receptacle PCB (P/N 15684) with two (2) screws (P/N 40191).

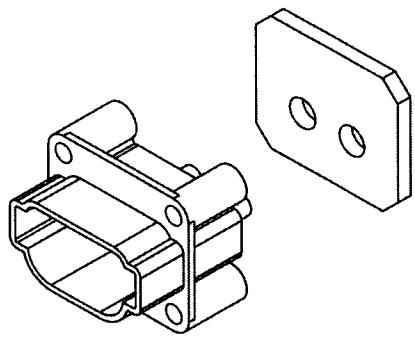


Figure 4.8 Sensor Receptacle Assembly (P/N 15684)

Pressure Regulator

1. Remove regulator bypass fixture (P/N 10287) from regulator mounting pad.
2. Position two (2) o-rings (P/N 03375) into the counterbore area at the bottom of the regulator.
3. Position the regulator onto the mounting pad with bleed fitting facing towards the front of the casting.
4. Using 9/64" Allen screws, (P/N 03257) secure regulator to the mounting pad. Insert screws from the bottom through the sealing plate.

Calibration

1. Remove the brass plug (P/N 01470) from mounting pad located at the pressure relief valve and install barb connector (P/N 00576) and secure PSIG precision test gauge or equivalent to barb connector.
2. Turn rotary ON/OFF valve to ON and slowly increase test harness regulator to 50 PSIG (3.5 $kgcm^2$).
3. Regulator operating pressure as observed on 0-30 PSIG gauge, must read 25.0 ± 0.5 PSIG (1.7 $kgcm^2$ ± 0.035 $kgcm^2$).
4. To adjust regulator, loosen locknut on regulator and adjust valve stem using a flat blade screw driver.
5. Re-secure locknut, then apply Vibratite (S1020) or equivalent locking material.

Note

Troubleshooting:

- *Cannot adjust to 25.0 PSIG (1.7 kgcm2). Confirm 50 PSIG (3.5 kgcm2) gas supply check for leaks at all possible leak areas. Replace regulator and repeat test.*

6. After testing is complete, remove pressure test harness and all test figures.

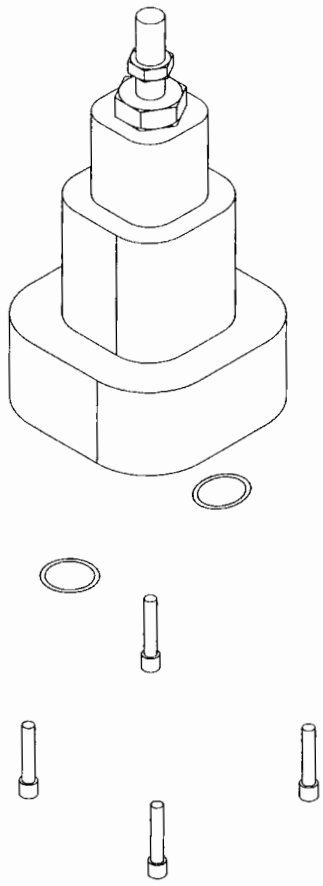


Figure 4-9. Pressure Regulator (P/N 33566)

Purge Valve Assembly & Barb Tube Fittings

1. Lightly lube and install o-rings (P/N 00114) onto the three barb tube fittings.
2. Using 1/4" deep socket driver, install the three barb fittings to their mounting pads as follows:
   - Install one at the inlet port on the pressure relief valve.
   - Install one at the inlet port next to the purge valve (P/N 10180).
   - Install one behind the regulator (P/N 33566) and alongside the main accumulator.
3. Install nylon washer (P/N 00109) and o-ring (P/N 00138) on the valve stem.
4. Install o-ring (P/N 07849) on valve body and the non-lubricated o-ring (P/N 00114) on inside front end of valve body.
5. Install valve stem with washer and o-ring into valve body.
6. Using two open end wrenches, tighten valve cap to valve body.
7. Using a ½" deep socket, install and secure purge valve assembly (P/N 10180) onto the casting.
8. Using a 3/32" Allen driver, rotate purge valve stem a full counter clockwise (CCW).

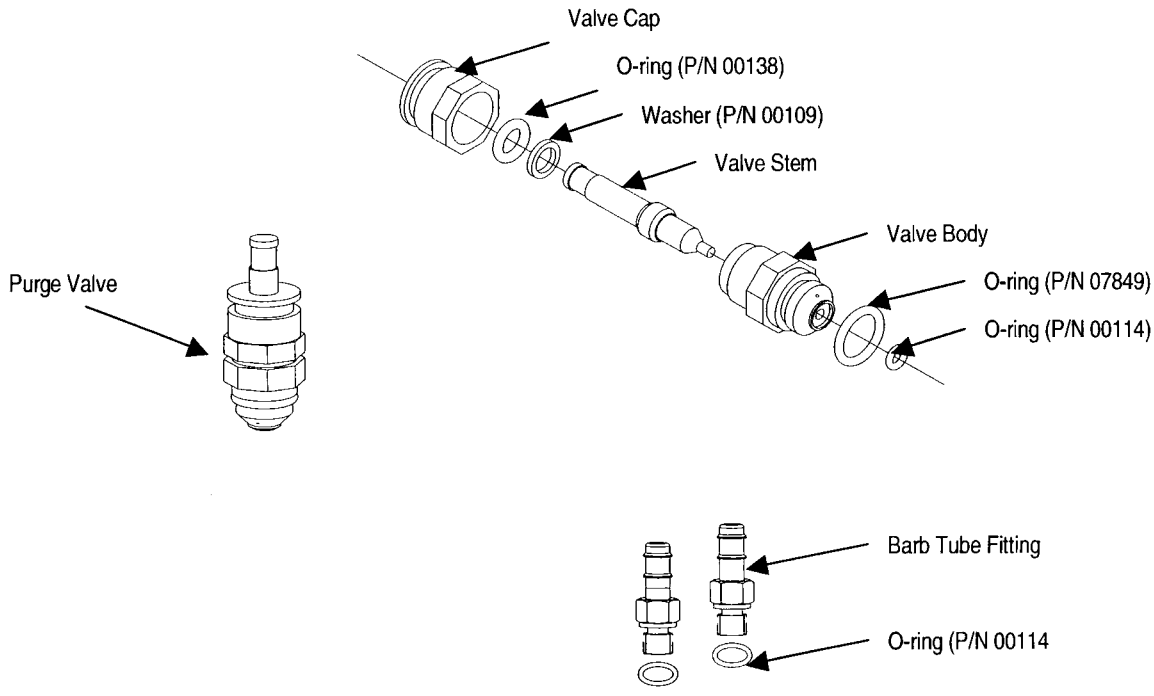


Figure 4-11. Purge Valve Assembly (P/N 10180) & Barb Tube Fittings (P/N 00575)

Safety Valve Assembly

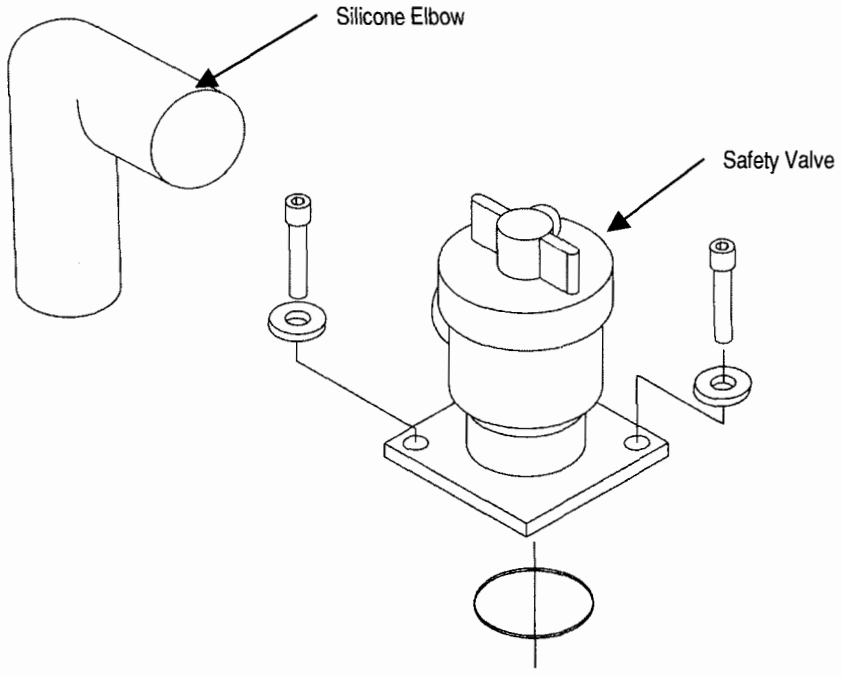


Figure 4-12. Safety Valve Assembly (P/N 09754)

1. Insert short leg of the Silicone elbow (P/N 09603) into side port of Safety Valve body with second ridge to the notch.
2. Install elbow fitting (P/N 04006) of regulator Purge Tube assembly (p/n 08934) into Silicone elbow.
3. Install o-ring (P/N 03373) into the counter bored area at the bottom of the Safety Valve assembly base plate.
4. Position and secure Safety Valve baseplate with Silicone elbow onto mounting pad of manifold casting with two (2) screws (P/N 03219) and two (2) washers (P/N 08964) using a 7/64" Allen driver. Tighten screws evenly.
5. Connect open end of Regulator Purge assembly to barbed fitting on Pressure Regulator.

Exhalation Valve (P/N 15739A)/Auto Zero Manifold (P/N 102708)

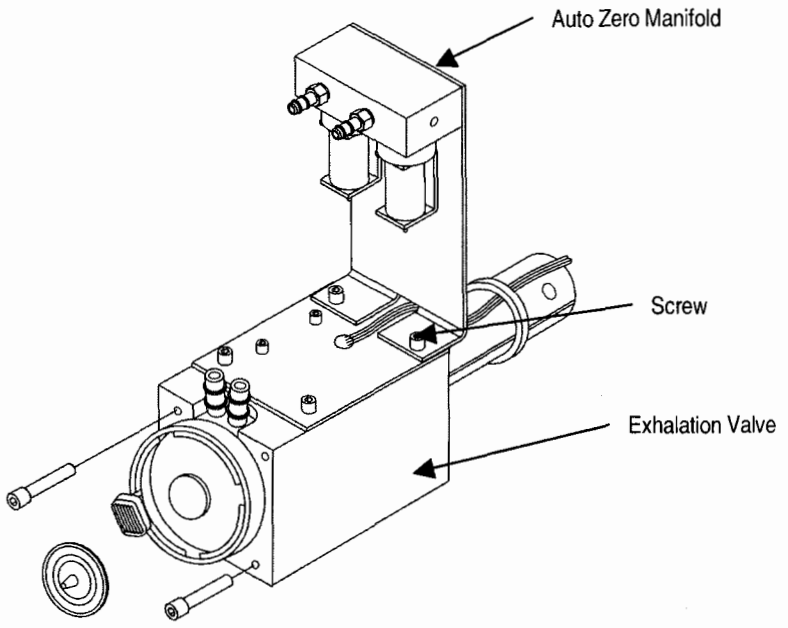


Figure 4-13. Exhalation Valve/Auto Zero Manifold

1. Using a 3/32" Allen driver, remove the two (2) Allen screws that are located at the rear, top, of the Exhalation Valve (P/N 15739A).
2. Align the holes of the Auto Zero Manifold with the holes on the rear of the Exhalation Valve.
3. Using a 3/32" Allen driver, install and secure two (2) Allen screws for the Auto Zero Manifold.
4. From inside of the casting, position and insert front end of Exhalation Valve into the large hole at the left side against the casting.
5. While holding up the weight of the Exhalation Valve assembly, install and secure the two (2) 7/64" Allen screws (P/N 03219) using a 7/64" Allen driver.
6. Install tube #10 and #11 onto Auto Zero Manifold

Patient Outlet Port (P/N 10089)

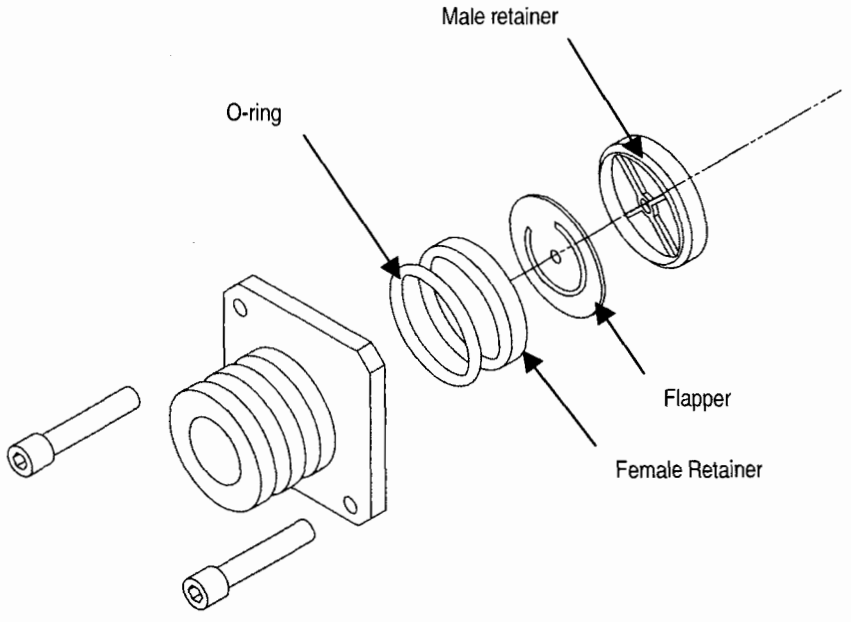


Figure 4-14. Patient Outlet Port

1. Install female retainer (P/N 05532) with flat side towards casting.
2. Install flapper gate (P/N 08881) onto the female retainer (P/N 05532).
3. Install male retainer (P/N 05531) with beveled side towards the flapper gate (P/N 08881).
4. Install o-ring (P/N 02013) onto the Patient Outlet manifold body.
5. Using a 3/32" Allen driver, install and secure Patient Outlet manifold to casting using two (2) 3/32" screws (P/N 40013).

Over Pressure Relief Valve (P/N 10092)

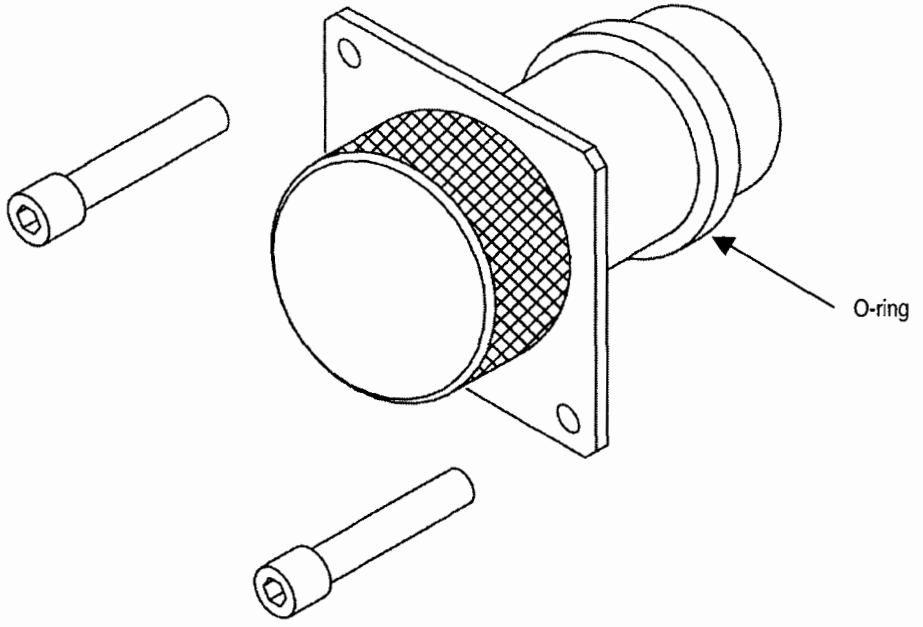


Figure 4-15. Over Pressure Relief Valve

1. Install o-rings (P/N 30006) onto the Over Pressure Relief valve body.
2. Align the Over Pressure Relief valve with the opening on the front of the unit. Using a twisting motion install the Over Pressure Relief valve into the casting.
3. Using a 7/64" Allen driver, install and secure Over Pressure Relief valve assembly using two (2) 7/64" screws (P/N 03219).

Jet Pump/I/E Hold Block Assembly (P/N 15651)

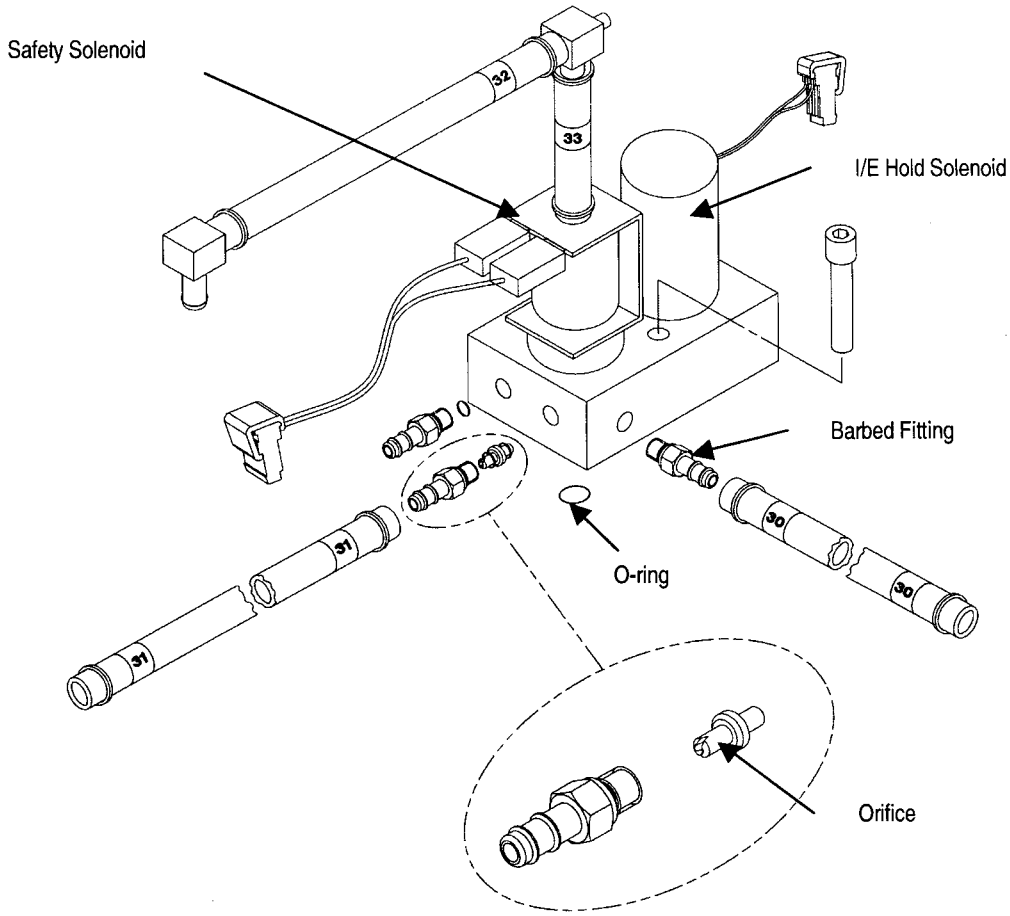


Figure 4-16. Jet Pump/I/E Hold Block Assembly (P/N 15651)

1. Install o-ring (P/N 00138) from the counter bore hole on the base of the Jet Pump assemblies.
2. Using a 9/64" Allen driver, install and securing two (2) screws (P/N 40015) to the Jet Pump/I/E Hold assembly the mounting pad on the casting.

Safety Solenoid/Zero Purge Solenoid (P/N 15652)

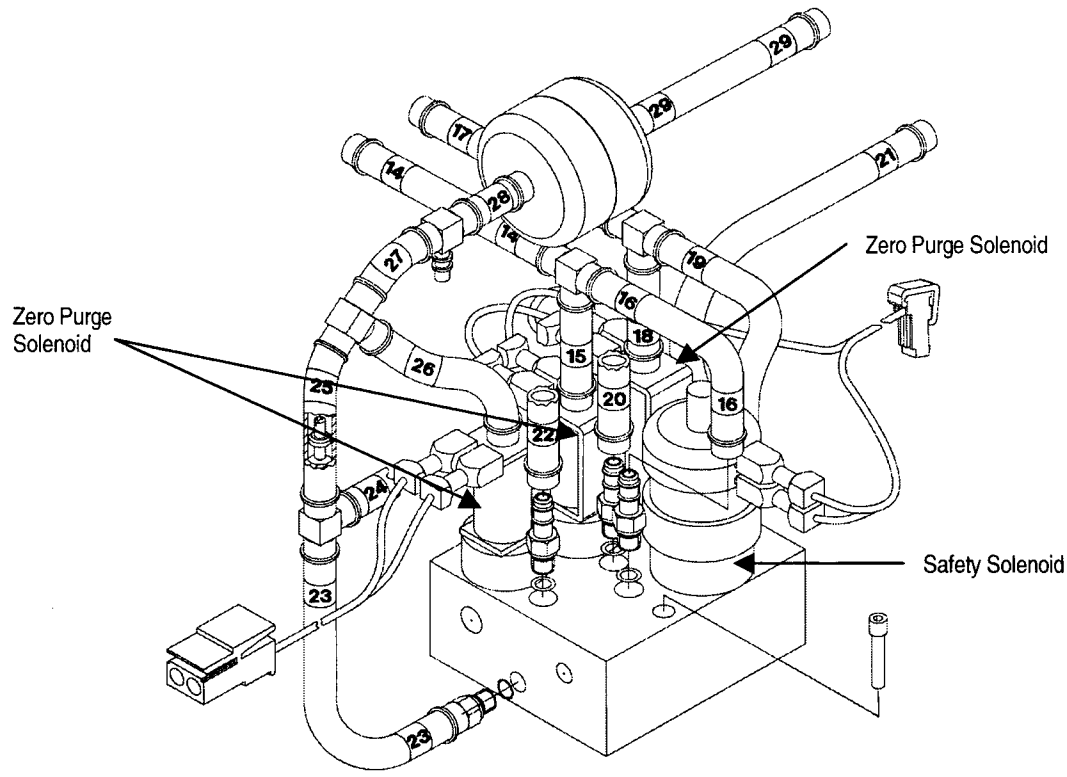


Figure 4-17. Safety Solenoid/Zero Purge Solenoid (P/N 15652)

1. Install two (2) o-rings (P/N 00138), one (1) o-ring (P/N 01943) and one (1) o-ring (P/N 03375) from the counter bore holes on the base of Safety Solenoid/Zero Purge Solenoid assembly.
2. Using a 9/64" Allen driver, install two (2) screws (P/N 40012) securing the Safety Solenoid/Zero Purge Solenoid assembly to the mounting pad on the casting.

Flow Control Valve (P/N 15768A)

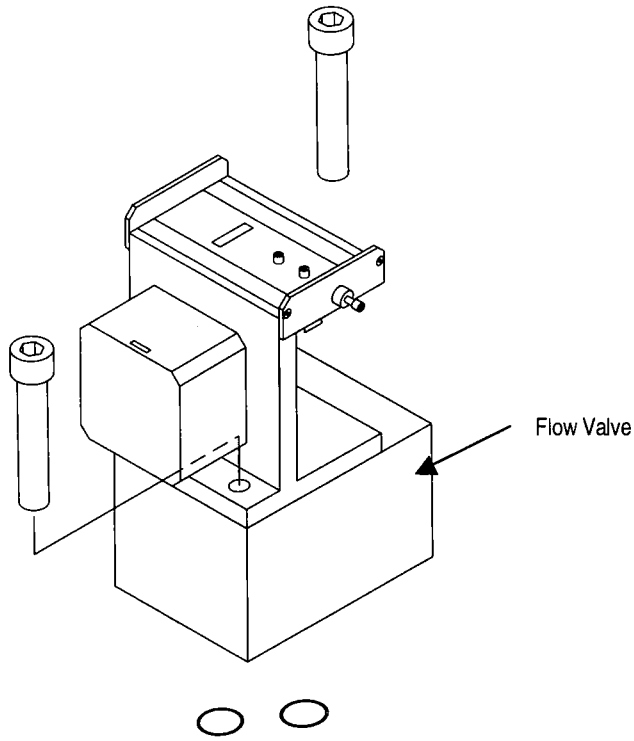


Figure 4-18. Flow Control Valve

1. Install two (2) o-rings (P/N 03374) into the counter bore on base of the Flow Control Valve.
2. Using a 9/64" Allen driver, install and secure the Flow Control Valve using two (2) screws (P/N 03225) onto the mounting pad.

Tubing Assembly

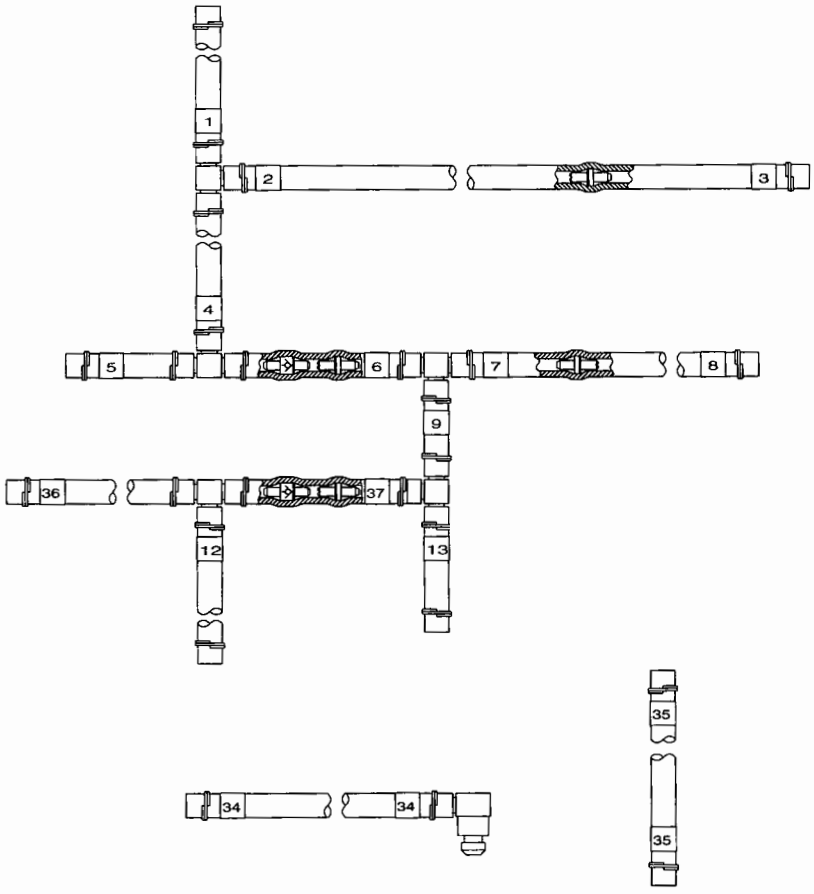


Figure 4-19. Tubing Assembly

1. Connect tube # 20 and #21 to the sensor receptacle PCB
2. Connect tube # 32 to the safety valve assembly
3. Connect tube # 34 to the pressure regulator. Connect the other end to the silicone elbow attached to the safety valve.
4. Connect tube # 29 to the barbed fitting behind the pressure regulator.

Power Transformer (P/N 15114)

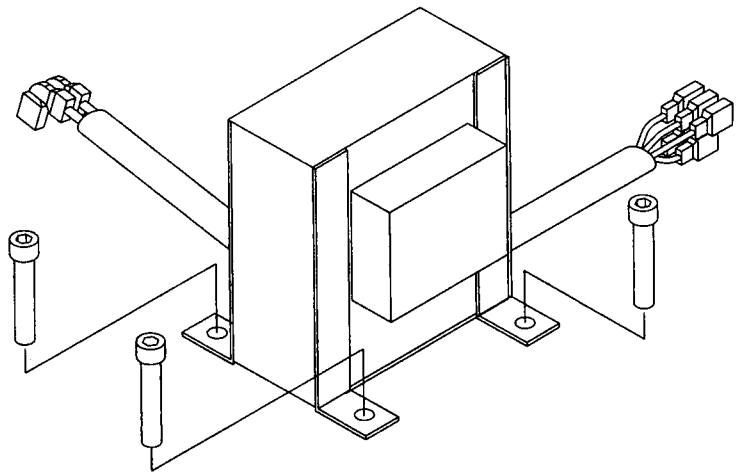


Figure 4-20. Power Transformer

1. Place Power Transformer on the four (4) stand off mounting pads with multicolored primary wires facing towards the rear of the casting.
2. Using a 9/64" Allen driver, install and secure the transformer using four (4) screws (P/N 08833).

Blender Assembly (P/N 10160)/Inlet Block Assembly (P/N 33519

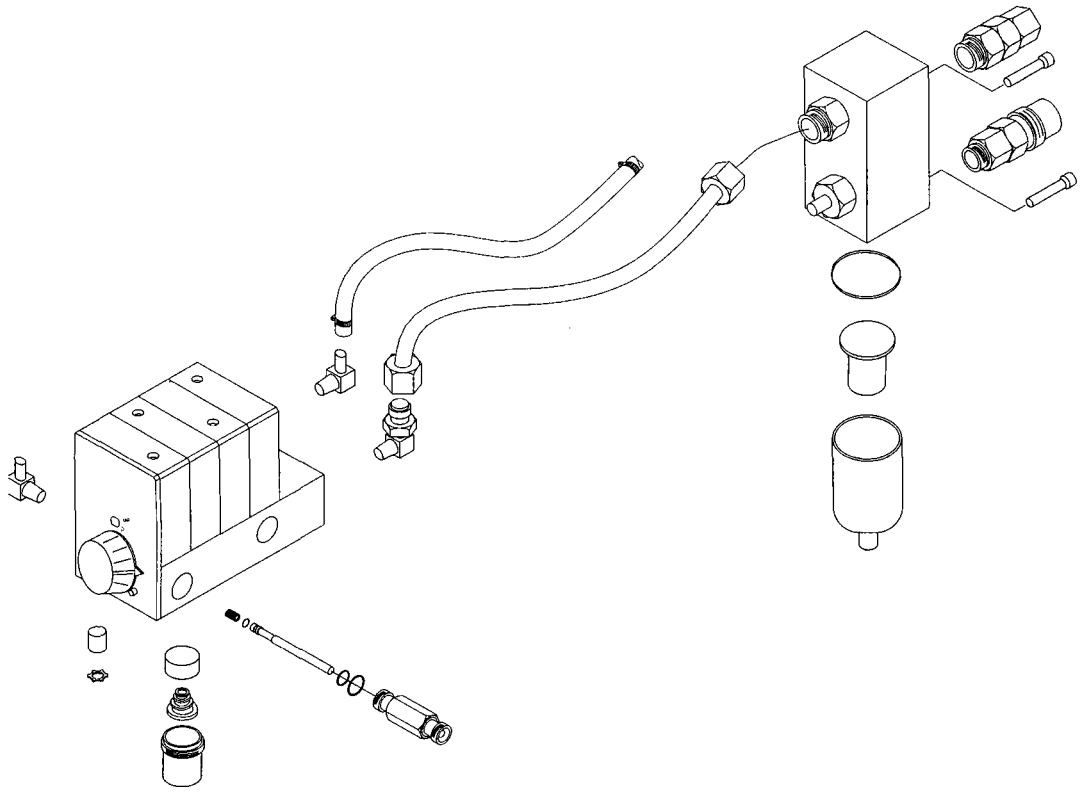


Figure 4-21 Blender Assembly

1. Place the Blender assembly (P/N 10160) into the casting. Cut a piece of Pressure Hose (P/N 9788X) to connect the Output elbow (P/N 33521) on the left side of the blender to the accumulator Input elbow (P/N 33615).
2. Install hose clamp (P/N 09487) onto the Pressure Hose (P/N 09788X). Attach the Pressure Hose (P/N 9788X) to the Output elbow (P/N 33521) on the blender.
3. Using a 1/4" nut driver, install and secure hose clamp (P/N 09787) to the Pressure hose on the blender.

