Service Manual

A5™ | A4™ | A3™

Anesthesia System

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A5™ | A4™ | A3™

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Table of Contents

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Foreword

This Service Manual is intended as a guide for technically qualified personnel performing repair and calibration procedures.

Warnings, Cautions, and Notes

Please read and adhere to all warnings, cautions, and notes listed here and in the appropriate areas throughout this manual.

A WARNING is provided to alert the user to potential serious outcomes (death, injury, or serious adverse events) to the patient or the user.

A CAUTION is provided to alert the user to use special care necessary for the safe and effective use of the device. They may include actions to be taken to avoid effects on patients or users that may not be potentially life threatening or result in serious injury, but about which the user should be aware. Cautions are also provided to alert the user to adverse effects on this device of use or misuse and the care necessary to avoid such effects.

A NOTE is provided when additional general information is applicable.

Warnings

WARNING: Whenever using anesthetic gases, nitrous oxide, oxygen, or any hospital gas, always follow the appropriate agent evacuation/collection procedures. Use the hospital gas evacuation system.

WARNING: Use only an approved lubricant on any O-ring in contact with oxygen. Krytox® is the recommended oxygen service lubricant.

WARNING: For continued protection against fire hazard, replace all fuses with the specified type and rating.

WARNING: In order to prevent an electric shock, the machine (protection class I) may only be connected to a correctly grounded mains connection (socket outlet with grounding contact).

WARNING: Remove all accessory equipment from the shelf before moving the anesthesia machine over bumps or on any inclined surface. Heavy top loading can cause the machine to tip over causing injury.

WARNING: Possible explosion hazard. Do not operate machine near flammable anesthetic agents or other flammable substances. Do not use flammable anesthetic agents (e.g., ether or cyclopropane.)

WARNING: The use of anti-static or electrically conductive respiration tubes, when utilizing high frequency electric surgery equipment, may cause burns and is therefore not recommended in any application of this machine.

WARNING: Possible electric shock hazard. The machine may only be opened by authorized service personnel.

WARNING: **Compressed gasses are considered Dangerous Goods/Hazardous Materials per I.A.T.A (International Air Transport Association). and D.O.T. (Department Of Transport) regulations. It is a violation of federal and international law to transport dangerous goods without the packages being appropriately identified, packed, marked, classified, labeled and documented according to D.O.T. and I.A.T.A. regulations. Please refer to the applicable I.A.T.A. Dangerous Goods Regulations and /or the Code of Federal Regulations 49 (Transportation, Parts 171-180) for further information.**

WARNING: **Avoid exposure to respiratory gases by always directing the fresh gas flow from the fresh gas outlet to the waste gas scavenger.**

WARNING: **When using the AG module to perform AG measurements on the patients who are receiving or have recently received anesthetic agents,connect the outlet to the waste gas disposal system to prevent the medical staff from breathing in the anesthetic agents.**

WARNING: **Remove the airway sampling line from the patient's airway and seal the sample port while nebulized medications are being delivered.Nebulized medications interfere with accuracy gas reading.**

WARNING: **Before connecting the exhaust line to the sample gas outlet on the compact airway module,ensure the other end is connected to the sample gas return port on the anesthesia machine.Incorrect connections may cause patient injury.**

WARNING: **Perform factory calibration in the working environment after completion of anesthesia machine assembling.Contact us if factory calibration is required during system use.**

WARNING: **Do not perform testing or maintenance on A5/A4/A3 anesthesia machine while it is being used on a patient.Possible injury can result.**

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

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

Cautions

CAUTION: **This device uses high pressure compressed gas. When attaching or disconnecting backup gas cylinders, always turn the cylinder valves slowly. Use the A5/A4/A3 flow meters to bleed down the pressure, watching the cylinder gauge indicate the depleting cylinder pressure, before disconnecting the cylinder from the yoke. Always open and close cylinder valves fully.**

CAUTION: **This device operates using compressed gas at high pressures from the hospital central supply. When connecting gas supply lines attach the hose connection to the machine before connecting the quick disconnect fitting to the hospital source. Disconnect the supply hose from the hospital source connection prior to disconnecting it from the A5/A4/A3 gas connection fittings.**

CAUTION: **Refer to section 3.3 Periodical Maintenance Schedule for assistance when performing scheduled periodic maintenance.**

CAUTION: **Do not leave gas cylinder valves open if the pipeline supply is in use and the system master switch is turned to 'ON'. If used simultaneously, cylinder supplies could be depleted, leaving an insufficient reserve supply in the event of pipeline failure.**

CAUTION: **Use cleaning agent sparingly. Excess fluid could enter the machine, causing damage.**

CAUTION: **This machine must only be operated by trained, skilled medical staff.**

CAUTION: **Perform the electrical safety inspection as the last step after completing a repair or after routine maintenance. Perform this inspection with all covers, panels, and screws installed.**

CAUTION: **After changing the CO2 absorbent, carry out a system leak test.**

CAUTION: **Only Selectatec™ compatible vaporizers with Interlock-System may be used with the A5/A4/A3 unit.**

CAUTION: **After each exchange of a vaporizer, carry out a system Leak test.**

CAUTION: **Do not clean the machine while it is on and/or plugged in.**

CAUTION: **Pressing "cancel" at any time during the procedure will cancel the session's settings and reload the previously-stored calibration coefficients.**

CAUTION: **Depleted sodalime changes color. Replace the sodalime if approximately 2/3 of the absorber content is discolored. CO2 absorbent can be safely changed without stopping mechanical ventilation.**

CAUTION: **This equipment contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautionary procedures when touching, removing, or inserting parts or assemblies.**

CAUTION: **The watertrap collects water drops condensed in the sampling tube and therefore prevents them from entering the AG module.If the collected water reaches a certain amount, you should drain it to avoid airway blockage.**

CAUTION: **The watertrap has a filter preventing bacterium,vapor and patient secretions from entering the module.After a long-term use,dust or other subtances may compromise the performance of the filter or even block the airway.In the case, replace the watertrap.Replacing the watertrap once a month is recommended.**

CAUTION: **Strong scavenging suction on the AG monitor exhaust port nay change the operating presure of the monitor and cause inaccurate readings or internal damage.**

Notes

NOTE: **Unauthorized servicing may void the remainder of the warranty. Check with the factory or with a local authorized distributor to determine the warranty status of a particular instrument.**

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1.0 Theory of Operation

1.1 Introduction

The A5/A4/A3 Anesthesia System is a continuous flow inhalation gas anesthesia system that delivers anesthetic vapor, and provides for automatic and manual modes of ventilation. It is equipped with a monitoring system for ventilation, inspired, and expired gas. The A5/A4/A3 is intended for use in operating rooms. It will be used with O2, N2O, and AIR supplied by a medical gas pipeline system or by externally mounted gas cylinders. Anesthetic agents can be delivered via vaporizers mounted on the machine.

Electronic PEEP is available in all ventilation modes. User control over inspiratory flow (Tslope) is possible in PCV, SIMV, and PS modes. Automatic fresh gas compensation limits the effect on the patient ventilation from changes in fresh gas flow rate by the operator. The traditional bellows system is driven by oxygen and makes patient disconnections clearly visible.

The A5/A4/A3 fresh gas dosing subsystem offers the ease of use and features of a traditional anesthesia system. The dual-flow tubes electronic flowmeter, which includes redundant numerical readouts, displays the O2, N2O, and Air flows at all times. A knob guard prevents inadvertent movement of the flow control knobs. Gas supply gauges and auxiliary O2/Air flowmeters with blended output indicate the gas pipeline supply pressures and gas cylinder pressures. An auxiliary O2 flowmeter is placed at a convenient location for the operator. The O2 flush button is in the traditional location near the front left corner of the table top.

Safety systems within the A5/A4/A3 work to prevent hypoxic mixtures from being delivered to the patient. Nitrous oxide will not be delivered unless oxygen pressure is present. A pneumatic safety system assures that at least 21% O2 is present when setting mixtures of O2 and N2O.

The A5/A4/A3 breathing system is warmed to minimize condensation inside the breathing system block and to return humid gas to the patient. The breathing system provides easy access to the Airway Pressure Limiting (APL) valve and breathing bag, and easy viewing of the Airway Pressure gauge (PAW). The APL valve has a comfortable, single turn knob that provides a clear view of the manual breathing pressure setting. The absorber assembly incorporates a cam lock device that is convenient to open and close. CO2 absorbent Pre-paks or loose fill can be used. A water trap that can be drained is also provided on the absorber assembly.

Two flow sensors in the breathing system measure inspired and expired gases for control and monitoring. Spirometry is standard on the A5. Inspired oxygen is monitored via a fuel-cell type sensor. Breathing pressure is also monitored. The breathing system can swivel into position. A test plug, next to the two main hose connections, allows automated leak testing during startup. The Anesthesia Gas Scavenging System (AGSS) connections are at the rear of A5/A4/A3.

The A5/A4/A3 is powered by an AC power source. In turn, the A5/A4/A3 power management system provides DC power for its main system functions while charging its internal battery supply. In case of AC power failure, the A5/A4/A3 operates on battery power for a minimum of 75 minutes with one (1) new battery installed (A3) or 150 minutes with two (2) new batteries installed (A5). A recessed main switch is provided to power the system ON and OFF. Four (4) auxiliary AC outlets on the A5 and three (3) auxiliary AC outlets on the A3 at the rear of the machine operate independently of the main switch position.

NOTE: The breathing system warmer does not operate when the A5/A4/A3 is on battery power.

NOTE: If the main switch is set to OFF, the O2 fresh gas flow will not flow.

