SECTION 1

Introduction

SECTION 1
INTRODUCTION

June, 1990

The 8400ST Volume Ventilator Service Manual contains pneumatic and electronic theories of operation, calibration, troubleshooting, replacement, and overhaul instructions to assist a qualified service technician in the maintenance of the ventilator.

The Service Manual is specifically intended for use by an authorized service person; that is, a person that has attended a 8400ST service seminar conducted or authorized by Bird's Service Training Center. Any repairs, adjustments, or procedures that exceed the scope of this manual should be referred to the Bird Products Corporation Factory Service Center. For specific operating instructions and clinical theory of operation, refer to the 9400ST Operating Instruction Manual, P/N L1141, or Sections 2 through 7 of this manual. Service personnel should become thoroughly familiar with the Operating and Maintenance procedures before attempting service on this equipment. The WARNINGS, CAUTIONS, and NOTES should be given particular attention.

Sections 8 through 17 of this manual cover the details related to the diagnoses and repair of defective subassemblies of the 8400ST ventilator. This manual is structured around the concept of isolating a problem to a defective **subassembly** and replacing that defective **subassembly.** The manual does not cover diagnoses and repair of, for example, component failures on the printed circuit board subassemblies; however, complete schematic information is provided to give the service technician complete technical information. Defective subassemblies can be replaced in the field by factory trained technical personnel.

Only factory trained personnel should attempt diagnosis and repair of a 8400ST ventilator. Bird's service training classes are based on fault analysis and repair at the subassembly level and also include detailed training on how to perform the 15,000 hour overhaul of the ventilator.

The maintenance schedule for a 8400ST ventilator includes preventative maintenance through the first 15,000 hours as follows:

Every 1000 hours:	examine inlet filter; replace as neccessary.
Every 3000 hours:	verify transducer calibration.
Every 5000 hours:	replace bacteria filters.
15,000 hours:	**COMPLETE OVERHAUL**

The 15,000 hour overhaul may be done by any factory trained service technician. It is important, however, that the overhaul be done using only the overhaul components provided by Bird Products Corporation. In addition, no overhaul should be considered complete until an Operational Performance Verification test has been performed in accordance with Section 14 of this manual.

All repair and maintenance, including the 15,000 hour overhaul, can be done at any faility where proper service equipment is available to qualified, trained service technicians.

SECTION 2

Specifications

SECTION 2
PRODUCT SPECIFICATIONS

June, 1990

CONTROLS

Power	On/Off (I/O)
Modes	Control Assist/Control, SIMV & CPAP
*Tidal Volume	50 to 2000 ml
Peak Flow	10 to 120 lpm
*Breath Rate	0 to 80 bpm
Waveforms	Square, Decelerating
Pressure Support	Off to 50 cmH_2O
Assist Sensitivity	-1 to -20 cmH_2O, OFF
PEEP/CPAP	0 to 30 cmH_2O
Manual Breath	Touch Button Activated
Inspiratory Hold	6 seconds (maximum)
Sigh	On/Off - 1 Sigh/100 breaths
Sigh Volume.....	1.5 x Tidal Volume (up to 3000 ml)
Sigh High Pressure Limit	1.5 x set (up to 140 cmH_2O)
Alarm Silence	60 seconds
Alarm Reset	Touch Button
AC Line/ALT PWR Source	Slide Switch for AC or DC Operation
Alarm Volume	74 to 84 dB
Back Up Breath Rate	0 to 80 bpm

*Maximum Minute Volume Capability - 56 L @ 50 PSIG inlet to blender.

MONITORS

Power "ON"	Green Indicator Lamp
Minute Volume	0 to 130.0 L
Tidal Volume	0 to 9999 ml
Breath Rate	0 to 255 bpm
I:E Ratio	1:1.0 to 99 or 1.0 to 99:1 (INVERSE)
Airway Pressure	-20 to 140 cmH_2O
Battery "ON"	Yellow Indicator Lamp
Patient Inspiratory Effort	Yellow Indicator Lamp
Hourmeter	0 to 99,999 hours

ALARMS

High Pressure Limit	1 to 140 cmH_2O
Low Peak Pressure	Off, 2 to 140 cmH_2O
Low Baseline Pressure	-20 to +30 cmH_2O
Low Minute Volume	0 to 99.9 L
High Breath Rate	3 to 150 bpm
Low Inlet Gas	17 PSIG Internal (1.19 kg/cm2)
Apnea Interval	10 to 60 seconds
Ventilator Inoperative	Red Indicator Lamp
CIRC	Flashing Display
Mode Switch Position	Rotating Display

INPUTS

Electrical	Fuse Rating
100 VAC + 10% - 15%, 50/60 Hz, 0.75 amps -	1.25SB
120 VAC + 10% - 15%, 50/60 Hz, 0.58 amps -	1.00SB
220 VAC + 10% - 15%, 50/60 Hz, 0.35 amps -	.63SB
240 VAC + 10% - 15%, 50/60 Hz, 0.32 amps -	.63SB
11.8 - 16VDC, 5 amps (maximum)	

Pneumatic
30 - 70 PSIG (2.10 - 4.90 kg/cm2)

OUTPUTS

Data Link	Optical Link for 8400ST Interface Module-RS232

PHYSICAL WEIGHTS & DIMENSIONS

Dimensions

Ventilator only	H - 9" (22.9cm) W - 16" (40.6cm) D - 13 1/2" (34.3cm)
Ventilator & Stand	H - 51 1/2" (130.8cm) W - 21" (53.3cm) D - 24" (60.9cm)
Ventilator & Compressor	H - 55" (14.5cm) W - 16" (40.6cm) D - 25 1/2"(64.8)

Weight

Ventilator only	32 lbs (14.5kg)
Ventilator & Stand	80 lbs (36.4kg)
Ventilator & Compressor	185 lbs. (84.1kg)

SHIPPING INFORMATION

Dimensions

Ventilator only	H - 15" (38.1cm) W - 19" (48.3cm) D - 18" (45.7cm)
Ventilator & Stand	H - 40 1/8" (102cm) W - 30 1/8" (76.5cm) D - 22 7/8" (58cm)
Ventilator w/Accessories & Compressor	H - 31" (78.7cm) W - 24" (60.9cm) D - 19" (48.3cm) H - 38 1/2" (97.4cm) W - 22" (55.9cm) D - 35 1/2" (90.2cm)

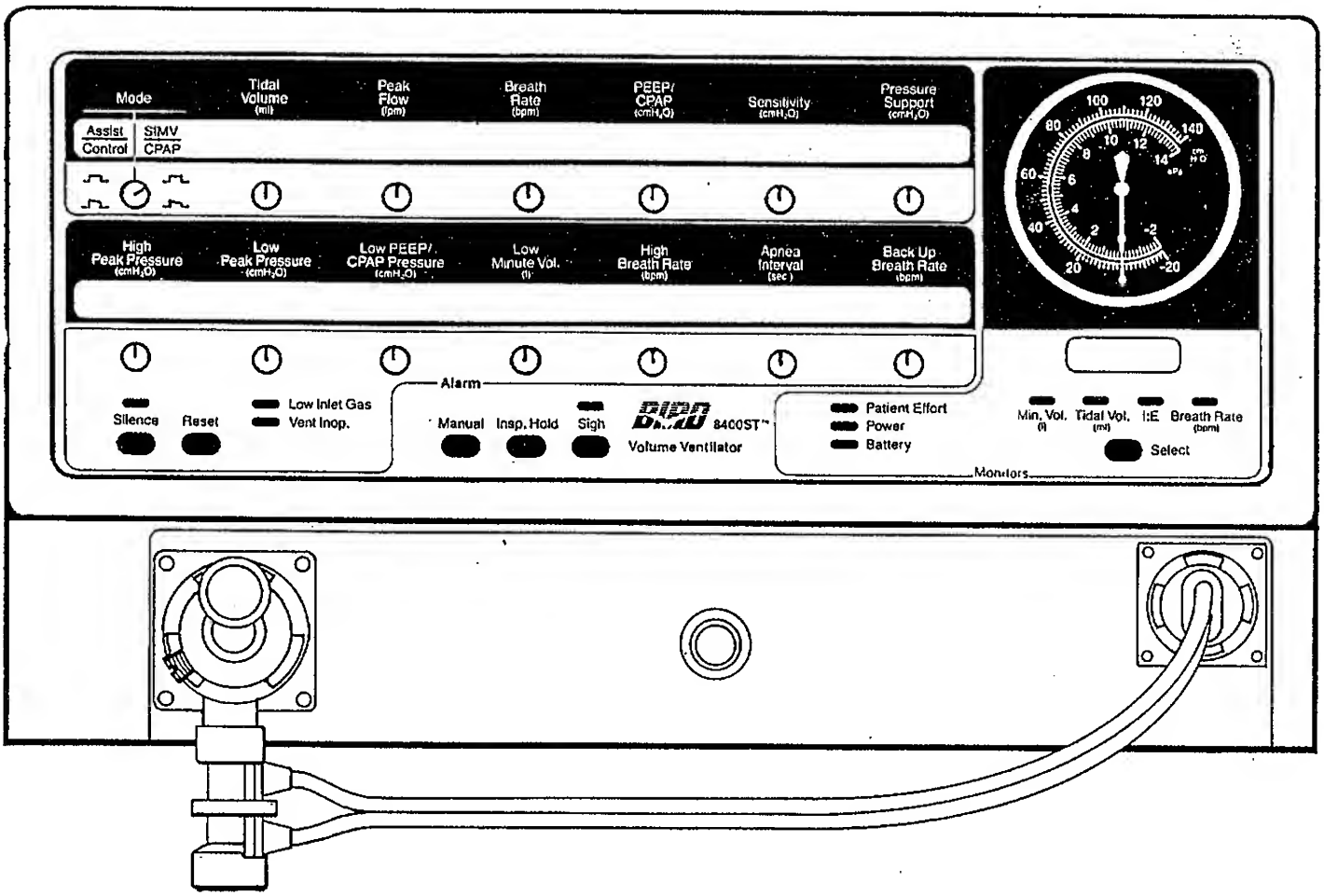
Weight

Ventilator only	38 lbs (17.3kg)
Ventilator & Stand	95 lbs (43.2kg)
Ventilator w/Accessories & Compressor	63 lbs (28.6 kg) 142 lbs (64.5kg)

NOTE: Prices, Terms, conditions and product specifications are subject to change without notice.

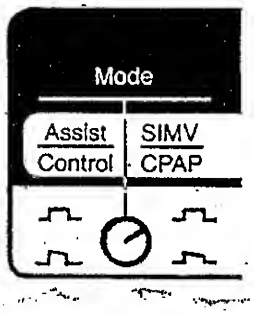
SECTION 3

Description of the Display, Controls and Alarm Indicator



FRONT PANEL 8400ST

■ CONTROLS



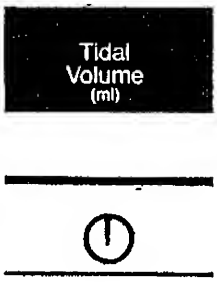
MODE CONTROL

Dual function control for selecting flow delivery waveform and basic operating mode.

Two basic operating selections (ASSIST/CONTROL and SIMV/CPAP)

are used in conjunction with breath rate and sensitivity controls to set up any one of four ventilation modes: Control, Assist/Control, SIMV and CPAP.

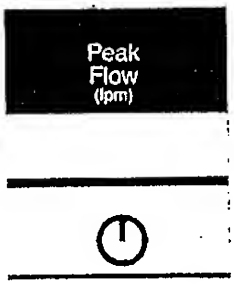
Two waveform options are available for each of the two basic operating selections. When a square waveform flow delivery is selected, inspiratory flow is delivered at a constant rate equal to the peak flow setting. When decelerating waveform flow delivery is selected, flow is initially delivered at the peak flow setting, then decelerates to 50% of the peak flow setting at the conclusion of the mechanical delivered breath.



TIDAL VOLUME CONTROL

Sets the volume of gas delivered to the patient for controlled, assisted and Apnea Back Up Ventilation breaths.

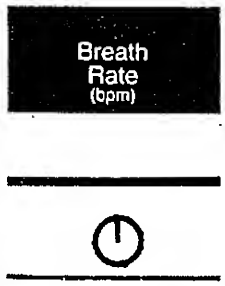
Range: 50 to 2000 ml



PEAK FLOW CONTROL

Sets the maximum flow delivered to the patient during controlled, assisted and Apnea Back Up Ventilation breaths. For square waveform, this is the flow rate delivered for the entire inspiratory phase. For decelerating waveform, this is the peak flow delivered before deceleration.

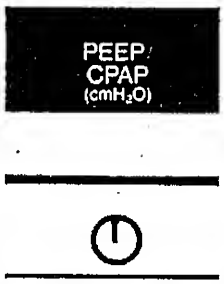
Range: 10 to 120 lpm



BREATH RATE CONTROL

Sets the number of ventilator initiated breaths to be delivered to the patient per minute in the Control, Assist/Control and SIMV modes of ventilation.

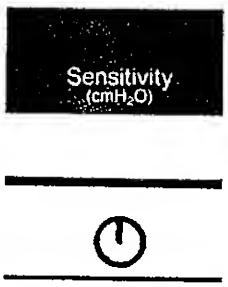
Range: 0 to 80 bpm



PEEP/CPAP CONTROL

Establishes the pressure in the patient circuit between the end of exhalation and the start of the next inspiration. Also known as baseline pressure.

Range: 0 to 30 cmH_2O



SENSITIVITY CONTROL

Sets the trigger level below baseline pressure for the initiation of spontaneous (CPAP), pressure supported, and assisted breaths.

Range: -1 to -20 cmH_2O, OFF

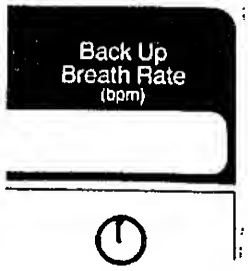
PRESSURE SUPPORT CONTROL

Sets the inspiratory patient circuit pressure during a spontaneous breath. This control is functional in SIMV/CPAP mode only.

Range: OFF, 0 to 50 cmH_2O

NOTE: This control sets the pressure level above PEEP. The total patient pressure equals PEEP + Pressure Support.

NOTE: Pressure Support in the 8400ST has a preset 3 second inspiratory time limit. (See Description of Alarms in this section.)

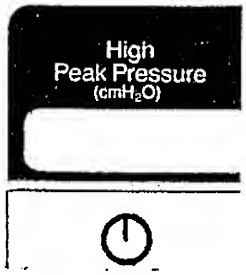


BACK UP BREATH RATE

Sets the breath rate to be used during Apnea Back Up Ventilation.

Back Up Breath Rate cannot be set to any value (other than zero) lower than the control Breath Rate setting. An incompatibility between the Back Up Breath Rate setting and the control Breath Rate setting is indicated by limiting the Back Up Breath Rate Display to the control setting and flashing the display value.

■ ALARMS



HIGH PRESSURE LIMIT ALARM

This alarm establishes the maximum allowable pressure in the patient system. Once violated, the following events will occur immediately:

1. Both audible and visual indicators will be activated.

2. The ventilator will be forced into an exhalation state, i.e., inspiratory flow is stopped and the exhalation valve opens. If the ventilator is operating correctly and there are no patient circuit kinks or occlusions, patient pressure will be reset to baseline and the audible portion of the alarm will cease.

3. If the patient pressure resets to baseline within 3 seconds, normal ventilation will resume. If the ventilator pressure remains above the High Pressure Alarm Limit for more than 0.3 seconds and/or is above baseline pressure plus 3 cmH_2O for longer than 3 seconds, the following will occur:

   ■ The safety system solenoid will open and pressure will begin to decrease, via a bleed orifice in the mainflow outlet check valve, back to baseline pressure.

   ■ At baseline pressure + 3 cmH_2O, the ventilator will reset and attempt to give another breath. If the problem is not resolved, the sequence will repeat as explained above.

   ■ Once corrected, the ventilator will resume normal operation.

   ■ The High Pressure Limit indicator will remain flashing until the reset button is activated.

The value of the alarm setting is automatically increased to 1½ times the set High Pressure Limit upon the delivery of a Sigh breath. The value cannot exceed the 140 cmH_2O maximum.

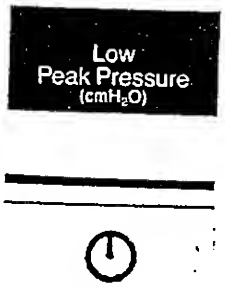
Range: 1 to 140 cmH_2O

Silence: Yes

Audible: Intermittent "Beep"

Visual: Flashing Digital Display

NOTE: This alarm cannot be set below PEEP +1 cmH_2O



LOW PEAK PRESSURE ALARM

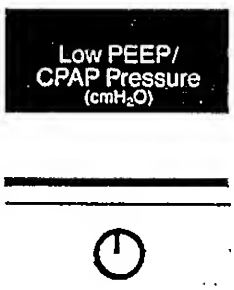
The Low Peak Pressure alarm is activated if the airway pressure fails to exceed the alarm setting during the inspiratory phase of a breath. This alarm is active for volume controlled and volume assisted breaths.

Range: Off, 2 to 140 cmH_2O

Silence: Yes

Audible: Intermittent "Beep"

Visual: Flashing Digital Display



LOW PEEP/CPAP PRESSURE ALARM

The Low PEEP/CPAP Pressure Alarm is activated if the airway pressure drops below the alarm setting at any time during the ventilation cycle for longer than 0.5 seconds.

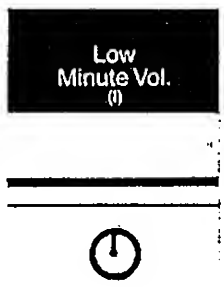
Range: -20 to +30 cmH_2O

Silence: Yes

Audible: Intermittent "Beep"

Visual: Flashing Digital Display

NOTE: Low PEEP/CPAP alarm can be set below zero baseline to detect return of ventilatory drive of a patient previously being controlled.



LOW MINUTE VOLUME ALARM

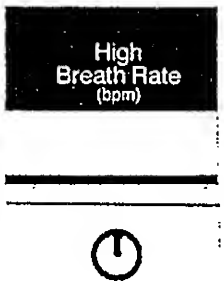
This alarm is activated whenever the minute ventilation, as measured by the volume monitoring system at the exhalation valve, does not exceed the alarm setting. The Low Minute Volume Alarm applies to all breath types.

Range: 0 to 99.9 L

Silence: Yes

Audible: Intermittent "Beep"

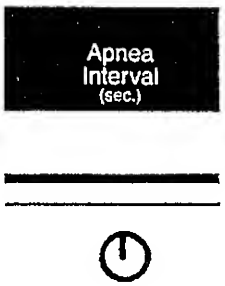
Visual: Flashing Digital Display



HIGH BREATH RATE ALARM

The High Breath Rate alarm is activated if the total breath rate (spontaneous plus machine) exceeds the alarm setting.

Range: 3 to 150 bpm
Silence: Yes
Audible: Intermittent "Beep"
Visual: Flashing Digital Display



APNEA INTERVAL

This alarm sets the apnea time interval. If no breaths (either machine or spontaneous) are sensed within the selected time interval, an audible and visual alarm is activated and Apnea Back Up Ventilation is initiated.

Range: 10 to 60 seconds
Silence: Yes
Audible: Intermittent "Beep"
Visual: Flashing Digital Display;
"AP" alternates with Apnea Interval setting

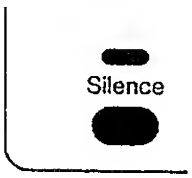
SENSOR DISCONNECT ALARM

The 8400ST is designed to operate with or without the flow sensor. If the flow sensor assembly is disconnected during operation of the ventilator, the following will occur:

- An audible alarm sounds
- "---" appears in the Low Minute Volume alarm setting display window.
- The Monitor section will sequentially display only I:E Ratio and Breath Rate.

Depression of the Alarm Silence button will silence the audible alarm for 60 seconds.

Depression of the Alarm Reset button will defeat the audible alarm until a flow sensor assembly is again connected to the ventilator.



ALARM SILENCE

Allows the operator to temporarily disable the audible alarm signal. Activating this control again, within the 60 second silence period will restore the audible alarm.

Duration: 60 seconds

NOTE: During an alarm condition resulting from loss of electrical power to the ventilator, continuous depression of the alarm silence button for 3-5 seconds will silence the alarm until power is resumed.

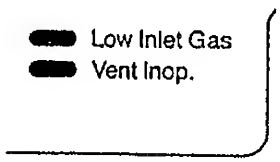
ALARM RESET

Resets the visual alarm indication of any alarm condition which no longer exists. Resets Apnea Back Up ventilation to normal ventilator operation. Defeats flow transducer disconnect alarm. Will not reset a Ventilator Inoperative condition.

ALARM LOUDNESS

Located on the rear panel, the alarm loudness knob varies the audible alarm level.

Range: 74dB to 84dB

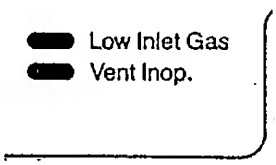


LOW INLET GAS ALARM

Alarm is activated whenever ventilator internal system gas pressure drops below 17 PSIG (1.19 kg/cm2). If this pressure drops below 16 PSIG (1.12 kg/cm2) for 1 second, an audible and visual Ventilator Inoperative state will be signaled. The alarm can be caused by any of the following conditions:

a) Low inlet gas pressure
b) Clogged inlet filter
c) Regulator malfunction
d) System pressure transducer malfunction

Silence: No
Audible: Continuous Tone
Visual: Flashing LED



VENTILATOR INOPERATIVE ALARM

This alarm condition causes the ventilator to cease normal gas delivery and activate a safety system, allowing the non-apneic patient to breathe spontaneously from "room" air.

The Ventilator Inoperative state will be activated if any of the following conditions occur:

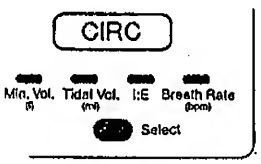
*a) Loss of electrical power

*b) Extended low ventilator inlet gas pressure, less than 16 PSIG (1.12 kg/cm2) or greater than 24 PSIG (1.68 kg/cm2) for 1 sec.

c) A system failure is detected by the ventilator control system, either electrical or mechanical.

* These are recoverable Ventilator Inoperative conditions. The ventilator will resume normal operation once the conditions have been corrected.

Silence: No
Audible: Intermittent "BEEP"
Visual: Flashing LED



"CIRC" DISPLAY

This alarm detects possible patient circuit or pressure transducer faults by comparing pressure measurements from the airway pressure transducer and the machine pressure transducer. If a pressure mismatch occurs, a "CIRC" message will be visually displayed in the "Monitors" display window along with an audible alarm. The following differences between the airway pressure transducer and the machine pressure transducer will activate the alarm:

■ **Inspiration:**

While in the inspiratory phase, if the machine pressure is more than 29 cmH_2O above or 9 cmH_2O below airway pressure for longer than 100 msec, the alarm will activate.

"CIRC" DISPLAY (Con't)

■ **Exhalation:**

While in the exhalation phase, if the machine pressure is more than 29 cmH_2O or 9 cmH_2O below airway pressure for longer than 1 second, the alarm will activate.

Once activated, the ventilator is immediately forced to the exhalation phase with the higher of the two pressures (either airway or machine pressure) fed to the exhalation servo for purposes of PEEP control. If the mismatch condition continues for greater than 10 - 12 seconds, the safety and exhalation valves will be opened in an attempt to allow the patient to breathe spontaneously. When the mismatch condition no longer exists and the higher of the two pressures drops below PEEP + 3 cmH_2O the unit will resume normal ventilation.

The following conditions can cause this alarm to be activated:

a) Blocked airway pressure sensing port

b) Occluded or kinked inspiratory or expiratory limb of breathing circuit

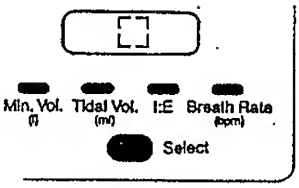
c) Transducer failure (either airway pressure or machine pressure transducer)

Silence: No

Audible: Intermittent "BEEP"

Visual: Flashing Digital Display

NOTE: When the airway pressure sensing port becomes blocked, the 0.05 to 0.1 lpm Purge Flow causes the manometer pressure to rise to 100 cmH_2O. The pressure seen on the manometer is not patient airway pressure. Approximately 10 seconds from the "CIRC" alarm notification, a solenoid opens and pressure is relieved. Once the pressure is relieved back to baseline +3 cmH_2O, the ventilator resets and attempts to cycle again. If the blockage is not resolved, the process will repeat until corrective action has been implemented.



MODE/WAVEFORM DISCREPANCY DISPLAY

Rotating illumination of one corner of a four corner square, gives visual indication that the mode selection switch is not properly located in one of the available positions for mode and waveform selection. Accompanying the visual display is an audible alarm that will only reset when correct switch positioning is attained.

Should the mode switch not be properly positioned while ventilator is in operation, the 8400ST will stay in the previous settings for mode and waveform. Concurrently, the visual and audible alerts will be activated.

Should the mode switch not be properly positioned during initial ventilator power-up, a default position of SIMV and decelerating waveform will be selected. Concurrently, the visual and audible alerts will be activated.

Silence: Yes

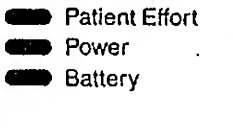
Audible: Intermittent "BEEP"

Visual: Rotating illumination of one corner of a four corner square in "Monitors" display window.

■ INDICATORS

PRESSURE SUPPORT INSPIRATORY TIME LIMIT

Pressure Support on the 8400ST incorporates a preset 3 second inspiratory time limit. Should inspiratory flow fail to reach 25% of the peak value during that breath (as might occur with a substantial air leak in the system), the Pressure Support breath will be terminated and the Pressure Support control digital display will flash.



PATIENT EFFORT INDICATOR

Indicates when an inspiratory effort meets or exceeds the sensitivity setting. This indicator will flash at the initiation of the following breath types: Assisted, Pressure Supported and Spontaneous.

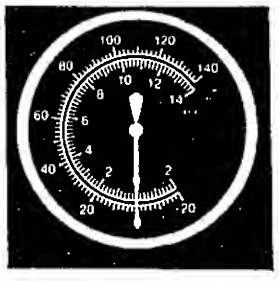
I:E	**I:E RATIO LED FLASHING** Indicates an inverse I:E ratio has been set. This indicator will flash as long as the combination of set breath rate, tidal volume and flow create an inverse I:E ratio. The flashing will stop when the set parameters no longer create an inverse I:E ratio.
Power	**POWER "ON" INDICATOR** Green Indicator lamp, illuminates when the main power switch is "ON" and AC power is connected and the AC Line/ALT Power switch is in AC Line position.
Battery	**BATTERY INDICATOR** Yellow Indicator lamp, illuminates when unit is operating from external 12 VDC power source. Input power must be 11.8 - 16 VDC.
	NOTE: Back panel switch must be in the DC (ALT PWR Source) position.

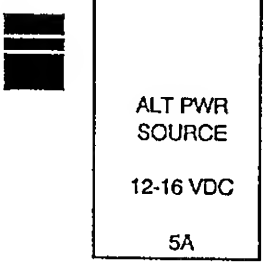
■ MONITORS

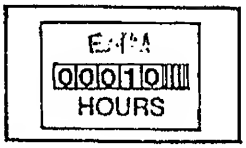
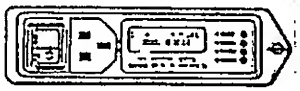
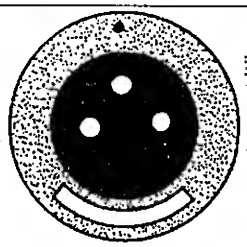
Select	**MONITOR SELECT BUTTON** Depression of this button allows for visual display of monitored parameters. 1) Minute Volume; 2) Tidal Volume; 3) I:E Ratio; 4) Breath Rate. When pressed repeatedly, sequentially displays 1 through 4, then jumps from 4 to 1.
Min. Vol. (l)	**MINUTE VOLUME DISPLAY** Displays minute volume of all breath types as measured by the flow sensor. Minute volume is calculated on an eight breath average as follows: Total Breath Rate X Sum Of Last 8 Tidal Volumes (ml)/ 8 X (1L / 1000 ml) Updated on a breath by breath basis.

Tidal Vol. (ml)	**TIDAL VOLUME DISPLAY** Displays tidal volume for all breath types as measured by the volume monitoring system. The tidal volume display is updated on a breath by breath basis. Range: 0 to 9999 ml
I:E	**I:E RATIO DISPLAY** Displays the value calculated as the ratio between inspiratory time and expiratory time for machine breaths only. Updated on a breath by breath basis. If breath rate is set to "0", then I:E ratio window will display - - - Range: 1:1.0 to 99, or 1:0 to 99:1
Breath Rate (bpm)	**BREATH RATE DISPLAY** Displays the average breath rate per minute (calculated on an eight breath average) for all breath types according to the following formula: 8 Breaths/Sum Of The Last 8 Breath Periods (min) Updated on a breath by breath basis.
	NOTE: If an inspiration (mechanical or spontaneous) is not detected within the Apnea Interval setting the breath rate will display zero, the apnea alarm will be initiated and Apnea Back Up ventilation will begin.

■ MISCELLANEOUS

	**AIRWAY PRESSURE DISPLAY** Displays airway pressure. Range: - 20 to 140 cmH_2O

Manual 	**MANUAL BREATH BUTTON** Used to deliver a single, operator initiated controlled breath. Tidal Volume, Waveform and Peak Flow are per control panel settings. Manual Breath requests which occur during the inspiratory or minimum exhalation phases of all breath types are ignored. Manual Breath available in all modes of ventilation. Manual Breath is non-functional during Ventilator Inoperative state.
Insp. Hold 	**INSPIRATORY HOLD BUTTON** When this button is depressed and held, an inspiratory hold will occur after the end of the next volume mandated breath until either the button is released or 6 seconds has elapsed, whichever occurs first. During the inspiratory hold, both the flow valve and the exhalation valve will remain closed to allow reading of static inspiratory pressure from the airway pressure manometer. During the inspiratory hold, both the breath rate timer and apnea interval timer will also be on hold to prevent breath stacking and inadvertent apnea alarms.
Sigh 	**SIGH "ON/OFF" BUTTON** Activates the automatic Sigh function allowing a Sigh breath once every 100 breaths. The Sigh breath is a controlled breath equal to 1½ x the Tidal Volume setting, delivered at a flow rate equal to the Peak Flow setting. The high pressure limit is automatically increased to 1½ x set value (up to a maximum of 140 cmH_2O) during a Sigh breath. Sigh function available in all modes of ventilation. Range: 75 to 3000 ml
	**AC/DC SWITCH** Switches power source from AC LINE to 12 VDC alternate external power supply.

	**DATA LINK** Provides optical connection of 8400ST Interface Module - RS232 to ventilator.
	**HOURMETER** The hourmeter records the total hours of ventilator operation. It is activated whenever the ventilator is AC line or 12VDC battery operated. The meter is non-resettable and records to the whole hour. The hourmeter allows the clinician to determine the actual usage hours as well as for establishing routine maintenance schedules.
	**POWER MODULE** Power module turns AC power On(I) and Off(O), accepts power cord and encloses fuse package for over current protection.
	**DC INPUT RECEPTACLE** Allows for attachment of an external 12 VDC power supply for emergency or transport application.

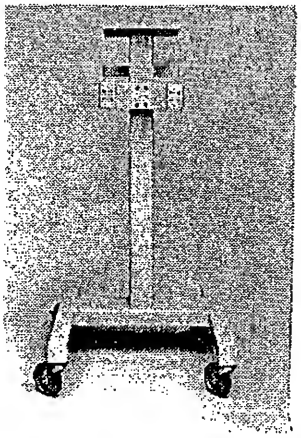
SECTION 4

Assembly Instructions

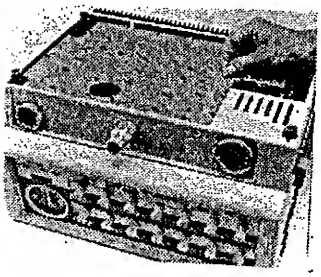
SECTION 4
ASSEMBLY INSTRUCTIONS

June, 1990

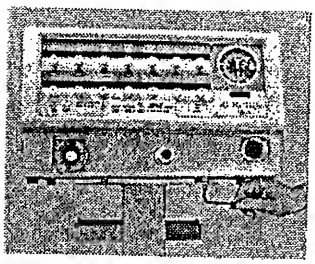
Prior to setting up the 8400ST Volume Ventilator, the operator must first read and understand Section 3 - "Warnings, Cautions and Notes."



1. Assemble stand, as pictured.

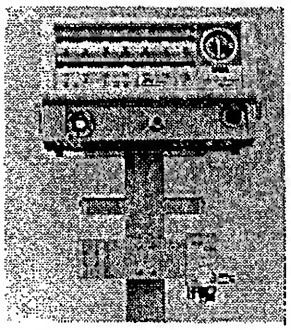


2. Place ventilator on its top, then install two (2) each alignment pins (P/N 04825) in diagonal corners as shown. Finger tighten to secure.

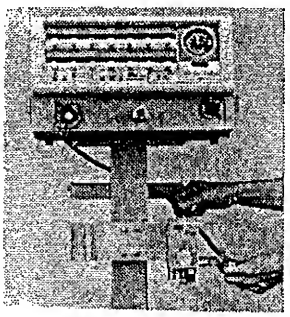


3. Install ventilator onto stand (P/N 04820) and secure in place with two (2) screws (P/N 03236) with 3/16" Allen wrench.

NOTE: Alignment pins (P/N 04875) position ventilator in place for attachment to stand.



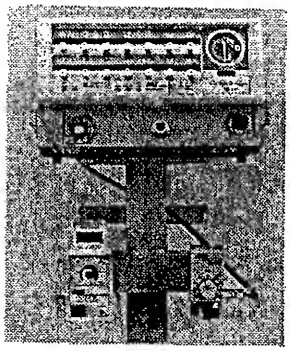
4. Install the 3800 MicroBlender into female dovetail bracket provided on ventilator stand (P/N 04820).



5. Attach one end of supply hose (P/N 09520) to 90° elbow adapter (P/N 00066), then connect elbow adaptor to auxiliary outlet of 3800 MicroBlender and the other end of supply hose to DISS Male fitting at back of ventilator. Next, connect air hose (P/N 02899) and oxygen hose assembly (P/N 00060) to blender inlets. (Not shown.)

WARNING:

WHEN USING THE 3800 MICROBLENDER IN CONJUNCTION WITH THE 8400ST VOLUME VENTILATOR, ALWAYS CONNECT P/N 09520, THE VENTILATOR/BLENDER HOSE ASSEMBLY, TO THE AUXILIARY OUTLET OF THE BLENDER. BLENDER AUXILIARY OUTLET CONNECTION WILL ENSURE ACCURACY OF OXYGEN DELIVERY AT THE LOWER FLOW SETTINGS OF THE VENTILATOR.



6. Install the Heated Humidifier Controller into female dovetail provided on Ventilator Stand (P/N 04820).

7. Wick Installation and Heater Module Assembly Instructions as follows:

WARNING:

ASSEMBLY OF THE HUMIDIFIER HEATER MODULE AND/OR INSERTION OF THE WICK IN A SEQUENCE OTHER THAN DESCRIBED BELOW MAY CAUSE A FAILURE OF THE WATER FEED SYSTEM AND MALFUNCTION OF THE HEATER MODULE.

A. Inspect metal water feed tube in center of top cap. If the tube is bent or tip is occluded or deformed, discard and replace with new Top Cap.

B. Twist the top cap clockwise onto the main body so that the inlet port is facing the rear of the Heater Module.

C. Insert a new wick following the steps below. For the individually packaged, sterilized wick:

1) Peel open bag

2) "Pop" wick into cylindrical shape.

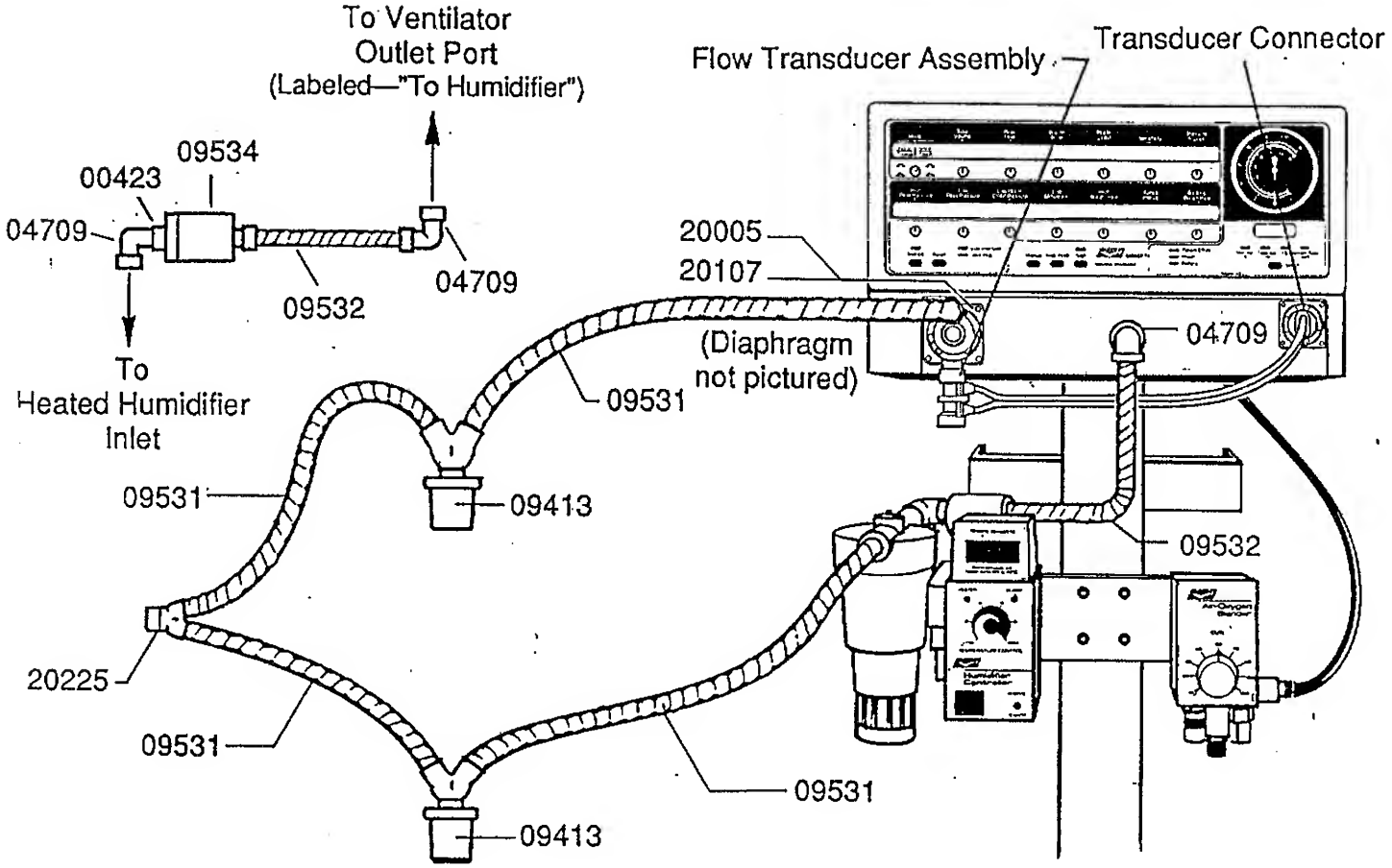
3) Insert wick through bottom of main body. Do not insert wick through top of main body.

4) Gently push the wick in until it meets top cap. Approximately 3/8 inch of the wick will extend below the main body. Do not bend or fold exposed portion of wick by forcing it further.

D. Float pad should be free of damage. Apply even pressure to upper float assembly for insertion into lower Float Assembly.

E. Hand-tighten the Dual Float Bottom Cap Assembly on the Humidifier Heater Module.

8. Attach the Heater Module to the Humidifier Controller with the inlet and outlet ports positioned as shown.



P/N 10172 Patient Breathing Circuit Kit (autoclavable) includes:

20225	Patient "Wye" w/temp port
09531	Circuit Tubing - 30" Smooth-Bor®
04709	90° Elbow adapter
09534	Mainflow Bacteria Filter
00423	22mm I.D. Cuff Adapter
09532	Circuit Tubing - 18" Smooth-Bor®
09413	Watertrap
20005	Exhalation Valve Body
20107	Exhalation Valve Diaphragm

a) Attach 90° elbow adapter (P/N 04709) to ventilator outlet labeled "To Humidifier", with male portion of adapter directed down.

b) Attach one end of short circuit tubing (P/N 09532) to the 90° elbow adapter, and the other end to the mainflow bacteria filter (P/N 09534).

c) Insert the 22mm female adapter onto outflow side of the mainflow bacteria filter, then connect 22mm male end of 90° elbow adapter (P/N 4709) into cuff (P/N 00423). Attach entire assembly to inlet of Humidifier Heater Module.

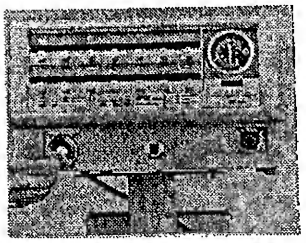
d) Connect one end of circuit tubing (P/N 09531) to outlet of Humidifier Heater Module, and the other end to one leg of watertrap (P/N 09413).

NOTE: Bird breathing circuit water traps (P/N 09413) have been incorporated into the inspiratory and expiratory limbs of the breathing circuit to collect excess condensate from the humidifier gas.

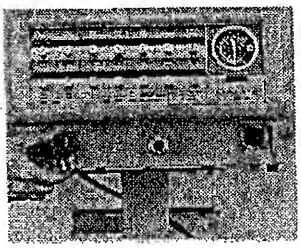
e) Connect second piece of patient tubing (P/N 09531) to remaining leg of watertrap, and the other end to inspiratory side of patient "Wye" (P/N 20225).

NOTE: Inspiratory side of patient "Wye" (P/N 20225) has a large port for attachment of Humidifier Temperature Probe.

f) Connect a third piece of circuit tubing (P/N 09531) to the expiratory side of patient "Wye", and other end to one leg of remaining watertrap (P/N 09413).



g) Install Exhalation Valve Diaphragm (P/N 20107) onto ventilator.



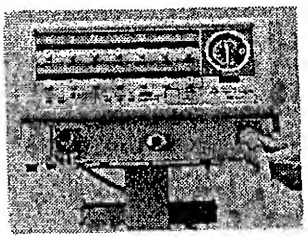
h) Install Exhalation Valve Body (P/N 20005) onto ventilator.

NOTE: Once the Exhalation Valve Body (P/N 20005) is properly installed into the Exhalation Valve Assembly, a spring loaded safety tab will engage and ensure placement.

i) Connect the last piece of the patient circuit tubing (P/N 09531) to remaining leg of watertrap, and other end to exhalation valve body on front of ventilator.

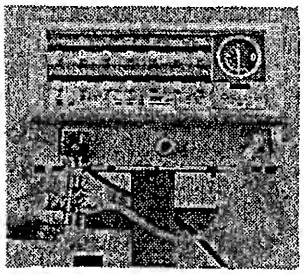
10. Secure the remote temperature sensor into the patient "Wye" and insert the remote sensor plug into the Humidifier Controller.

11. Flow Transducer (P/N 10081R) installation:



a) Install male portion of the Flow Transducer Assembly (gray connector) into the female receptacle on front of ventilator casting and turn clockwise to lock into position.

NOTE: When properly installed, a click will be heard and the reference marks will be in alignment.



b) Attach opposite end of Flow Transducer Assembly into the Exhalation Valve Body (P/N 20005) outlet port. Be sure that the arrow on the body of the flow transducer is pointing in the direction of gas flow.

NOTE: Position the Flow Transducer Pressure lines so that they are directed towards the right side of the ventilator as shown above

c) Ensure all connections are secure.

WARNING:

BEFORE PATIENT APPLICATION, "PRESSURE TEST" THE PATIENT CIRCUIT INCLUDING HUMIDIFIER HEATER MODULE FOR POSSIBLE AIR LEAK DUE TO MISASSEMBLY OR DAMAGED COMPONENTS. (SEE SECTION 6 - PERFORMANCE CHECK)

For additional information on the Bird Heated Humidifier and Bird 3800 MicroBlender, refer to the following instruction manuals:

L1001 - Bird Heated Humidifier Instruction Manual
L1008 - Bird 3800 MicroBlender Instruction Manual

SECTION 5

Overview of the 6400ST Volume Ventilator System Operation

■ PNEUMATIC THEORY OF OPERATION

■ INTRODUCTION

The 8400ST Volume Ventilator is an electronically controlled, pneumatically activated device capable of supporting a wide range of patients. The electronic control system is based on three microprocessors: a main processor, a flow valve control processor and a display/exhalation valve control processor. The main processor controls overall ventilator functions such as breath rate timing and volume while the valve control processors control the actual motion of flow and exhalation valves.

The pneumatic system is based on two main electro-mechanical valves, the Flow Control Valve and Exhalation Valve. All gas delivery to the patient is controlled by the Flow Control Valve while all exhaled flow from the patient is controlled by the Exhalation Valve.

The main flow of gas through the 8400ST is shown in Figure 1. The Pneumatic components are described in the following pages and keyed to the numbers in Figure 1.

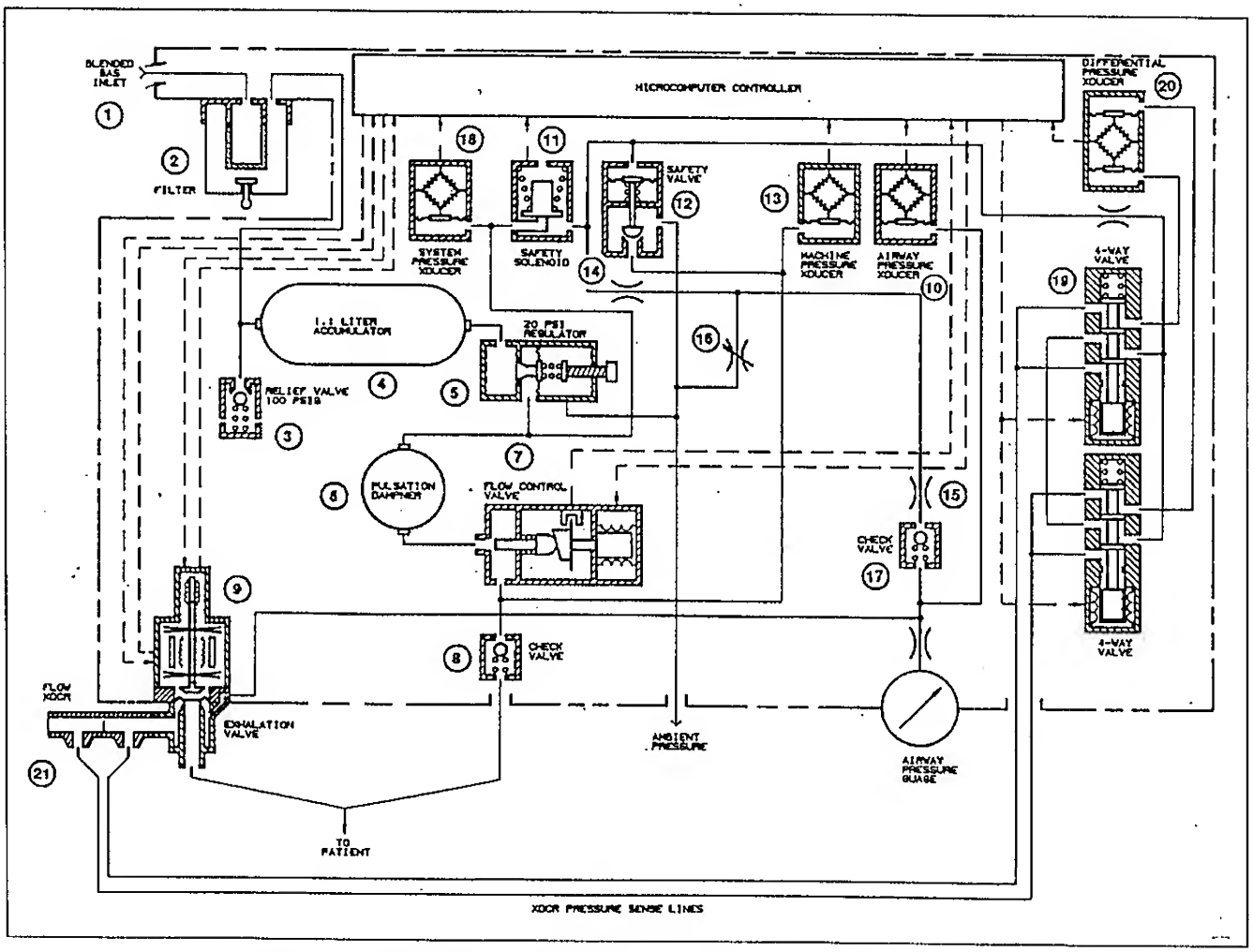
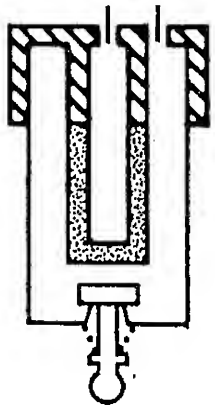


FIGURE 1. PNEUMATIC SCHEMATIC, 8400ST VOLUME VENTILATOR

■ GAS INLET FILTER(2)

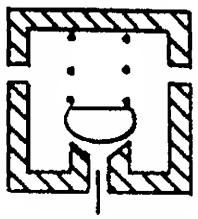


Blended gas from an external source is connected to the Blended Gas Inlet (1). The ventilator is designed to be used with the 3800 MicroBlender operating at 50 PSIG inlet pressure to the blender. When mixed gas from any other source is utilized, the alternate device must be capable of delivering flow in excess of 75 lpm within the range of 35-75 PSIG (2.45-5.25 kg/cm2) to the blended gas inlet to the ventilator.

The incoming blended gas passes through a Coalescing Filter (2) which reduces both liquid and solid particles from the gas stream. This contamination is collected in the filter bowl where it is visible to the user. A drain is provided for removal of accumulated liquid contaminants.

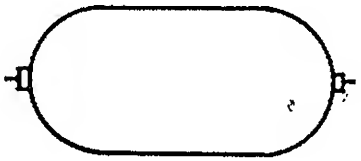
NOTE: Coalescing filter is 99.97% efficient in filtering aerosol particles down to .75um and solid particles down to .3um.

■ RELIEF VALVE(3)



The Relief Valve (3) vents inlet gas to ambient if the inlet pressure exceeds 100 PSIG. This protects the pneumatic system in the event excessive inlet pressure is applied to the unit.

■ ACCUMULATOR(4)



Filtered gas then passes into a 1.1 liter Accumulator (4). The purpose of the Accumulator is to store pressurized gas for augmenting the blender flow during high inspiration flow demands. The 3800 MicroBlender is capable of delivering approximately 75 lpm with inlet and outlet pressures of 50 and 35 PSIG (3.50-2.45 kg/cm2) respectively, while the ventilator can deliver flow rates up to 120 lpm. This extra flow capacity is provided from gas stored in the accumulator during the exhalation phase. Since the Accumulator is a rigid vessel, charging and discharging is accompanied by large pressure variations as shown on page 4, Figure 2.

It should be noted that the pressure fluctuations shown in Figure 2 occur only within the accumulator and are <u>not</u> transmitted to the patient circuit.

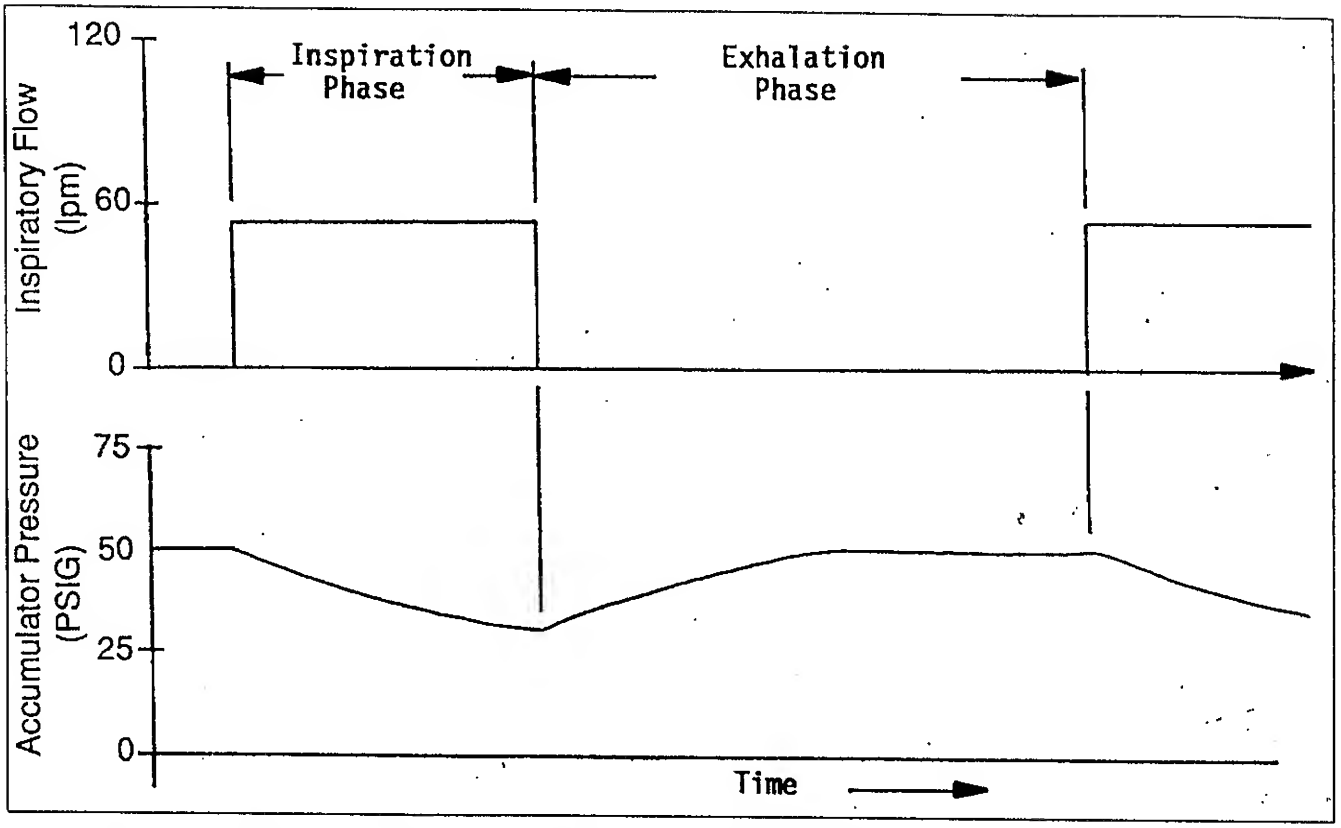
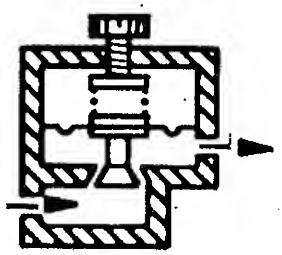


FIGURE 2. ACCUMULATOR PRESSURE WITH RESPECT TO PATIENT INSPIRATORY FLOW

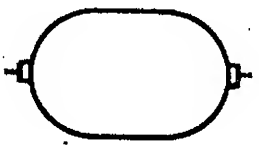
■ REGULATOR(5)



A precision pneumatic Regulator (5) establishes the system pressure at 20 PSIG (1.40 kg/cm2). This pressure is used for the following functions:

1. A precise stable supply pressure to the Flow Control Valve for purposes of accurate flow control
2. Driving pressure for the airway Pressure Line Purge function
3. Pilot pressure for actuating the Safety Valve

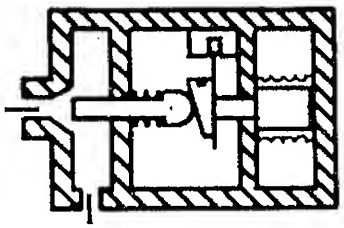
■ PULSATION DAMPENER(6)



The Pulsation Dampener (6) 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 in order to maintain a constant system pressure. During these transient flow conditions, pressure fluctuations occur due to the

response time of the Regulator. The Pulsation Dampener acts as a buffer between the Flow Control Valve and Regulator by minimizing the pressure fluctuations.