Note

For the Output port make sure to turn the Hose clamp so the adjustment nut is against the side of the blender .

4. Install the Inlet Assembly into the port at the rear right of the casting.
5. Using a 9/64" Allen driver, install and secure three (3) Allen screws into the bottom of the Inlet Block assembly.
6. Cut a piece of pressure hose (P/N 09788X) to connect the Air Outlet Port (P/N 10078) on the Inlet Block assembly (P/N 33519) to the Air Inlet elbow (P/N 33521) the back of the Blender (P/N 10160).

7. Install two (2) hose clamps (P/N 09787) onto the pressure hose (P/N 09788X). Attach the Pressure hose (P/N 09788X) to the Air Inlet elbow (P/N 33521) on the Blender (P/N 10160).
8. Using a 1/4" nut driver, secure hose clamp (P/N 09787) to the pressure hose (P/N 09788X) on the blender.
9. Using a 5/8" open end wrench, install and secure oxygen hose (P/N 10197) to the O_2 inlet (P/N 00086, 00087) on the blender assembly.
10. Place the blender into the casting of the ventilator.
11. Once the blender in place then turn casting onto its side.

Note

Hold blender in your hand to support its weight during installation.

12. Using a 1/8" Allen driver, install and secure two (2) screws (P/N 01432) into bottom of blender through the casting.
13. Install the open end of the blender Outlet Pressure hose (P/N 09877X), to the accumulator elbow inlet fitting (P/N 33615).
14. Using a 1/4" nut driver, install and secure hose clamp (P/N 09787) to the pressure hose on the accumulator inlet elbow fitting.
15. Install the open end of the pressure hose on the back of the blender to the air fitting (P/N 09835) on the Inlet Block assembly (P/N 33519).
16. Using a 1/4" nut driver, install and secure hose clamp (P/N 09787) to the pressure on the inlet fitting.
17. Using a 5/8" open end wrench, install and secure oxygen hose (P/N 10197) to the O2 fitting on the inlet block assembly (P/N 33519).

Power Supply PCB (P/N 50160)

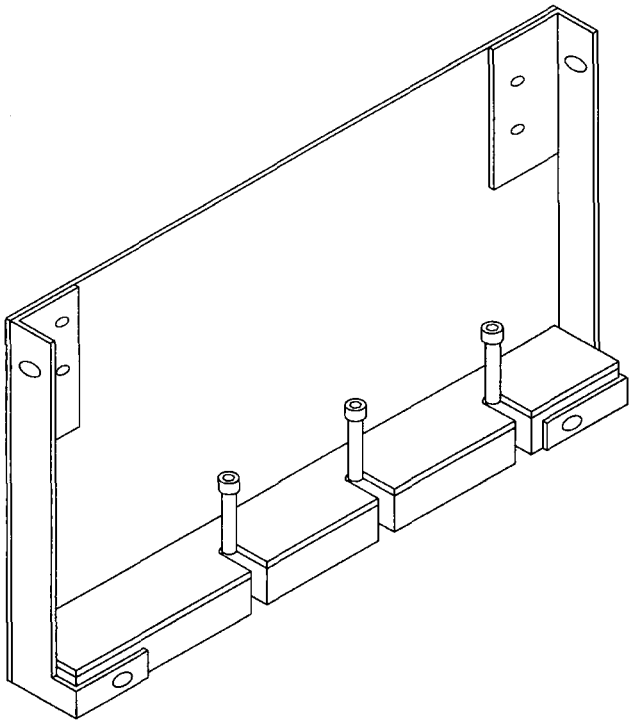


Figure 4-22 Power Supply PCB

1. Install the three (3) securing screws (P/N 08883) to the power supply board mounting pad approximately one (1) full turn clockwise (CW).
2. Slide the power supply board assembly onto the mounting pad.
3. Using a 9/64" Allen driver, loosely attach the three (3) screws (P/N 08883) to the power board assembly.
4. Connect the transformer (P/N 15114) three (3) pin Molex connector (P/N 15044) to J9 on the power board.
5. Connect eight (8) pin Molex connector to J8 on the power board.
6. Connect Safety Solenoid cable (P/N 15020) to J303 on the power board.
7. Connect Jet Pump cable (P/N 15046) to J301 on the power board.
8. Connect data cable (P/N 15043 to J2 on the power board.
9. Connect power cable (P/N 15039) to J3 to the power board.
10. Connect exhalation control valve (P/N 15029) to J202 on the power board.
11. Connect flow control valve (P/N 15005) to J201 on the power board.

Rear Panel Assembly (P/N 15004

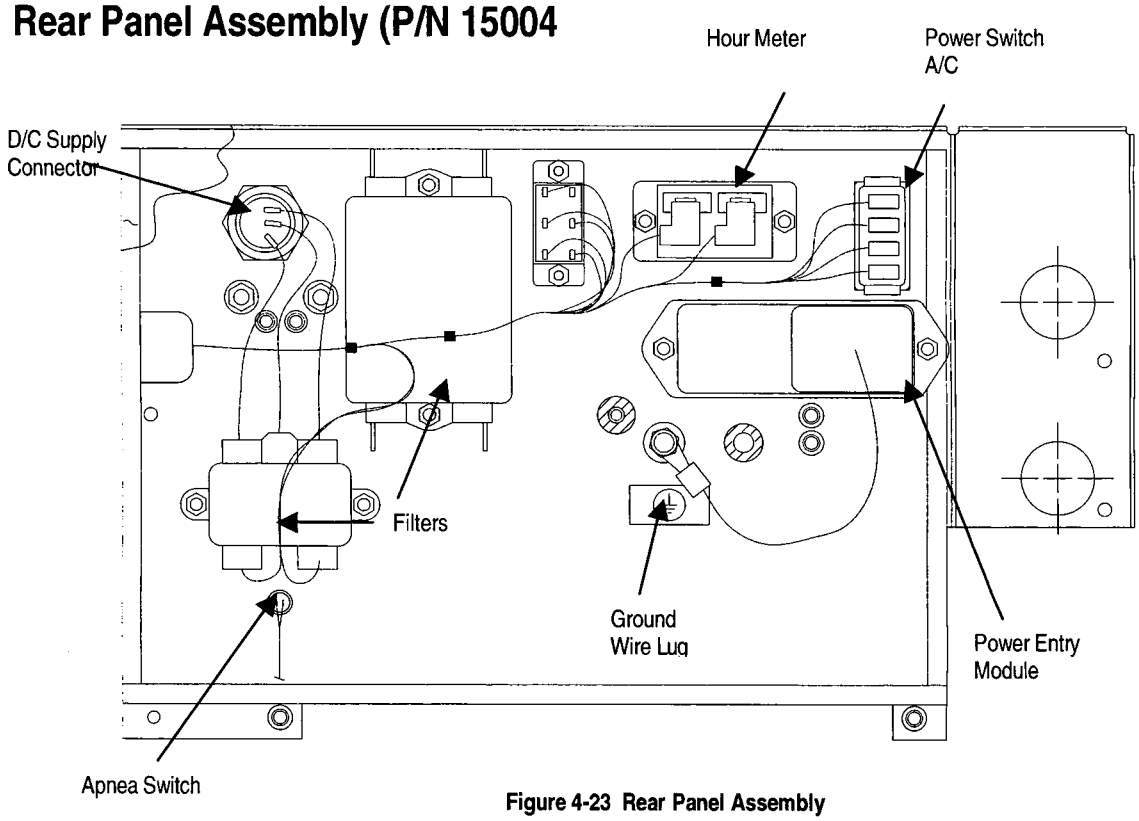


Figure 4-23 Rear Panel Assembly

1. Using a 7/16" open end wrench or 7/16" deep socket, install and secure the transformer ground wire to the ground lug located on the inside of the rear panel.
2. Install and secure the two (2) fiber optic cables (P/N 15126) to the rear panel on the left inside of the unit location B and C.
3. Position rear panel to the casting and inlet block (P/N 33519).
4. Connect power transformer (P/N 15114) primary wire terminals to their corresponding male terminals on the Power Entry Module (P/N 15085).
5. Using a 7/64" Allen driver install and secure two (2) screws (P/N 03219) through the rear panel and into the inlet block assembly (P/N 33519).
6. Install the one (1) 7/64" securing screw (P/N 03219) through the rear panel (P/N 15004) and secure to the power board bracket (P/N 20174R).
7. Using a 9/64" driver secure the three (3) screws (P/N 08883) to the Power Supply PCB (P/N 50160).

Manometer Assembly (P/N 09799)

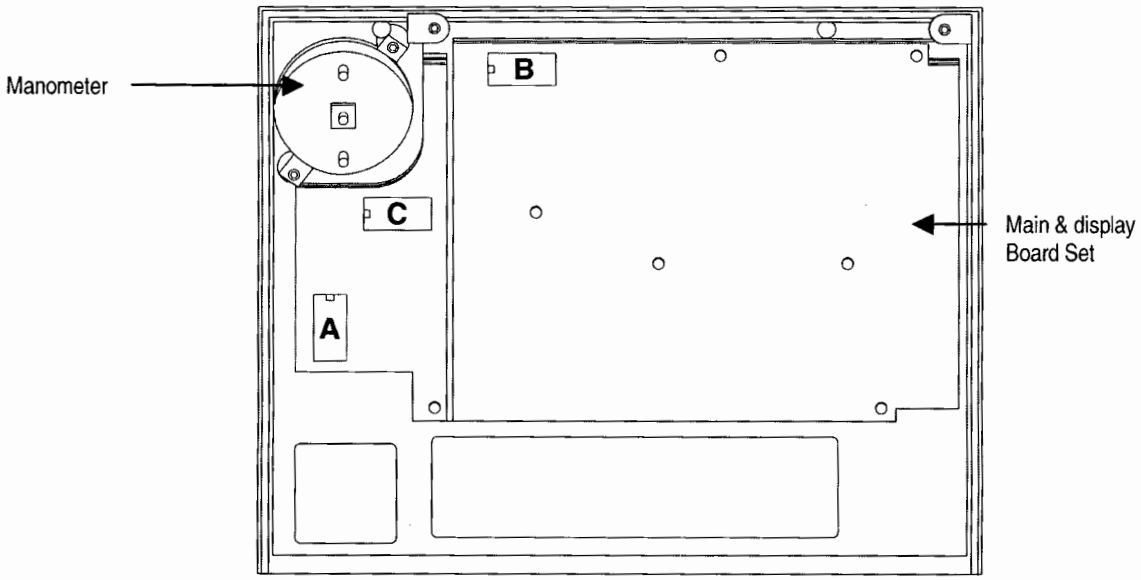


Figure 4-24 Manometer Assembly

1. Install manometer against rear surface of front panel (P/N 20120).
2. Using the two (2) bracket (P/N 09639) with long leg of bracket retaining manometer lip, secure manometer in place with two (2) securing screws (P/N 03219) using a 7/64" Allen driver.

Main (P/N 50880 Gold & 50920 Sterling) & Display (P/N 50870) PCBs

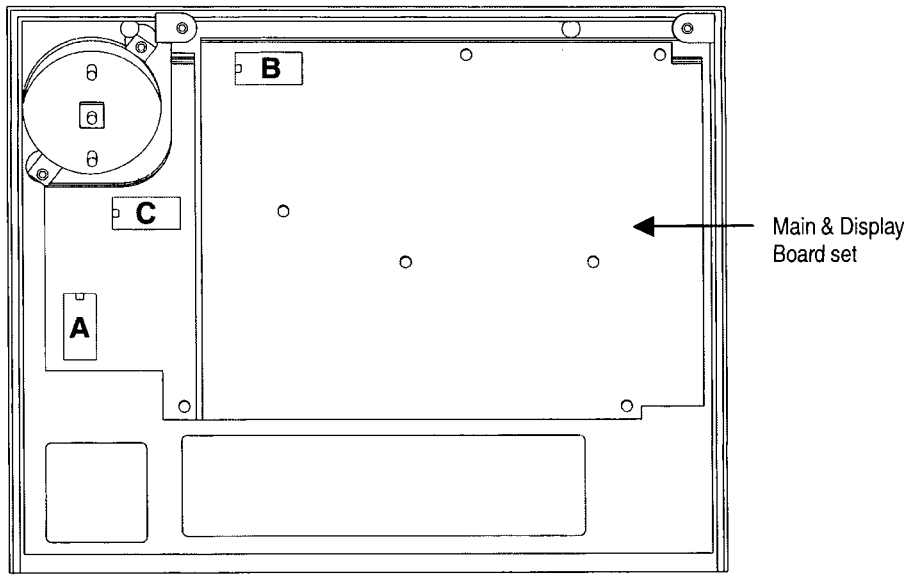


Figure 4-25 Main & Display PCBs

1. Install eighteen (18) ESD washers (P/N 20590) onto potentiometer shafts.
2. Carefully place Display and Main PCB onto the rear surface of the front panel (P/N 20120).
3. Using a 7/64" Allen driver, secure loosely the four (4) screws (P/N 03221) through the Main and Display PCB. See figure 25 for proper placement of the screws.
4. Using a 5/16" nut driver, install and secure the eighteen (18) locking nuts (P/N 03281) starting with the mode selector.
5. Install the (16) friction bushings (P/N 09780) starting with the Tidal Volume control and ending with the Termination Sensitivity control.
6. Secure only finger tight the sixteen (16) friction bushings.

Volume Monitor PCB (P/N 50860) & Fan Bracket (P/N 15561)

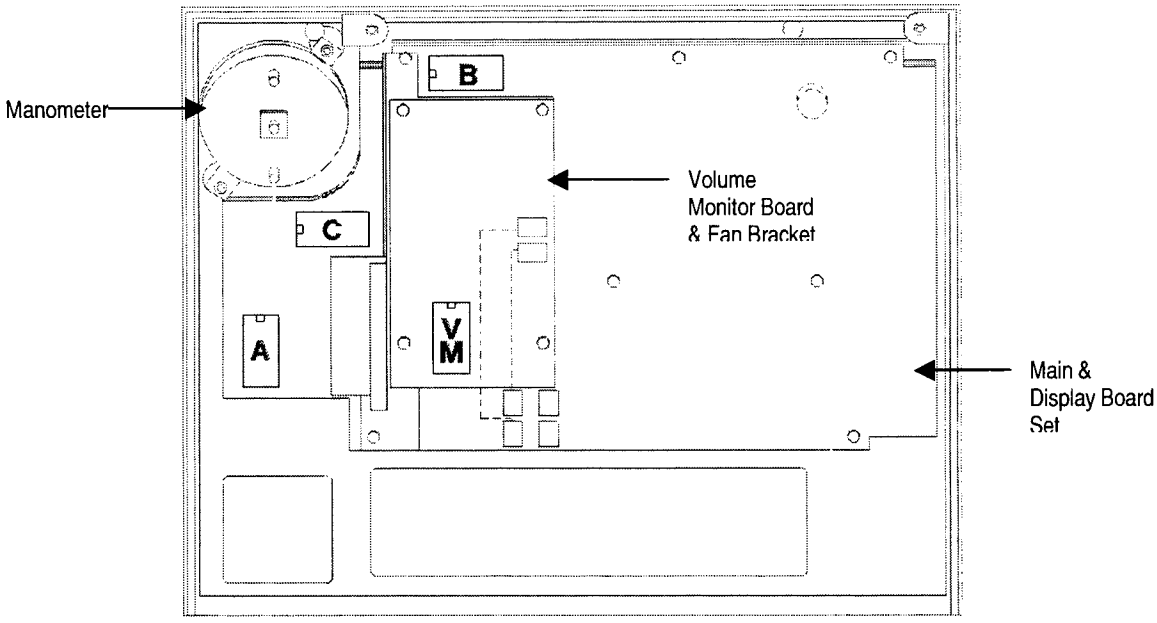


Figure 4-26 Volume Monitor PCB & Fan Bracket

1. Align fan/bracket assembly (P/N 15661) with the holes in the Main PCB. See figure 26 for proper location of screws.
2. Using a 7/64" Allen driver, install and secure three (3) Allen screws (P/N 03220) for the fan bracket assembly.
3. Carefully place the Volume Monitor PCB (P/N 50860) onto the fan/bracket assembly. Make sure to align the hole in the board with the bracket assembly.
4. Using a 7/64" Allen driver, install and secure four (4) screws (P/N 40155) to the Volume Monitor PCB (P/N 50860).
5. Using a 7/64" Allen driver tighten the four (4) screws that hold the Main and Display PCB to the front Panel.

Front Panel Assembly (P/N 15657)

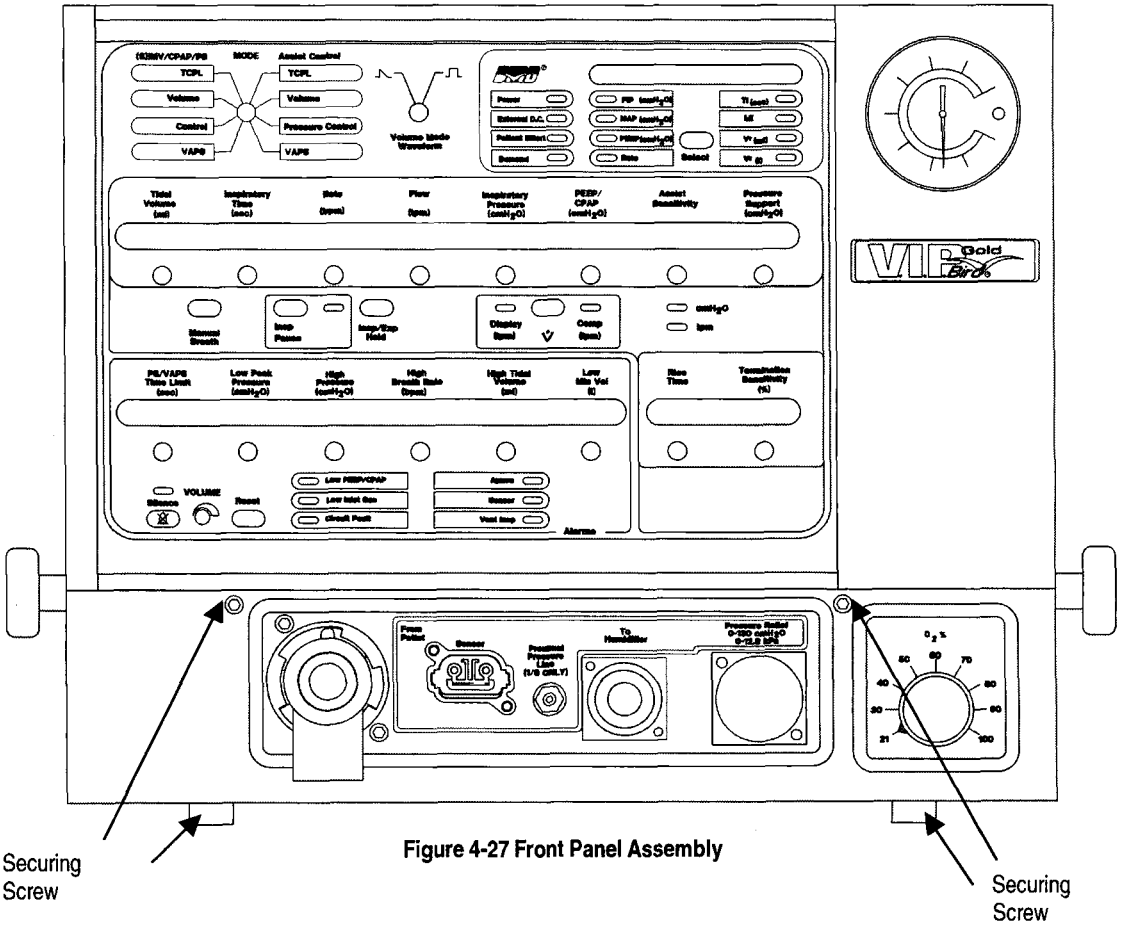


Figure 4-27 Front Panel Assembly

1. Place the ventilator on its base with the unit facing forward.
2. Install the blue fiber optic cable (P/N 15016) from the Volume Monitor PCB to position U713 on the Main PCB.
3. Install the gray fiber optic cable (P/N 15126) from the Volume Monitor PCB to position U701 on the Main PCB.
4. Install the gray fiber optic cable (P/N 15126) from the rear panel assembly to position U702 on the Main PCB.
5. Install the gray fiber optic cable (P/N 15126) from the rear panel assembly to position U703 on the Main PCB.
6. Align the front panel with the casting. Carefully align the Exhalation and Proximal transducers with the tube, #10 & #11 attached to the Auto Zero manifold.

NOTE

To avoid damaging the four (4) transducers on the Main PCB extreme care should be taken when connecting the tube assemblies. The proper method for connecting these tubing assemblies is to push them firmly straight forward avoiding applying side load to the transducer.

7. Carefully slide the front panel onto the unit and install tubing #10 & #11 onto the Proximal and Exhalation transducers.
8. Using a 9/64" Allen driver, secure the front panel with two (2) screws (P/N 08833).
9. Using a 7/64" Allen driver, secure the two (2) bumper feet (P/N 33524) to the bottom of the front panel.
10. Install all 18 (eighteen) control knobs onto the controls beginning with the mode selector switch.
11. Position unit so that the front panel is facing you.
12. Install tube # 35 to the transducer on the Main PCB labeled MACH.
13. Install tube # 24 to the transducer on the Main PCB labeled GAS.
14. Connect tube # 14 from the Volume Monitor PCB transducer, to the tubing assembly attached to the Safety/Zero Purge assembly. Tube #14 attaches to the tee fitting (P/N 00358) with tube #16.
15. Connect tube # 17 from the Volume Monitor PCB transducer, to the tubing assembly attached to the Safety/Zero Purge assembly. Tube #17 attaches to the tee fitting (P/N 00358) with tube #19.

NOTE

***Tube #14 and #17 are calibrated tubes.* DO NOT CUT OR DISCARD THE TUBES.**

16. Connect power cable (P/N 15039) to J3 on the Main PCB.
17. Connect data cable (P/N 15043) to J2 on the Main PCB.
18. Connect volume monitor power cable (P/N 15649) to JI on the Volume Monitor PCB (P/N 50860).
19. Connect zero/purge cable (P/N 15648) to J2 on the Volume Monitor PCB (P/N 50860).
20. Connect Apnea switch cable (P/N 15650) to J3 on the Volume Monitor PCB (P/N 50860).
21. Connect receptacle cable (P/N 15684) to J4 on the Volume Monitor PCB (P/N 50860).

Auxiliary Outlet Assembly(P/N 20221)

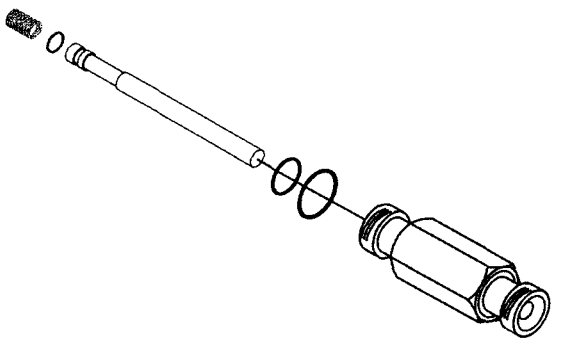


Figure 4-28 Auxiliary Outlet Assembly

1. Position unit so that it is facing you.
2. Using a thin needle nose pliers, install the poppet spring (P/N 03810) into the outlet port of the blender.
3. Install two (2) o-rings (P/N 00193 & 03808) onto the auxiliary outlet body (P/N 03809).
4. Install one (1) o-ring (P/N 00138) onto the poppet (P/N 20222).
5. Install poppet (P/N 20222) into the auxiliary outlet body (P/N 03809).
6. Using a 1/16" open end wrench, install and secure auxiliary outlet (P/N 20221) to the blender.

Power Cord (P/N 08925) & Bracket (P/N 06148)

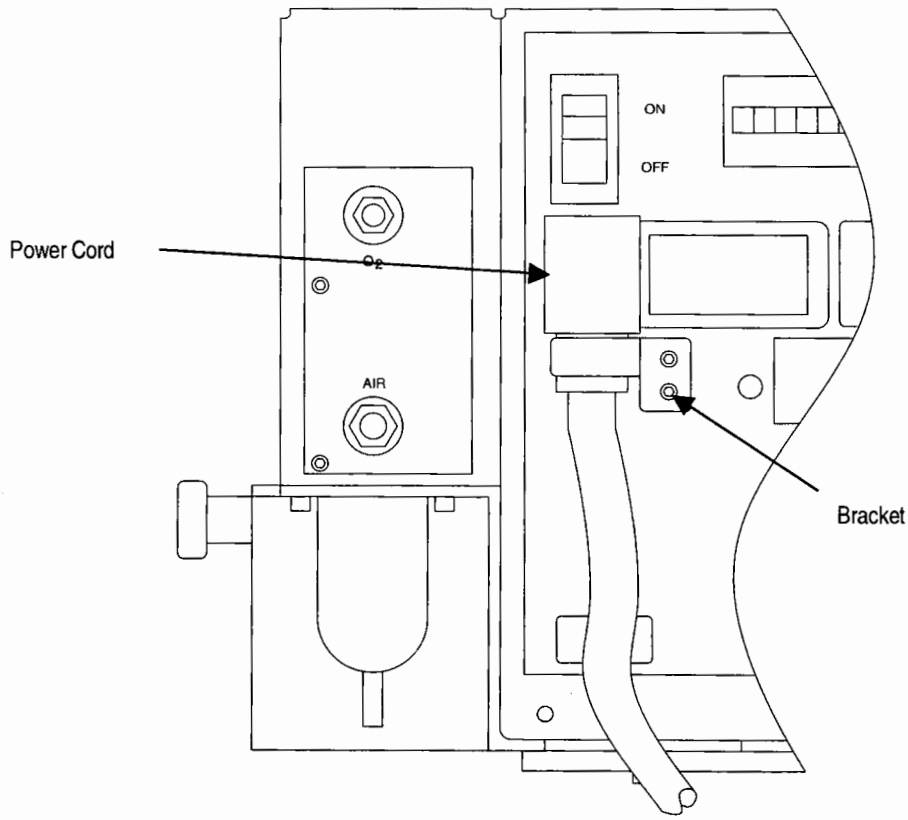


Figure 4-29 Power Cord & Bracket

1. Attach the female end of the power cord to the three (3) pin socket in the power entry module.
2. Using a 9/64" Allen driver, secure the power cord clamp (P/N 06148) using two (2) screws (P/N 04381).
3. The unit is ready for the Calibration and Operation Verification Procedure to be performed. Continue to the next section for the procedure.

Chapter 5 Operational Verification

1.0 Equipment Setup

1.1 Place ventilator on top of worktable. Table should be covered with grounded anti-static mat. Place the anti-static wrist strap around your wrist.

1.2 Make sure the ON/OFF switch is in the OFF position. Using a 9/64" Allen driver remove top cover.

1.3 Connect the pressure gauges to their respective regulators. Connect air and oxygen supply source regulator to their respective gas sources and make certain that pressure regulators are turned full counterclockwise OFF, CLOSED.

1.4 Connect O2 supply hose, P/N 00060 and air supply hose, P/N 02899 to their respective input DISS fittings on the VIP.

1.5 Open and adjust both supply source pressures to 50 PSIG. Set Blender concentration selection knob to 60%.

NOTE

If the Purge Valve (PN 10180) has been removed and replaced, it must be turned counterclockwise, full open to prevent excess pressure to the manometer and in purge system.

2.0 Pre-Operation Check

2.1 This procedure can be conducted without any electrical accessories or test equipment attached to the ventilator: however, normal gas inlet pressure (50 PSIG) and appropriate electrical voltage must be connected to the power entry module. Do not switch the ventilator to the ON position.

2.2 Do not install the exhalation valve body (P/N 10188) or the patient circuit at this time.

2.3 Before performing the Operational Verification Procedure, check and/or calibrate the system manometer adjustment for zero. Check off the Operational Verification Check Sheet (OVCS).

2.4 Connect the master manometer to the tube assembly # 24 by use of a tee fitting. Power the unit ON, if the master manometer does not read 25.0 PSIG ±0.5 then adjust the regulator to read 25.0 ±0.25 PSIG. When regulator pressure is set record the result on the OVCS. When finished turn the VIP OFF. Reconnect tube #24 as before.

2.5 Before turning the unit on, locate DIP switch SW504 on the Main Board. Turn switch # 4 and #8 ON (See Figure 5.1). This will put unit into the Service Diagnostics Test (SDT). Also turn off switches #6 and #7, this will disable Auto Zero Manifold.

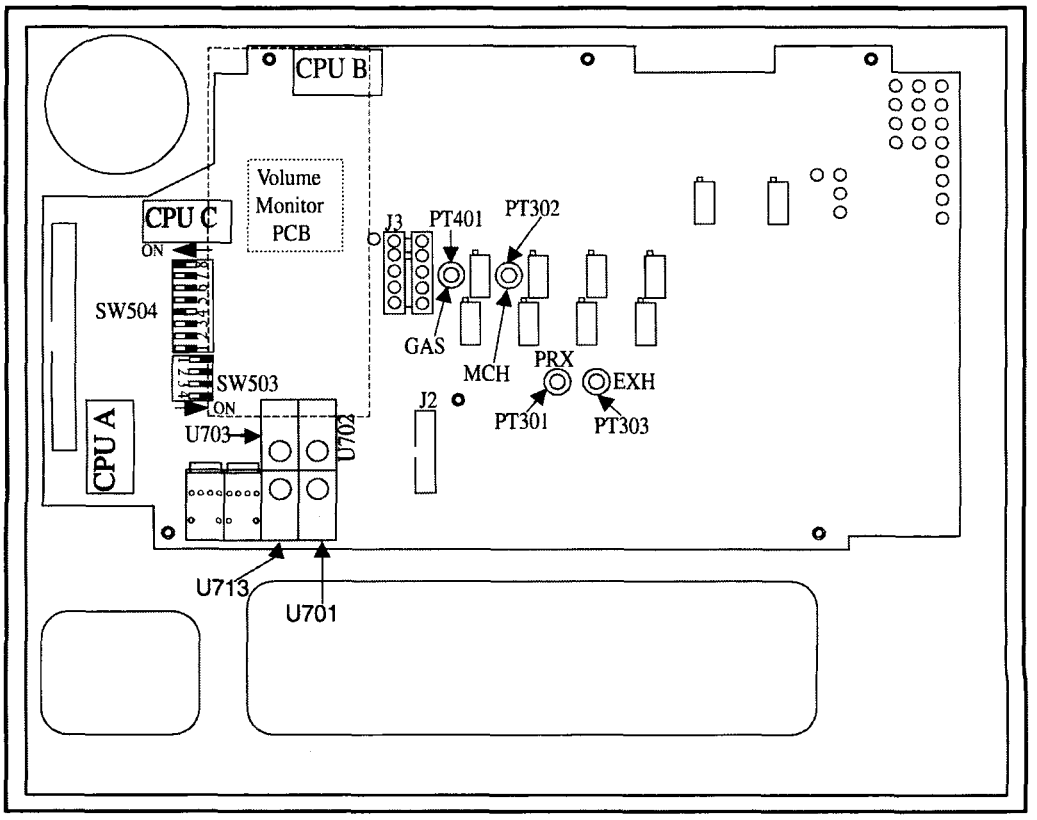


Figure 5.1

3.0 Power Up

3.1 Turn the VIP ON/OFF switch to ON.

3.2 Verify that the Flow Valve "HOMES" within 5 seconds and does not move thereafter. After "HOMING "all seven segment LED displays must cycle through all positions.