1.2 Electrical and Pneumatic Connections

1.2.1 Electrical Connections (A3/A4)

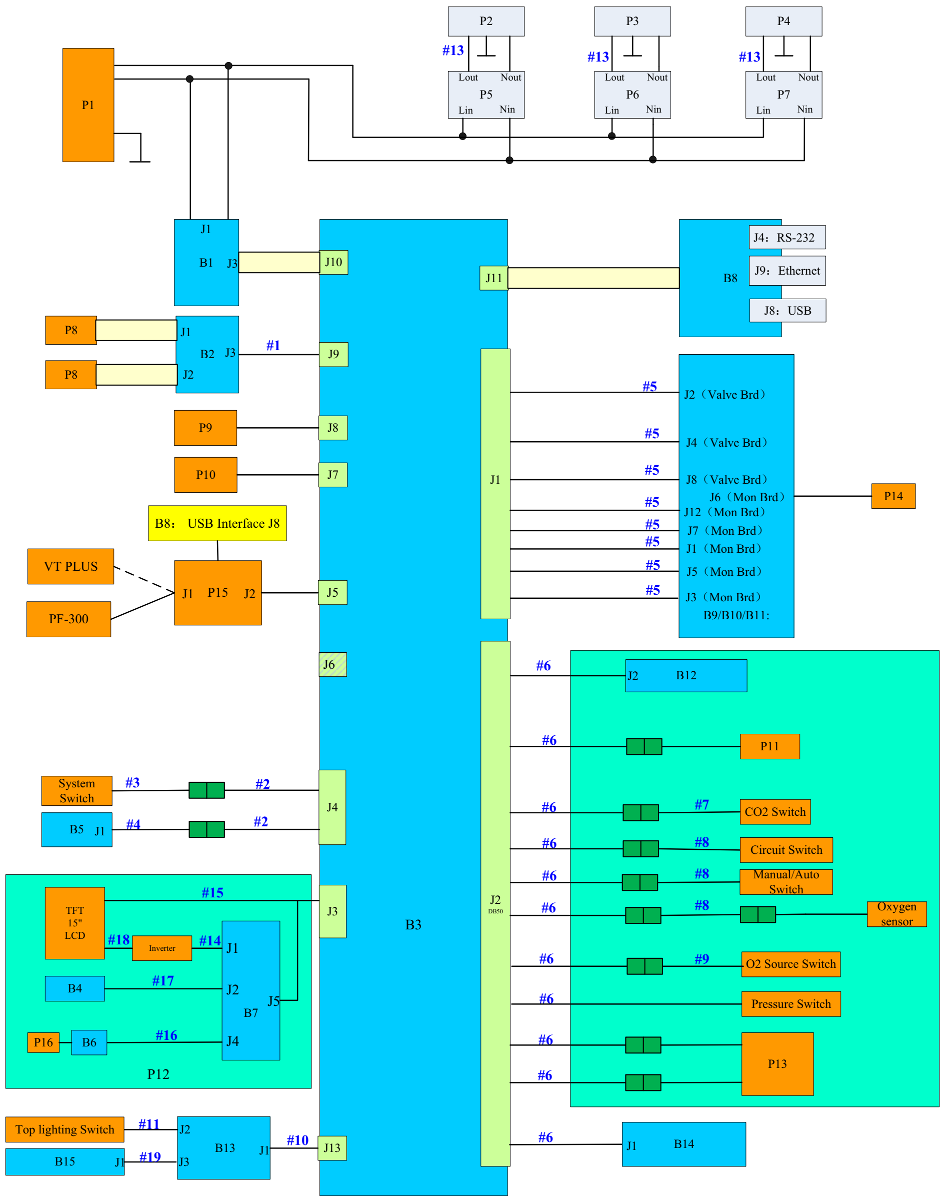


FIGURE 1-1 A3/A4 Electrical Connections

No.	Description	P/N
B1	Power Board	801-0631-00025-00
B2	Battery Interface Board	801-0631-00109-00
B3	Mother Board	801-0631-00108-00
B4	Warning Light Board	801-0631-00019-00
B5	Indicator Light Board	801-0631-00004-00
B6	Touch Screen Control Board	801-0631-00018-00
B7	Display Interface Board	801-0631-00017-00
B8	CPU Board	801-0633-00004-00 115-052901-00 (A4) 115-056938-00 (A5 EPSON, New) 115-056937-00 (A3 EPSON, New) 115-056940-00 (A5 DSP, New) 115-056941-00 (A4 DSP, New)
B9-11	Ventilator Control Board	801-0631-00027-00 115-058771-00 (DSP)
B12	Sensor Interface board	801-0631-00089-00 (A3)
B13	Top Lighting Board	801-0631-00039-00
B14	Electronic Flowmeter Assembly	115-046746-00
B15	Aux FlowMeter Lighting Board	/
P1	Filter Power 250VAC 15A Panel Mount (0633)	801-0633-00003-00
P2-4	Auxiliary Output Socket	801-0631-00032-00
P5-7	Breaker (3.0A)	801-0631-00031-00
P8	Lithium-ion Battery	115-018012-00
P9	Speaker and Connecting Cable	801-0631-00038-00
P10	Fan	801-0631-00028-00
P11	Drive Gas Assembly	801-0631-00047-00 (For software bundle versions earlier than 02.04.00, EPSON platform) 115-020937-00(For software bundle version 02.04.00 and later, EPSON platform) 115-052762-00 (DSP platform)
P12	Display Exchange Package	801-0631-00075-00
P13	Circuit Heater	115-034450-00
P14	Solenoid valve assembly	801-0631-00046-00
P15	A5 Calibration set FRU	801-0631-00121-00
P16	Touch Screen	801-0631-00014-00
#1	Cable, battery	009-000969-00
#2	Cable, Patient Monitor	009-000971-01
#3	Cable, System Switch	009-001776-00

No.	Description	P/N
#4	Cable, Indicator	009-000977-00
#5	Cable, Ventilator	009-000979-00
#6	Cable, Breathng System	009-000980-00
#7	Cable, Sodalime Canister Switch Cable	009-000987-00
#8	Cable, Circuit Switch	0621-20-78593
#9	Cable, O2 Pressure Switch	0621-20-69588
#10	Cable, Top Lighting A	009-000982-00
#11	Cable, Lighting Switch	009-000981-00
#12	Cable, AC Power Cable	009-002224-00
#13	Cable, Power, AC Internal	009-000985-01
#14	Cable, Inverter Cable(old) Cable,LED Backlight Input(new)	009-000988-00 (old) 009-006382-00 (new)
#15	Cable, Display	009-000973-00
#16	Cable, Touch Screen	009-000978-00
#17	Cable, Alarm	009-000976-00
#18	Cable, Inverter LED (old) Cable,Screen Backlight (new) **NOTE:** **When there is a Screen Backlight Board (See section 1.6.1.3 (pg. 1-48) "Screen Backlight Board"), please use the new cable.**	009-000974-00 (old) 009-006731-00 (new)
#19	Cable, Display Lighting	009-000986-00

1.2.2 Electrical Connections (A5)

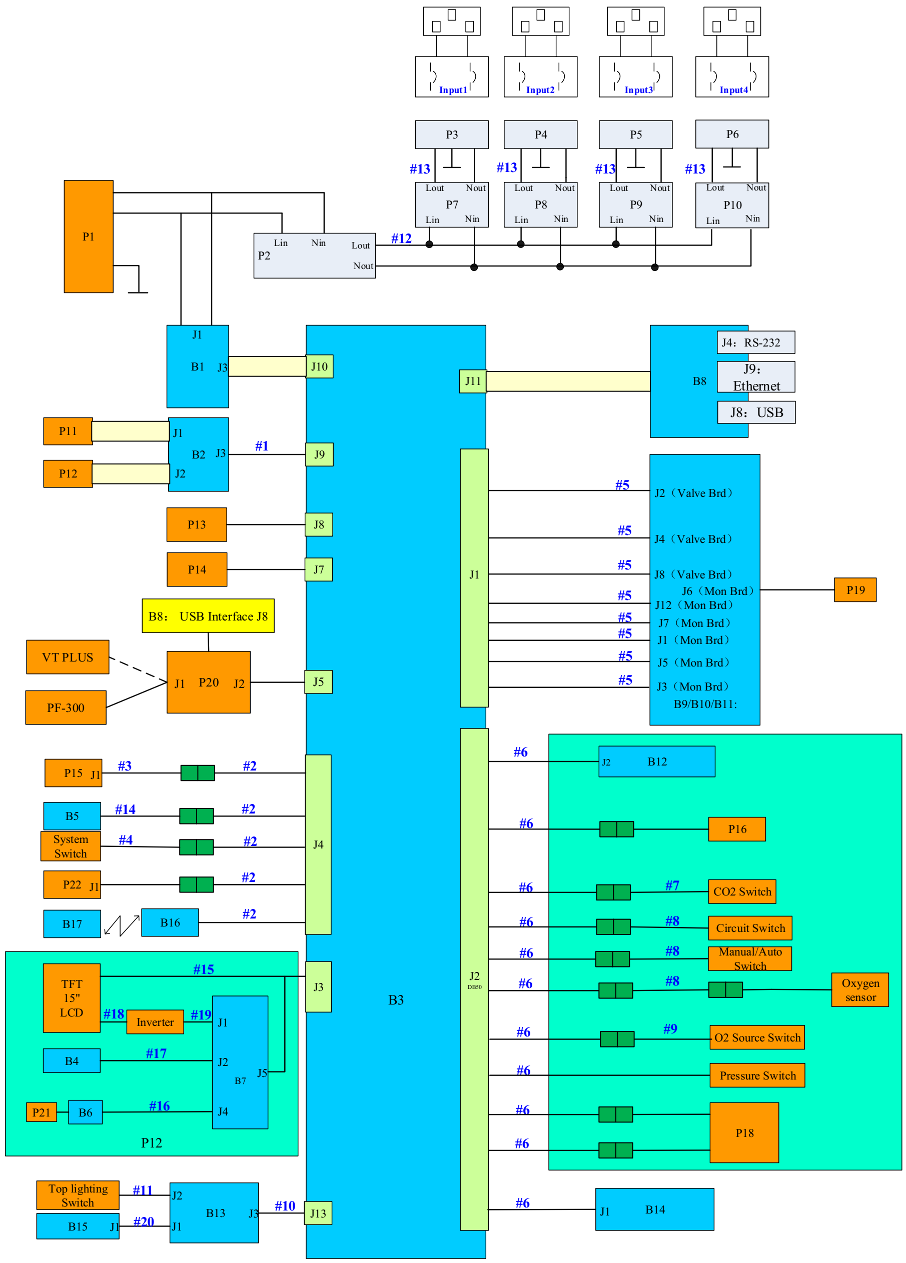


FIGURE 1-2 A5 Electrical Connections

No.	Description	P/N
B1	Power Board	801-0631-00025-00
B2	Battery Interface Board	801-0631-00109-00
B3	Mother Board	801-0631-00108-00
B4	Warning Light Board	801-0631-00019-00
B5	Indicator Light Board	801-0631-00004-00
B6	Touch Screen Control Board	801-0631-00018-00
B7	Display Interface Board	801-0631-00017-00
B8	CPU Board PCBA	801-0631-00026-00 (A5 EPSON Platform) 115-052902-00 (A5 DSP platform)
B9-11	Ventilator Control Board	801-0631-00027-00 (A5 EPSON Platform) 115-058771-00
B12	Sensor Interface board	801-0631-00089-00 (EPSON)
B13	Top Lighting Board	801-0631-00039-00
B14	Electronic flowmeter assembly	115-046746-00
B15	Aux FlowMeter Lighting Board	/
B16	Infrared Communication Board	801-0621-00165-00
B17	AG Module	6800-30-50502
P1	Filter Power 250VAC 10A Panel Mount (0631)	801-0631-00029-00
P2	Breaker (10.0A)	801-0631-00030-00
P3-6	Auxiliary Output Socket	801-0631-00032-00
P7-10	Breaker (3.0A)	801-0631-00031-00
P11-12	Lithium-ion Battery	115-018012-00
P13	Speaker and Connecting Cable	801-0631-00038-00
P14	Fan	801-0631-00028-00
P15	Touchpad	801-0631-00052-00
P16	Drive Gas Assembly	801-0631-00047-00 (For software bundle versions earlier than 02.04.00, EPSON platform) 115-020937-00(For software bundle version 02.04.00 and later, EPSON platform) 115-052762-00 (DSP platform)
P17	Display Exchange Package	801-0631-00075-00
P18	Circuit Heater	801-0631-00069-00
P19	Solenoid valve assembly	801-0631-00046-00
P20	A5 calibration set FRU	801-0631-00121-00
P21	Touch Screen	801-0631-00014-00
P22	Fan	024-000407-00
#1	Cable, battery	009-000969-00