■ FLOW CONTROL VALVE(7)

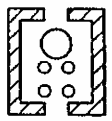


Gas flow to the patient is controlled by the Flow Control Valve (7). The valve is an electro-mechanical device. Rotary motion of the electro-mechanical driver is transformed to linear motion required for throttling flow through a variable poppet type orifice. The valve is designed and calibrated to obtain a known relationship between position and orifice opening. With the system pressure at 20 PSIG (1.40 kg/cm2) flow through the variable orifice is sonic up to a downstream pressure of approximately 3 PSIG (210 cmH_2O). Mass flow through the valve is unaffected by downstream pressures of up to 3 PSIG (210 cmH_2O) in the patient circuit. This combination of features leads to a known relationship between the electro-mechanical driver position and flow rate which is used by the Microprocessor Controller to control flow and volume to the patient. The range of the valve is 0-120 lpm with an approximate resolution of 1 lpm/step. An optical sensor detects the 'zero' flow position.

The following table describes the method of flow delivery for various breath types:

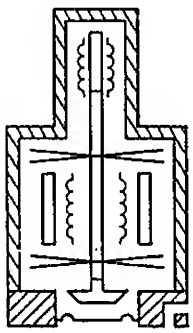
BREATH TYPE	METHOD OF INSPIRATORY FLOW DELIVERY
Volume Controlled	Using the known relationship between valve position and flow rate, the Microprocessor Controller moves the valve in a predetermined sequence to satisfy the tidal volume, peak flow, and waveform settings.
Spontaneous	Using feedback from the airway pressure transducer, 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 flow is controlled to maintain the pressure support setting.

■ CHECK VALVE(8)



The Check Valve (8) works in combination with the exhalation valve diaphragm to insure one way gas flow when the patient is breathing spontaneously. This is critical when the patient is breathing through the Safety Valve (12) with the ventilator in an inoperative condition.

■ EXHALATION VALVE(9)

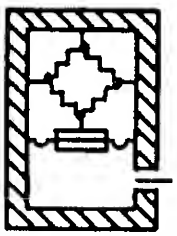


All exhaled gas from the patient is controlled by the Exhalation Valve (9). The flow of exhaled gases through a large poppet valve is controlled by a linear motion electro-mechanical actuator. The valve performs the following functions under Microprocessor Control:

1. Closes the exhalation leg of the patient circuit during all types of inspiration.
2. Opens wide at the beginning of exhalation for minimum flow resistance.
3. In conjunction with the Flow Control Valve (7), Microprocessor Controller and Airway Pressure Transducer (10), controls PEEP/CPAP to the desired level.

Additionally, the exhalation valve diaphragm acts as a check valve during spontaneous breathing to insure one way gas flow.

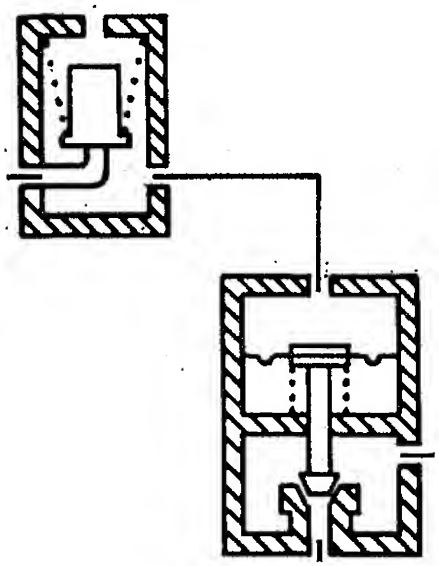
■ AIRWAY PRESSURE TRANSDUCER(10)



The Airway Pressure Transducer (10) converts airway pressure to an electrical analog signal. This signal is used by the Microprocessor Control system for the following functions:

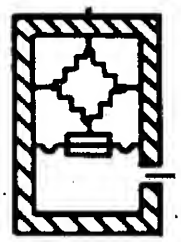
- PEEP/CPAP control
- Pressure Supported Breathing
- High Pressure Limit Alarm
- Low Peak Pressure Alarm
- Low PEEP/CPAP Alarm
- Detection of Patient Indicated Breaths

■ SAFETY SYSTEM(11)(12)



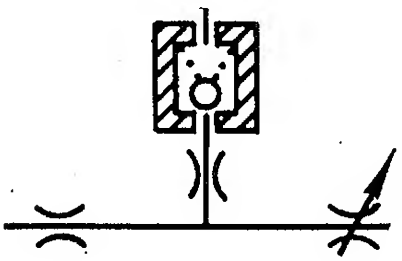
The safety system consists of a Safety Solenoid (11) that drives the Safety Valve (12). During normal operation the solenoid is open, passing 20 PSIG (1.40 kg/cm2) system pressure to the upper safety valve chamber. This closes the safety valve poppet and seals the inspiratory leg of the patient system. When electrical power is lost or the unit is in a Ventilator Inoperative state, the Solenoid closes, venting the upper chamber of the Safety Valve to ambient pressure. This opens the Safety Valve poppet allowing the patient to inspire spontaneously from 'room' air.

■ MACHINE PRESSURE TRANSDUCER(13)



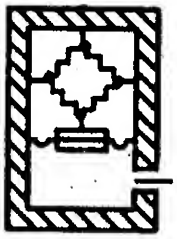
The Machine Pressure Transducer (13) monitors machine outlet pressure. This transducer is used as a safety monitor to the Airway Pressure Transducer. During certain phases of inspiration, the Microprocessor Controller compares the two pressure signals. The two signals must agree within a predetermined range of pressures (see "CIRC Display" in Section 4) which allows for transducer tolerances and pressure drops in the patient circuit during inspiration. If this test fails, the unit sounds an audible alarm and "CIRC" flashes in the monitor window.

■ AIRWAY PRESSURE SENSE LINE PURGE(14)(15)(16)(17)



The airway pressure sense line purge provides a forward flow of blended gas through the airway pressure sense line. This prevents moisture from migrating up into the ventilator pneumatics. The two fixed orifices (14) and (15) and the variable orifice (16) are calibrated to provide a .05 - .10 lpm purge flow. In the event the line is blocked, pressure to the gauge and transducer will not exceed 100 cmH_2O. The Check Valve (17) prevents back flow into the pneumatic system in the event airway pressure exceeds purge drive pressure.

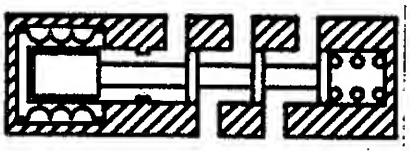
■ SYSTEM PRESSURE TRANSDUCER(18)



The System Pressure Transducer (18) continuously monitors the 20 PSIG (1.40 kg/cm2) system pressure and converts it to an electrical analog signal. The microprocessor compares this signal to a predetermined tolerance range. If the system pressure is out of range, the controller will activate the Low Inlet Gas Pressure Alarm or Ventilator Inoperative state depending on the severity of the out of range condition. The following conditions can cause the system pressure to be out of range:

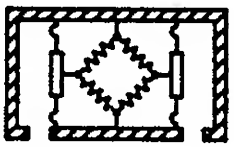
- Insufficient gas supply
- Clogged inlet filter
- Regulator out of calibration

■ FOUR WAY PURGE VALVES (19)



During normal operation the two four way purge valves (19) are configured to connect the pressure sense lines from the Flow sensor to the differential pressure transducer (20) and to close off a 5.0 lpm flow source. Every 60 seconds (approx.) and during an inspiratory phase, the two four way purge valves are designed to connect both ports of the differential pressure transducer (20) together and allow the 5.0 lpm (2.5 lpm per port) flow to purge the pressure sense lines preventing moisture from accumulating. During this purge interval a microprocessor samples the voltage from the differential pressure transducer. This voltage is then used as a zero reference point so that volume measurements can maintain their accuracy independently of temperature and component variations.

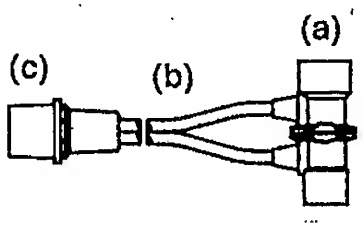
■ DIFFERENTIAL PRESSURE TRANSDUCER (20)



The differential Pressure Transducer (20) measures the pressure across the variable orifice of the Flow Transducer. As the flow through the transducer increases so does the differential pressure. A microprocessor then converts the differential pressure to a volumetric flow rate and then calculates both Tidal Volume and Minute Volume.

■ FLOW TRANSDUCER ASSEMBLY (21)

The flow transducer assembly consists of the following components:



■ Variable Orifice Flow Transducer (a):

The flow transducer consists of two chambers separated by a variable orifice flow element. The flow element bends in the direction of flow and creates a small pressure difference between the two chambers. The difference in pressure is directly related to the amount of flow passing through the sensor.

When a flow transducer is properly attached to the connector port on the ventilator, the pressures in the chambers are transmitted to a differential pressure transducer. The differential pressure transducer measures the pressure difference between the two chambers in the sensor and then sends an analogue signal which is digitized and "read" by the microprocessor. Since the flow element is made from a material whose properties are known and remain constant for millions of cycles, the relationship between pressure difference and flow is known and thus can be used by the microprocessor to determine flow rate. Every four milliseconds, the microprocessor translates the measured flow to a tidal volume and minute volume. These volumes are then displayed at the beginning of the next breath cycle.

■ Pressure Sense Lines (b):

These two sense lines transmit the respective pressure of the two chambers in the flow transducer to the differential pressure transducer (20).

■ Flow Transducer Connector (c):

The flow sensor connector not only connects the flow transducer assembly to the ventilator, but also provides information required by the microprocessor to determine the proper calibration curve. Each connector incorporates an optical coding system to match the properties of the flow element located in the flow transducer to the proper curve. This calibration is done at the factory and insures that system accuracy is maintained.

SECTION 6

Warnings, Cautions and Notes

SECTION 6
WARNINGS, CAUTIONS, NOTES

June, 1990

The 8400ST Volume Ventilator should be operated by trained, qualified medical personnel under the direct supervision of a licensed physician. Before clinical application, the WARNINGS, CAUTIONS, and NOTES should be read and understood.

CAUTION: Conditions may exist that could damage the ventilator or other pieces of equipment.

WARNING:

CONDITIONS MAY EXIST THAT COULD ADVERSELY AFFECT THE OPERATOR OR PATIENT.

NOTE: A specific point is made to assist the operator in understanding the equipment.

WARNINGS:

■ ***DO NOT*** *USE VENTILATOR IN THE PRESENCE OF FLAMMABLE ANESTHETICS AS A POSSIBLE EXPLOSION HAZARD EXISTS.*

■ *THE 8400ST VOLUME VENTILATOR SHOULD NOT BE USED UNTIL A "PERFORMANCE CHECK" HAS BEEN COMPLETED (SECTION 6).*

■ *A 8400ST VOLUME VENTILATOR WHICH IS NOT FUNCTIONING OR DOES NOT MEET MANUFACTURER'S DESIGN SPECIFICATIONS SHOULD NOT BE USED UNTIL ALL NECESSARY REPAIRS HAVE BEEN MADE. CONTACT YOUR BIRD DISTRIBUTOR OR BIRD PRODUCTS CORPORATION FOR REPAIR.*

■ *ALWAYS OPERATE THE 8400ST VOLUME VENTILATOR WITH CLEAN/DRY MEDICAL GRADE GASES.*

■ *ELECTRICAL SHOCK HAZARD; DO NOT REMOVE THE VENTILATOR COVER. REFER ALL SERVICING TO A BIRD TRAINED TECHNICIAN, YOUR BIRD DISTRIBUTOR OR BIRD PRODUCTS CORPORATION.*

■ *WHEN THE 8400ST VOLUME VENTILATOR IS CONNECTED TO A PATIENT, IT IS RECOMMENDED THAT A TRAINED CLINICIAN BE IN ATTENDANCE AT ALL TIMES, TO TAKE PROMPT ACTION SHOULD AN ALARM OCCUR.*

■ *FOR CONTINUED PROTECTION, REPLACE THE FUSE OR FUSES IN THE POWER ENTRY MODULE ONLY WITH ONE OF IDENTICAL TYPE AND RATING.*

■ *A FLASHING "OFF" IN THE LOW PEAK PRESSURE ALARM DISPLAY INDICATES THE ALARM LIMIT HAS NOT BEEN PROPERLY ESTABLISHED. ALWAYS ENSURE THAT THE LOW PEAK PRESSURE ALARM LIMIT AND OTHER CRITICAL ALARMS (I:E HIGH PEAK PRESSURE ETC.) ARE PROPERLY ESTABLISHED BEFORE LEAVING THE PATIENT UNATTENDED.*

WARNINGS: (Continued)

■ *BEFORE PATIENT APPLICATION, "PRESSURE TEST" THE PATIENT CIRCUIT INCLUDING HUMIDIFIER HEATER MODULE FOR POSSIBLE AIR LEAK DUE TO MISASSEMBLY OR DAMAGED COMPONENTS. (SEE SECTION 6- PERFORMANCE CHECK)*

■ *IT IS RECOMMENDED THAT P/N 10172, THE PATIENT BREATHING CIRCUIT KIT BE USED WITH THE 8400ST VOLUME VENTILATOR. THIS CIRCUIT HAS BEEN VERIFIED ACCEPTABLE FOR USE WITH THE 8400ST.*

■ *THE OPERATION OF EACH ALARM AND ALERT FUNCTION, BOTH AUDIBLE AND VISUAL, SHOULD BE VERIFIED DAILY.*

■ *CONSULT A PHYSICIAN ON PROPER FRACTIONAL CONCENTRATION OF INSPIRED OXYGEN (FIO_2). MONITOR THE INSPIRED GAS WITH A CALIBRATED OXYGEN ANALYZER AND OBTAIN SERIAL BLOOD GAS DETERMINATIONS.*

■ *MONITOR OXYGEN CONCENTRATIONS WITH AN ACCURATE OXYGEN ANALYZER WITH HIGH AND LOW (FIO_2) ALARMS TO BE ASSURED THAT THE DESIRED FIO_2 IS BEING DELIVERED.*

■ *WHEN USING THE 3800 MICROBLENDER IN CONJUNCTION WITH THE 8400ST VOLUME VENTILATOR, ALWAYS CONNECT THE VENTILATOR/BLENDER HOSE ASSEMBLY (P/N 09520) TO THE AUXILIARY OUTLET OF THE BLENDER. THE BLENDER AUXILIARY OUTLET CONNECTION WILL ENSURE ACCURACY OF OXYGEN CONCENTRATION DELIVERY AT THE LOWER FLOW SETTINGS OF THE VENTILATOR.*

■ *BIRD PRODUCTS CORPORATION DOES NOT RECOMMEND THE USE OF BREATHING CIRCUIT TUBING WITH AN INSIDE DIAMETER OF LESS THAN 3/4" (1.91cm), LARGE BORE TUBING ONLY.*

■ *THE EXHALATION VALVE DIAPHRAGM SHOULD BE CHECKED DAILY FOR EXCESSIVE WEAR OR PERFORATION AND REPLACED WHEN NECESSARY. OTHERWISE IMPROPER PATIENT VENTILATION MAY OCCUR.*

■ *MANUAL BREATH CAPABILITY IS NON-FUNCTIONAL DURING VENTILATOR INOPERATIVE CONDITION.*

■ *UNDER CASES OF EXTREMELY HIGH MINUTE VENTILATION DEMANDS, THE PRIMARY BLENDER OUTLET PORT CAN BE USED TO EXTEND THE UNIT'S CAPABILITY. HOWEVER, O_2 CONCENTRATIONS WILL DRIFT OUT OF SPECIFICATIONS AT MINUTE VOLUME DEMANDS OF 6 LITERS OR LESS WHEN USING THIS PORT.*

■ *WHEN THE 8400ST VOLUME VENTILATOR IS CONNECTED TO A PATIENT, IT IS RECOMMENDED THAT THE LOW PEEP/CPAP ALARM ALWAYS BE SET TO A LEVEL, NOT TO EXCEED 3cmH_2O, BELOW THE SENSITIVITY SETTING (EVEN WHEN PEEP/CPAP = 0cmH_2O). PROPER ESTABLISHMENT OF THIS ALARM PROVIDES ANOTHER AUDIBLE/VISUAL INDICATOR SHOULD A PROBLEM OCCUR IN THE FLOW DELIVERY SYSTEM.*

CAUTIONS:

■ **Do not** sterilize the 8400ST Volume Ventilator. The internal components are not compatible with sterilization techniques.

■ As with any other piece of medical equipment, care should be exercised when moving the equipment in the hospital environment.

■ Bird Products Corporation Bacteria Filters are compatible with steam autoclaving "ONLY". Do not wash, rinse, soak, pasteurize, ethylene oxide sterilize, or immerse the bacteria filters in liquid sterilizing agents.

■ **Do not** insert any cleaning instruments (cloth, brush, pipe cleaner, etc) into the flow transducer. Such action can seriously damage the flow element and result in inaccurate volume readings.

NOTES:

■ Federal law restricts this device to sale by or on the order of a physician. The Volume Ventilator is a restricted medical device intended for use by qualified personnel under the direction of a qualified physician.

■ Tidal Volume Indicator Flashing - The operator has attempted to set a tidal volume too large for the peak flow setting and breath rate that have been selected. In response, the ventilator has limited the tidal volume proportionately to the established breath rate and peak flow, then notifies the clinician of this incompatible setting by flashing the tidal volume indicator. The limited tidal volume (flashing display) is the actual volume delivered.

■ Peak Flow Indicator Flashing - The operator has attempted to set a peak flow that is too high for the tidal volume selected. In response, the ventilator has limited the peak flow to a value that is acceptable for that tidal volume, then notifies the clinician of this incompatible setting by flashing the peak flow indicator. Limited peak flow (flashing display) is the actual flow delivered.

■ Back Up Breath Rate Flashing - A) The operator has attempted to set a breath rate that is too high for the tidal volume and flow settings. In response, the ventilator has limited the Back Up Breath Rate setting to the number in the flashing display. B) The operator has attempted to set the Back Up Breath Rate below the primary Breath Rate control setting. In response, the ventilator has increased the setting to the current primary Breath Rate control setting as indicated in the flashing display.

■ Excessive Volume/Flow Limit - In the event of a patient circuit disconnect while in the SIMV/CPAP mode, the system will provide maximum flow for a brief period in an effort to maintain the PEEP level. This could exceed the flow capacity of the oxygen blender and/or gas supply system resulting in a Ventilator Inoperative due to low system gas pressure. To avoid this situation, the unit will automatically reduce the flow to 20 lpm after 2.5 liters has been delivered in the inspiratory phase. This restriction will not apply to Sigh breaths.

NOTES: (Continued)

■ When "I" Time exceeds "E" Time, the I:E Ratio "LED" will flash every 3 seconds, giving visual indication of the inverse state.

■ When the pressure support inspiratory time limit of 3 seconds is exceeded, the pressure support setting display will flash.

■ Power up self test - subsequent to initiating power to the ventilator (On/Off switch) a 5 second test is automatically conducted. During the test the following occurs:

1. Power "LED" turns "ON" and an audible alarm is briefly sounded
2. Front panel LED's segmentally display in unison
3. Microprocessors verify communication
4. Flow control valve returns to "Home" position and exhalation valve opens
5. Second audible alarm briefly sounds
6. Front panel displays illuminate
7. Ventilator begins to operate

■ Selected vs Displayed Tidal Volume - It is important to note that the 8400ST will accurately deliver volume controlled or volume assisted breaths within ±10% of the set value. It is also important to note that the measured volume, as displayed in the monitors section, will be accurate to within ±5% of the exhaled volume.

■ When the ventilator is not in use, it is recommended that the supply sources be disconnected from the unit, so that the 10-12 lpm bleed from the 3800 MicroBlender does not continue to consume supply gas. This is important if the 8400ST is in the transport configuration.

SECTION 7

Cleaning and Sterilization

SECTION 7
CLEANING AND STERILIZATION

June, 1990

■ VENTILATOR

The exterior of the 8400ST Volume Ventilator may be wiped clean with an appropriate bactericidal or germicidal agent. Care should be exercised not to allow the liquid agent to pool in areas on the ventilator (primarily the front panel), so as to minimize the potential for the liquid to penetrate to the inside of the ventilator.

- **DO NOT** use harsh abrasives on ventilator.
- **DO NOT** immerse ventilator in liquid sterilizing agents.
- **DO NOT** sterilize ventilator.

■ FLOW TRANSDUCER

The flow transducer can be cleaned by flushing with a gentle stream of water or agitating it in a solution of soap and water.

The flow transducer can be sterilized by liquid agents, heat pasteurization, autoclave or ethylene oxide gas.

- **DO NOT** insert any cleaning instrument (cloth, brush, pipe cleaner, etc.) into the flow sensor.
- **DO NOT** use a high pressure gas nozzle to dry the sensor.

■ BREATHING CIRCUIT

(See page 29 for diagram)

The ventilator breathing circuit, not including the humidifier module (P/N 03010 or 03010C) and autoclavable filters, may be submerged in liquid agents, ethylene oxide or steam autoclaved to sterilize.

The main flow bacteria filter is compatible with steam autoclave ONLY.

NOTE: For additional information on cleaning and sterilization of the 8400ST Volume Ventilator System, please refer to the following literature:

L1001 - Heated Humidifier Instruction Manual
L1008 - 3800 MicroBlender Instruction Manual

SECTION 8

Maintenance Service Policy

SECTION 8
MAINTENANCE AND SERVICE POLICY

WARNING:

A 8400ST VOLUME VENTILATOR WHICH IS NOT FUNCTIONING OR DOES NOT MEET THE MANUFACTURER'S DESIGN SPECIFICATIONS SHOULD NOT BE USED UNTIL ALL NECESSARY REPAIRS HAVE BEEN MADE.

CAUTION: The 8400ST Volume Ventilator should be serviced and/or calibrated by a Bird Products Corporation trained service technician.

Bird Products Corporation equipment has been designed to provide the maximum amount of utilization with a minimum amount of maintenance. When determining the desired frequency of maintenance, many variables must be considered.

- Frequency and length of use
- Cleanliness of compressed air source
- Use of an air inlet water trap/filter

The 8400ST Volume Ventilator, like other pieces of Health Care equipment will require routine maintenance over a period of time. Refer to the following for recommended maintenance intervals.

■ 8400ST RECOMMENDED MAINTENANCE SCHEDULE

Every 1000 Machine Hours	**Ventilator inlet filter** - remove and examine the internal surface of the inlet filter for foreign material. If filter appears to be dirty or discolored, replace with new coalescing filter replacement element (P/N 06146). **CAUTION:** A dirty inlet filter can reduce the machine's working pressure and subsequently result in a "VENTILATOR INOPERATIVE" condition.
Every 3000 Machine Hours	**Machine or Airway Pressure Transducer calibration** - Verify transducer calibration to ensure accuracy of measurement (see page 54). If accuracy varies by more than $\pm$ 3 cmH_20, contact your Bird distributor or Bird Products Corporation for repair.
Every 5000 Machine Hours	**Bacteria Filters** - The main flow and proximal airway filters should be replaced once each year or more often if the resistance to flow through either filter exceeds the maximum allowable limit (see page 54). Main Flow Bacteria Filter: 2 cmH_20 @ 60 lpm Proximal Airway Bacteria Filter: 1 cmH_20

Every 15,000 Machine Hours	A complete machine maintenance will be required at a minimum of once every 15,000 machine hours. Contact your Bird distributor or Bird Products Corporation for repair.

■ TESTING AND VERIFICATION INSTRUCTIONS

■ **Transducer Calibration** - With ventilator cycling (set a 6 bpm) and test lung (P/N 04845) attached to patient "Wye", adjust PEEP/CPAP display to 20 cmH_2O elevated baseline with control knob. Observe manometer reading for PEEP/CPAP level. If the display value and manometer reading differ by more than $\pm$ 3 cmH_2O, then transducer needs to be recalibrated. Contact your Bird distributor or Bird Products Corporation for repair.

NOTE: Ensure manometer reads zero with ventilator OFF prior to transducer verification.

■ **Main flow bacteria filter resistance test** - Attach inspiratory limb of breathing circuit directly to ventilator outlet. Remove expiratory limb of breathing circuit, then connect bacteria filter onto expiratory side of patient "Wye". Observe the proper flow direction. Adjust mode control knob to "Assist/Control", set tidal volume at 2000 ml's, rate at 12 bpm and peak flow to 60 lpm. Turn ventilator "ON" and observe peak reading on manometer. Duplicate test with filter removed from circuit. Should the values recorded differ by 2 cmH_20 or more, then replace filter.

NOTE: Ventilator will go into a low peak pressure alarm condition, unless alarm is turned "OFF", but this will have no influence on the test.

SECTION 9

Recommended Tools

SECTION 9
8400ST TOOLS AND EQUIPMENT LIST

March 1992

■ 8400ST 15,000 HOUR OVERHAUL – RECOMMENDED TOOLS AND EQUIPMENT

1.0 Common Tools (Not available from Bird Products Corporation.)

Nutdrivers – (deep socket): 1/4", 5/16", 11/32", 3/8", 1/2", 7/16"
Open End Wrenches: 1/2", 7/16", 9/16", 5/8", 11/16"
Allen Hex Socket Driver Set No. 99-85-40 Xcelite or equivalent: 3/16", 3/32", *7/64", *9/64", and *5/32" Allen wrenches [*Ball end with 7 " (18 cm) long shank]
Common screwdriver (slotted) - 8" long shank
#2 Phillips screwdriver - 8" long shank
Long thin needle nose pliers
Diagonal cutter
Trimpot adjustor
Stopwatch

2.0 Special Bird items required for the testing and calibration which may be obtained from Bird Products Corporation under the following part numbers:

Part No.	Description
00042	Lubricant
00066	Elbow
00077	Inline Pressure Manometer
00358	1/8" Tube Connector
00631	Lubricant
01233	22 mm Male x 15 mm Female, 2 each
01449	Pressure Gauge 0 - 60 PSIG 1/4 NPT to 1/8" I.D. tube
01741	Connector 4.5 mm x 1/8" tubing, required to seal the water feed opening
02187	22F x 22M x 15F, Connection, 2 each
03010R	BHH Heating Module
03234	Corona Dope
03389	8400ST Pressure Transducer Test Harness
15127	Replacement Kit 8400ST
03884	Vibre-Tite Thread Locking Compound
03414	6400ST Service Tool Kit consisting of: • P/N 03415, Fixture Assembly, regulator bypass • P/N 03416 Fixture Assembly, pressure test - flow valve • P/N 03426 Safety Solenoid Removal/Assembly Tool\
03800	Hi/Low Flow MicroBlender
03913	Connection Assembly Jumper
04124	7.5 mm Tapered Plug - plugs BHH temperature sensing port in patient "Wye"
08929	Alternate Power Source (DC) Cable Assembly

J (Continued)

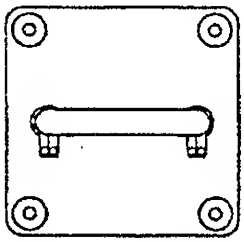
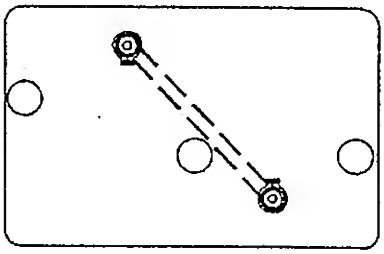
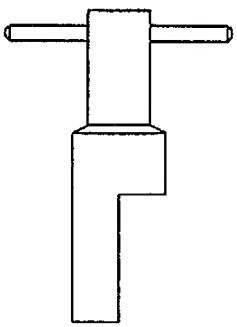
Part No.	Description
09220	Flowmeter 0 - 15 LPM
09520	Blender Hose
10172	Patient Circuit
09531	Corrugated Hose 30" smooth bore with cuffs to fit 22.0 mm O.D. fittings or its equivalent
10234	Flow Transducer Test Harness
10233	Prox/Purge Test Housing

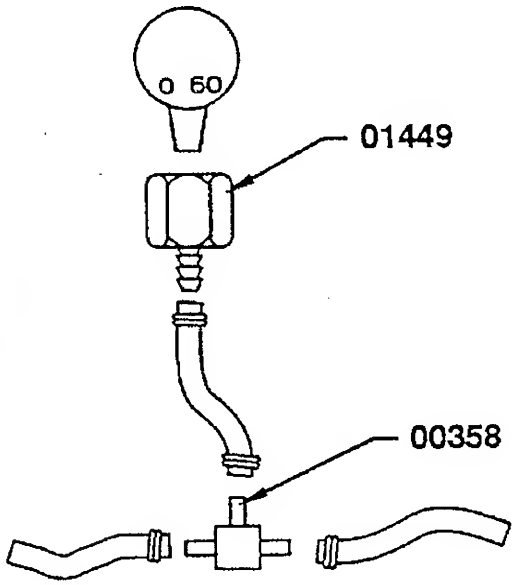
3.0 Special equipment, tools not made available by Bird Products Corporation:

Torque screwdriver 0 - 100 inch/ounce • 7/64" Allen driver • Adapter 5/16" hex to 1/4" square
Torque wrench 20 - 100 inch/pounds • 5/32" Allen, 3/8" drive female
Digital voltmeter
0 - 30 PSIG Precision pressure manometer + .05 PSIG accuracy - .1 or .2 PSIG increments
Standard test lung: • Rigid compliance 20 ml/cmH_2O + 5% • Bottle filled with 22 pounds (10kg) fine grade copperwool
Flow Tube 0 - 10 LPM, 0.1 LPM increments
Endotracheal tube 7 mm I.D x 20 cm long non cuffed with 2 adapters 7 mm x 15 mm
Thermometer 50° - 120°F (9 - 48° C) with 2 temperature probes
Pressure Transducer - 20 to + 140 cmH_2O accuracy + .5 at 0 cmH_2O to + 2 cmH_2O at full scale
Variable transformer 1 - 140 volts or 1 - 260 volts
12 - 16 VDC power supply 5 amp minimum
4 function calculator - must have square root/memory
Anti-static mat to cover worktable
Anti-static wrist strap
Anti-static mat ground connecting cable
Anti-static D.I.P. remover (for EPROMS and IC)
Anti-static bags
R.T.V. clear silicon, adhesive sealant or equivalent
8 Ltr volume spirometer ± 2% accuracy or its equivalent
Slant tube manometer

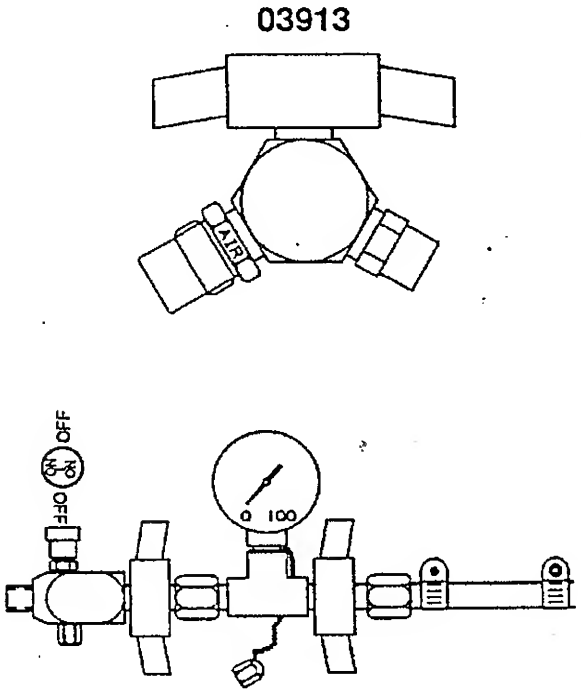
■ KIT, SERVICE TOOL P/N 03414

This assembly consists of the following:

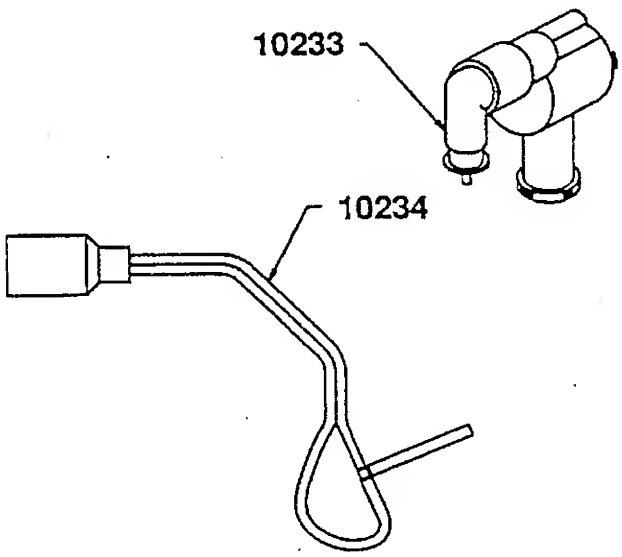
P/N	Description	Qty
03415 	Fixture Assy, Regulator Bypass	1
03416 	Fixture Assy, Flow Valve Pressure Test	1
03426 	Tool, Solenoid Wrench	1



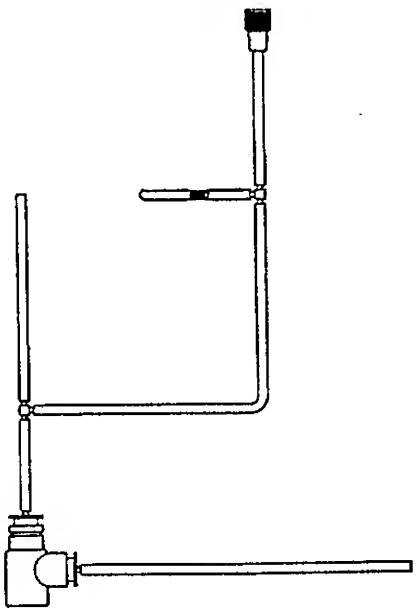
0 - 30 PSIG Pressure Manometer



Test Hose Assembly



P/N 10233 Proximal/Purge Test Housing
P/N 10234 Flow Transducer Test Harness



P/N 03389 Pressure Transducer Test Harness

SECTION 10

Overhaul - Maintenance Kits

SECTION 10
MAINTENANCE KIT P/N 15127

March 1992

■ 8400ST MAINTENANCE KIT INCLUDES:

P/N	Description	Qty.
00274	O-Ring, .145 x 070	2
* 0075D	O-Ring, .301 x .070 Silicone	2
* 0114D	O-Ring, .117 x .040	4
* 0138D	O-Ring, .176 x .070	1
03288	O-Ring, .551 x .070	1
* 03372D	O-Ring, .72 x .103	3
* 03373D	O-Ring, .801 x .070	1
* 03374	O-Ring, .364 x .070	2
03516	Insulator Bridge Rectifier	1
03901	Tubing, 1/4" x 6" I.D. Reinforced	1
04876	Plug Gauge Adjust	1
05038	Cable Tie Wrap	1
06146	Element, Filter	1
06194	O-Ring, P/N 09672 Filter	1
06195	Bowl, P/N 09762 Filter	1
07803	Cable Tie Wrap	10
* 07849D	O-Ring, .313 x .051	1
08195	Housing	1
08880	Gasket, Flow Control	1
* 08963	O-Ring, .924 I.D. x .103	1

P/N	Description	Qty.
09603	Connection Elbow Safety Valve/Manifold	1
09632	Gasket, Manifold	1
* 09672D	Insulator, TO-3	4
09712	Regulator, 2 - 25 PSIG	1
09740R	Valve, Flow Control Assy 8400ST	1
10004	Safety Valve Cartridge	1
10080	Tube Assy Manometer Transducer	1
10083	Exhalation Valve Assy	1
15053	Manifold Flow Transducer	1
15179	Kit, Fuse Overhaul	1
20005	Body Exhalation Valve with Seal	1
20097	Pad, Thermal Interphase	2
* 20107D	Diaphragm	1
20244	Seal, Safety Valve	1
50060	PCB Assy Flow Receptacle	1

* Suffix D indicates packages of 10, however, the quantity required is indicated.

SECTION 11

Disassembly

SECTION 11
DISASSEMBLY

June, 1990

■ INTRODUCTION

The Bird 8400ST Volume Ventilator has been designed to provide the maximum amount of utilization with a minimum of maintenance. The 8400ST Volume Ventilator should be serviced only by Bird Products Corporation trained, Hospital/Dealer Service Technicians.

Before servicing or calibrating, the technician must be familiar with the design, operation, warnings, cautions and notes as explained in Section 6 of this manual.

A numbering system is utilized so that one can easily identify the steps involved with each operation.

If during Assembly and Operational Verification Procedure a suggested parameter is not met, refer to "Troubleshooting" instructions before proceeding with the next step.

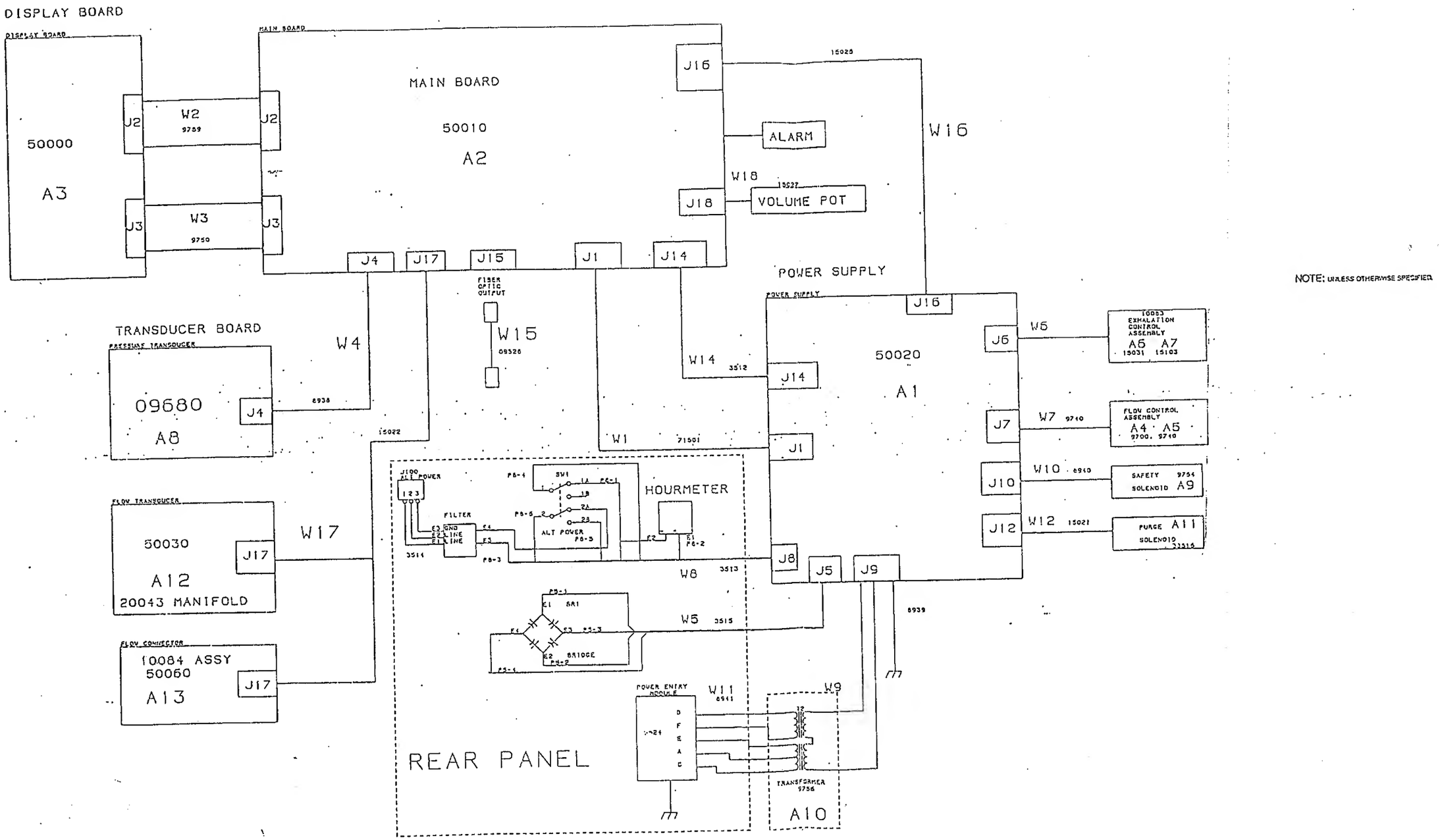
CAUTION: The work area must be Electro Static Discharge (E.S.D.) protected. The technician's work surface must be grounded before removing the top cover and while working on ventilator. All Printed Circuit Board assemblies (PCB) in the 8400ST have Integrated Circuits (IC) and can be severely damaged by static electricity. All PCB assemblies must be placed in anti-static bags after removal.

CAUTION: Always remove exhalation valve body with checkvalve assembly (P/N 08877) prior to placing the ventilator on a flat work surface.

CAUTION: Always unplug power cord from electrical power source, wall plug, before removing top cover.

INDEX

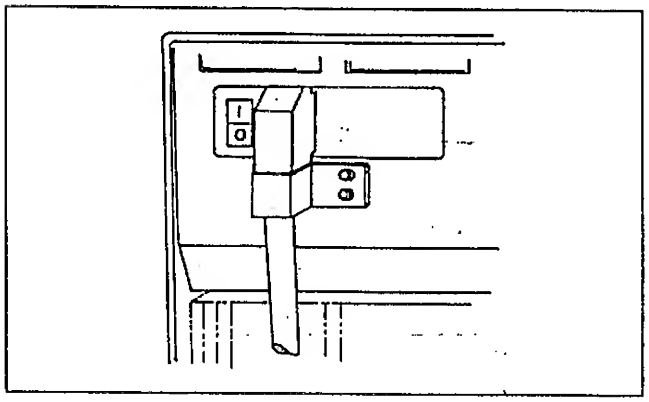
WIRING DIAGRAM, 8400ST ELECTRICAL SYSTEM



NOTE: UNLESS OTHERWISE SPECIFIED.

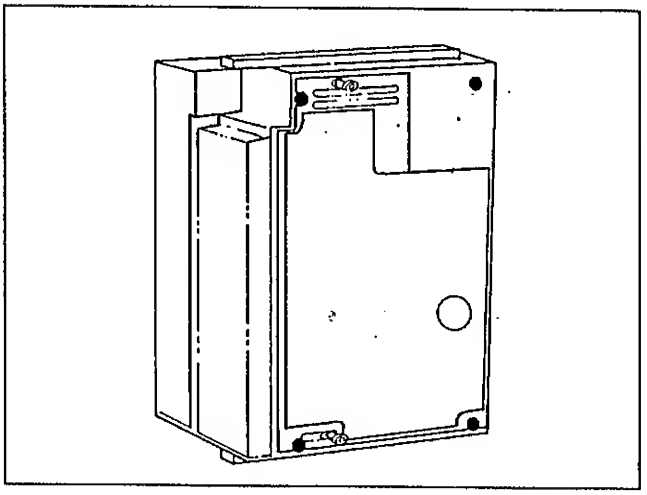
1) POWER CORD AND BRACKET ASSEMBLY P/N 08925

- Remove screws securing power cord clamp (P/N 06148) or into left side of rear panel below power entry module.
- Remove power cord (P/N 08925) from power entry module (P/N 08941).

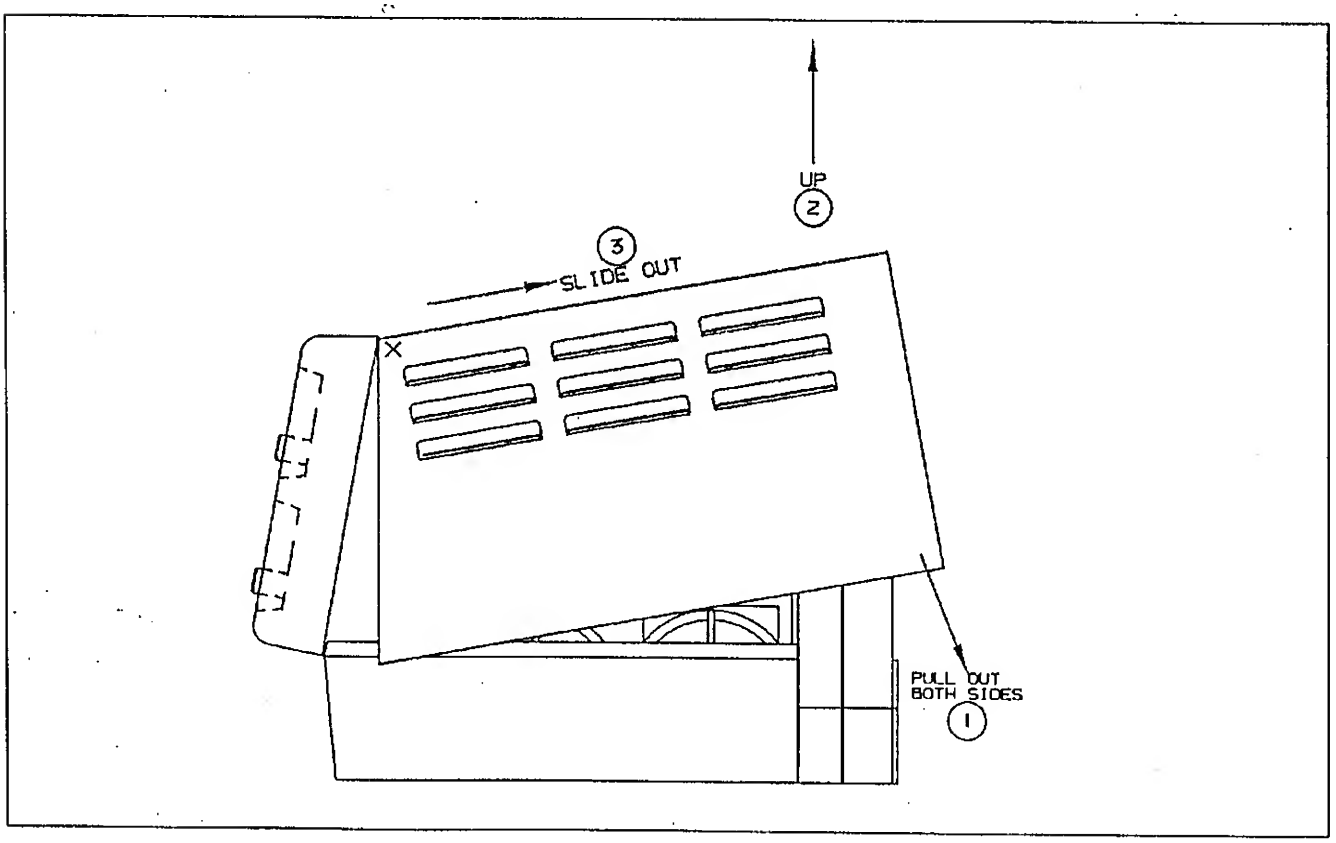


2) TOP COVER ASSEMBLY P/N 09698

- Using 9/64" Allen driver remove two Allen screws (P/N 03222) from manifold base, securing the ventilator top cover to casting. Screws are inserted from under manifold bottom through casting into top cover.



- Place ventilator upright on bench. Lift the rear end of top cover (P/N 09698) with both jhands about 1-1/2" upwards and slide top cover back to disengage lip from front panel housing and remove cover.

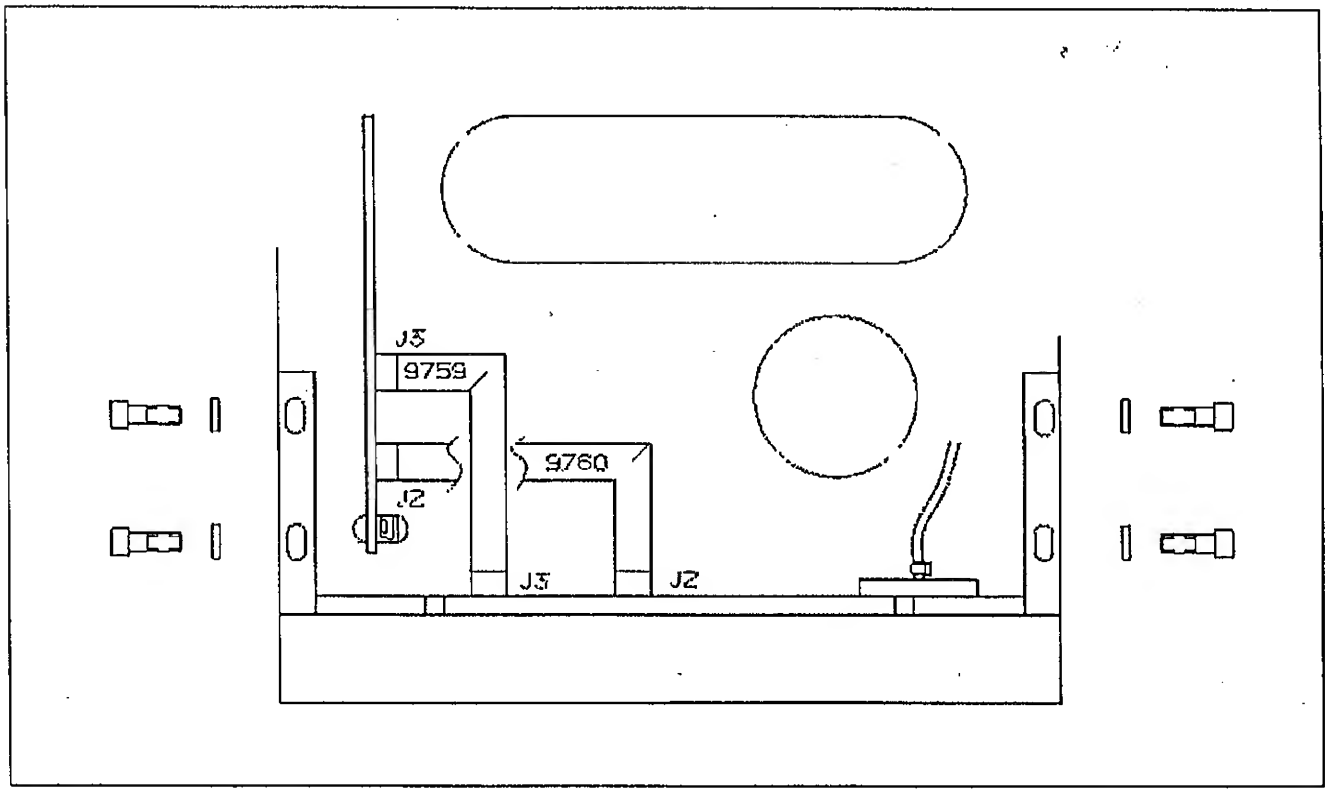


3) FRONT PANEL ASSEMBLY P/N 09678

- At Main PCB Assembly, unplug from manifold ribbon cable (P/N 09760) at J2 and P/N 09759 at J3.
- At manometer, remove tubing.
- Unscrew and remove four Allen screws (P/N 03219) and washers (P/N 08963) using a 7/64" Allen driver.
- Remove front panel from manifold base.

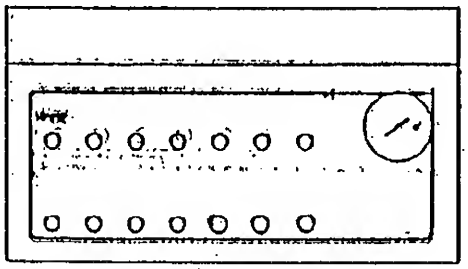
■ MANOMETER ASSEMBLY P/N 09799

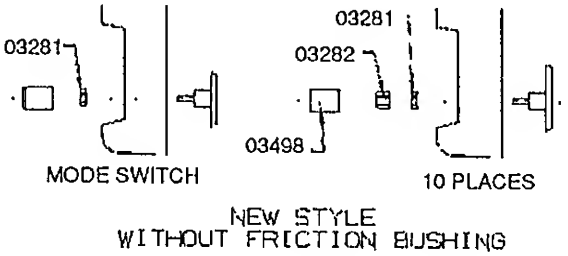
- Remove manometer from panel.
- For installation and calibration refer to Assembly Section.