3.3 When the seven segment displays have finished cycling, the monitor display will flash the message: **"Caution Remove Patient and Press Select to begin S.D.T."** Check off the OVCS.

3.4 Press the Select button, the monitor display will read "SOFT REV." (Software Revision).

3.5 Activate the Manual Breath button. Monitor display will read "A: XX.XXX". With XX.XXX representing CPU A software revision level. Record the result on the OVCS.

3.6 Activate the Select button. Monitor display will read "B: XX.XXX". With XX.XXX representing CPU B software revision level. Record the result on the OVCS.

3.7 Activate the Select button. Monitor display will read "C: XX.XXX'. With XX.XXX representing CPU C software revision level. Record the result on the OVCS.

3.8 Activate the Select button. Monitor display will read "P: XX.XX". With XX.XX representing PAL (Watchdog Timer) revision level. Record the result on the OVCS.

3.9 Press the Select button. The monitor display will read "V: X.XX". With X.XX representing the software revision for the Volume Monitor Board. Record the result on the OVCS.

3.10 Press the Select button. The monitor display will read "PV: XX.XX". With XX.XX representing the Volume Monitor Pal (Watchdog Timer) software revision level. Record the result on the OVCS.

4.0 Language Test

4.1 Press the Select button: the monitor display will read "LANG TST" (Language Test).

4.2 Press the Manual Breath button: the monitor display will read the user selected language. Check off the OVCS. To check all the language settings. Set the Dip switch SW503 to the following positions for the different languages: (Not Required).

Language Test Setting

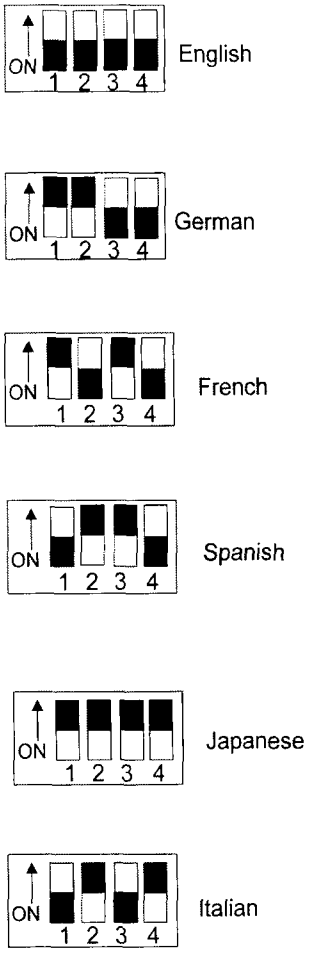


Figure 5.2 Language Dip Switch Settings

NOTE

You must turn the VIP OFF before changing dip switch settings.

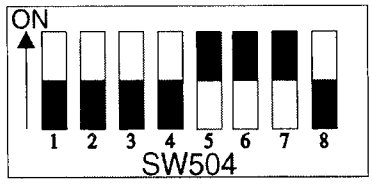
5.0 Apnea Settings Verification

5.1 Press Select button: The monitor display will read "APNE TEST" (Apnea Test).

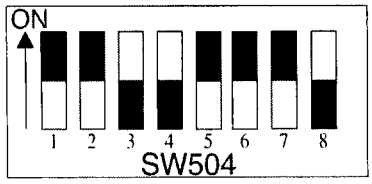
5.2 Press Manual Breath button: the monitor display VM AP XX. XX represents last set value for the Volume Monitor Apnea switch. Repeatedly press and release the Apnea switch on the rear of the unit to scroll the display from 10 to 60 in increments of 5 seconds.

5.3 Press the Select button: monitor display will read the selected Apnea interval for the VIP. This is preset at the factory for 20 seconds. Check off the OVCS. All Backup Apnea interval settings can be checked by setting the proper switches on the eight (8) position dip switch located on the Main Board at SW504. The Backup Apnea time is controlled by position of dip switch #1, #2 and #3. The

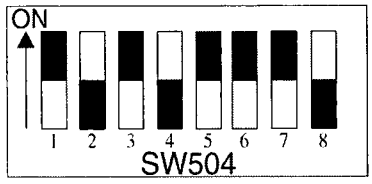
APNEA Setting Test



20 Second



40 Second



60 Second

Apnea Interval settings are as follows:

Figure 5.3 Apnea Interval Settings

6.0 Display Test

6.1 Press the Select button: monitor display will read "Lamp TST" (Lamp Test).

6.2 Press Manual Breath button: All seven-segment display and discrete LED's will light up with the exception of the VENT INOP LED and the EXTERNAL D.C. LED.

6.3 Press Select button: this will execute the second part of the LAMP TST. The second test operates by lighting a single segment in each of the seven segment displays. Then sequencing the lighted segment through each of the segments in a display. This allows the user to ensure that no two segments are shorted to each other. If two segments were shorted, they would either be ON or OFF in a single display. Check off the OVCS.

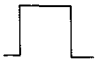
7.0 Control Test

7.1 Activate the Select button. Monitor display will read "CTRL TST". Press the Manual Breath button to activate the control test. There are three parts to the Control Test.

A) Mode Control Test: Rotate the Mode control knob through all the positions. Monitor window will read the following messages as you check the positions:

(S)IMV/CPAP	ASSIST CONTROL
*VAPS: VAPS IMV	TCPL: TIME A/C
Volume: VOL SIMV	*Pressure Control: PCTL A/C
*Pressure Control: PC SIMV	Volume: VOL A/C
TCPL: TIME IMW	* VAPS: VAPS A/C

B) Turn the Volume Mode Waveform switch and the monitor display will read:

For  the display will read: "SQUARE"

For  the display will read: "DECTAPER"

C) Push-button Test: Activate the following push-buttons and verify that the name is displayed in the monitor display:

BUTTONS PRESSED	MONITOR DISPLAY MESSAGE
Manual Breath	BREATH
*Insp	INSPPAUS
*Insp/Exp	I/E HOLD
V	FLOW D/C

Silence	SILENCE
Reset	RESET

D) Control Test: Rotate each control knob on the ventilator. Verifying that the numbers on the respective display increments from minimum to maximum setting. See chart below for control ranges.

CONTROLS	RANGES
Tidal Volume	10 - 1200 mL
Inspire Time	0. 10 - 3.0 seconds
Rate	0 - 150 bpm
Flow	Time Cycle Mode: 3 - 40 Lpm Volume Cycle Mode: 3 - 120 Lpm
Inspiratory Pressure	3 - 80 cmH_20
PEEP/CPAP	0 - 24 cmH20
Assist Sensitivity	1.0 - 20.0 cmH20 OFF
Pressure Support	OFF, I - 50 cmH_2O
PS Time Limit	0. 10 - 3.00 sec.
Low Peak Pressure	OFF, 3 - 120 cmH20
High Pressure	3 - 120 cmH20
High Breath Rate	OFF, I to 300 Bpm
High Tidal Volume	2 - 2.0 L, OFF
Low Min. Vol.	OFF, 0.05 - 30.0 L
*Rise Time	I - 7 sec.
Termination Sensitivity	OFF, 5% - 25% increments of 5%

Once all tests have been completed check off the OVCS. Return to Standard Setting (See step 36.0).

NOTE

These controls are only on the VIP Gold.

8.0 Audible Alarm Loudness Verification

8.1 Press Select button: monitor display will read "AUDIBLE". Press the Manual Breath button: Audible alarm will sound.

8.2 Verify the alarm loudness by using a small standard screw driver, adjust the alarm loudness control (between the Silence and Reset buttons) as follows:

- Minimum: full counterclockwise (CCW)
- Maximum: full clockwise (CW)

8.3 Check off the OVCS when finished checking the alarm loudness.

8.4 Press Select to cancel Audible Alarm. Monitor display will read "XDCR CAL".

9.0 Proximal Purge Pressure Verification

NOTE

Set Mode switch to Assist Control Volume Cycle.

9.1 Tee in a Master manometer to tube #3, this is the system manometer tube.

NOTE

If the proximal pressure adjustment takes more than 10 seconds, the purge flow will stop because the safety valve and solenoid will open. Remove occlusion momentarily to allow the purge flow to restart and complete 60 cmH2O adjustment.

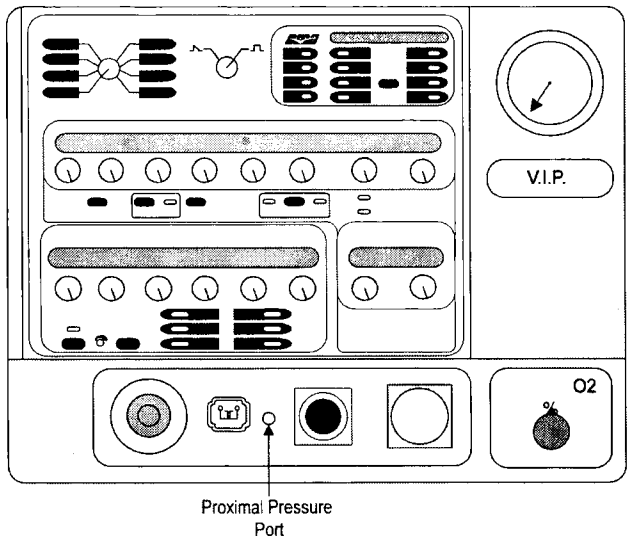


Figure 5.4

9.2 Block the proximal port on the front of the ventilator (see Figure 5.4). Adjust the Purge Valve, (PN 10180) valve stem until the master manometer reads 60 ±3.0 cmH2O. Record the result on the OVCS. Apply torque seal between stem and body of the purge valve.

9.3 Check system manometer, it should read 60 ±3.0 cmH20. If out of specification replace manometer and retest. Check off the OVCS.

9.4 Connect a flow tube or equivalent to the proximal port on the front of the unit. The flow tube should read 0.03 to 0.08 LPM. (See Test Figure 5.3). Check off the OVCS.

10.0 Exhalation Purge Flow Verification

10.1 Take off the Exhalation Valve Body. Connect a flow tube to the Exhalation Pressure Port. (See figure 5.5).

10.2 The Exhalation Pressure port is the hole located to the right. The flow should be 0.03 to 0.08 lpm. Check off the OVCS.

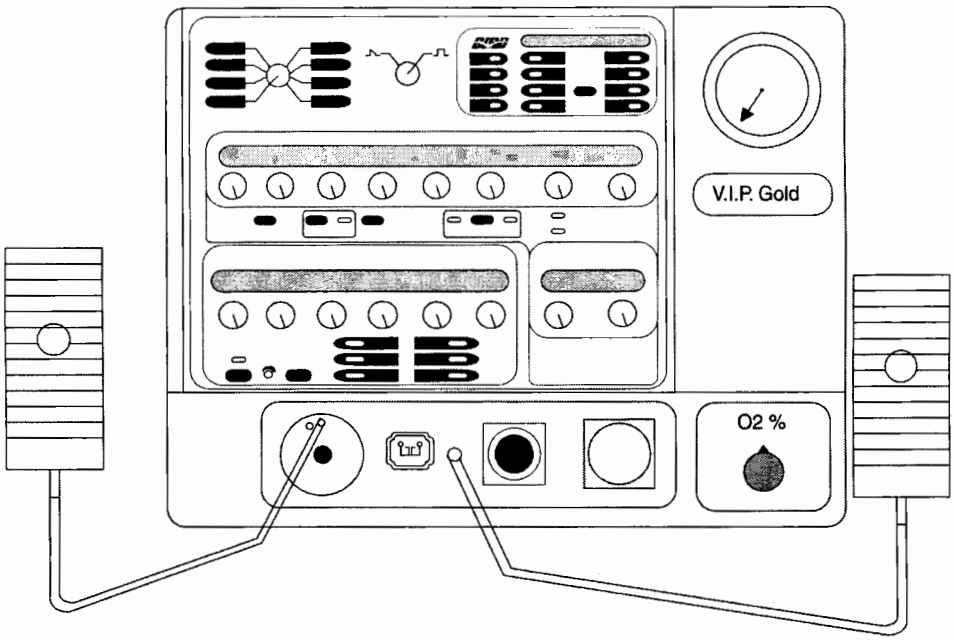


Figure 5.5

11.0 System Pressure Transducer Verification

NOTE

This will check the calibration of the System Pressure, Proximal, Exhalation, and Machine Transducers. By pressing the Select button it will advance the monitor display through the four (4) transducers. The transducer reading being display is indicated by the first character appearing in the monitor display: "S" for System Pressure, "P" for Proximal Pressure, "X" for Exhalation Pressure, and "M" for Machine Pressure.

11.1 With the display monitor showing "XDCR CAL", press the Manual Breath button: monitor display should read S 25.0 ±0.5 PSIG.

NOTE

The unit must warm up for 30 minutes with the cover in place before the transducers can be adjusted

11.2 Attach a digital multimeter (DMM), set to volts dc between TP402 (positive lead) and TPI01 (ground lead) on the Main PCB (See Test Figure 5.7).

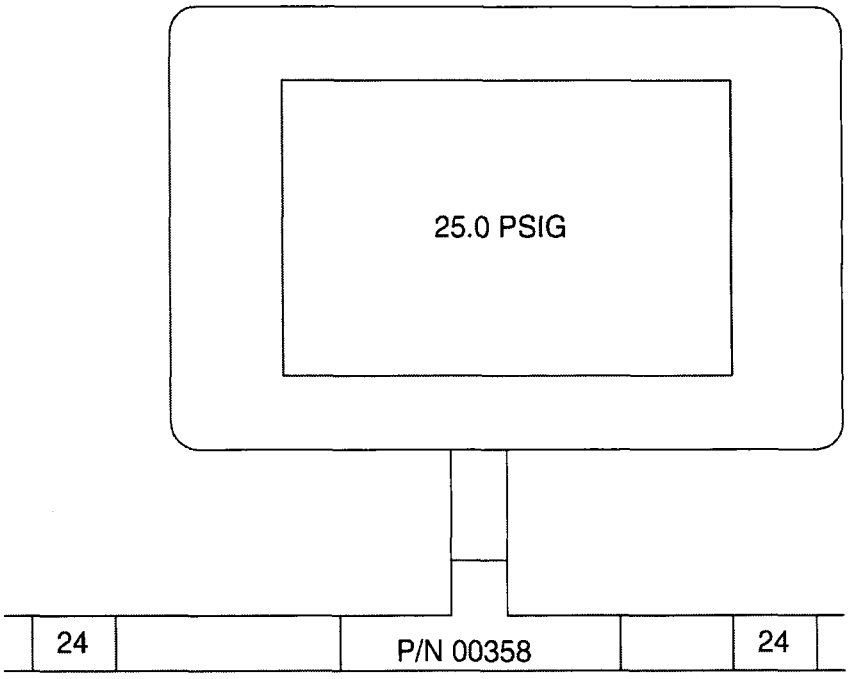


Figure 5.6

11.3 Verify pressure regulator by connecting the master manometer to the tubing assembly tube 924 by use of a tee fitting (see figure 5.6).

11.4 If the master manometer doesn't read 25.0 +/- 0.5 PSIG, then adjust the System Pressure Regulator until the master manometer reads 25.0 +/- 0.25 PSIG.

11.5 Once the System Pressure Regulator is set, then verify the Gas transducer calibration. The DMM should read 4.2975Vdc - 4.4525Vdc. If in specification, record results on the OVCS.

Table 5.1 System Pressure Table

System Pressure (PSI)	Nominal Voltage (Vdc)	Set Point Range (Vdc)
24.5	4.3125	4.2975-4.3275
24.6	4.325	4.315-4.340
24.7	4.3375	4.3225-4.3525
24.8	4.350	4.335-4.365
24.9	4.3625	4.3475-4.3775
25.0	4.375	4.360-4.390
25.1	4.3875	4.3725-4.4025
25.2	4.400	4.385-4.415
25.3	4.4125	4.3975-4.4275
25.4	4.425	4.410-4.440
25.5	4.4375	4.425-4.4525

11.6 If the gas transducer is out of specification, then adjust R442 until the DMM reads 4.375 Vdc (System Pressure regulator setting). Record the result on the OVCS.

Note

See Test Figure 5.7 for the Main board layout of the Test Points (TP), Potentiometer (Pot), and Pressure Transducer (PT) location. There are two types of Main boards, P/N 50920 (VIP Sterling), and P/N 50880 (VIP Gold).

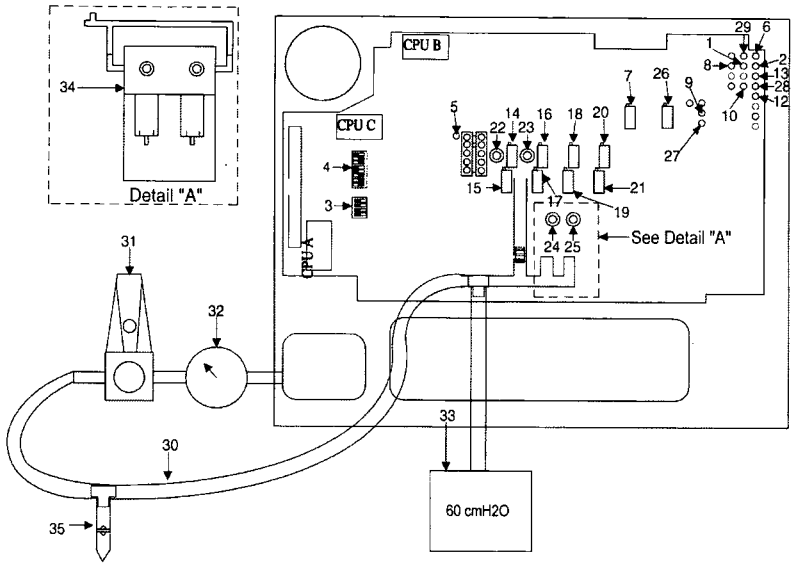


Figure 5.7 Main PCB layout

Table 5.2 Figure 5.7 Identification Numbering

1.	TP1005	20.	R342 Full Scale (Span) Adjust for the Exhalation Transducer.
2.	TP1004	21.	R349 Zero Adjust for the Exhalation Transducer
3.	SW503	22.	Gas Transducer PT401.
4.	SW504	23.	Machine Transducer PT302.
5.	TP104	24.	Proximal Transducer PT301
6.	TP1003	25.	Exhalation Transducer PT303
7.	RI013 Adjustment for Flow Valve Reference Voltage	26.	R204 Adjustment for Open Potentiometer Detection Circuit.
8.	TP 10 1 Ground for all test point readings.	27.	TP402
9.	TP803	28.	TP301
10.	TP401	29.	TP306
11.	TP3 10	30.	Pressure Transducer Test Harness
12.	TP309	31.	Flowmeter
13.	TP308	32.	P/N 0077 Inline manometer
14.	R442 Full Scale (Span) Adjust for the Gas Transducer	33.	Master manometer
15.	R449 Zero Adjust for the Gas Transducer.	34.	Auto Zero manifold(mounted on the Transducer.
16.	R330 Full Scale (Span) adjust for the Machine Transducer	35.	Bleed **(Do not block, will damage transducer)**.
17.	R337 Zero Adjust for the Machine Transducer.	.	
18.	R318 Full Scale (Span) Adjust for the Proximal Exhalation		
	Valve).		
19.	R325 Zero Adjust for the Proximal Transducer.		

11.7 Once the System Pressure Transducer and the System Pressure Regulator are set, they must be within 0.25 PSIG of each other.

12.0 Proximal Pressure Transducer Zero Verification

12.1 Press the Select button: the Monitor display will read P 0.00 +/- 1.00 cmH2O. If the reading is within specification check off the OVCS. If not, calibrate the transducer as follows.

12.2 Locate R325, the zero adjustment potentiometer for the proximal transducer. Adjust the potentiometer until the monitor display reads 0.00 +/- 0.25 cmH2O.

13.0 Exhalation Pressure Transducer Zero Verification

13.1 Press Select: the monitor should read X 0.00 +/- 1.00 cmH2O. If the reading in within specifications, check off the OVCS. If not, calibrate the transducer as follows.

13.2 Locate R349, the adjustment potentiometer for the exhalation pressure transducer. Adjust the pot until the monitor display reads 0.00 +/- 0.25 cmH2O. Check off the OVCS

14.0 Machine Pressure Transducer Zero Verification

14.1 Press the Select button: monitor display must read M 0.00 ±2.00 cmH2O. If in specification then record the result on the OVCS. If transducer is out of specification then calibrate as follows.

14.2 Locate R337, the zero adjustment pot for the Machine Transducer. Adjust R337 until the monitor display reads 0.00 ±0.25 cmH2O. Check off the OVCS.

15.0 Auto Zero Manifold Operation Verification

15.1 Turn VIP OFF. Attach Pressure Test Harness (P/N 10388) to the flowmeter as shown in Test figure 5.

15.2 Connect two tubes of the Transducer Test Harness (P/N 10388) to the Auto Zero Manifold exhaust ports (See Test Figure 5.5 "A"). Refer to schematic 90765. Remove tube #35, attach the test harness to the Machine transducer. Tee in Master manometer as shown in Test Figure 5.

15.3 Locate SW504 turn switch #6 and switch #7 to the ON position and #4 and #8 to the OFF position. Slowly open the flowmeter until the master manometer reads 10.0 cmH20. Turn the VIP ON.

15.4 Monitor display will read "Auto Zero Error". Check off the OVCS. Turn the VIP OFF. Turn the flowmeter to the off position. Locate SW504 turn #6 and #7 to the OFF position and #4 and #8 to the ON position. Turn the VIP ON again.

NOTE

Leave Transducer Test Harness (P/N 10388) attached to the ventilator.

15.5 Press the Select button until monitor display reads "XDCR CAL". Then press the Manual Breath button.

16.0 Proximal Pressure Transducer Span Verification

16.1 Press Select button twice: monitor display will read P 0.00 ± 1.00 cmH20.

16.2 Slowly open the flowmeter until Master manometer reads 50.00 ±0.25 cmH20.

16.3 Monitor display must read P 50.00 ±1.00 cmH2O. If in specification, then record the result on the OVCS. If the transducer is out of specification then, calibrate per step 16.4.

16.4 Locate R318, this is the Full Scale (Span) adjustment for the Proximal Transducer. Adjust R318 until the monitor display reads 50.00 ±0.25 cmH20. Record the result on the OVCS.

17.0 Exhalation Pressure Transducer Span Verification

17.1 Press the Select button: monitor display must read X 50.00 ±1.00 cmH20. If in specification, then record the result on the OVCS. If the transducer is out of specification, then calibrate per step 17.2.

17.2 Locate R342, this is the Full Scale (Span) adjustment for the Exhalation Transducer. Adjust R342 until the monitor display reads 50.00 ±0.25 cmH20. Record the result on the OVCS.

18.0 Machine Pressure Transducer Span Verification

18.1 Press the Select button: monitor display must read M 50.00 ±2.00 cmH2O. If in specification, then record the result on the OVCS. If the transducer is out of specification, then calibrate per step 18.2.

18.2 Locate R330, this is the Full Scale (Span) adjustment for the Machine Transducer. Adjust R330 until the monitor display reads 50.00 ±0.25 cmH20. Record the results on the OVCS.

18.3 Turn flowmeter to OFF and disconnect the Pressure Test Harness from the Machine transducer and the Auto Zero Manifold.

18.4 Press the Manual Breath button: Repeat steps 12.0 to 18.0 to verify the transducer calibration at zero before continuing with the procedure. Remove test harness when testing is complete. Apply torque seal (P/N S 1020) to all the zero and span potentiometers you have adjusted. Reattach tube #35 to the machine transducer.

Table 5-3 Summary of Transducer Calibration

OPERATING SPECIFICATION	TRANSDUCER	CALIBRATING SPECIFICATION
0.00 ± 1.00 cmH20	Proximal Zero	0.00 ± 0.25 cmH20
0.00 ± 1.00 cmH20	Exhalation Zero	0.00 ± 0.25 cmH20
0.00 ± 2.00 cmH20	Machine Zero	0.00 ± 0.25 cm.H2O
50.00 ± 1.00 cmH20	Proximal Span	50.00 ± 0.25 cmH20
50.00 ± 1.00 cmH2O	Exhalation Span	50.00 ± 0.25 cmH20
50.00 + 2.00 cmH20	Machine Span	50.00 ± 0.25 cmH20

19.0 Volume Monitor EPROM Initialization

19.1 Press Select button: monitor display will read VM E2INI. ***There is* no *test procedure to perform at this step.*** This is an assembly only test. Pressing any key other then Select will cause the calibration of the volume monitor board to be erased.

20.0 Volume Monitor Balance Test

20.1 Press Select button: monitor display will read VM TR BL. ***There is* no *test procedure to perform at this step.*** This is an assembly only test. Pressing any key other then Select will cause the calibration of the volume monitor board to be erased.

21.0 Volume Monitor Flow Transducer Calibration

21.1 Press the Select button: monitor display will read VM F CAL. This is the volume monitor transducer calibration.

21.2 Press the Manual Breath button: monitor display will read 0 F-CAL. Press Select to scan through the three transducer. The monitor display will read 0 F-CAL, HP F-CAL and LP F-CAL.

NOTE

Do not have a flow sensor or test harness connected to the unit.

21.3 Disconnect the two tubes 14 & 17 from the transducer assembly on the Volume Monitor PCB.

21.4 Press the Select button until the monitor display reads 0 F CAL. Press the Manual Breath button. The monitor display will read 0.000 +/- 0.008 cmH2O.

21.5 Press the Manual Breath button to calibrate the transducer for zero. The monitor window will read **0 F CAL OK.** Check off the OVCS.

21.6 Press the Select button: monitor display will read **HP F-CAL**. Press Manual Breath button. Tee a low pressure source to a master manometer and the transducer PI port (see figure 5.8A)

21.7 With the 2.000 cmH_20 applied to the transducer test harness, the monitor display should read 2.000 +/- 0.028. If in specification then record the result on the OVCS. If the transducer is out of specification then calibrate per step 21.8.

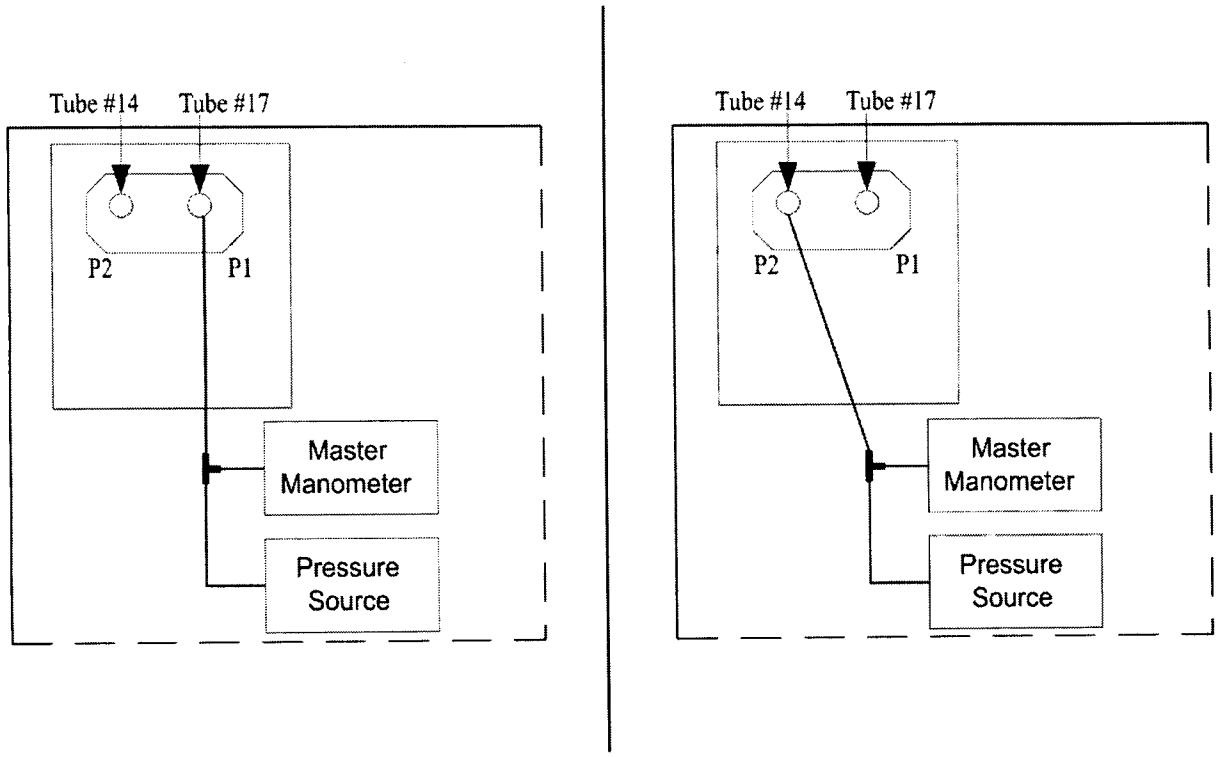
21.8 If the reading in the monitor display is out of specification, then press the Manual Breath button to calibrate the transducer for 2.000 cmH20. The monitor window will read **HP F CAL OK** Check off the OVCS.

21.9 Press the Select button: monitor display will read **LP F-CAL**. Tee a low pressure source to a master manometer and the transducer P2 port (see figure 5.8B).

21.10 With the 2.000 cmH20 applied to the transducer test harness the monitor display should read 2.000 +/- 0.028. If in specification, record the result on the OVCS. If the transducer is out of specification, calibrate per step 21.11.

21.11 If the reading in the monitor display is out of specification, press the Manual Breath button to calibrate the transducer to the 2.000 cmH20. The monitor window will read **LP F CAL OK**. Check off the OVCS.

21.12 Disconnect the transducer test harness. Press the Select button: monitor display will read **0 F-CAL**. Repeat steps 21.2 to 21.10, verify the calibration points. Once the transducer calibration is complete, press the Reset button to continue.



Figures 5.8A & 5.8B

22.0 Volume Monitor Purge Verification

22.1 The monitor display will read **VM PURGE**. Connect the Transducer Test Harness and test lung (P/N 10107) to the V.I.P. as shown in figure 5.9.

22.2 Press the Manual Breath button. This will activate the purge function. The flow tube must read greater then 10 cmH_2O less then 3 0 cmH_2O. Check off the OVCS.

22.3 Once the purge function is done, the monitor display will read **PRG DONE**. Disconnect the Transducer Test Harness and flow tube from the unit. Reattach tube # 14 and # 17 to the transducer.