No.	Description	P/N
#2	Cable, Patient Monitor	009-000971-01
#3	Cable, Touchpad	009-000972-00
#4	Cable, System Switch	009-001776-00
#5	Cable, Ventilator	009-000979-00
#6	Cable, Breathng System	009-000980-00
#7	Cable, Sodalime Canister Switch Cable	009-000987-00
#8	Cable, Circuit Switch	0621-20-78593
#9	Cable, O2 Pressure Switch	0621-20-69588
#10	Cable, Top Lighting A	009-000982-00
#11	Cable, Lighting Switch	009-000981-00
#12	Cable, Auxiliary Outlet	009-000984-00
#13	Cable, Power, AC Internal	009-000985-01
#14	Cable, Indicator	009-000977-00
#15	Cable, Display	009-000973-00
#16	Cable, Touch Screen	009-000978-00
#17	Cable, Alarm	009-000976-00
#18	Cable, Inverter LED (old) Cable,Screen Backlight(new)	009-000974-00 (old) 009-006731-00 (new)
#19	Cable, Inverter Cable(old) Cable,LED Backlight Input(new) **NOTE:** **When there is a Screen Backlight Board (See section 1.6.1.3 (pg. 1-48) "Screen Backlight Board"), please use the new cable.**	009-000988-00 (old) 009-006382-00 (new)
#20	Cable, Display Lighting	009-000986-00

1.2.3 Pneumatic Connections (A3/A4)

NOTE: **This diagram reflects the latest version of the pneumatic connections. Please refer to label on the back of the service door of the anesthesia system.**