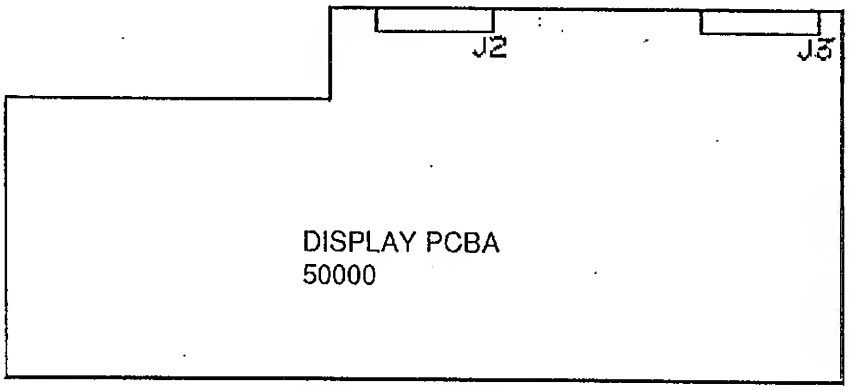


■ DISPLAY PC BOARD ASSEMBLY P/N 50000

- To remove Display PC Board Assembly from front panel, pull all control knobs (P/N 03498) off from potentiometer shafts.
- From mode selector switch located at left hand side of top row controls, remove nut and washer using a 5/16" nut driver.
- With a 5/16" nut driver removeall 13 Jam Nuts and Washers (P/N 03281 and 03282) and washers from potentiometer shafts.
- Remove Display PC Board Assembly from inside of rear panel housing by removing four Allen screws (P/N 03219) with a 7/64" Allen driver.
- Disconnect and remove Cable Assembly (P/N 09760) (long cable) from J2 and Cable Assembly (P/N 09759) (short cable) from J3.
- Place Display PC Board Assembly in anti-static bag.



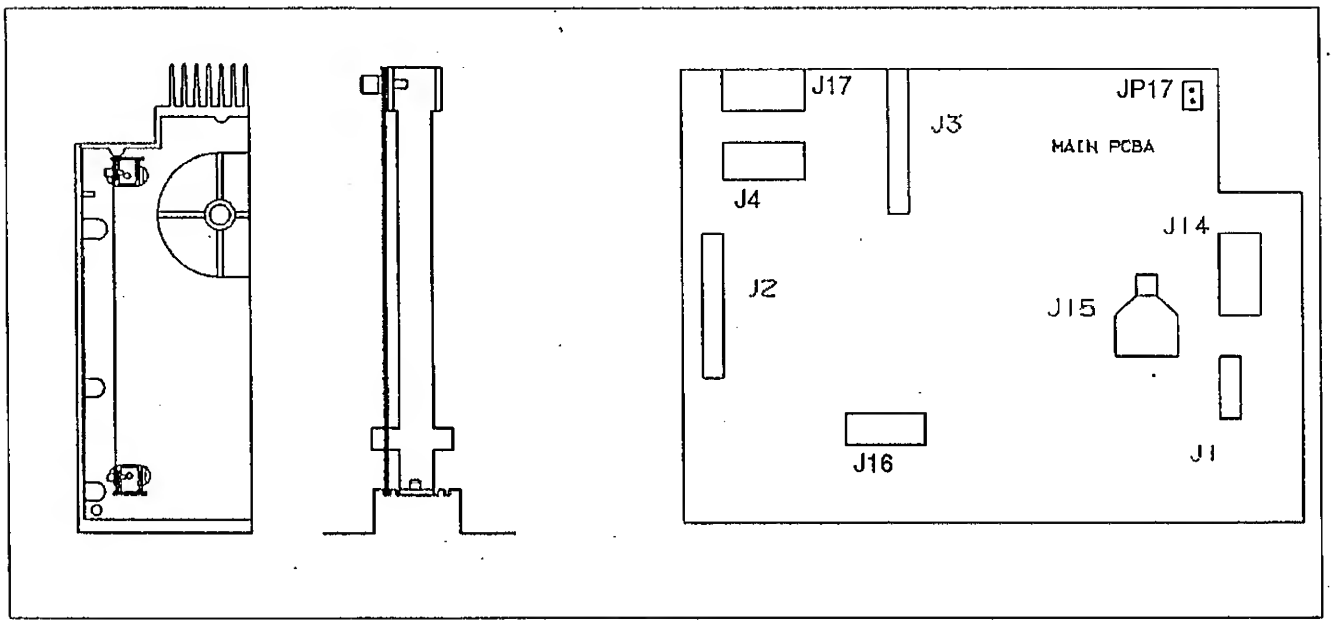




REAR VIEW

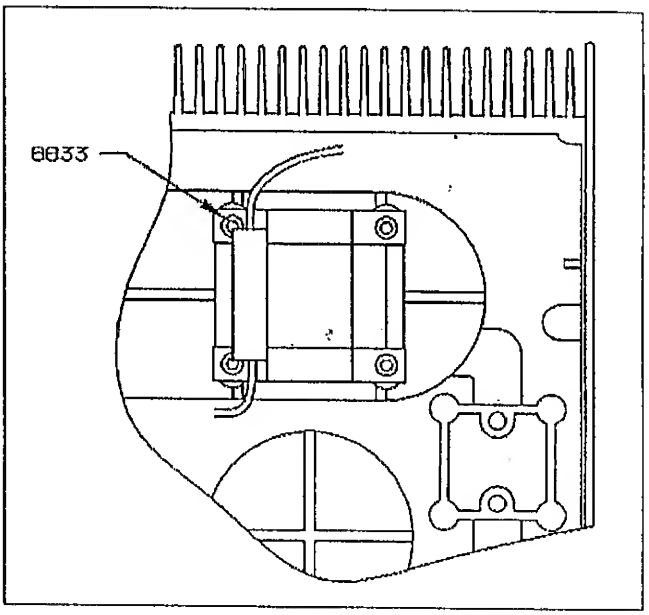
4) MAIN PC BOARD ASSEMBLY, P/N 50010

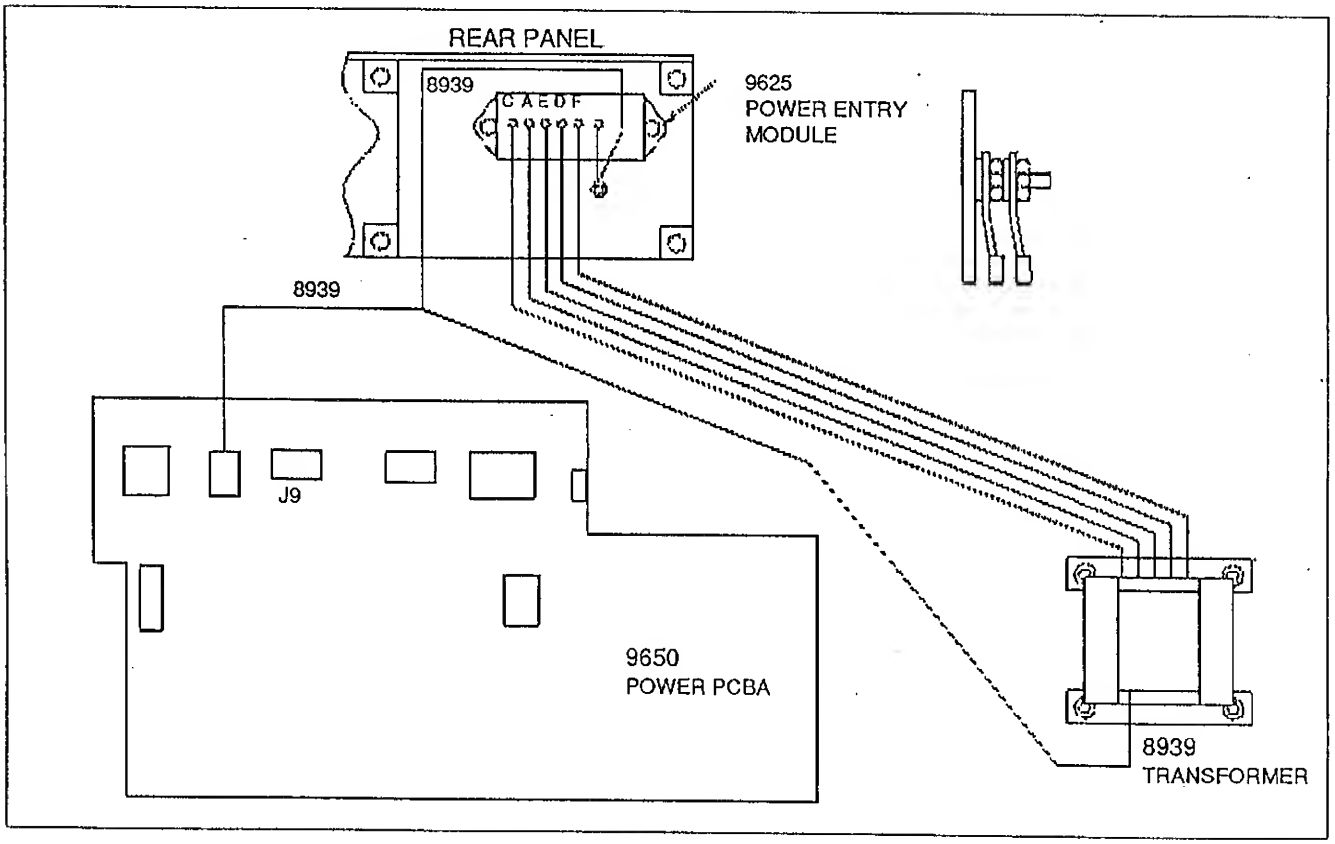
- Using a 7/64" Allen driver, remove two Allen screws (P/N 03219) from upper left and right side of main PC board.
- Lift board upwards and carefully unplug from board the following cables at the following locations.
- Ribbon Cable (P/N 15022) Flow Trasnder from J17.
- Ribbon Calbe (P/N 08938) circuit/ machine transducer's board from J4.
- Ribbon Cable (P/N 15025) Main Exhal from J16.
- Unplug alarm loudness cable wires from JP17.
- Unplug Fiber Optic (P/N 09793) from J15.
- Unplug 8 Pin Cable Assembl;y (P/N 09793) from J15.
- Ribbon Cable (P/N 71501) main signal from J1.
- Carefully remove main PC board assembly and place in Anti-Static Bag.
- Using 7/64" Allen driver, remove both screws (P/N 03219) securing brackets onto manifold.



5) POWER TRANSFORMER ASSEMBLY P/N

- Remove primary wire terminals from Power Entry Module (P/N 08941) located at right side, inside of rear panel.
- Remove green/yellow ground wire terminal (P/N 08432) from ground lug located below power entry module at inside of rear panel after removing nut (P/N 01066) with a 7/16" nut driver.
- With a 9/64" Allen driver, remove four Allen screws (P/N 08833) securing transformer base onto mounting pad on main accumulator, and remove power transformer.
- Unplug secondary output wire socket from J9 at Power PC Board Assembly (P/N).





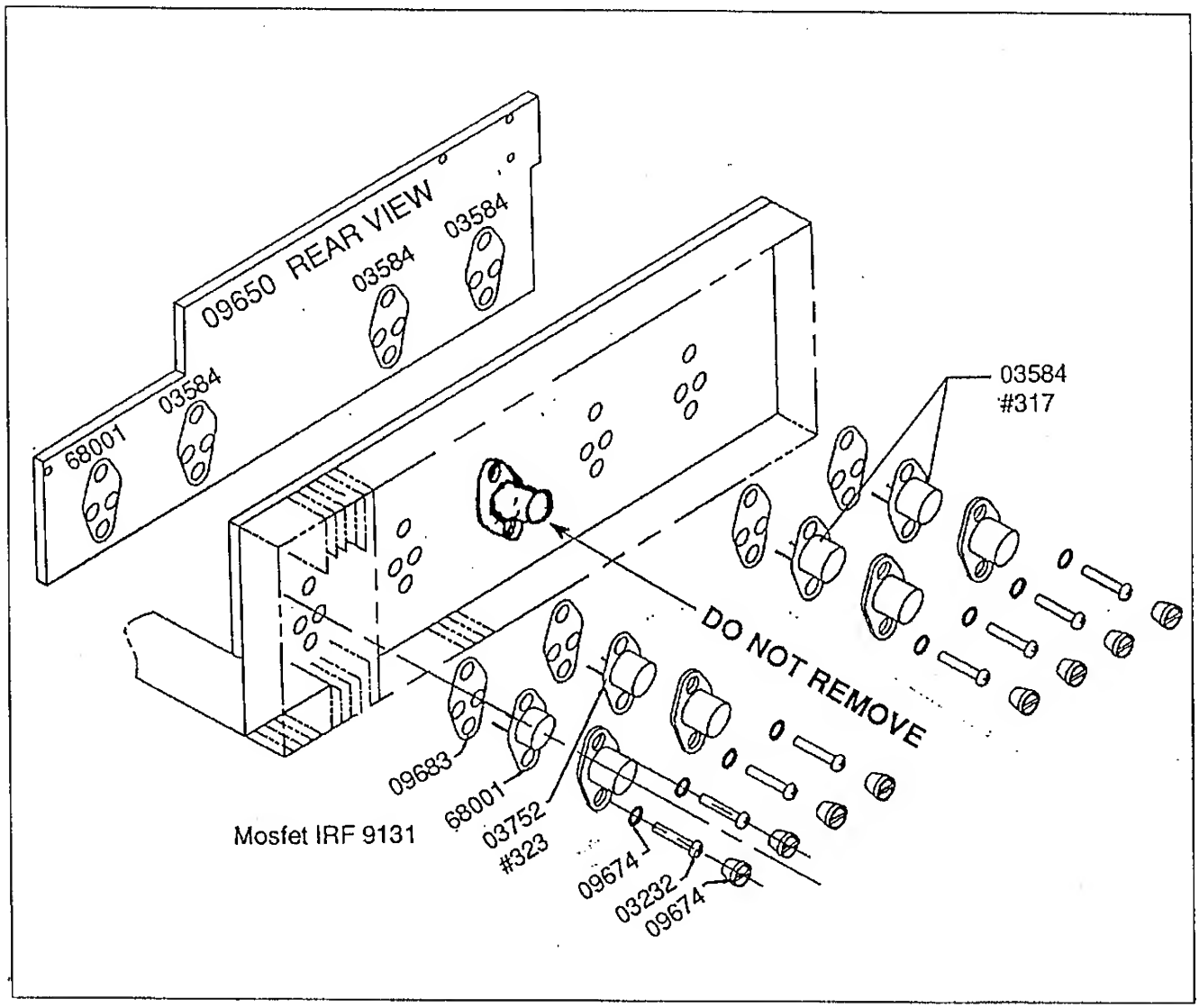
6) POWER SUPPLY PC BOARD ASSEMBLY P/N 50020

- Facing rear of casting finned area, remove all eight plugs, screws (P/N 03232), washers and four plastic covers from all regulators.
- With a thin long needle nose pliers, carefully remove all four regulators and insulator gaskets. Discard gaskets.

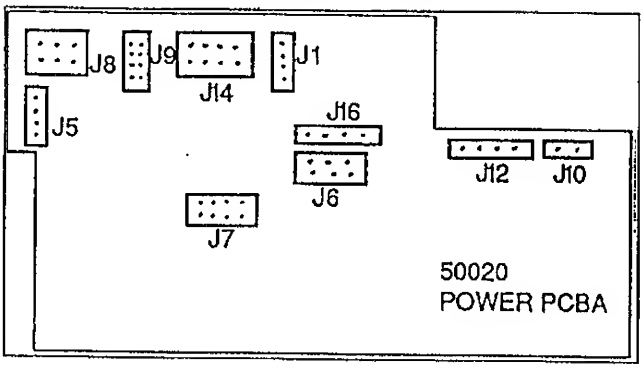
NOTE: Look at finned area rear of casting, it appears there are five regulators. However, the center Regulator Cover (P/N 09764) is a blank. (DO NOT REMOVE)

See diagram for proper IC regulator location and identification.

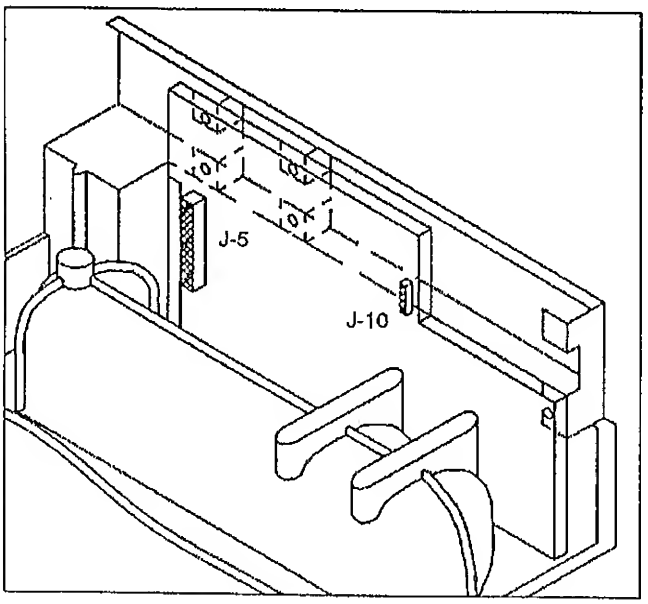
- Remove four screws (P/N 03221) with a 7/64" Allen driver from upper left and right hand side of finned area.



- Facing inside rear of ventilator, unplug from Power Supply PC Board the following cable connections:
- Safety Solenoid (P/N 08940) at J10.
- Flow Control Valve Assembly (P/N 09740) at J7.
- Exhalation Valve Cable at J6.

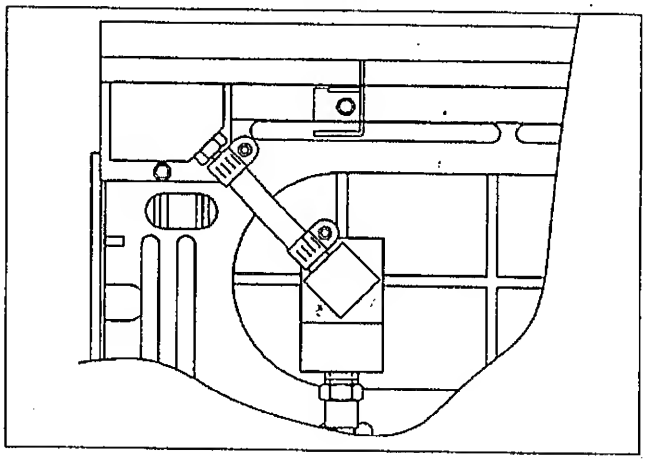


- With 7/64" Allen driver, remove the five Allen screws (P/N 03219) holding Power Supply PC Board assembly to rear panel.
- Lift Power Supply PC Board upwards, enough to clear Bridge Rectifier (P/N 03798) and unplug cable (P/N 03515) at J5 and cable assembly (P/N 03513) at J8.
- Carefully remove Power Supply PC Board (P/N 50020) and place in anti-static bag.
- Remove and discard Insulators (P/N 20097).

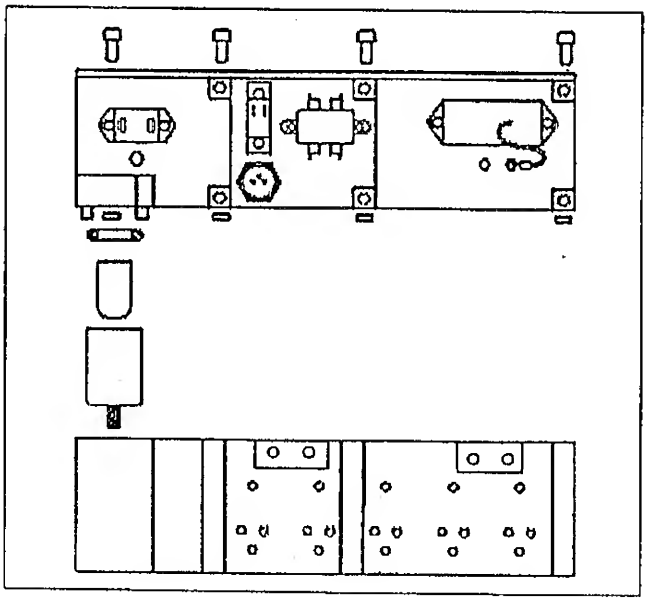


7) REAR PANEL ASSEMBLY P/N 09677

- With screwdriver, loosen hose clamp (P/N 09787) at inlet tee assembly, located at left hand top side of accumulator and push hose clamp back.



- With a 7/64" Allen driver, remove the four Allen screws (P/N 03219) and washers (P/N 04383) securing rear panel to manifold base.
- Lift rear panel upwards, pry and remove hose from elbow connector (P/N 09785) and remove rear panel.
- From Inlet Filter Assembly (P/N 09762) unscrew and remove glass bowl, filter element and O-ring. Discard element and O-ring.



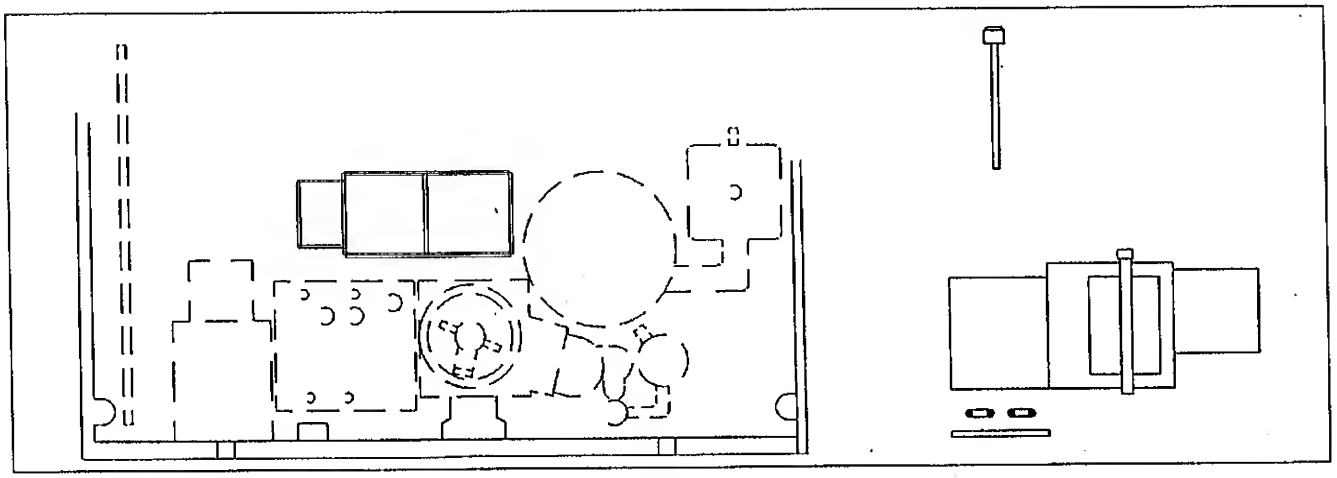
8) FLOW CONTROL VALVE ASSEMBLY P/N 09740

- Using a 9/64" Allen driver, remove two Allen screws (P/N 03218) securing the valve assembly on manifold mounting pad and lift assembly out of unit.
- Remove and discard two O-rings (P/N 03374) from counterbore holes in base of valve body.
- Remove and discard Valve Gasket (P/N 08880) located on mounting pad. Place vale in anti-static bag.

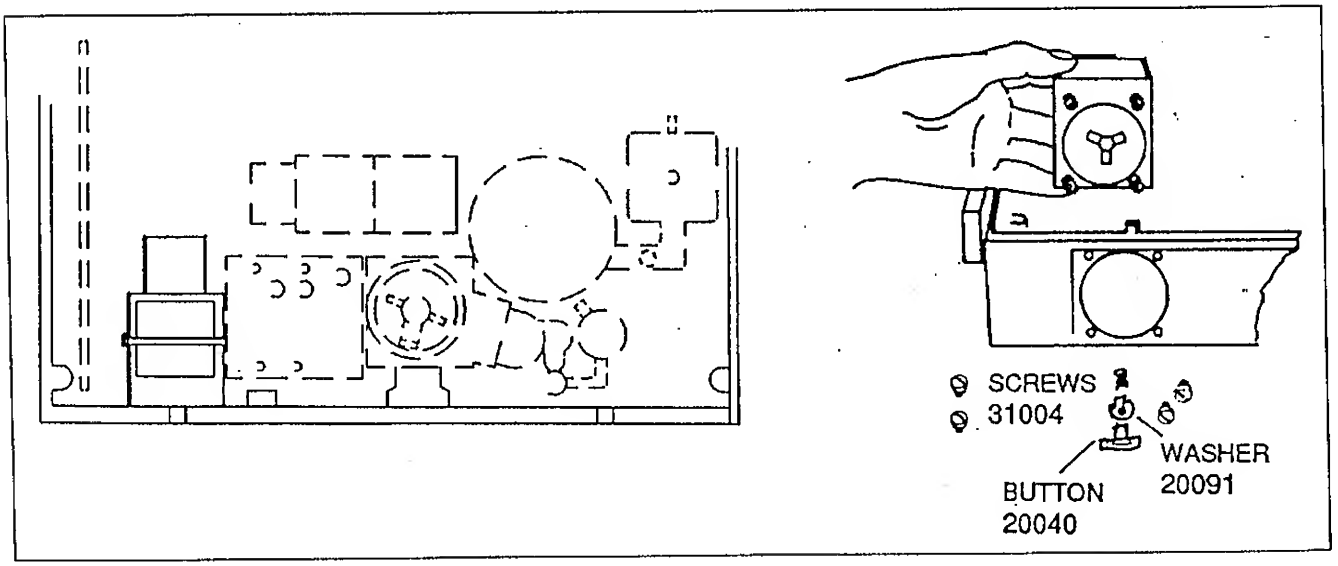
9) EXHALATION VALVE ASSEMBLY P/N 09741

NOTE: Support weight of valve while removing shoulder washers.

- Remove exhalation valve assembly from unit and place in an anti-static bag.

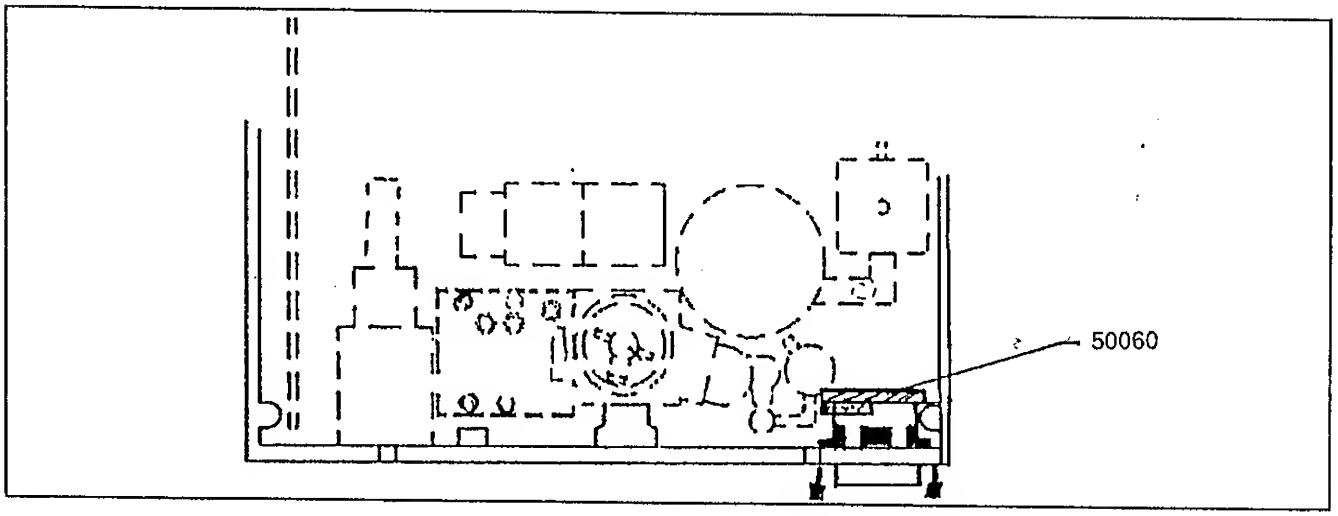


(8)



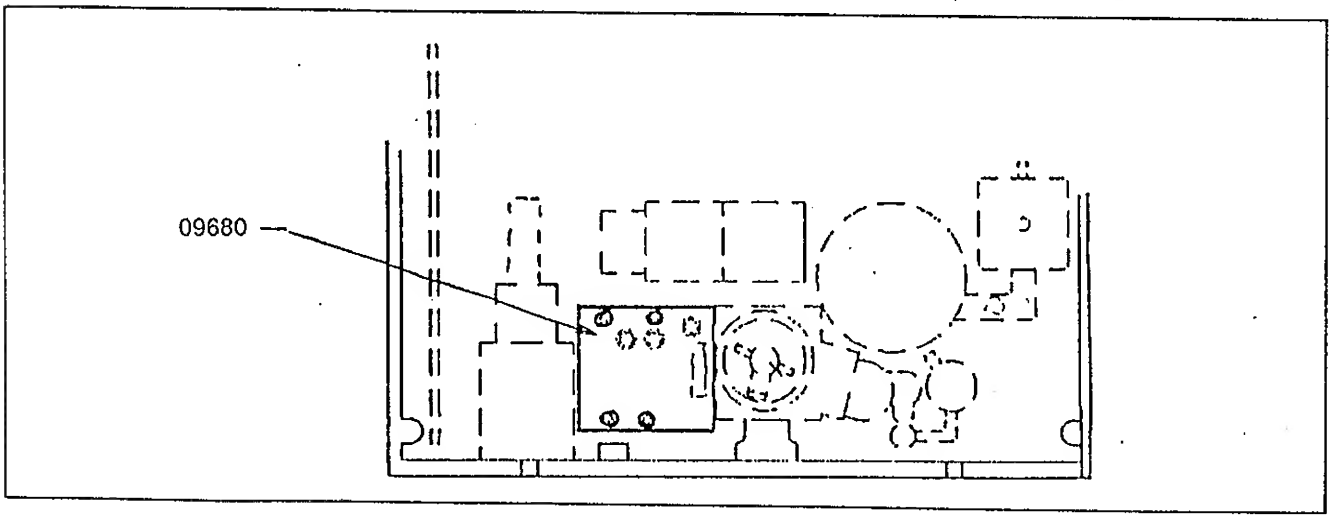
(9)

- Remore flow sensor connector and PC Board (P/N 50060) assembly from lower front of casing by removing four 3/32" Allen screws. Place assemlby in anti-static bag.



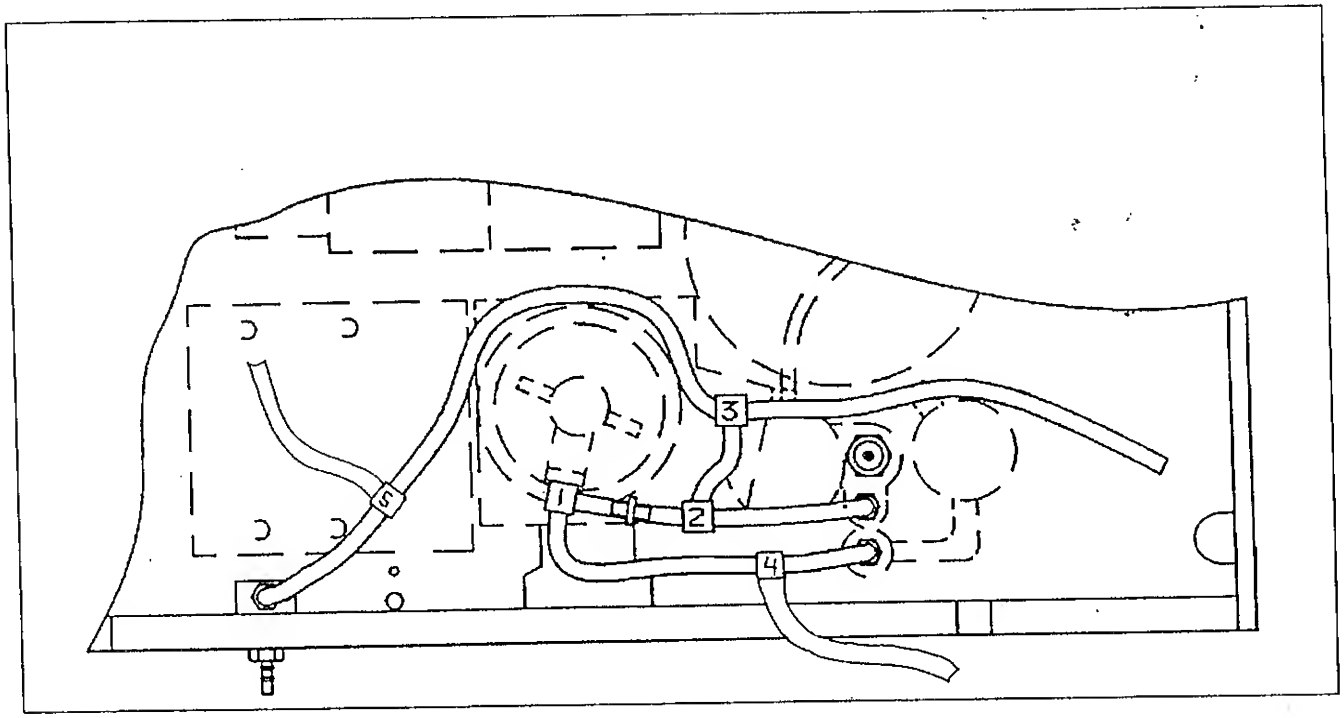
10) TRANSDUCER PC BOARD ASSEMBLY P/N 09680

- Using 7/64" Allen driver, remove four Allen screws (P/N 03220) securing board onto manifold mounting pad, then remove board.
- Remove and discard O-rings (P/N 03372) from transducer and/or manifold mounting pad.
- Carefully place Transducer PCB Assembly in anti-static bag.



11) PROXIMAL AIRWAY PRESSURE/ MANOMETER TUBING ASSEMBLY P/N 10080

- First, twist and pull tube connector tee fitting from intake of Safety Valve Cap (P/N 00172A) and then remove the other three tube ends from their barbed tube fittings (P/N 00576).

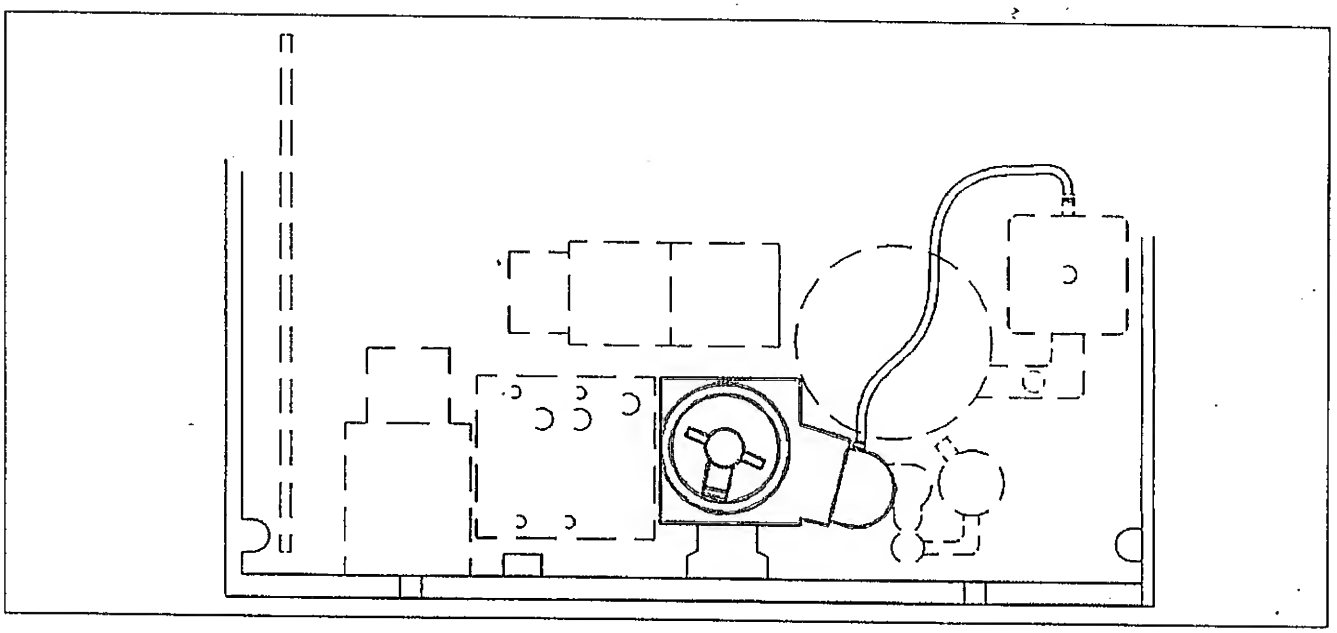


12) BARBED TUBE FITTINGS P/N 00576/

- With 1/4" nut driver remove all four barbed tube fittings. Three P/N 00576 on top of manifold base.
- Remove and discard all four O-rings (P/N 00114).

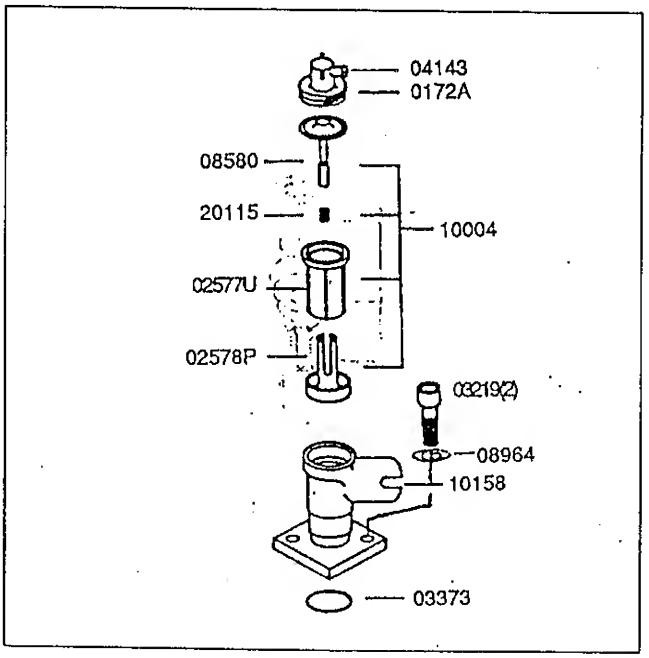
13) SAFETY VALVE ASSEMBLY P/N 09754

- Regulator Purge Tube Assembly (P/N 08934).
- Pull tube from fitting of pressure opulator.
- On opposite end of purge tube, cut cable tie wrap (P/N 07803) at elbow fitting (P/N 04506) and pull fitting out of silicone rubber elbow (P/N 09603).
- With fingers, pinch silicone rubber elbow and pull long end from manifold base and lift out.
- Pinch elbow and remove remaining short end from safety valve assembly body.



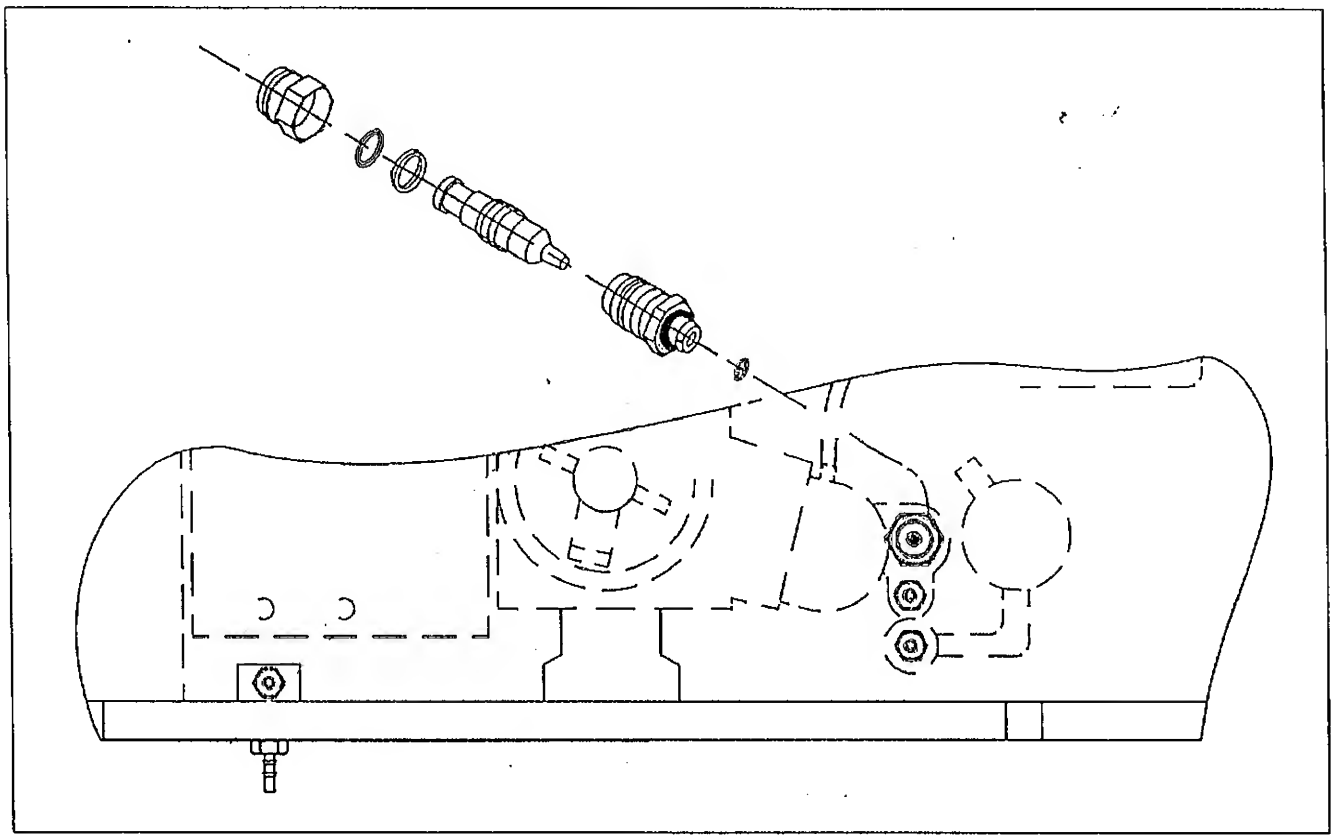
■ SAFETY VALVE REMOVAL

- At safety valve body top, unscrew valve cap (P/N 00172A), lift out diaphragm, gate assembly (P/N 10004) for cleaning or replacement.
- With a 7/64" Allen driver, remove two Allen screws (P/N 03219) and washers securing safety valve assembly (P/N) to manifold mounting pad.
- Remove and discard O-ring (P/N 03373) located inside of valve assembly base plate.



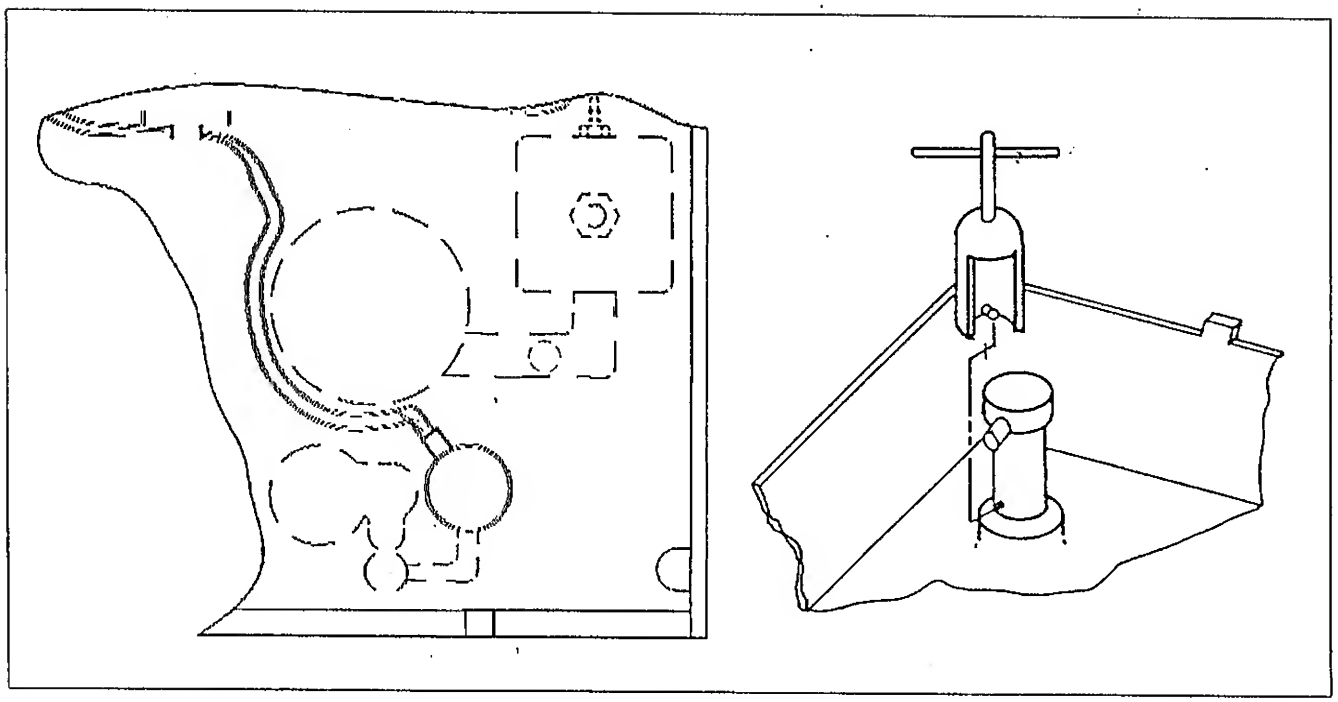
14) PURGE VALVE ASSEMBLY P/N 02756A

- With 1/2" deep socket, remove purge valve assembly from manifold base.
- Use 1/2" open end wrench, 1/2" nut driver and 3/32" Allen wrench to disassemble valve body, stem, cap, nylon washer for cleaning. Discard O-rings P/N 00114, P/N 00138 and P/N 07849.



15) SAFETY SOLENOID ASSEMBLY P/N 08940

- Cut cable tie (P/N 07803) on pad (P/N 08231) located right front side of accumulator.

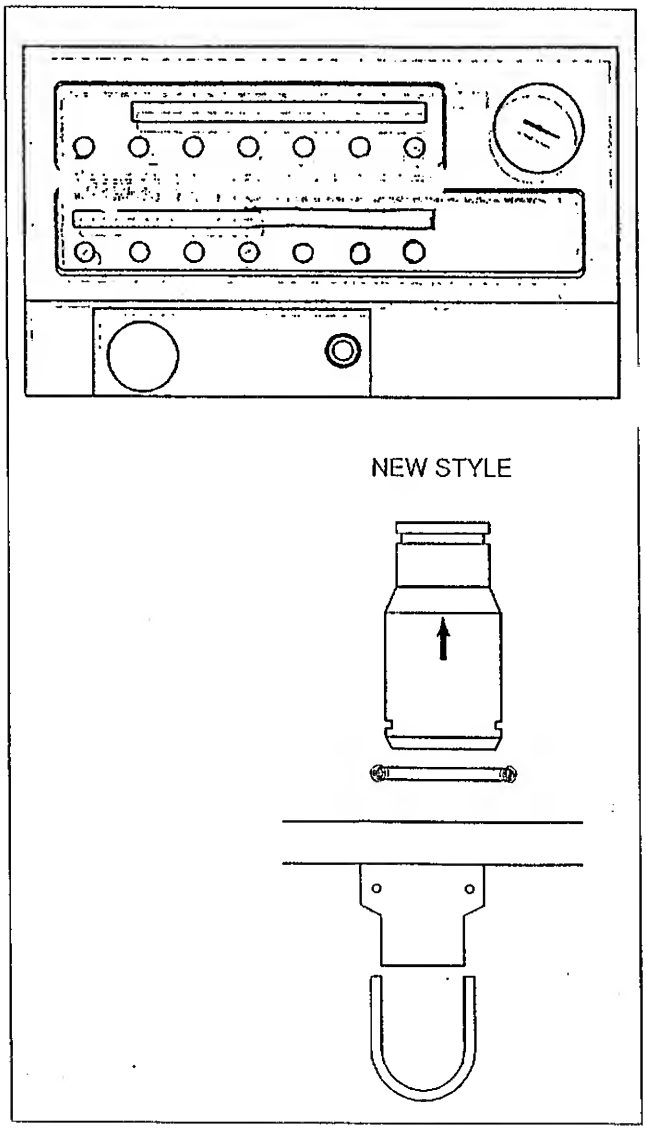


- Insert pin of solenoid wrench (P/N 03426) in one of three holes at base of valve body (P/N 09627) and turn counterclockwise until removed.

NOTE: Hold up wires to prevent them from tangling while turning.

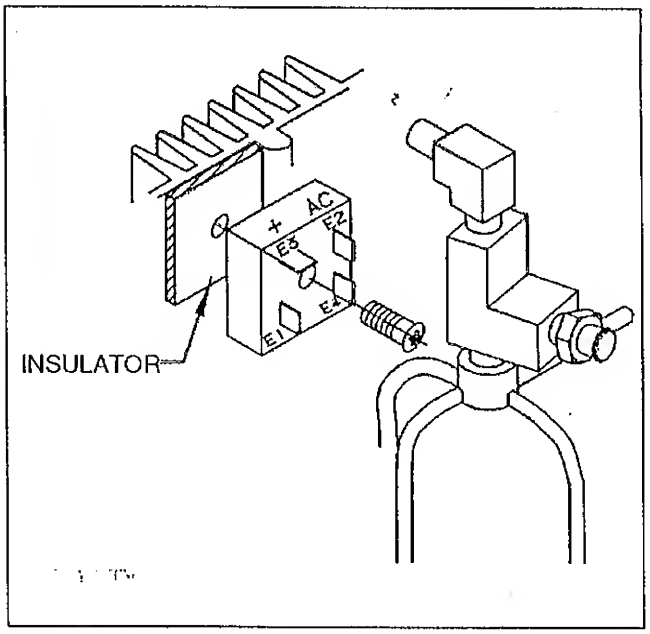
16) PATIENT OUTLET MANIFOLD ASSEMBLY P/N 09692

- Pull upwards to remove clip.
- From hole marked "TO HUMIDIFIER" pull patient outlet manifold towards you.
- To prevent scratching of inner surface, with a soft material, carefully remove O-ring (P/N 08963 or 03373) and discard.



17) BRIDGE RECTIFIER ASSEMBLY P/N 3798

- Using #2 Philips screwdriver, remove screw (P/N 04368) from left inside corner of rear of manifold casting holding Bridge Rectifier and Insulator (P/N 03516) in place. Discard insulator.

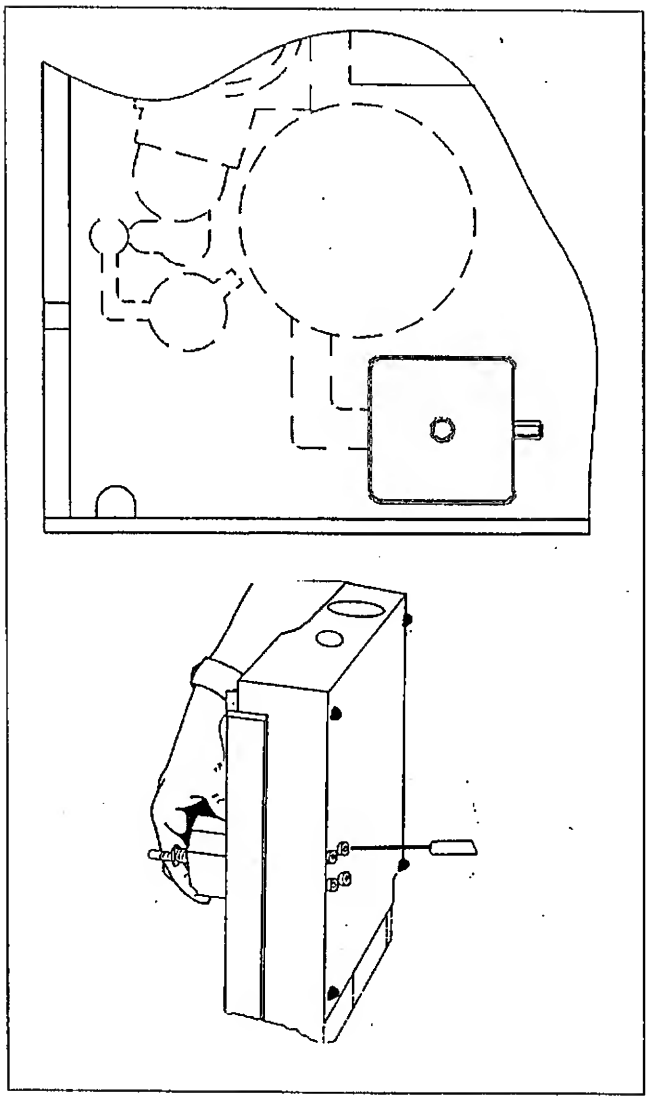


18) PRESSURE REGULATOR P/N 09712

- Position manifold base on its fins to expose base bottom plate.
- Insert 9/64" Allen driver through holes in manifold base plate, remove four Allen screws (P/N 03217) securing regulator on mounting pad and remove regulator.

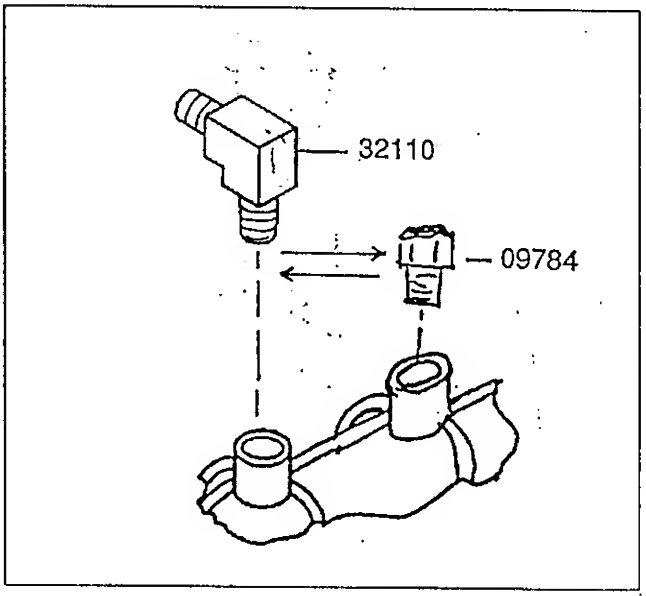
NOTE: Hold regulator up with your hand to support its weight during removal of screws.

- Remove and discard two O-rings (P/N 3375) from holes in regulator base.
- Remove 20 PSI test port plug and gasket.