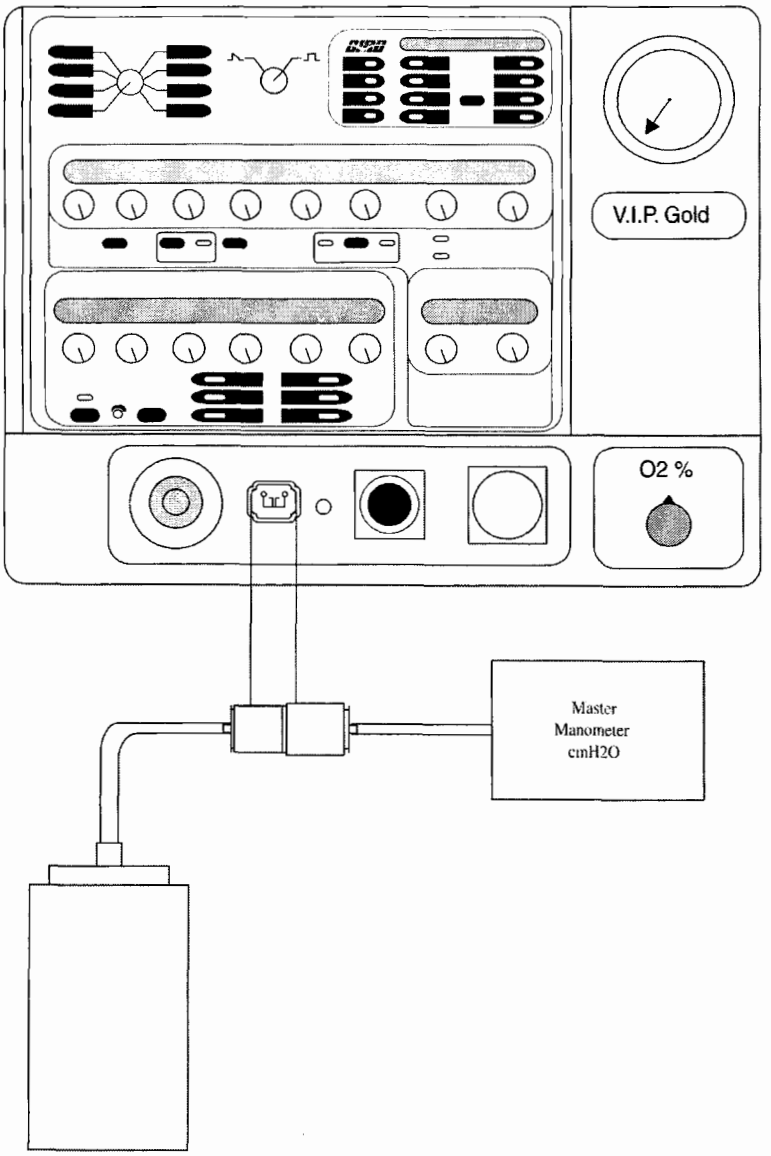


Figure 5.9

23.0 Volume Monitor Solenoid Leak Test

23.1 Press the Select button, the monitor display will read **VM SL CK**. Connect an Infant flow transducer P/N 15678 to the ventilator. See figure 5.10

23.2 Press the Manual Breath button. The monitor display will read "PRESS SELECT TO START VM SL CK". Press Select to start the test. When the ventilator passes the test, the monitor display will read **SL PASS**. Check off the OVCS. Disconnect the Infant flow transducer P/N 15678 from the ventilator.

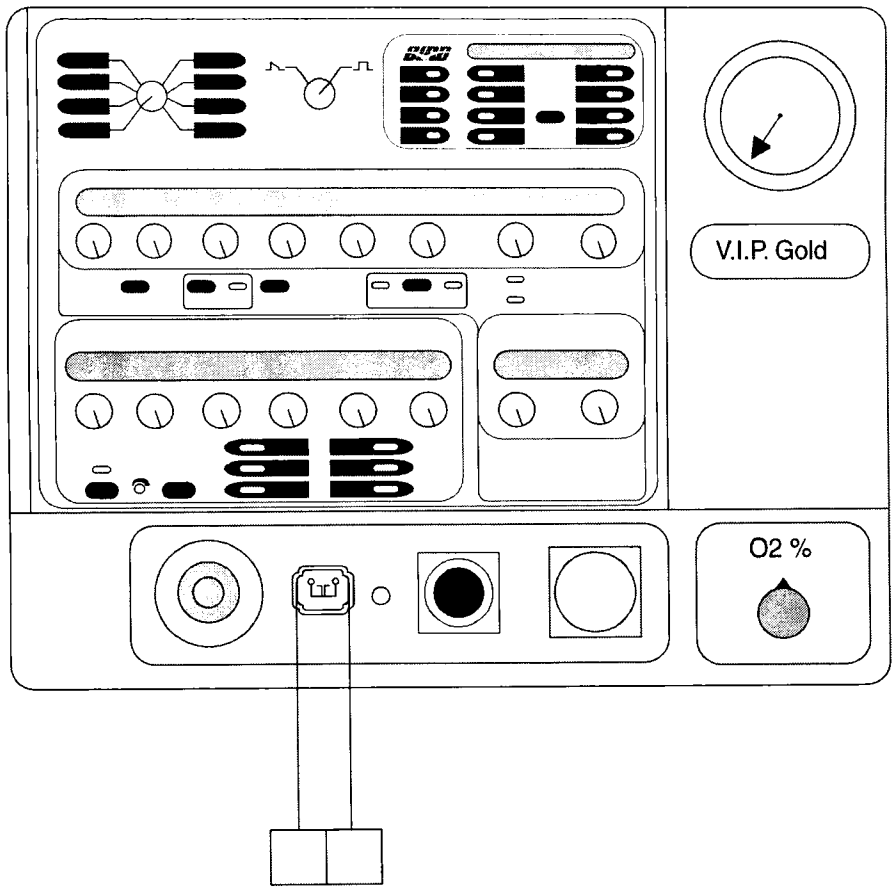


Figure 5.10

24.0 Volume Monitor Event Code Verification

24.1 Press the Select button, the monitor display will read **VM Event.** Press the Manual Breath button.

24.2 The monitor display will now show a number representing the last event code detected by the Volume Monitor. See Appendix B for a complete list of error and event codes. Record any event codes found and repair as needed. Check off the OVCS.

25.0 Volume Monitor Fiber Optic Loopback Test

25.1 Press the Select button, the monitor display will read **VM FOTST**. Press the Manual Breath button, the monitor displays will flash **CONNECT VM LOOP PRESS SELECT**.

25.2 Remove fiber optic cable from Volume Monitor PCB locations U9 and U 12. Connect the fiber optic test cable P/N 09528 between fiber optic ports U9 and U12 on the Volume Monitor PCB. Press the Select button, the monitor display will read **TESTING**.

25.3 After testing is complete the monitor display will read **RECONNECT VM BOARD PRESS SELECT**. Reconnect the fiber optic cables to the Volume Monitor PCB. Press the Select button. If the unit passes then the monitor display will read **VMF PASS**. Check off the OVCS.

25.4 If the unit fails the monitor display will read **VM FAIL.** Press the Select button until the monitor display reads **VM FOTST** and repeat the test.

26.0 Open Potentiometer Detection Circuit Verification

26.1 Connect the Digital Multimeter (DMM) ground lead to TP 101 (See test figure 5.5) and positive lead of the DMM to TP301.

26.2 Make note of the voltage measurement from TP 301. Now take that voltage and add 0.10 volts to the measurement.

i.e. TP 301 measures 8.05 + 0.10 = 8.15. This is the VPOT reference voltage. That is the voltage for TP 306.

26.3 Connect positive lead to TP 306. The voltage must be the same as the calculated VPOT reference voltage. If the voltage at TP 306 is not the same as VPOT reference voltage calculated then adjust R204 until the voltage is the same.

26.4 Record the value of VPOT reference voltage, TP 306 on the OVCS.

27.0 Fiber Optic Link Verification

27.1 Remove fiber optic cables from the Volume Monitor PCB at locations U9 and U12. Connect these two fiber optic cables together using a fiber optic coupler.

27.2 Press Select button: monitor display will read "FIBR TST". Press Manual Breath button: This test will check the integrity of the fiber optic link system. This test will run approximately 30 seconds. VAPS/PS TIME LIMIT and LOW PEAK PRESSURE display will flash and three dashes between the two controls. If the expected data does not appear, the monitor display will read "Fail XXX". Every 32 milliseconds, the monitor display will indicate which data failures appear from 0 to 999 (XXX are these numbers). If the test executes properly, the display will show the message "FIBR PASS". Check off the OVCS. Reconnect the fiber optic cables to the Volume Monitor PCB.

28.0 Exhalation Valve Drive Current Verification.

NOTE

Ventilator must be on the ventilator stand or on a 7 degree angle (slanted back) for this test.

28.1 Turn the VIP OFF. Unplug the Exhalation Valve from the power board at J202. Plug current measuring test fixture (P/N 15137) into the power board at J202.

28.2 Plug Exhalation Valve into the current measuring test fixture. Connect the DMM to the current measuring test fixture. Set DMM to 200 mA reading.

28.3 Turn the unit back on again. Press the Select button until the monitor display reads "XVLV TST" (Exhalation Valve Test). Set Low Peak Pressure alarm to 10 cmH20- Press Manual Breath button: monitor display will read "XVLV CAL".

28.4 DMM must read 181 ±2.0 mA. If DMM reads out of specification, calibrate per step 28.5. If not record the result on the OVCS.

28.5 Locate pot R262 on the Power PCB (P/N 50160). The pot will be on the component side of the board. Adjust the pot until the DMM reads 181 ±0.25 mA. Record the result on the OVCS.

28.6 Turn the VIP OFF. Disconnect the DMM from the test fixture. Disconnect the Exhalation Valve cable from the test fixture. Disconnect the test fixture from J202. Do not reconnect the Exhalation Valve to J202. Turn the VIP back ON.

29.0 Flow Valve Reference Voltage Verification

29.1 Press the Select button until monitor display reads "FLOW POS". Set Breath Rate to 10. Press the Manual Breath twice until the monitor display reads "FLOW CAL". The Flow Valve should be de-energized.

29.2 Connect DMM ground lead to TP 101, and the positive lead to TP 1003. Right down the measured voltage on a piece of paper. Now connect the positive lead to TP 1004. Right down the measured voltage on a piece of paper.

29.3 The average of TP 1003 and TP 1004 should show about the same voltage 2.5 Vdc. Connect the positive lead to TP 1005 should be 2.5 ± 0.2 Vdc. (the average of TP 1003 and TP 1004). If in specification, record the result on the OVCS.

29.4 If out of specification, adjust pot R1013 until TP 1005 is the same as the average of TP 1003 and TP1004 ± 0.05 Vdc. Record results on the OVCS.

30.0 Watchdog Test

30.1 Press Select: monitored display will read WDOG TST. Press the Manual Breath button.

30.2 The ventilator will go VENT INOP. The monitor display will read WDOG XXX Where XXX is the millisecond counter. The timer is considered within tolerance if the counter reads 100 ± 32 milliseconds. Check off the OVCS.

30.3 Turn the unit OFF and press the Silence button. Locate dip switch SW504. Set switch #4 and #8 to OFF position.

30.4 Turn dip switch #6 & #7 to ON position for the Auto Zero Manifold. Make sure Dip switch #5 is turned ON for the auto scan function for the monitor display.

31.0 Transducer Zero Test Verification

31.1 Attach test circuit, P/N 10383 to ventilator as in Figure 5.11, except for the test lung.

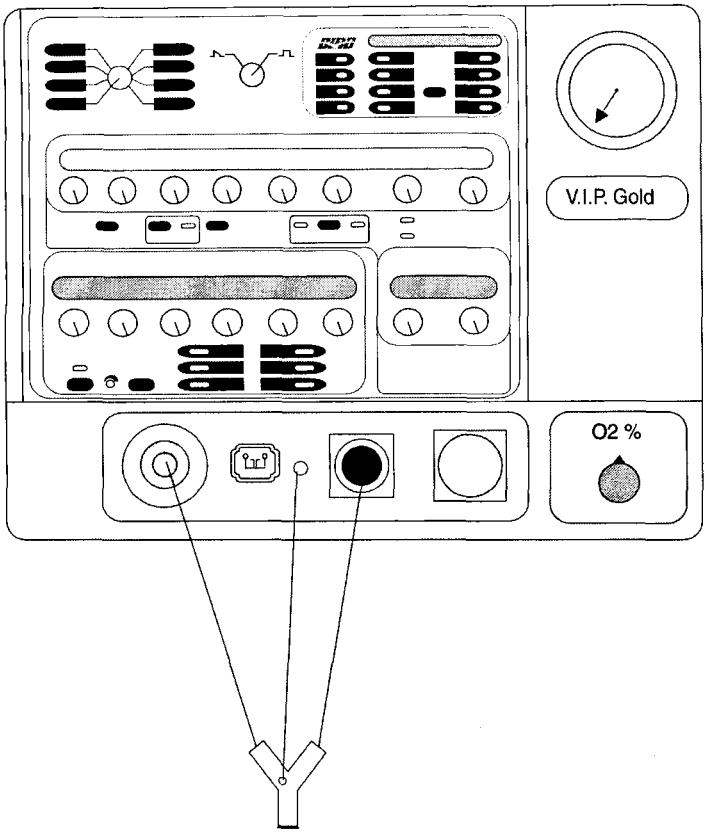


Figure 5.11

31.2 Press and hold the Select button then power up the ventilator. Hold the Select button until the monitor window reads 226. Press Select until the monitor display reads "0 TST". The ventilator will proceed to test the three pressure transducers under a no flow condition. After 1.0 second, the results of the test can be obtained by pressing the Select button again. If the unit passes, the message "0 PASS" will appear in the monitor window. If any transducer fails the test, one of the following messages will appear in the monitor window:

PRX FAIL

EXH FAIL

MCH FAIL

These messages are for the Proximal, Exhalation, and Machine transducers respectively. Check off the OVCS once the test is completed.

32.0 Pressurized Circuit Test

32.1 Activate the Select button. The monitor window will flash "PRSR TST BLOCK PATIENT WYE PRESS SELECT". The patient wye must be blocked in order to close the patient circuit. Once this is done then press the Select button. The monitor window will read "TESTING". The ventilator will pressurize the circuit to a minimum of 55 to 65 cmH20. If this should not occur within five seconds, the message "LOW PRSR" will appear in the monitor window. If pressure is reached within five seconds, the ventilator will proceed to test the three transducers. After approximately eight seconds, the results will automatically be displayed. If the test passes, the message "PRS PASS" will appear in the monitor window. If any transducer fails the test, one of the following messages will appear in the monitor window.

PRX FAIL

EXH FAIL

MCH FAIL

MLT FAIL

(this last message is for more then one transducer failing)

Check off the OVCS once the test is completed.

NOTE

If any portion of this test fails, the Pressure Test will automatically repeat. Press Select and the monitor window will read the message "PRSR TST BLOCK PATIENT WYE PRESS SELECT". The test will be continuously repeated until it either passes or the VIP is reset. To reset the VIP, turn the unit OFF or press the Silence and Reset button at the same time.

33.0 Circuit Leak Test

33.1 Once the Pressurized Circuit Test passes ("PRS PASS"), press the Select button. Using data collected during the pervious test, the ventilator determines the amount of leak in the patient circuit. If this test passes, the message "LEAKPASS" will appear in the monitor window. If the test failed, the message "HIGHFLOW' or "LEAKFAIL" will be displayed. When the Select button is pressed, UVT will return to the beginning of the PRESSURIZED CIRCUIT TEST. The test will be continuously repeated until it either passes or you press Reset to terminate UVT test. Check off the OVCS once the test has passed. Turn the ventilator OFF.

34.0 Jet Pump Test Verification

34.1 Turn the ventilator ON and ***return to Standard settings*** (see step 36.0) except for set PEEP/CPAP to zero. Take off the Exhalation Valve Body. Connect a flowtube to the Jet Pump Port. (See figure 5.12).

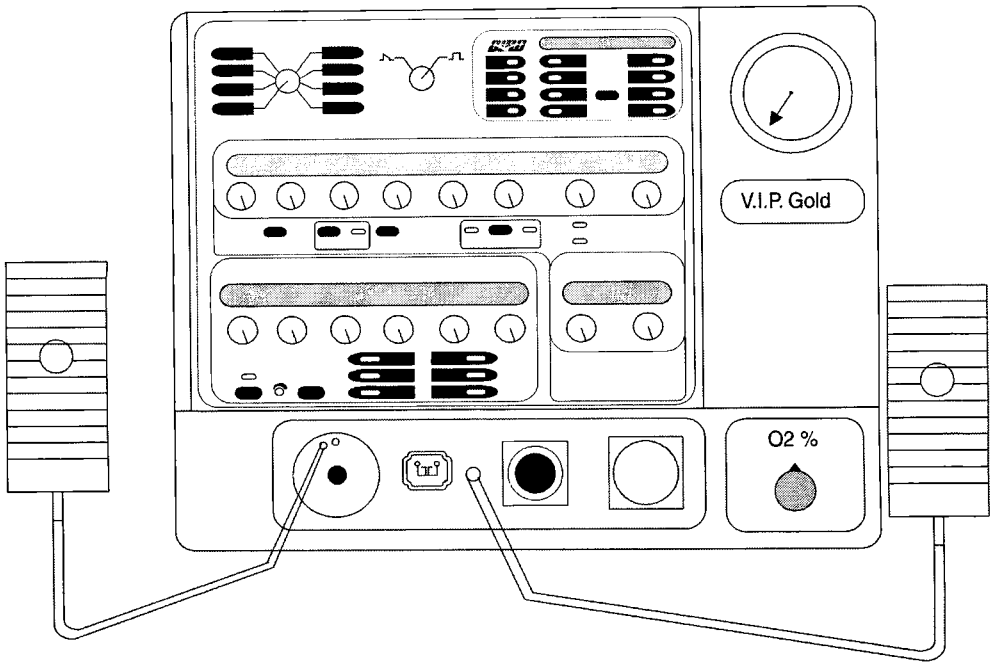


Figure 5.12

34.2 The Exhalation Pressure port is the hole located to the left. The flow should be 4.5 to 9.0 lpm. Check off the OVCS.

34.3 Attach master manometer that reads negative pressure from -10 to +30 in increments of -0.51+1.0 or equivalent to the inlet of the Exhalation Valve Body (See Figure 5.13).

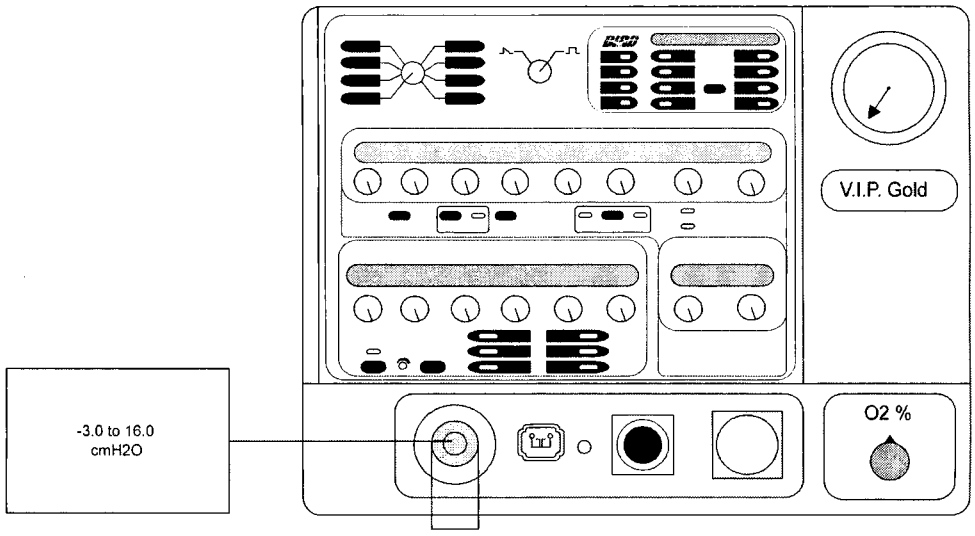


Figure 5.13

34.4 Master manometer reading must be -3.0 to -7.5 cmH_2O. Record the result on the OVCS. Reinstall diaphragm. Turn the VIP OFF and reconnect the Exhalation Valve to J202 on Power Supply PCB. (See figure 5.14).

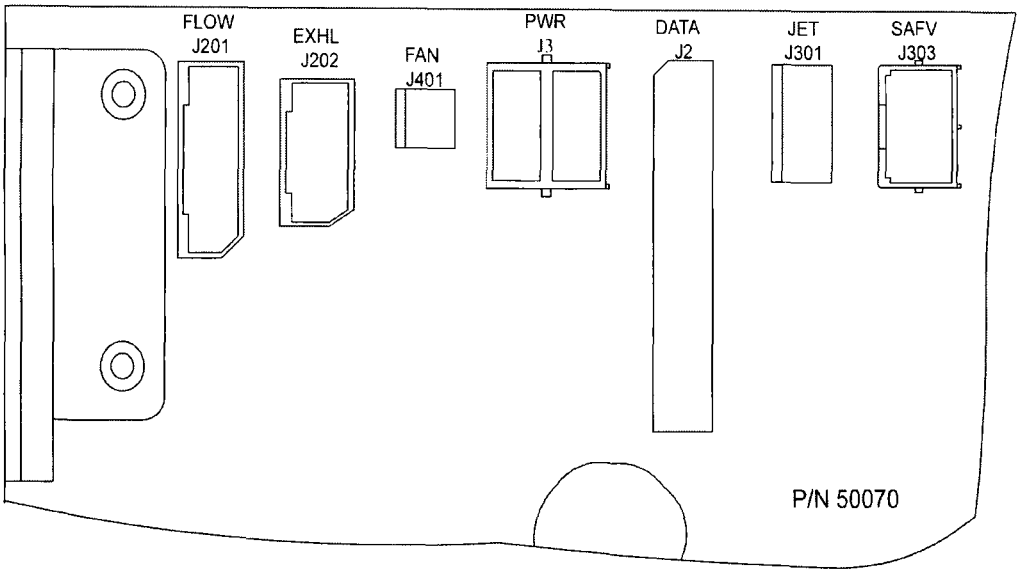


Figure 5.14

35.0 Inspiratory Pressure Verification

NOTE

Ventilator must be on the ventilator stand or on a 7 degree angle (slanted back) for this test.

35.1 Connect Infant Flow Volume Test Harness P/N 10383. ***Return to Standard Settings*** (step 36.0) except for the following:

Do not connect the Pediatric Sensor

Mode	(S)IMV/CPAP (TCPL)
Inspiratory Time	3.00 sec.
Flow	15
Inspiratory Pressure	30
PEEP/CPAP	0

35.2 Allow the ventilator to deliver 5 breaths. Verify that the PIP monitor value (Peak Inspiratory Pressure) is 30 ± 2.0 cm.H_2O. Check off the OVCS.

36.0 Standard Settings

With the ventilator configured in accordance with previous paragraph, set the controls as follows:

Table 5.4 Standard Settings

Mode	(S)IMV/CPAP/PS Volume Cycle	PS Time Limit	---
Volume Mode Waveform	⌐¬	Low Peak Pressure	OFF
Tidal Volume	400 ml	High Pressure	120
Inspiratory Time	---	High Breath Rate	300
Rate	10 bpm	High Tidal Volume	2.0L
Flow	40 lpm	Low Minute Vol.	0.1L
Inspiratory Pressure	---	*Rise Time	---
PEEP/CPAP	5	Termination Sensitivity	---
Assist Sensitivity	OFF	Over Pressure Relief	MAX
Pressure Support	---	02% Concentration	60%
Insp. Pause	OFF	COMP	ON
APNEA (Volume Monitor)	20 sec		
When the instruction: ***Return to Standard Settings*** is given, place all controls as shown above. For the tests that follow the ventilator should be set-up as shown in figure 5.15. Connect the pediatric sensor (P/N 15685). Connect the test lung P/N 33754 to the patient wye.			

** Is a control only on the VIP Gold ventilator.*

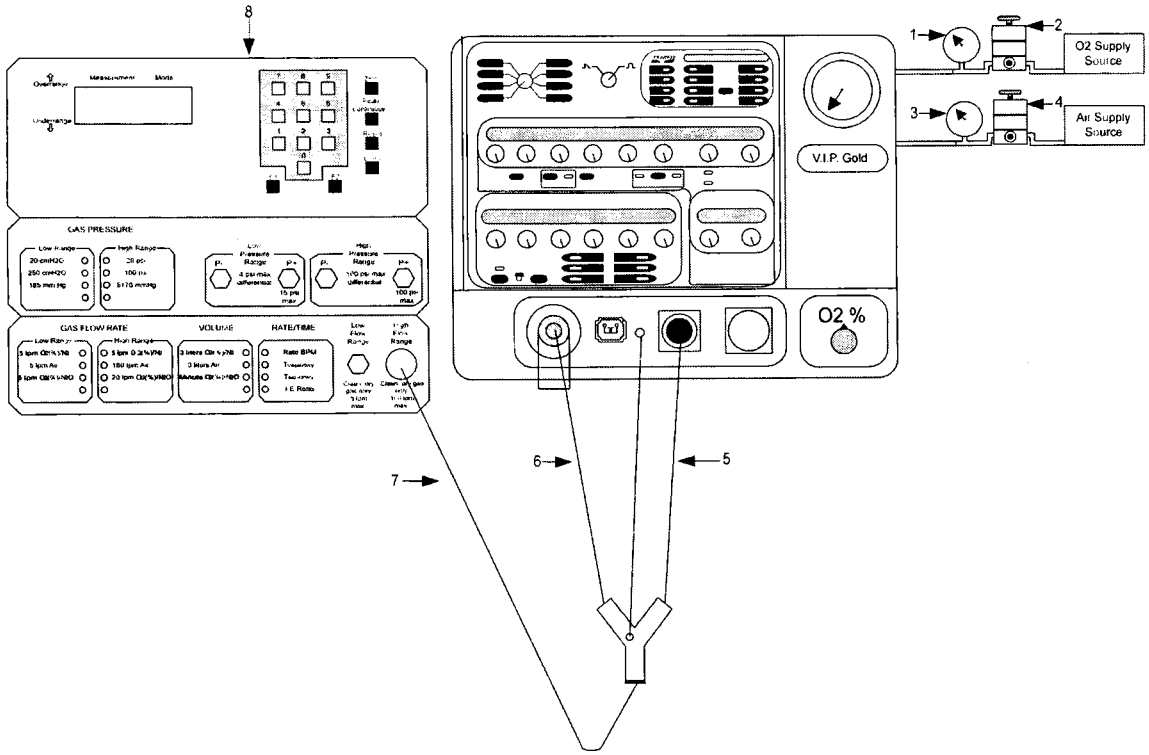


Figure 5.15

1. O2 gauge 0-100PSIG
2. O2 two stage regulator
3. Air Gauge 0-100 PSIG
4. Air two stage regulator
5. Inhalation limb of patient circuit
6. Exhalation limb of patient circuit
7. Section of patient circuit connecting patient wye to the RT-2000
8. RT-200 set for temperature compensation.

37.0 Tidal Volume Verification

37.1 Install test lung P/N 33754. ***Return to Standard Settings*** (See step 36.0), except for the following:

Breath Rate	5
Flow	20
PEEP/CPAP	0
Volume Waveform	

37.2 Between the end of exhalation and before the beginning of the next inspiration, connect the hose from the patient wye and the inlet of the volume measuring device.

37.3 Collect 5 consecutive breaths in the volume measuring device. Disconnect the volume measuring device immediately after the 5th breath to avoid collecting additional purge flow.

37.4 Record the result on the OVCS. For the Flow Valve to pass the test, results must be 2.0 liters 10%.

37.5 Repeat steps 37.3 to 37.4 for the following settings:

37.6 Set Volume Mode waveform to  and Flow to 20Lpm

37.7 Set Volume Mode waveform to  Flow to 30Lpm.

37.8 Set Volume Mode waveform to  Flow to 60Lpm.

37.9 All recorded valves must be 2.0 liters ± 10% for the Tidal Volume readings.

37.10 When you finished the testing then remove the tube between the Exhalation Valve and the spirometer. Leave the patient circuit in place.

38.0 Monitor Display Verification

38.1 ***Return to Standard Settings.*** Let the ventilator deliver about five breaths before checking the values.

NOTE

*Turn the Bias Flow OFF before advancing to step **38.2.***

38.2 Activate the Select button until Peak Inspiratory Pressure (PIP) LED is lit then the monitor display will read 25 cmH_2O +/- 10. Check off the OVCS.

38.3 Activate the Select button, the Mean Airway Pressure (MAP) LED is lit. The monitor display will read 9 cmH_2O +/-2.0. Check off the OVCS.

38.4 Activate the Select button, the PEEP LED is lit. The monitor display will read 5.0 +/- 2.0 cmH_2O. Check of the OVCS.

38.5 Activate the Select button, the BPM LED is lit. The monitor display will read 10 +/- 2.0 BPM. Check off the OVCS.

38.6 Activate the Select button, the Inspiratory Time (Ti) LED is lit. The monitor display will read 0.6 +/- 0.10 seconds. Check off the OVCS.

38.7 Activate the Select button, the I:E Ratio LED is lit. The monitor display will read 1:6.5 to 1:9.0. Check off the OVCS.

38.8 Activate the Select button, the VT LED is lit. The monitor display will read 400 +/- 60 mL. Check off the OVCS.

38.9 Activate the Select button, the VE LED is lit. The monitor display will read 4.0+/- 0.6L. Check off the OVCS.

39.0 Blender Percent Oxygen Concentration Verification

39.1 Set ventilator as follows:

Mode	(S)IMV/CPAP/PS (Time Cycle)
Tidal Volume	—
Inspiratory Time	3.00
Rate	10
Flow	15
Inspiratory Pressure	30
PEEP/CPAP	0
Assist Sensitivity	—
Pressure Support	—
PS Time Limit	—
Low Peak Pressure	OFF
High Pressure	80
High Breath Rate	300
High Tidal Volume	2.01
Low Min Vol.	OFF
*Rise Time	—
Termination Sensitivity	—

NOTE

**This control is on the VIP Gold only.*

39.2 Connect the oxygen sampling hose to the patient wye (See Figure 5.16). Put the other end of the sampling hose into the sampling container. Connect your Oxygen analyzer to the sampling container. Your oxygen analyzer should be calibrated to manufacture specifications.

39.3 Set the 0_2% concentration knob to 21 %. Wait for analyzer to stabilize. The reading should be 21.0% to 22.0%. Record the result on the OVCS.

39.4 Set the 0_2% concentration knob to 30%. Wait for analyzer to stabilize. The reading should be 27.0% to 33.0%. Record the results on the OVCS.

39.5 Set the 0_2% concentration knob to 60%. Wait for analyzer to stabilize. The reading should be 57.0% to 63.0%. Record the result on the OVCS.

39.6 Set the 0_2% concentration knob to 90%. Wait for analyzer to stabilize. The reading should be 87.0% to 93.0%. Record the result on the OVCS.

39.7 Set the 0_2% concentration knob to 100%. Wait for analyzer to stabilize. The reading should be 99.0% to 100.0%. Record the result on the OVCS.

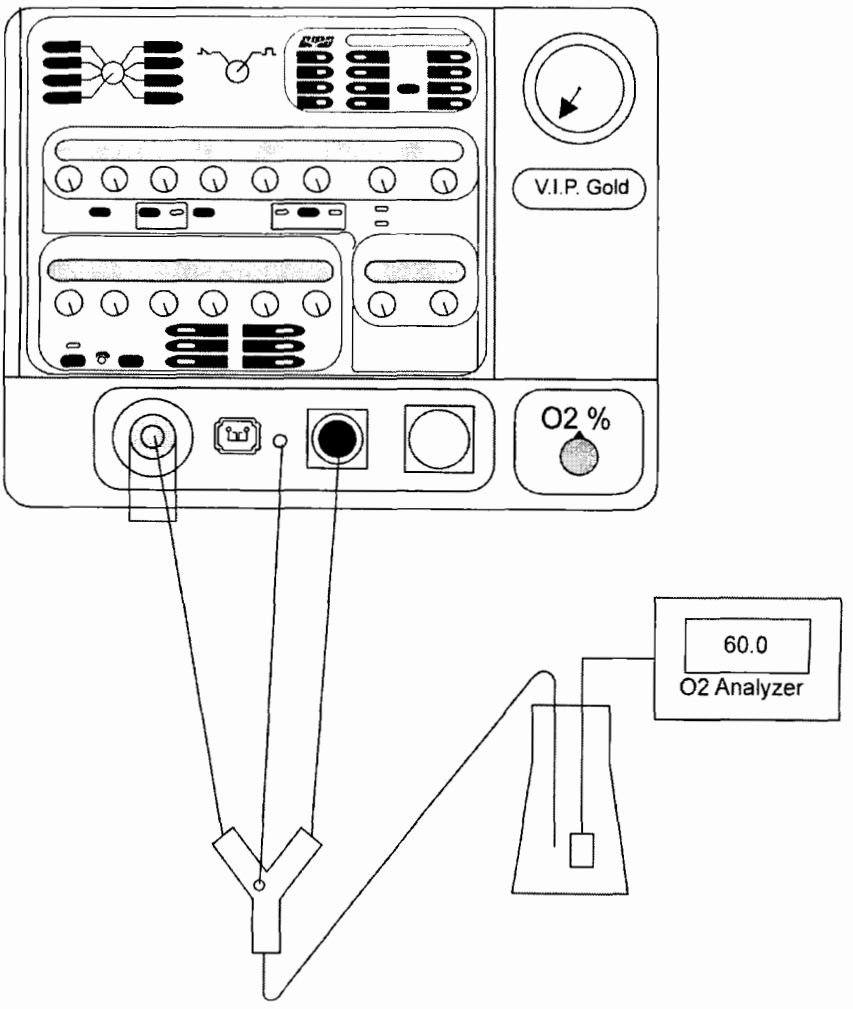


Figure 5.16

40.0 Blender Alarm Verification

40.1 Reduce the air inlet pressure slowly. The blender should alarm at 30 ±2.0 PSIG. Restore the air pressure slowly. The alarm should reset at no greater then 44 PSIG. Check off the OVCS.