NOTE: **The green tube in the tube diagram needs to paste the oxygen label.**

NOTE: **The orange tube in the tube diagram needs to paste the air label.**

NOTE: **The blue tube in the tube diagram needs to paste the N2O label.**

NOTE: **The black tube in the tube diagram needs to paste the neutral label.**

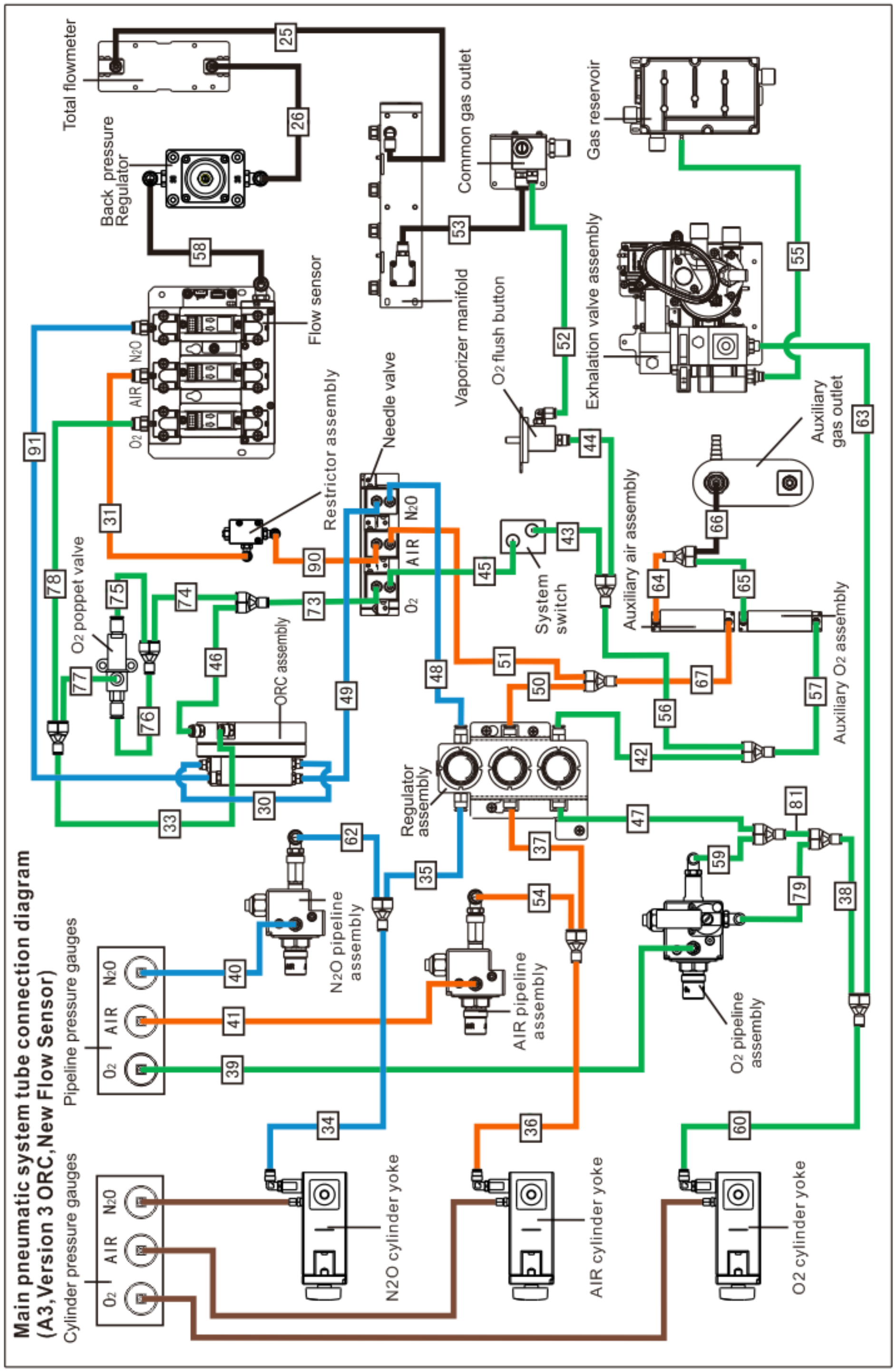


FIGURE 1-3 A3 Pneumatic Connections

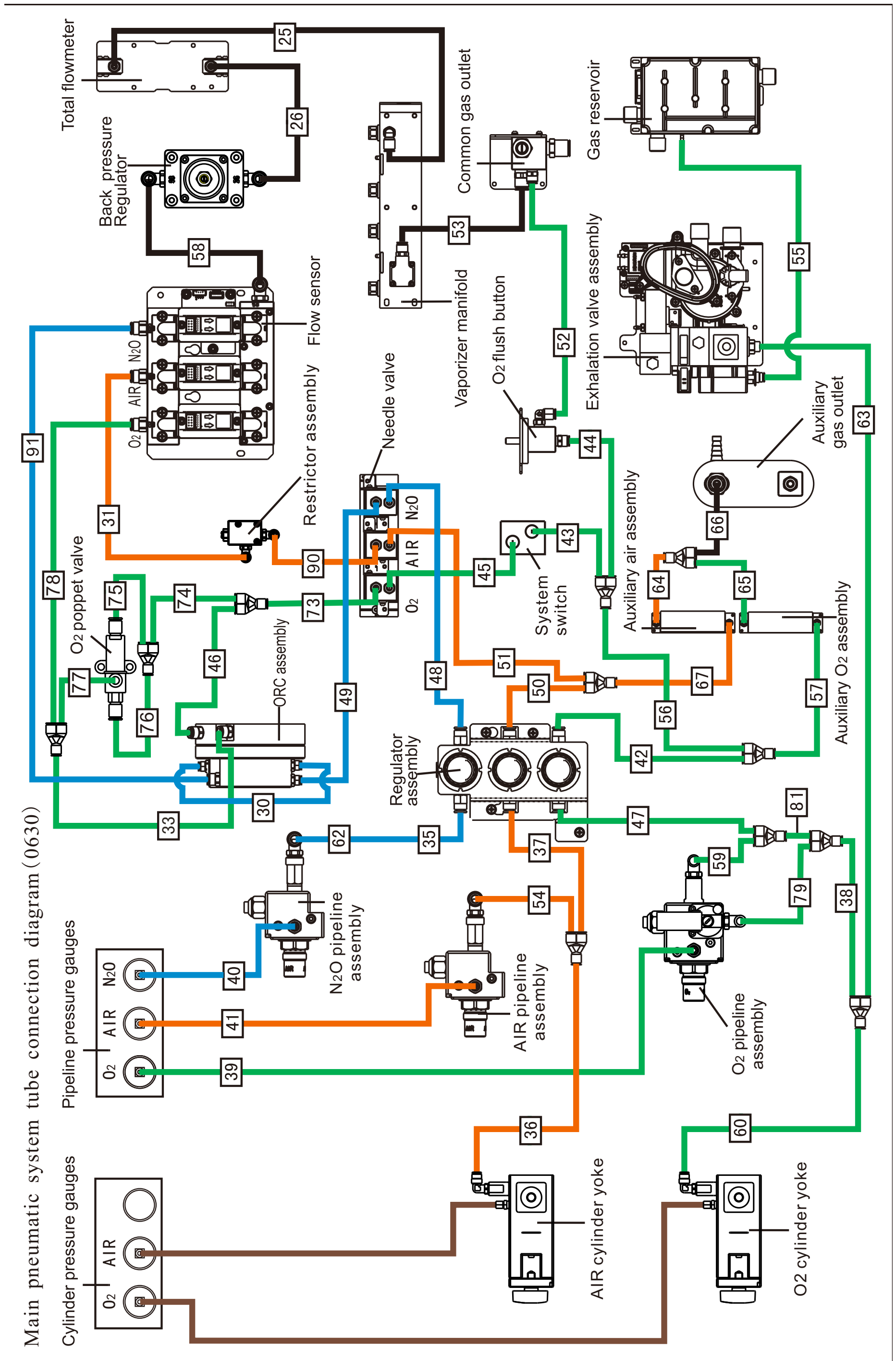


FIGURE 1-4 A4 Pneumatic Connections

S/N	From	To	P/N
25	Total Flow Meter	Vaporizer Manifold	M6G-020014---
26	Back Pressure Regulator	Total Flow Meter	M6G-020014---
27	N2O Flow Sensor	Gas Mixer	M6G-020026---
28	Air Flow Sensor	Gas Mixer	M6G-020026---
29	O2 Flow Sensor	Gas Mixer	M6G-020026---
30	Restrictor Assembly	ORC Assembly	M6G-020026---
31	ORC Assembly	Air Flow Sensor	M6G-020026---
33	ORC Assembly	Y2	M6G-020026---
34	N2O Cylinder Yoke	Y1	M6G-020045---
35	Y1	N2O Regulator	M6G-020045---
36	Air Cylinder Yoke	Y1	M6G-020045---
37	Y1	Air Regulator	M6G-020045---
38	Y1	Y1	M6G-020045---
39	O2 Pipeline Pressure Gauge	O2 Pipeline Assembly	M6G-020046---
40	N2O Pipeline Pressure Gauge	N2O Pipeline Assembly	M6G-020046---
41	Air Pipeline Pressure Gauge	AIR Pipeline Assembly	M6G-020046---
42	O2 Regulator	Y2	M6G-020026---
43	Y2	System Switch	M6G-020026---
44	Y2	O2 Flush Button	M6G-020026---
45	System Switch	O2 Needle Valve	M6G-020026---
46	Y2	ORC Assembly	M6G-020026---
47	Y1	O2 Regulator	M6G-020045---
48	N2O Regulator	ORC Assembly	M6G-020046---
49	ORC Assembly	N2O Needle Valve	M6G-020026---
50	Air Regulator	Y2	M6G-020026---
51	Y2	Air Needle Valve	M6G-020026---
52	O2 Flush Button	Common Gas Outlet	M6G-020026---
53	Vaporizer Manifold	Common Gas Outlet	M6G-020014---
54	Y1	Air Pipeline Assembly	M6G-020045---
55	Exhalation Valve Assembly	Gas Reservoir	M6G-020026---
56	Y2	Y2	M6G-020026---
57	Y2	Auxiliary O2 Assembly	M6G-020026---
58	Gas Mixer or Electronic Flowmeter Assembly	Back Pressure Regulator	M6G-020014---
59	Y1	O2 Pipeline Assembly	M6G-020045---
60	O2 Cylinder Yoke	Y1	M6G-020045---
62	Y1	N2O Pipeline Assembly	M6G-020045---
63	Y1	Exhalation Valve Assembly	M6G-020045---
64	Auxiliary Air Assembly	Y2	M6G-020026---
65	Auxiliary O2 Assembly	Y2	M6G-020026---
66	Y2	Auxiliary Gas Outlet	M6G-020026---
67	Y2	Auxiliary Air Assembly	M6G-020026---

S/N	From	To	P/N
73	O2 Needle Valve	Y2	M6G-020026---
74	Y2	Y2	M6G-020026---
75	O2 Poppet Valve	Y2	M6G-020026---
76	O2 Poppet Valve	Y2	M6G-020026---
77	Y2	O2 Poppet Valve	M6G-020026---
78	Y2	O2 Flow Sensor	M6G-020026---
79	Y1	O2 Pipeline Assembly	M6G-020045---
81	Y1	Y1	M6G-020045---
90	Air Needle Valve	Restrictor Assembly	M6G-020026---
91	N2O Needle Valve	N2O Flow Sensor	M6G-020026---
Y1	Three-way Connector		082-000583-00
Y2	Three-way Connector		082-000582-00

1.2.4 Pneumatic Connection (A5)

FIGURE 1-5

NOTE: **This diagram reflects the latest version of the pneumatic connections. Please refer to label on the back of the service door of the anesthesia system.**

NOTE: **The green tube in the tube diagram needs to paste the oxygen label.**

NOTE: **The orange tube in the tube diagram needs to paste the air label.**

NOTE: **The blue tube in the tube diagram needs to paste the N2O label.**

NOTE: **The black tube in the tube diagram needs to paste the neutral label.**

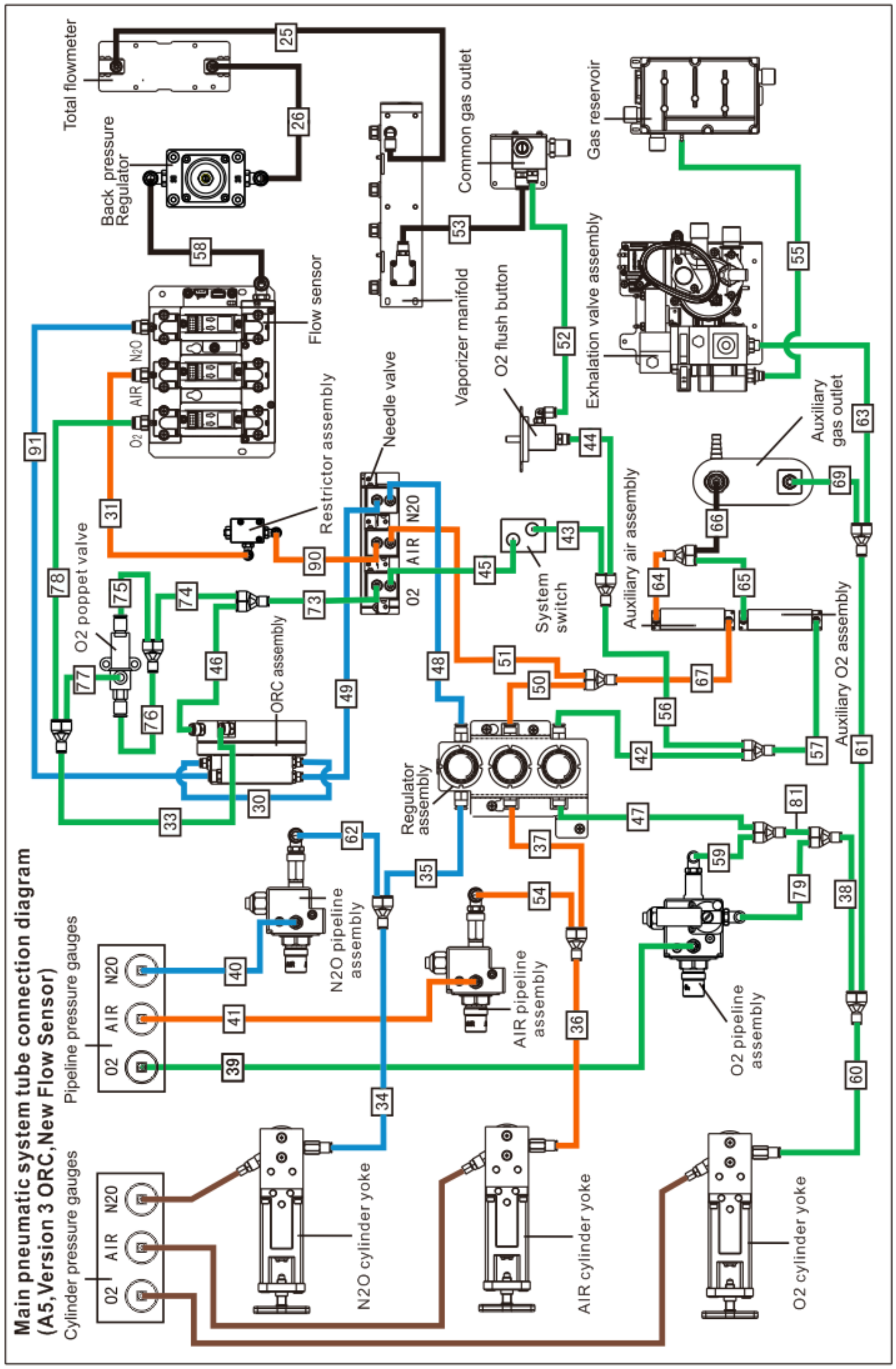


FIGURE 1-6 A5 Pneumatic Connections (New Version)

S/N	From	To	P/N
25	Total Flow Meter	Vaporizer Manifold	M6G-020014---
26	Back Pressure Regulator	Total Flow Meter	M6G-020014---
27	N2O Flow Sensor	Gas Mixer	M6G-020026---
28	Air Flow Sensor	Gas Mixer	M6G-020026---
29	O2 Flow Sensor	Gas Mixer	M6G-020026---
30	ORC Assembly	ORC Assembly	M6G-020026---
31	Restrictor Assembly	Air Flow Sensor	M6G-020026---
33	ORC Assembly	Y2	M6G-020026---
34	N2O Cylinder Yoke	Y1	M6G-020045---
35	Y1	N2O Regulator	M6G-020045---
36	Air Cylinder Yoke	Y1	M6G-020045---
37	Y1	Air Regulator	M6G-020045---
38	Y1	Y1	M6G-020045---
39	O2 Pipeline Pressure Gauge	O2 Pipeline Assembly	M6G-020046---
40	N2O Pipeline Pressure Gauge	N2O Pipeline Assembly	M6G-020046---
41	Air Pipeline Pressure Gauge	AIR Pipeline Assembly	M6G-020046---
42	O2 Regulator	Y2	M6G-020026---
43	Y2	System Switch	M6G-020026---
44	Y2	O2 Flush Button	M6G-020026---
45	System Switch	O2 Needle Valve	M6G-020026---
46	Y2	ORC Assembly	M6G-020026---
47	Y1	O2 Regulator	M6G-020045---
48	N2O Regulator	ORC Assembly	M6G-020046---
49	ORC Assembly	N2O Needle Valve	M6G-020026---
50	Air Regulator	Y2	M6G-020026---
51	Y2	Air Needle Valve	M6G-020026---
52	O2 Flush Button	Common Gas Outlet	M6G-020026---
53	Vaporizer Manifold	Common Gas Outlet	M6G-020014---
54	Y1	Air Pipeline Assembly	M6G-020045---
55	Exhalation Valve Assembly	Gas Reservoir	M6G-020026---
56	Y2	Y2	M6G-020026---
57	Y2	Auxiliary O2 Assembly	M6G-020026---
58	Gas Mixer or Electronic Flowmeter Assembly	Back Pressure Regulator	M6G-020014---
59	Y1	O2 Pipeline Assembly	M6G-020045---
60	O2 Cylinder Yoke	Y1	M6G-020045---
61	Y1	Y1	M6G-020045---
62	Y1	N2O Pipeline Assembly	M6G-020045---
63	Y1	Exhalation Valve Assembly	M6G-020045---
64	Auxiliary Air Assembly	Y2	M6G-020026---
65	Auxiliary O2 Assembly	Y2	M6G-020026---
66	Y2	Auxiliary Gas Outlet	M6G-020026---