19) INLET TEE AND 100 PSI PRESSURE RELIEF VALVE ASSEMBLY P/N 09784/09786

- If pressure relief valve assembly (P/N) needs replacement, remove assembly using 11/16" open end wrench.
- Remove inlet fitting using 11/16" wrench.

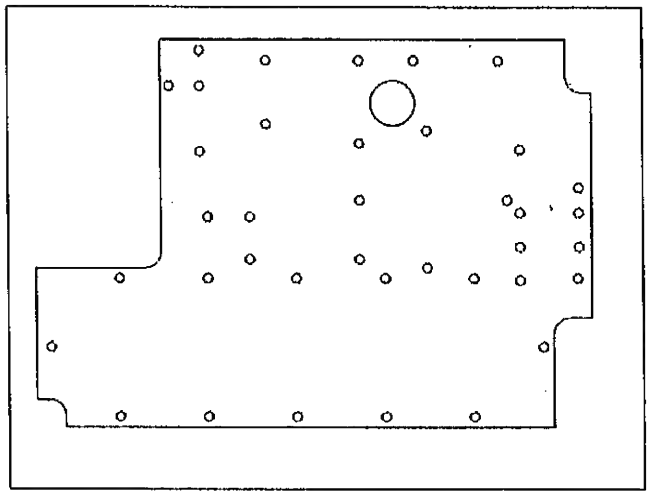


20) MANIFOLD SEALING PLATE P/N 09631

- With 3/32" Allen driver, remove the remaining 32 Allen screws (P/N 03216).
- Remove sealing plate, being careful not to scratch sealing surface.

21) MANIFOLD GASKET P/N 09632

- Remove manifold gasket and discard.

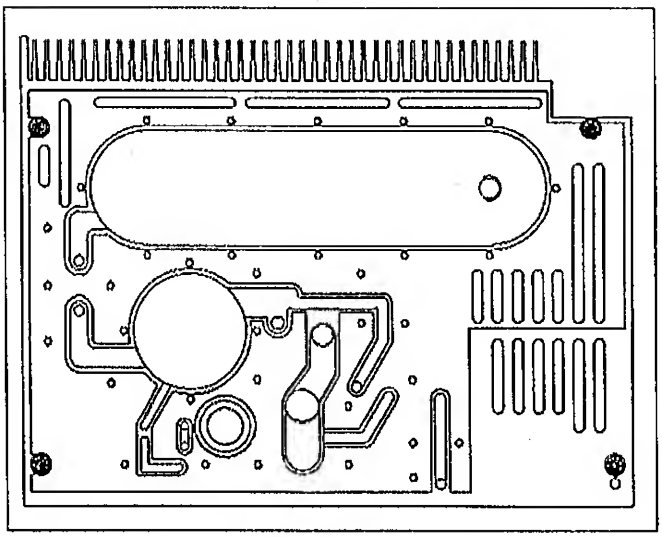


22) RUBBER BUMPER FEET P/N 04873

- If replacement is required, remove bumper feet by turning them counter-clockwise.

23) CLEANING

- Manifold base is now ready for cleaning. The manifold base may be soaked in a liquid detergent for superficial cleaning. After soaking, the manifold may be scrubbed if necessary to remove all debris and traces of lubricant. The manifold should then immediately be thoroughly rinsed with distilled or soft water and blown dry with clean/dry compressed air.
- Disassemble purge valve assembly (P/N 02576A) and and clean cap, stem, valve body as described above.
- For additional information refer to Section 6, "Cleaning and Sterilization".



SECTION 12

Assembly

SECTION 12
ASSEMBLY: INDEX

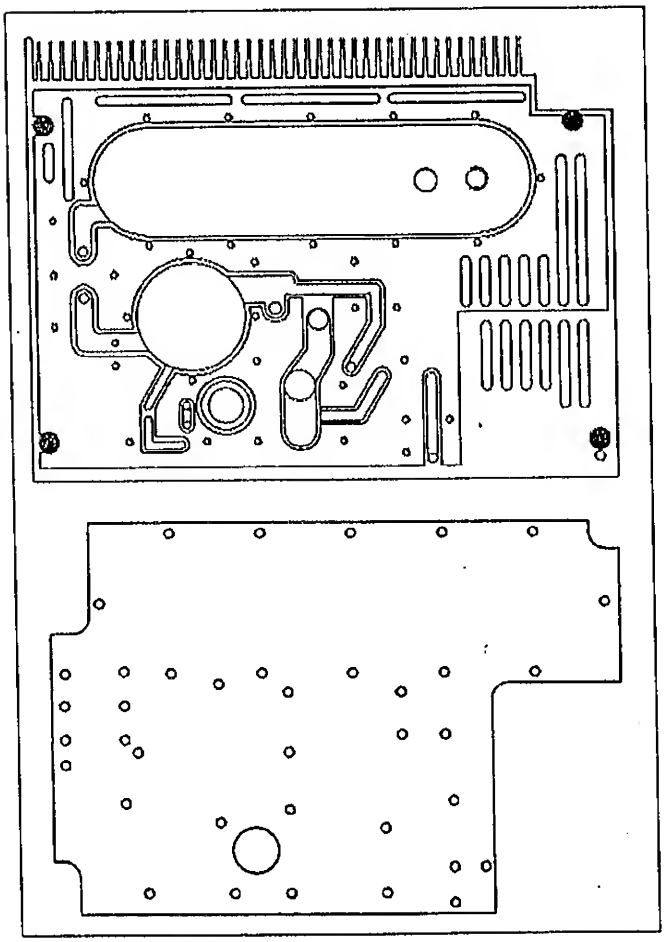
June, 1990

INDEX

■ MANIFOLD:

1) MANIFOLD GASKET P/N 09632:

- Make certain that new gasket surfaces are clean.
- Position Manifold Gasket onto bottom of manifold casting assuring correct orientation and hole alignment.



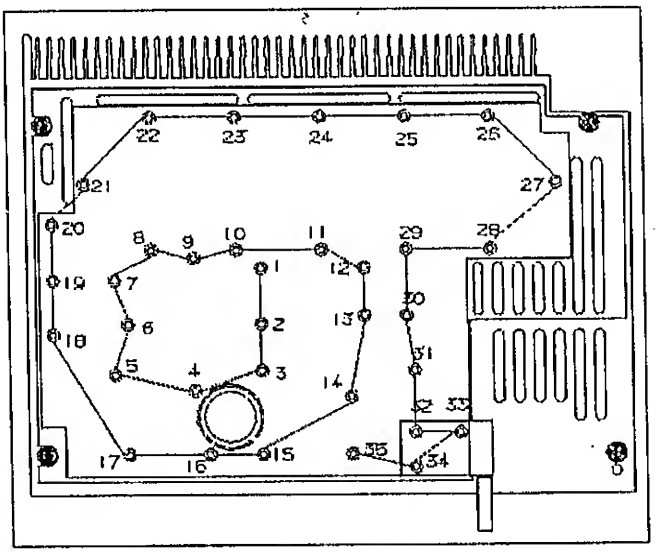
2) SEALING PLATE P/N 09631:

- Position Sealing Plate into gasket assuring proper hole alignment.
- Install 35 each 5/32" Allen screws (P/N 03216) finger-tight only.

NOTE: Using a spiral tightening sequence starting at No. 1 location, make two passes. First pass; tighten to 25 inch/lbs. Second and final pass; tighten to 40 inch/lbs.

CAUTION: It is important to follow sequence indicated!

NOTE: The 3 screws at the lower right hand corner are not installed at this time.



3) BUMPER FEET: P/N 04873:

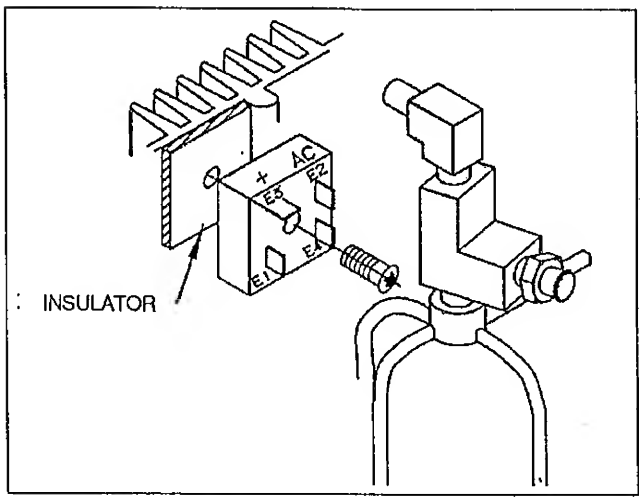
4) BRIDGE RECTIFIER P/N 03798: A

- Insert screw (P/N 08271) through center of Bridge Rectifier and Insulator (P/N 03516).
- Install assembly into hole at left hand inside corner of manifold with bridge rectifier reference corner marked + in 9 o'clock position.

CAUTION: TIGHTEN CAREFULLY, AS RECTIFIER MAY CRACK.

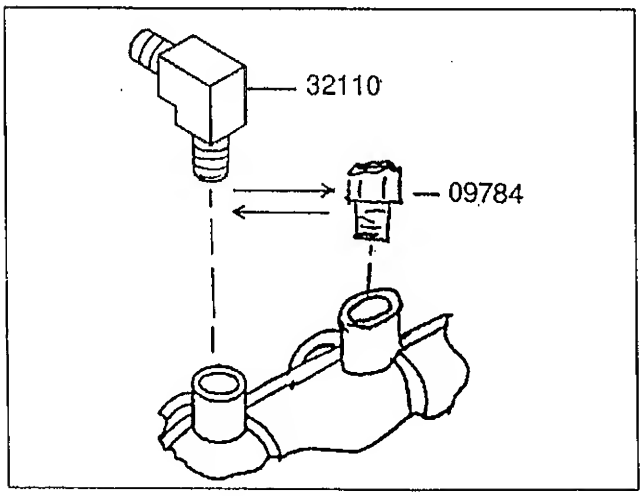
- Connect terminal of wire harness (P/N 03515) as follows:

E3	Red Color Cable	VDC+
E2	Gray Color Cable	AC
E4	Black Color Cable	VDC-
E1	Violet Color Cable	AC



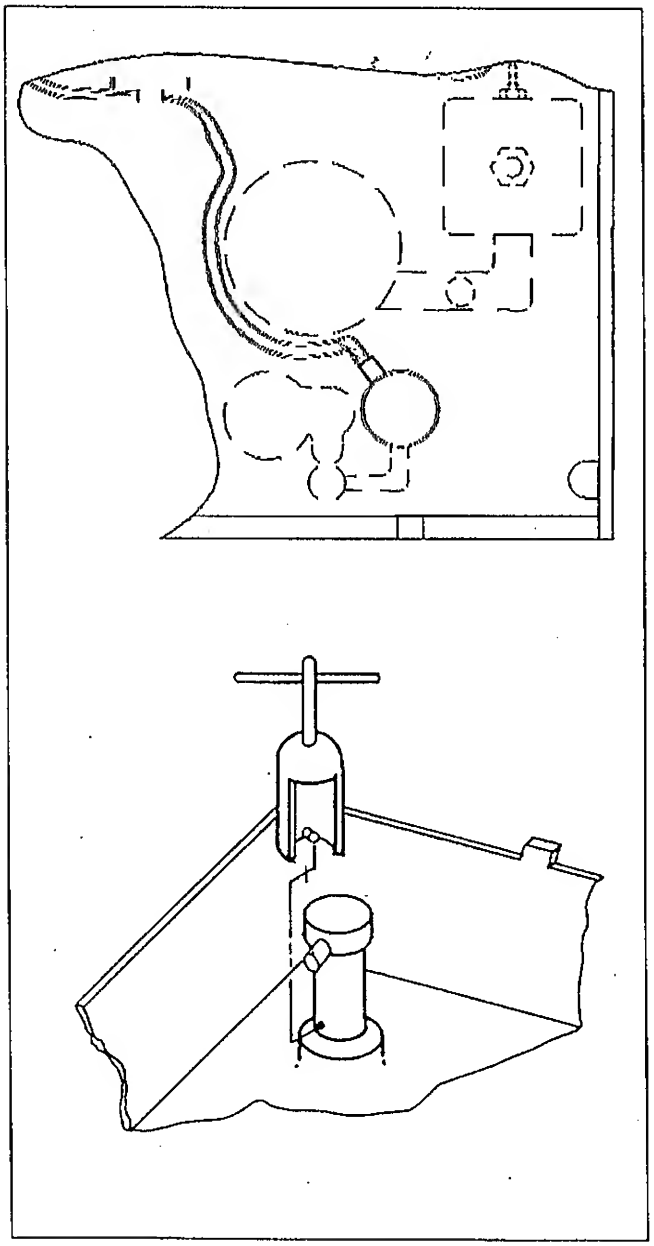
5) INLET TEE/PRESSURE RELIEF VALVE ASSEMBLY P/N 09784/09786:

- If assembly was removed, proceed as follows:
- On adjacent sides of inlet tee install Pressure Relief Valve (P/N 09784) and 45° Elbow (P/N 32110) using teflon tape.
- Place teflon tape on threaded end and hand tighten into accumulator inlets.



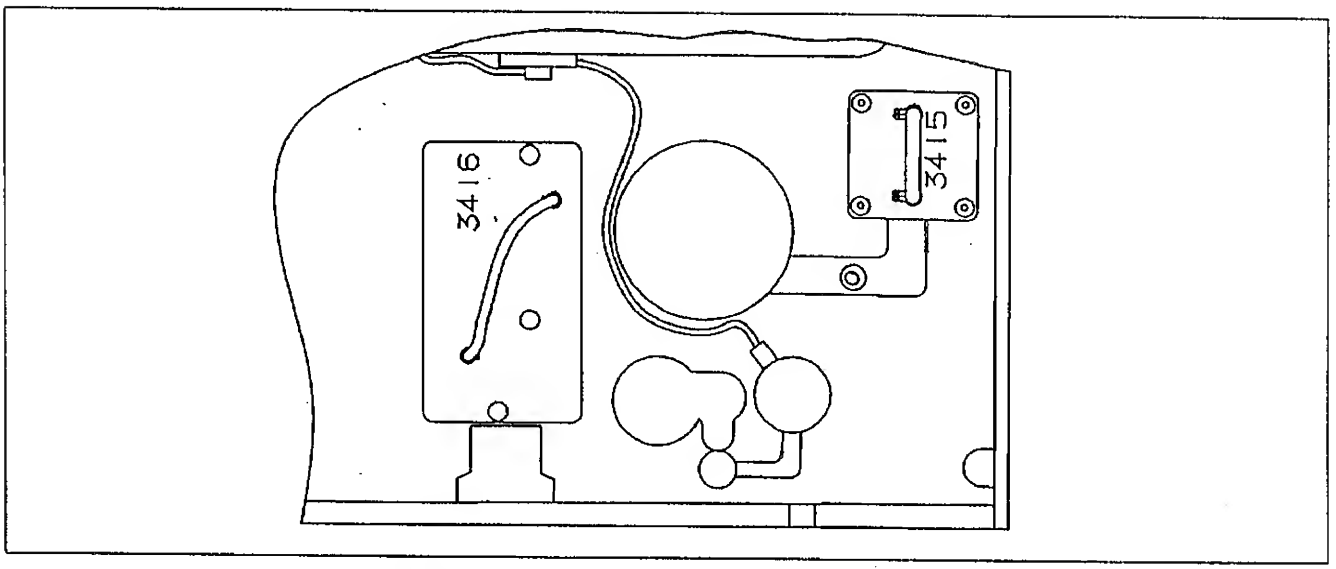
6) SAFETY SOLENOID ASSEMBLY P/N 08940:

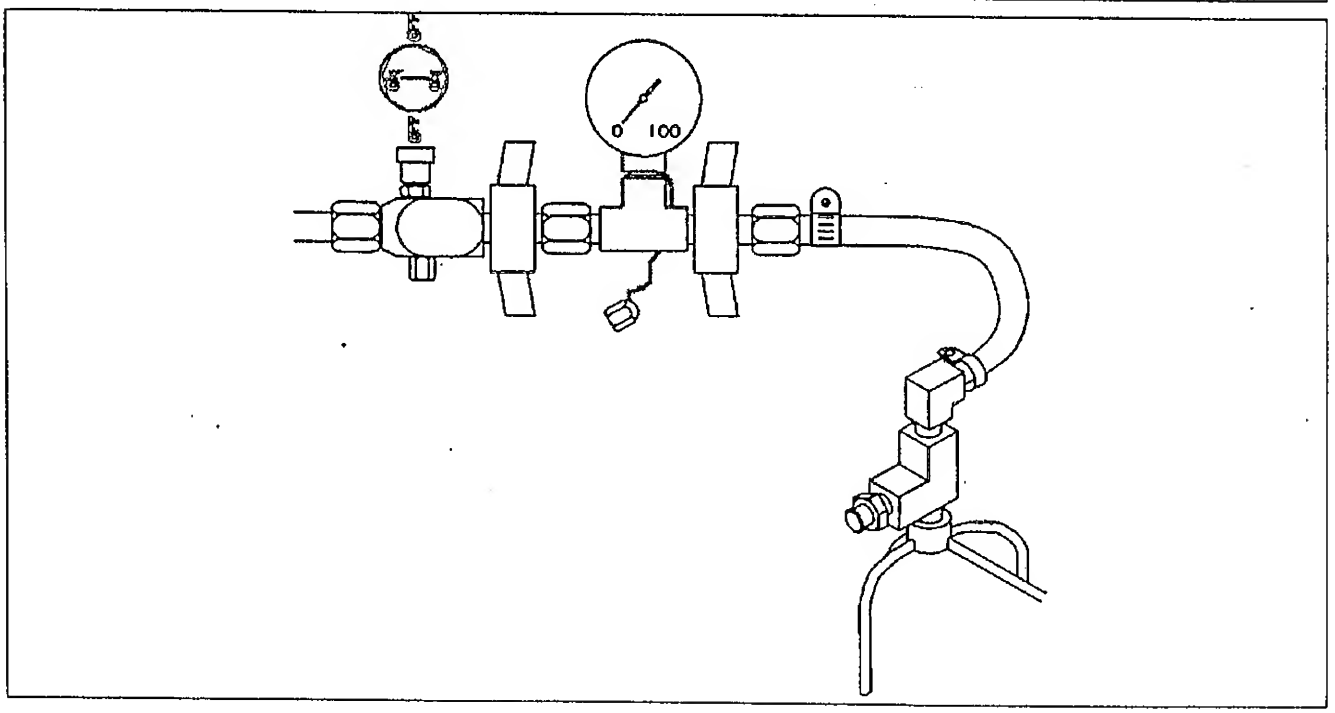
- Install Safety Solenoid (P/N 09627) using Solenoid wrench (P/N 03426). Hold wires upwards while tightening to prevent tangling.
- Position wires around dome of Pulsation Dampener Accumulator to square pad (P/N 08231) located on right front side of main accumulator. Secure with cable tie wrap (P/N 07803).



7) LEAK TEST MANIFOLD P/N 09602A:

- Attach Regulator Bypass Fixture (P/N 03415) to pressure regulator mounting pad and secure with four 9/64" Allen screws (P/N 03257) inserted from bottom through sealing plate.
- Attach Accumulator Pressure test fixture (P/N 03416) onto flow control valve mounting pad and partially cover safety valve assembly inlet opening and one port on the transducer mounting pad. Install O-ring/plug onto 20 PSI test port.
- Install 0-60 PSI or 0-100 PSI pressure regulator to supply source, make certain that pressure regulator control is turned full counter-clockwise **-OFF-** position to prevent damage to test gauge.
- Install and secure with hose clamp (P/N 09787) test hose to elbow of inlet tee/ pressure relief valve assembly on accumulator.
- Connect opposite end of test hose to gas supply source.





NOTE: TURN ON-OFF VALVE TO ON POSITION.

- Turn gas source ON and adjust supply source pressure regulator to read 50 PSIG on test gauge.
- Turn ON-OFF valve OFF and observe pressure behavior on test gauge. If pressure decays more than 2 PSI per minute, check for leaks. If pressure remains stable, system is leak tight.
- If pressure decays, remedy the problem before continuing with the next step.
- Remove at this time only Regulator.

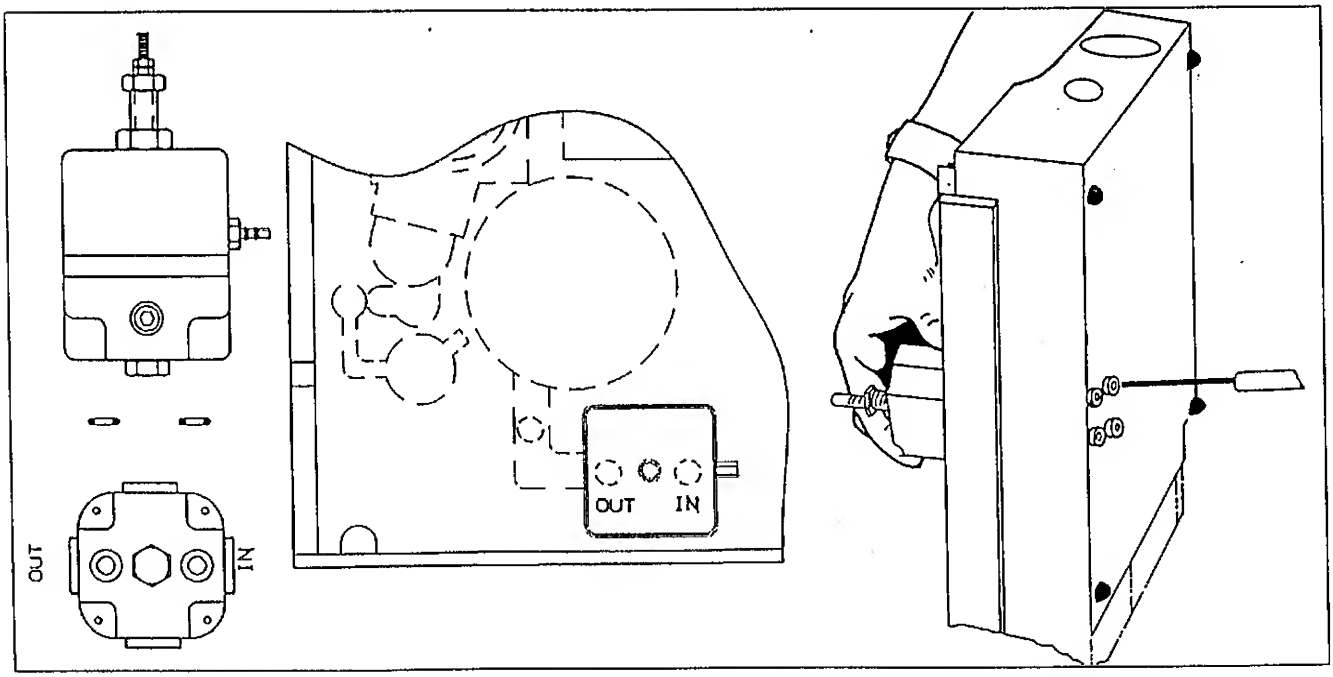
■ **TROUBLESHOOTING:**

- Check for leaks at baseplate, fittings of test fixture (P/N 03415, P/N 03415, test gauge, safety solenoid, and test hose ON-OFF valve assembly or its equivalent.
- If there is no leak, go to next step. If there is a leak, repair problem and repeat pressure test.
- Repeat 40 inch pound torque sequence and repeat test.
- If leak still persists, change gasket and repeat steps.

8) PRESSURE REGULATOR P/N 09712:
(Control air - 100)

- Install fitting included with regulator into side of regulator body using Teflon tape and secure with a 1/4" nut driver.
- Position two O-rings (P/N 03375) into counterbore of holes in bottom of regulator.
- Position regulator on top of manifold mounting pad positioned with fitting (or part marked IN) toward rear of manifold casting.
- Secure regulator onto manifold mounting pad with four 9/64" Allen screws (P/N 03217). Tighten evenly .

NOTE: Fairchild - position regulator on top of manifold mounting pad with fitting facing towrds Display PC Board Assembly. (Bleed fitting is already installed.)



9) PRESSURE LEAK TEST AND/ OR CALIBRATION OF REGULATOR ASSEMBLY P/N 09712:

- Remove 0-60 PSIG test gauge and connect 0-30 PSIG precision test gauge to test port on Flow Valve Test Fixture (P/N 03416).
- Turn test hose assembly ON-OFF valve to ON and adjust gas source supply pressure regulator to 50 PSIG.
- Regulator operating pressure as identified on test gauge should read 20 PSIG ± .4 (19.6 PSIG - 20.4 PSIG).
- If regulator needs adjustment, loosen locknuts on regulator and adjust valve stem as required for pressure to read 20 PSIG on test gauge.
- Secure locknut using Vibratitè (P/N 03884) or equivalent locking material.
- Turn gas source supply OFF, remove test fixture (P/N 03416), test gauge and test hose assembly from inlet elbow fitting by loosening up hose clamp (P/N 09787).

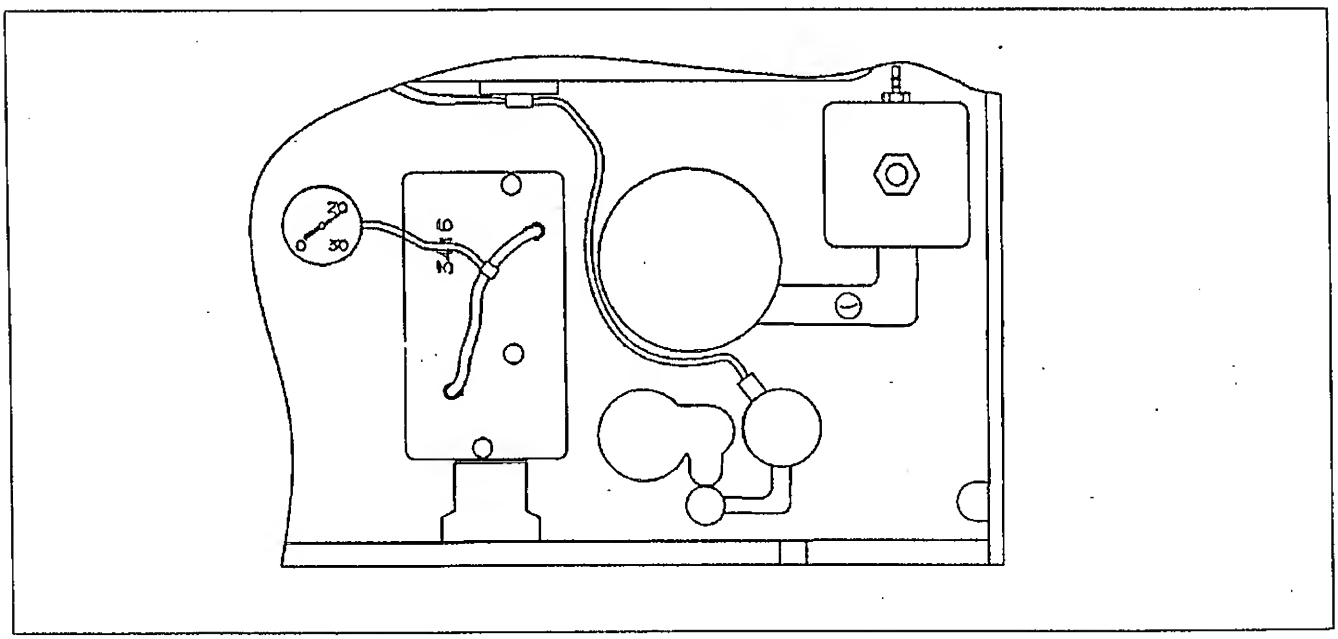
■ TROUBLESHOOTING

CAN'T ADJUST TO 20 PSIG.

- Confirm 50 PSIG supply source.
- Check for gas leaks - audible sound, remedy problem.
- Check for leaks at regulator base and mounting pad, 0-30 PSIG test gauge connections.
- Damaged 0-30 PSIG test gauge.
- Replace regulator and repeat test procedure.

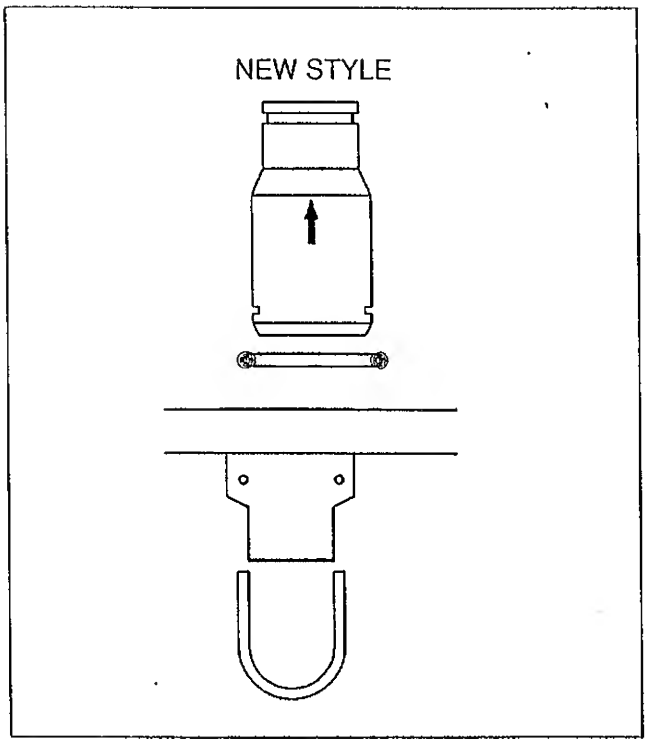
SLUGGISH — SLOW RESPONSE:

- Confirm 50 PSIG supply source.
- Check for leaks around 0-30 PSIG test gauge and fitting on test fixture (P/N 03416).
- Damaged O-ring(s) (P/N 3375).
- Purge line fitting partially obstructed.
- Replace regulator, repeat test procedure.



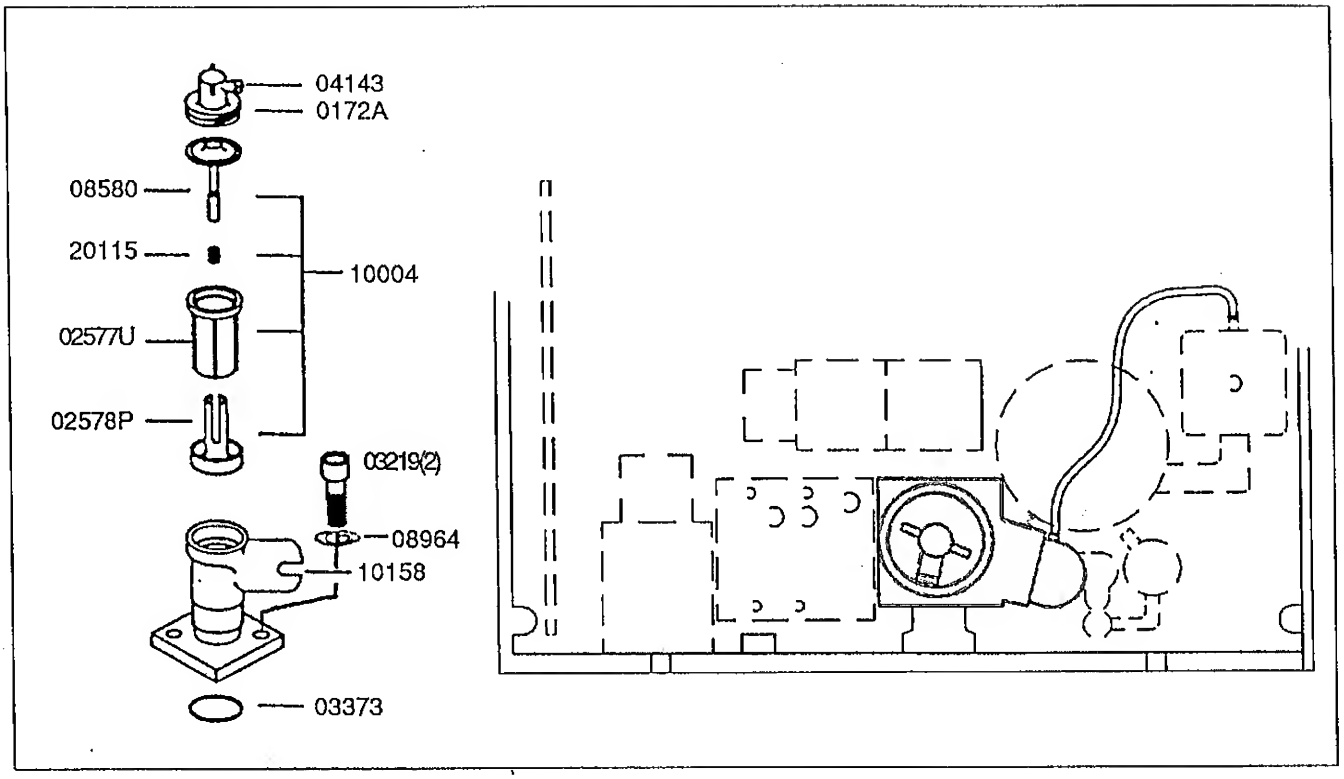
10) PATIENT OUTLET MANIFOLD ASSEMBLY P/N 04586

- Install and position O-ring (P/N 08963) into hole in front flange of manifold casting marked "TO HUMIDIFIER".
- Install Patient Outlet Manifold into opening with small left to right turning motion against O-ring and align groove in patient outlet manifold body with the 2 holes in manifold base.
- With arrow in top location, insert retaining clip (P/N 09693) into holes.
- Pull on Patient Outlet Manifold and insure that manifold remains in place.



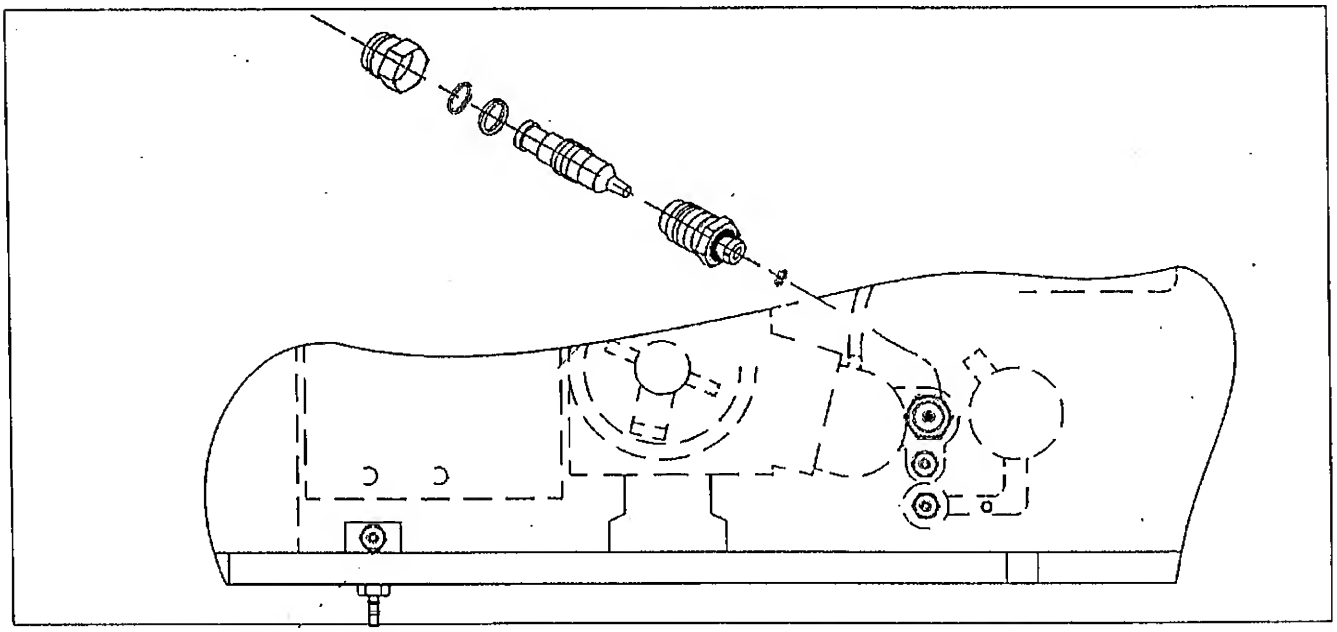
11) SAFETY VALVE ASSEMBLY P/N 09754

- Insert short leg of silicone elbow (P/N 09603) into side port of safety valve body with first ridge past notch.
- Install elbow fitting (P/N 04006) of Regulator Purge Tube Assembly (P/N 08934) into silicone elbow.
- Secure regulator purge tube on elbow fitting with bracelet (P/N 01587). If P/N 07803 is used, cut off and discard excess length.
- Install O-ring (P/N 03373) onto inside of Safety Valve Assembly base plate.
- Position and secure safety valve baseplate with silicone elbow onto mounting pad on manifold casting with two screws (P/N 03219) and washers (P/N 08964) using a 7/64" Allen driver. Tighten screws evenly.
- Insert end of long leg of silicone rubber elbow into remaining large hole in manifold casting until ridge makes contact with casting surface without kinking or collapsing.
- Install new cartridge assembly (P/N 02581) in safety valve body. Install and secure safety valve assembly cap (P/N 00172A).
- Connect open end of regulator purge tube assembly to barbed fitting on pressure regulator and secure tube with tie wrap (P/N 07803). Cut off and discard excess length.



12) PURGE VALVE ASSEMBLY P/N 02756A :

- Before installing O-rings (P/N 00138-07849), lightly lubricate them using Lubricant (P/N 00042).
- Install nylon washer (P/N 00109), O-ring (P/N 00138) on valve stem, O-ring (P/N 07849) on valve body, and position NON lubricated O-ring (P/N 00114) on inside front end of valve body.
- Use a 1/2" deep socket and install Valve Assembly (P/N 02756A) in manifold base.



13) BARBED TUBE FITTINGS P/N 00576:

- Install O-rings (P/N 00114) onto the four barbed fittings.
- Install and secure using 1/4" nut driver, the barbed fittings to the manifold castings as follows:

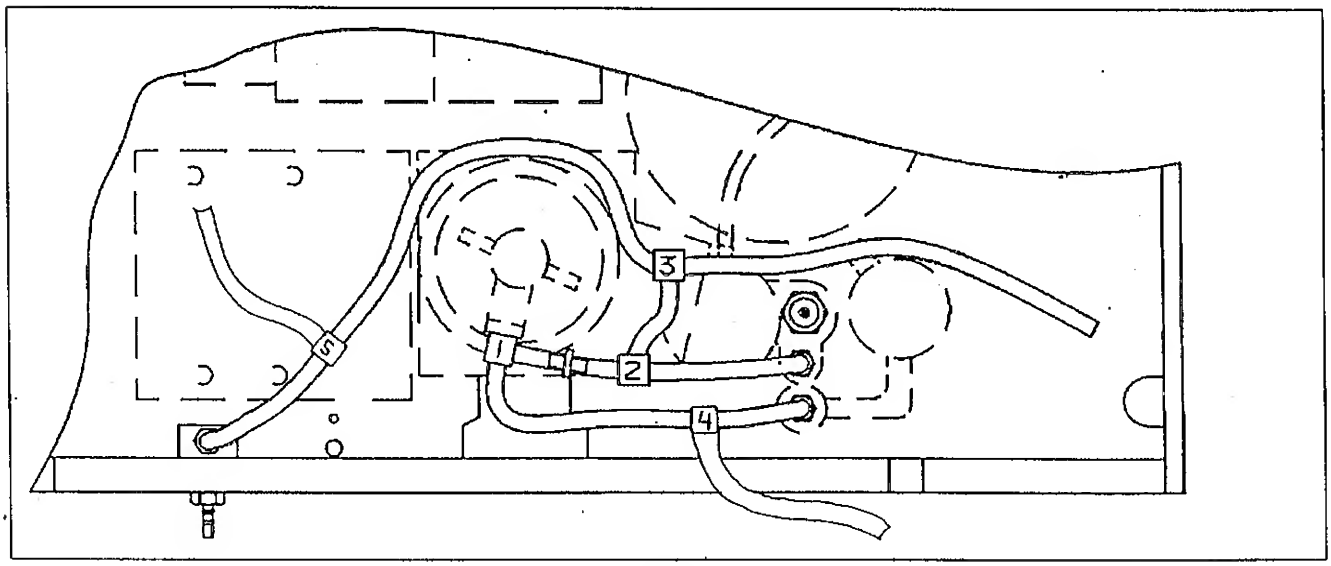
14) TRANSDUCER SAFETY VALVE/ MANOMETER TUBING ASSEMBLY P/N 10080

- Install bracelets P/N 01587 over each tubing end.
- Lubricate Orings P/N 06435 and insert tee connector #1 P/N 06409 into safety valve cap P/N 00172A
- Connect distal end of tee #2 tubing to barbed fitting closest to purge valve P/N 02756A assembly
- Connect distal end of tee #4 tubing to barbed fitting further away from purge valve. Center leg of tee #4 not connected at this time.
- Connect distal end of tee #5 tubing to barbed fitting of circuit transducer. Center leg of tee #5 not connected at this time.
- Distal end of tee #3 with blue orifice is for manometer, not connected at this time.

15) TRANSDUCER PC BOARD ASSEMBLY P/N 09680:

- Install three new O-rings (P/N 03372) into counter bore ports in manifold base.
- Place Transducer PC Board Assembly onto manifold casting, positioning the three pressure ports from the transducer to align with the three ports and O-rings in manifold base.
- Secure Transducer PC Board Assembly to manifold base with four Allen screws (P/N 03220) using a 7/64" Allen torque screwdriver.

NOTE: Torque Allen screws (P/N 03220) evenly to 16 inch ounces. First run screws down to make contact with PC Board.



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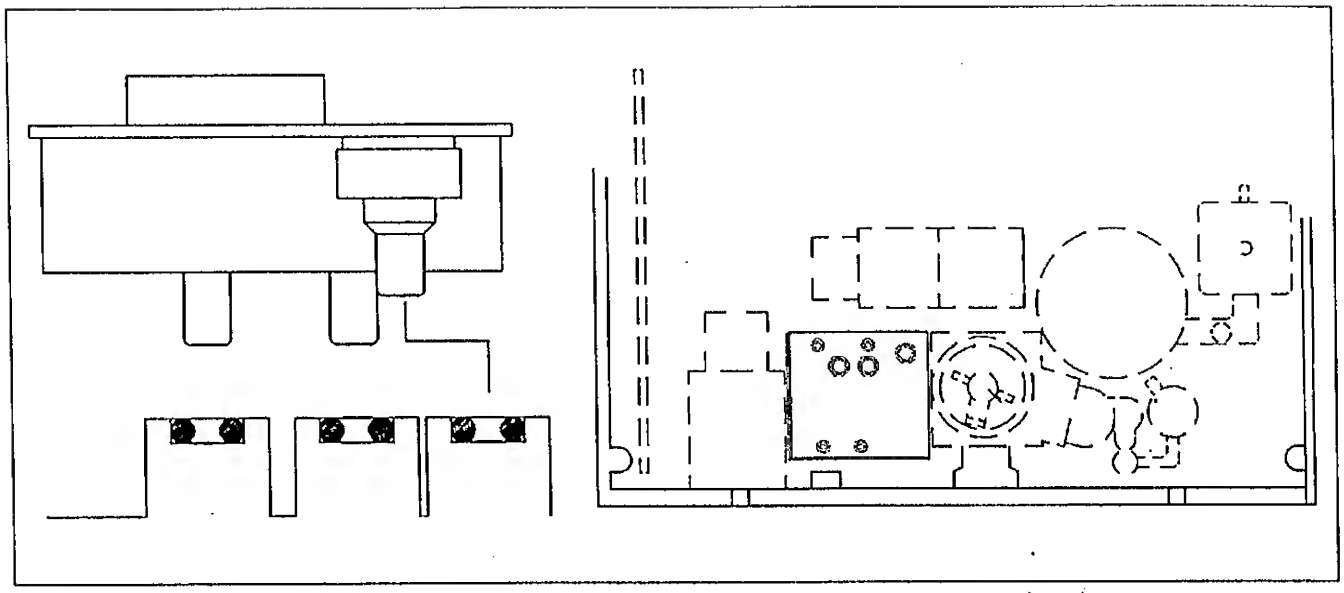


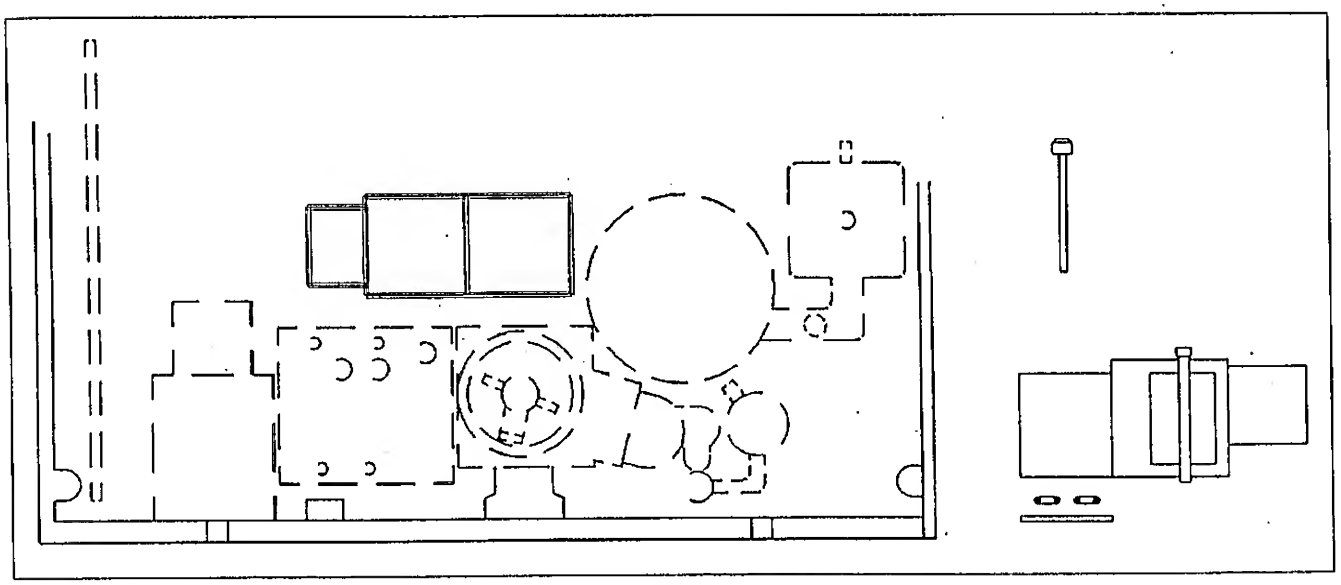
(15)

16) FLOW CONTROL VALVE ASSEMBLY P/N 09740:

- Install two O-rings (P/N 03374) into counter bores of flow control valve body.
- Position and align holes of flow control valve gasket (P/N 08880) with holes in flow control valve body mounting pad on manifold base.
- Seat Flow Control Valve Assembly onto gasket.
- Using a 9/64" Allen driver, secure the two Allen screws (P/N 03218).

NOTE: Tighten screws evenly.

- Install dust cover (P/N 08930) and secure with tie wrap cable (P/N 05038) at conclusion of Operation Verification Procedure.



(16)

17) EXHALATION VALVE ASSEMBLY P/N 10083:

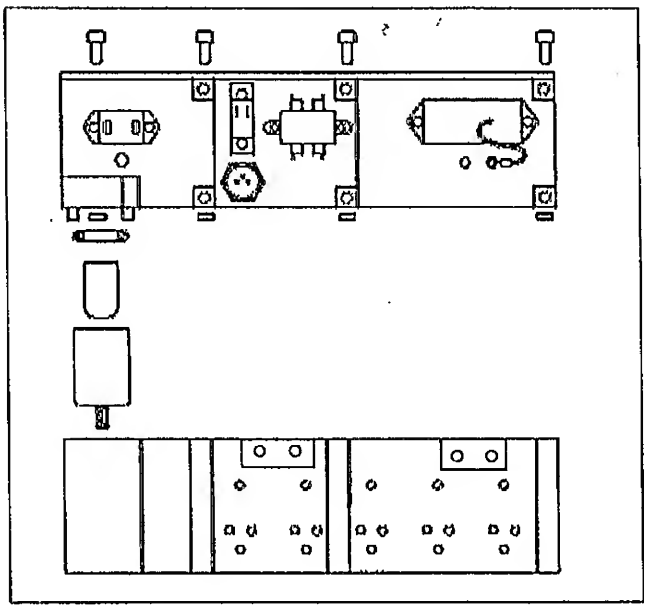
- Position exhalation valve assembly inside front of machine (lower left as your face front of unit), with tube fitting upwards.
- Secure with a 7/64" Allen driver three screws P/N 03219 in all but the lower left corner from the front.
- Into lower left corner recess of exhalation valve, place a button and spring P/N 20040. While holding button depressed, position washer/retainer P/N 20041 over remaining hole and secure using fourth screw P/N 03219.
- Button should now be spring loaded and actuate smoothly.

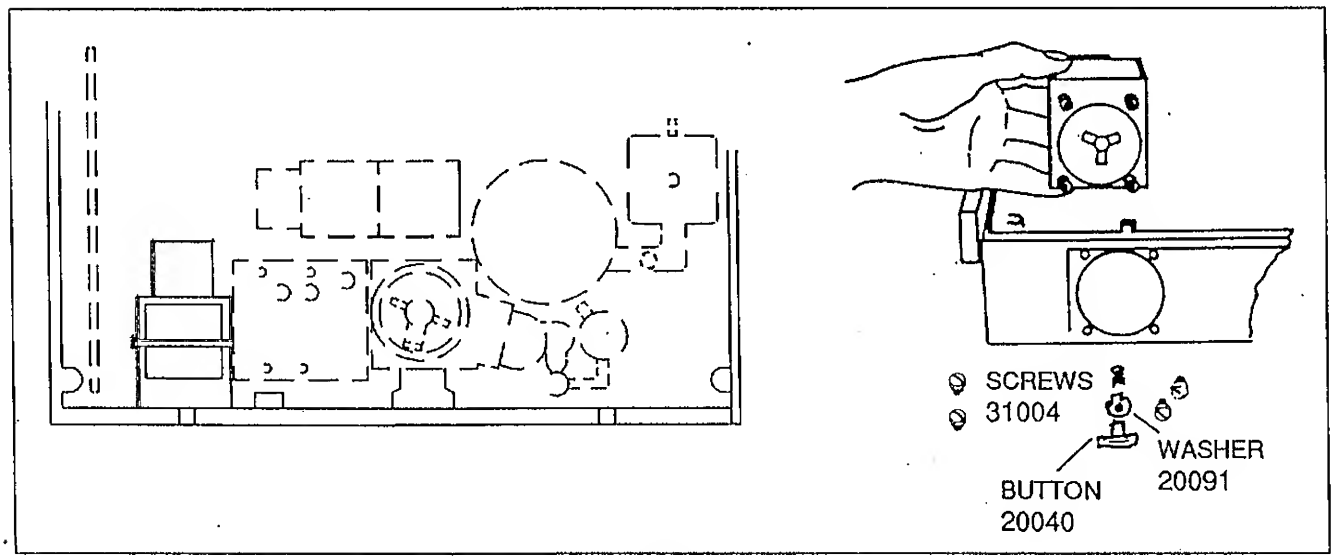
18) REAR PANEL ASSEMBLY:

- Check condition of moisture seal strip (P/N 08882) on top of panel, replace if necessary.
- Install and secure O-ring (P/N 06194), filter element (P/N 06146) into Air Coalescing Filter Assembly (P/N 09762) and install transparent bowl, hand tighten only.

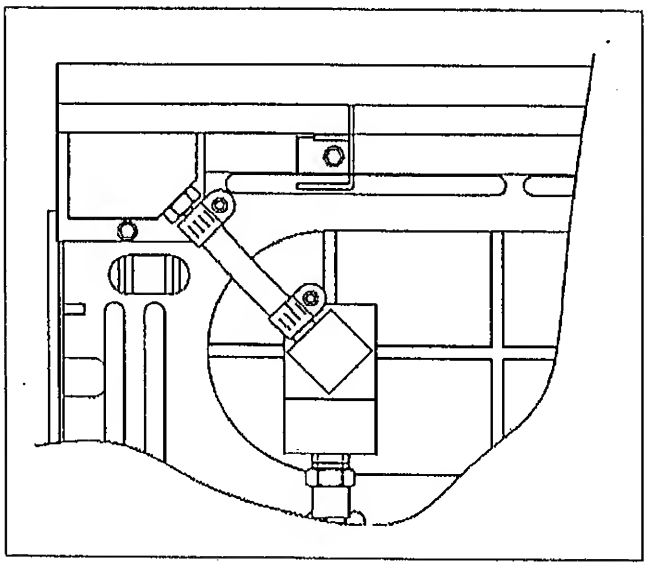
NOTE: Ensure that drain valve in bottom of bowl is closed.

- Install four internal tooth washers (P/N 04383) on top of casting (finned area).
- With all components on panel in place, position and align rear panel assembly down on top manifold assembly.



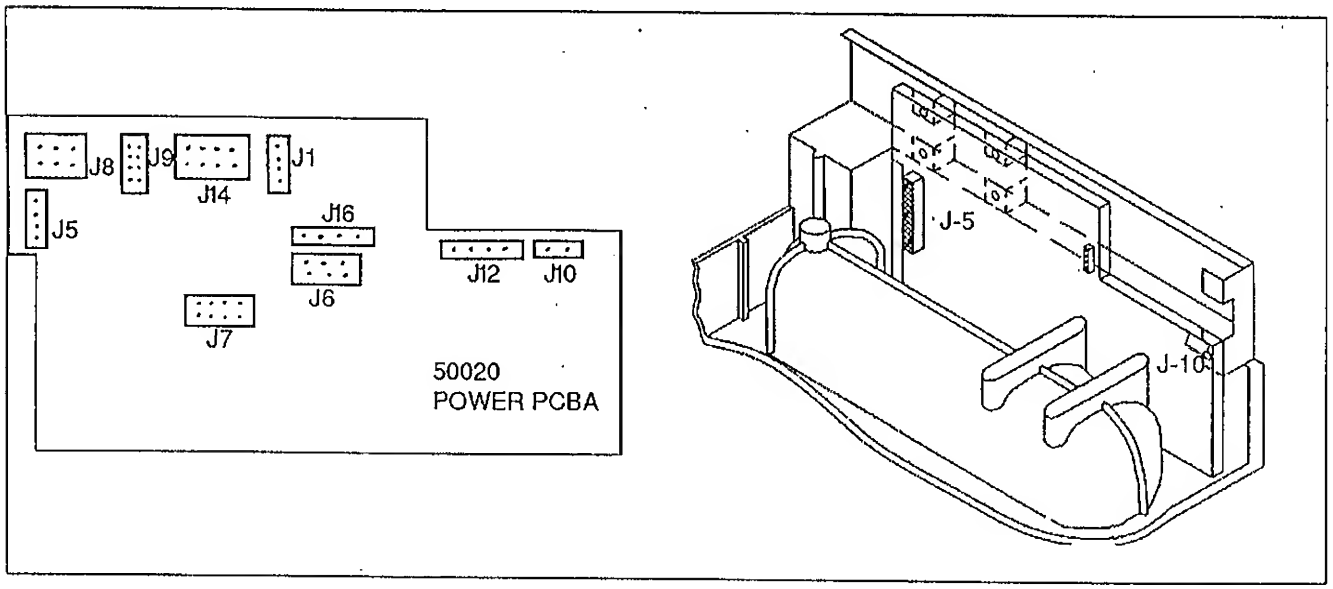


- Install, but do not secure at this time, four screws (P/N 03219) and washers (P/N 04383) using a 7/64" Allen screwdriver and hold rear panel in place.
- Connect and secure 6" tubing (P/N 03019 from inlet assembly to filter inlet with hose clamp (P/N 09787).