40.2 Reduce the oxygen inlet pressure slowly. The blender should alarm at 30 ±2.0 PSIG. Restore the 0_2 pressure slowly. The alarm should reset at no greater then 44 PSIG. Check off the OVCS.

40.3 Remove the 0_2 sample hose and reattach the test lung to the patient wye.

41.0 Manual Breath Verification

41.1 ***Return to Standard Settings.*** Press the Manual breath button. The VIP should deliver one breath. Check off the OVCS.

42.0 Breath Rate Verification

42.1 Set rate to 10. Measure the time interval between breaths using a stopwatch while observing the pressure excursions on the manometer (beginning of inspiration to beginning of next inspiration).

42.2 Verify that the breath interval is 6.0 ±0.2 seconds. This corresponds to 10.0 ±0.3 breaths per minute. Check off the OVCS.

43.0 PEEP/CPAP/Sensitivity/Pressure Support

43.1 ***Return to Standard Settings***, except for the following

Mode	(S)IMV/CPAP/PS Volume Cycle
Tidal Volume	100
Flow	10
PEEP/CPAP	Zero
Breath Rate	Zero
Sensitivity	2
PS Time Limit	3.00

Remove the Pediatric Sensor P/N 15685 and connect the Infant Sensor P/N 15678.

Remove test lung P/N 33754 and attach the Infant test lung P/N 1070

43.2 Squeeze the test lung to create a patient demand. The ventilator should deliver a breath once you have exceeded the Sensitivity setting (2). Watch the system manometer it will read -2 +/-1.0 cmH_2O. Also the patient demand indicator will light. Check off the OVCS.

43.3 Set PEEP/CPAP = 10, and the Pressure Support = 20.

43.4 Squeeze the test lung until the ventilator delivers a breath. Watch the system manometer, it will read PEEP/ CPAP + Pressure Support = 30 +/- 3.0 cmH_2O, Check off the OVCS.

44.0 Manual Over Pressure Relief Verification

44.1 ***Return to Standard Settings***, except for the following: Flow = 20 and PEEP/CPAP = 0.

44.2 Block the patient wye. This is a mechanical test only to verify that the Over Pressure Relief Valve is functional.

44.3 While observing the excursion of the manometer, adjust the Over Pressure Relief Valve counterclockwise until 30 cmH20 is reached. Then adjust the Over Pressure Relief Valve counterclockwise until 20 cmH_2O is reached. Check off the OVCS. Readjust the Over Pressure Relief Valve full clockwise (closed) before continuing on to the next step.

45.0 Apnea/Silence/Reset

45.1 ***Return to Standard Settings.*** Set the Rate to zero. Activate the Manual Breath button. With a stopwatch, measure the time interval between the Manual Breath activation and the audible and visual alarm activation. The time must be 20 ± 2 seconds. Check off OVCS.

45.2 Activate the Alarm Silence button. The elapsed time between the button activation and the alarm reinstatement must be 60 ± 5 seconds. Check off OVCS.

45.3 Activate the Manual Breath button 3 times and the audible alarm must cancel. Activate the Reset button and the visual alarm must cancel. Set the Rate to 10.

46.0 Low Peak Pressure Alarm

46.1 ***Return to Standard Settings.*** Note the value of the peak pressure on the system manometer during the inspiratory cycle of the ventilator.

46.2 Between machine breaths, increase Low Peak Pressure Limit above the noted peak pressure.

46.3 Verify audible and visual alarms activate. Between machine breaths, decrease Low Peak Pressure Limit to OFF, audible alarm cancels, and OFF flashes. Check off the OVCS.

47.0 High Pressure Verification

47.1 ***Return to Standard Settings.*** Set the High Pressure Alarm to 60.0 cmH2O and disconnect the test lung from the unit. Occlude the patient wye.

47.2 Activate Manual Breath button and verify that the High Pressure audible and visual alarms occur at 60.0 ±6.0 cmH2O. Check off the OVCS.

NOTE

The monitor display will flash HIGH PROLONGED PRESSURE.

47.3 Measure the time from the initiation of the alarm to the initiation of the Safety Valve dump. The opening of the Safety Valve is noted by a fast decay of pressure on the system pressure gauge, a "rushing air" sound, and an illuminated "Circ Fault" LED. The time should be 3.0 ±0.5 seconds. Check off the OVCS.

47.4 Verify that the system pressure gauge drops from 60.0 to within 3.0 cmH2O of PEEP within 5 seconds.

47.5 Remove the blockage from the Exhalation Valve Body outlet, verify that audible alarm cancels.

47.6 Press Reset and verify "Circ Fault" cancels and that High Pressure display stops flashing. Check off the OVCS.

48.0 High Breath Rate Alarm

48.1 ***Return to Standard Settings.*** Set the High Breath Rate control below the set Rate. The audible and visual High Breath Rate alarm should activate.

48.2 Set the High Breath Rate control to 300. The audible alarm should reset. Activate the Reset button and the visual alarm will reset. Check off the OVCS.

49.0 High Tidal Volume

49.1 ***Return to Standard Settings.*** Set the High Tidal Volume control to 300mL. The High Tidal Volume audible and visual alarm should activate.

49.2 Set the High Tidal Volume control to 2.OL. The audible alarm should cancel. Activate the Reset button and the visual should cancel. Check off the OVCS.

50.0 Low Minute Volume

50.1 ***Return to Standard Settings.*** Set the Low Minute Volume control to 25.OL. The Low Minute Volume audible and visual alarm should activate.

50.2 Set the Low Minute Volume control to OFF. The audible alarm should cancel. Activate the Reset button and the visual alarm should cancel. Check off the OVCS.

51.0 Electrical Power Disruption

51.1 Remove electrical power from the ventilator.

51.2 Verify audible and visual (Vent Inop indictor will light) Vent Inop alarms activate; also verify Safety Valve opens, Flow Valve closes and Exhalation Valve opens.

51.3 Restore electrical power to the ventilator. Verify the ventilator returns to normal operation (after power-up, self test sequence) and Vent Inop alarms cancel. Check off the OVCS.

52.0 Low Inlet Gas Pressure Alarm

52.1 ***Return to Standard Settings.*** Reduce inlet pressure to 30 PSIG, on the inline gauge.

52.2 Set Pressure Support to 10 cmH2O or above, and Sensitivity to 1.0 cmH2O. Remove inspiratory hose from the patient output port on the ventilator.

52.3 Audible and Visible alarm for Low Inlet Gas & will activate.

52.4 Reconnect inspiratory hose to the ventilator. Restore gas inlet pressure to 50 PSIG. Audible alarm will cancel. Press Reset and the LED will no longer be lit. Check off the OVCS.

53.0 Loss Of Gas Supply

53.1 Remove air and oxygen supply pressure.

53.2 Verify audible and visual Low Inlet Gas alarms activate.

53.3 Restore gas supply pressure. Verify ventilator returns to normal operation. Check off the OVCS.

54.0 Circuit Fault Alarm Verification

54.1 Remove the proximal pressure line from the proximal pressure port on the front of the unit. An audible and visual alarm must activate. Indicator light for Circuit Fault will be lit.

54.2 Reconnect the Proximal Pressure line to the ventilator and press Reset button. The ventilator must return to normal operation. ***Return to Standard Settings***. Check off to the OVCS.

55.0 Electrical Systems Verification

Equipment Required:

- VAC or 0 - 280 VAC variac.
- Multimeter DMM. (AC Voltmeter).

Equipment Setup:

- Turn power ON/OFF switch to OFF.
- Remove ventilator power cord and insert into Variac.
- With Variac ON/OFF switch in OFF position insert Variac power cord into proper grounded receptacle.
- Switch Variac ON/OFF switch to ON and adjust Variac to local power voltage.
- Switch the ventilator ON/OFF to the ON position.

56.0 Electrical Power Tolerance AC Test

56.1 Set the ventilator input power to Minimum AC voltage required for operation. Use the following chart to determine the minimum voltage:

- For 100 volt units85 volts
- For 120 volt units 102 volts
- For 220 volt units 187 volts
- For 240 volt units 204 volts

56.2 Verify unit operates normally for 5 machine breaths. Check off the OVCS.

56.3 Adjust Variac to Maximum AC voltage required for operation. Use the following chart to determine the maximum voltage:

- For 100 volt units 110 volts
- For 120 volt units 132 volts
- For 220 volt units 242 volts
- For 240 volt units 264 volts

56.4 Verify unit operates normally for 5 machine breaths. Check off the OVCS.

56.5 Adjust Variac to "Brown Out" voltage. Use the following chart to determine the Brown Out voltage:

- For 100 volt units 70 volts
- For 120 volt units85 volts
- For 220 volt units154 volts
- For 240 volt units168 volts

56.6 Verify that the ventilator at least briefly shows Vent Inop alarm (audible and visual) activation followed by an attempt to power up and restart. Check off the OVCS.

56.7 Reset the input power to normal voltage and verify unit returns to normal operation. Set ventilator ON/OFF switch to OFF, remove power cord from Variac and silence Vent Inop audible alarm.

57.0 Electrical Power Tolerance DC Test

Equipment Required:

DC Power Supply Source, 12-16 volts, 5 amps (minimum).

Digital multimeter.

PN 08929 Power Source Cable Assembly.

Equipment Setup:

Insert Alt Power Accessory Power Cable connector to socket in rear panel and the DC Power Supply source fitting.

57.1 Set AC Line/Alt Pwr AC/DC switch to Alt Pwr position (switch is on the rear panel).

57.2 Set the DC voltage to minimum voltage, 12 volts. Turn the Power Supply ON/OFF switch to the ON. Verify normal operation for 5 breaths. The External DC LED indicator must be lit. Check off the OVCS

57.3 Set the DC voltage to maximum, 16 volts. Verify normal operation for 5 breaths. The External DC LED indicator must be lit. Check off the OVCS .

57.4 Turn the Power Supply ON/OFF switch to OFF. Disconnect DC power cord. Set AC Line/Alt Power switch back to AC Line position. Insert ventilator power cord into proper grounded voltage receptacle. Turn the ventilator ON. It should return to normal operation after the initial start up.

58.0 Ground Continuity

58.1 Measure ground continuity between power cord ground and socket head cap screws on the bottom of the unit.

58.2 Verify ground resistance is less than 0. 1 ohms. Record the result on the OVCS.

59.0 Leakage Current

59.1 Check for maximum leakage current by comparing Normal and Reverse Polarity in both Normally Open, and Normally Closed ground conditions.

59.2 Verify leakage current for Normal Polarity and Closed Ground (N/C) is less then 100 microamps. Record the result on the OVCS.

59.3 Verify leakage current for Normal Polarity and Open Ground (N/O) is less then 100 mircoamps. Record the result on the OVCS.

59.4 Verify leakage current for Reverse Polarity and Closed Ground (R/C) is less then 100 microamps. Record the result on the OVCS.

59.5 Verify leakage current for Reverse Polarity and Open Ground (R/0) is less then 100 mircoamps. Record the result on the OVCS.

60.0 Dielectric Test

NOTE

You need only to perform this test if you disconnect the Transformer primary wires from the Power Entry Module.

CAUTION

High voltages are present during this test "DO NOT TOUCH!!!" the ventilator or the power cord while test is in progress.

60.1 Plug power cord of the ventilator into the Hi-pot tester receptacle.

60.2 Set the Hi-pot tester voltage to 1200 VAC and the duration to 1.0 second. Leakage current setting of tester must be set to trigger at an equivalent resistance of 120K ohms.

60.3 Press start button for about 2 seconds. Check the insulator failure indicator. Record the result on the OVCS.

60.4 Unplug power cord from the tester. Make sure the tester if OFF before you touch the power cord.

61.0 Final Assembly and Cleaning

61.1 Clean the top cover before you re-install it on the ventilator.

61.2 With the top cover in place you need to clean the front and back panel. Spray cleaner on a rag then wipe the unit.

61.3 Check that the input power module has been configured to the correct power before you ship the unit.

61.4 Check to see that the OVCS is completely filled out. List all critical components you have replaced in the unit. Read the release and then sign the unit off as being finished.

62.0 Instructions on Completing the OVCS

62.1 Fill out the Date of the testing.

62.2 Record the number of hours the unit has on it at the time of the testing.

62.3 Write in the Model Number and Serial Number.

62.4 Check off the model type, Sterling or Gold and if you are checking a Front Panel.

62.5 Record the results for the test performed. Check Pass or Fail. If the unit fails, mark the corrective action taken on the check sheet.

62.6 Do a general inspection of the unit. Check and clean all exterior parts.

62.7 Read, sign and date the Operational Verification Check Sheet when you have completed the testing of the unit. Unit must be signed off before the unit can be returned to service.

V.I.P. Gold/Sterling Infant-Pediatric Ventilator Operational Verification Check Sheet

This Check Sheet may be duplicated for use

Hours: _____ M/N : _____ S/N : _____ S/C : _____

☐ VIP Sterling ☐ VIP Gold ☐ VIP Sterling Front Panel ☐ VIP Gold Front Panel

Section 1

Procedure reference	Description	Record Value		Pass	Fail
2.3	Manometer 0 adjust	XX	XX		
2.4	Adjust regulator 25.0 +/- 0.25 PSIG	R			
3.3	Power-up self test verification	XX	XX		
3.5	CPU A version	R			
3.6	CPU B version	R			
3.7	CPU C version	R			
3.8	PAL version	R			
3.9	Volume Monitor software version	R			
3.10	Volume Monitor PAL version	R			
4.2	Language test	XX	XX		
5.3	Apnea interval setting, Volume Monitor & VIP	XX	XX		
6.3	Display illumination test part 1 and part 2	XX	XX		
7.1	Control test	XX	XX		
7.1	Control range end points	XX	XX		
8.3	Alarm loudness verification	XX	XX		
9.2	Proximal purge 60.0 +/- 5.0 cmH2O	R			
9.3	System manometer check 60 +/- 3.00 cmH2O	XX	XX		
9.4	Proximal line purge flow 0.03 to 0.08 LPM	XX	XX		
10.2	Exhalation purge flow 0.03 to 0.08 LPM	XX	XX		
11.5/11.6	System pressure transducer 4.335 to 4.415 volts	R			
12.1/12.2	Proximal transducer (auto zero) 0.00 +/- 1.00 cmH2O	XX	XX		
13.1/13.2	Exhalation transducer 0.00 +/- 1.00 cmH2O	XX	XX		
14.1/14.2	Machine transducer 0.00 +/- 1.00 cmH2O	XX	XX		
15.4	Auto Zero manifold operation verification	XX	XX		
16.3/16.4	Proximal transducer 50.0 +/- 1.0 cmH2O (for a unit with Auto Zero and no Auto Zero)	R			

Procedure reference	Description	Record Value		Pass	Fail
17.1/17.2	Exhalation transducer 50.0 +/- 1.0 cmH2O	R			
18.1/18.2	Machine transducer 50.0 +/- 1.0 cmH2O	R			
21.5	Volume Monitor flow transducer calibration	XX	XX		
21.7/21.8	Volume Monitor flow calibration, high port	R			
21.10/21.11	Volume Monitor flow calibration, low port	R			
22.2	Volume Monitor purge verification	XX	XX		
23.2	Volume Monitor solenoid leak test	XX	XX		
24.2	Volume Monitor event code verification	XX	XX		
25.3	Volume Monitor fiber optic loopback test	XX	XX		
26.4	VPOT fiber optic test	R			
27.2	VIP fiber optic test	XX	XX		
28.4/28.5	Exhalation Valve drive current 181.0 +/- 12.0 mA	R			
29.3/29.4	Flow Valve reference voltage 2.50 +/- 0.20 vdc	R			
30.2	Watchdog test	XX	XX		
31.2	Transducer zero test verification	XX	XX		
32.1	Pressure test verification	XX	XX		
33.1	Leak test verification	XX	XX		
34.2	Jet Pump flow test 4.5-9.0 lpm	R			
34.4	Jet Pump test –3.5 to –6.0 cmH2O	R			
35.2	Inspiratory pressure verification	XX	XX		
37.4	Tidal Volume measurement +/- 10%	R			
37.6	Tidal Volume measurement +/- 10%	R			
37.7	Tidal Volume measurement +/- 10%	R			
37.8	Tidal Volume measurement +/- 10%	R			
38.2	Monitor check, Peak Inspiratory Pressure (P.I.P.) 25 +/- 10 cmH2O	XX	XX		
38.3	Monitor check, Mean Airway Pressure (M.A.P.) 9.0 +/- 2.0	XX	XX		
38.4	Monitor check, PEEP 5.0 +/- 2.0 cmH2O	XX	XX		
38.5	Monitor check, Breath Rate 10.0 +/- 2.0 bpm	XX	XX		
38.6	Monitor check, Ti 0.6 +/- 0.1 seconds	XX	XX		
38.7	Monitor check, I:E ratio 1:6.5 to 1:9.0	XX	XX		
38.8	Monitor check, Vt 400 ml +/- 60 ml	XX	XX		

Procedure reference	Description	Record Value		Pass	Fail
38.9	Monitor check, VE 4.0 +/- 0.6 L	XX	XX		
39.3	21% Blender check	R			
39.4	30% Blender check	R			
39.5	60% Blender check	R			
39.6	90% Blender check	R			
39.7	100% Blender check	R			
40.1	Blender alarm verification	XX	XX		
40.2	Blender alarm verification	XX	XX		
41.2	Manual breath verification	XX	XX		
42.2	Breath rate 6.0 +/- 0.2 seconds	XX	XX		
43.2	Sensitivity verification	XX	XX		
43.4	PEEP/CPAP and Pressure Support verification	XX	XX		
44.3	Manual over-pressure relief valve	XX	XX		
45.1	Apnea alarm 20 +/- 2 seconds	XX	XX		
45.2	Silence alarm 60 +/- 5 seconds	XX	XX		
46.3	Low peak pressure alarm	XX	XX		
47.2	High pressure limit 60.0 +/- 6.0 cmH2O	XX	XX		
47.3	Safety valve activation 3.0 +/- 0.5 seconds	XX	XX		
47.6	Circuit fault alarm activation and reset	XX	XX		
48.2	High breath rate alarm verification	XX	XX		
49.2	High tidal volume alarm verification	XX	XX		
50.2	Low minute volume alarm verification	XX	XX		
51.3	Electrical power disruption and reset	XX	XX		
52.4	Low inlet gas alarm and reset	XX	XX		
53.3	Loss of gas alarm and reset	XX	XX		
54.2	Circuit fault alarm verification	XX	XX		
56.2	Minimum AC voltage	XX	XX		
56.4	Maximum AC voltage	XX	XX		
56.6	Brown-out voltage	XX	XX		
57.2	Minimum DC voltage	XX	XX		
57.3	Maximum DC voltage	XX	XX		

Procedure reference	Description	Record Value		Pass	Fail
58.2	Ground continuity	XX	XX		
59.2	Leakage current N/C	R			
59.3	Leakage current N/O	R			
59.4	Leakage current R/C	R			
59.5	Leakage current R/O	R			
60.3	Dielectric test	XX	XX		

Section 2

General Inspection: Clean the top cover, front display, back panel, and etc.. Check for proper labels. Check the input voltage configuration to make sure it is set proper for the model type unit indicated. Make sure any literature need for updates and upgrades is included with the unit when it is shipped.

Section 3

I here by certify that the product with the above Serial Number has passed all operational specifications and is certified for clinical use. (The unit must be signed off before returning to clinical use)

Signature _____ Date _____

Chapter 6 Troubleshooting

This chapter describes how to troubleshoot the ventilator if:

- The ventilator does not turn on properly.
- A Vent Inop occurs when you turn on the ventilator.
- A User Verification Test fails.
- A malfunction occurs.

If The Ventilator Does not Turn ON

If you turn the power switch ON and the ON indicator does not illuminate, perform the troubleshooting procedures given in Table 6.1.

Table 6.1
Troubleshooting Power-Up Problems

Problem	Possible Cause	Action
Ventilator plugged into an AC source but does not power up.	No power at AC outlet, or the AC/DC select switch is in the ALT PWR SOURCE position, or the AC Line Voltage switch is set to the wrong voltage.	Try connecting to a known good AC power source. Make sure the AC/DC switch is in the AC position. Make sure, the voltage setting of the ventilator matches the voltage of your power source. Check the fuse assembly if the ventilator still does not power up, Contact your Bird Products Certified Service Technician. Check the DC voltage output supply from transformer at J9. Check DC voltage at J3. Black is ground. Red is 5 volts DC and Yellow is 14.7 to 20 DC. If voltage is not present, replace Power Supply PCB.
Ventilator attached to alternate external DC power source but does not power up.	If the external source is a battery, the battery may not be charged, or the AC/DC select switch may be in the AC position.	Plug the ventilator into a known good AC source, or to a known good battery and see if it powers up. If using a 12VDC power source, set the AC/DC select switch to the ALT PWR SOURCE position. Check the fuse assembly. If the ventilator still does not power up, contact your Bird Products Certified Service Technician. Check DC voltage at J3. Black is ground. Red is 5 volts DC and Yellow is 14.7 to 20 DC. If voltage is not present, replace Power Supply PCB.

If A Vent Inop Occurs During POST

When you turn the ventilator ON, the Power On Self Tests (POST) will run. These tests check the internal circuits to make sure everything is functioning properly. As each test executes, a message appears in the Monitor Display window to identify the internal component being tested. Since the entire POST only takes five (5) seconds, the messages appear rapidly. When the test ends successfully, the final message in the Monitor Display window is 226.

If any test fails, the ventilator terminates the power up sequence and generates a Vent Inop condition.

The ventilator:

- Sounds the audible alarm.
- Illuminates the **Vent Inop** indicator.
- Retains the last code number in the Monitor Display window so you can identify the test that failed.

Note

Before turning off the ventilator, record the code number so you can give it to your Bird Products Certified Service Technician.

If a Vent Inop occurs during the POST, check for the following items:

- Make sure the mode select switch is set to a mode.
- Make sure the air and oxygen sources are turned on and properly connected to the ventilator. Supply gas pressures must be between 35 to 70 PSIG (2.4 to 4.8 bar).
- If operating on AC power, make sure the AC/DC switch is set to the AC LINE position, and confirm that the AC line voltage is set to the proper input voltage.
- If operating on DC power, make sure the power source is supplying 12 VDC and is capable of providing 5 amps of continuous power.
- If any of these conditions are causing the problem, correct the condition and turn the **Power switch OFF, then ON to** clear the **Vent Inop** alarm. The ventilator should then complete the POST. If the Vent Inop repeats, take the ventilator out of service and contact your Bird Products Certified Service Technician.

If a UVT Fails

Table 6.2 lists suggested corrective actions if a User Verification Test Fails. If you cannot correct the problem causing the test failure, contact your Bird Products Certified Service Technician.

Table 6.2 UVT Troubleshooting

UVT	Problem	Corrective Action
Ambient Pressure Test	The test fails.	The internal transducers may be reading flow through the patient breathing circuit. Disconnect the patient breathing circuit and the exhalation valve body from the ventilator and repeat the test. Perform OVP transducer calibration for proximal exhalation and machine transducers.
Pressurized Circuit Test	The test fails.	Check for leaks in the humidifier and in the patient breathing circuit. Inspect the Exhalation Valve Body for proper installation and for leaks. Inspect the Exhalation Valve Diaphragm for proper installation and leaks. Confirm that the Pressure Relief Valve is adjusted to its full clockwise position. Confirm that the Inspiratory Pressure Control and High Pressure Alarm control are at their maximum settings. Perform OVP transducer calibration for proximal, exhalation and machine transducers. Verify proximal Purge Valve Calibration per OVP.
Circuit Leak Test	The test fails.	Check for leaks in the patient breathing circuit and humidifier. Inspect the Exhalation Valve Body for proper installation and for leaks. Inspect the Exhalation Valve diaphragm for proper installation and for leaks. Turn the Pressure Relief Valve three turns counterclockwise, then turn it all the way to the clockwise position. In normal operation, set ventilator for performance test setting. Set PEEP to 10 cmH2O. Verify ventilator will maintain PEEP ± 2.0 cmH2O. If unit does not maintain PEEP replace exhalation valve. Verify Safety Valve Assembly and o-ring. Verify o-ring seals for Jet pump/I hold solenoid assembly. Verify Over pressure relief valve.
Lamp Test	One or more indicator lamps or display segments fail to illuminate. Note that the Vent Inop or External DC visuals (unless connected to a battery) will not illuminate during this test.	Verify ribbon cable P/N 15481 is connected between Main Display and is tight. Remove Main Display assembly from front panel. Verify all LEDs and seven (7) segment decoders are in sockets correctly and are not loose. Replace any and all LEDs and seven (7) segments that will not light. Contact your Bird Products Certified Service Technician.
Controls Test	A variable control, a push button switch, or the **Mode Select** switch fail to perform correctly.	Remove Main/Display boards from front panel. Inspect all solder joints on main board for mode switch, waveform switch and control pots. For control problems verify push button alignment and length. Contact your Bird Products Certified Service Technician.

UVT	Problem	Corrective Action
Audible Alarm Test	The audible alarm is too loud or too low. No alarm.	Adjust the alarm volume control located on the front panel between the Silence and Reset Buttons. Check that the alarm has not been silenced. The Silence indicator will be illuminated if the alarm has been silenced. Press the Silence button to end the silence period.
Volume Monitor Solenoid Test	The test fails.	Contact your Bird Products Certified Service Technician.

Note

If the UVT fails and you cannot correct the problem, call your Bird Products Certified Service Technician

If a Malfunction Occurs

Table 6.3 lists suggested corrective actions for various malfunctions that might occur. In all cases, make sure that the ventilator is set up properly and that the exhalation valve body, exhalation valve diaphragm, and the patient circuit are properly assembled and free from leaks or damage.

Table 6.3
Basic Troubleshooting

Problem	Corrective Action
High Pressure alarm does not appear to be accurate	1. Check the setting of the pressure relief valve. 2. Replace exhalation valve body. 3. Remove patient circuit and valve body. If alarm is clear, replace with a new one. 4. Verify transducer verification. 5. Contact your Bird Products Certified Service Technician.
Peak Flow does not appear to be accurate.	1. Run the Performance Test to confirm that the Tidal Volume range is correct for your altitude. Refer to OVP. 2. Verify Over Pressure Relief Valve setting. 3. Perform UVT ambient and pressure test. 4. Perform OVP Tidal Volume verification. 5. Contact your Bird Products Certified Service Technician.
Low FIO_2 (Fraction of Inspired oxygen).	1. Set the %02 knob to the correct setting. 2. Check your oxygen analyzer for accuracy. The 02 analyzer should meet ANSI Z-79.10 or an equivalent standard. 3. Overhaul blender if not overhauled in the last two (2) years. 4. Perform Calibration procedure Blender Verification section. 5. Contact your Bird Products Certified Service Technician.
Blender Alarm/Low Inlet Gas Pressure Alarm(either with or without a Vent Inop alarm).	1. Check and adjust inlet pressures. Gas must be delivered from 35 to 70 PSIG (2.4 to 4.8 bar). The pressure difference between the two gases must be less than 20 PSIG (1.4 bar). 2. Perform Blender alarm calibration in the Blender section. 3. Overhaul blender if not overhauled in the last two (2) years. 4. Contact your Bird Products Certified Service Technician.
Circuit Fault Alarm	1. Check the passages in the exhalation valve body to make sure they are not occluded. Replace the valve body if necessary. 2. Check for an occluded Inspiratory/Expiratory limb of the patient breathing circuit.

Problem	Corrective Action
	3. Check for an occluded or disconnected Proximal airway line. 4. Perform UVT test. 5. Check transducer verification. 6. Contact your Bird Products Certified Service Technician.
Manometer needle not moving during breaths.	1. Check all connections in the patient breathing circuit. 2. Check the position and condition of the exhalation valve diaphragm. Reseal or replace the diaphragm. 3. Verify tubing connected to manometer. 4. Perform UVT test. 5. Contact your Bird Products Certified Service Technician.
Monitor Display will not scan monitored parameters.	1. Press and hold the Select button for three seconds to start automatic scanning. 2. Verify SW504 switch 5 is in the ON position. 3. Contact your Bird Products Certified Service Technician.
Error codes appear in Monitor Display window.	1. Record the codes. 2. Look up error code on chart. 3. Contact your Bird Products Certified Service Technician.
System will not hold PEEP.	1. Check all connections in the patient breathing circuit. 2. Check the position and condition of the exhalation valve body and diaphragm. 3. Reset or replace the diaphragm. 4. Reset or replace the exhalation valve body. 5. Perform UVT leak test. 6. Verify the internal tubing is connected correctly. 7. Contact your Bird Products Certified Service Technician.
Auto Cycling.	1. Check the patient breathing circuit connections for leaks. If leaks are greater than the Assist Sensitivity setting, auto cycling will continue. 2. Adjust the Assist Sensitivity setting. 3. Perform UVT test. 4. Do the performance test. Set PEEP to 10cmH_2O. Verify unit maintains PEEP. If not, replace exhalation valve. 5. Contact your Bird Products Certified Service Technician.
Low Peak Pressure Alarm.	1. Confirm that patient has not become disconnected from the patient breathing circuit. 2 Check the patient circuit connections for leaks. 3. Confirm the correct alarm setting. 4. Contact your Bird Products Certified Service Technician.
Monitored exhaled tidal volumes are high or low.	1. Check that a flow sensor is properly installed. 2. Check for water migration in one or both lines of the sensor tubing. If water migration is present, replace the sensor assembly. 3. Check for mucus or debris in sensor. 4. Check for leaks in patient circuit or at patient's endotracheal tube. 5. Perform Tidal Volume Verification described in Chapter 6, *OVP*. 6. Replace the flow sensor, if Tidal Volume Check does not pass. 7. Perform UVT solenoid test. 8. Verify volume monitor purge flow. 9. Verify Volume transducer calibration. (See OVP section 6). 10. Contact your Bird Products Certified Service Technician.