S/N	From	To	P/N
67	Y2	Auxiliary Air Assembly	M6G-020026---
69	Y1	Auxiliary Gas Outlet	M6G-020045---
73	O2 Needle Valve	Y2	M6G-020026---
74	Y2	Y2	M6G-020026---
75	O2 Poppet Valve	Y2	M6G-020026---
76	O2 Poppet Valve	Y2	M6G-020026---
77	Y2	O2 Poppet Valve	M6G-020026---
78	Y2	O2 Flow Sensor	M6G-020026---
79	Y1	O2 Pipeline Assembly	M6G-020045---
81	Y1	Y1	M6G-020045---
90	Air Needle Valve	Restrictor Assembly	M6G-020026---
91	N2O Needle Valve	N2O Flow Sensor	M6G-020026---
Y1	Three-way Connector		082-000583-00
Y2	Three-way Connector		082-000582-00

1.2.5 Connections Between Pneumatic Circuit, Breathing System and Ventilator Control Board

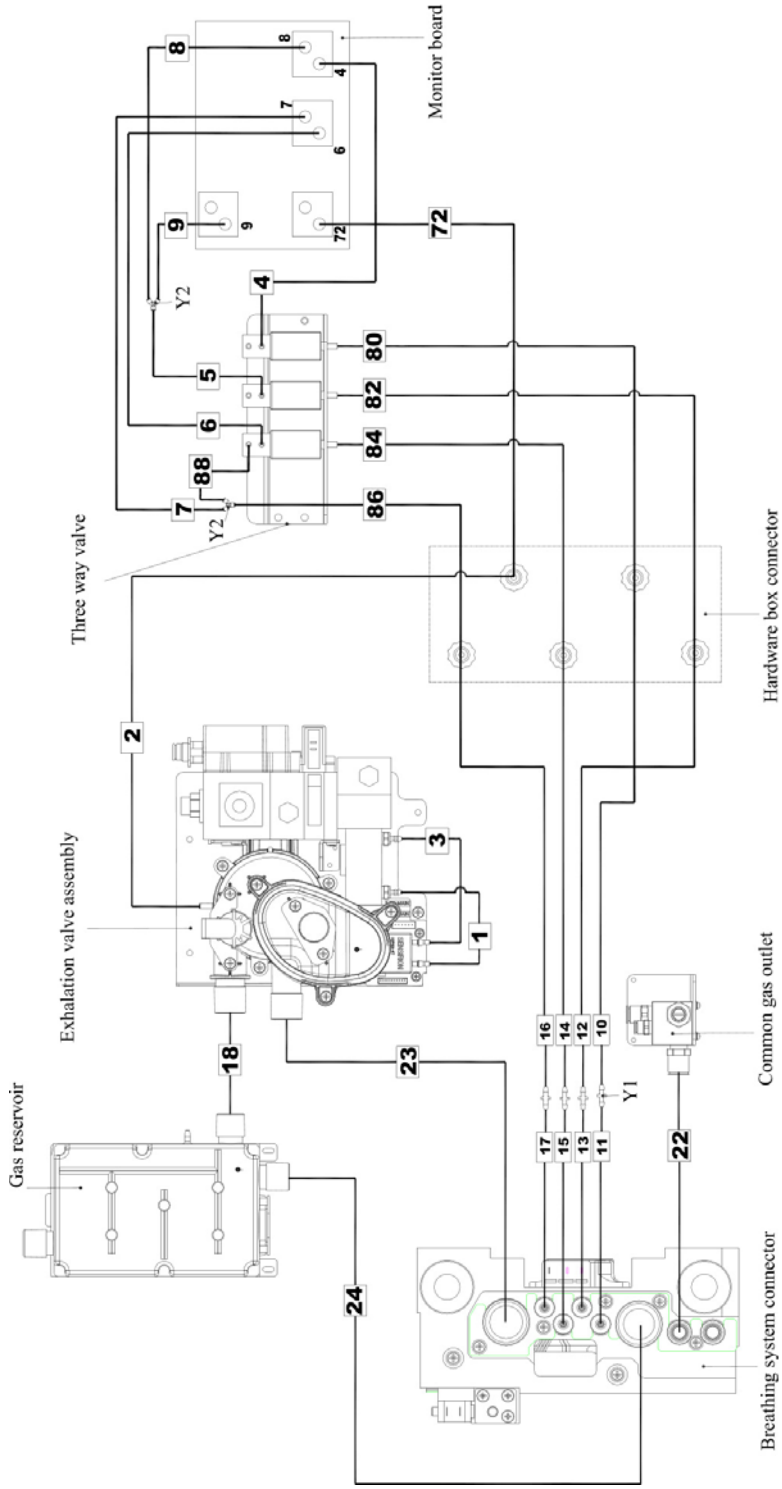


FIGURE 1-7 Control Board Connections (EPSON Platform)

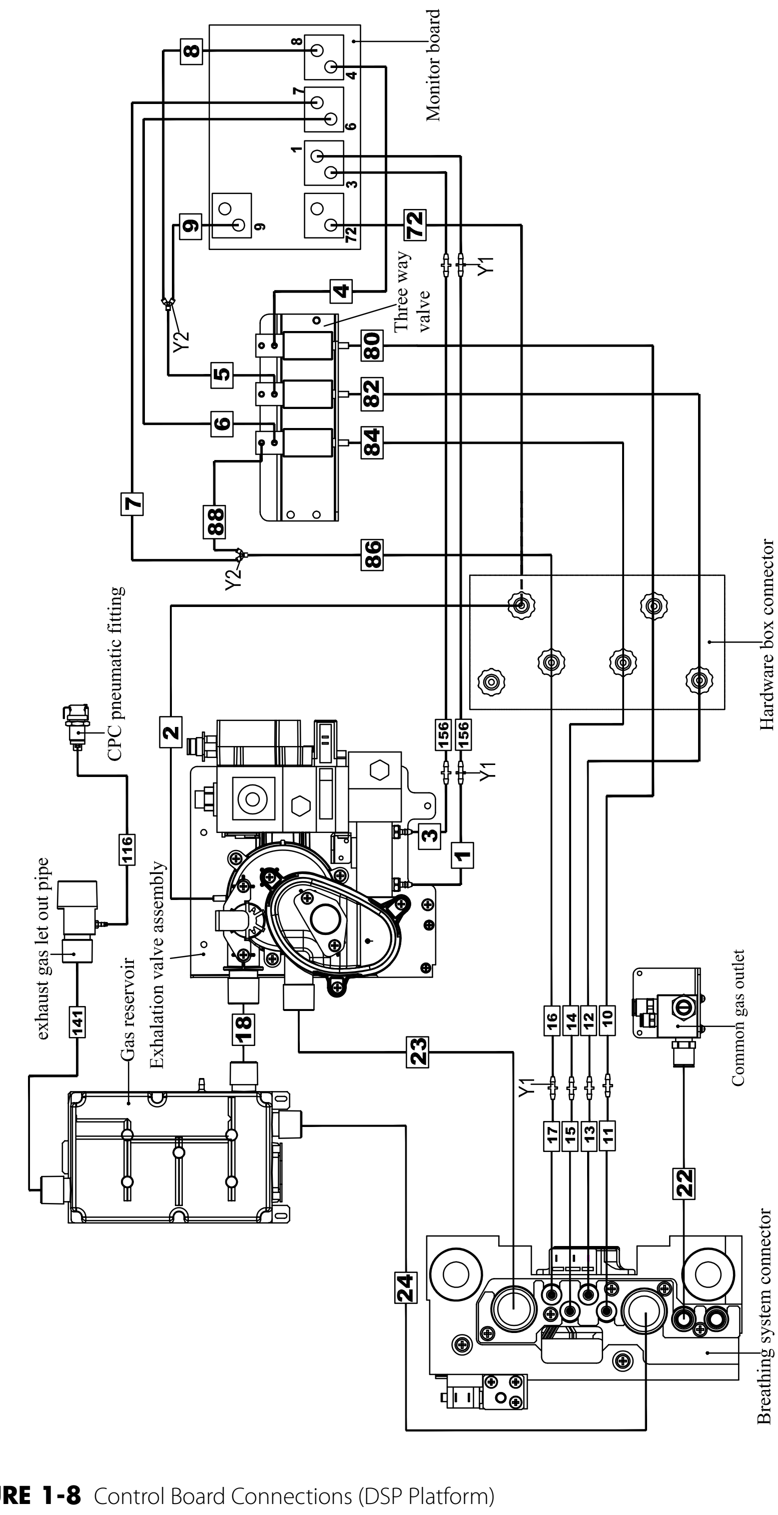


FIGURE 1-8 Control Board Connections (DSP Platform)

S/N	From	To	P/N
1	Exhalation Gas Assembly	Flow Sensor connector	A21-000007---
2	Exhalation Gas Assembly	Hardware Box Connector	A21-000007---
3	Exhalation Gas Assembly	Flow sensor connector	A21-000007---
4	Three-way Valve	Ventilator Control Board	A21-000007---
5	Three-way Valve	Y2	A21-000007---
6	Three-way Valve	Ventilator Control Board	A21-000007---
7	Three-way Valve	Y2	A21-000007---
8	Y2	Ventilator Control Board	A21-000007---
9	Y2	Ventilator Control Board	A21-000007---
10	Hardware Box Connector	Y1	A21-000007---
11	Y1	Breathing System Connector	M6G-020046---
12	Hardware Box Connector	Y1	A21-000007---
13	Y1	Breathing System Connector	M6G-020046---
14	Hardware Box Connector	Y1	A21-000007---
15	Y1	Breathing System Connector	M6G-020046---
16	Hardware Box Connector	Y1	A21-000007---
17	Y1	Breathing System Connector	M6G-020046---
18	Exhalation Gas Assembly	Gas Reservoir	082-002365-00
22	Gas-out Connector of CGO Connector	Fresh Gas	082-000519-00
23	Breathing System Connector	Exhalation Gas Assembly	115-034448-00
24	Breathing System Connector	Gas Reservoir	115-034449-00
72	Hardware Box Connector	Ventilator Control Board	A21-000007---
80	Hardware Box Connector	Ventilator Control Board	A21-000007---
82	Hardware Box Connector	Ventilator Control Board	A21-000007---
84	Hardware Box Connector	Ventilator Control Board	A21-000007---
86	Hardware Box Connector	Y2	A21-000007---
88	Y2	Three-way Valve	A21-000007---
Y1	Two-way Connector	\	M02A-10-25945
Y2	Three-way Connector	\	M90-100030---
156	Y1	Y1	M6G-020046---