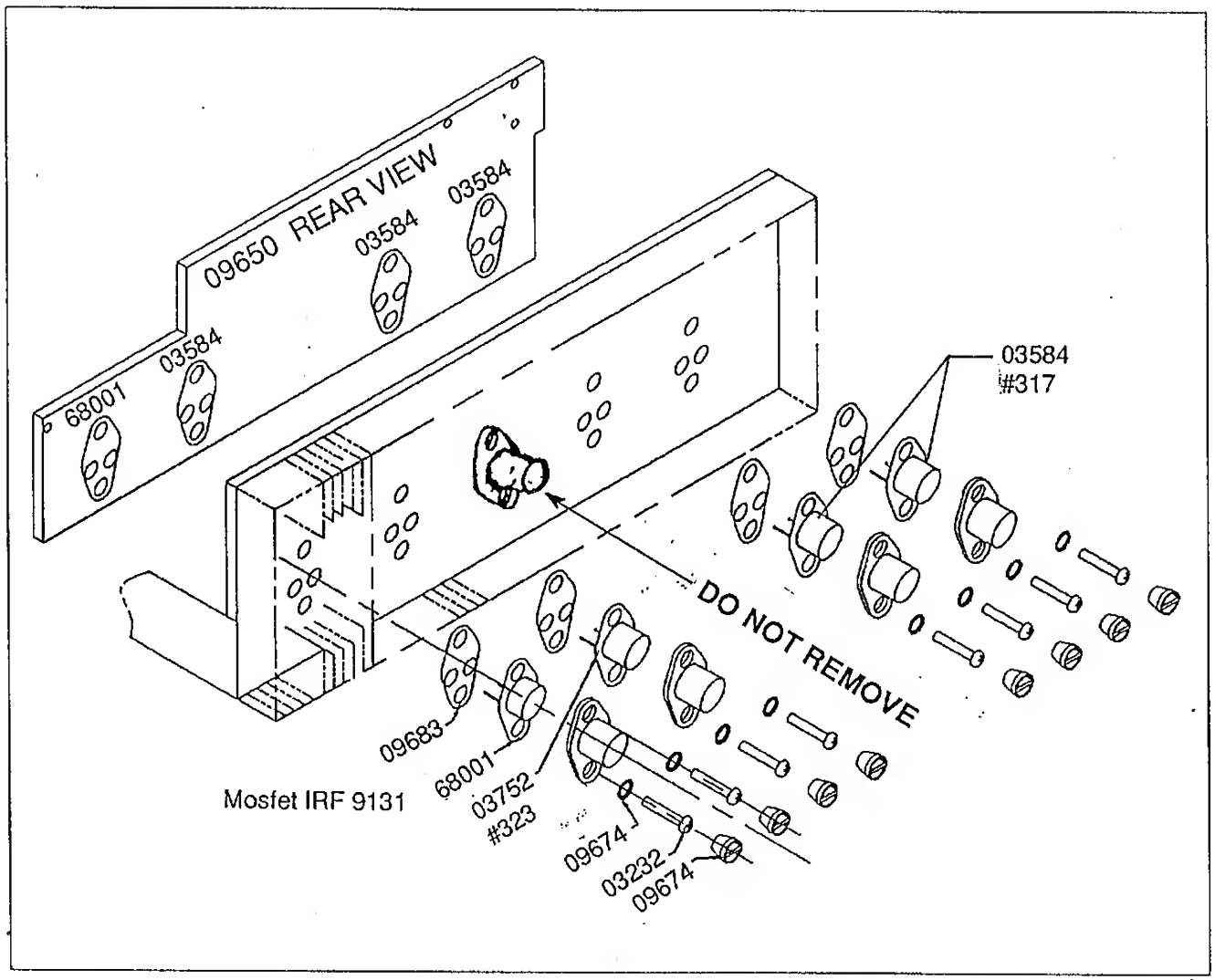
19) POWER SUPPLY PC BOARD ASSEMBLY P/N 50020:

- Carefully remove Power Supply PC Board Assembly from anti-static bag and lower board down into place at back of manifold casting.
- Position two insulators (P/N 20049) onto inside rear of heat sink. Insulators are placed into recessed regions while registering with holes in heat sink. Press into place firmly.
- Install four screws (P/N 03221) through rear of heat sink into metal blocks on power supply board and tighten.
- Before securing panel, connect cable assembly (P/N 03515) from bridge rectifier to J5 on the Power Supply PC Board and the 6 pin connector of cable assembly (P/N 03513) from rear panel to J8 on Power Supply PC Board panel.
- Align IC regulator sockets with socket holes in rear of manifold casting finned area. Hold Power Supply PC Board panel in place while installing and securing five screws (P/N 03219) with a 3/32" Allen wrench.
- Connect safety solenoid assembly connector to Power Supply PC Board at J10.



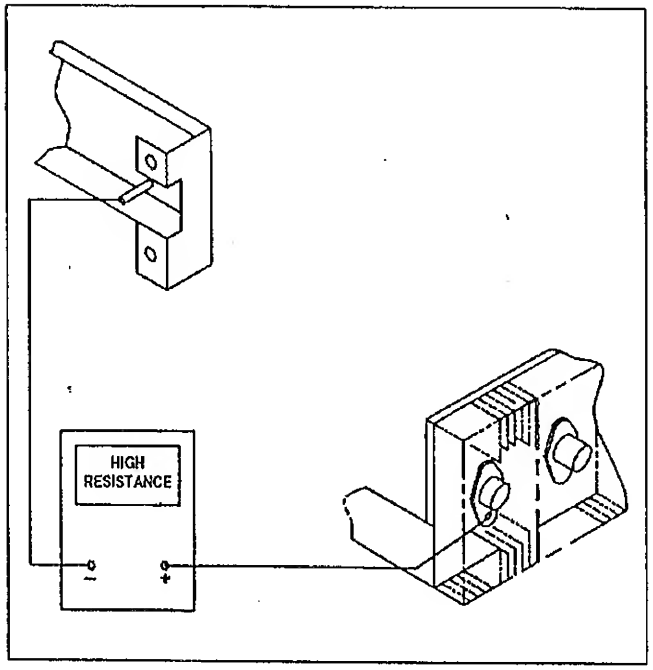
- Facing rear of casting with long needle nose plier, carefully install the Mosfet IC P/N 68001 onto 1st position of heat sink (left hand rear of casting). Use insulator P/N 09672 between devise and manifold.
- Install one Regulator P/N 03752 into 2nd position of casting heat sink. Use Insulator P/N 09672 between device and manifold.. Place cover P/N 09674 over device and attach using two screws P/N 03233 and two washers P/N 09874, which are provided with cover P/N 09674.
- Install two Regulator IC's P/N 03584 into 4th and 5th position of rear of casting heat sink. Use Insulator P/N 09672 between device and casting, place cover P/N 09674 over device and attach using two screws P/N 03233 and two washers which are provided with cover P/N 09674.

NOTE: 3rd position is empty. Perform installation test as per page XX, after each IC insulation.



■ IC REGULATORS INSULATION TEST:

- After installing IC regulator, check circuit for proper insulation. With Ohmmeter, check to insure that circuit reads open from screwhead securing IC regulator to ground lug on rear panel below power entry module.
- If Ohmmeter reads low resistance or short implement troubleshooting guide, before continuing with next step, power transformer (P/N 09756) installation.



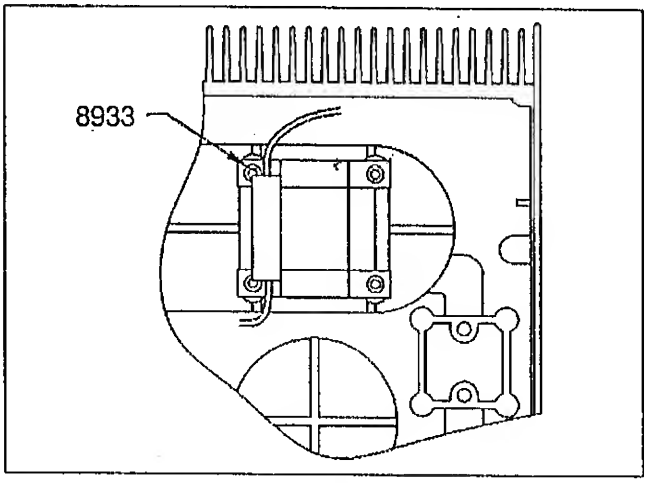
■ IC REGULATOR TROUBLESHOOTING CHECK

- Ohmmeter reads CLOSED instead of OPEN.
  - Cut in insulator (P/N 09672).
  - Misalignment of IC regulator socket into casting.
  - IC regulator not properly installed.

NOTE: If all checks correctly go to next step.

20) POWER TRANSFORMER P/N 09756:

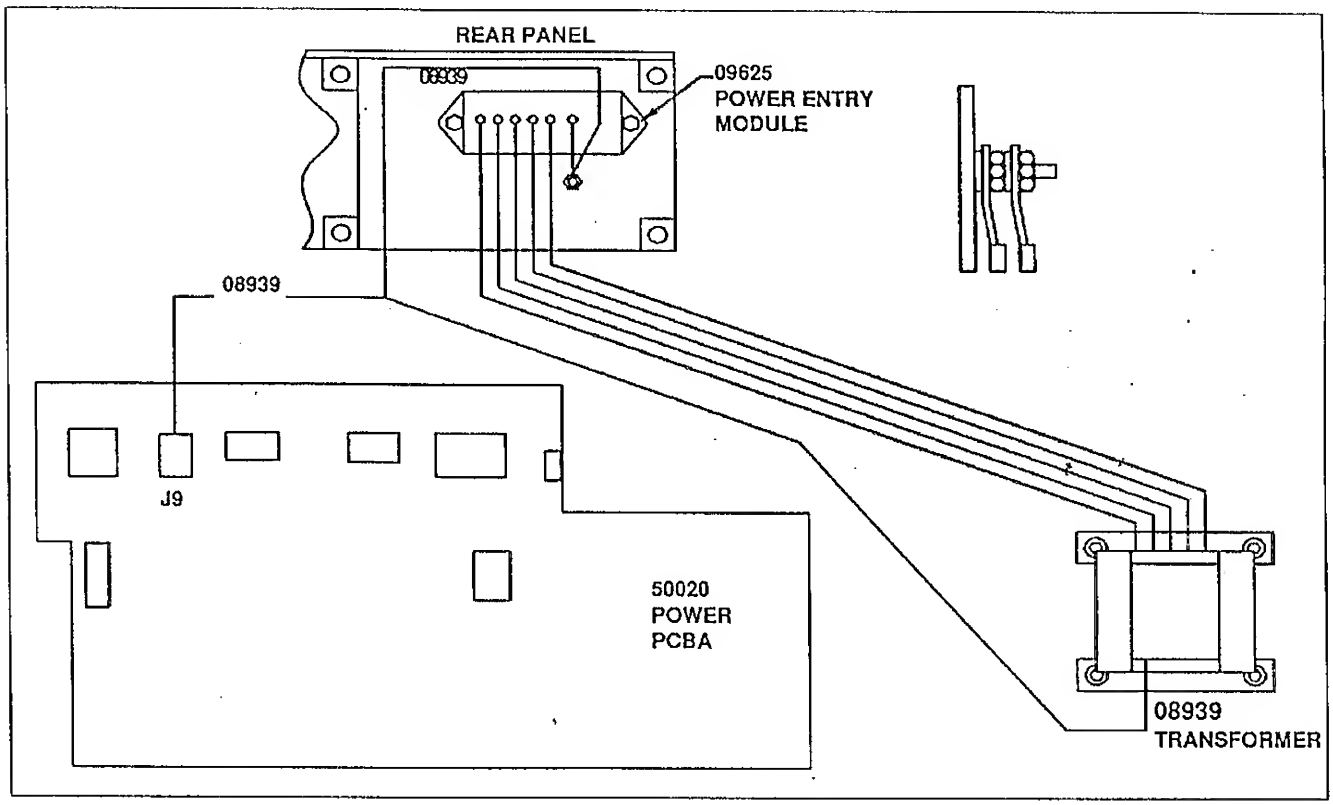
- With multicolored primary wires facing rear panel, position transformer into mounting pad on accumulator manifold.
- Install and secure 9/64" Allen screws (P/N 08833).



- Connect primary wire terminals from transformer to power entry module as follows:

Gray from transformer to F on power entry module
Yellow from transformer to E on power entry module
Violet from transformer to D on power entry module
Orange from transformer to A on power entry module
Red from transformer to C on power entry module

- Insall transformer green/yellow ground wire to the ground lug stud at inside of rear panel located below the power entry module. Install nut (P/N 01066) and secure with nutdriver.



NOTE: Make certain that ground wires do not touch transformer surfaces.

■ CONDUCTIVITY TEST:

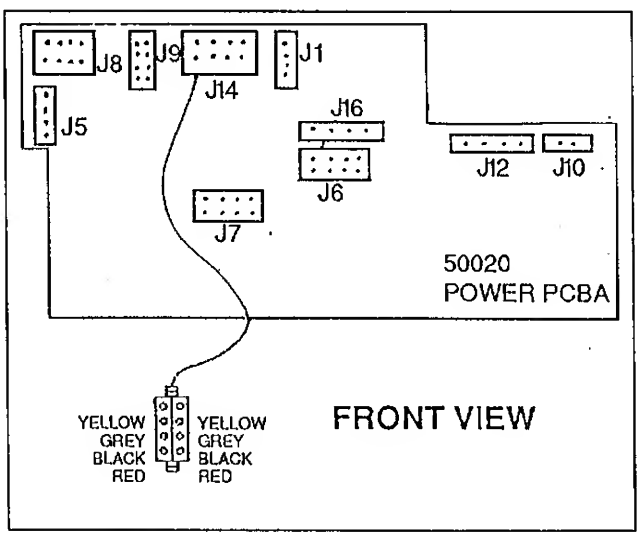
- With transformer installed and wires properly connected, connect Ohmmeter from ground to screwhead holding 5 Volt IC regulator Generic 323, Bird P/N 03752.
- Ohmmeter should read low resistance.

If problem persists:

- Recheck green yellow ground wire connections on rear panel and other end at middle pin of three pin connector.
- Check continuity of wire.
- If all is correct insert plugs into the IC covers (P/N 09674).

21) VERIFICATION POWER SUPPLY PC BOARD ASSEMBLY PROPER VOLTAGE OUTPUT:

- Insert 8 pin connector of Cable Assembly (P/N 03512) into J14 on Power Supply PC Board.
- Insert female end of power cord (P/N 09184) into power entry module and plug male end into proper AC Power Source.



- Set Main Power Switch to ON position.
- On the transformer 3 pin connector, measure two outer pins of the 3 pin connector of transformer, voltmeter should read 12-15 Volt AC. If not, check wiring to power entry module, if wiring is correct replace transformer. If transformer test outcome is good, plug 3 pin connector to J9 at Power Supply PC Board.
- Connect voltmeter to 8 pin socket of Power harness (P/N 03512) as follows and confirm the proper voltage outputs.
- Connect negative (-) from voltmeter to black lead on power harness.
- Positive lead (+) TO YELLOW = 14.7 to 20 VDC:

■ 14.7-20 VOLT DC FAULT CHECK:

- Double check all connections of J5, J8, J9.
- Check fuse in power entry module and fuse F1 on Power Supply PC Board.
- Check that AC/ALT Power Switch is on the AC LINE position.

■ 5 VOLT DC FAULT CHECK:

- Positive lead (+) TO RED = 5 VDC
- Check 5 Volt IC regulator socket for oversize connector.
- Replace 5 Volt IC regulator.
- Replace Power Supply PC board.
- Switch Main Power Switch OFF and remove power cord from ventilator and AC power supply source.

■ BRIDGE RECTIFIER P/N 03798 FAULT CHECK:

- Unplug J5 from Power Supply PC Board.
- With Ohmmeter, select lowest resistance range on Ohmmeter (diode check range preferable).
- Using an Ohmmeter, set selector knob to diode test range. Test bridge rectifier by connecting DMV red and black leads to bridge rectifier terminals as follows:

		RED 1	2	3	4
BLACK	1	-	>100 K	>100 K	>50
	2	>100 K	-	>100 K	>50
	3	<50	<50	-	<100
	4	>100 K	>100 K	>100 K	-

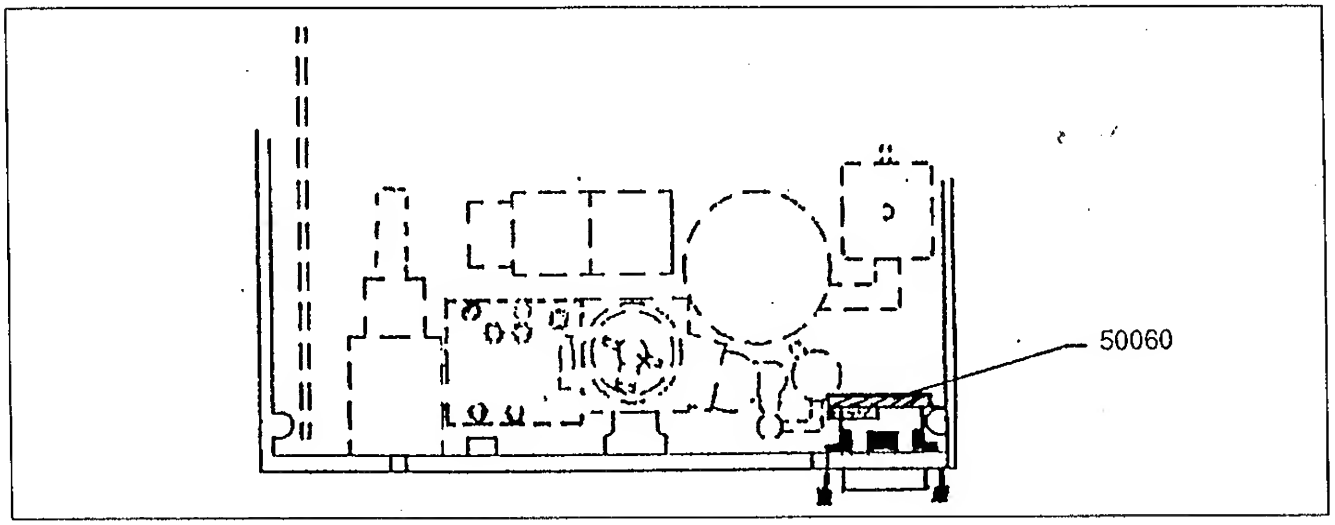
NOTE: Some multimeters may require red and black leads connected in reverse.

- Insert black lead in pin 3 and red lead to pin 1-2. Ohmmeter should read approximately 50 Ohms.
- Insert red lead in pin 3 and black lead to pin 1-2. Ohmmeter should read more than 100K.
- Insert exhalation valve cable connector into J6 and flow control valve cable connector into J7 on Power Supply PC Board.

22) FLOW SENSOR CONNECTOR / PCBA P/N 50060

Install flow sensor connector and PC board (P/N 50060) assembly into lower front of casting as shown and secure with four 3/32" Allen screws.

- Install new Orings P/N XXXXX inner/ outer.

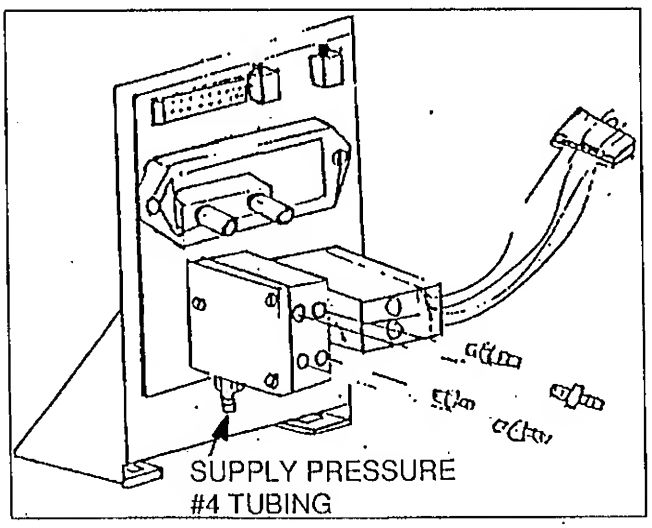


23) FLOW/VOLUME TRANSDUCER PCBA AND MANIFOLD ASSEMBLY P/N 50030

- Carefully remove flow/volume transducer PCBA from anti-static bag.

NOTE: If manifold and solenoids have been removed, reinstall manifold/solenoids onto transducer board at this time, using the two 7/64" Allen screws.

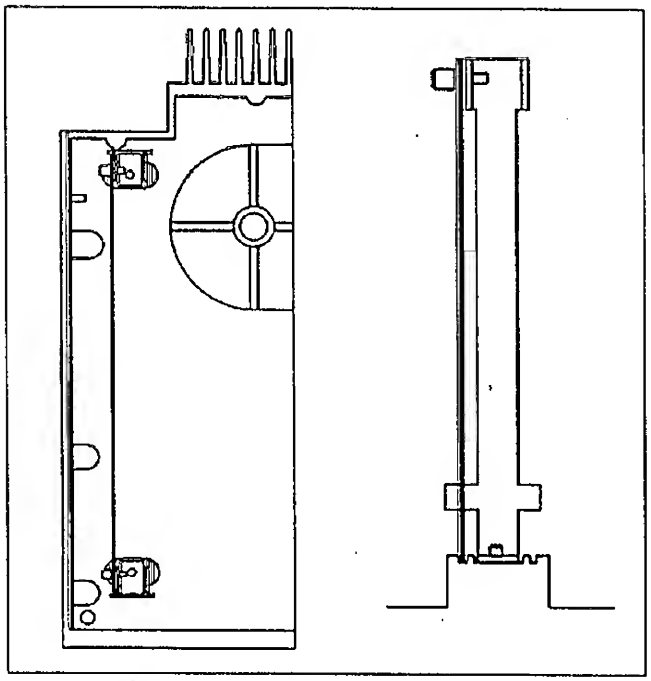
- Reconnect the 4 pin solenoid plug at J15 on the power supply PC board.
- Connect supply tubing from #4 tee connection to bottom fitting of flow transducer manifold. Slide the flow transducer mounting bracket under the two screws of the transformer and secure.
- Reconnect the short end of ribbon cable (P/N 15022) from the intermediate plug connection to J17 on the flow transducer PC board.
- Reconnect the intermediate plug to J17 on the flow sensor connector PC board (P/N 50060).



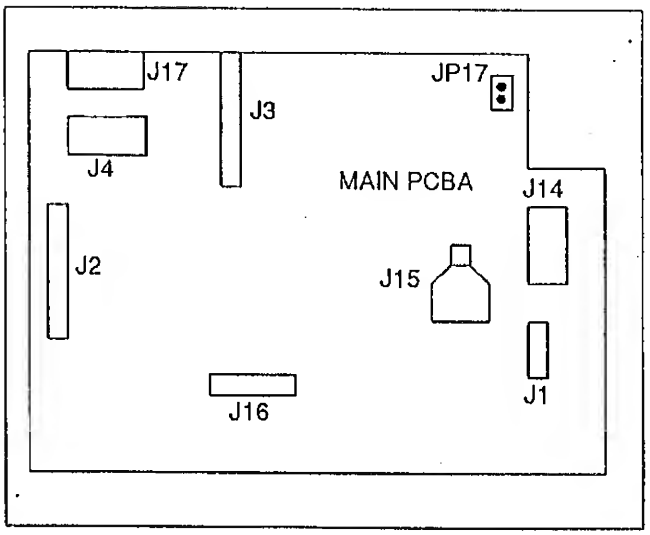
24) MAIN PCB ASSEMBLY P/N 09640

■ MAIN PCB ASSEMBLY BRACKETS P/N 09690:

- Install brackets into manifold base using 2 each Allen screws (P/N 03219). Position brackets on recesses vertically with a "U" shape inward and secure with Allen driver.



- Carefully remove Main PCB Assembly from anti-static bag.
- Position Main PC Board Assembly with components towards center of unit. Connect cables as outlined before securing board in place.
- Ribbon cable (P/N 71501) from Power Supply PC Board Assembly to J1 at Main PC Board Assembly.
- Ribbon cable (P/N 03512) 8 pin connector from Power Supply PC Board Assembly to J14 on Main PC Board Assembly.
- Ribbon cable (P/N 08938) from Transducer PC Board Assembly to J4 on Main PC Board Assembly.
- Install Fiber Optic Cable (P/N 09793) from rear panel to Socket J15 on Main PC Board Assembly.
- Ribbon cable (P/N 15025) from Power Supply PC Board to J16 on Main PC Board Assembly.
- Ribbon cable (P/N 15022) from Flow/ Volume Transducer Connector to J17 on Main PC Board Assembly.
- Connect the volume control alarm wires to JP17 on Main PC Board Assembly.
- Place Main PC Board Assembly in grooved slots in manifold base and attach to brackets with two Allen screws (P/N 03219) and secure with 7/64" Allen driver.

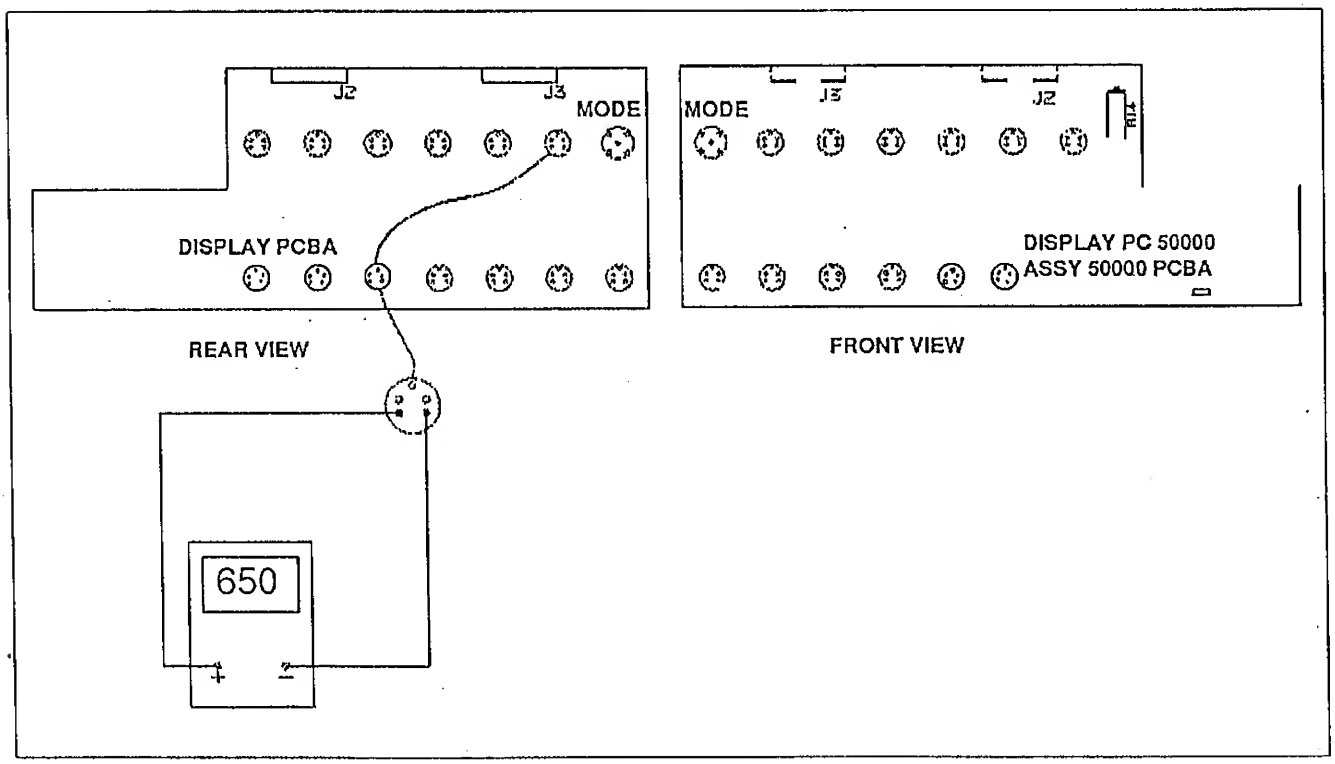


25) FRONT PANEL/DISPLAY PC BOARD ASSEMBLY P/N 50000:

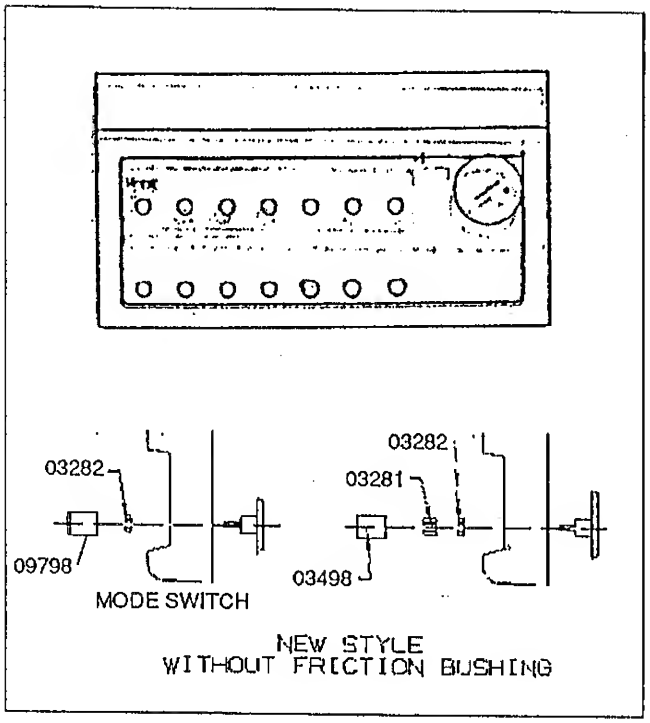
- Carefully remove Display PC Board Assembly front anti-static bag.
- Prior to installing Display PC Board Assembly to front panel housing, a resistance check of the potentiometers must be performed first.
- Plug cable assembly (P/N 09760) (long cable) into J2 and plug cable assembly (P/N 09759) (short cable) into J3 on Display PC Board.
- Connect Ohmmeter at locations on Display PC Board as shown in the figure below. Reading must be 650 OHMS.
- Readjust if necessary by turning trimpot at R40 location.
- Ensure that cables are connected to J2 and J3.
- If Ohm reading is still not correct, replace Display PC Board before continuing with the next step.
- Attach Display PC Board Assembly to rear of front panel housing.

NOTE: Make certain that there are no nuts or washers on pots before installation. Align and insert potentiometer shafts through holes in front panel. Facing rear side of Display PC Board Assembly panel, install three Allen screws (P/N 03219) using a 3/32" Allen wrench.

- Install one internal tooth washer and 11/32" nut on mode selector switch shaft, but do not tighten nut yet.
- Install 10 internal tooth washers and 10 friction bushings (P/N 09780) onto remaining potentiometer shafts. Tighten nut with a 11/32" nut wrench and friction bushings with a 3/8" nut wrench and torque evenly to 12 inch/ounce.
- Tighten nut on mode selector switch using a 5/16" nutdriver, install brackets as described.



NOTE: DO NOT over torque as Display Panel Overlay (P/N 80004 may get damaged (ripple).

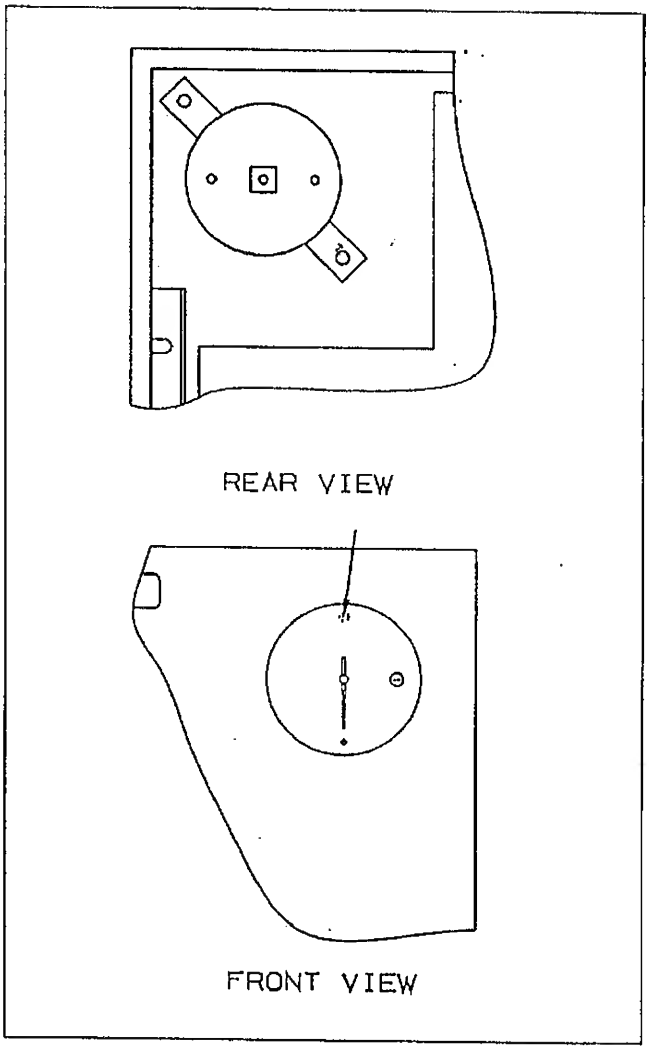


- Install eleven Control Knobs (P/N 9798) onto potentiometer and mode selector switch shaft.
- Verify that all control knobs rotate with a smooth functional feel.

26) PRESSURE MANOMETER ASSEMBLY P/N 09799:

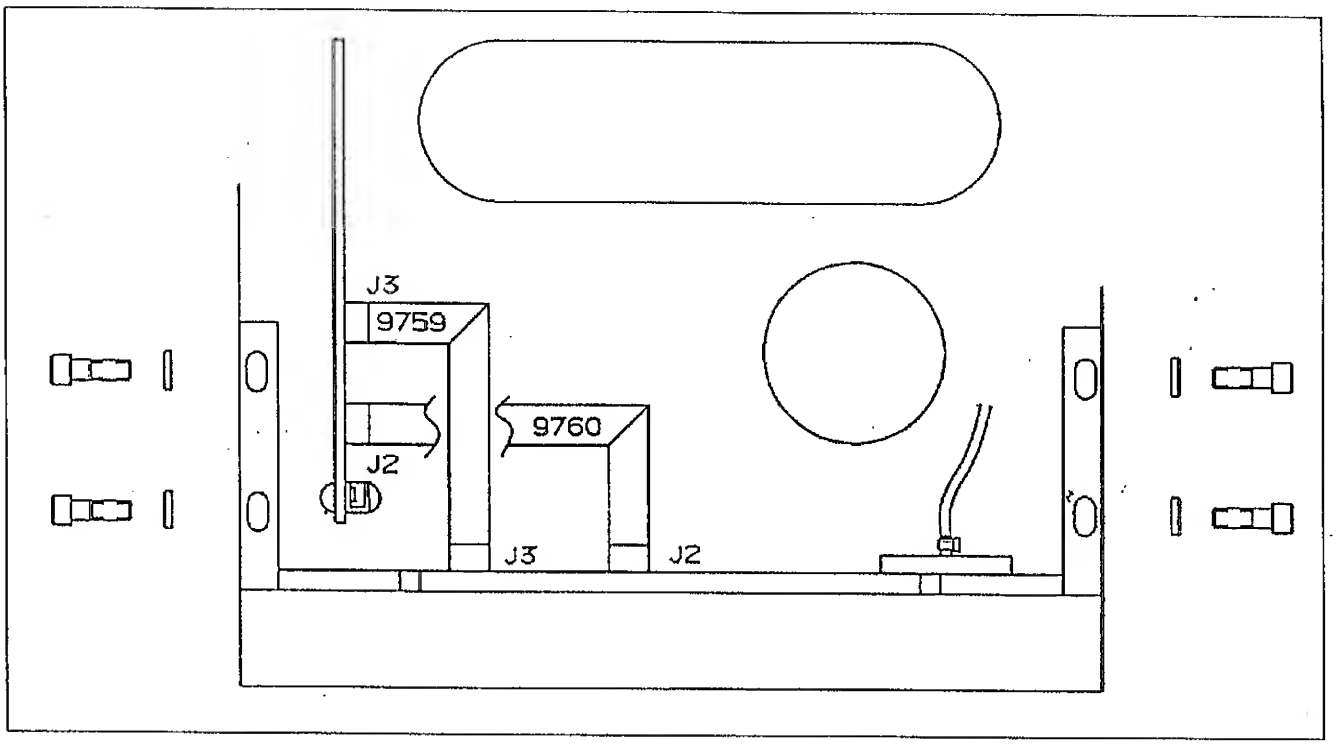
■ **Bezel lens P/N 09617 replacement:**

- Remove manometer and bracket installation, refer to Disassembly Section.
- Remove bezel and clean RTV sealant material from surface at inside of front panel.
- Clean new bezel lens.
- Place RTV sealing material on inside of front panel around hole openings.
- Install clean bezel lens flange against inside of rear panel and remove excess sealing material.



27 FRONT PANEL ASSEMBLY TO MANAFLOLD INSTALLATION P/N

- Position front panel on front of manifold base and align slots in bottom of panel brackets to align with screws (P/N 03219) in base.



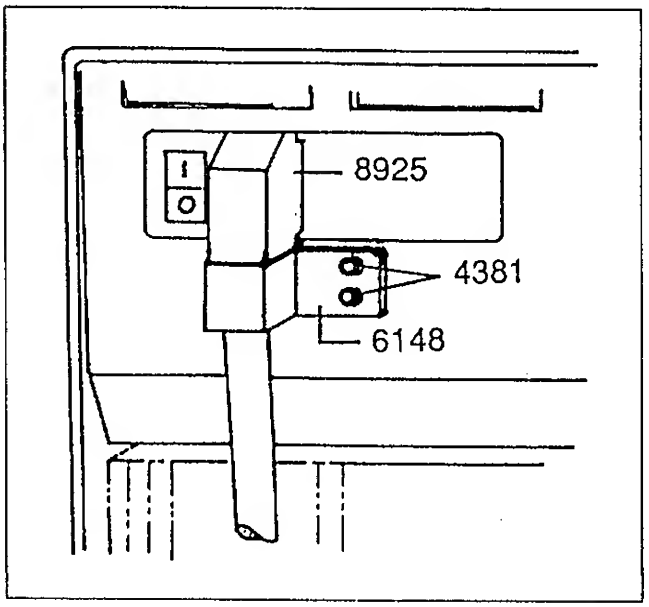
- Install 4 washers (P/N 08964) and 4 Allen screws (P/N 03323) through holes and secure screws with a 7/64" Allen driver.
- Connect remaining tube of tube assembly (P/N) to manometer and secure with cable tie wrap (P/N 07803).
- Plug long ribbon cable assembly (P/N 09760) from front panel assembly into Main PCB Assembly at location J2.
- Plug short ribbon cable assembly (P/N 09759) into Main PC Board assembly at J3 location.

28) POWER CORD ASSEMBLY
P/N 08925:

■ **On present units, proceed as follows:**

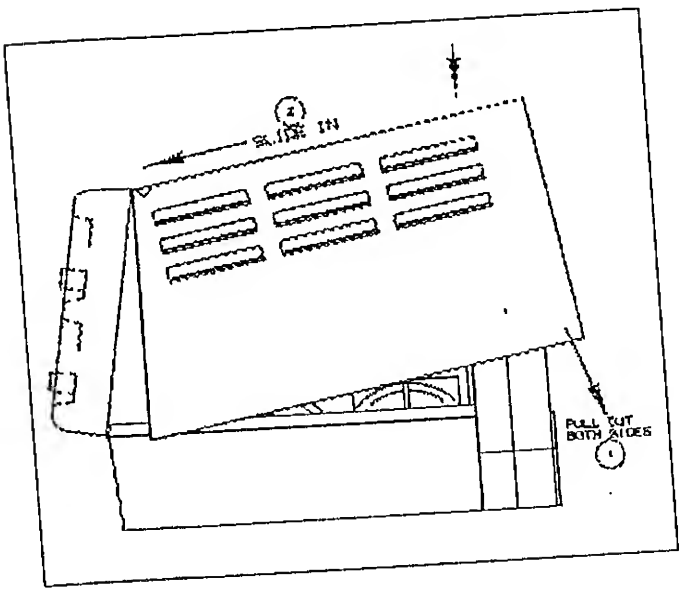
- Attach female end (angled connector) of Power Cord Assembly into 3 pin socket in power entry module located at left side of rear panel.
- Use clamp (P/N 06148) and secure power cord by inserting screws (P/N 04381) through holes in clamp and tightening into hole located in rear panel below power entry module.

NOTE: To secure old type Power Cord Assembly (P/N 09184), use old clamp (P/N 07158) or new clamp (P/N 06148).



29)) TOP COVER ASSEMBLY P/N 9698 INSTALLATION:

- At completion of operational verification procedure:
- Check and if necessary, replace moisture seal on top cover lip.
- To install top cover on manifold base, raise back of cover and slide panel forward to slip front lip under front panel housing.



- Lower cover down onto manifold base and secure using 9/64" Allen driver and two Allen screws (P/N 03222) with two washers (P/N 02159) inserted from under manifold base.

■ OPTION:

If on older ventilators, dustcover. (P/N 04874) is desired modify top cover before installation. (See dustcover configuration).

SECTION 13

Operational Verification Procedures

SECTION 13
8400ST OPERATIONAL VERIFICATION PROCEDURES

March 1992

This section is divided as follows:

1. Equipment required
2. Preparation
3. Operational Verification Procedures
4. Post Verification

A numbering system is utilized so that one can easily identify the steps involved with each major operation.

Complete each step in the sequence outlined to obtain the required calibration parameters.

If the required parameters are not met, refer to the troubleshooting instructions.

OPERATIONAL VERIFICATION PROCEDURES

PRE-CALIBRATION

Equipment required:

Stopwatch
Temperature Indicator, 50 - 120 degrees F (9.9 - 48.8 degrees C) range ± 2% accuracy
2 temperature probes
Standard test lung Required compliance 20 ml/cmH_2O ± 5%. A 5 gallon rigged container filled with 22 pounds (10 kg) of fine grade copperwool or equivelant
Endotracheal tube, 7mm, I.D. x 20 cm long, noncuffed with two 15mm OD adapters
3/32" Allen wrench, long shank
9/64" Allen wrench, long shank
Flowmeter 0 - 1 LPM in .1 LPM increments
Variable transformer 1 - 260 volt, 1 - 160 volt depending on local voltage
12 - 16 VDC power supply, 5 amp minimum
Digital 0 - 150 cm/H_2O pressure calibrated test manometer
Air/oxygen supply sources
Air/oxygen pressure regulators
Digital voltmeter
Anti-static mat covering worktable and grounded to earth
Anti-static wrist strap
Cable tie wrap tool, or it's equivalent
Slant Manometer 0 - 4 cmH_2O
P/N 00077 - Inline Pressure Manometer, 0 - 100 PSIG
P/N 00358 - 1/8" I.D. Tube Connector
P/N 01233 - 22mm male x 15mm female, 2 each
P/N 01741 - 4.5mm x 1/8" tubing connector or its equivalent
P/N 02187 - 22mm F x 22mm x 15mm F tee connection, 2 each
P/N 03010R - BHH Heating Module
P/N 03234 - Corona Dope
P/N 03389 - Test Harness
P/N 03800 - Hi/Low Flow MicroBlender
P/N 04124 - 7.5mm plug
P/N 08929 - Alternate Power Source (DC) Cable Assembly
P/N 09220 - 0 - 15 LPM Flowmeter
P/N 09520 - Blender Hose
P/N 09531 - 30" smooth corrugated hose and cuffs for installation between spirometer inlet and exhalation valve body check valve assembly
P/N 10172 - 8400ST Patient Breathing Circuit Kit (Autoclavable)
P/N 10233 - Prox/Purge Test Harness
P/N 10234 Flow Transducer Test Harness

■ VERIFICATION PROCEDURES

☐ Preparation:

1. Strap anti-static wrist strap around wrist.

2. Place ventilator on top of worktable. Table should be covered with grounded anti-static mat.

3. Install Exhalation Valve Diaphragm P/N 20117.

4. Install exhalation valve body (P/N 20005)

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

6. Open and adjust air pressure regulator and check for water contents in discharged air. Turn pressure regulator counterclockwise OFF, CLOSED.

7. Connect O_2 supply hose (P/N 00060) and air supply hose (P/N 02899) from their respective pressure regulators to their respective connection on the 3800 Hi/Low Flow MicroBlender.

8. Set O_2% concentration selection knob on 60%.

9. Attach elbow (P/N 00066) to side outlet of MicroBlender auxiliary flow outlet, secure using a $^{11}/_{16}$" open end wrench.

10. Install and secure 0-100 PSIG inline pressure manometer (P/N 00077) to elbow (P/N 00066) and tighten wingnut.

11. Connect one end of supply hose (P/N 09520) to inline pressure manometer, and other end to ventilator inlet filter fitting. Secure using $^{11}/_{16}$" open end wrench. Check that inlet filter drain valve is CLOSED.

12. Open and adjust both supply source pressure regulators to 50 PSIG (3.5 kg/ cm^2).

13. Make certain that flow control valve stepper motor dustcover is removed.

14. On ventilator rear panel, set power entry module ON/OFF switch in OFF position.

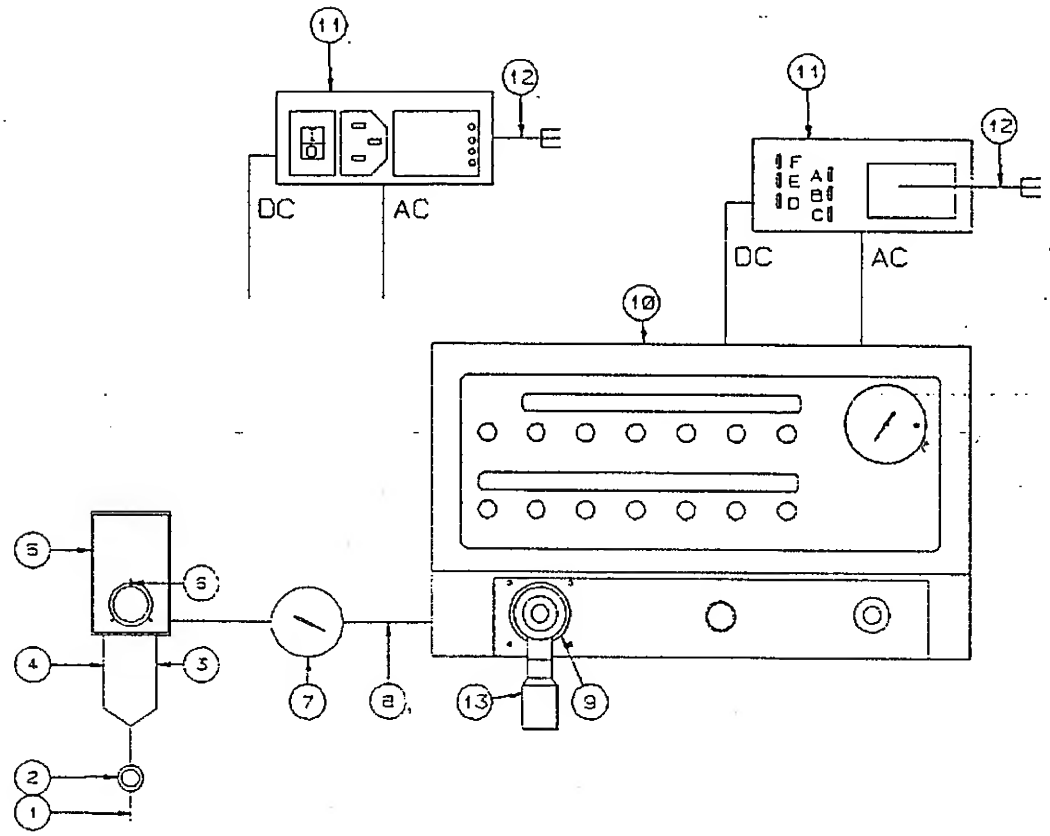
15. Insert electric power source cord into proper grounded, appropriate voltage.

16. Proceed by implementing "Operational Verification Procedures".

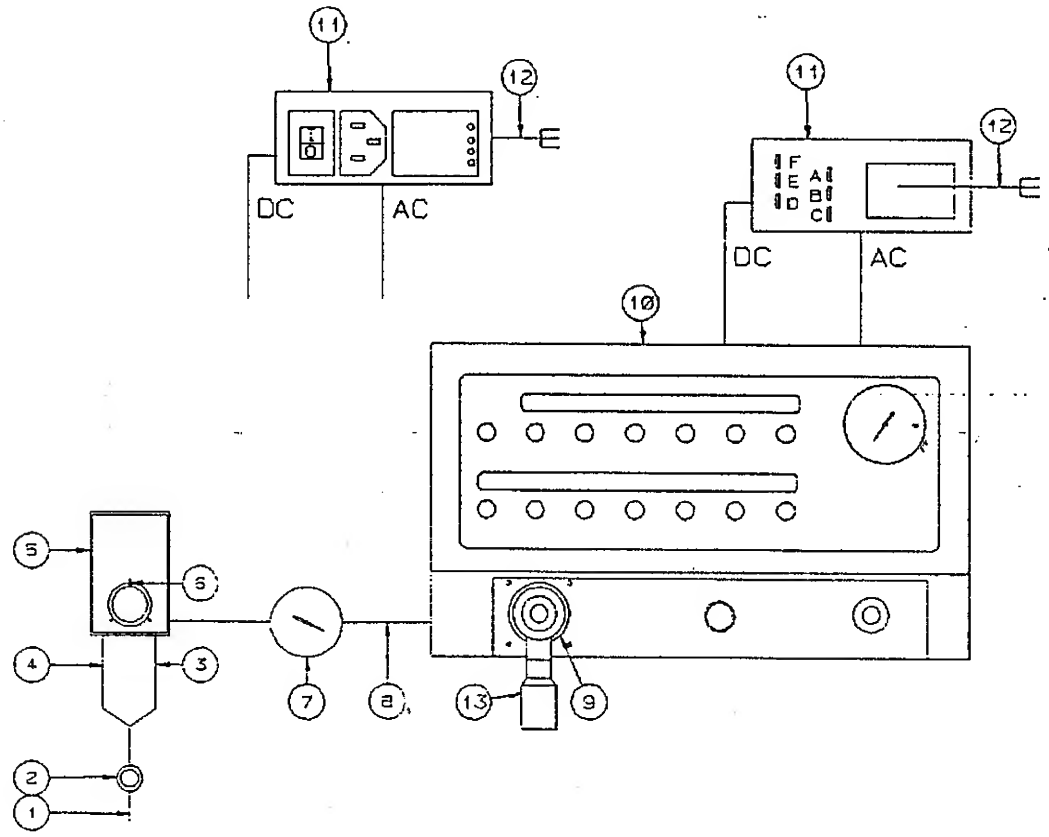
17. Adjust manometer dial to 0 cmH_2O.

18. Turn Purge Valve Stem (P/N 10180) full counterclockwise, full open.

NOTE: If Purge Valve (P/N 10180) has been removed and replaced, it must be turned counterclockwise, full open to prevent excess pressure in the manometer and purge system. Final calibration to follow.



1. Supply Source
2. 0 - 60 PSIG Pressure Regulator
3. P/N 02899, Air Hose
   P/N 00060, O_2 Pressure Hose
5. P/N 03800, MicroBlender
6. O_2 Control Knob 60%
7. P/N 00077, 0 - 100 PSIG Inline Pressure Manometer
8. P/N 09520, O_2 Pressure Hose
9. P/N 20107, Exhalation Valve Diaphragm Assembly
10. 8400ST Ventilator to Test
11. Power Supply Rear Panel
12. P/N 08925, Power Cord
13. P/N 20005, Exhalation Valve Body



1. Supply Source
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7. P/N 00077, 0 - 100 PSIG Inline Pressure Manometer
8. P/N 09520, O_2 Pressure Hose
9. P/N 20107, Exhalation Valve Diaphragm Assembly
10. 8400ST Ventilator to Test
11. Power Supply Rear Panel
12. P/N 08925, Power Cord
13. P/N 20005, Exhalation Valve Body

1.0 POWER UP VERIFICATION

1.1 This procedure can be conducted without any electrical accessories or test equipment attached to the ventilator; however, normal gas inlet pressure (50) PSIG, 3.4 kg/cm^2) and appropriate electrical voltage must be connected to the power entry module.

1.2 Verify that exhalation valve diaphragm and exhalation valve housing are properly installed. **NO BREATHING CIRCUIT IS REQUIRED AT THIS TIME.**

1.3 Before applying electrical power to the ventilator, confirm or readjust pressure regulator to read 20 PSIG on the test manometer. Refer to Section 12, item 9.0.

2.0 POWER UP

2.1 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.

After valve "HOMING", a series of dots will appear on the ventilator's monitor section display. Release the select button. All 7 segment LED displays must be off except for the monitor window display and Backup Breath Rate (BBR).