Problem	Corrective Action
Low Peak Pressure alarm in CPAP mode will not reset.	1. If the ventilator was generating the alarm before you set the breath rate to zero, press the Manual Breath button to allow the ventilator to deliver a breath that exceeds the alarm setting. 2. Press the Reset button. 3. Perform UVT test. 4. Perform OVP transducer calibration for proximal, exhalation, and machine transducer. 5. Contact your Bird Products Certified Service Technician.
Low PEEP/CPAP Alarm.	1. Confirm that patient has not become disconnected from the patient breathing circuit. 2. Check the patient breathing circuit connections for leaks. 3. Perform UVT test. 4. Conduct performance test. Dial in PEEP at 10cmH_2O. Verify unit maintains 10.0 ± 2.0 cmH_2O. Set alarm to 8. 5. Confirm the correct alarm setting. 6. Check for a kinked or occluded inspiratory line of the patient breathing circuit. 7. Perform OVP transducer calibration for exhalation, proximal, and machine transducers. 8. Contact your Bird Products Certified Service Technician.
High Breath Rate.	1. Check for leaks in the proximal pressure sensing line. 2. Check High Breath Rate alarm setting. 3. Check for leaks in the patient breathing circuit. 4. Check for water in circuit. 5. Evaluate the Assist Sensitivity setting. 6. Perform UVT leak test with sensor inline. 7. Conduct Performance test. Set PEEP to 10cmH_2O. Verify unit reads 10±2.0cmH_2O. 8. Contact your Bird Products Certified Service Technician.
Patient not triggering machine breaths.	1. Evaluate the Assist Sensitivity setting. It may need to be lowered. 2. If IMV/CPAP is the desired mode, Assist Sensitivity should be set to OFF and the mode set to (S)IMV/CPAP/PS. No patient triggered breaths will occur in this mode as the ventilator will operate in IMV mode. 3. Perform UVT leak test. 4. Perform OVP transducer calibration for proximal, exhalation, and machine transducers. 5. Contact your Bird Products Certified Service Technician.
Apnea Alarm.	1. Check for leaks in the patient circuit. 2. Confirm that the flow sensor is attached to the patient circuit. 3. Evaluate the patient breath rate. 4. Evaluate the Apnea Alarm Interval setting. 5. Contact your Bird Products Certified Service Technician.
AUTO ZERO Error.	1. Remove the ventilator from service. 2. Perform OVP transducer calibration for proximal and exhalation transducers. 3. Contact your Bird Products Certified Service Technician.

Problem	Corrective Action
High Pressure Limit Alarm.	1. Check the endotracheal tube for occlusion or obstruction. 2. Check the setting of the alarm. 3. Check for a blocked or occluded patient circuit. 4. Confirm that patient has not become disconnected from the patient breathing circuit. 5. Check the patient breathing circuit connections for leaks. 6. Perform UVT test. 7. Conduct performance test. Dial in PEEP at 0cmH_2O. Verify unit maintains 10.0 ± 2.0 cmH_2O. Set alarm to 8. 8. Confirm the correct alarm setting. 9. Check for a kinked or occluded inspiratory line of the patient breathing circuit. 10. Perform OVP transducer calibration for exhalation, proximal, and machine transducers. 11. Contact your Bird Products Certified Service Technician.
Sensor Alarm.	1. Check all connections to the sensor and the ventilator. 2. Check all connections in the patient breathing circuit. 3. Install a new sensor. 4. Verify transducer receptacle has cable correctly connected. 5. Verify Volume Monitor power and fiber optic cable connections. 6. Perform OVP Volume Monitor transducer calibration. 7. Contact your Bird Products Certified Service Technician.
Tidal Volume display shows a value of zero (0).	1. Confirm that a flow sensor is in place. 2. Confirm that the flow sensor is installed in the correct position in the patient circuit. 3. Check all connections to the flow sensor and in the patient circuit. 4. Check for leaks at patient endotracheal tube or displaced endotracheal tube. 5. Perform Tidal Volume Check. 6. Replace the flow sensor if defective. 7. Perform UVT test. 8. Verify tubing connection at sensor receptacle and transducer on Volume monitor PCB. 9. Verify all cable connections between Volume Monitor & receptacle. 10. Perform OVP Volume Monitor transducer calibration. 11. Contact your Bird Products Certified Service Technician
Low Minute Volume Alarm sounds when using an infant flow sensor.	1. Confirm that the flow sensor is in place. 2. Check all connections to flow sensor and in patient circuit. 3. Check for leaks at patient endotracheal tube or displaced endotracheal tube. 4. Perform OVP Tidal Volume test. 5. Replace the flow sensor if defective. 6. Set Low Minute Volume alarm to OFF or per clinical protocol. When alarm is set to OFF, the alarm display will flash as a reminder that the alarm has been turned off. 7. Perform UVT test. 8. Verify tubing connection at sensor receptacle and transducer on Volume monitor PCB. 9. Verify all cable connections between Volume Monitor and receptacle. 10. Perform OVP Volume monitor transducer calibration. 11. Contact your Bird Products Certified Service Technician.

Chapter 7 Parts List

This section of the V.I.P. Bird Gold and Sterling Service Manual details the parts that are available for the repair of the ventilator.

It is intended for the Thermo Respiratory Group trained biomedical technician.

This section is composed in accordance with Thermo Respiratory Group's repair policy, which excludes the following parts:

1. Any component soldered to PCB's
2. Component parts of electromechanical or pneumatic assemblies

If a part is not specifically included in this section, field repair is limited to the replacement of the next higher assembly containing this part.

Refer to the Removal & Replacement sections of this manual for installation instructions.

After replacement of any part, a thorough check of the ventilator is mandatory. This will verify that the original problem has been corrected and that no additional problems have been created by the repair process.

Front Panel Assembly (P/N 15657)

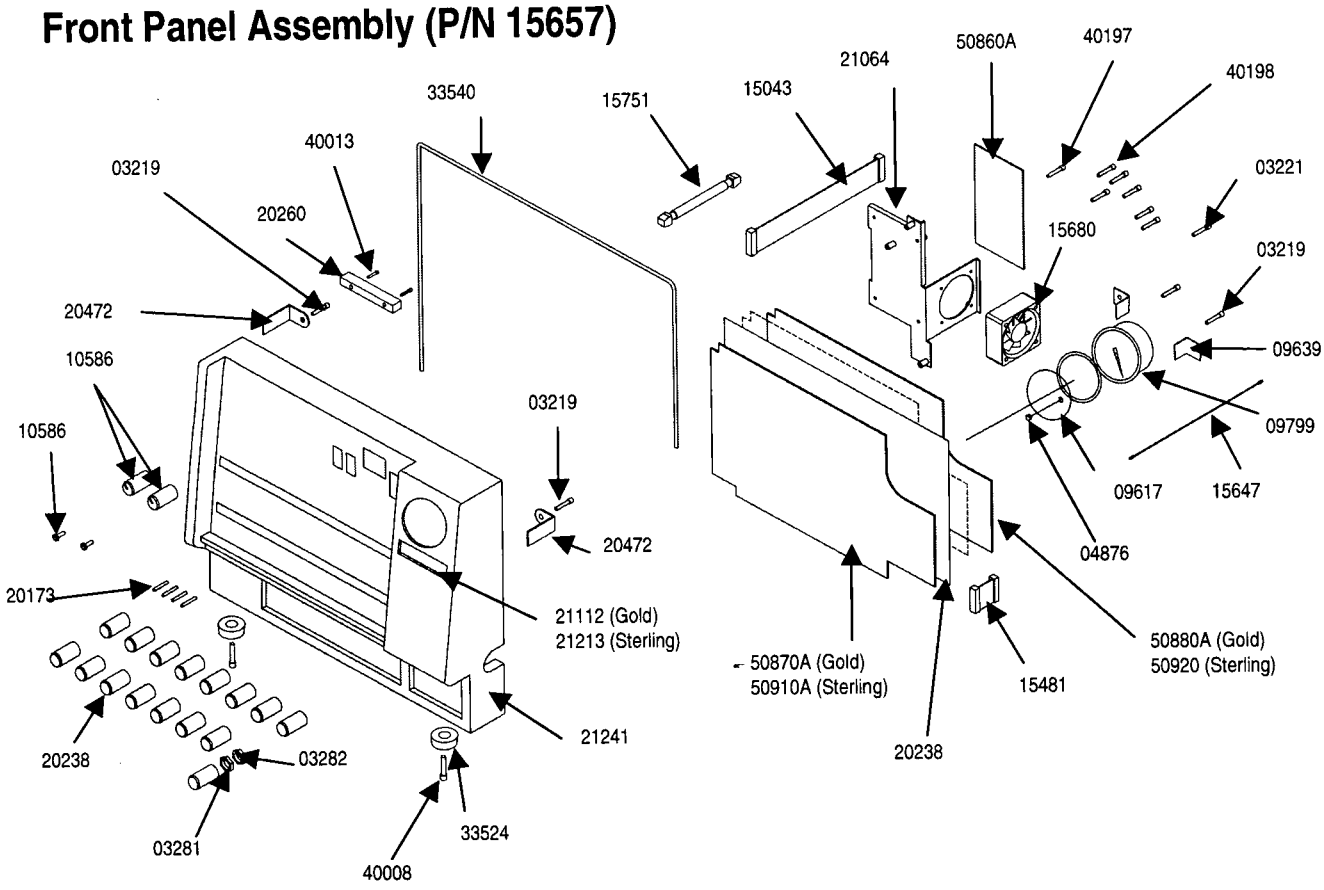


Figure 7-1. Front Panel Assembly

Qty	P/N	Description
16	03281	Nut, 1/4-43 x 0.157 jamnut
16	20238	Knob, control
2	xxxxx	Knob, mode and waveform
2	40008	Screw, 6-32 x .7
2	33524	Rubber bumper
7	20173	Push rod, switch
2	08833	Screw, 8x32x0.3
1	20120	Panel, front bezel
1	21112	Logo, gold
1	21213	Logo, sterling
2	20472	Bracket, hinge
4	03219	Screw, 6-32 x 0.3
1	20260	Bracket, cover
2	40013	Screw, 6-32 x 0.375 Hxcap
1	33540	Gasket
8	03221	Screw, 6-32x0.5
1	50870A	Display PSBA, Gold
1	50880A	Main, PCBA, Gold
1	15481	Cable, ribbon inconnect

Qty	P/N	Description
1	50860A	Volume Monitor PCBA
1	04876	Plug, lens
1	09617	Lens, bezel
1	09799	Manometer -20 to +140 cmH^2O
2	09639	Mounting, bracket gauge
18	03282	Nut, 1/4-32x0.076 locknut
18	20590	Washer, ESD, 0.125 THK
4	40197	Screw, 6-32 x 0.437 SKHDCP
3	40198	Screw, 6-32 x 1.125 SKTHDCP
2	15647	Cable assembly, F10 VMB to Main
2	15126	Cable assembly, F10 Main to Rear panel (not shown)
1	15751	Cable assembly, Power to Main
1	15043	Ribbon Cable assembly, Power to Main
1	15680	Cable assembly, fan
1	21064	Bracket, fan mount
1	80270	Overlay, Gold (not shown)
1	80289	Overlay, Sterling (not shown)

Rear Cover Assembly (P/N 20242)

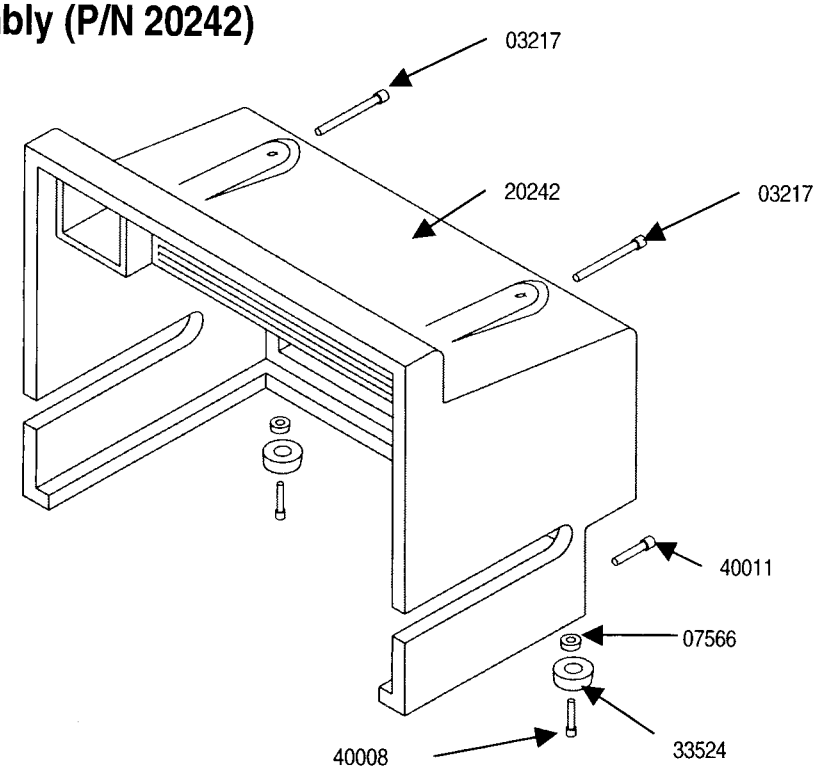


Figure 7-2. Rear Cover Assembly

Qty	P/N	Description
2	03217	Screw, 8-32 x 1.375 HXCAP
2	40008	Screw, 6-32 x .7
2	40011	Screw, 8-32 x .625 HXSCHD
2	07566	Nut, 8-32 HEX
2	33524	Rubber bumper
1	20242	Cover, top rear

Manifold Base Assembly

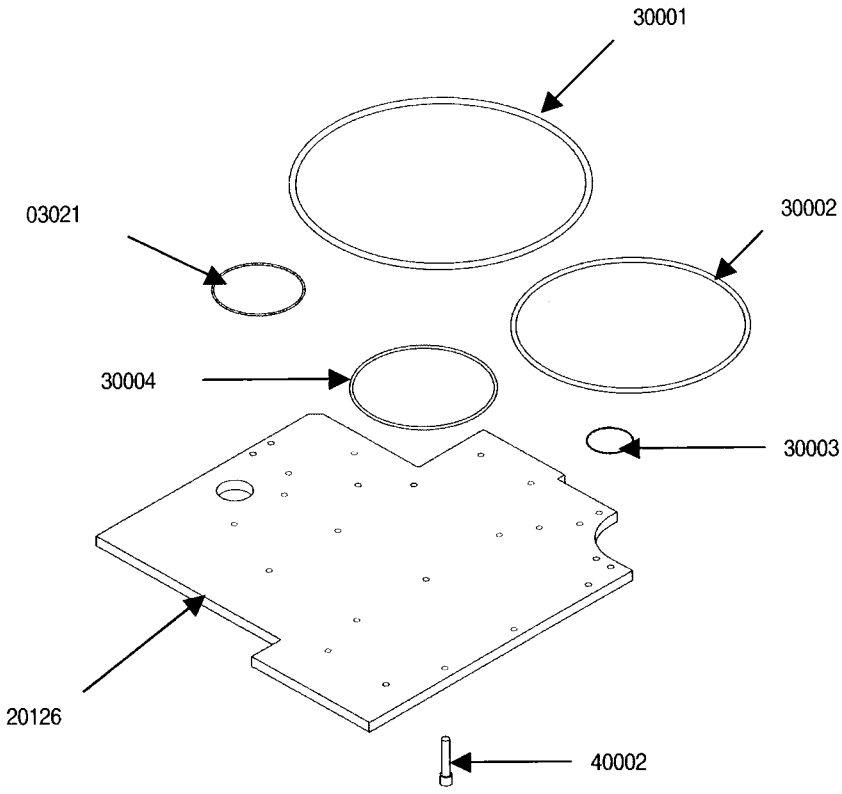


Figure 7-3. Manifold Base Assembly

Qty	P/N	Description
1	30001	O-ring, 549 x .103
1	30002	O-ring, 5.987 x .103
1	30003	O-ring, 3.643 x .103
1	30004	O-ring, 8.487 x .103
1	03021	O-ring, 2.175 x .103
23	40002	Screw, 10-32 x .50 SKHDCP
1	20126	Plate, sealing

Exhalation Valve (P/N 15739A)/Auto Zero Manifold (P/N 10278)

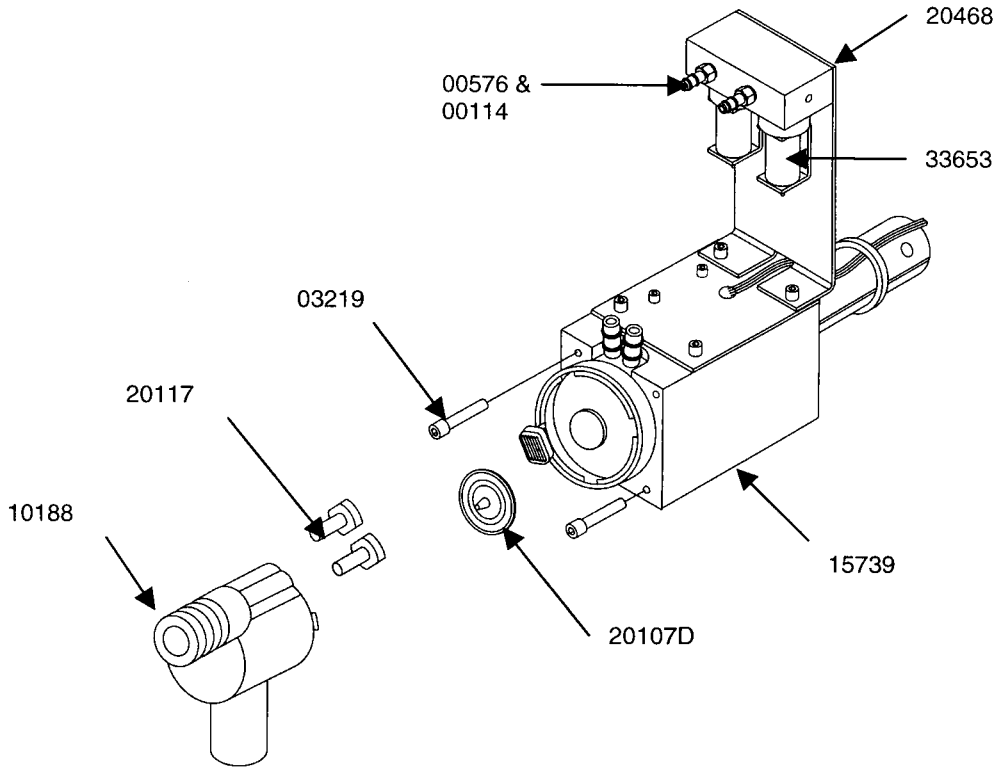


Figure 7-4. Exhalation Valve/Auto Zero Manifold Assembly

Qty	P/N	Description
1	10278	Assembly, Auto zero manifold
1	15739A	Assembly, Exhalation valve
1	10188	Exhalation valve body
1	*20117D	Seal, barrel, L.E.V.
1	20107	Diaphragm, L.E.V.
2	03219	Screw, 6-32 x .375
2	00576	Adapter, 10-3213A, 118 tube
2	00114	O-ring, .117 x .040 (not shown)
2	33653	Valve, solenoid, 3-way
1	20468	Manifold, bracket auto zero

** The suffix "D" denotes a pack of 10*

Manifold Assembly

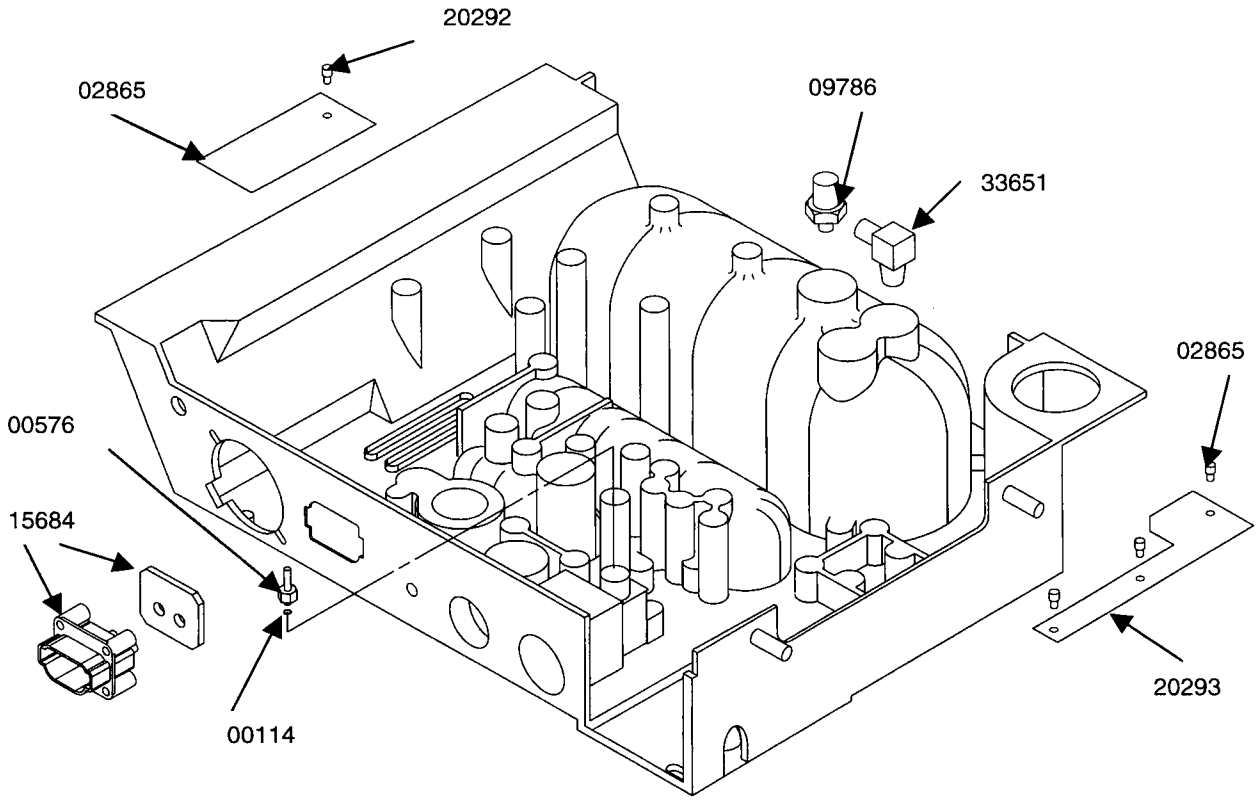


Figure 7-5. Manifold Assembly

Qty	P/N	Description
1	20292	Screen, ventilator lefthand side
4	02865	Screw, 6-32 x .250 HXSKRDH
1	09786	Valve, pressure relief
1	33651	Connector, 1/4 NPTM
1	00576	Adapter, 10 x 32 x 1/8" tubing
1	00114	O-ring, .117 x .040
1	20293	Screen, ventilator right-hand side
1	15684	Assembly, receptacle V.I.P. Gold/Sterling

Patient Outlet Assembly

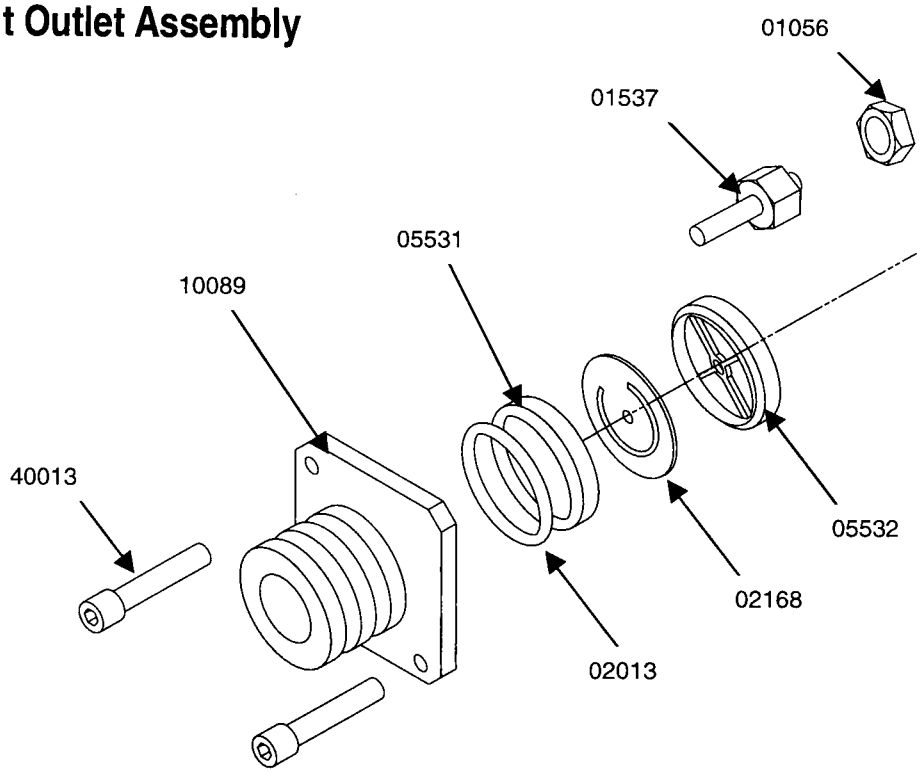


Figure 7-6. Patient Outlet Assembly

Qty	P/N	Description
1	01056	Nut, 1/4-28 E Keeps
1	01537	Coupling panel, 1/8 x 3/16 tube
2	40013	Screw, 8-32 x 1.250 HXSCH
1	10089	Outlet, patient, V.I.P. Bird
1	02013	O-ring, .864 x .070
1	05531	Retainer, valve, male
1	02168	Valve, flapper
1	05532	Retainer, valve, female

Over Pressure Valve Assembly (P/N 10092)

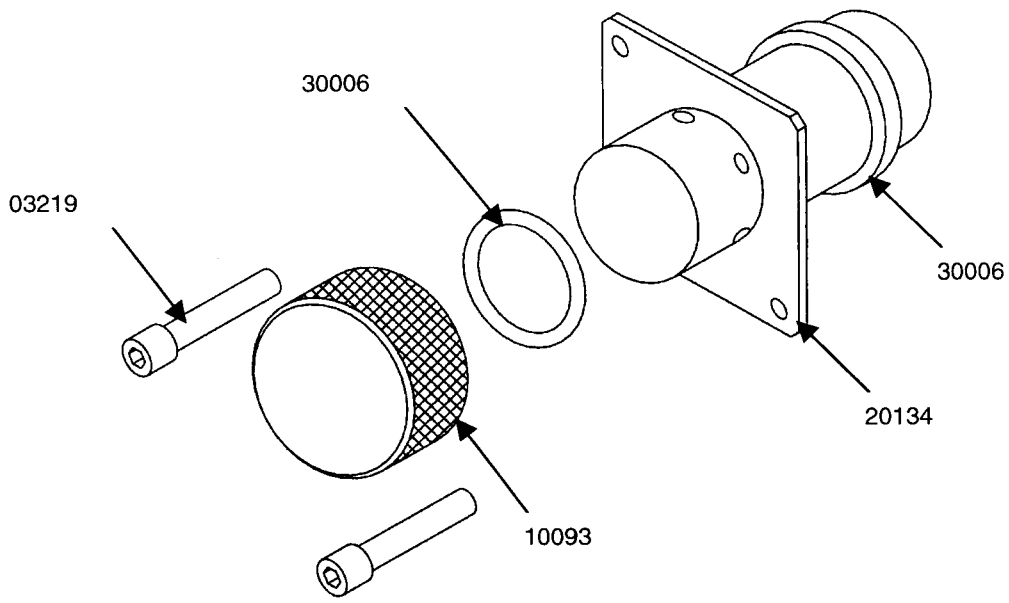


Figure 7-7. Over Pressure Valve Assembly

Qty	P/N	Description
2	03219	Screw, 6-32 x .375 HXCAP
1	10093	Knob assembly, relief valve
2	30006	O-ring, .989 x .070 self lube
1	20134	Body, relief valve

Safety Valve Assembly (P/N 09754)

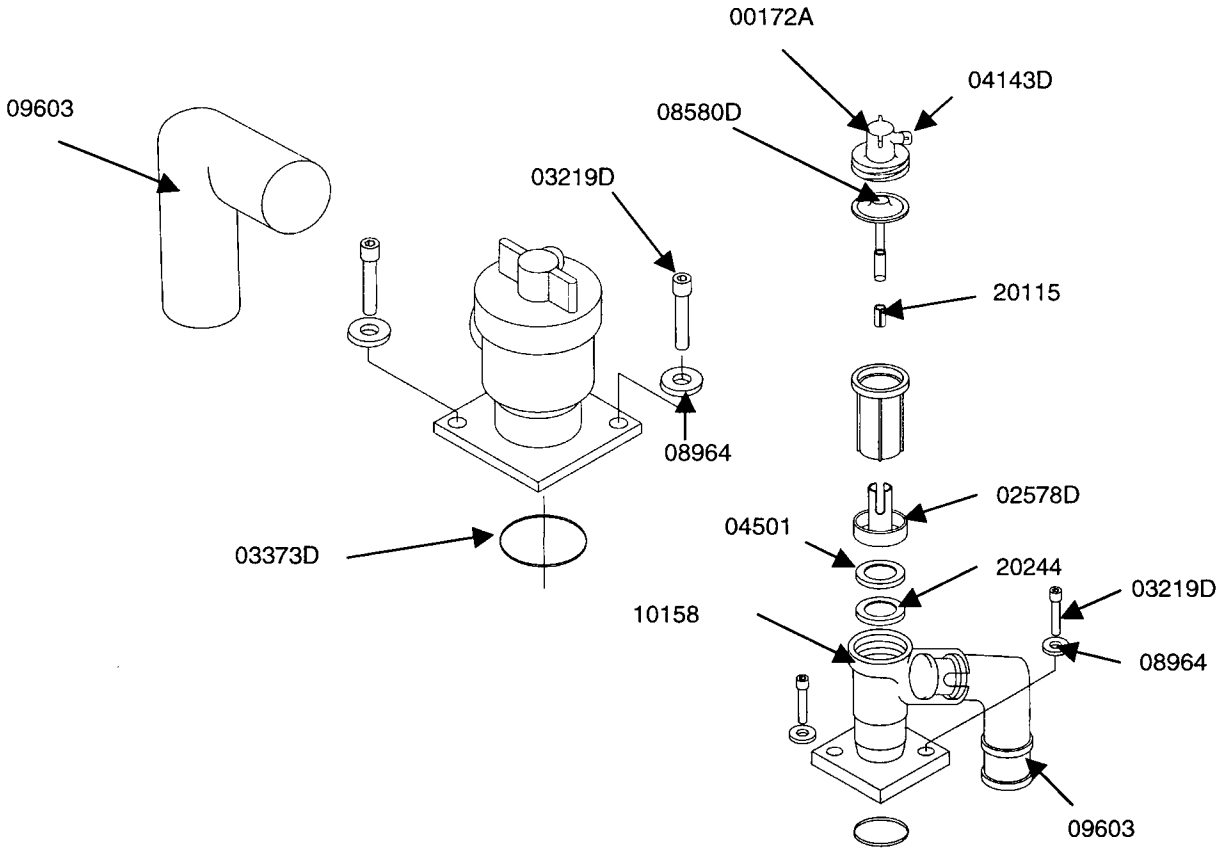


Figure 7-8. Safety Valve Assembly

Qty	P/N	Description
1	09754	Safety Valve Assembly
1	**03373D	0-ring,.801 X 0.070
2	**08964D	Washer, .148 X. 272 X. 030
2	**03219D	Screw, 6-32 X.375 HXCAP
1	*10158	Valve, Body Plate Assembly
1	*20244	Seal, Safety Valve
1	*02578D	Valve, Mushroom
1	*02577U	Insert, Exhalation Valve Cartridge
1	*20115	Spacer, Safety Valve
1	*08580D	Diaphragm, Exhalation Valve
1	04143D	Retainer, Tube Connector
1	00172A	Cap, Exhalation Valve Assembly
1	10004	Cartridge, Safety Valve
1	04501	Washer, 1.100 X.900 X.20
1	09603	Connection, Elbow Safety Valve to manifold

*** Not a part of item 09754 Safety Valve Assembly*

** Subparts of 10004, Cartridge Safety Valve*

Purge Valve Assembly (P/N 10180)