1.3 Gas Flow

1.3.1 Pneumatic Circuit Diagram

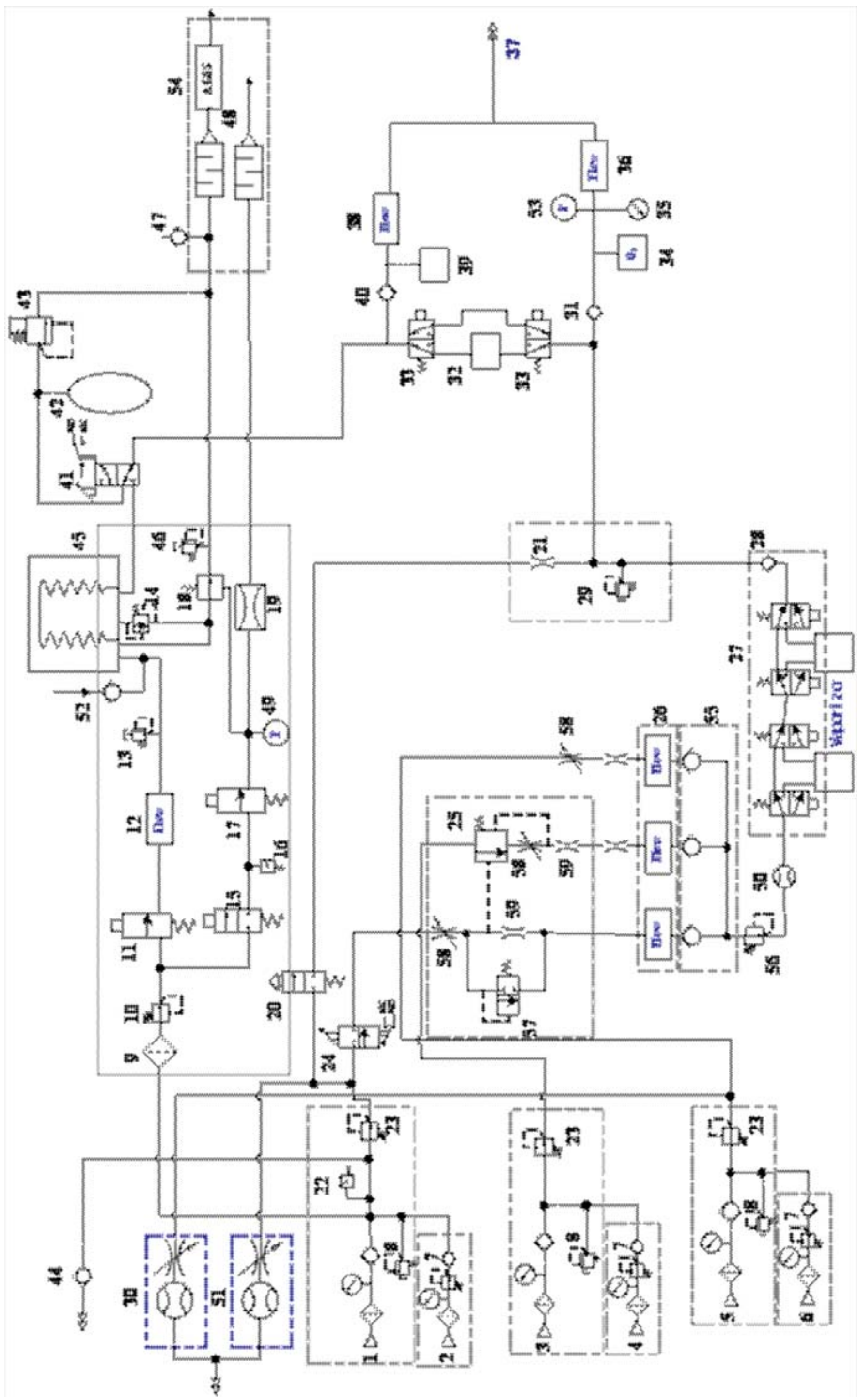
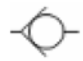
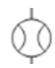
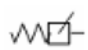


FIGURE 1-9 Pneumatic Circuit Diagram

1.3.2 Parts List

1	O2 Pipeline	30	Auxiliary Air Supply
2	O2 Cylinder	31	Inspiratory Valve
3	N2O Pipeline	32	CO2 Absorber Canister
4	N2O Cylinder	33	Bypass Valve
5	Air Pipeline	34	O2 Sensor
6	Air Cylinder	35	Airway Pressure Gauge
7	Regulator (0.4 MPa)	36	Inspiratory Flow Sensor
8	Pressure Relief Valve	37	Patient
9	Filter	38	Expiratory Flow Sensor
10	Regulator (0.2 MPa)	39	Water Collection Cup
11	Inspiratory Flow Valve	40	Expiratory Valve
12	Flow Sensor	41	Auto/Manual Ventilation Switch
13	Mechanical Overpressure Valve (110 cmH2O)	42	Manual Bag
14	Pop-Off Valve	43	APL Valve
15	PEEP Safety Valve	44	High Pressure O2 Output
16	Pressure Switch (140 kPa)	45	Bellows Assembly
17	Proportional PEEP Valve	46	Pressure Relief Valve (10 cmH2O)
18	Expiratory Valve	47	Negative Pressure Valve (1 cmH2O
19	Pneumatic Resistor	48	Scavenging Reservoir and Noise Eliminator
20	O2 Flush Valve	49	Pressure Sensor
21	Flow Restrictor	50	Total Flow Meter
22	Pressure Switch	51	Auxiliary O2 Supply
23	Regulator (0.2 MPa)	52	Negative Pressure Valve
24	System Switch	53	Pressure Sensor
25	Oxygen Ratio Controller (ORC)	54	AGSS (AGSS Transfer and Receiving System)
26	Electronic Flowmeter Sensor	55	Check Valve
27	Double-vaporizer Manifold	56	Back Pressure Valve
28	Check Valve	57	Poppet Valve
29	Pressure Relief Valve	58	Needle Valve
59	Adjustable Restrictor		

1.3.3 Key to Symbols

	Filter		Regulator
	Pressure Gauge		Check Valve
	Gas Supply Connector		Pressure Relief Valve
	Flowmeter		Flow Control Valve
	Pressure Switch		Flow Restrictor

1.3.4 Description

1.3.4.1 Anesthetic Gas Delivery System

The Anesthetic Gas Delivery System is connected to the anesthetic agent delivery device (vaporizer), breathing system, and anesthetic ventilator; and outputs fresh gas. The following figure shows the pneumatic circuit of the Anesthetic Gas Delivery System.

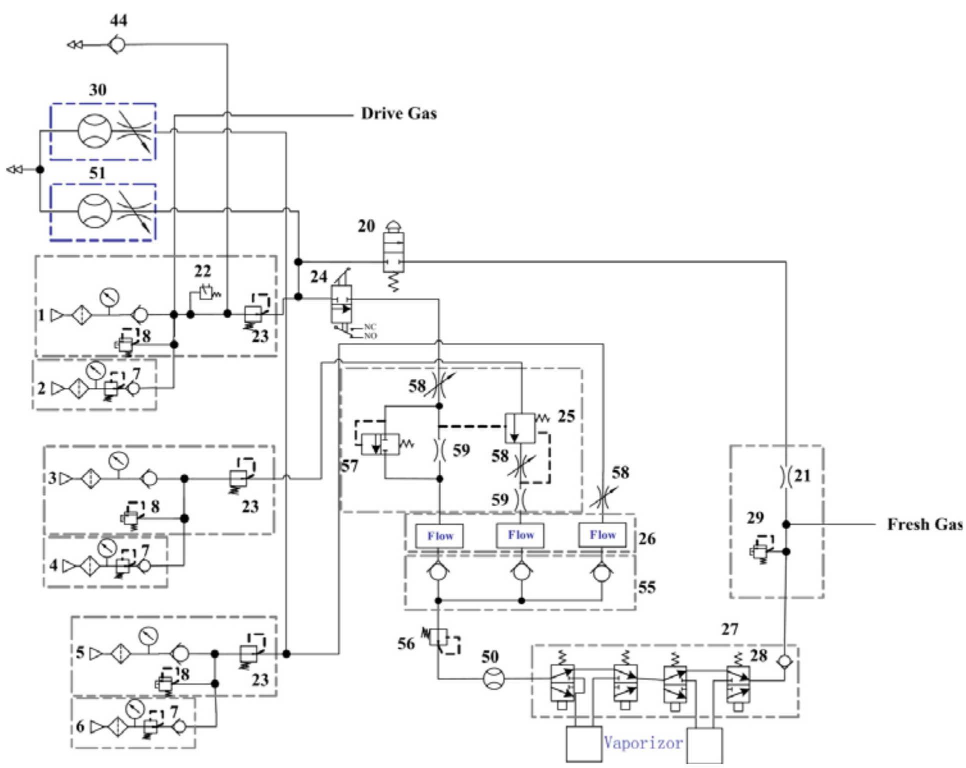


FIGURE 1-10 Pneumatic Circuit Diagram

The following picture illustrates how gas supplies are outputted. O2 is divided into four pathways - system switch (24), O2 flush valve (20), auxiliary O2 supply (51), and high pressure O2 output (44), respectively. Air enters two pathways - one pathway to the needle valve (58) and the other to the auxiliary Air supply (3). N2O goes to the ORC (25).

When the system switch (24) is turned on, O2 enters the needle valve (58). When O2 flow is greater than 300ml, N2O can enter the needle valve (58) through ORC 25. After passing through the needle valve (58), the pre-set pneumatic resistance (59) controls the O2 and N2O proportions and ensures the minimum O2 concentration.