SOFTWARE REVISION VERIFICATION: The four-digit number, representing the Main PC Board software revision level, is displayed in the monitor window, Backup Breath Rate display (BBR) is number 1.

2.2 Activate the select button, (BBR) Display is number 2. A four-digit number representing the Power Supply PC Board software revision level will appear in the monitor window.

2.3 Activate the select button, (BBR) Display is number 3. A four-digit number representing the Display PC Board software revision level will appear in the monitor window.

2.4 Activate the select button, (BBR) Display is number 4. A four-digit number representing the PAL software revision level will appear in the monitor window.

NOTE: The select and manual breath buttons will allow for toggling the monitor display between all 4 pressure transducer readings, and the pressure transducer mode is identified by a number displayed in the backup breath rate window.

MODE:
- #5 THE FLOW PRESSURE
- #6 THE AIRWAY PRESSURE
- #7 THE MACHINE PRESSURE
- #8 THE SYSTEM PRESSURE

NOTE: When in Mode #5, depressing the manual breath button will activate the auto-zero function.

2.5 Activate the select button, (BBR) Display is number 6. The Airway Pressure will appear in the monitor window. Without the test lung connected, adjust R1 trim pot on Pressure Transducer PC Board to indicate 0.0 in the monitor window.

Airway pressure = 0.00 $\pm$ .2 cmH_2O

2.6 Activate the select button, (BBR) Display is number 7. The Machine Pressure will appear in the monitor window. Without the test lung connected, adjust R3 on Presure Transducer PC Board to indicate 0.0 in the monitor window.

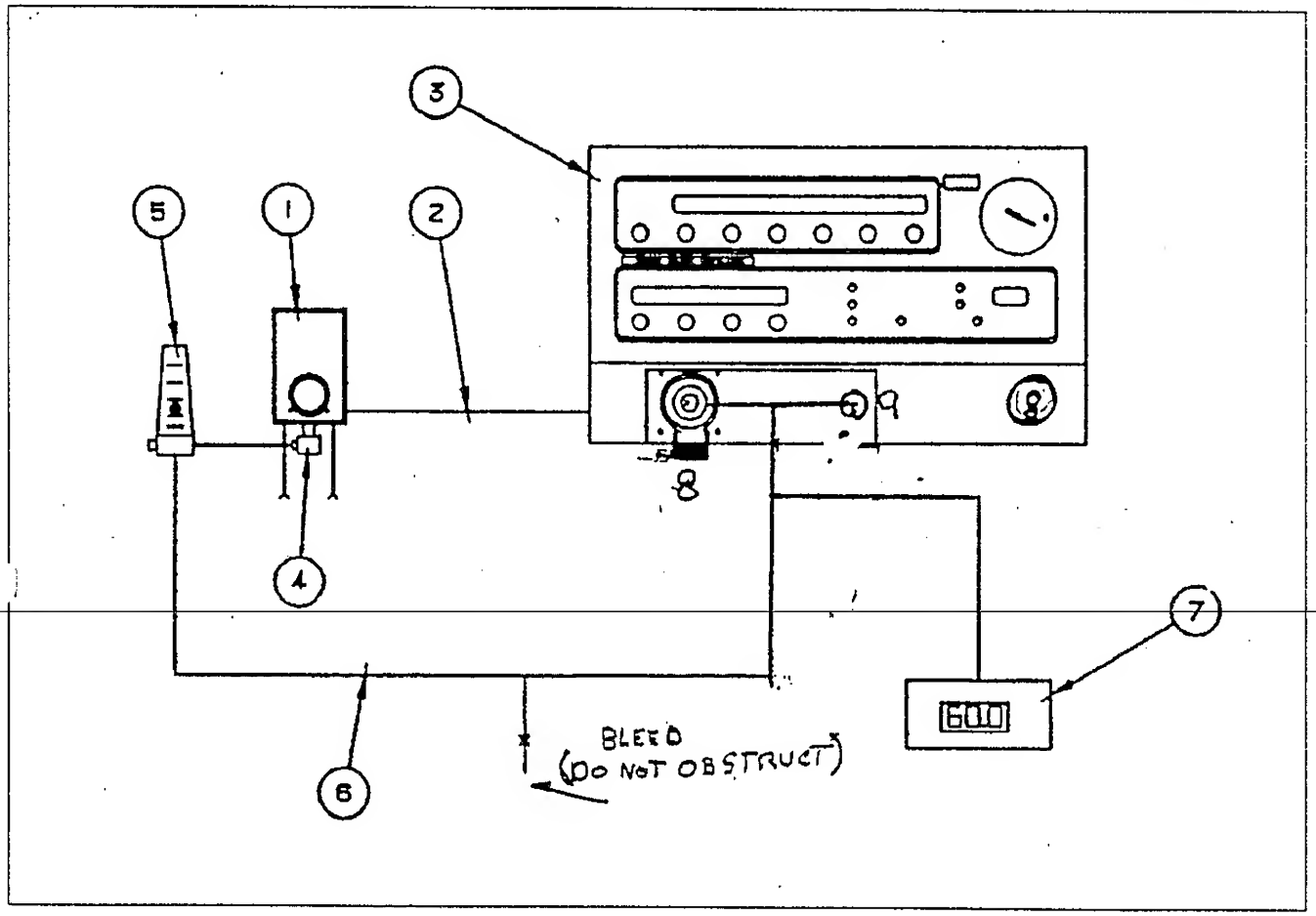
Machine Pressure = 0.00 $\pm$ 0.4 cmH_2O

Activate the select button, (BBR) Display is number 8. The System pressure will appear in th monitor window. Adjust R9 on the Pressure Transducer PC Board to indicate the System pressure as set/or recorded, to read in the monitor window.

System Pressure = 20.0 ± 0.3 PSIG

Using the Transducer Pressure Test Harness (P/N 03389) and Prox Purge Test Housing (P/N 10233), connect the tubing from th pressure source to the Exhalation Valve inlet and Patient Outlet of the 8400ST and the Digital Master Manometeer 0 - 140 cmH_2O. Adjust the flowmeter for 60 + 0.25 cmH_2O.

CAUTION: DO NOT occlude the Transducer Pressure Test Harness, P/N 03389, bleed orifice, as this will cause over-pressure damage to the transducers and manometer system.



1. P/N 03800, MicroBlender, set to 60% at 50 PSIG
2. P/N 09520, Pressure Hose
3. P/N 015020, Unit under test, 8400ST Ventilator
4. P/N 00066, Elbow
5. P/N 09220, Flowmeter
6. P/N 03389, Transducer Pressure Test Harness
7. Digital Master Manometer (0 - 140 cmH_2O) or equivelent
8. P/N 10233, Prox Purge Test Housing
9. Patient Outlet Manifold

- Machine pressure = 60.00 ± 1.4 cmH_2O

Press Manual Breath Button to reverse back to BBR - 7, set R4 (Machine Pressure Gain Adjustment) on the Pressure Transducer PC Board to read 60.00 in the Monitor Display.

- Proximal Pressure = 60.00 + 1.4 cmH_2O

Press Manual Breath Button to BBR - 61, set R2 (Airway Pressure Gain) to 60.0 in the Monitor Display. Remove the test harness

3.0 FLOW TRANSDUCER, P/N 50030, VERIFICATION

3.1 Activate the Manual Breath button until the Backup Breath Rate (BBR) displays "5". This is the flow transducer off set reading. It should read 103 ± 50 in the monitor window.

IF THE FLOW TRANSDUCER OFF SET IS OUT OF SPECIFICATION, READJUST AS FOLLOWS:

a) Adjust the trim pot R2 on the Flow Volume PC Board assembly to read 103 + 10 as displayed in the monitor window.
b) Push the manual breath button to perform the Auto-Zero function.

4.0 FLOW TRANSDUCER TEST HARNESS. P/N 10234

4.1 Connect the Flow Transducer Test Harness (P/N 10234) to the flow transducer receptacle and apply 1.5 ± 0.10 cmH_2O pressure to center tube of the test harness.

(Slant tube manometer is not part of the harness.)

IF THE FLOW TRANSDUCER GAIN NEEDS ADJUSTMENT OR CALIBRATION, PROCEED AS FOLLOWS:

a) Adjust R6 of the Flow Transducer PC Board so that 1.5 ± 0.20 cmH_2O is displayed in the monitor window, as indicated on a slant tube manometer.
b) Remove the slant tube manometer.

5.0 FLOW TRANSDUCER PURGE

5.1 While in BBR #5, with both tubes tied together and connected to flowmeter, measure the purge flow while pressing the Manual Breath button.

Flow Range: 5 - 9 LPM

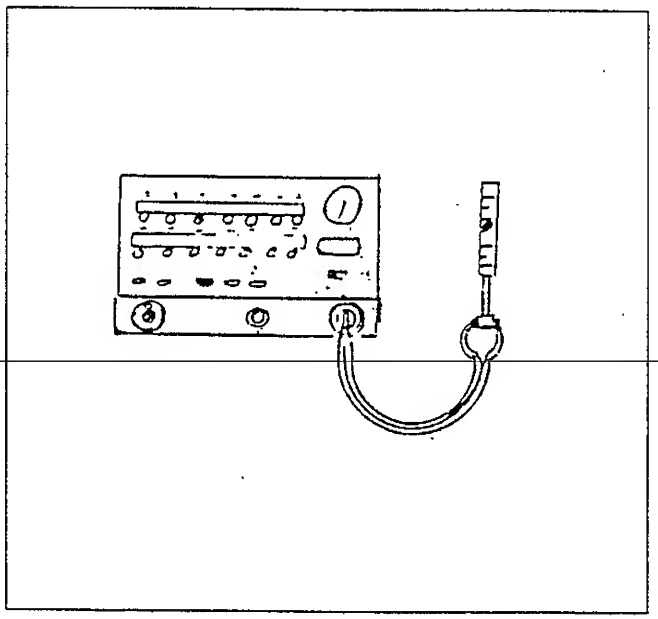


Fig. 5.1

5.2 Remove the test harness.

6.0 AIRWAY PURGE AND FLOW VERIFICATION

6.1 With the exhalation valve housing removed, occlude the airway pressure port at 12 o'clock position and adjust the Purge Valve, P/N 10180 valve stem for the pressure manometer to read 100 $cmH_2O \pm 5$.

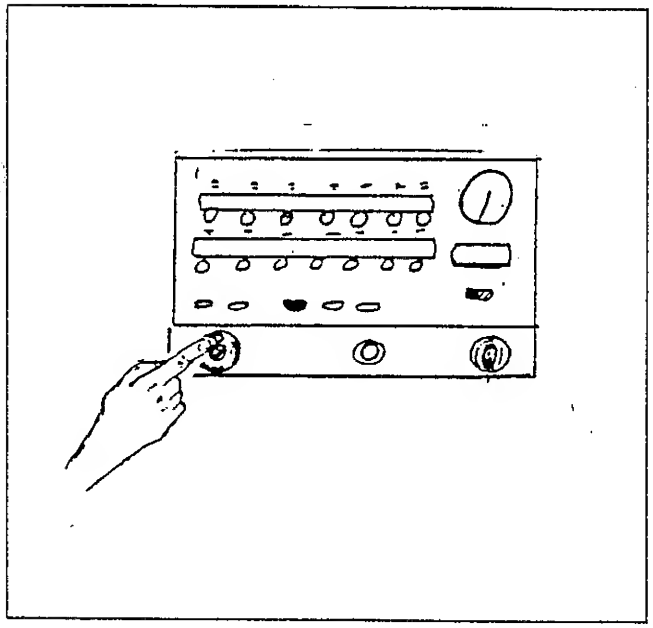


Fig. 6.0

NOTE: If the Airway Pressure Purge flow adjustment takes more than 10 seconds, the purge flow will stop. Remove occlusion momentarily to allow the purge flow to restart and complete 100 cmH_2O adjustment.

6.2 Apply VIBRA-TITE, (P/N 03884) between the purge valve stem and the valve body to maintain calibration setting.

6.3 Install the Prox/Purge Test Housing (P/N 10233) and diaphragm, to the exhalation valve receptacle. Connect the tubing from the inlet of the test housing to the flowmeter and measure the purge flow. Flow must be 0.05 to 0.1 LPM.

6.4 Remove Prox/Purge Test Housing and tubing from the ventilator. Reinstall standard exhalation valve housing.

7.0 DISPLAY TEST

7.1 Activate the Select button 4 times. Verify that all seven segment displays and the associated decimals illuminate. All point source LED's must also illuminate except for Vent Inop and Battery.

8.0 WATCH DOG VENT-INOP VERIFICATION

8.1 While pressing in and holding the Silence and Reset buttons, momentarily press and release the Select button. The unit's Vent Inop Visual and audible alarm must activate. Fault code "250" must appear in the monitor display. Turn the ventilator power switch off and then on. The ventilator should function normally.

9.0 CONTROL RANGE VERIFICATION

9.1 Connect Flow Transducer Assembly (P/N 10081R) and press Reset button. Rotate TIDAL Volume Control fully clockwise. Operate all remaining controls through their entire range to verify MIN/MAX endpoints according to the following charge.

NOTE: OFF* = Blinking "OFF".

CONTROL	MIN	MAX
Peak Flow	10	120
Breath Rate	0	80
PEEP/CPAP	0	
Sensitivity	1	OFF
Pressure Support	OFF 50	
High Pressure Limit	1	140
Low Peak Pressure	OFF*	140
Low PEEP/CPAP Pressure	-20	30
Low Minute Volume	,0	60.0
High Breath Rate	3	150
Apnea Interval	10	60

NOTE: Set PEEP/CPAP Control on 0.

9.2 Set Breath Rate control to 0, Peak Flow to 12 and rotate Tidal Volume and Backup Breath Rate through entire range.

CONTROL	MIN	MAX
Tidal Volume	50	2000
Backup Breath Rate	0	80

9.3 Disconnect Flow Transducer Assembly.

9.4 Set Mode Control switch between waveform positions and verify that "four corner" rotating display occurs in monitor window and audible alarm is activated. Return waveform switch to A/C Squarewave mode and verify that visual and audible alarm cancels.

10.0 MANUAL BREATH

10.1 Set the ventilator controls to standard condition (See below). Press the Manual Breath button. One pressure breath must be delivered.

11.0 STANDARD CONTROL SETTINGS

With the ventilator configured in accordance with the previous paragraph, turn power switch to ON and set controls as follows:

MODE:	**AC**	**HIGH PRESSURE LIMIT:**	**140**
WAVEFORM	**(SQUARE)**	**LOW PEAK PRESSURE:**	**OFF**
TIDAL VOLUME:	**800**	**LOW PEEP/CPAP:**	**-20**
PEAK FLOW:	**40**	**LOW MINUTE VOLUME:**	**7.0**
BREATH RATE:	**10**	**HIGH BREATH RATE:**	**150**
PEEP/CPAP:	**5**	**APNEA INTERVAL:**	**60**
SENSITIVITY:	**OFF**	**BACKUP BREATH RATE:**	**0**
PRESSURE SUPPORT:	**OFF**		

Controls should remain in these positions unless specific instructions are given to change. When an instruction: RETURN TO STANDARD SETTINGS" is given, place all controls to the settings shown above.

0 STANDARD VENTILATOR CONFIGURATION FOR TESTING

12.1 The ventilator must be configured with the patient circuit and ventilator accessories as shown in figure. This configuration must be used for all verification tests in the following paragraphs, except as specifically noted. Verify gas inlet pressure are set to 50 ± 5 PSIG (3.4 + kg/cm2), the power line voltage and frequencies are appropriate for the unit under test (check rating table).

a) PATIENT CIRCUIT P/N 10172

P/N 03210, 03210C, Heating Module, no water, water feed hole plugged.

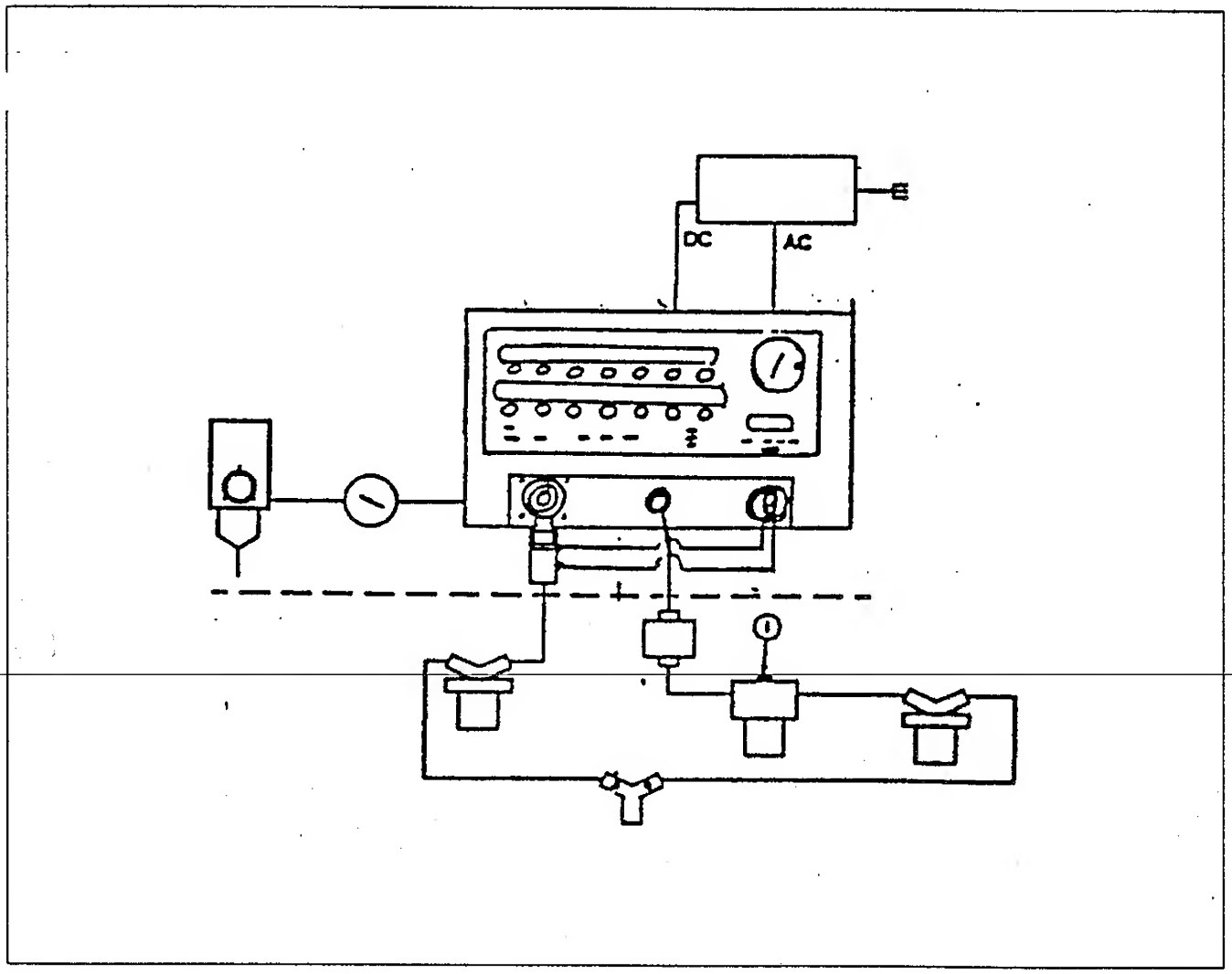


Fig. 12.0

13.0 CONTROL FUNCTIONS

Connect the test lung and spirometer to the ventilator as shown in the figure below.

NOTE: Incorporate the following items with the exception of No. 1 into the Patient Breathing Circuit (P/N 10172).

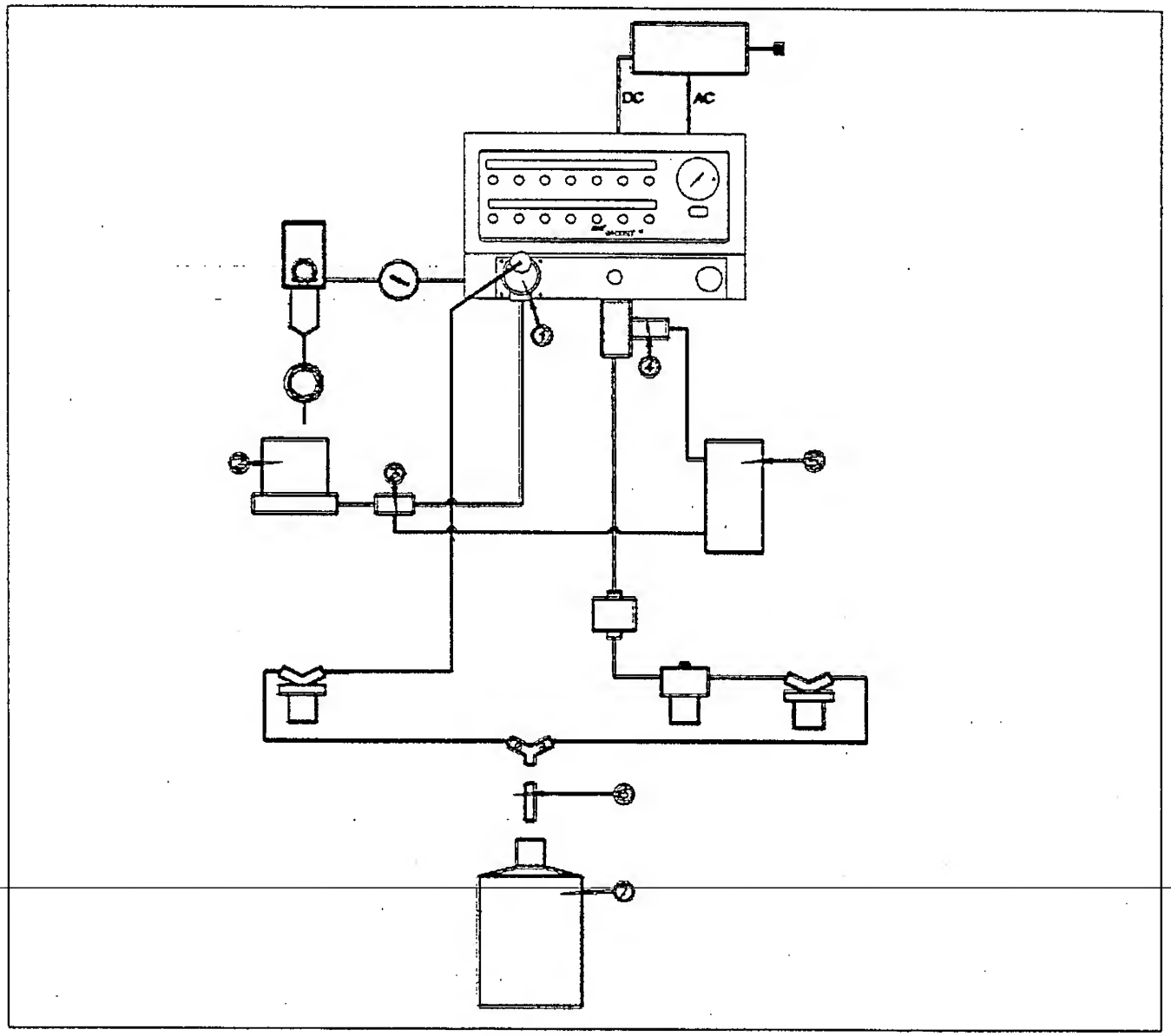


Fig. 13.0

1. Hose connection between exhalation valve body assembly and spirometer inlet.
2. 8 liter volume spirometer ±2% accuracy, or its equivalent.
3. Temperature probe connection connected to volume spirometer inlet. (Tmeas)
4. Temperature probe connection to patient outlet assembly. (Tact)
5. Temperature indicator, 50° - 120°F range (10° - 49°C).
6. Endotracheal tube 7.0 mm I.D. x 20 cm long.
7. Standard test lung.
   - 5 gallon (19 liters) glass container.
   - Rigid compliance chamber, C=20 ml/ cmH_2O +/- 5% filled with 22 lbs. (10 Kg) of fine grade copper wool.
8. Volume Transducer Harness.

.0 TIDAL VOLUME VERIFICATION

14.1 Turn digital thermometer ON.

14.2 Complete Circuit Pressure Test (see section 14, item 10)

14.3 Adjust the following controls:

Mode Selector	A/C
Waveform	Square
Tidal Volume	800
Peak Flow	20
Breath Rate	5
PEEP/CPAP	0
Low PEEP/CPAP	-20

14.4 Turn digital thermometer ON.

14.5 Let ventilator warm up for 15 minutes.

14.6 Set spirometer recording pen on 0 line of recording paper on drum.

14.7 Between the end of expiratory and the beginning of the next inspiration, connect the hose from the outlet of exhalation valve body to the inlet of the spirometer.

14.8 Connect 5 consecutive breaths in spirometer while noting the peak valves of the outlet air temperature of the ventilator (Tact) and the air temperature of the spirometer (Tmeas). Disconnect the spirometer immediately after the 5th breath to avoid collecting additional proximal purge flow.

14.9 Compute calibrated volume (Vcal) per the following equation:

$$Vcal = (Vmeas - .08 \times \frac{(558)}{(Tmes = 460)} \quad \frac{(Tact = 460)}{(558)})$$

Vcal must be 4.0 liters ± 10%

- Set WAVEFORM to ⎍ and repeat test.
- Set FLOW to 60 LPM and repeat test.
- Set WAVEFORM to ⎍ and repeat test.
- Set FLOW to 120 LPM and repeat test.
- Set WAVEFORM to ⎍ and repeat test.

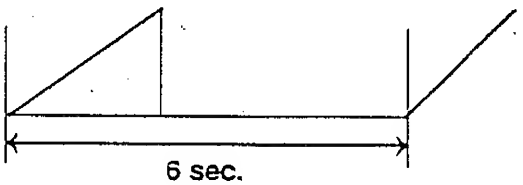
RETURN TO STANDARD CONTROL SETTINGS (Page 13-9, 11.0)

15.0 BREATH RATE

15.1 Set rate to 10.

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

15.3 Verify that the breath interval is 6 ± 0.2 seconds. This corresponds to 10 ± 0.3 breaths per minute.



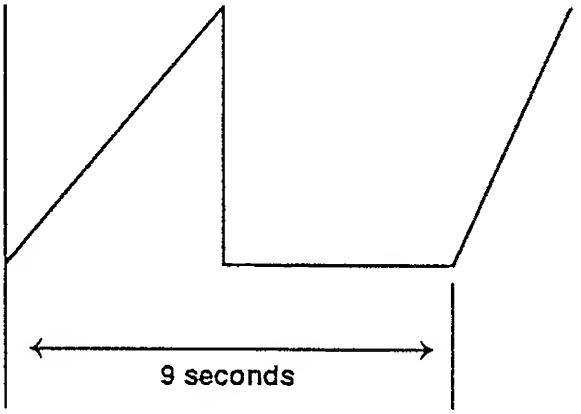
16.0 SIGH

16.1 Activate SIGH and note SIGH indicator light.

16.2 With the stopwatch, time the interval from the beginning of inspiration to the

beginning of the next inspiration. Verify that the time interval is 9 ± 0.2 seconds.

16.3 Depress the SIGH button (OFF). Verify that indicator light is OFF.



17.0 INSPIRATORY HOLD PERIOD

17.1 Push in and hold Inspiratory Hold button while actuating Manual breath button.

17.2 The Inspiratory Hold time, which is the time from end of inspiration to beginning of expiration, must be 6.0 ± 0.2 seconds.

18.0 PEEP/CPAP/SENSITIVITY

- Set MODE selector to SIMV/CPAP.
- Set WAVEFORM to ⎍ (square).
- Set BREATH RATE to 0.
- Set SENSITIVITY to 1.
- Set PEEP/CPAP to 15.
- Verify PEEP reading on test gauge is 15 ± 2 cmH_2O.
- Set PEEP to 30 cmH_2O. Verify gauge reads 30 ± cmH_2O.

19.0 APENA/SILENCE/RESET

19.1 Set the ventilator controls to Standard Settings except SIMV/CPAP Square, Breath Rate 0, PEEP/CPAP 15, SENSITIVITY 1, LOW MINUTE VOLUME 1.0, APENA INTERVAL control = 10. Activate the Manual Breath button. With the stopwatch, measure the elapsed time between the button activation and audible and visual Apena alarm. The time must be 10 + 1 seconds. Visual Apena alarm includes flashing "AP" in Apena Interval display window.

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

19.3 Activate the Manual Breath button 3 times and the audible alarm must cancel. Activate the Reset button and the visual alarm must cancel.

20.0 HIGH PEEK PRESSURE ALARM

20.1 Remove Flow Transducer assembly from ventilator.

20.2 Set HIGH PRESSURE LIMIT to 60.

20.3 Occlude (block) exhalation valve outlet.

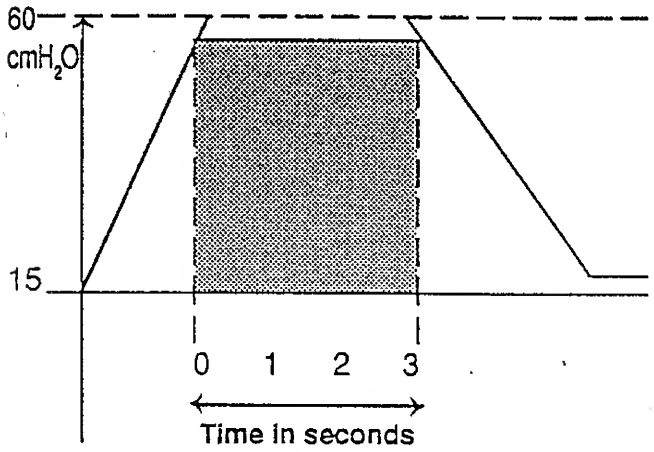
20.4 Activate Manual Breath and verify that high pressure limit audible and visual (flashing) alarms occurs at 60 ± 6 cmH_2O.

20.5 Measure the time from the initiation of the alarm to the initiation of the safety valve dump. The opening of safety valve is noted by the fast decay of

gauge pressure, a "rushing air" sound, and flashing "CIRC" indication in the MONITORS display window. This time should be less than 1 second.

20.6 Verify that the gauge pressure drops from 60 within 3 cmH_2O of PEEP within 1 second.

HIGH PEAK PRESSURE LIMIT



20.7 Remove blockage from exhalation valve outlet, verify that audible alarm cancels.

20.8 Press Reset and verify "CIRC" cancels and that high pressure limit display stops flashing.

RETURN TO STANDARD CONTROL SETTING. (Page 13-9, 11.0)

21.0 LOW PEAK PRESSURE ALARM.

21.1 Note the valve of the peak pressure on proximal airway pressure gauge during the inspiratory cycle of the ventilator.

21.2 Between machine breaths, increase A LOW PEAK PRESSURE limit unit it is five (5) cmH_2O above the noted peak pressure.

21.3 Verify audible and visual (flashing) alarms.

21.4 Between machine breaths, decrease LOW PEAK PRESSURE limit to OFF and note audible alarm cancels and OFF flashes.

22.0 LOW PEEP/CPAP PRESSURE ALARMS

22.1 Set LOW PEEP/CPAP PRESSURE to +7 cmH_2O.

22.2 Verify audible and visual (flashing) alarms activation).

22.3 Set LOW PEEP/CPAP PRESSURE to -20 cmH_2O.

22.4 Verify audible alarm cancels.

22.5 Press RESET.

22.6 Verify visual alarm cancels

22.7 Press RESET.

22.8 Verify visual (flashing) alarm cancels.

RETURN TO STANDARD CONTROL SETTING. (Page 13-9, 11.0)

23.0 LOW MINUTE VOLUME ALARM.

23.1 Set LOW MINUTE VOLUME control to 8.5. The LOW MINUTE VOLUME audible and visual alarm must immediately activate. Return control to 7.0 and press RESET.

24.0 HIGH BREATH RATE ALARM.

24.1 Set HIGH BREATH RATE control to 3. The HIGH BREATH RATE audible and visual alarm must immediately activate. Return control to 150 and press RESET.

25.0 LOW INLET GAS PRESSURE ALARM.

25.1 Reduce inlet pressure to 30 PSIG on inline pressure gauge.

25.2 Set TIDAL VOLUME to 1500.

25.3 Set PEAK FLOW to 120.

25.4 Verify activation of audible and visual LOW INLET GAS alarms dating inspiration.

25.5 Set inlet gas pressure to 50 PSIG.

25.6 Verify audible alarm cancels.

25.7 Press RESET. Verify cancellation of visual alarm.

26.0 ELECTRICAL POWER DISRUPTION.

26.1 Remove electrical power from ventilator.

26.2 Verify audible and visual VENT INOP alarms; also verify safety valve opens, flow control valve closes, ad exhalation valve opens.

26.3 Verify ventilator return to normal operation (after power-up, self-test sequence) and VENT INOP alarm cancel.

27.0 LOSS OF GAS SUPPLY

27.1 Remove gas supply pressure.

27.2 Verify audible and visual VENT INOP alarms activate, and all other displays extinguish.

27.3 Restore gas supply pressure.

27.4 Verify ventilator returns to normal operation (after power-up, self-test sequence) and VENT INOP alarm cancels.

28.00 "CIRC" ALARM VERIFICATION

28.1 Remove the Exhalation Valve Body and block the Airway Pressure Port at 12:00 o'clock position. An audible and visual alarm must activate and "CIRC" must be displayed in the ventilator monitor display.

28.2 Reconnect the Exhalation Valve Body to the ventilator and press the RESET button. The ventilator must return to normal operation.

RETURN TO STANDARD CONTROL SETTINGS. (Page 13-9. 11.0)

29.0 ELECTRICAL SYSTEMS VERIFICATION

■ **Equipment Required:**

- 0-160 VAC or 0-280 VAC uncalibration variac.
- Multimeter D.V.M. (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 ventilator ON/OFF switch to ON.
- Proceed as per 13.9.1 Electric Power Tolerance AC Test.

29.1 Electrical Power Tolerance (AC Power) AC Test. AC Voltage Range Operation.

a) Set ventilator input power to low end of specified voltage range as follows:

For 100 volt units .....85 volts
For 120 volt units .....102 volts
For 220 volt units .....187 volts
For 240 volt units .....204 volts

b) Verify unit operates normally for 5 machine breaths.

29.2 Adjust Variac to high end of specific voltage range as follows:

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

a) Verify unit operates normally for 5 machine breaths.
b) Set input power to "brown out" voltage as follows:

For 100 volt units.....70 volts
For 120 volt units.....85 volts
For 220 volt units.....154 volts
For 240 volt units.....168 volts

c) Verify that ventilator at least briefly shows VENT INOP alarm (audible and visual) activation followed by an attempt to power up and restart.

29.3 Reset input power to normal voltage and verify return to normal operation.

a) Set ventilator ON/OFF switch to OFF, remove power cord from Variac and silence VENT INOP audible alarm.

29.4 Electrical Power Tolerance (DC Power)

■ **Equipment Required:**

- DC Power Supply Source, 12-16 volts, 5 amps (minimum).
- Digital multimeter.
- P/N 08929 Power Source Cable Assembly.

■ **Equipment Setup:**

- Insert ALT POWER ACCESSORY POWER CABLE connector to socket in rear panel and DC Power Supply source fitting.

29.5 Set AC LINE/ALT PWR AC/DC switch to ALT PWR position.

a) Apply 12 volts DC to ALT PWR SOURCE connector.
b) Verify normal operation and illumination of front panel battery indicator green lamp.

29.6 Increase Voltage from 12 to 16 Volts.

a) Verify normal operation for at least 5 breaths.
b) Disconnect DC Power Connection.

29.7 Set AC LINE/ALT Power Switch from ALT PWR (DC) AC/DC mode position to AC LINE position.

a) Insert ventilator cord into proper grounded voltage receptacle.
b) Ventilator should return to normal operation after the initial start up.
c) Set AC/DC switch to AC Line.
d) Disconnect DC power.

29.8 Ground Continuity

a) Measure ground continuity between power cord ground plug and sockethead cap screws on bottom of unit.
b) Verify ground resistance is less than 0.1 ohms.

29.9 Leakage Current

a) Check for maximum leakage current by comparing normal and reversed connections in both open/ closed ground conditions.
b) Verify leakage current under all conditions is less than 100 micro amps.

30.0 TOP COVER P/N 09698 ASSEMBLY

30.1 Install dustcover (P/N 08930) on top of flow control valve body.

30.2 Install, position tie wrap cable (P/N 05038) around valve body and dustcover. Cut off and discard excess length of tie wrap cable.

30.3 Position top cover on manifold base.

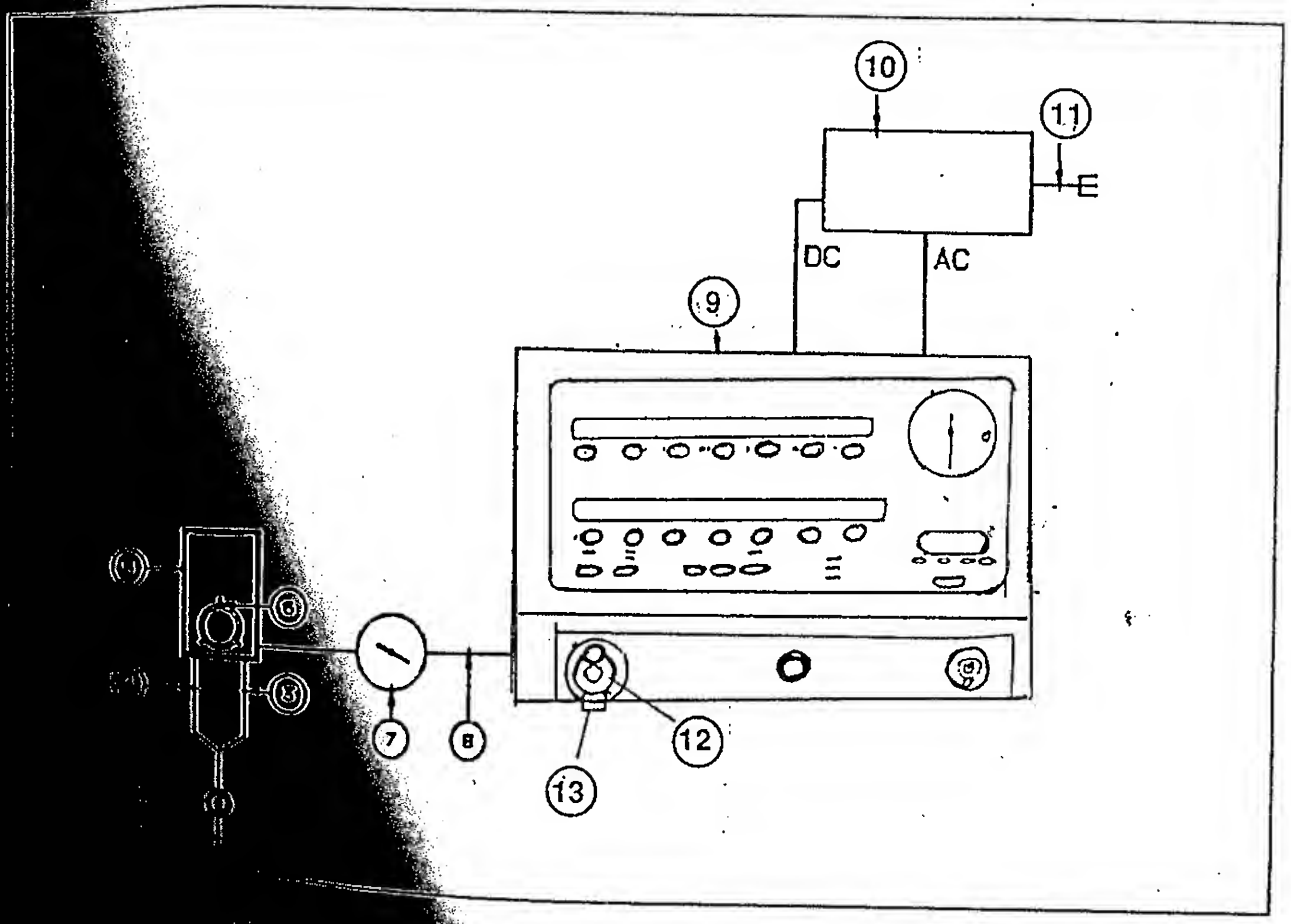
30.4 Raise back of cover 1 to 1 ½" upwards and rear area of slide panels outward.

30.5 Slide panel forward to slip front lip under front panel housing.

30.6 Lower rear end of top cover down on base.

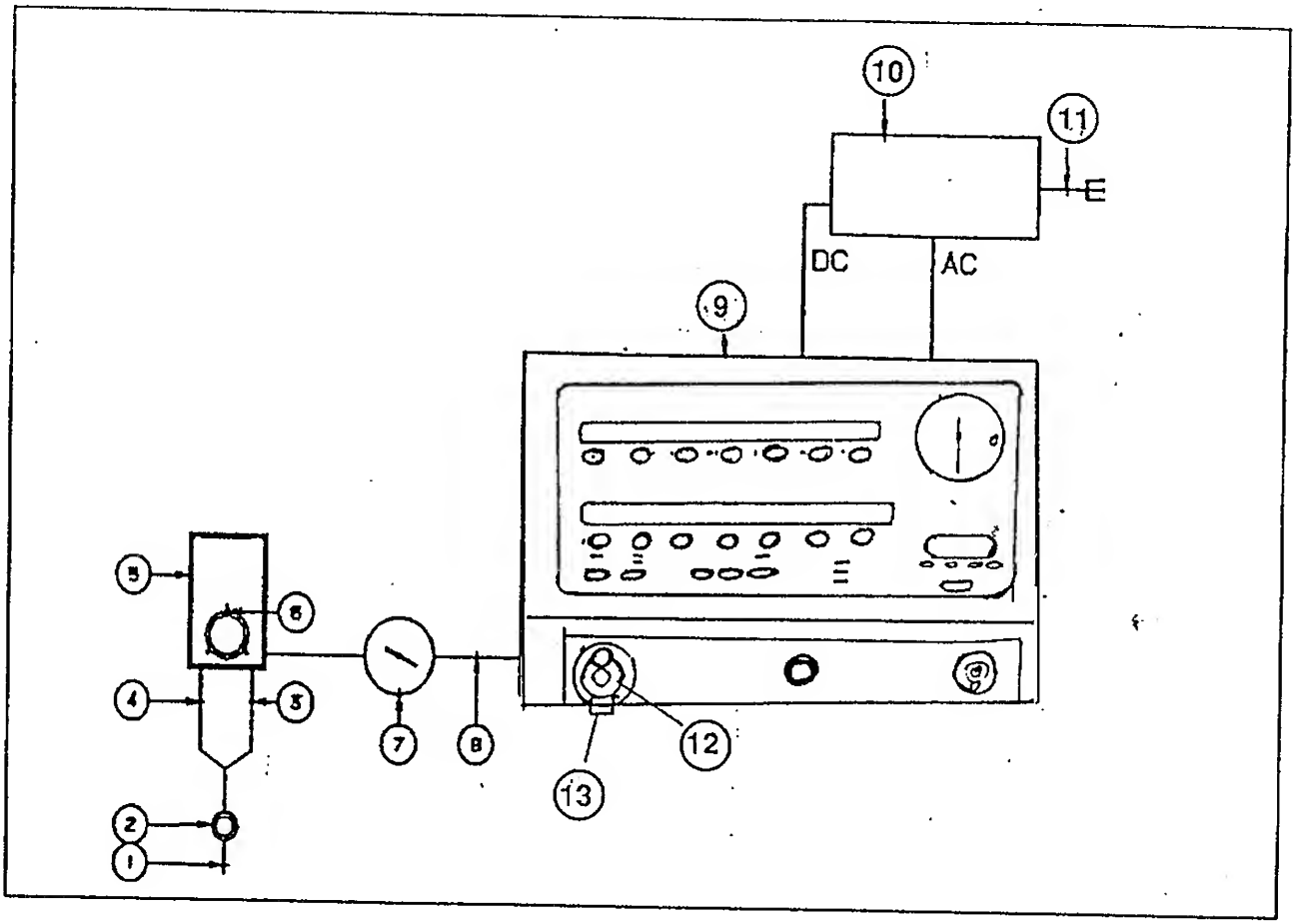
30.7 From below of manifold base, insert screws (P/N 03222) with starwashers (P/N 02159) through manifold into top cover ad secure using 9/64" Allen driver.

30.8 Clean external surfaces of ventilator with an appropriate bacterial or germicidal agent. CAUTION, refer to Section 7, Cleaning ad Sterilization.



Source
Pressure Regulator
Air Hose
O2 Pressure Hose
Knob 60
Electro Blender
100 PSIG Inline Pressure Manometer
Pressure Hose
Flow to Test
Front Panel
Power Cord
Inspiration Valve Diaphragm Assembly
Inspiration Valve Body

OPERATIONAL VERIFICATION PROCEDURES



1. Supply Source
2. 0-60 PSIG Pressure Regulator
3. P/N 02899, Air Hose
4. P/N 00060, 02 Pressure Hose
5. 02 Control Knob 60
6. P/N 03800, MicroBlender
7. P/N 00077, 0-100 PSIG Inline Pressure Manometer
8. P/N 09520, 02 Pressure Hose
9. 8400ST Ventilator to Test
10. Power Supply Rear Panel
11. P/N 08925, Power Cord
12. P/N xxxxx, Exhalation Valve Diaphragm Assembly
13. P/N xxxxx, Exhalation Valve Body

13.0 OPERATIONAL VERIFICATION AND CALIBRATION PROCEDURE

13.1.0 Before turning on the power to the ventilator, check, and or set, pressure regulator output to 20 PSI. Pressure can be measured at pressure measurement P/N 00576 fitting, or by removing flow valve and using the special fitting at the flow delivery port. Set pressure to 20 $\pm$ 0.25 PSI.

13.2.1 Power Up Verification.

This procedure can be conducted without any external accessories or test equipment attached to the ventilator. However, normal gas inlet pressure and appropriate power voltage must be connected to the power entry module. Refer to figure.

13.2.2 Verify that exhalation valve diaphragm and exhalation valve housing are properly installed.

13.2.3 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.

After valve "Homing", a series of dots will appear on the ventilator's monitor section display. Release the select button. All 7 segment LED displays must be off except for the monitor window and Backup Breath Rate (BBR). Verify that the controls rotate with a smooth, firm feel.

13.3.0 Software Revision Verification

13.3.1 A four-digit number, representing the main board software revision level, is displayed in the monitor window, Backup Breath Rate Display (BBR) is number 1.

13.3.2 Activate the select button. (BBR) Display is number 2. A four-digit number representing the power board software revision level will appear in the monitor window.

Activate the Select button. BBR - 3. A four-digit number representing the display software revision level will appear in the monitor window.

Activate the Select button. BBR - 4. A four-digit number representing the PAL software revision level will appear in the monitor window.

Pressure Transducer Zero & 20 PSI Calibration

Activate the Select button twice. BBR - 6. The Airway Pressure will appear in the monitor window. Without test lung connected, adjust R1 on Pressure Transducer Board to indicate 0.0 in monitor window.

Airway Pressure = 0.00 $\pm$ 0.2 cmH_2O

Activate the Select button. BBR - 7. The Machine Pressure will appear in the monitor window. Without test lung connected, adjust R3 on Pressure Transducer Board to indicate 0.0 in monitor window.

Machine Pressure = 0.00 $\pm$ 0.4 cmH_2O

Using the Transducer Pressure Test Harness, P/N xxxxx, connect the tubing from the pressure source to the Exhalation Valve inlet and Patient Outlet of the 8400ST and the Digital Master Manometer 0-140 cmH_2O. Set the low pressure source for 60 $\pm$ 0.25 cmH_2O.

With BBR - 6 (press Manual Breath Button if necessary) set R2 (Airway Pressure Gain) to 60.0 on Monitor display.

Proximal Pressure = 60.00 $\pm$ 1.4 cmH_2O

With BBR - 7 (press select button) set R4 (Machine Pressure Gain Adjustment) on the Transducer Board to read 60.0 on the Monitor display. Remove test harness.

Machine Pressure = 60.00 $\pm$ 1.4 cmH_2O

Activate the Select Button. BBR - 8. The System Pressure will appear in the monitor window. Adjust R5 on Pressure Transducer Board to indicate the System Pressure as set/or recorded, as viewed in monitor window.

System Pressure = 20.0 $\pm$ 0.2 PSIG.

Manometer and Purge Calibration

Without expiratory limb of patient circuit connected to the exhalation valve input, adjust the manometer to 0 $\pm$ 1 cmH_2O.

Remove the Exhalation Valve Body and occlude the Airway Pressure port at 12:00 o'clock and adjust, if necessary, P/N 02756A valve so the manometer reads 100 $\pm$ 5 cmH_2O. CIRC displayed.

Apply Corona Dope, P/N 003234, between rotating and stationary parts of P/N 02756A valve to maintain calibration setting.

The select and manual breath button will allow for toggling the monitor display between all 4 pressure readings, and the pressure mode is identified by a number displayed in the backup breath rate window.

MODE:

#5 THE FLOW PRESSURE
#6 THE AIRWAY PRESSURE
#7 THE MACHINE PRESSURE
#8 THE SYSTEM PRESSURE

Actuate the Select or Manual button until Backup Breath Rate displays "5".

With the flow transducer TEST APPARATUS disconnected, push the manual breath button to perform auto-zero function.

Press the Select button to toggle the system to the next monitor (6) state, then press the Manual button to return to the flow pressure monitor state. (5) Readjust R2 to read 103 ± 10 on the monitor display. 0-19

Push the Manual breath button to perform the Auto-Zero function.

Connect flow transducer test apparatus to flow transducer receptacle and apply 4.00 ± 0.10 cmH_2O differential pressure of center tube.

Adjust R6 of flow transducer board so that 4000 ± -.20 is displayed in the Monitor window as displayed on a master manometer. (RT 200 or better)

Remove the test apparatus and press the Manual breath button to perform the Auto-Zero function.

Measure Flow Transducer Purge

Toggle with BBR #5. Connect the Flow Transducer pressure Test Harness, P/N xxxxx, to the flow transducer receptacle on the front of the ventilator. With both tubes teed together, measure the purge flow from the tee outlet while pressing the Manual breath button. Flow Range: 5 - 9 lpm.

Disconnect Pressure Test Harness.

Measure Airway Pressure Purge Flow

Connect Exhalation Valve Body with blocked outlet port, (GAS TIGHT) to exhalation valve receptacle. Connect tubing from inlet of Exhalation Valve to flow meter and measure purge flow. Flow must be 0.05 to 0.1 lpm. Remove Exhalation Valve Housing with blocked port and tubing from Ventilator. Reinstall standard exhalation valve housing.

Display Test

Activate the Select button 4 times. Verify that all seven segment displays and the associated decimals illuminate. All point source LEDs must also illuminate except for Vent. Inop and Battery.

Watch Dog Vent. Inop. Verification

While pressing in and hold the Silence and Rest buttons, momentarily press and release the Select button. The unit's Vent Inop visual and audible alarm must activate. Fault Code "250" must appear in Monitor Display. Turn ventilator power switch off and then on. Ventilator should function normally.

Control Range Verification

Connect Flow Transducer and press Reset button. Rotate TIDAL VOLUME Control fully clockwise. Operate all remaining controls through their entire range to verify MIN/MAX endpoints according to the following charge.

NOTE: OFF * = Blinking "OFF".

CONTROL	MIN	MAX
PEAK FLOW	10	120
BREATH RATE	0	80
PEEP/CPAP	0	30
SENSITIVITY	1	OFF
PRESSURE SUPPORT	OFF	50
HIGH PRESSURE LIMIT	1	140
LOW PEAK PRESSURE	OFF *	140
LOW PEEP/CPAP PRESSURE	-20	30
LOW MINUTE VOLUME	.0	60.0
HIGH BREATH RATE	3	150
APNEA INTERVAL	10	60

NOTE: SET PEEP/CPAP CONTROL ON 0.

Set BREATH RATE Control to 0, PEAK FLOW to 10 and rotate TIDAL VOLUME and BACKUP BREATH RATE through entire range.

CONTROL	MIN	MAX
TIDAL VOLUME	50	2000
BACKUP BREATH RATE	0	80

Disconnect Flow Transducer Assembly.

Set Mode Control switch between waveform positions and verify that "four corner" rotating display occurs in monitor window and audible alarm is activated. Return waveform switch to A/C Squarewave mode and verify that visual and audible alarm cancels.

Manual Breath

Set the ventilator controls to standard condition (see page xx). Press the Manual Breath button. One pressure breath must be delivered.

STANDARD CONTROL SETTINGS

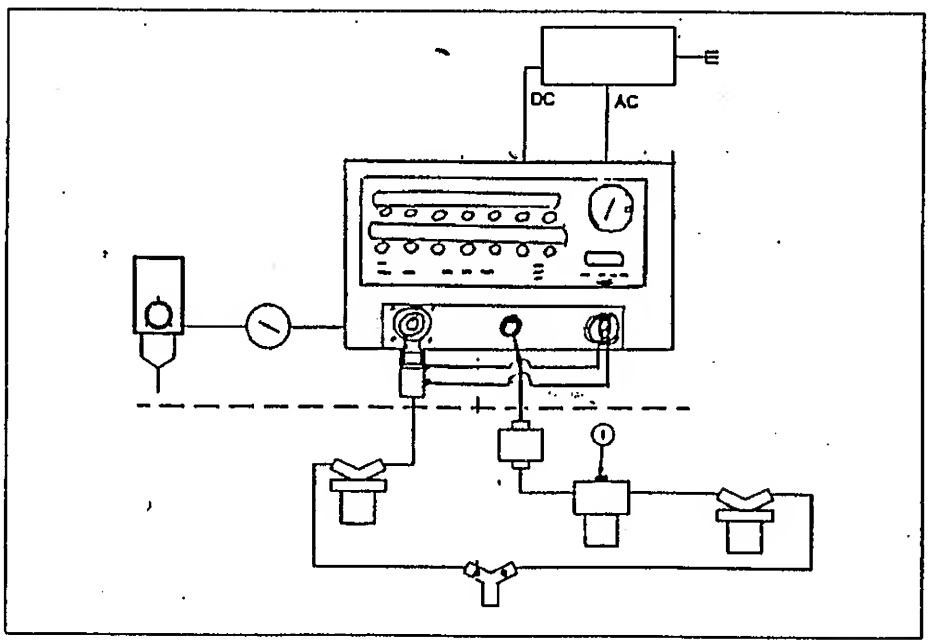
With the ventilator configured in accordance with the previous paragraph, turn power switch to ON and set controls as follows.