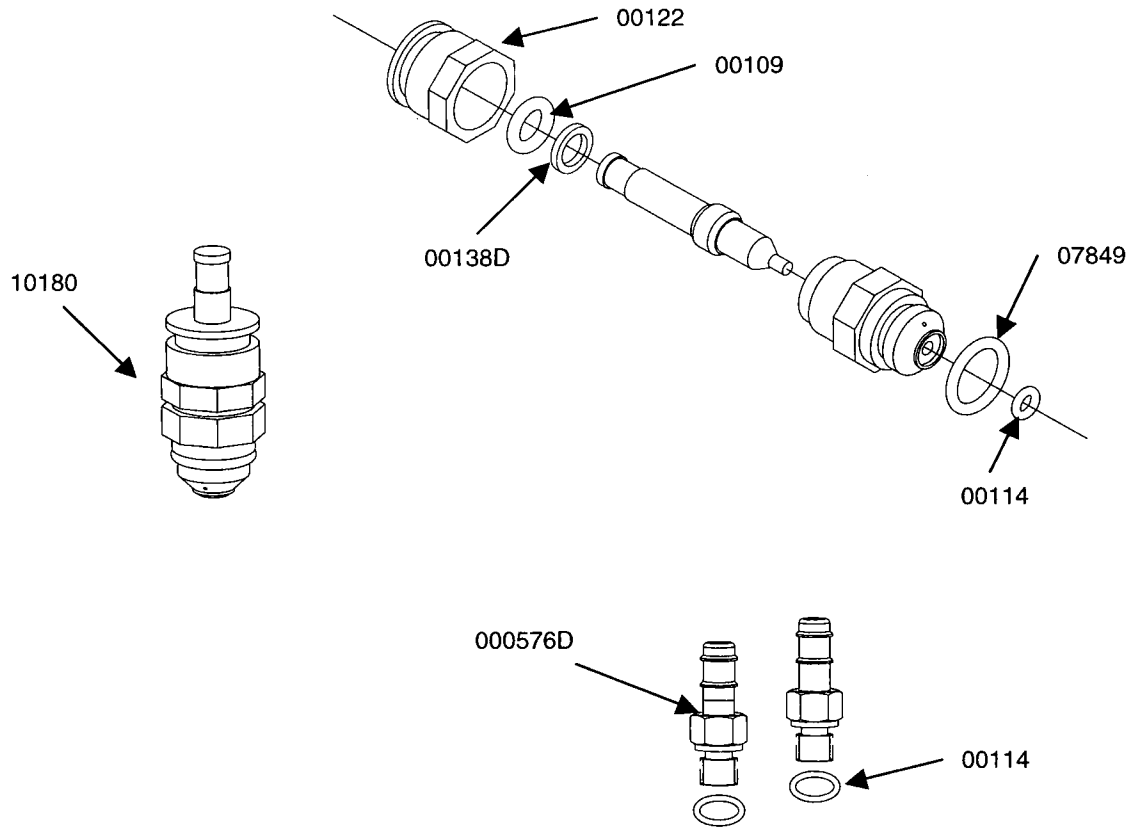


Figure 7-9. Purge Valve Assembly

Qty	P/N	Description
1	10180	Assembly, Purge valve
1	00122	Nut, packing valve
1	00109	Washer, .193 x .281 x .031
1	00138	O-ring, .176 x .070
1	07849	O-ring, .313
3	00114	O-ring, .117 x .040
1	00579D	Adapter, 10-32 x 3, 1/8 " ID tube

Side Rails Assembly

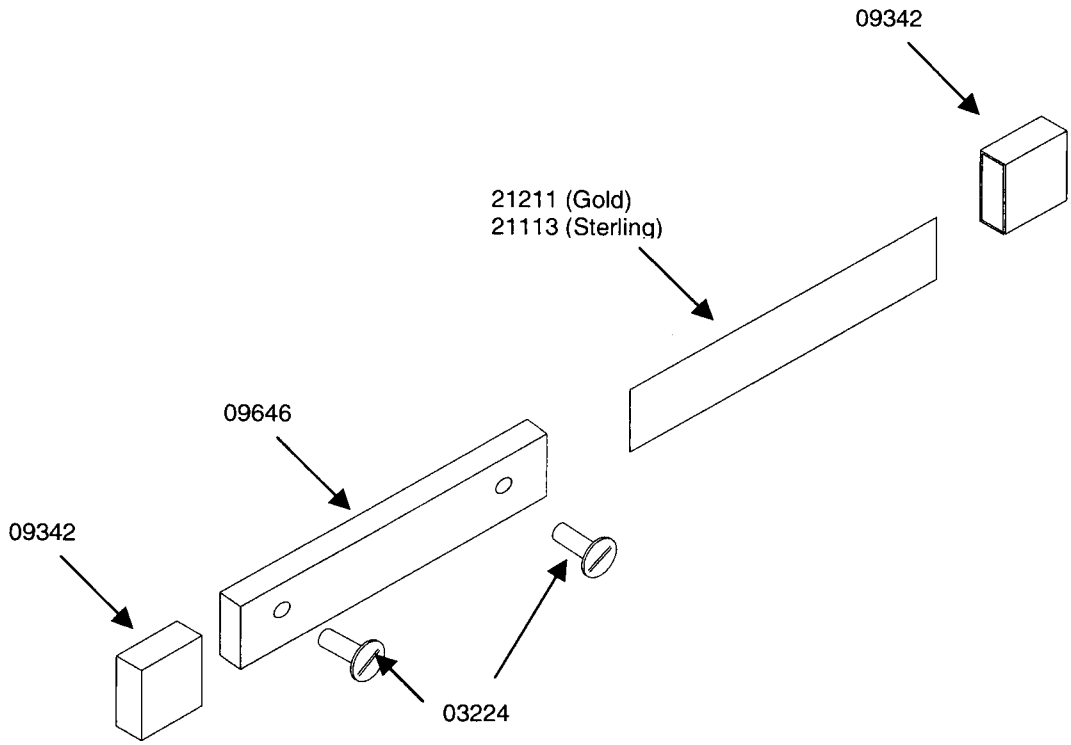


Figure 7-10. Side Rails Assembly

Qty	P/N	Description
2	03224	Screw, 1/4-20 x .75 FLHSK
2	09342	Cap, end rail
2	09696	Rail side
1	21211	Insert, side rail, Gold
1	21113	Insert, side rail, Sterling

Regulator

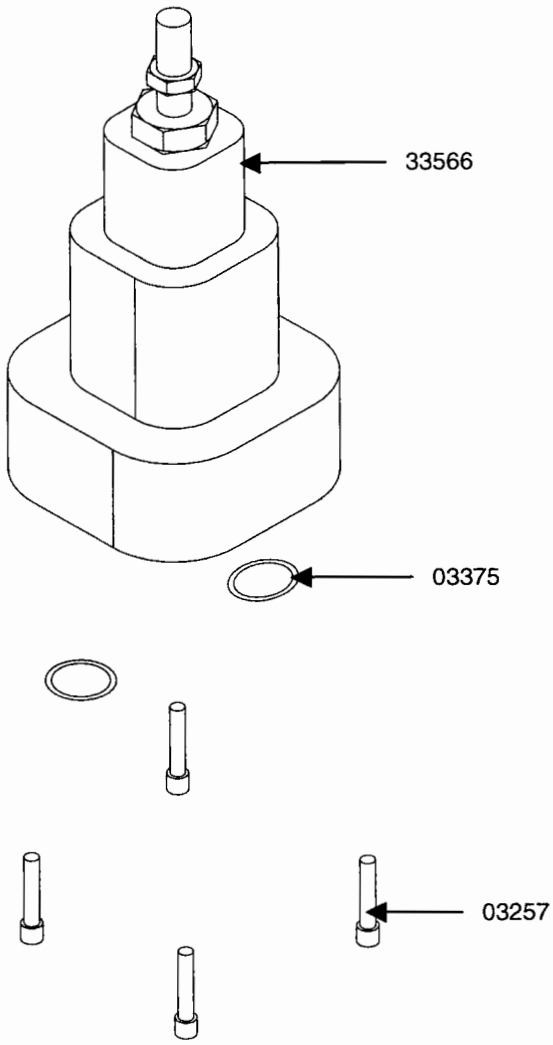


Figure 7-11. Regulator

Qty	P/N	Description
4	03257	Screw, 8-32 x 1.5 HXCAP
2	03375	O-ring, .301 x .070 silicon
1	33566	Pressure regulator

MicroBlender (P/N 10160)

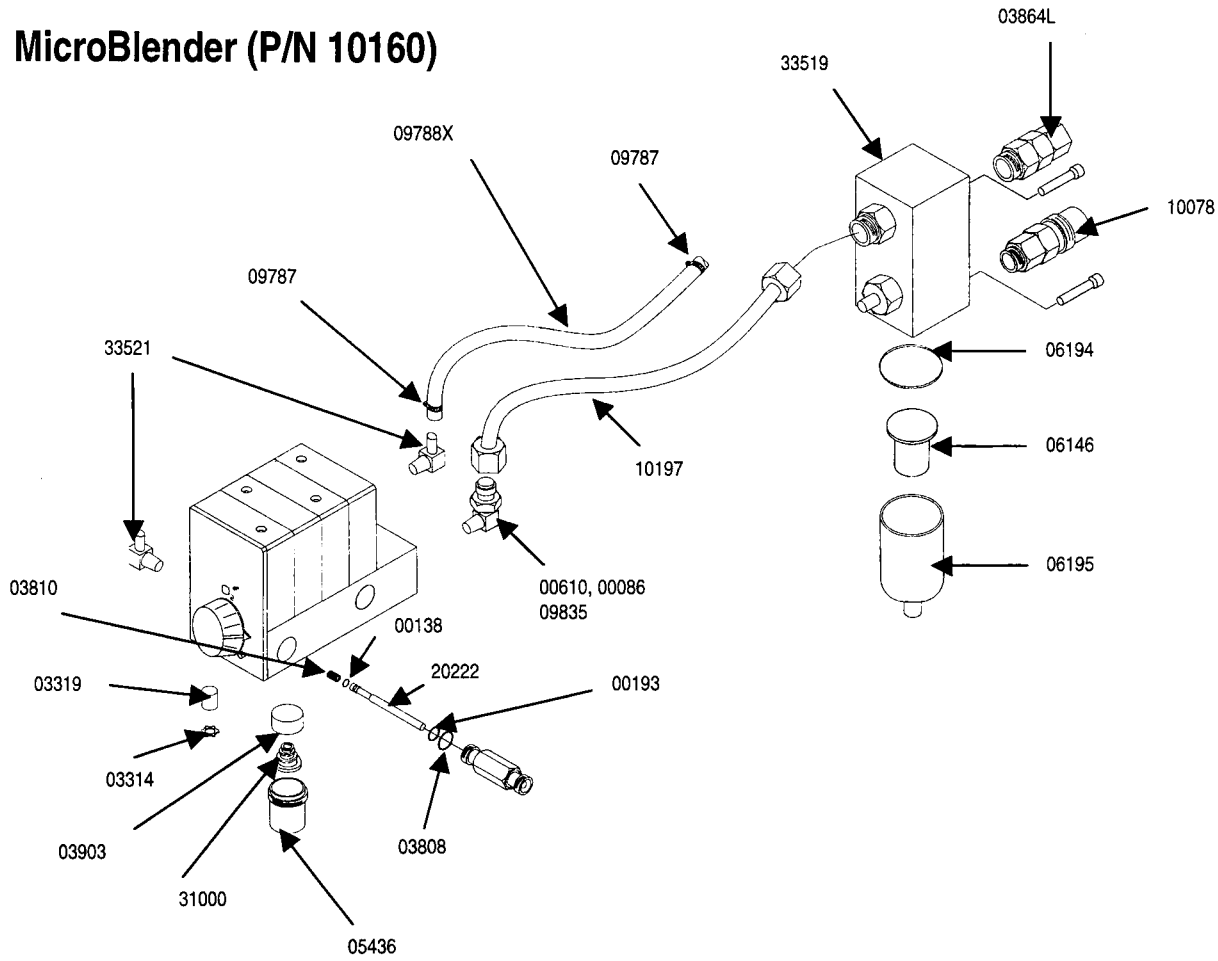


Figure 7-12. Microblender

Qty	P/N	Description
1	10160	Blender
2	33521	Adapter 90°, 118 NPT 114 tube
1	00086	Adapter, 9/16 18 x 1/8 NPT ML
17	09788X	Tubing, 1/4 IP reinforced
3	09787	Clamp hose
1	10197	Hose, assembly
1	03864L	O2 Inlet, DISS female
1	10078	Air Inlet, DISS male
1	09835	Connector, 1/4 NPT x 1/4 tube
1	00610	Adapter, 9116 18 x 1/4 NPT
1	33519	Block, Air inlet filter
1	06194	O-ring, filter
1	06146	Filter, element with retainer

Qty	P/N	Description
1	06195	Housing, filter
1	05436	Alarm, blender bypass assembly
1	31000	Spring, .84 x .50 x .325 SS
1	03903	Plug, foam alarm cap
1	03314	O-ring, star retainer
1	03319	Muffler, bleed
1	20222	Poppet
1	03810	Spring
1	00138	O-ring1
1	00193	O-ring
1	03808	O-ring

Flow Control Valve Assembly (P/N 15768A)

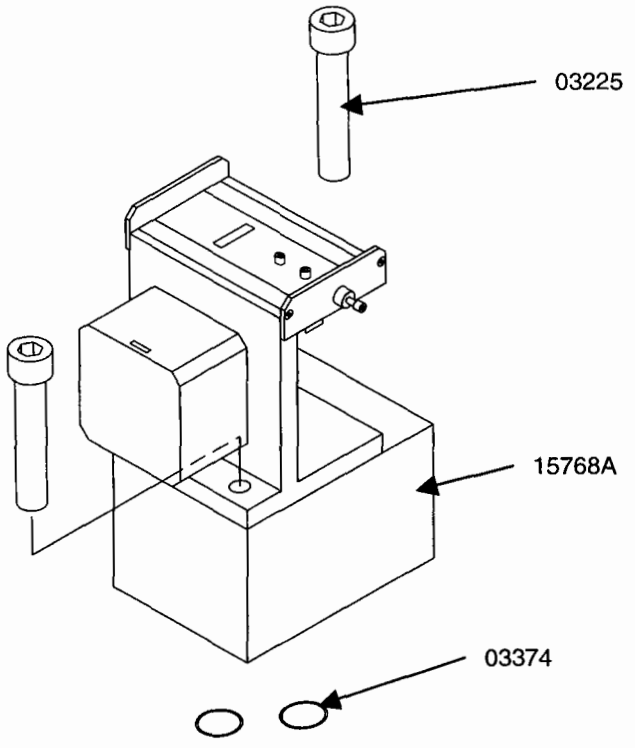


Figure 7-13. Flow Control Valve Assembly

Qty	P/N	Description
2	03225	Screw, 8-32 x 2.00 HXCAP
2	03374	O-ring, .364 x .070
1	15768A	Flow valve

Transformer Assembly (P/N 15734)

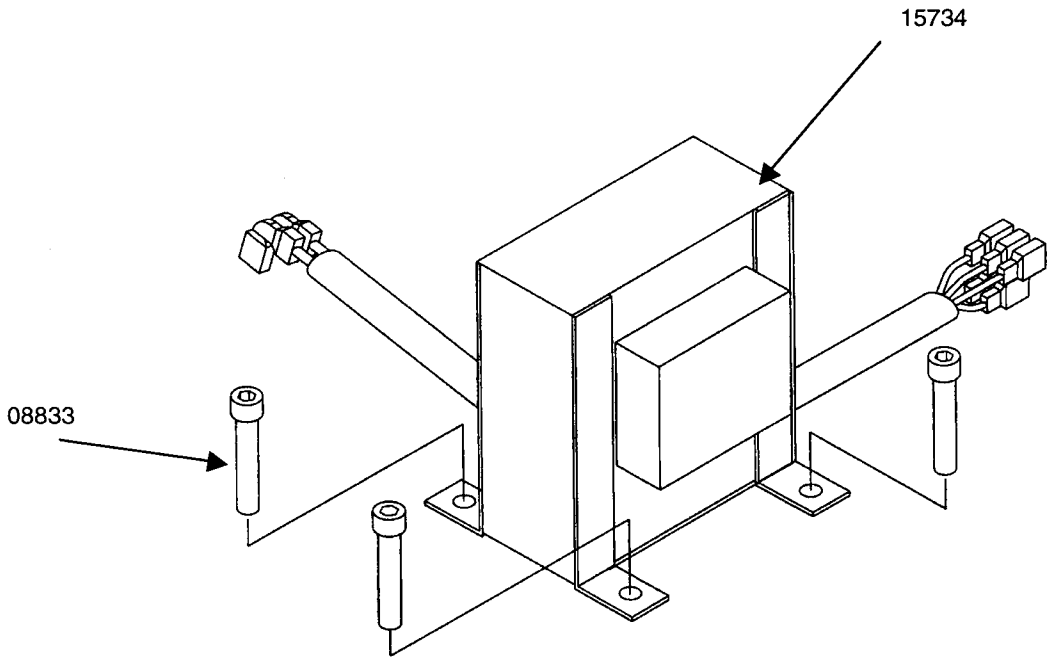


Figure 7-14. Transformer Assembly

Qty	P/N	Description
1	15734	Transformer with cable assembly
4	08833	Screw, 8-32 x .375 SKTHDCP

Jet Pump Assembly (P/N 15651)

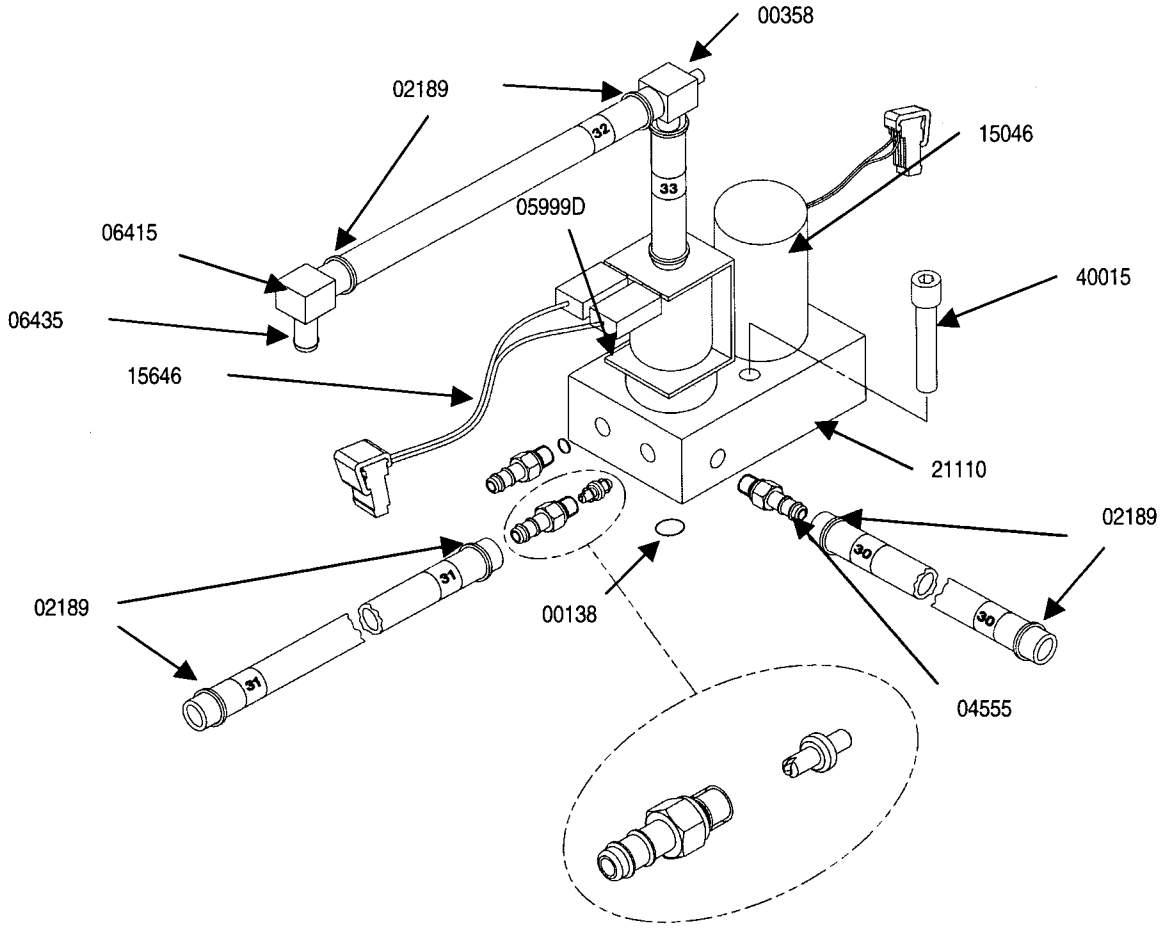
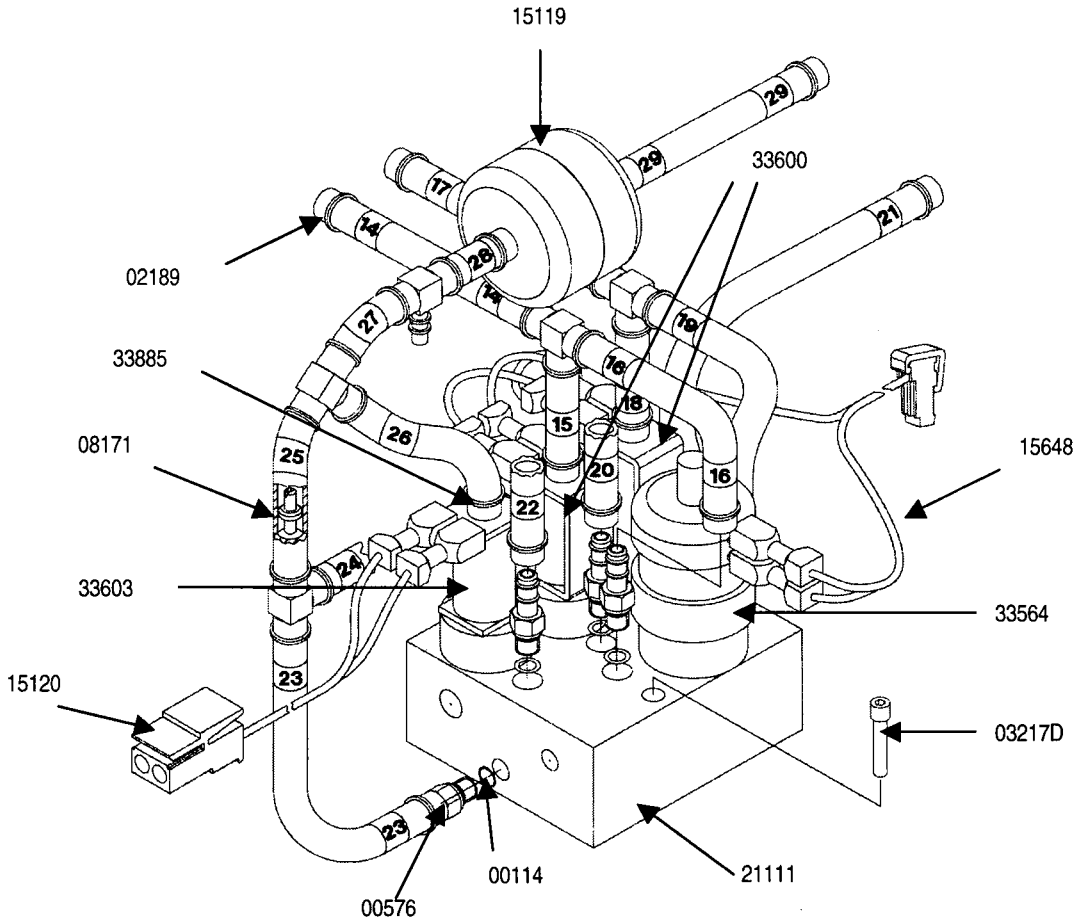


Figure 7-15 Jet Pump Assembly

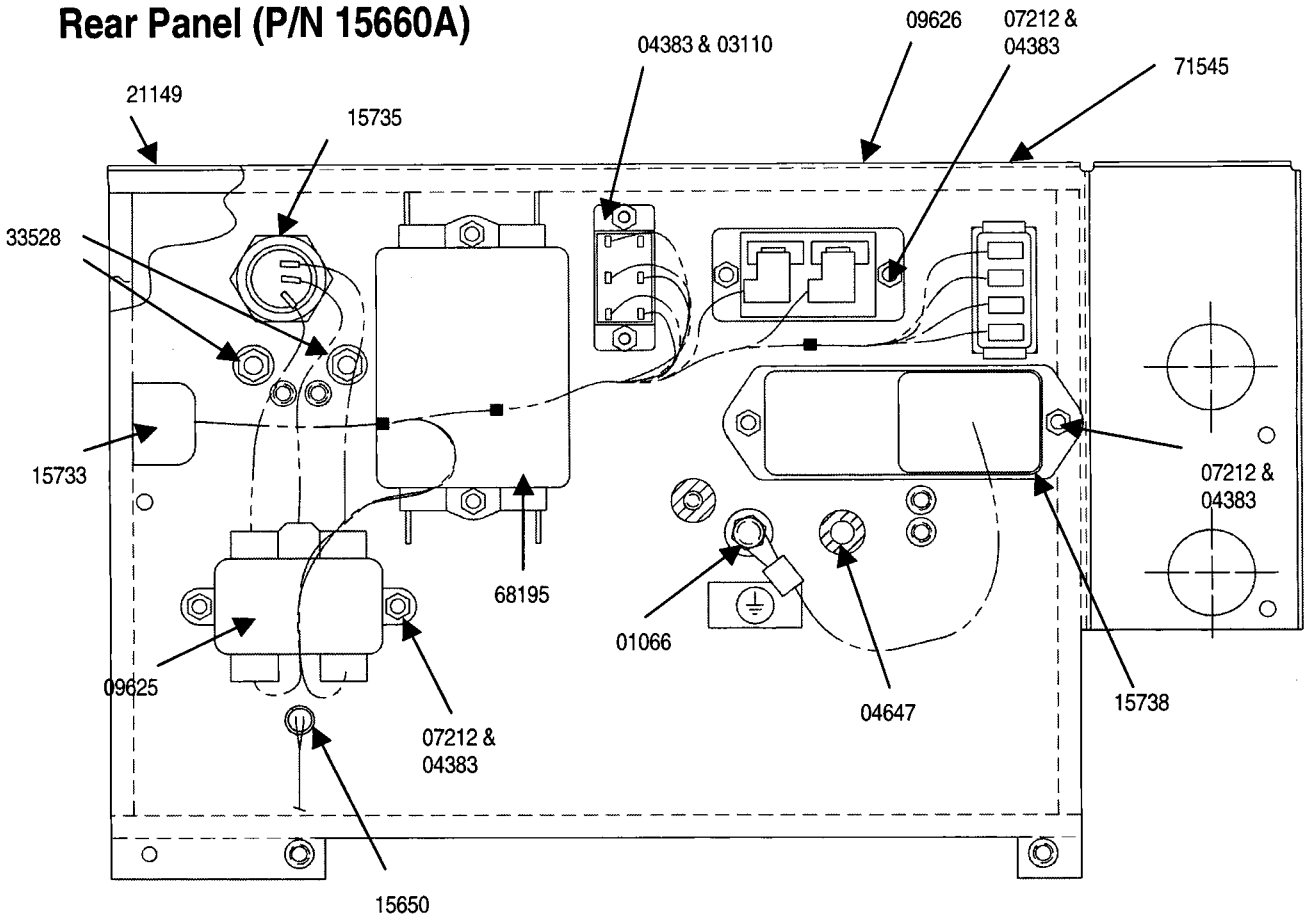
Qty	P/N	Description
1	21110	Block, I/E Hold
1	15046	Solenoid assembly, Jet Pump
1	33603	Valve, High Flow, 3-way (I/E Hold Solenoid)
3	05999	O-ring, 0.18 x 0.040
3	04555	Adapter, 1/4 28 x 1/8 tube 0.104
1	15646	Cable assembly, I/E Hold
1	08171	Orifice, 0.20 x 1.16 tube, blue
1	00358	Connector, 1/8 tube tee
8	02189	BRCLT, 5/16 tube
A/R	04029X	tube, 1/8 ID silicon bulk
1	06415	Connector, 4.5 mm x 1/8 tube el
1	00138	O-ring, 0.070 x 0.070
1	00328	O-ring, 0.176 x 0.070
1	06435	O-ring, 0.097 x 0.02
1	40015	Screw 8-32 Plug x 1.00 Hx Schd

Safety Solenoid/Zero Manifold Assembly (P/N 15652)



Qty	P/N	Description
1	21111	Block, sensor purge
6	00576	Adapter, 10-32/3a 1/8" tubing
6	00114	O-ring, 0117 x .040
1	15648	Cable assembly, zero purge
	33564	Valve 3-way
2	33600	Valve, solenoid, 3-way NC
1	15120	Cable assembly, safety solenoid
32	02189	Bracelet, 5/16 tube
A/R	04029X	Tubing, 1/8" ID silicone
5	00358	Connector, 1/8" tube tee
2	08171	Orifice, .020 x 1/16 tube, blue
1	15119	Muffler assembly
1	40026	Screw, 10-32 plug w/gasket
1	33885	Adapter, pneumatic port
2	08217D	Screw, 8-32 x 1.375 HxCap
1	33603	Safety solenoid

Rear Panel (P/N 15660A)



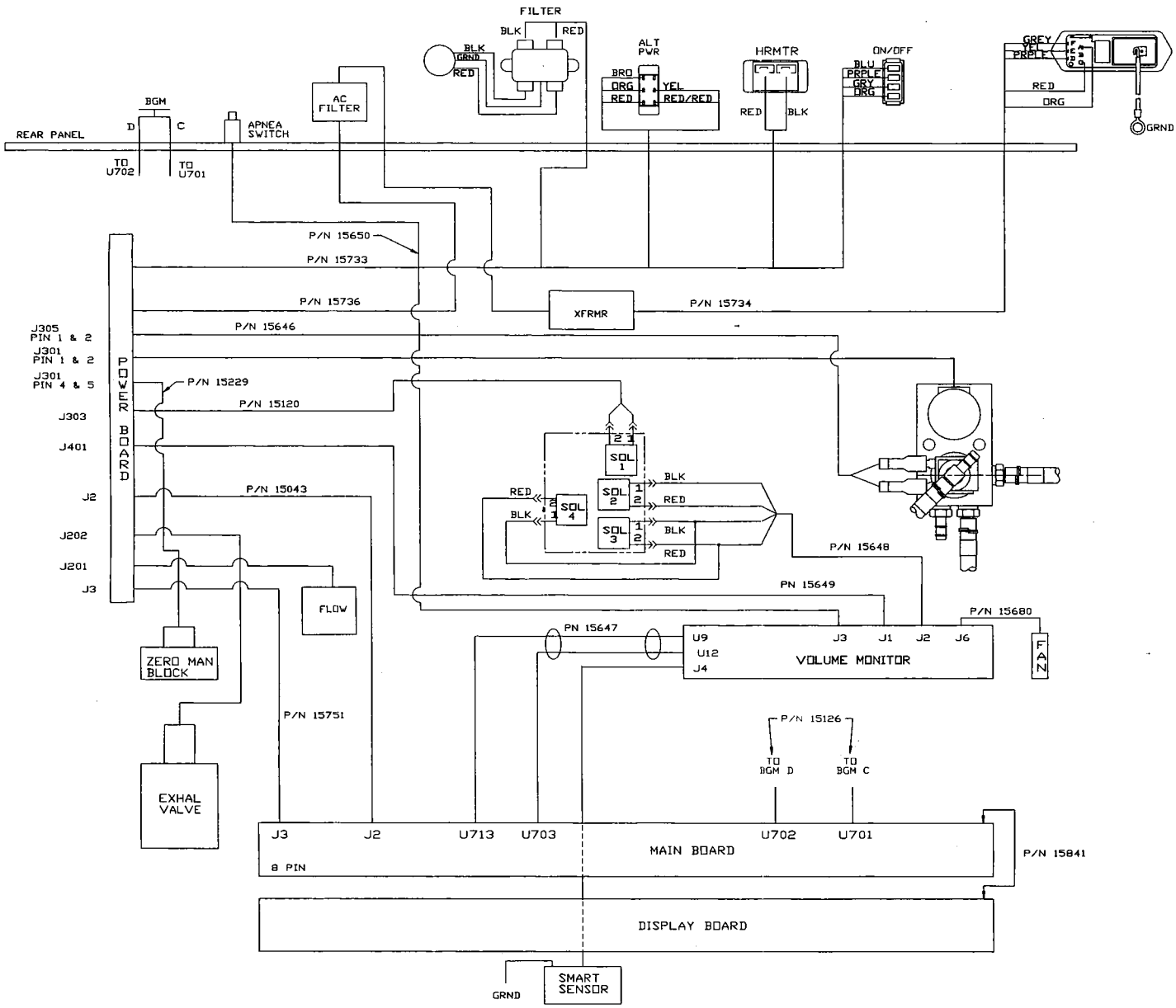
Qty	P/N	Description
1	21149	Rear Panel
1	09226	Hour Meter
1	71595	Circuit Breaker, ON/OFF Switch
1	15738	Power Entry Module with Cable Assembly
2	01066	1/4-20 Nut
1	04647	Plug, Hole .250 Dia Blk
1	09625	AC Input Filter
1	15733	Cable Assembly, Power Input
8	07212	Nut, 6-32 x .093
10	04383	Washer, Locking
2	03110	Nut 4-40 UNC 2B x .087 Hex
2	33528	Bulkhead Connector, Fiber Optic
1	45735	Cable Assembly, Bulkhead Connect, DC Input
2	33628	Cap, Fiber Optic Connector
6	03219	Screw Skhd Cap S/L 6-32
1	05650	Apnea Switch & Cable