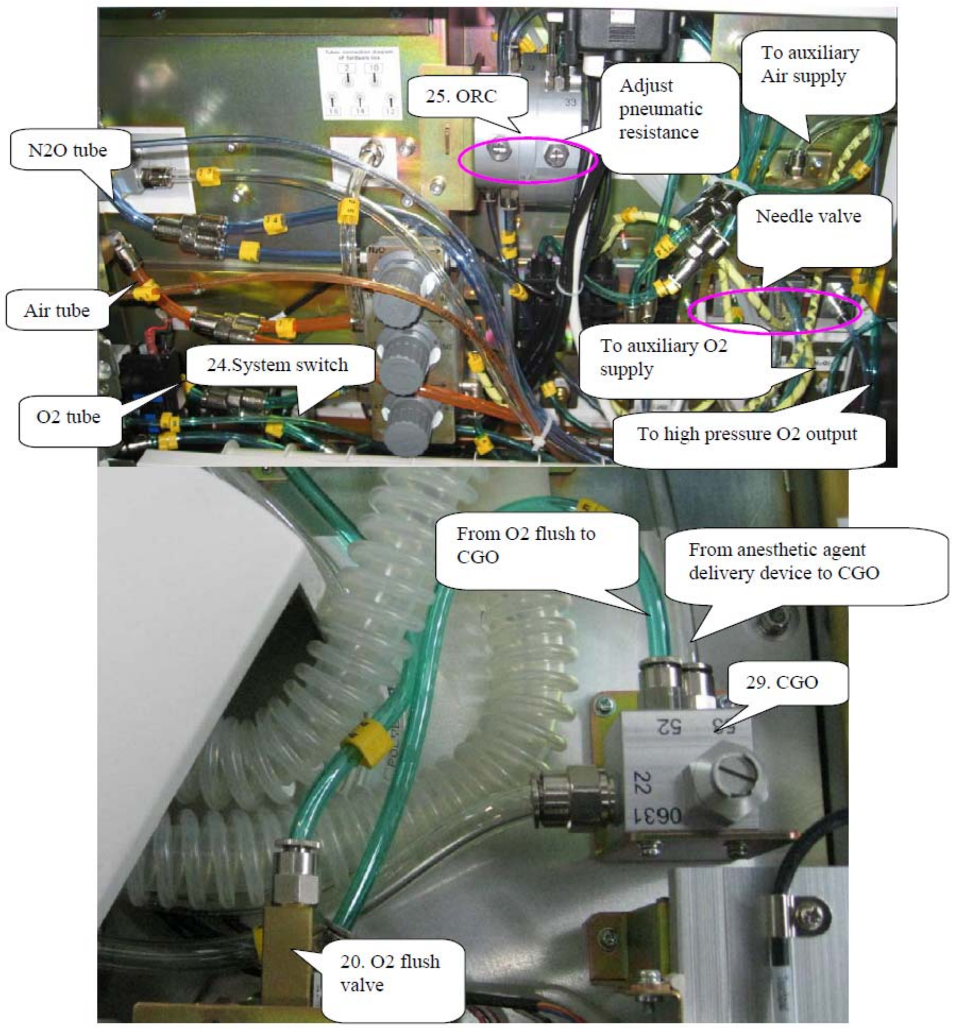


FIGURE 1-11 Gas Supply Output

After passing through the pneumatic resistance (59), O2 and N2O enter the electronic flow sensor (26). Air enters the electronic flow sensor (26) after passing through the needle valve (58) and the electronic flow meter monitors, and displays the gas flow.

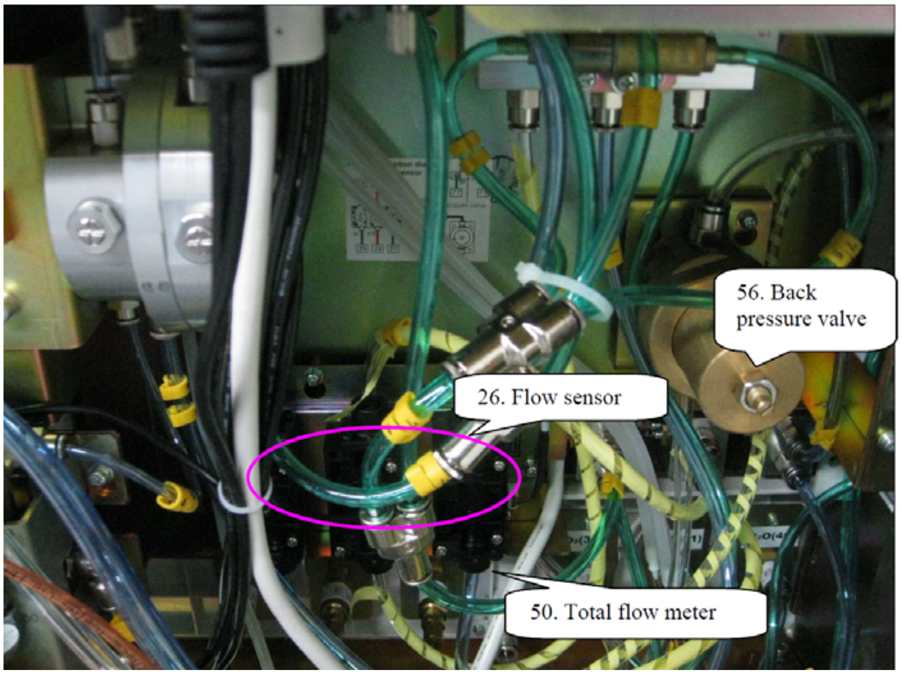


FIGURE 1-12 Flow Sensor Tubing

The converged gas goes from the total flow meter (50) to the anesthetic agent delivery device (vaporizer), forming fresh gas after mixed with the anesthetic agent. The fresh gas then goes from the check valve (28) through the CGO (29) assembly to the breathing system. The flushing O2 also enters the breathing system through the CGO (29) assembly.

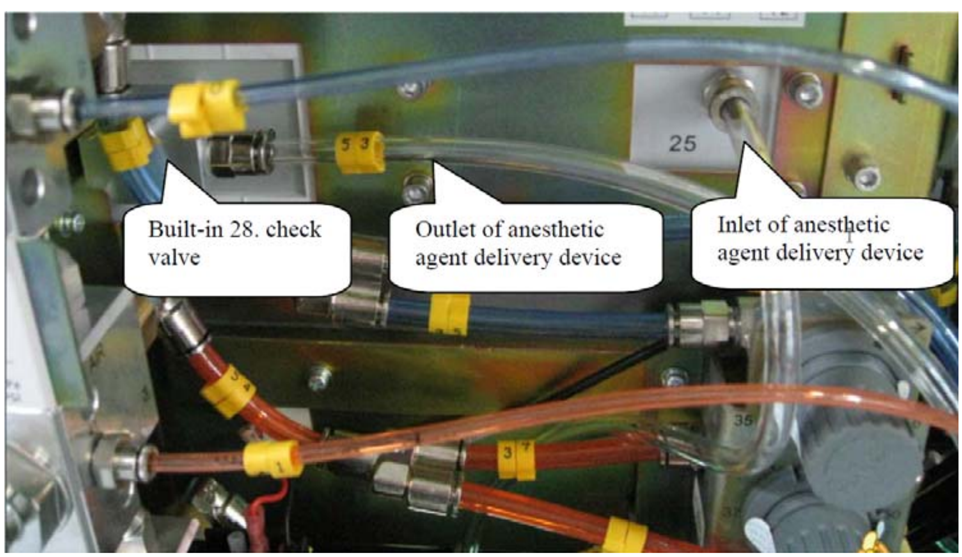


FIGURE 1-13 Outlet/Inlet of Anesthetic Agent Delivery Device

1.3.4.2 Gas Supplies

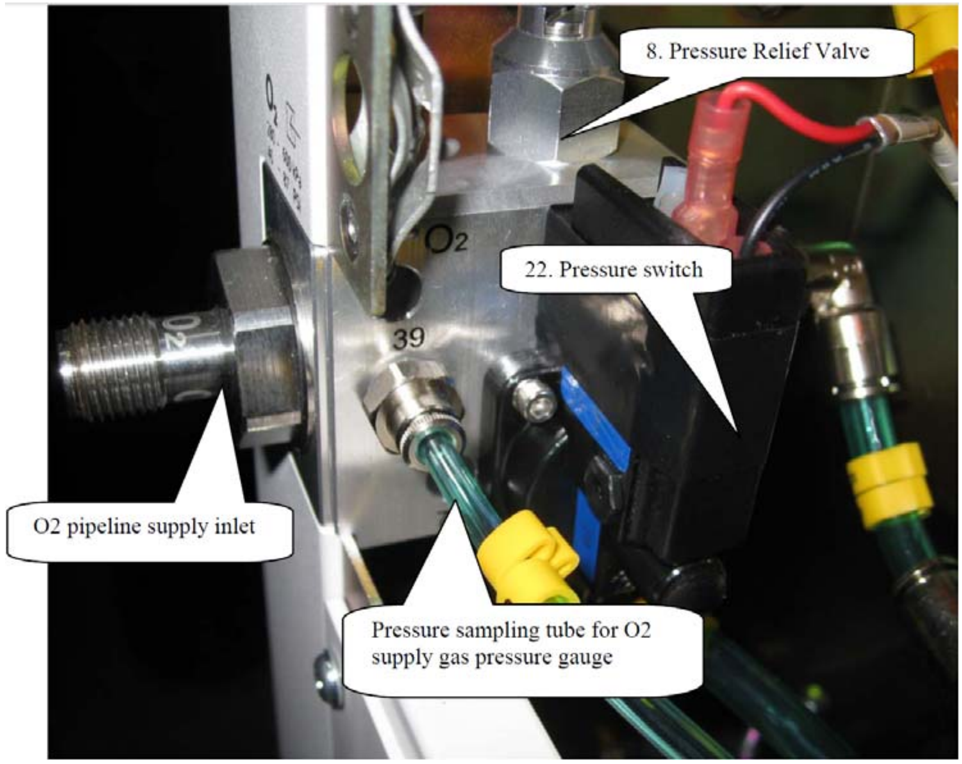


FIGURE 1-14 O2 Pipeline Supply Inlet Assembly

The above picture shows the O2 pipeline supply inlet assembly. The anesthesia machine's pneumatic circuit starts from the gas supplies, which function to introduce the external pipeline or cylinder gases into the machine. Since the pressure of external gas is very high and the external gas contains foreign substances, the pressure reducing valves, filters, and pressure relief valves are available in the supply gas circuit. Also, the check valves are equipped in the supply gas circuit to prevent gas from flowing back into the pipeline or cylinder.