MODE:	AC	HIGH PRESSURE LIMIT:	140
WAVEFORM:	(SQUARE)	LOW PEAK PRESSURE:	OFF
TIDAL VOLUME:	800	LOW PEEP/CPAP:	-20
PEAK FLOW:	40	LOW MINUTE VOLUME:	7.0
BREATH RATE:	10	HIGH BREATH RATE:	150
PEEP/CPAP:	5	APNEA INTERVAL:	60
SENSITIVITY:	OFF	BACKUP BREATH RATE:	0
PRESSURE SUPPORT:	OFF		

Controls should remain in these position unless specific instructions are given to change. When an instruction: "RETURN TO STANDARD SETTINGS" is given, place all controls to the settings shown above.

STANDARD VENTILATOR CONFIGURATION FOR TESTING

The ventilator must be configured with the patient circuit and ventilator accessories as shown in figure. This configuration must be used for all verification tests in the following paragraphs, except as specifically noted. Verify gas inlet pressure are set to 50 ± 5 PSIG. (3.4 ± Kg/cm2), the power line voltage and frequencies are appropriate for the unit under test (check rating table).



PATIENT CIRCUIT P/N 10172

1. P/N 03210, 03210C, Heating Module, no water, water feed hole plugged.

CONTROL FUNCTIONS

Connect the test lung and spirometer to the ventilator as shown in figure, page xx.

NOTE: Incorporate the following items with the exception of No.1 into the Patient Breathing Circuit (P/N 10172).

1. Hose connection between exhalation valve body assembly and spirometer inlet.

2. 8 liter volume spirometer ± 2% accuracy, or its equivalent.

3. Temperature probe connection connected to volume spirometer inlet. (Tmeas)

4. Temperature probe connection connected to patient outlet assembly. (Tact)

5. Temperature indicator, 50^{o} - $120^{o}F$ range (10^{o} - $49^{o}C$).

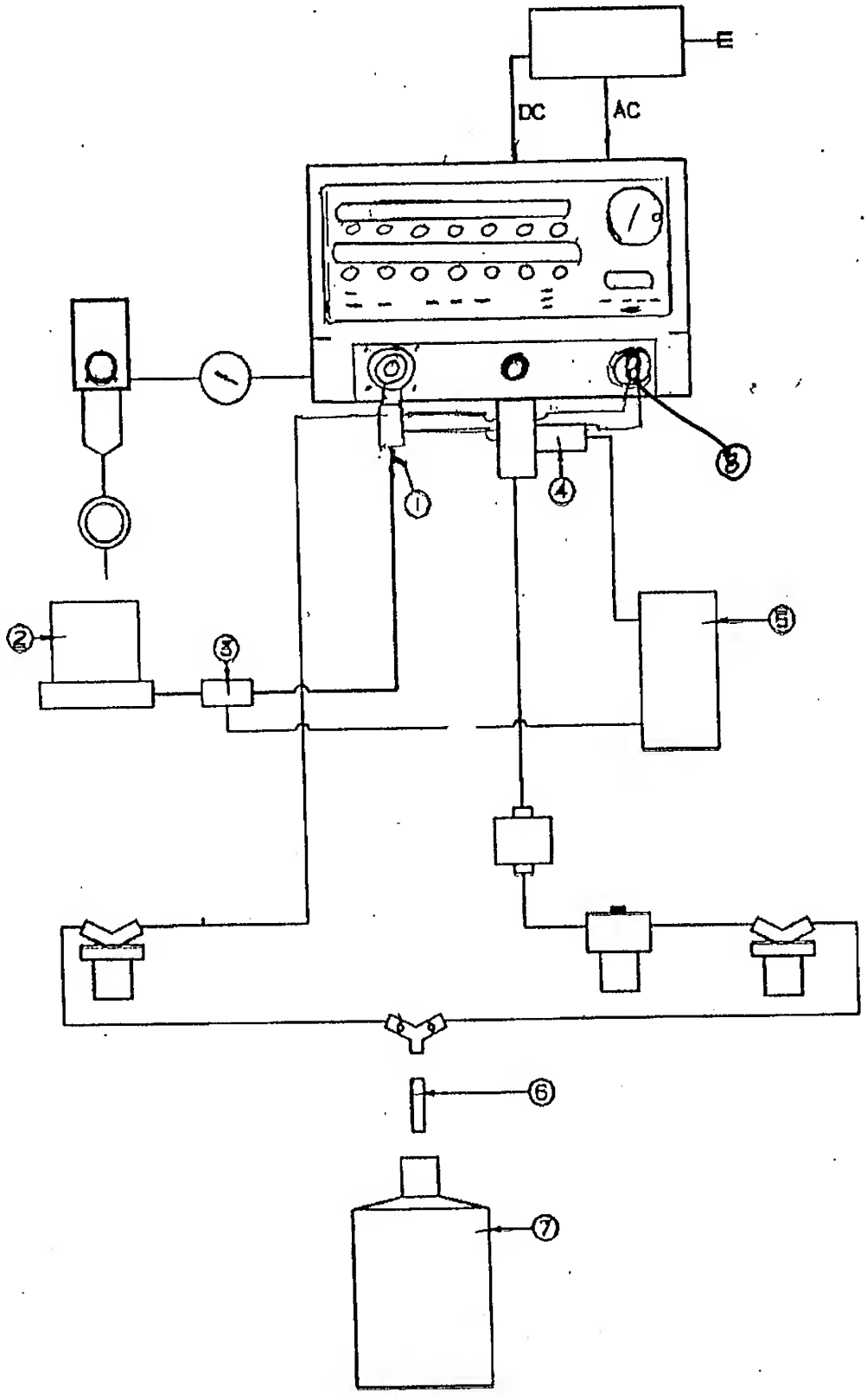
6. Endotracheal tube 7.0 mm I.D. x 20 cm long.

7. Standard test lung.

* 5 gallon (19 liters) glass container.

* Rigid compliance chamber, C=20 ml/cmH_2O ± 5% filled with 22 lbs. (10 Kg) of fine grade copper wool.

8. Volume Transducer Harness.


E
DC
AC
1
2
3
4
5
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8

PROCEDURE

Tidal Volume Verification

- Turn master ON/OFF switch ON.
- Adjust the following controls:

Mode Selector	A/C
Waveform	Square
Tidal Volume	800
Peak Flow	20
Breath Rate	5
PEEP/CPAP	OFF
Low PEEP/CPAP	-20

- Turn digital thermometer ON.

- Let ventilator warm up for 15 minutes.

- Set spirometer recording pen on 0 line of recording paper on drum.

- Between the end of expiratory and the beginning of the next inspiration, connect the hose from the outlet of exhalation valve body to the inlet of the spirometer.

- Connect 5 consecutive breaths in spirometer while noting the peak values of the outlet air temperature of the ventilator (Tact) and the air temperature of the spirometer (Tmeas). Disconnect the spirometer immediately after the 5th breath to avoid collecting additional proximal purge flow.

- Compute calibrated volume (Vcal) per the following equation:

$$Vcal = (Vmeas-.08) \times \frac{(558)}{(Tmeas+460)} \times \frac{(Tact+460)}{(558)}$$

Vcal must be 4.0 $\pm$ 10% liters

- Set WAVEFORM to ⎍ and repeat test.

- Set FLOW to 60 LPM and repeat test.

- Set WAVEFORM to ⎍ and repeat test.

- Set FLOW to 120 LPM and repeat the test.

- Set WAVEFORM to ⎍ and repeat test.

RETURN TO STANDARD CONTROL SETTINGS

BREATH RATE

o Set rate to 10.

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

o Verify that the breath interval is 6 $\pm$ 0.2 seconds. This corresponds to 10 $\pm$ 0.3 breaths per minute.

SIGH

o Activate SIGH and note SIGH indicator light.

o With the stopwatch, time the interval from the beginning of inspiration to the beginning of the next inspiration. Verify that the time interval is 9 $\pm$ 0.2 seconds.

o Depress SIGN button (OFF). Verify that indicator light is OFF.

INSPIRATORY HOLD PERIOD

o Push in and hold Inspiratory Hold button while actuating Manual breath button.

o The Inspiratory Hold time, which is the time from end of inspiration to beginning of expiration, must be 6.0 $\pm$ 0.2 seconds.

PEEP/CPAP/SENSITIVITY

o Set MODE selector to SIMV/CPAP.

o Set WAVEFORM to ⎍ (square).

o Set BREATH RATE to 0.

o Set SENSITIVITY to 1.

o Set PEEP/CPAP to 15.

o Set LOW INSP TIDAL VOLUME to 20.

o Verify PEEP reading on test gauge is 15 $\pm$ 2 cmH_2O.

o Set PEEP to 30 cmH_2O. Verify gauge reads 30 $\pm$ 2 cmH_2O.

APNEA/SILENCE/RESET

o Set the ventilator controls to Standard except SIMV/CPAP Square, Breath Rate 0, PEEP/CPAP 15, SENSITIVITY 1, LOW MINUTE VOLUME 1.0, APNEA INTERVAL control 10. Activate the Manual Breath button. With the stopwatch, measure the elapsed time between the button activation and audible and visual Apnea alarm. The time must be 0 $\pm$ 1 seconds. Visual Apnea alarm includes flashing "AP" in Apnea Interval display window.

o Activate the Alarm Silence button. The elapsed time between the button activation and the alarm reinstatement must be 60 $\pm$ 5 seconds.

o Activate the Manual Breath button 3 times and the audible alarm must cancel. Activate the Reset button and the visual alarm must cancel.

HIGH PEAK PRESSURE ALARM

o Set HIGH PRESSURE LIMIT to 60.

o Occlude (block) exhalation valve outlet.

o Activate Manual Breath and verify that high pressure limit audible and visual (flashing) alarms occurs at 60 $\pm$ 6 cmH_2O.

o Measure the time from the initiation of the alarm to the initiation of the safety valve dump. The opening of safety valve is noted by the fast decay of gauge pressure, a "rushing air" sound, and flashing "CIRC" indication in the MONITORS display window. This time should be less than 1 second.

o Verify that the gauge pressure drops from 60 within 3 cmH_2O of PEEP within 1 second.

o Remove blockage from exhalation valve outlet, verify that audible alarm cancels.

o Press Reset and verify "CIRC" cancels and that high pressure limit display stops flashing.

RETURN TO STANDARD CONTROL SETTING.

Low Peak Pressure Alarm.

o Note the value of the peak pressure on proximal airway pressure gauge during the inspiratory cycle of the ventilator.

o Between machine breaths, increase LOW PEAK PRESSURE limit until it is five (5) cmH_2O above the noted peak pressure.

o Verify audible and visual (flashing) alarms.

o Between machine breaths, decrease LOW PEAK PRESSURE limit to OFF and note audible alarm cancels and OFF flashes.

Low PEEP/CPAP Pressure Alarms.

o Set LOW PEEP/CPAP PRESSURE to 7 cmH_20.

o Verify audible and visual (flashing) alarms activation).

o Set LOW PEEP/CPAP PRESSURE to -20 cmH_20.

o Verify audible alarm cancels.

o Press RESET.

o Verify visual (flashing) alarm cancels.

RETURN TO STANDARD CONTROL SETTINGS

Low Minute Volume Alarm.

o Set LOW MINUTE VOLUME control to 8.5. The LOW MINUTE VOLUME audible and visual alarm must immediately activate. Return control to 7.0 and press RESET.

High Breath Rate Alarm.

o Set HIGH BREATH RATE control to 3. The HIGH BREATH RATE audible and visual alarm must immediately activate. Return control to 150 and press RESET.

Low Inlet Gas Pressure Alarm.

o Reduce inlet pressure to 30 PSIG on inline pressure gauge.

o Set TIDAL VOLUME to 1500.

o Set PEAK FLOW to 120.

o Verify activation of audible and visual LOW INLET GAS alarms during inspiration.

o Set inlet gas pressure to 50 PSIG.

o Verify audible alarm cancels.

o Press RESET. Verify cancellation of visual alarm.

Electrical Power Disruption.

o Remove electrical power from ventilator.

o Verify audible and visual VENT INOP alarms; also verify safety valve opens, flow control valve closes, and exhalation valve opens.

o Verify ventilator return to normal operation (after power-up, self-test sequence) and VENT INOP alarm cancel.

LOSS OF GAS SUPPLY

o Remove gas supply pressure.

o Verify audible and visual VENT INOP alarms activate, and all other displays extinguish.

o Restore gas supply pressure.

o Verify ventilator returns to normal operation (after power-up, self-test sequence) and VENT INOP alarms cancel.

"CIRC" ALARM VERIFICATION

o Remove the Exhalation Valve Body and block the Airway Pressure Port at 12:00 o'clock position. An audible and visual alarm must activate and "CIRC" must be displayed in the ventilator monitor display.

o Reconnect the Exhalation Valve Body to the ventilator and press the RESET button. The ventilator must return to normal operation.

o Return to Standard Control Settings.

13.9 ELECTRICAL SYSTEMS VERIFICATION

o Equipment Required:
  - o 0-160 VAC or 0-280 VAC uncalibration variac.
  - o Multimeter D.V.M. (AC) voltmeter.

o Equipment Setup:
  - o Turn power ON/OFF switch to OFF.
  - o Remove ventilator power cord and insert into Variac.
  - o With Variac ON/OFF switch in OFF position insert Variac power cord into proper grounded receptacle.
  - o Switch Variac ON/OFF switch to ON and adjust Variac to local power voltage.
  - o Switch ventilator ON/OFF switch to ON.
  - o Proceed as per 13.9.1 Electric Power Tolerance AC Test.

NOTE: Switch ventilator ON/OFF power switch OFF every time the AC power selection is changed, then set ventilator ON/OFF switch to ON again.

13.9.1 Electrical Power Tolerance (AC Power) AC Test. AC Voltage Range Operation.

o Set ventilator input power to low end of specified voltage range as follows:

For 100 volt units:	85 volts
For 120 volt units:	102 volts
For 220 volt units:	187 volts
For 240 volt units:	204 volts

o Verify unit operates normally for 5 machine breaths.

13.9.2 Adjust Variac to high end of specific voltage range as follows:

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

o Verify unit operates normally for 5 machine breaths.
o Set input power to "brown out" voltage as follows:

For 100 volt units:	70 volts
For 120 volt units:	85 volts
For 220 volt units:	154 volts
For 240 volt units:	168 volts

o Verify that ventilator at least briefly shows VENT INOP alarm (audible and visual) activation followed by power up and restart.

13.9.3 Reset input power to normal voltage and verify return to normal operation.

o Set ventilator ON/OFF switch to OFF, remove power cord from Variac and silence VENT INOP audible alarm.
o Disconnect AC power.

13.9.4 Electrical Power Tolerance (DC Power)

o Equipment Required:
  o DC Power Supply Source, 12-16 volts, 5 amps (minimum).
  o Digital multimeter.
  o P/N 08929 Power Source Cable Assembly.

o Equipment Setup:
  o Insert ALT POWER ACCESSORY POWER CABLE connector to socket in rear panel and DC Power Supply source fitting.

13.9.5 Set AC LINE/ALT PWR AC/DC switch to ALT PWR position.

o Apply 12 volts DC to ALT PWR SOURCE connector.
o Verify normal operation and illumination of front panel battery indicator green lamp.

13.9.6 Increase Voltage from 12 to 16 Volts.

o Verify normal operation for at least 5 breaths.
o Disconnect DC Power Connection.

13.9.7 Set AC LINE/ALT Power Switch from ALT PWR (DC) AC/DC mode position to AC LINE position.

o Insert ventilator cord into proper grounded voltage receptacle.
o Ventilator should return to normal operation after the initial start up.
o Set AC/DC switch to AC Line.
o Disconnect DC power.

13.9.8 Ground Continuity

o Measure ground continuity between power cord ground plug and sockethead cap screws on bottom of unit.
o Verify ground resistance is less than 0.1 ohms.

13.9.9. Leakage Current

o Check for maximum leakage current by comparing normal and reversed connections in both open/closed ground conditions.
o Verify leakage current under all conditions is less than 100 micro amps.

TOP COVER P/N 09698 ASSEMBLY

- Position top cover on manifold base.
- Raise back of cover 1 to 1-1/2" upwards and rear area of side panels outward.
- Slide panel forward to slip front lip under front panel housing.
- Lower rear end of top cover down on base.
- From below of manifold base, insert top screws (P/N 03222) with starwashers (P/N 02159) through manifold into top cover and secure using 9/64" Allen driver.
- Clean external surfaces of ventilator with an appropriate bacterial or germicidal agent. CAUTION, refer to Section 6, Cleaning and Sterilization.

SECTION 14

Performance Test

Prior to placing the 8400ST Volume Ventilator into clinical use, perform the following test:

WARNING:

IF THE 8400ST VOLUME VENTILATOR DOES NOT FUNCTION AS DESCRIBED BELOW, REFER THE UNIT TO A BIRD TRAINED SERVICE TECHNICIAN, YOUR BIRD DISTRIBUTOR OR TO BIRD PRODUCTS CORPORATION SERVICE CENTER, 3101 EAST ALEJO ROAD, PALM SPRINGS, CA 92262, (619) 778-7200 OR (800) 328-4139. DO NOT USE THE VENTILATOR UNTIL CORRECT PERFORMANCE IS VERIFIED.

1. Assemble the breathing circuit to the ventilator as outlined in Section 5 - "Assembly Instructions" of this manual.

2. Attach volume sensor and sensor connector. Refer to figure on page 30 and instructions on page 31.

3. Attach a Test Lung (P/N 04845) to the patient "Wye" (P/N 20225).

4. Attach air (P/N 02899) and oxygen (P/N 00060) supply hoses to source gas outlets (wall or tank).

5. Turn source gas valves "open" and adjust pressure regulators to 50 PSIG ± 5 (3.50kg/cm^2).

WARNING:

ALWAYS OPERATE THE 8400ST VOLUME VENTILATOR WITH CLEAN/DRY MEDICAL GRADE GASES.

6. Connect the power cord to an appropriate electrical outlet.

7. Move the power module "On/Off" switch to the ON(I) position (rear panel).

NOTE: Power up self test - subsequent to initiating power to the ventilator (ON/OFF switch) a 5 second test is conducted. During the test the following occurs:

- Power "LED" turns "ON" and an audible alarm is briefly sounded
- Front panel LED's segmentally display in unison
- Microprocessors verify communication
- Exhalation and flow control valve "HOME"
- Second audible alarm briefly sounds
- Front panel displays illuminate
- Ventilator begins to operate

8. Set operational parameters as follows:

- Mode- Assist/Control, square wave
- Tidal Volume- 500 ml
- Peak Flow- 60 lpm
- Breath Rate- 12 bpm
- PEEP/CPAP- 5 cmH_2O
- Assist Sensitivity- "OFF"
- Pressure Support- "OFF"

9. Set Alarm Parameters as follows: (Recommended settings for Performance Check "only")

- **High Pressure Limit:** 5 cmH_2O above peak pressure reading on manometer.
- **Low Peak Pressure:** 10 cmH_2O below peak pressure reading on manometer.
- **Low PEEP/CPAP:** 2 cmH_2O below PEEP/CPAP reading on manometer.
- **High Breath Rate:** 14 bpm
- **Low Minute Volume:** 4 L
- **Apnea Interval:** 20 seconds
- **Back Up Breath Rate:** 12 bpm

10. Complete Circuit Pressure Test as Follows:

- Set Breath Rate Control to zero
- Press Inspiratory Hold Button
- Press Manual Breath Button
- Circuit pressure should rise and hold following manual breath. If pressure rises then begins to decrease, check for circuit and/or humidifier leaks and correct.
- Readjust Breath Rate Control to 12 bpm and continue performance check.

11. Complete the following ventilator monitor performance checks:

- Check that ventilator parameters are set as indicated in # 8 above.
- Allow ventilator to operate for two minutes.
- Push the Monitor Select Button to check the following monitored values:

- Minute Volume:	6 L ± .6 L ± .9 L
- Tidal Volume:	500 ml ± 7.5 ml
- I:E Ratio:	1:5.7 ± 5%
- Breath Rate:	12 bpm ± 2 bpm

12. Complete the following alarm checks to verify the integrity of the audible/visual warnings:

- **Power Failure** - Remove power cord from electrical wall outlet. "Ventilator Inoperative" LED will illuminate, audible warning should sound, display will go blank. Reconnect power cord to cancel alarm and resume verification.
- **High Pressure Limit** - Restrict test lung with hand. When ventilator cycles to inspiration and High Pressure Limit setting is violated, display will flash and audible alarm will sound briefly. At the same time, the ventilator should terminate inspiration and cycle to exhalation. Release test lung, then press "RESET" button to cancel visual indicator and resume alarm verification.
- **Low Peak Pressure - Low PEEP/CPAP Pressure** - Disconnect test lung from patient "Wye". Low PEEP/CPAP audible and visual alarms should activate followed shortly thereafter by a Low Peak Pressure visual alarm. Reattach test lung to patient "Wye" to cancel audible alarm once ventilator cycles. Press the "RESET" button to cancel visual Indicator and resume alarm verification.

- **Low Minute Volume** - Set breath rate control to 6 bpm. Audible and visual Low Minute Volume alarms should activate within 45 seconds. Readjust breath rate back to 12 bpm to cancel audible alarm, then press "RESET" button to cancel visual indicator and resume alarm verification.

- **High Breath Rate** - Set breath rate control to 15 bpm. Audible and visual High Breath Rate alarms should activate within 45 seconds. Readjust breath rate back to 12 bpm to cancel audible alarm, then press "RESET" button to cancel visual indicator and resume alarm verification.

- **Apnea Interval/Apnea Backup Ventilation** - Adjust breath rate to 0. In approximately 20 seconds, the digital display for Apnea Interval should begin to flash and the audible alarm should sound. The ventilator will now initiate Apnea Back Up Ventilation in the Assist/Control mode using the set Tidal Volume, Peak Flow and Backup Breath Rate. "AP" will flash in the monitored values digital display window. Press "SILENCE" button to silence audible alarms. Readjust breath rate back to 12 bpm. Press "RESET" button to cancel visual indicator and resume alarm verification.

- **Flow Transducer Alarm Verification** - During operation of the ventilator, disconnect the flow transducer connector from the front of the ventilator. Upon removal, an audible alarm is sounded and the low minute volume display flashes (---). Reconnect flow transducer to receptacle and audible alarm will silence. Press reset button to clear flashing display.

- **"CIRC" alarm and display** - During operation of the ventilator on the test lung, disconnect the circuit from the exhalation valve housing and occlude the end with your hand. As soon as the machine pressure transducer registers 29 cmH_2O (usually within the first breath after occlusion of the circuit with your hand), the monitor display window will begin to flash "CIRC" and the audible alarm will sound. Reconnect the circuit to the exhalation valve housing to cancel the audible alarm, then press the "RESET" button to cancel the visual indicator.

After satisfactory completion of the Performance Check, refer to Section 7, Operating Instructions.

Should the 8400ST Volume Ventilator fail the performance test as outlined above, and you are unable to correct the problem, refer unit to a Bird trained technician, your Bird distributor or Bird Products Corporation for service.

SECTION 15

Troubleshooting

SECTION ~~8~~ 15
CLINICAL TROUBLESHOOTING

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
"Ventilator Inoperative" LED lights and audible alarm sounds and all displays are disabled	1. Loss of electrical power 2. Extended Low Inlet Gas Pressure 3. System Failure	1. Restore electrical power 2. Restore Inlet Gas Pressure 3. Contact your Bird distributor or Bird Products Corporation
Ventilator unable to power up (no lights or alarms) AC power display operation	1. Power Cord not plugged into wall or back of unit 2. Fuse blown in "ON/OFF" switch power entry module 3. AC LINE/ALT Power switch on back of ventilator set to ALT power operation 4. No power at wall outlet 5. System failure	1. Plug power cord into wall outlet or at back of ventilator 2. Contact your Bird distributor or Bird Products Corporation 3. Switch to "AC" LINE position 4. Use alternate wall outlet 5. Contact your Bird distributor or Bird Products Corporation
Ventilator unable to power-up (no lights or alarms) 12 VDC external power supply operation	1. AC LINE/ALT Power switch on back of ventilator set to "AC" operation 2. External power supply (battery) has lost its charge	1. Switch to DC ALT/Power position 2. Replace with fully charged battery

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Ventilator unable to power-up (no lights or alarms) 12 VDC external power supply operation (Continued)	3. System failure	3. Contact your Bird distributor or Bird Products Corporation
	4. External Power Supply cable not correctly connected or shorted	4. Insert cable correctly and check for current leaks
Tidal Volume Display flashing (no audible alarm)	1. Set Tidal Volume is too large for peak flow and breath rate setting (Incompatible setting)	1. Re-evaluate and reset ventilator parameters
"Low Inlet Gas" LED lights and audible alarm sounds. Source gas pressure okay (35 - 75 PSIG)	1. Obstructed blender inlet filters - gas supply contaminated	1. Replace blender and/or contact your Bird distributor or Bird Products Corporation
	2. Clogged ventilator Inlet Filter - gas supply contaminated	2. Replace inlet filter and/or contact your Bird distributor or Bird Products Corporation
Incomplete Display character on front panel	1. Seven Segment LED defective	1. Contact your Bird distributor or Bird Products Corporation
Peak Flow Display flashing (no audible alarm)	1. Set Peak flow is too high for tidal volume setting (Incompatible setting)	1. Re-evaluate and reset ventilator parameters
High Pressure Limit Audible/Visual Alarm activated	1. Kinked or obstructed patient circuit tubing	1. Check patient circuit and correct problem
	2. Endotracheal tube occlusion	2. Check patient status

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
High Pressure Limit Audible/Visual Alarm activated (Continued)	3. High Pressure Alarm limit set below actual pressure 4. Change in patient compliance 5. Change in Ventilatory parameters	3. Readjust alarm limit after verifying actual pressure 4. Evaluate patient status 5. Re-evaluate settings
Low Peak Pressure Audible/Visual Alarm activated	1. Change in patient compliance 2. Leak or disconnects in the patient circuit including humidifier system 3. Alarm set too high	1. Evaluate patient status 2. Check for circuit leaks, (Humidifier included) and patient disconnect 3. Re-adjust alarm
"CIRC" flashing accompanied with an audible alarm 3. Pressure Transducer out of calibration	1. Inspiratory limb of breathing circuit kinked or occluded 2. Airway Pressure sensing line disconnected or occluded	1. Examine circuit and correct problem 2. Examine exhalation valve body to ensure proper installation. If not resolved contact your Bird Distributor or Bird Products Corporation
Sequential four corner display in monitor window w/Audible Alarm	1. Mode selector switch is improperly positioned	1. Set mode selector switch to proper positon
Pressure support setting display flashing	1. Pressure support inspiratory time exceeding 3 sec. time limit	1. Examine circuit for leaks and correct if found 2. Check for leaks around endotracheal tube and correct if found

PROBLEM	POTENTIAL CAUSE	CORRECTIVE ACTION
Low Minute Volume Alarm Activated- "—" appears in window	1. Flow Transducerr connector not installed properly	1. Reinstall Flow Transducer connector
	2. Defective Flow Transducer assembly	2. Replace Flow Transducer assembly
Low Minute Volume Alarm activated- "0" Minute Volume reading	1. Flow Transducer not connected to Exhalation valve properly.	1. Check for proper connection
	2. Defective Flow Transducer	2. Replace Flow Transducer assembly
Low Minute Volume Alarm activated	1. Leak or disconnects in the patient circuit including humidifier system	1. Check for circuit leaks (Humidifier included) and patient disconnects
	2. Alarm set too high	2. Readjust alarm
	3. Defective Flow Transducer	3. Replace Flow Transducer assembly
Back Up Breath Rate flashing (no audible alarm)	1. The set Back Up Breath Rate is set too high for Tidal Volume and Peak Flow settings (incompatible settings)	1. Reevaluate and reset ventilator parameters
	2. The set Back Up Breath Rate is lower than the Primary Breath Rate	2. Reevaluate and reset Back Up Breath Rate
Inaccurate Tidal Volume reading	1. Defective Flow Transducer assembly	1. Replace Flow Transducer assembly
	2. Ventilator out of calibration	2. Contact your Bird Distributor or Bird Products Corporation

8400ST VOLUME VENTILAOTR
NON-RECOVERABLE "VENT INOP" CODES

Error Code		Description
0	;	Unknown error
1	;	Motor Processor failed to communicate with main processor following power up
2	;	Invalid status in serial interface transmit function
3	;	PAL in reset state
4	;	PAL detected single error
5	;	PAL detected double error
6	;	EPROM checksum test failed
7	;	EPROM CRC test failed
8	;	
9	;	Prox pressure and Machine outlet pressure data do not match sufficiently
10	;	Flow Control Valve failed to home promptly in exhalation XFIZ
11	;	Flow Control Valve failed to home promptly in exhalation XCUT
12	;	Exhalation Valve failed to position promptly in exhalation XPOP
13	;	Exhalation Valve failed to position promptly in exhalation XCUT
14	;	Exhalation Valve not promptly at home for start of exhalation XPOP
15	;	Flow Control Valve failed to close promptly for start of exhalation XTOP
16	;	Exhalation Valve positioning delayed over 240mS by home in progress XPOP
17	;	Exhalation Valve positioning delayed over 240mS by home in progress XCUT
18	;	
19	;	
20	;	Exhalation Valve not closed for start of Square Wave Inspiration
21	;	Flow Control Valve failed to open promptly in Square Wave Inspiration
22	;	Flow Control Valve failed to close promptly in Square Wave Inspiration
23	;	Square Wave Inspiration delayed over 240mS by exhalation home in progress
24	;	
25	;	Exhalation Valve not closed for start of Decelerating Taper Inspiration
26	;	Flow Control Valve failed to open promptly in Decelerating Taper Inspiration
27	;	Flow Control Valve failed to close promptly in Decelerating Inspiration
28	;	Decelerating Taper Inspiration delayed over 240mS by exhalation home in progress

Error Code		Description
29	;	
30	;	A/D #1 overrange in front panel control potentiometer read
31	;	A/D #2 overrange in front panel control potentiometer read
32	;	A/D #1 and A/D #2 multiplexor data does not match in front panel control potentiometer read
33	;	A/D #1 and A/D #2 data does not match in front panel control potentiometer read
34	;	
35	;	
36	;	
37	;	
38	;	
39	;	
40	;	A/D #1 overrange in prox pressure read - simulated full scale data created
41	;	A/D #2 overrange in prox pressure read - simulated full scale data created
42	;	A/D #1 and A/D #2 data do not match in prox pressure read, #1 ¶¶ #2
43	;	A/D #1 and A/D #2 data do not match in prox pressure read, #2 ¶¶ #1
44	;	A/D #1 and A/D #2 data do not match in prox pressure read, data similar
45	;	
46	;	
47	;	
48	;	
49	;	
50	;	A/D #1 overrange in machine pressure read - simulated full scale data created
51	;	A/D #2 overrange in machine pressure read - simulated full scale data created
52	;	A/D #1 and A/D #2 data do not match in machine pressure read, #1 ¶¶ #2
53	;	A/D #1 and A/D #2 data do not match in machine pressure read, #2 ¶¶ #1
54	;	A/D #1 and A/D #2 data do not match in machine pressure read, data similar
55	;	
56	;	
57	;	A/D #1 and A/D #2 data do not match in Flow pressure read, #1 ¶¶ #2
58	;	A/D #1 and A/D #2 data do not match in Flow pressure read, #2 ¶¶ #1
59	;	A/D #1 and A/D #2 data do not match in Flow pressure read, data similar
60	;	A/D #1 overrange in inlet regulator pressure read - simulated data created

Error Code		Description
61	;	A/D #2 overrange in inlet regulator pressure read - simulated data created
62	;	A/D #1 and A/D #2 data do not match in regulator pressure read, #1 ¶¶ #2
63	;	A/D #1 and A/D #2 data do not match in regulator pressure read, #2 ¶¶ #1
64	;	A/D #1 and A/D #2 data do not match in regulator pressure read, data similar
65	;	
66	;	
67	;	
68	;	
69	;	
70	;	A/D #1 overrange in 2.5 volt test reference read
71	;	A/D #1 too high in 2.5 volt test reference read
72	;	A/D #1 too low in 2.5 volt test reference read
73	;	A/D #1 does not match A/D #2 in 2.5 volt test #1 ¶ #2
74	;	
75	;	A/D #2 overrange in 2.5 volt test reference read
76	;	A/D #2 too high in 2.5 volt test reference read
77	;	A/D #2 too low in 2.5 volt test reference read
78	;	A/D #2 does not match A/D #1 in 2.5 volt test #2 ¶ #1
79	;	
80	;	A/D #1 overrange in potentiometer reference read
81	;	A/D #1 too high in potentiometer reference read
82	;	A/D #1 too low in potentiometer reference read
83	;	
84	;	
85	;	A/D #2 overrange in potentiometer reference read
86	;	A/D #2 too high in potentiometer reference read
87	;	A/D #2 too low in potentiometer reference read
88	;	
89	;	
90	;	Can't find mode switch when Patient Effort detected in exhalation
91	;	Can't find mode switch when Vol Breath to be delivered with breath rate timer reset in exhalation
92	;	Can't find mode switch when Vol Breath to be delivered without breath rate timer reset in exhalation
93	;	
94	;	Failure of processor B to respond to 1 ms interrupt
95	;	
96	;	
97	;	
98	;	
99	;	
100	;	Internal RAM memory test failed Pass 1, invert bit DPL, Byte B
101	;	Internal RAM memory test failed Pass 1, read/verify, byte DPH

Error Code		Description
102	;	Internal RAM memory test failed Pass 2, invert bit DPL, Byte B
103	;	Internal RAM memory test failed Pass 2, read/verify, byte DPH
104	;	
105	;	External RAM memory 0 test failed Pass 1, invert bit B, Byte R0
106	;	External RAM memory 0 test failed Pass 1, read/verify, byte R1
107	;	External RAM memory 0 test failed Pass 2, invert bit B, Byte R0
108	;	External RAM memory 0 test failed Pass 2, read/verify, byte R1
109	;	
110	;	Exhalation valve failed to home at system start up
111	;	Exhalation valve failed position trial at system start up
112	;	Flow control valve failed to home at system start up
113	;	
114	;	External RAM memory test failed Pass 3, address bit
115	;	External RAM memory test failed Pass 4, inverted address bit
116	;	
117	;	Prox and Machine pressure data do not match sufficiently during exhalation
118	;	
119	;	Exhalation valve not closed for start of Servo Inspiration
180	;	A/D #1 overrange in Exhalation Reference voltage read
181	;	A/D #1 too high in Exhalation Reference voltage read
182	;	A/D #1 too low in Exhalation Reference voltage read
183	;	
184	;	
185	;	A/D #2 overrange in Exhalation Reference voltage read
186	;	A/D #2 too high in Exhalation Reference voltage read
187	;	A/D #2 too low in Exhalation Reference voltage read
188	;	
189	;	
190	;	Communication fault - Motor Processor reports lost data byte(s) from main
191	;	Communication fault - Motor Processor reports lost header from main
192	;	Communication fault - Main Processor reports lost data byte(s) from motor
193	;	Communication fault - Main Processor reports lost header from motor
194	;	
195	;	
196	;	
197	;	
198	;	

Error Code	Description
199	;
200	;
201	;
202	;
203	;
204	;
205	;
206	;
207	;
208	;
209	;
210	; Motor Processor encountered illegal flow valve motion control state 00
211	; Motor Processor encountered illegal flow valve motion control state 0D
212	; Motor Processor encountered illegal flow valve motion control state 10
213	; Motor Processor encountered illegal flow valve motion control state 1D
214	;
215	; Motor Processor encountered illegal exhalation motion control state 00
216	; Motor Processor encountered illegal exhalation motion control state 0D
217	; Motor Processor encountered illegal exhalation motion control state 10
218	; Motor Processor encountered illegal exhalation motion control state 1D
219	;
220	; Motor Proc Int RAM memory test failed Pass 1, invert @SP, Bit B should not be set
221	; Motor Proc Int RAM memory test failed Pass 1, read/verify, byte R0
222	; Motor Proc Int RAM memory test failed Pass 2, invert @SP, Bit B should not be clr
223	; Motor Proc Int RAM memory test failed Pass 2, read/verify, byte R0
224	;
225	;
226	;
227	;
228	;
229	;
230	; Motor Processor timed out awaiting comm from main processor
231	;
232	;
233	;
234	;
235	;
236	; Motor Processor Program Memory checksum test failed

Error Code	Description
237	;
238	;
239	;
240	; A/D #1 overrange in Negative Bias voltage read
241	; A/D #1 too high in Negative Bias voltage read
242	; A/D #1 too low in Negative Bias voltage read
243	;
244	;
245	; A/D #2 overrange in Negative Bias voltage read
246	; A/D #2 too high in Negative Bias voltage read
247	; A/D #2 too low in Negative Bias voltage read
248	;
249	;
250	; Operator Initiated Safety System Test
251	;
252	;
253	;
254	;
255	;

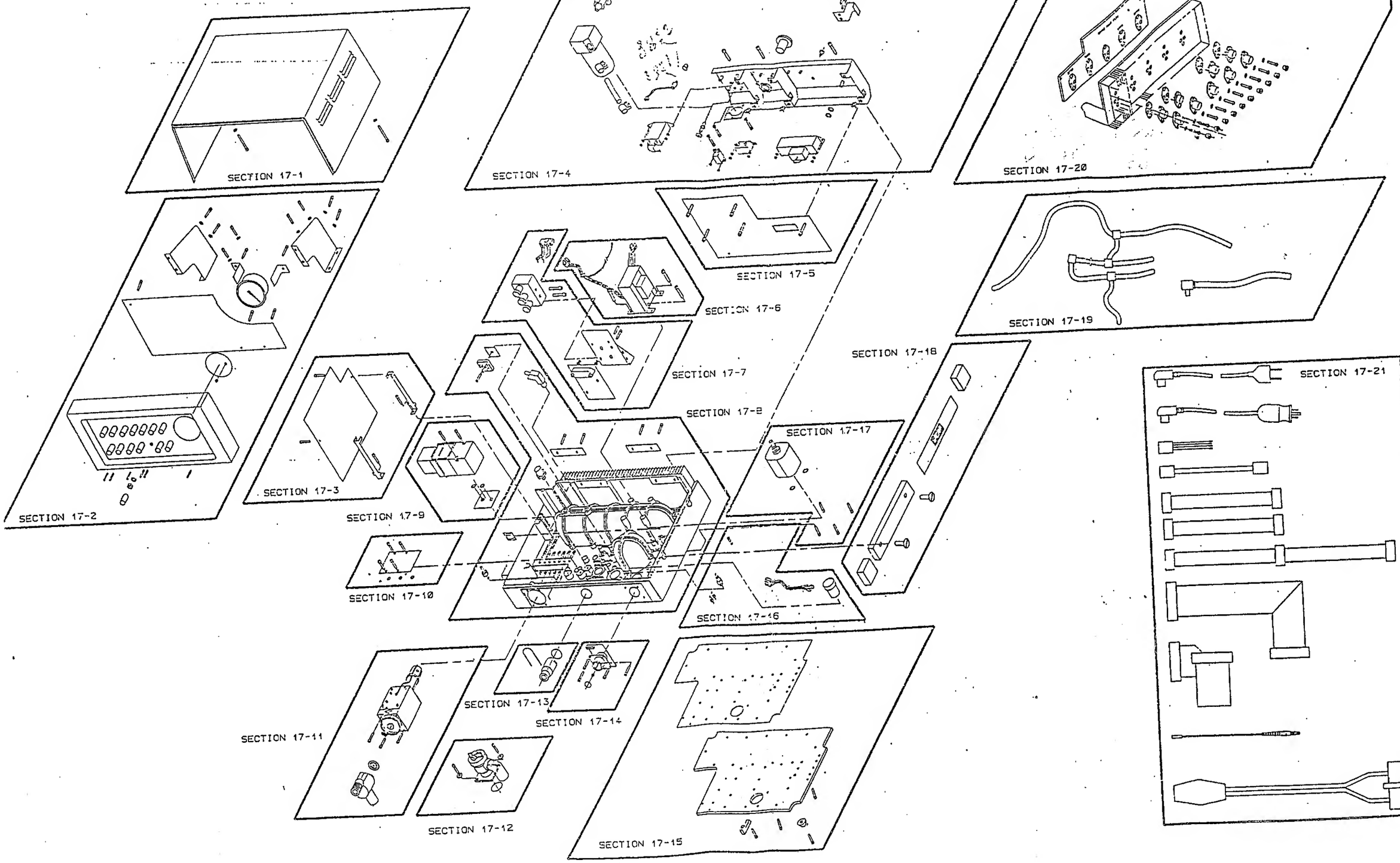
NOTE: Fault Codes that "DO NOT" have a description, are presently not used.

a:/84aerr.equ

SECTION 16

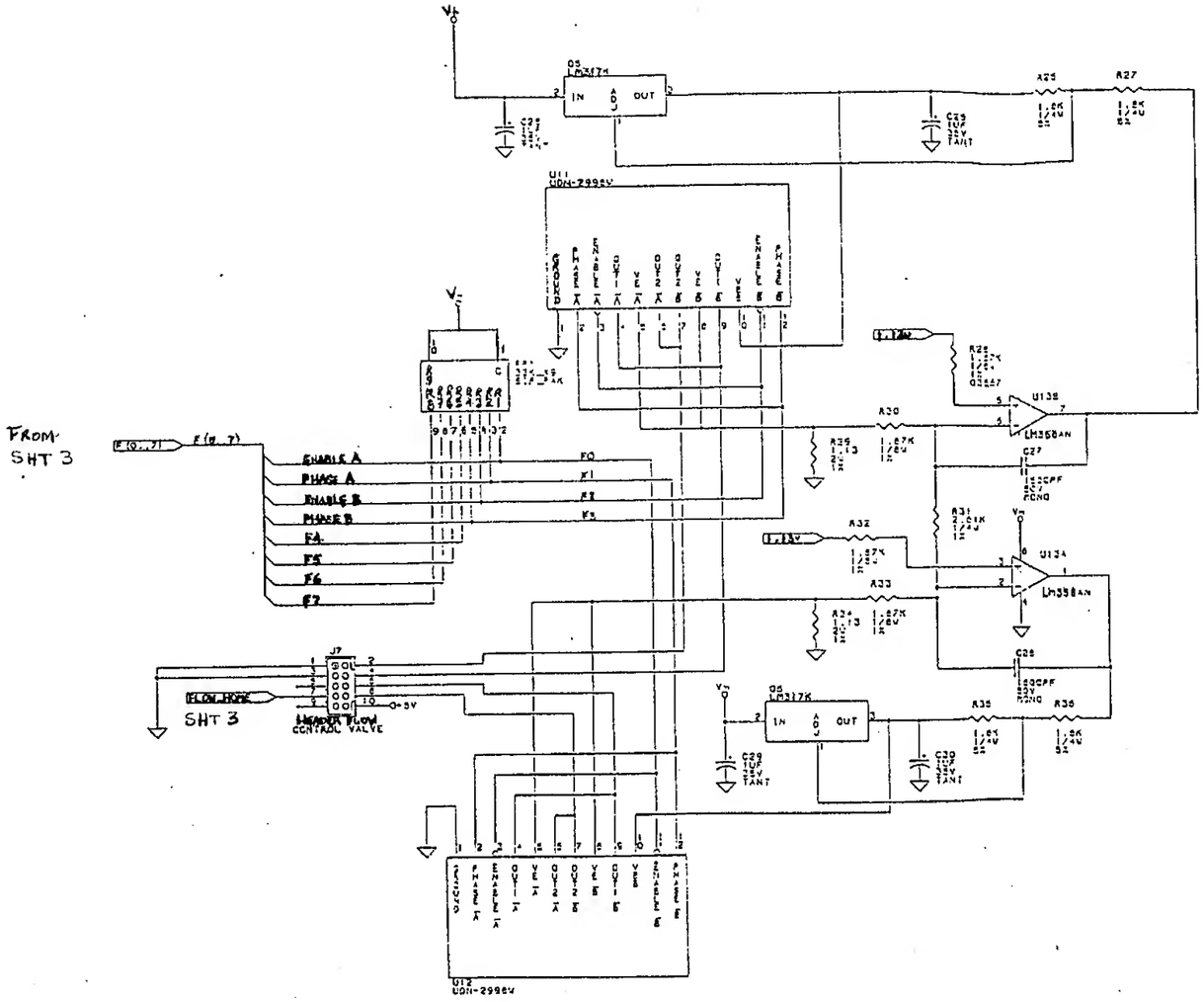
Schematics - Drawings

BIRD PRODUCTS CORPORATION
8400ST VOLUME VENTILATOR



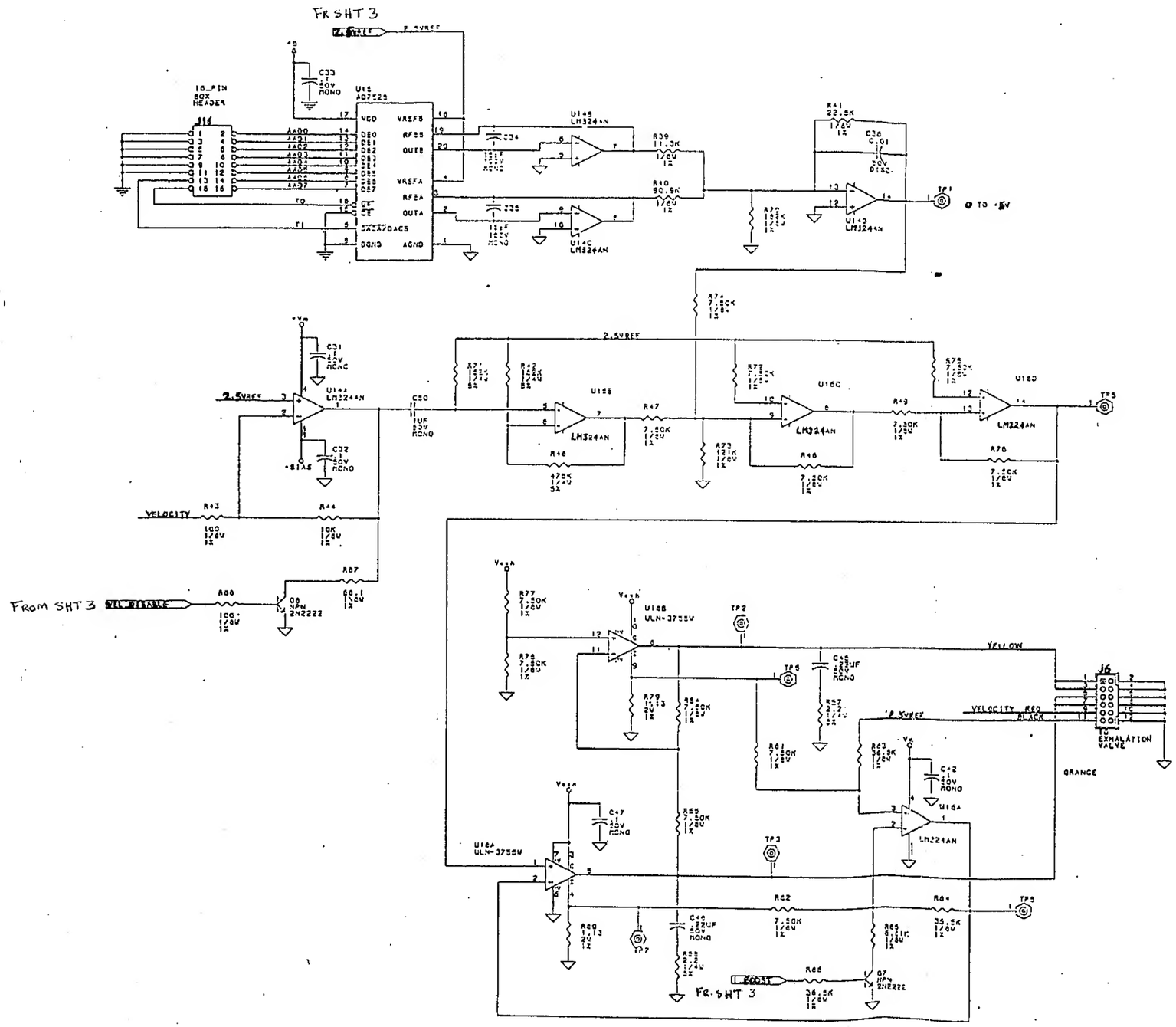
SECTION 17

Parts List



POWER SUPPLY BOARD.

D	DWG NO. 50022	
SCALE NONE	DO NOT SCALE DRAWING	SHEET 5 OF 5



POWER SUPPLY BOARD

BIRD			
D	DWG NO.	50022	
SCALE NONE	DO NOT SCALE DRAWING	SHEET 4 OF 5	

8 7 6 5 4 3 2 1

FR SHT 3
TO SHT 4
TO SHT 4

SHT 2

CPU C

U3
P80C31BH-1
40_PIN

EX-HOME
FLOW HOME
I_BOOST
VEL_DISABLE

RESETA
/PSEN
ALE
VEXHOFF
/VA
XTAL2
XTAL1
VSS
VCC
/EA

C15 18PF
C16 18PF
X1 12MHz

U4 74HC573
U5 27C256
U6 74HC377
SELECTOR JP1
64K 32K

C17 .1 50V MONO
C18 .1 50V MONO
C19 .1 50V MONO

U9D 74HC32
U9A 74HC32

ENABLE A
PHASE A
ENABLE B
PHASE B

F(0..7)
F(10..17)
TO SHT 5

U7A 754538
D5 DIODE 1N4002
J10
SAFETY VALVE

NOTE: ENERGIZED SOLENOID
HOLDS SAFETY VALVE CLOSED

OPEN SAFETY VALVE = HI
CLOSE SAFETY VALVE = LO

U7B 754538
D4 DIODE 1N4002
J12
PURGE VALVE

NOTE: ENERGIZED SOLENOID
ENABLES AUTO ZERO AND PURGE

FR SHT 2

U10
AD1403
2.5V
IN GND OUT

C20 .1 50V MONO
C21 10UF 35V TANT
R19 681 1/8W 1%
R20 562 1/8W 1%
1.13V
4.13V

Q4
RFH12P06
MOSFET P

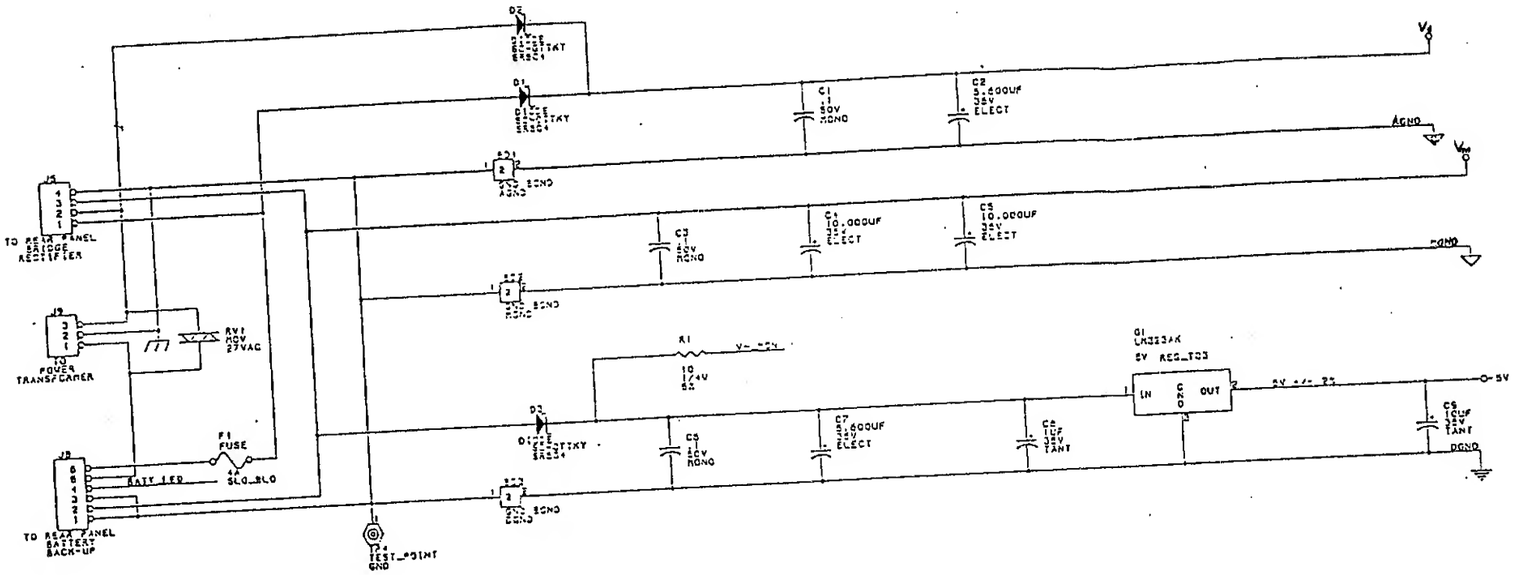
C22 .1 50V MONO
C23 .1 50V MONO
C24 10UF 35V TANT

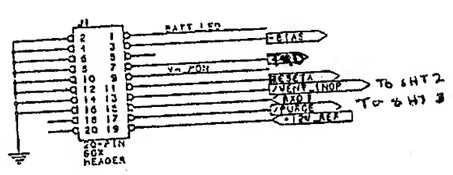
R14 1.7K 1/4W 5%
R13 1K 1/4W 5%
Q3 2N2907
R15 1K 1/4W 5%
R16 1.7K 1/4W 5%
R17 9.53K 1/8W 1%
R18 2.49K 1/8W 1%
+12V REF

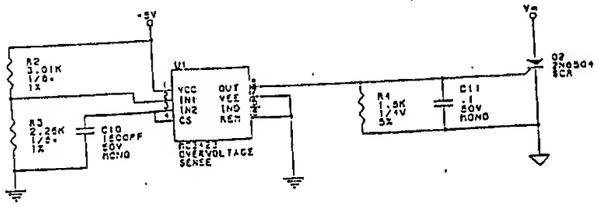
U8A LM358AN
U8B LM358AN

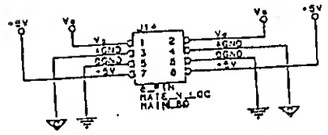
POWER SUPPLY BOAR

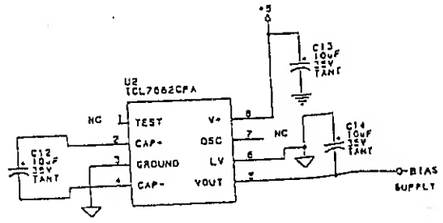
DWG NO. 50022
SCALE NONE
DO NOT SCALE DRAWING











POWER SUPPLY BOARD.