Appendix A Schematics

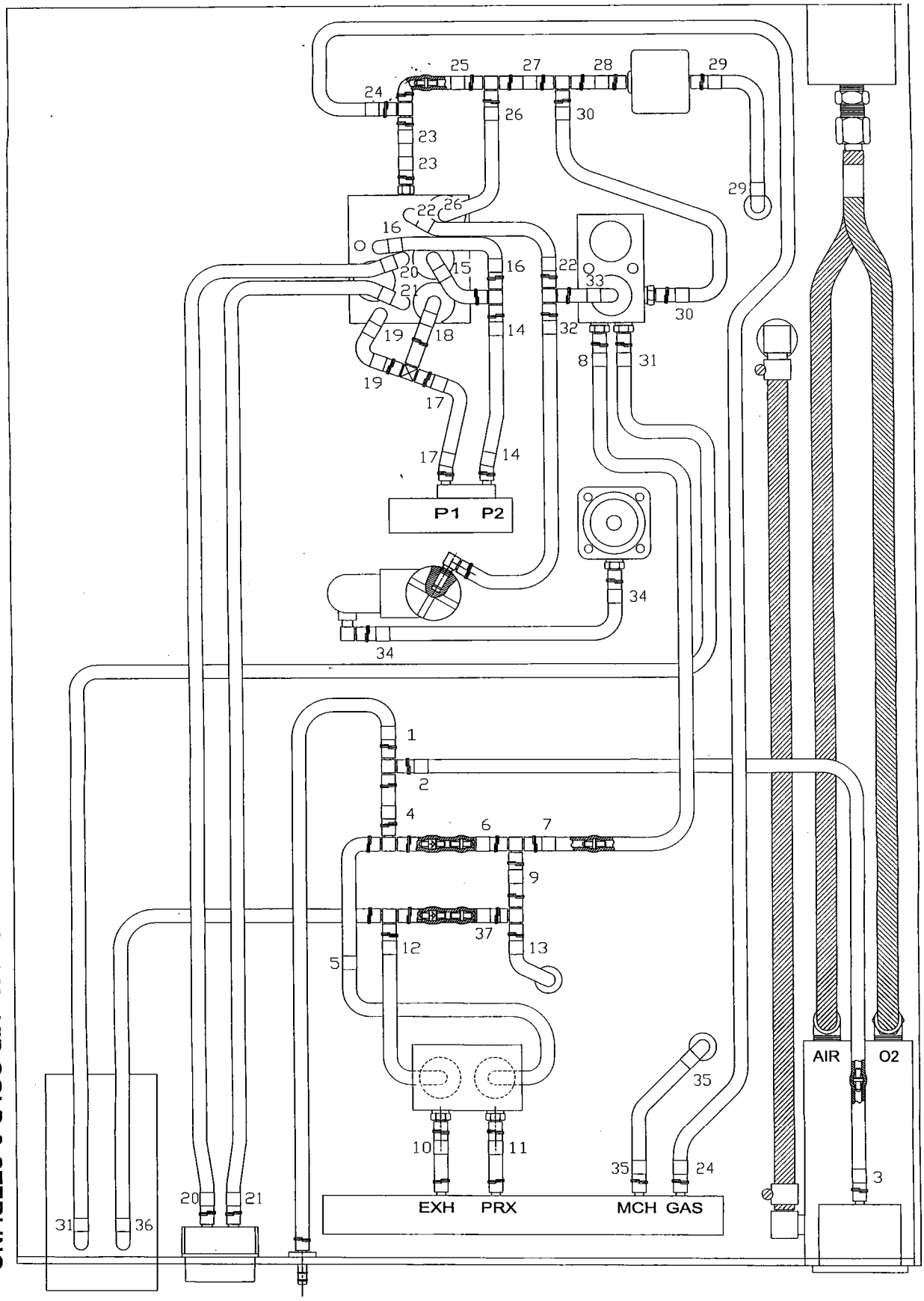
The following schematics are included for reference only and are controlled and revised separately from this manual. Please check with Bird Products Service Department for current revision information on these documents.

90761 Wiring Schematic

90765 Tubing Interconnect Schematic



Wiring Schematic V.I.P. Ventilators
P/N 90761



PNEUMATIC TUBING DIAGRAM - VIP GOLD & STERLING

Appendix B Error and Event Codes

01 Indicates CPU A executed unused memory space

02 Indicates CPU B executed unused memory space

03 Indicates CPU C executed unused memory space

04 Indicates CPU B interrupted CPU A with a VENT INOP condition

05 Indicates CPU B did not interrupt CPU C

06 Indicates CPU A did not interrupt CPU B

07 Indicates CPU A did not complete 32 mSec interrupt cycle within 40 mSec

08 Indicates one of the Dual-Port watchdogs timed out

Watchdogs are:
DPAB oscillator frequency hardware check

DPCB oscillator frequency hardware check

09 Indicates either CPU B or CPU C failed the watchdog check byte

10 Indicates that CPU A failed when determining the breath type

11 Indicates safety bytes received by CPU A were not complements

2I ndicates safety bytes received by CPU B were not complements

13 Indicates timeslot bytes received by CPU B were not complements

14 Indicates timeslot bytes received by CPU C were not complements

15 Watchdog PAL has failed

16 PROM configuration bytes do not match

17 Indicates ventilator mode switch failed

18 Indicates waveform switch failed

19 Indicates autozero loop failed to terminate

20 Indicates Pot 00 reading was over range (FFH)

21 Indicates Pot 01 reading was over range (FFH)

22 Indicates Pot 02 reading was over range (FFH)

23 Indicates Pot 03 reading was over range (FFH)

24 Indicates Pot 04 reading was over range (FFH)

25 Indicates Pot 05 reading was over range (FFH)

26 Indicates Pot 06 reading was over range (FFH)

27 Indicates Pot 07 reading was over range (FFH)

28 Indicates Pot 08 reading was over range (FFH)

29 Indicates Pot 09 reading was over range (FFH)

30 Indicates Pot 10 reading was over range (FFH)

31 Indicates Pot 11 reading was over range (FFH)

32 Indicates Pot 12 reading was over range (FFH)

33 Indicates Pot 13 reading was over range (FFH)

34 Indicates Pot 14 reading was over range (FFH)

35 Indicates Pot 15 reading was over range (FFH)

40 Indicates Pot 00 readings did not match

41 Indicates Pot 01 readings did not match

42 Indicates Pot 02 readings did not match

43 Indicates Pot 03 readings did not match

44 Indicates Pot 04 readings did not match

45 Indicates Pot 05 readings did not match

46 Indicates Pot 06 readings did not match

47 Indicates Pot 07 readings did not match

48 Indicates Pot 08 readings did not match

49 Indicates Pot 09 readings did not match

50 Indicates Pot 10 readings did not match

51 Indicates Pot 11 readings did not match
52 Indicates Pot 12 readings did not match
53 Indicates Pot 13 readings did not match
54 Indicates Pot 14 readings did not match
55 Indicates Pot 15 readings did not match
56 A/D #3 and A/D #4 disagree about flow data
57 A/D #3 and A/D #4 disagree about exhalation data
58 A/D #3 and A/D #4 disagree about machine data
59 A/D #3 and A/D #4 disagree about prox data
60 A/D #1 internal reference above tolerance
61 1A/D #1 internal reference below tolerance
62 A/D #2 internal reference above tolerance
63 A/D #2 internal reference below tolerance
64 A/D #3 internal reference above tolerance
65 A/D #3 internal reference below tolerance
66 A/D #4 internal reference above tolerance
67 A/D #4 internal reference below tolerance
70 A/D #3 pot supply voltage above tolerance
71 A/D #3 pot supply voltage below tolerance
72 A/D #4 pot supply voltage above tolerance
73 A/D #4 pot supply voltage below tolerance
74 A/D #3 reference voltage above tolerance
75 A/D #3 reference voltage below tolerance
76 A/D #4 reference voltage above tolerance
77 A/D #4 reference voltage below tolerance
79 No flow data present
80 Flow control valve did not home, volume breath, square wave
81 Flow control valve did not home, volume breath, sine wave
82 Flow control valve did not home, volume breath, accelerating taper wave
83 Flow control valve did not home, volume breath, decelerating taper wave
84 Flow control valve did not home, pressure supported breath (not used)
85 Flow control valve did not home, spontaneous breath (both spont and pspt)
86 Flow control valve did not home, TCPL breath
87 Flow control valve did not home, High Frequency breath
89 Flow control valve illegal motion control code 00
90 Branch through mode switch indicated illegal setting
91 Branch through wave switch indicated illegal setting
93 Software executed illegal jump in a branch table
94 Software executed illegal jump in a branch table
95 Software executed illegal jump in a branch table
96 Software executing self test at incorrect time in CPU C
97 Software executing self test at incorrect time in CPU A
98 Illegal Self Test number sent to CPU A
99 Watchdog timer failed to timeout

This section contains the numerical values written to the monitor display during the Power On Self Test.

200 CPU C began execution of Interrupt Test
201 CPU C began execution of 8032 Timer test
210 Invalid (corresponds to DPCB interrupt failure)
211 CPU A Interrupt failure in DPAB
212 CPU A 8031 Internal Timer failure
213 CPU A 8031 Internal RAM failure
214 CPU A Checksum failure
215 CPU A Stepper Motor failure (flow valve)
216 Invalid (corresponds to cell integrity test)
217 CPU A address test of DPAB
218 Invalid (corresponds to inverse address test)
219 Invalid (corresponds to monitor display failure)
220 CPU B Interrupt failure in DPCB
221 CPU B Interrupt failure in DPAB
222 CPU B 8031 Internal Timer failure

223 CPU B 8031 Internal RAM failure

224 CPU B Checksum failure

225 Invalid (corresponds to stepper motor failure)

226 CPU B cell integrity test of DPAB

227 CPU B address test of DPCB

228 CPU B inverse address test of DPAB

229 Invalid (corresponds to monitor display failure)

230 CPU C Interrupt failure in DPCB

231 Invalid (corresponds to DPAB interrupt failure)

232 CPU C 8031 Internal Timer failure

233 CPU C 8031 Internal RAM failure

234 CPU C Checksum failure

235 Invalid (corresponds to stepper motor failure)

236 CPU C cell integrity test of DPCB

237 Invalid (corresponds to address test)

238 CPU C inverse address test of DPCB

This section contains the numeric values stored in the VM board and can be displayed during the OVP for the Volume Monitor Board. If no event has occurred, an event code of 255 will display.

00 Unknown event

02 Internal RAM error

03 Internal RAM error

04 Internal RAM error

05 Internal RAM error

06 Internal Timer error

07 ROM Checksum Error

08 Analog to Digital converter error

11 External RAM Error

28 Pressure stuck low (= 0 for 6 seconds)

30 EEPROM Checksum error

31 EEPROM Invalid Block Pointer Error

35 Pressure stuck high (greater than MAX for 6 seconds)

48 SERIAL EEPROM Page Write Error

49 SERIAL EEPROM Page Byte Error

50 Breath type Error, unknown breath type – VPSPX.SRC

51 External Interrupt 0 Error

52 External Interrupt 1 rror

53 8Kx8 EEPROM is full

54 8Kx8 EEPROM Write failure

55 8Kx8 EEPROM Write failure (protected write)

255 No Event Code stored

Appendix C Theory of Operation

This appendix gives a brief overview of the physical operation of the ventilator. It shows you how air and oxygen enter the ventilator, blend together, and are delivered to the patient.

Schematic

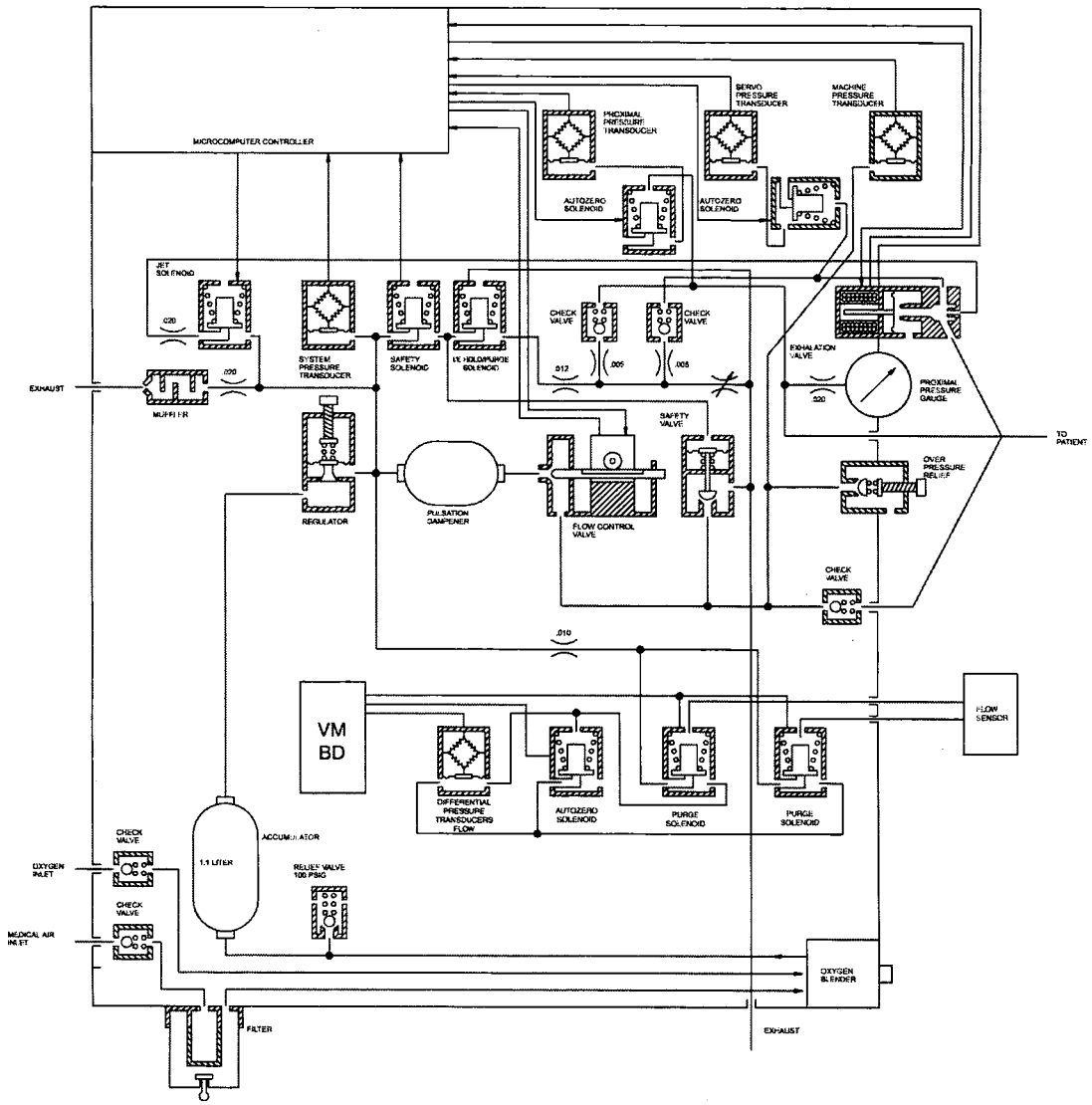


Figure C-1 Flow Delivery System Schematic

Gas Inlet Filter

Compressed air and oxygen (35 to 70 PSIG) are connected to the DISS gas inlets on the rear of the ventilator. Each inlet connector incorporates a 30 micron particulate filter. After passing through the

filters, the gases travel through a duckbill check valve which prevents possible reverse gas flow from either gas source. The incoming compressed gas passes through a Coalescing Filter which removes both liquid and solid particles from the gas stream. The liquid is collected in the filter bowl where it is visible to the user. A drain is provided for removal of accumulated liquid contaminants.

Oxygen Blender

The V.I.P. Bird Gold and Sterling is equipped with an internal oxygen blender that provides precise oxygen concentrations by means of a single control. The MicroBlender mixes medical grade compressed air and oxygen to provide a pressurized gas source ranging from 21% to 100% oxygen. For complete information on the theory of Blender operation, see Appendix D.

Relief Valve

The Relief Valve vents inlet gas to atmosphere if the inlet pressure to the accumulator exceeds 100 PSIG. This protects the pneumatic system in the event that excessive inlet pressure is applied to the ventilator.

Accumulator

Filtered and blended gas passes into a 1.1 liter Accumulator. The accumulator stores pressurized gas for augmenting the blender flow during high inspiratory flow demands. The MicroBlender is capable of delivering flow of up to approximately 75 lpm, while the ventilator can deliver flow up to 120 lpm. The accumulator provides the extra flow capacity required for high inspiratory flow demands.

Regulator

A precision pneumatic Regulator establishes the system pressure at 25 PSIG (1.75 kg/cm2). This pressure is used for the following functions:

- A precise and stable supply pressure to the Flow Control Valvefor purposes of accurate flow control.
- Driving pressure for the proximal and exhalation valve (servo) pressure line purge functions.
- Pilot pressure for actuating the Safety valve.
- Driving pressure for the exhalation jet venturi system.

Blender Bleed System

A continuous flow of approximately 6 LPM is maintained to assure blender accuracy during low flow states. This flow is maintained through the accumulator to enable a continuous flush of gas, enhancing the systems response to changes in FIO2.

Pulsation Dampener

The Pulsation Dampener is a rigid chamber with a volume of approximately 200 ml. The Flow Control Valve is capable of very fast changes in gas flow which in turn forces the Regulator to respond rapidly to maintain constant system pressure. The Pulsation Dampener acts as a buffer between the Flow Control Valve and Regulator to minimize pressure fluctuations.

Flow Control Valve

Gas flow to the patient is controlled by the Flow Control Valve. The valve is an electromechanical device with a range of 0 to 120 LPM with resolution of approximately 0.1 LPM. Rotary motion of the electromechanical driver is transformed to the linear motion required to throttle gas flow through the variable poppet type orifice. The valve is calibrated to obtain a known relationship between the valve position and the orifice opening. The design of the valve prevents flow delivery from being affected by pressures from the patient breathing circuit.

Using data from the proximal pressure transducer, the exhalation valve transducer, and from front panel controls, the microcomputer controls the valve to provide flow to maintain the required pressure for each ventilation mode.

Table C-1 Method of Flow Delivery for Various Breath Types

Breath Type	Method of Inspiratory Flow Delivery
Volume Controlled	Using the known relationship between valve position and flow rate, the Microprocessor Controller moves the valve in a predetermined sequence to satisfy the tidal volume and peak flow setting.
Spontaneous	Using feedback from the proximal and exhalation valve pressure transducers, the Microprocessor Controller moves the valve to provide flow as required to maintain a stable PEEP/CPAP pressure.
Pressure Support	Identical to spontaneous breath except the inspiratory flow is controlled to the Pressure Support setting plus the PEEP/CPAP setting.
Time Cycled	Maintains a constant flow during inspiration according to the Flow Control input.

Check Valve

The Check Valve ensures one way gas flow when the patient is breathing spontaneously. On the inspiratory leg of the patient circuit, the Exhalation Valve Diaphragm also acts as a one way check valve. One way flow is critical when the patient is breathing through the Safety Valve with the ventilator in an inoperative condition.

Exhalation Valve

All exhaled gas from the patient is controlled by the Exhalation Valve. The valve performs the following functions under Microcomputer control:

- It closes the exhalation leg of the patient circuit during inspiration for all breath types except TCPL breaths.
- It Servos to the Inspiratory Pressure level during inspiration of TCPL breaths.
- It opens completely at the beginning of exhalation to minimize flow resistance.
- It works in conjunction with the Flow Control Valve, Microprocessor Controller, the Proximal Pressure Transducer, and the Exhalation Pressure Transducer to maintain PEEP/CPAP and Pressure Support at the desired level.
- It opens completely following a High Pressure alarm or a Circuit Fault alarm to allow immediate evacuation of circuit pressure.

Safety System

The safety system consists of a Safety Solenoid that drives the main Safety Valve. During normal operation the solenoid is open, passing the system pressure (25 PSIG) to the upper chamber of the Safety Valve. This closes the safety valve poppet and seals the inspiratory leg of the patient system.

If electrical power is lost or when the ventilator is in an inoperative condition, the Safety Solenoid closes, venting the upper chamber of the Safety Valve to ambient pressure. This opens the Safety Valve poppet, allowing the patient to breath spontaneously from room air.

Inspiratory/Expiratory Hold - Inspiratory Pause Solenoid

The Inspiratory/Expiratory Hold and Inspiratory Pause System involves the Flow Valve, the Exhalation Valve and the Inspiratory/Expiratory Hold - Inspiratory Pause Solenoid. When Inspiratory/Expiratory Hold or Inspiratory Pause functions are not active, the Inspiratory/Expiratory Hold - Pause Solenoid is not energized and it allows purge flow to travel out the proximal and exhalation pressure sensing lines (See Proximal and Exhalation Valve Pressure Sensing Line Purge). When Inspiratory/Expiratory Hold or Inspiratory Pause functions are active, the Inspiratory/Expiratory Hold - Pause Solenoid is energized and diverts the proximal and exhalation pressure sensing line purge flow out to exhaust and prevents back flow into the pneumatic system. Also, when any of these functions are active the Flow Valve will stop delivering flow and the Exhalation Valve will close.

Proximal Pressure Transducer

This Transducer converts proximal airway pressure to an electrical analog signal. The signal is generated continuously and read every 2 msec. Data from the transducer is used by the Microprocessor Control System for the following functions:

- Primary servo system pressure data source
- Inspiratory Pressure Control
- PEEP/CPAP control
- Leak Compensation
- Pressure Triggering
- Pressure Supported breathing
- High Pressure alarm
- Low Peak Pressure alarm
- Low PEEP/CPAP alarm
- Apnea alarm
- High/Prolonged Pressure alarm
- Circuit Fault checks

Machine Pressure Transducer

The Machine Pressure Transducer monitors machine outlet pressure every 2 msec. This transducer is used as a safety monitor to the Proximal Pressure Transducer. During certain phases of inspiration, the Microcomputer Controller compares the two pressure signals. If the two signals do not agree within the predetermined tolerance band, the ventilator generates an audible and visual alarm.

Exhalation Valve Pressure Transducer

This transducer is used in conjunction with the exhalation valve to control PEEP/CPAP for all breath types, and Peak Inspiratory Pressure (PIP) for TCPL breaths. A pressure signal is generated every millisecond.

Proximal And Exhalation Valve Pressure Sensing Line Purge

The proximal and exhalation valve purge provides a forward flow of blended gas through the proximal airway and exhalation valve pressure sensing lines. This prevents moisture from migrating up into the ventilator pneumatics.

The three fixed orifices and the variable orifice are calibrated to provide 0.05 to 0.10 lpm purge flow. The check valves prevent back flow into the pneumatic system in the event that patient circuit pressure exceeds the purge drive pressure.

System Transducer

The System Transducer monitors the system pressure (25 PSIG) and compares it to a predetermined tolerance range. If the system pressure is out of range, the controller will activate the Low Inlet Gas

Pressure alarm or Vent Inop alarm depending on the severity of the condition. The following conditions can cause the system pressure to be out of range:

- Insufficient gas supply
- Clogged inlet filters
- Regulator out of calibration
- Oxygen blender malfunction

Jet Solenoid

The Jet Solenoid controls the drive pressure to the exhalation valve jet venturi. It is active only during TCPL ventilation. Under Microprocessor control, the solenoid is activated as needed, to overcome the PEEP created by continuous flow through the exhalation leg of the patient breathing circuit.

Pressure Relief Valve

The Pressure Relief Valve is a mechanical backup to the High Pressure Alarm. It can be adjusted from 0 to 130 cmH2O. If pressure in the inspiratory leg of the patient circuit reaches the valve setting, the valve opens, venting gas to the atmosphere and reducing the airway pressure to below the valve setting.

In all modes of ventilation, the Pressure Relief valve should always be set greater than 5 cmH2O above the High Pressure Alarm setting. If set at a value lower than that, it may prevent the High Prolonged Pressure alarm from activating. In this case gas will not be vented back through the safety valve in the event of a blockage in the expiratory leg of the patient circuit.

Autozero Manifold

The Autozero Manifold periodically checks the Proximal and Exhalation Pressure transducers to see if they read zero at ambient pressure, with no system pressure present. If either solenoid is out of reference, the solenoid will compensate to 3.0 cmH2O to bring the transducer back to a zero reference.

Solenoids activate:

- On Power Up
- After five (5) minutes
- Every 30 minutes for the first 3 hours
- Every 3 hours with continued use

Volume Measurement/Differential Pressure Transducer

Volume measurement is derived from the measurement of flow through an Infant or a Pediatric flow sensor. As flow passes through the two chambers of the sensor, the flow element creates a small

pressure difference. The pressure difference is transmitted to the Differential Pressure Transducer by the tubing attached to the two chambers of the sensor. The pressure difference is measured, using the Differential Pressure Transducer. The pressure difference is converted to a volume measurement by using the flow/pressure calibration data stored in the flow sensor.

Volume Monitor Autozero/Purge Manifold

A Volume Monitor Purge is activated every minute when a flow sensor is attached. The Purge is used to send gas down the pressure sensing lines of the flow sensor to help prevent blockage and water migration to the Differential Pressure Transducer. Activation of the Purge is synchronized to the patient's exhalation so that no additional volume is delivered to the patient. The Purge flow is delivered for approximately 150 milliseconds. The amount of Purge flow is approximately 12 ml of gas.

The Volume Monitor Autozero function is accomplished at the same time as the Volume Monitor Purge. This Autozero function is used to zero calibrate the Differential Pressure Transducer.

Electronic Theory of Operation

Power for electronic components is provided by the Power Entry Module, Power Transformer, and Alternate Power Input.

The ventilator contains four Printed Circuit Board Assemblies (PCBA's): the Display PCBA, the Main PCBA, the Power/Driver PCBA, and the volume monitor PCBA.

The Power/Driver PCBA conditions the electrical power used by the rest of the electronics. It also provides the constant current needed for the Flow Control Valve step motor and the Exhalation Valve linear solenoid. A special High Frequency Flow Interrupter solenoid valve driver circuit is also part of the Power/Driver PCBA. Up to 8 small solenoid valves can be driven from the PCBA: including 1 or 2 jet pump valves, the safety solenoid valve, and 1 to 3 purge/autozero valves. The Hour Meter and is also driven from this PCBA.

The Display PCBA provides visual information, certain push button switch functions and alarm volume adjustment. The displays and indicators inform the user of ventilator status, ventilation parameters, and control settings. The push button switches select, activate, or adjust various functions.

The Main PCBA collects and processes data from pressure transducers, switches, and the control potentiometers. This data provides information to the Power/Driver PCBA allowing it to control the action of the Flow valve, Exhalation valve, and various solenoid valves. The Main PCBA has three microcontroller systems referred to as "CPU Unit A" and "CPU Unit B" and "CPU Unit C." CPU Unit A provides overall system control functions such as breath rate timing, volume control, and flow and exhalation valve servo operation. CPU Unit B reads and controls analog inputs such as front panel control settings, pressure transducer readings, monitoring data, and alarm testing and monitoring. Also contained in the Main PCBA are up to three Pressure transducers, the Audible alarm, fiber optic connectors, and two sets of DIP switches.

"CPU Unit C" controls the operation of the display devices and monitors switches for input information.

The pneumatic system is based on two electromechanical valves: the Flow Control valve and the Exhalation Control valve. All gas delivery to the patient is controlled by the Flow Control valve and all exhaled flow from the patient is controlled by the Exhalation Control valve.

Pneumatic Theory of Operation

Volume Monitor PCBA

The Volume Monitor PCBA takes data from a pressure transducer to measure and compute the volume of gas being delivered by the ventilator to a patient. The pressure data from the transducer is processed through an A/D converter circuit and fed to a CPU. The CPU performs the necessary calculations and transmits flow data to the Main PCBA through fiber optic cables. The Volume Monitor Board takes information from an Electronic Erasable Programmable Read Only Memory (EEPROM) that is incorporated into the flow sensor. The data from the EEPROM provides information about what type of sensor is being used which in turn allows the ventilator to adjust settings to accommodate either an infant patient or a pediatric patient. The Volume Monitor Board controls a heater circuit that prevents moisture built up around the external infant sensor. The Volume Monitor Board also takes input from an Apnea switch, which allows the user to vary the Apnea Interval settings. And lastly, the Volume Monitor board controls a fan that circulates air inside the ventilator.

Gas inlet assembly

The gases enter through the air and oxygen inlet connectors located on the rear of the ventilator. Each inlet blender connector incorporates a 30 micron particulate filter. From the filter, the gases travel through a duckbill check valve, which prevents possible reverse gas flow from either the air oxygen supply system.

Balance Module

The gases then enter a two-stage balance module. This module equalizes the two gas sources before they enter the proportioning module. This balancing is accomplished through movement of a diaphragm, which directs a poppet contained within the air and oxygen chambers. The movement of the poppet adjusts the amount of gas flowing through the module, equalizing the two pressures.

Proportioning Module

From the balance module the gases flow into the proportioning module. Here the gases are mixed according to the oxygen percentage selected on the control knob. This module consists of a double-ended valve positioned between two valve seats. One valve controls passage of medical air and the other controls passage of medical oxygen. When the microblender is set to 21%, only medical air is passed through the proportioning module. When the microblender is set to 100%, only medical oxygen is passed through the microblender.

Alarm/Bypass Module

The alarm feature provides for an audible alarm if the source pressures differ by more than ñ20 PSIG. The bypass function operates in unison with the alarm. The bypass is a poppet assembly which communicates directly with medical air and medical oxygen. When the two gas sources near equal in pressure, the alarm bypass poppet is positioned over the bypass channel, blocking the flow of both gases. Once a 20 PSIG difference is seen by the poppet, the higher gas pressure will overcome the spring and pressure at its opposite end, thus creating a path for gas (air and oxygen) to flow into the alarm channel. The higher gas pressure will also flow directly to the blender outlet port bypassing the balance and proportioning module. The alarm channel directs the gas out to the reed alarm creating an audible alarm. The oxygen percentage will be either be 100% or 21%, which ever is the higher gas pressure. The blender will remain in alarm/bypass until the inlet gas pressures are with 20 PSIG each other.

Appendix D Blender

Operator's Manual 3800 MicroBlender

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