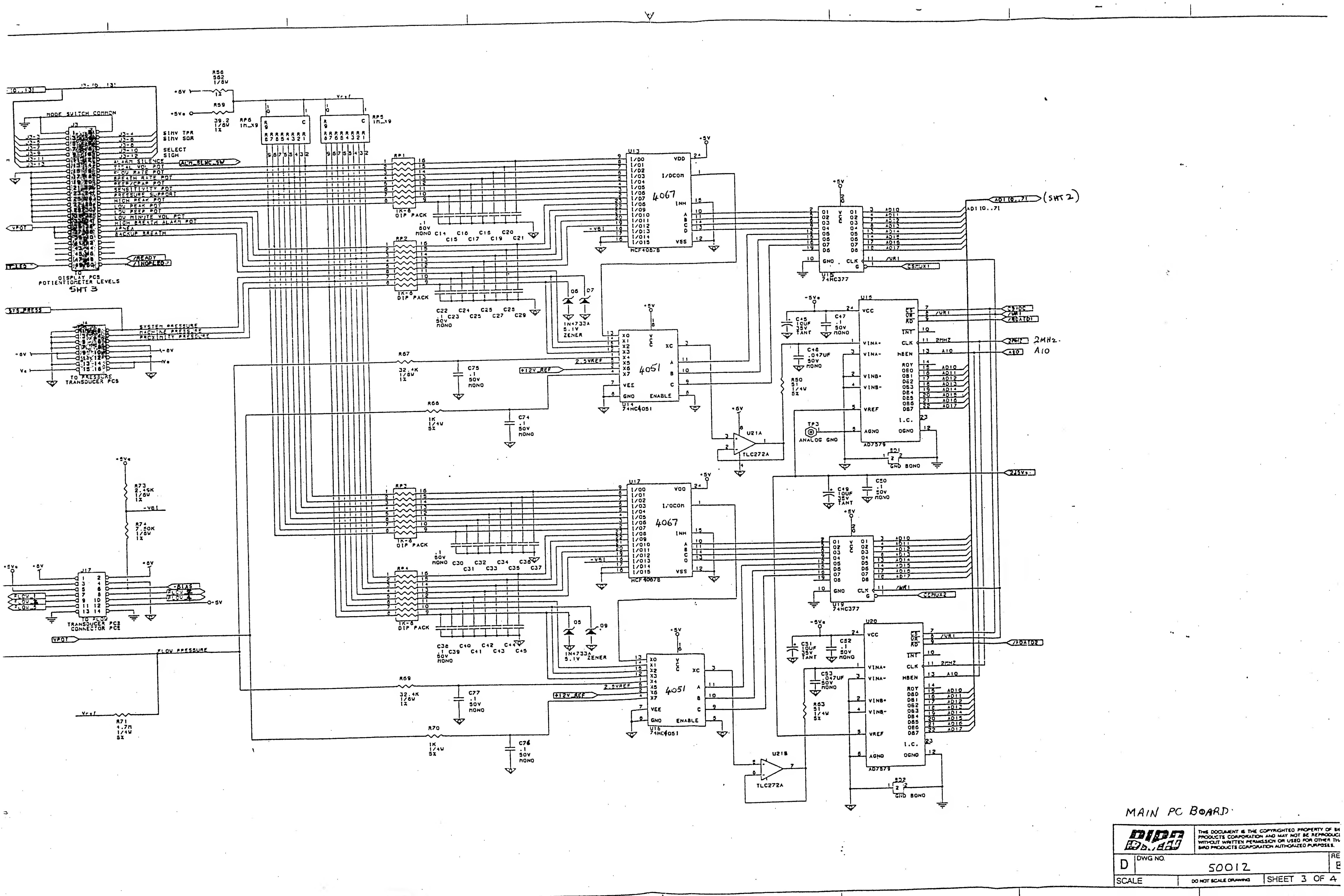
D	DWG NO. 50022	RE C
SCALE NONE	DO NOT SCALE DRAWING	SHEET 2 OF 5

J14
FROM POWER BOARD

U1A LM356AN
U1B LM356AN
U2 CMOS_555
U3 MC1403 2.5V REF
U4A LM339AN
U4B LM339AN
U4C LM339AN
U5A LM339AN
U5B LM339AN
U5C LM339AN
U6A LM339AN
U6B LM339AN
U6C LM339AN
U7A 4011B
U7B 4011B
U8A 74HC00
U8B 74HC00
U8C 74HC00
U9A 74HC14
U9B 74HC14
U10 CMOS_555
U11A 74S18
U12A LM356AN
U40A LM339A
U40B LM339A
Q1 2N3906
Q2 2N3906
Q3 NPN 2N2222
D1 1N4148
D2 1N4148
D3 1N5817 SCHOTTKY
D4 1N4148
D10 1N4148
J15 HFBR-1302 OPTO TRANSMITTER
JP17 ALARM LOUDNESS
DS1 ALARM SONOLERT
E1 RED
E2 BLK
+6V
+5V
-5V
VFQT
EXH_SV
SYS_PRESS
ROY2
2.5VREF
/ALARM
/VENT_INOP
/INOPLED
ALARM_SLNC
ALM_SLNC_SW
J3-14
FR. SHT 2

MAIN PC BOARD.

D	DWG NO. 50012	REV. B
SCALE	DO NOT SCALE DRAWING	SHEET 4 OF 4



DISPLAY PCB POTIENTIOMETER LEVELS
SHT 3
MODE SWITCH COMMON
ALARM SILENCE
TIDAL VOL POT
FLOW RATE POT
BREATH RATE POT
PEEP/CPAP POT
SENSITIVITY POT
PRESSURE SUPPORT
HIGH PEAK POT
LOW PEAK POT
LOW PEEP POT
LOW MINUTE VOL POT
HIGH BREATH ALARM POT
APNEA
BACKUP BREATH
SYSTEM PRESSURE
MACHINE PRESSURE
PROXIMITY PRESSURE
TO PRESSURE TRANSDUCER PCB
TO FLOW TRANSDUCER PCB CONNECTOR PCB
FLOW PRESSURE
4067
HCF4067B
4051
74HC4051
74HC377
AD7579
TLC272A
1N4733A 5.1V ZENER
DIP PACK
AD1[0..7] (SHT 2)
2MHz
A10
ANALOG GND
GND BOND
MAIN PC BOARD
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D
DWG NO.
50012
SCALE
DO NOT SCALE DRAWING
SHEET 3 OF 4

MAIN PC BOARD.

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D	DWG NO. 50012	REV. B
SCALE	DO NOT SCALE DRAWING	SHEET 2 OF 4

7 | 6 | 5 | 4 | 3 | 2 | 1

RM
NCE

RM
T

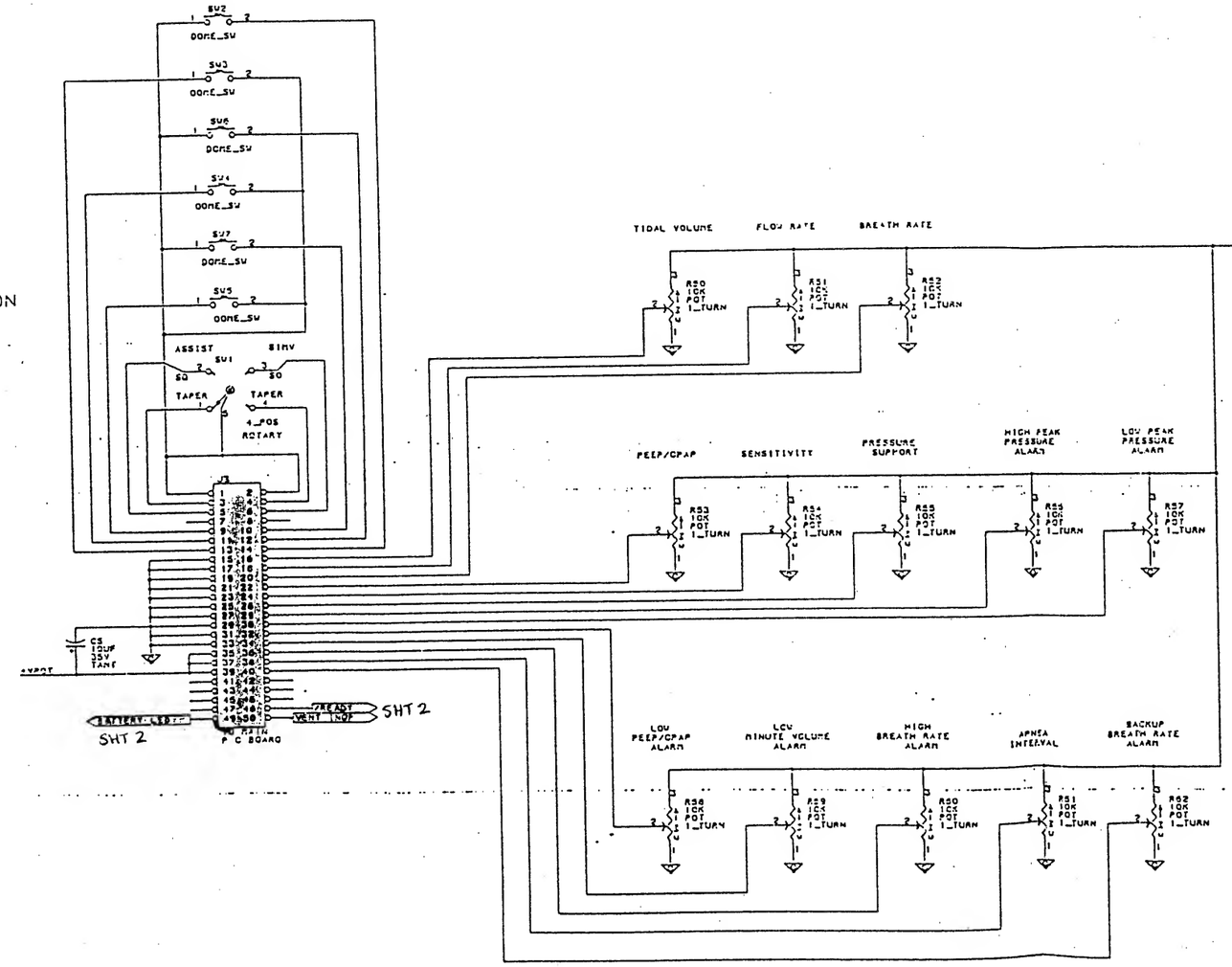
H

UAL
ATH

ECT

PIRATION
D

E SW



DISPLAY BOARD

D	DWG NO. 50002	REV. A
SCALE NONE	DO NOT SCALE DRAWING	SHEET 3 OF 3

TIDAL VOLUME

PEAK FLOW

BREATH RATE

PEEP/CPAP

SENSITIVITY

PRESSURE SUPPORT

HIGH PEAK PRESSURE ALARM

LOW PEAK PRESSURE ALARM

LOW PEEP/CPAP ALARM

LOW MINUTE VOL ALARM

HIGH BREATH RATE ALARM

APNEA INTERVAL

BACKUP BREATH RATE

MODE

TIDAL VOLUME YELLOW_LED

TOTAL BREATH RATE YELLOW_LED

MINUTE VOLUME YELLOW_LED

I:E RATIO YELLOW_LED

PATIENT EFFORT YELLOW_LED

SIGH YELLOW_LED

ALARM SILENCE YELLOW_LED

LOW INLET GAS RED_LED

VENT INOP RED_LED

POWER GREEN_LED

BATTERY YELLOW_LED

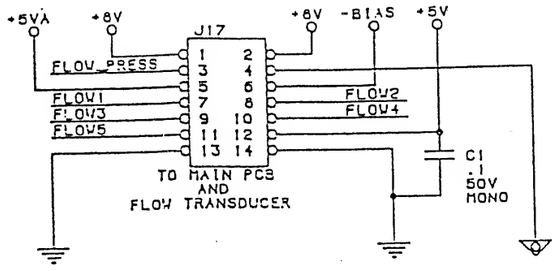
SHT 3

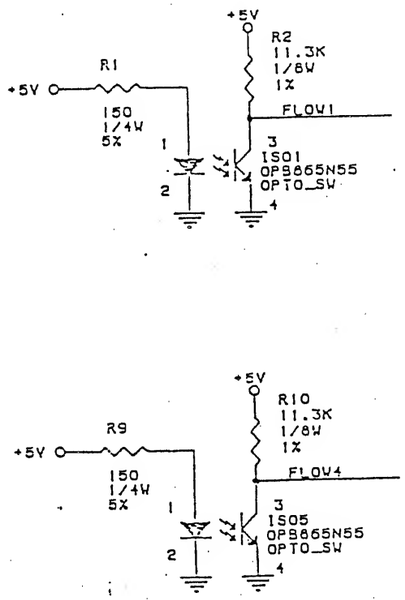
SHT 3

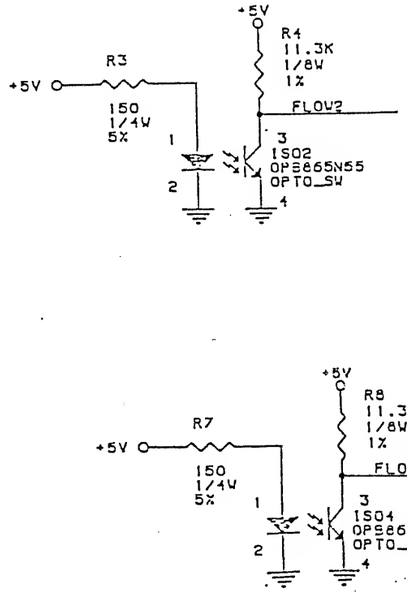
SCHEMATIC
DISPLAY PCB 84005

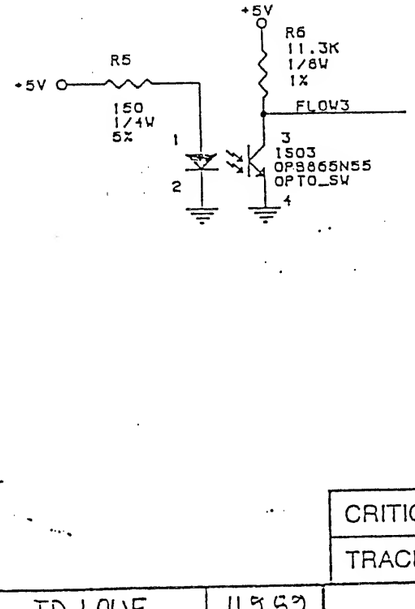
D	DWG NO. 50002	REV. A
SCALE NONE	DO NOT SCALE DRAWING	SHEET 2 OF 3

REVISIONS				
SYM	DESCRIPTION	DRFTG	APPROVED	DATE
X1	REL FOR PILOT RUN PER ECO# 40348	JKD	MN.	11/29/8
A	PROD REL PER ECO# 40518	JKD	MN	3/8/9









CRITICAL	☐ COMPONENT	☐ DEVICE	☐ N/A
TRACEABLE	☐ SERIAL NO.	☐ LOT NO.	☐ N/A

DRAWN	T.D. LOWE	11.9.89
CHECKED	J.K. DACK	11.9.89
APPROVED	M. NORTON	11.29.89
RELEASED		

UNLESS OTHERWISE SPECIFIED
1. TOLERANCES
   .X ±.1 .XXX ±.005
   .XX ±.01 ANG. ±1°00'
2. MACH SURFACES 64 ✓ OR BETTER
3. CORNER FILLETS & RADII .005/.010
4. BREAK ALL SHARP EDGES BY 45°
5. CHAMFER FIRST & LAST THREADS 45°
6. CONC TOLERANCE .005 F.I.M.
7. INTERPRET PER ANSI Y14
8. DIMENSIONS ARE IN INCHES

TITLE: SCHEMATIC, FLOW CONNECTOR PCB-8400ST

B	DWG NO. 50062	REV A
SCALE: NONE	SHEET 1 OF 1	

REVISIONS				
SYM	DESCRIPTION	DRFTG	APPROVED	DATE
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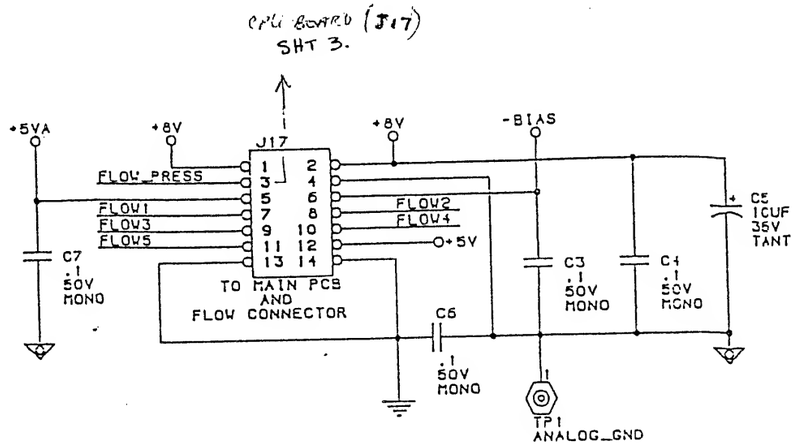
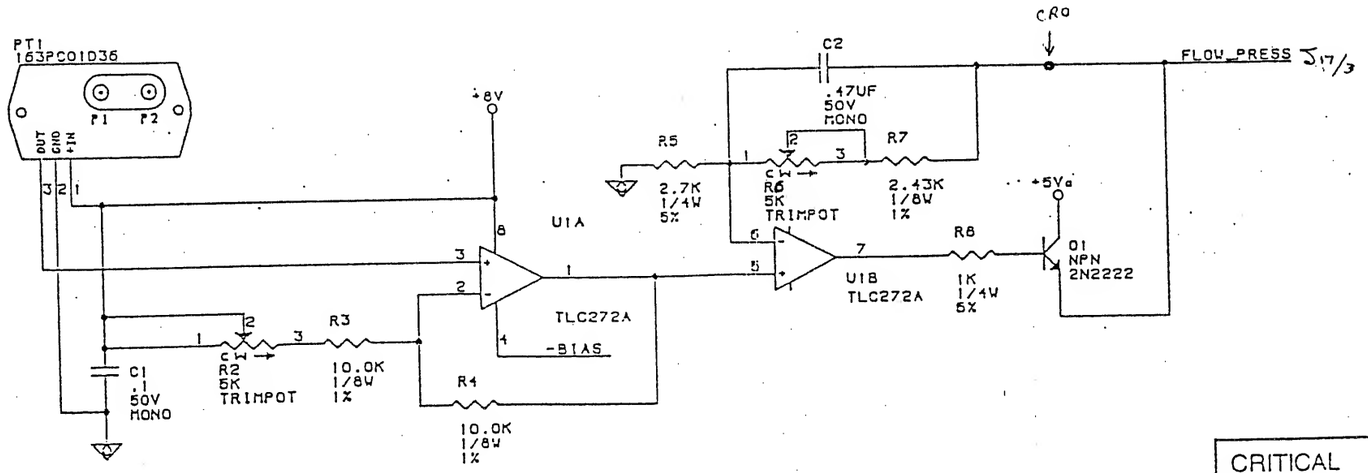
A	PROD REL PER ECO# 40518	JKD	MN	3/8/9





CRITICAL	☐	COMPONENT	☐	DEVICE
TRACEABLE	☐	SERIAL NO.	☐	LOT NO.

☐ N/A

☐ N/A

DRAWN	T.D. LOWE	11.9.89
CHECKED	J.K.DACK	11.9.89
APPROVED	M.NORTON	11.29.89
RELEASED		

UNLESS OTHERWISE SPECIFIED

1. TOLERANCES
   - X ±.1 .XXX ±.005
   - .XX ±.01 ANG ±1°00'
2. MACH SURFACES 64 ✓ OR BETTER
3. CORNER FILLETS & RADII .005/.010
4. BREAK ALL SHARP EDGES BY 45°
5. CHAMFER FIRST & LAST THREADS 45°
6. CONC TOLERANCE .005 F.I.M.
7. INTERPRET PER ANSI Y14
8. DIMENSIONS ARE IN INCHES

TITLE

SCHEMATIC, FLOW XDCR PCB - 8400ST

ASSY N° 50030 Rev C

SIZE	DWG NO.	REV
B	50032	A

SCALE	SHEET
NONE	1 OF 1

SECTION 18

Appendix

SECTION 18
EXPLANATION OF ABBREVIATIONS

June 1990

amp ..... Ampere

bpm ..... Breaths Per Minute

°C ..... Degrees Centigrade

CIRC ..... Circuit

cmH_2O ..... Centimeters of Water Pressure

CMV ..... Controlled Mechanical Ventilation

CPAP ..... Continuous Positive Airway Pressure

D.I.S.S. .... Diameter Index Safety System

ETO ..... Ethylene Oxide

°F ..... Degrees Fahrenheit

FIO_2 1 ..... Fractional Concentration of Inspired Oxygen

H ..... Height

Hz ..... Hertz

I.D. ..... Inner Diameter

I ..... ON

IMV ..... Intermittent Mandatory Ventilation

kg ..... Kilogram

kg/cm2 ..... Kilograms per centimeter square

lb ..... Pound

LED ..... Light Emitting Diode

lpm ..... Liters Per Minute

ml ..... Milliliter

MSEC ..... Millisecond

0 ..... OFF

PEEP ..... Positive End Expiratory Pressure

P/N ..... Part Number

PSIG ..... Pounds Per Square Inch Gauge

SIMV ..... Synchronized Intermittent Mandatory Ventilation

VAC ..... Volts Alternating Current

VDC ..... Volts Direct Current

W ..... Weight

SECTION 19

Bulletins

SECTION 19

Bulletins

SERVICE BULLETIN

TO: All 6400ST/8400ST Domestic and International Service Dealers

SUBJECT: Power Board Fuse (F1) Failure When Switching from AC to DC

FROM: Ed Messineo, National Service Manager DATE: 11/21/90 NO. A0010

WARNING: The following procedure should only be done by Factory Trained Service personnel, who have full knowledge of the 6400ST & 8400ST Volume Ventilators, and are in possession of a service manual.

Section 19
add to.

CAUTION: Take all necessary precautions to avoid static discharge. Be sure you and the table on which you are working are grounded when handling the Power PCB.

On rare occasions, the failure of the fuse (F1) on the Power PCB of either the 6400ST or 8400ST may occur when switching the Mode Switch, located on back of unit, from AC to DC with wall AC power on. This failure is caused by voltage spikes, under certain conditions, that activate the crowbar circuit, which in turn shorts the fuse. This situation is eliminated by installing a Metal Oxide Varistor (MOV), P/N 60100, across the transformer secondary input to the Power PCB. See Figure 1.

The following are instructions for the installation of the Metal Oxide Varistor:

EQUIPMENT REQUIRED:

- Tools required for disassembly and assembly of 6400ST/8400ST:
  - Soldering Iron
  - Metal Oxide Varistor (MOV), P/N 60100, one per ventilator
  - Small tube of RTV (available at any hardware store)

PROCEDURE:

1. Disconnect the ventilator from the power source and remove the top cover. See Service Manual, Section 11.
2. Remove the Power PCB. See Service Manual, Section 11. Note: On 8400ST, identify tubing locations for Flow Transducer to facilitate easy reassembly.
3. On the solder side of the Power PCB, carefully remove the Mylar insulator and locate solder pads of J9. See Figure 2.
4. Clip the leads of the MOV (P/N 60100) to length in such a manner that once it is soldered in place, it may be pushed flat against the board without shorting other components.

Carefully solder the MOV (P/N 60100) to the other pins (1 and 3) of J9. Lay the MOV (P/N 60100) over flat on the board and secure it with a small dab of RTV. See Figure 2.

Replace the Mylar Insulator.

Reinstall the Power PCB. See Service Manual, Section 12. Note: On the 8400ST ventilator, be sure that flow transducer tubing is correctly connected.

Reinstall the ventilator top cover.

Apply power to the ventilator and perform Operational Performance Check. See Service Manual, Section 14.

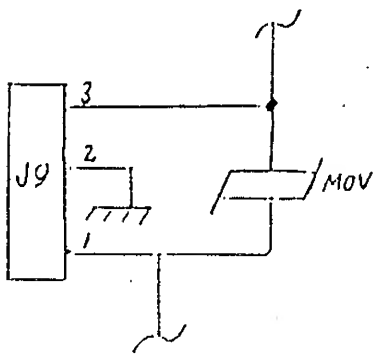


Figure 1
Schematic of MOV Installation

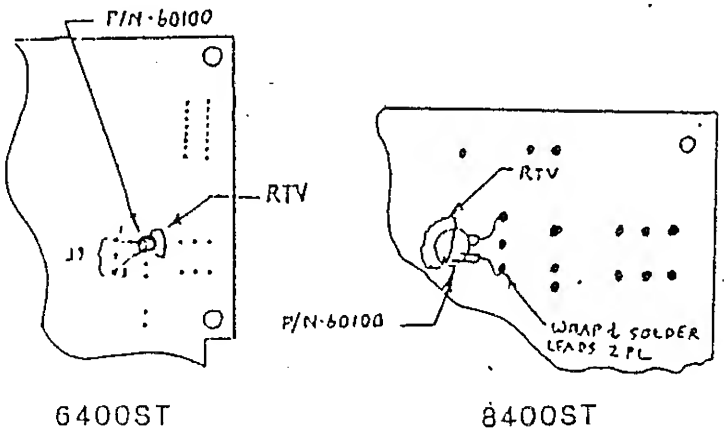


Figure 2
Power PCB J9 Location
Solder Side

SALES BULLETIN

TO: All 6400ST* & 8400ST** Volume Ventilator Domestic Dealers and Dealer Sales Representatives

SUBJECT: VENTILATOR CLEANING PRECAUTIONS

FROM: Gregory M. Oliver, Product Manager DATE: 5/10/91 NO. A0035

Spraying of a bactericidal or germicidal agent on the exterior of ventilators is standard practice in many respiratory therapy departments for topical cleaning of the equipment following clinical use. This practice is acceptable for surface cleaning provided the liquids are not allowed to pool or collect on or in critical components of the ventilator (i.e. exhalation valve, flow transducer receptacle, etc.). Repeated use of the cleaning agent can cause build-up of residue on critical components of the ventilator, possibly affecting operation, if care is not exercised in the cleaning procedure.

Outlined below, you will find caution statements for both the 6400ST and 8400ST volume ventilators which must be observed when using this method of topical cleaning and a recommended alternative procedure for cleaning critical components of the ventilator as discussed above.

6400ST VOLUME VENTILATOR

CAUTION:

- Do not spray cleaning solution directly into exhalation valve assembly.
- Do not allow cleaning solution to pool on exhalation valve shaft or microswitch stem.

NOTE: Repeated use of the cleaning agent can cause build-up of residue on critical components of the ventilator, possibly affecting operation, if care is not exercised in the cleaning procedure.

8400ST VOLUME VENTILATOR

CAUTION:

- Do not spray cleaning solution directly into exhalation valve assembly.
- Do not spray cleaning solution directly into flow transducer receptacle.
- Do not allow cleaning solution to pool on exhalation valve shaft or poppet.
- Do not allow cleaning solution to pool in flow transducer receptacle.

NOTE: Repeated use of the cleaning agent can cause build-up of residue on critical components of the ventilator, possibly affecting operation, if care is not exercised in the cleaning procedure.

CRITICAL COMPONENT ALTERNATIVE CLEANING PROCEDURE (EXHALATION VALVE ASSEMBLY AND FLOW TRANSDUCER RECEPTACLE)

1. Apply topical solution to a clean soft cloth and wipe exposed surfaces. An evaporative solution (i.e. alcohol) is recommended.
2. Visually inspect all surfaces (internal and external) to ensure that all cleaning solution has been removed.

Please take the opportunity when calling on institutions in your area of primary responsibility, that own 6400ST and/or 8400ST volume ventilators, to discuss the information presented with the appropriate individuals responsible for equipment cleaning.

If you have any questions regarding the above information, please do not hesitate to contact the technical service department in Palm Springs, California at 800/328-4139 or 619/778-7200.

* 6400ST is a registered trademark of Bird Products Corporation

** 8400ST is a trademark of Bird Products Corporation

tml.cm0035

SALES BULLETIN

TO: All 6400ST and 8400ST Domestic Dealers and Dealer Sales Representatives

SUBJECT: Hospital Grade Outlet Strip (P/N 15050)

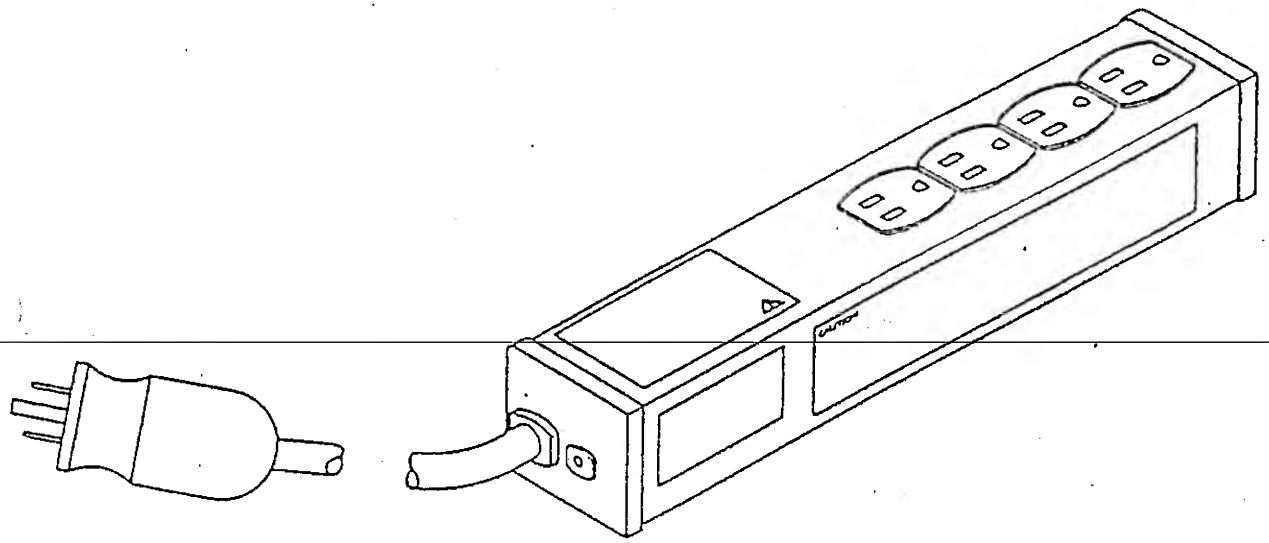
FROM: Gregory M. Oliver, Product Manager DATE: 6/7/90 NO. A0030

Bird Products Corporation is pleased to announce that the Hospital Grade Outlet Strip (P/N 15050) will be available for purchase on July 2, 1990. With four (4) Hospital Grade Outlets, over-current protection and ETL approval, the Hospital Grade Outlet Strip (P/N 15050) will make an outstanding accessory for your 6400ST* or 8400ST* Volume Ventilator Systems.

To order, please contact the Bird Products Customer Service Department in Palm Springs at 619/778-7200 or 800/328-4139.

Part Number	Description	List Price
15050	Hospital Grade Outlet Strip	$125.00

If you have any questions, please contact your local Bird Representative or myself at 714/782-2400.



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*8400ST is a Trademark of Bird Products Corporation

SALES BULLETIN

TO: All International Distributors

SUBJECT: Ventilator Coalescing Inlet Filter Maintenance

FROM: Gregory M. Oliver, Product Manager DATE: 8/08/90 NO. A0020

The ST line of volume ventilators, like other pieces of health care equipment, will require routine maintenance over a period of time. One area of particular attention is the maintenance of the "VENTILATOR COALESCING INLET FILTER". Refer to the following for recommended maintenance interval and removal instructions.

RECOMMENDED MAINTENANCE SCHEDULE

Very 1000 Machine Hours	VENTILATOR INLET FILTER - remove and examine the internal surface of the inlet filter for foreign material. If filter appears to be dirty or discolored, replace with new coalescing filter replacement element (P/N 06146). CAUTION: A dirty inlet filter can reduce the machine's working pressure and subsequently result in a "VENTILATOR INOPERATIVE" condition.

REMOVAL AND INSPECTION INSTRUCTIONS

NOTE: The inlet filter is a coalescing type, not an absorber. To properly determine the cleanliness of the filter element, P/N 06146, it must be removed to examine the "INTERNAL" surface for foreign material as flow enters through the center of the element and out.

- To remove the filter, first unscrew the filter bowl. A belt or flat strap will give added leverage and aid in the removal of the bowl by hand.
- Unscrew filter retainer at bottom of filter and slide filter element off retainer.
- If filter appears "INTERNALLY"to be dirty or discolored, replace with new coalescing filter element, P/N 06146.
- Reinstall filter element and bowl onto ventilator in reverse order of removal. Ensure inlet filter bowl is securely in place.
- Maintenance is now completed.

Please take the opportunity when calling on institutions that own 6400ST and/or 8400ST Volume Ventilators, to reinforce the importance of performing maintenance on the "VENTILATOR COALESCING INLET FILTER". A proactive approach to maintenance will minimize problems in the future.

If you have any questions regarding the above information, please contact me at 714/782-2400, or Technical Service at 619/778-7200.

sales13

SALES BULLETIN

TO: Domestic Dealers and Dealer Sales Representatives

SUBJECT: SERVICE TRAINING PRICING

FROM: Ed Messineo, National Service Manager DATE: XXXXXXX NO. Z0048

BIRD Service Training is often an issue at point of sale. Although it is the Company's policy to provide Service Training to our customers for a fee, it is sometimes the "bargaining chip" that allows us to close the deal.

Whenever we do discount or include Service Training as a no charge item in a sale, it should be listed as a separate line item on written quotes and the invoice with its list price and the discount price or no charge, as the Net Amount. This maintains the value of our program and shows the customer how much we are giving them.

Please use the current pricing and part number information when quoting BIRD Service Training:

PART NO.	DESCRIPTION	PRICE
STEGS	Service Training, 8400ST System	$800.00
STEGL	Service Training, 8400ST Ventilator	$500.00
STSGS	Service Training, 6400ST System	$800.00
STSGL	Service Training, 6400ST Ventilator	$500.00
STJJS	Service Training, VIP Bird System	$800.00
STJJL	Service Training, VIP Bird Ventilator	$675.00
STPTR	Service Training, PARTNER Vol. Monitor	$150.00
STCMP	Service Training, 6500 Compressor	$200.00
STMBL	Service Training, 3800 MicroBlender	$175.00
STMBF	Service Training, MicroBlender Family	$400.00

If you have any questions regarding the above information, please do not hesitate to contact me at 800/328-4139 or 619/778-7200.

bul.dz0048

SECTION 20

6400ST Test Box, Fiber Optic Link Operation Manual

SECTION 20

NON-RECOVERABLE "VENT INOP" CODES

8400ST VOLUME VENTILAOTR
NON-RECOVERABLE "VENT INOP" CODES

Error Code		Description
0	;	Unknown error
1	;	Motor Processor failed to communicate with main processor following power up
2	;	Invalid status in serial interface transmit function
3	;	PAL in reset state
4	;	PAL detected single error
5	;	PAL detected double error
6	;	EPROM checksum test failed
7	;	EPROM CRC test failed
8	;	
9	;	Prox pressure and Machine outlet pressure data do not match sufficiently
10	;	Flow Control Valve failed to home promptly in exhalation XFIZ
11	;	Flow Control Valve failed to home promptly in exhalation XCUT
12	;	Exhalation Valve failed to position promptly in exhalation XPOP
13	;	Exhalation Valve failed to position promptly in exhalation XCUT
14	;	Exhalation Valve not promptly at home for start of exhalation XPOP
15	;	Flow Control Valve failed to close promptly for start of exhalation XTOP
16	;	Exhalation Valve positioning delayed over 240mS by home in progress XPOP
17	;	Exhalation Valve positioning delayed over 240mS by home in progress XCUT
18	;	
19	;	
20	;	Exhalation Valve not closed for start of Square Wave Inspiration
21	;	Flow Control Valve failed to open promptly in Square Wave Inspiration
22	;	Flow Control Valve failed to close promptly in Square Wave Inspiration
23	;	Square Wave Inspiration delayed over 240mS by exhalation home in progress
24	;	
25	;	Exhalation Valve not closed for start of Decelerating Taper Inspiration
26	;	Flow Control Valve failed to open promptly in Decelerating Taper Inspiration
27	;	Flow Control Valve failed to close promptly in Decelerating Inspiration
28	;	Decelerating Taper Inspiration delayed over 240mS by exhalation home in progress

Error Code		Description
29	;	
30	;	A/D #1 overrange in front panel control potentiometer read
31	;	A/D #2 overrange in front panel control potentiometer read
32	;	A/D #1 and A/D #2 multiplexor data does not match in front panel control potentiometer read
33	;	A/D #1 and A/D #2 data does not match in front panel control potentiometer read
34	;	
35	;	
36	;	
37	;	
38	;	
39	;	
40	;	A/D #1 overrange in prox pressure read - simulated full scale data created
41	;	A/D #2 overrange in prox pressure read - simulated full scale data created
42	;	A/D #1 and A/D #2 data do not match in prox pressure read, #1 ¶¶ #2
43	;	A/D #1 and A/D #2 data do not match in prox pressure read, #2 ¶¶ #1
44	;	A/D #1 and A/D #2 data do not match in prox pressure read, data similar
45	;	
46	;	
47	;	
48	;	
49	;	
50	;	A/D #1 overrange in machine pressure read - simulated full scale data created
51	;	A/D #2 overrange in machine pressure read - simulated full scale data created
52	;	A/D #1 and A/D #2 data do not match in machine pressure read, #1 ¶¶ #2
53	;	A/D #1 and A/D #2 data do not match in machine pressure read, #2 ¶¶ #1
54	;	A/D #1 and A/D #2 data do not match in machine pressure read, data similar
55	;	
56	;	
57	;	A/D #1 and A/D #2 data do not match in Flow pressure read, #1 ¶¶ #2
58	;	A/D #1 and A/D #2 data do not match in Flow pressure read, #2 ¶¶ #1
59	;	A/D #1 and A/D #2 data do not match in Flow pressure read, data similar
60	;	A/D #1 overrange in inlet regulator pressure read - simulated data created

Error Code		Description
61	;	A/D #2 overrange in inlet regulator pressure read - simulated data created
62	;	A/D #1 and A/D #2 data do not match in regulator pressure read, #1 ¶¶ #2
63	;	A/D #1 and A/D #2 data do not match in regulator pressure read, #2 ¶¶ #1
64	;	A/D #1 and A/D #2 data do not match in regulator pressure read, data similar
65	;	
66	;	
67	;	
68	;	
69	;	
70	;	A/D #1 overrange in 2.5 volt test reference read
71	;	A/D #1 too high in 2.5 volt test reference read
72	;	A/D #1 too low in 2.5 volt test reference read
73	;	A/D #1 does not match A/D #2 in 2.5 volt test #1 ¶ #2
74	;	
75	;	A/D #2 overrange in 2.5 volt test reference read
76	;	A/D #2 too high in 2.5 volt test reference read
77	;	A/D #2 too low in 2.5 volt test reference read
78	;	A/D #2 does not match A/D #1 in 2.5 volt test #2 ¶ #1
79	;	
80	;	A/D #1 overrange in potentiometer reference read
81	;	A/D #1 too high in potentiometer reference read
82	;	A/D #1 too low in potentiometer reference read
83	;	
84	;	
85	;	A/D #2 overrange in potentiometer reference read
86	;	A/D #2 too high in potentiometer reference read
87	;	A/D #2 too low in potentiometer reference read
88	;	
89	;	
90	;	Can't find mode switch when Patient Effort detected in exhalation
91	;	Can't find mode switch when Vol Breath to be delivered with breath rate timer reset in exhalation
92	;	Can't find mode switch when Vol Breath to be delivered without breath rate timer reset in exhalation
93	;	
94	;	Failure of processor B to respond to 1 ms interrupt
95	;	
96	;	
97	;	
98	;	
99	;	
100	;	Internal RAM memory test failed Pass 1, invert bit DPL, Byte B
101	;	Internal RAM memory test failed Pass 1, read/verify, byte DPH

Error Code		Description
102	;	Internal RAM memory test failed Pass 2, invert bit DPL, Byte B
103	;	Internal RAM memory test failed Pass 2, read/verify, byte DPH
104	;	
105	;	External RAM memory 0 test failed Pass 1, invert bit B, Byte R0
106	;	External RAM memory 0 test failed Pass 1, read/verify, byte R1
107	;	External RAM memory 0 test failed Pass 2, invert bit B, Byte R0
108	;	External RAM memory 0 test failed Pass 2, read/verify, byte R1
109	;	
110	;	Exhalation valve failed to home at system start up
111	;	Exhalation valve failed position trial at system start up
112	;	Flow control valve failed to home at system start up
113	;	
114	;	External RAM memory test failed Pass 3, address bit
115	;	External RAM memory test failed Pass 4, inverted address bit
116	;	
117	;	Prox and Machine pressure data do not match sufficiently during exhalation
118	;	
119	;	Exhalation valve not closed for start of Servo Inspiration
180	;	A/D #1 overrange in Exhalation Reference voltage read
181	;	A/D #1 too high in Exhalation Reference voltage read
182	;	A/D #1 too low in Exhalation Reference voltage read
183	;	
184	;	
185	;	A/D #2 overrange in Exhalation Reference voltage read
186	;	A/D #2 too high in Exhalation Reference voltage read
187	;	A/D #2 too low in Exhalation Reference voltage read
188	;	
189	;	
190	;	Communication fault - Motor Processor reports lost data byte(s) from main
191	;	Communication fault - Motor Processor reports lost header from main
192	;	Communication fault - Main Processor reports lost data byte(s) from motor
193	;	Communication fault - Main Processor reports lost header from motor
194	;	
195	;	
196	;	
197	;	
198	;	

199 ;
200 ;
201 ;
202 ;
203 ;
204 ;
205 ;
206 ;
207 ;
208 ;
209 ;
210 ; Motor Processor encountered illegal flow valve motion control state 00
211 ; Motor Processor encountered illegal flow valve motion control state 0D
212 ; Motor Processor encountered illegal flow valve motion control state 10
213 ; Motor Processor encountered illegal flow valve motion control state 1D
214 ;
215 ; Motor Processor encountered illegal exhalation motion control state 00
216 ; Motor Processor encountered illegal exhalation motion control state 0D
217 ; Motor Processor encountered illegal exhalation motion control state 10
218 ; Motor Processor encountered illegal exhalation motion control state 1D
219 ;
220 ; Motor Proc Int RAM memory test failed Pass 1, invert @SP, Bit B should not be set
221 ; Motor Proc Int RAM memory test failed Pass 1, read/verify, byte R0
222 ; Motor Proc Int RAM memory test failed Pass 2, invert @SP, Bit B should not be clr
223 ; Motor Proc Int RAM memory test failed Pass 2, read/verify, byte R0
224 ;
225 ;
226 ;
227 ;
228 ;
229 ;
230 ; Motor Processor timed out awaiting comm from main processor
231 ;
232 ;
233 ;
234 ;
235 ;
236 ; Motor Processor Program Memory checksum test failed

```
237   ;
238   ;
239   ;
240   ;     A/D #1 overrange in Negative Bias voltage read
241   ;     A/D #1 too high in Negative Bias voltage read
242   ;     A/D #1 too low in Negative Bias voltage read
243   ;
244   ;
245   ;     A/D #2 overrange in Negative Bias voltage read
246   ;     A/D #2 too high in Negative Bias voltage read
247   ;     A/D #2 too low in Negative Bias voltage read
248   ;
249   ;
250   ;     Operator Initiated Safety System Test
251   ;
252   ;
253   ;
254   ;
255   ;
```

NOTE: Fault Codes that "DO NOT" have a description, are presently not used.

a:/84aerr.equ

SECTION 21

Warranty

The products of Bird Products Corporation (Bird herein) are warranted to be free from defects in materials and workmanship and to meet the published specifications.

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

Any authorization of Bird for repair or alteration by the Buyer must be in writing to prevent voiding warranty. In no event shall Bird be liable to 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.

Bird 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 Bird or its agents in connection with 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 or parts. This warranty shall be void and shall not apply if the equipment is used with accessories or parts not manufactured by Bird or authorized for use in writing by Bird, 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 one year from date of delivery with the following exceptions:

1. All components for remote monitoring of physical variables such as temperature, pressure, oxygen saturation 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 Bird has no control are warranted for sixty (60) days from date of receipt.

The foregoing is in lieu of any other warranty, expressed or implied, including, without limitation, any warranty of merchantability, except as to title, and can be amended only in writing by a duly authorized representative of Bird.

CALIBRATION OF BIRD 8400T SERIES

FLOW SUPPORT ONLY

STEP 1.

1. Turn on Ventilator.
2. Connect circuit to ventilator and attach a "Test lung".
3. Set front panel as below-

	800	46	13	10	OFF	10
80	4	-4	4.4	36	27	17

STEP 2.

1. On the DISPLAY panel, press the INS/EXP button until IHOL (I hold) is displayed on the LED.
2. Press the SELECT button (under LED) ON INSPIRATION and hold for approximately 6 seconds.
3. Note the **number displayed** and watch if the number remains static or falls.
4. If the number is stable, proceed to step 3. If it fails investigate further as in Point 1.

STEP 3.

1. Turn the grey end of the transducer to the left and then immediately to the right.
2. Observe the LED and note CAL (Calibrate) will display.
3. Depress the manual button on the DISPLAY panel until an audible sound of oxygen passing through the circuit is heard.
4. Observe the LED and note if the number is the same noted in STEP 2.
5. If the number remains static proceed to STEP 4. If it fails investigate further as in Point 1.

STEP 4.

1. Press the INS/EXP button and scroll through the LED until MV (Minute Volume) is highlighted on the LED.
2. Press SELECT button under LED and highlight Tidal Volume.
3. Note if Tidal Volume displayed is the same as the set number on the front Panel (as in STEP 1). A variation of approximately 10% is acceptable.

POINT 1.

If the test has failed in STEP 2 or 3 check the following-

1. If all the connections of the circuit are tightly fitted.
2. If the Water Trap is fitted securely.
3. If there is possibly a leak/hole in the silicone circuit.
4. If the 111 flange is properly in position.

POINT 2.

Further Troubleshooting if Required Prior to Calibration.

DEACTIVATION OF PRESSURE CONTROL OPTION

To activate the Pressure Control and resume volume ventilation, the following steps must be implemented:

1. Decrease the inspiratory control to 5 cm.
2. Depress pressure control key (LED will not be lit).
3. Adjust tidal volume to deliver ordered parameters.
4. Adjust peak flow.
5. Check alarm limits and adjust accordingly.

TO CANCEL THE INSPIRATORY PAUSE FUNCTION

ACTION	KEY	DISPLAY
Press	Insp/Exp & Hold	1 HLD
Press	Insp/Exp & Hold	E HLD
Press	Insp/Exp & Hold	IPXX
Press	Reset	IP 0.0
Press	Insp/Exp & Hold	X:XX

TROUBLESHOOTING THE 8400ST

PROBLEM	POTENTIAL CAUSE	ACTION
"Ventilator Inoperative" LED lights & audible alarm sounds & all displays are disabled	1. Loss of electrical power. 2. Low inlet gas pressure 3. System failure	1. Restore electrical power 2. Restore inlet gas pressure 3. Contact Bird distributor
Ventilator unable to power up (no lights or alarms)	1. Power cord not plugged into wall or unit. 2. No power at wall outlet. 3. AC/ALT Power switch set to ALT Power 4. Fuse blown in power entry 5. System failure	1. Plug power cord into wall or unit. 2. Use alternate wall outlet 3. Switch to AC access position. 4. Contact Bird distributor. 5. Contact Bird distributor.
Tidal Volume display flashing (no audible alarm)	Set Tidal Volume is too large for Peak Flow and Breath Rate setting (incompatible setting)	1. Reset ventilator parameters.
Peak Flow display flashing (no audible alarm).	Set Peak Flow is too high for Tidal volume setting (incompatible setting).	1. Reset ventilator settings.
Low Inlet gas LED lights and audible alarm sounds. Source gas pressure OK (35-75 PSIG)	1. Obstructed blender inlet filters. 2. Clogged ventilator inlet filter	1. Replace blender 2. Replace inlet filter
Low Minute Volume Alarm activated "..." appears in window	1. Flow transducer connector not installed properly. 2. Defective Flow Transducer Assembly. 3.	1. Reinstall Flow Transducer connector. 2. Replace Flow Transducer Assembly.
Low Minute Volume Alarm activated "0" Minute Volume reading	1. Flow Transducer not connected to Exhalation Valve properly. 2. Defective Flow Transducer Assembly. 3. Flow Delivery system not operating properly. 4. Circuit disconnected. 5.	1. Check for proper connection. 2. Replace Flow Transducer Assembly. 3. Contact Bird distributor. 4. Reconnect circuit.
Low Minute Volume Alarm activated	Leak or disconnection in the patient circuit including the humidifier system.	1. Check for circuit leaks (humidifer included) and patient disconnection. 2. Readjust alarm. 3. Replace Flow Transducer Assembly. 4.
Back Up Breath rate flashing (no audible alarm)	1. The set Back Up Breath rate is set too high for Tidal Volume and Peak Flow settings (incompatible settings). 2. The set Back Up Breath rate is lower than the Primary Breath rate. 3.	1. Replace Flow Transducer Assembly. 2. Re-evaluate and reset Back Up Breath Rate.
Inaccurate Tidal Volume reading.	1. Defective Flow Transducer Assembly. 2. Ventilator out of calibration	1. Replace Flow Transducer Assembly. 2. Contact Bird distributor

- 9929 8725.

CALIBRATION OF BIRD 8400T SERIES

FLOW SUPPORT ONLY

STEP 1.

1. Turn on Ventilator.
2. Connect circuit to ventilator and attach a "Test lung".
3. Set front panel as below-

	800	46	13	10	OFF	10
80	4	-4	4.4	36	27	17

STEP 2.

1. On the DISPLAY panel, press the INS/EXP button until IHOL (I hold) is displayed on the LED.
2. Press the SELECT button (under LED) ON INSPIRATION and hold for approximately 6 seconds.
3. Note the **number displayed** and watch if the number remains static or falls.
4. If the number is stable, proceed to step 3. If it fails investigate further as in Point 1.

STEP 3.

1. Turn the grey end of the transducer to the left and then immediately to the right.
2. Observe the LED and note CAL (Calibrate) will display.
3. Depress the manual button on the DISPLAY panel until an audible sound of oxygen passing through the circuit is heard.
4. Observe the LED and note if the number is the same noted in STEP 2.
5. If the number remains static proceed to STEP 4. If it fails investigate further as in Point 1.

STEP 4.

1. Press the INS/EXP button and scroll through the LED until MV (Minute Volume) is highlighted on the LED.
2. Press SELECT button under LED and highlight Tidal Volume.
3. Note if Tidal Volume displayed is the same as the set number on the front Panel (as in STEP 1). A variation of approximately 10% is acceptable.

POINT 1.

If the test has failed in STEP 2 or 3 check the following-

1. If all the connections of the circuit are tightly fitted.
2. If the Water Trap is fitted securely.
3. If there is possibly a leak/hole in the silicone circuit.
4. If the 111 flange is properly in position.

POINT 2.

Further Troubleshooting if Required Prior to Calibration.

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To activate the Pressure Control and resume volume ventilation, the following steps must be implemented:

1. Decrease the inspiratory control to 5 cm.
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4. Adjust peak flow.
5. Check alarm limits and adjust accordingly.

TO CANCEL THE INSPIRATORY PAUSE FUNCTION

ACTION	KEY	DISPLAY
Press	Insp/Exp & Hold	1 HLD
Press	Insp/Exp & Hold	E HLD
Press	Insp/Exp & Hold	IPXX
Press	Reset	IP 0.0
Press	Insp/Exp & Hold	X:XX

TROUBLESHOOTING THE 8400ST

PROBLEM	POTENTIAL CAUSE	ACTION
"Ventilator Inoperative" LED lights & audible alarm sounds & all displays are disabled	1. Loss of electrical power. 2. Low inlet gas pressure 3. System failure	1. Restore electrical power 2. Restore inlet gas pressure 3. Contact Bird distributor
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Tidal Volume display flashing (no audible alarm)	Set Tidal Volume is too large for Peak Flow and Breath Rate setting (incompatible setting)	1. Reset ventilator parameters.
Peak Flow display flashing (no audible alarm).	Set Peak Flow is too high for Tidal volume setting (incompatible setting).	1. Reset ventilator settings.
Low Inlet gas LED lights and audible alarm sounds. Source gas pressure OK (35-75 PSIG)	1. Obstructed blender inlet filters. 2. Clogged ventilator-inlet-filter	1. Replace blender 2. Replace inlet filter
Low Minute Volume Alarm activated "..." appears in window	1. Flow transducer connector not installed properly. 2. Defective Flow Transducer Assembly. 3.	1. Reinstall Flow Transducer connector. 2. Replace Flow Transducer Assembly.
Low Minute Volume Alarm activated "0" Minute Volume reading	1. Flow Transducer not connected to Exhalation Valve properly. 2. Defective Flow Transducer Assembly. 3. Flow Delivery system not operating properly. 4. Circuit disconnected. 5.	1. Check for proper connection. 2. Replace Flow Transducer Assembly. 3. Contact Bird distributor. 4. Reconnect circuit.
Low Minute Volume Alarm activated	Leak or disconnection in the patient circuit including the humidifier system.	1. Check for circuit leaks (humidifier included) and patient disconnection. 2. Readjust alarm. 3. Replace Flow Transducer Assembly. 4.
Back Up Breath rate flashing (no audible alarm)	1. The set Back Up Breath rate is set too high for Tidal Volume and Peak Flow settings (incompatible settings). 2. The set Back Up Breath rate is lower than the Primary Breath rate. 3.	1. Replace Flow Transducer Assembly. 2. Re-evaluate and reset Back Up Breath Rate.
Inaccurate Tidal Volume reading.	1. Defective Flow Transducer Assembly. 2. Ventilator out of calibration	1. Replace Flow Transducer Assembly. 2. Contact Bird distributor