The anesthesia machine has pipeline and cylinder gas supplies available. Pipeline gas supplies go into the pipeline gas supply inlet assemblies through pipeline connectors 1, 3, and 5, respectively. The pipeline pressure ranges between 280 and 600 kPa. Cylinder gas supplies go into the system through cylinder connectors 2, 4, and 6, respectively. The O2 and Air cylinder pressures are 6.9 to 15 MPa, and the N2O cylinder pressure is 4.2 to 6 MPa, both of which are decreased to 400 kPa through three regulators (7). Each connector is clearly marked and designed to prevent misconnection. All connectors have filters and check valves. Color coded gauges show the pipeline and cylinder pressures. The Pressure Relief Valve (8) functions to prevent the supply gas pressure from being too high. It releases excess gas when the gas pressure exceeds 758 kPa. Each supply gas is outputted after gas pressure is decreased below 200 kPa through the regulator (23). The Pressure Switch (22) monitors the O2 supply pressure. When the O2 supply pressure is less than approximately 220 kPa, the ventilator gives an alarm indicating O2 supply failure.

1.3.4.3 System Switch Assembly

O2 goes into the system switch (24); and flows into the needle valve. The system switch has an electrical outlet that controls the power-on status of the system. When the system switch is turned on, O2 enters the needle valve and the system is powered on simultaneously. The anesthetic ventilator starts to monitor the status of the system. When the system switch is turned off, O2 cannot enter the needle valve and the system is powered off.

1.3.4.4 Flow Adjust and Control Assembly

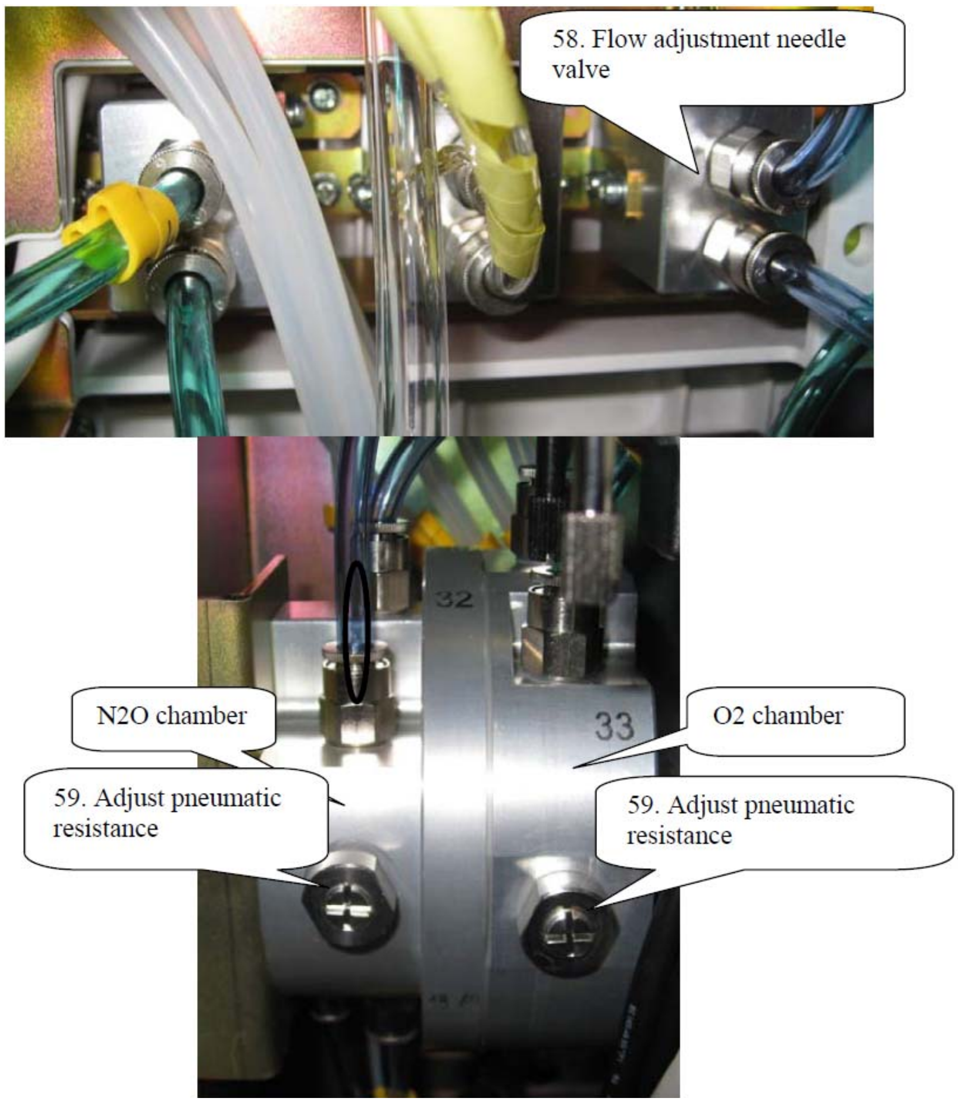


FIGURE 1-15 Flow Adjust and Control Assembly

The Needle Valve (58) controls the gas flows. The ORC (25) controls the proportion between O2 and N2O, and ensures that the O2 concentration is not less than 25%. Turning the needle valve knob counterclockwise increases the flow; turning it clockwise decreases the flow.

1.3.4.5 Flow Display Assembly

The electronic flowmeter (26) and total flow meter (50) constitute the flow display assembly. Gases from the flow adjust and control assembly and mixed gas going through the anesthetic agent delivery device (vaporizer) are outputted. The electronic flowmeter (26) measures and displays the flow of each gas. The total flow meter (50) displays the total gas flow.

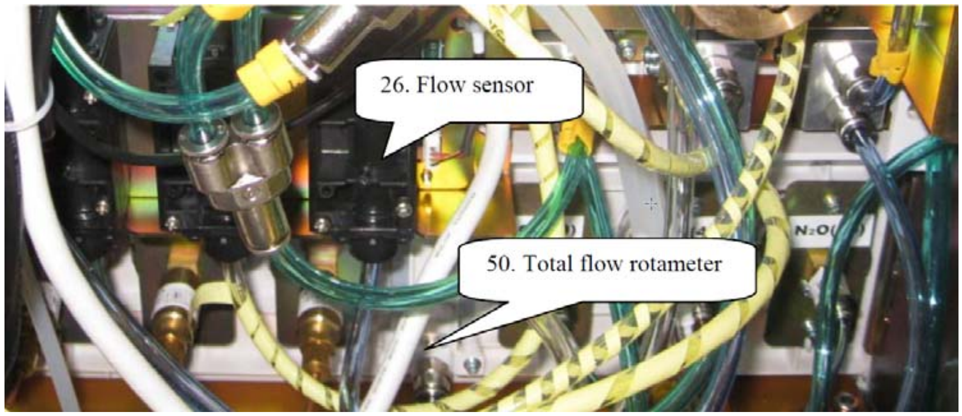


FIGURE 1-16 Flow Display Assembly

1.3.4.6 O2 Flush Button Assembly

FIGURE 1-17 O2 Flush Button Assembly

The above picture shows the O2 flush button assembly. When the O2 flush valve (20) is depressed, O2 rushes into the pneumatic circuit, which is cut off when this valve is released. The O2 supply gas at 0.2 MPa, after being regulated, goes through the O2 flush valve, the CGO assembly, and into the breathing system. The O2 flush button assembly is not affected by the system switch. Flushing O2 can be performed as long as O2 supply is normal. The O2 flush valve has a slide valve structure inside that ensures automatic reset each time the valve is depressed and released via the spring.

1.3.4.7 Vaporizer Manifold

FIGURE 1-18 Vaporizer Manifold

The above picture shows the vaporizer manifold assembly. The anesthetic agent delivery device (vaporizer) is connected to the anesthetic gas delivery system. The mixed gas of N2O, O2, and Air go into the device; the fresh gas containing these three gases and anesthetic agent is finally outputted to the CGO assembly.

Either vaporizer manifold (27) is integrated with a check valve (28) that prevents flushed O2 and fresh gas from flowing back to the vaporizer. The Selectatec mounting with interlocking function prevents the user from turning on two vaporizers simultaneously.

1.3.4.8 CGO Assembly

FIGURE 1-19 CGO Assembly

The above picture shows the CGO assembly. The CGO assembly includes a flow restrictor (21) and a pressure relief valve (29). Flushed O2 and fresh gas that are mixed enter the CGO. The pressure relief valve (29) at the front restricts the pressure of flushed O2, and also restricts the fresh gas from exceeding 37.9 kPa.

1.3.4.9 Auxiliary O2 and Air Supply Assembly

The Auxiliary O2 Supply Assembly (51) and Auxiliary Air Supply Assembly (30) control flow by two needle valves. The individual flows are displayed by glass tube flowmeters. The blended gas is output through a single barbed fitting to the patient. The flow range adjusted is from 0 to 15 L/min. Turning the flow control counterclockwise increases the flow; turning it clockwise decreases the flow.

1.3.4.10 High Pressure O2 Output Assembly (A5 Only)

The high pressure O2 output (available on the A5 only) comes from the gas source directly and provides high pressure O2 for the external ventilation device (jet ventilation devices) without passing through the pressure regulator. When no external device is connected, the high pressure O2 output is closed. The maximum flow is greater than 90L/min.

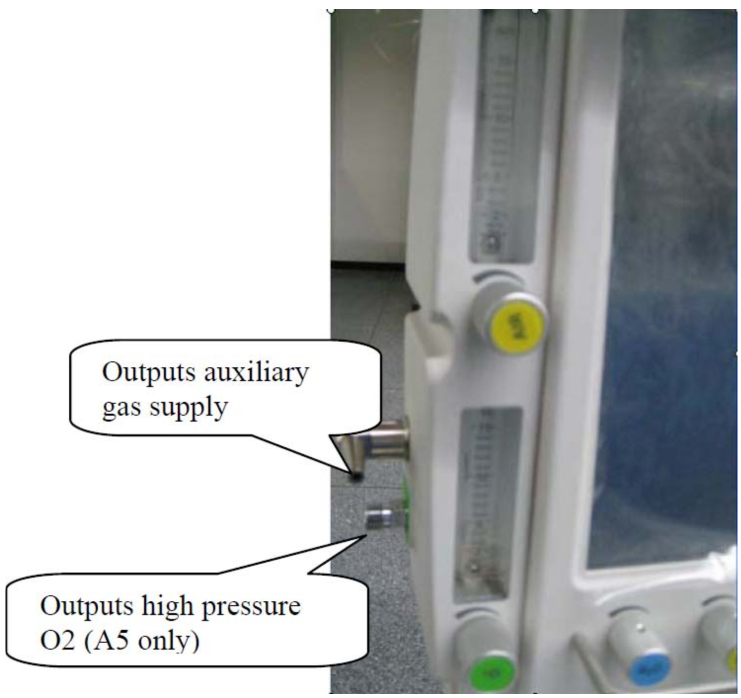


FIGURE 1-20 High Pressure O2 Output Assembly (A5 only)

1.3.4.11 Anesthetic Ventilator

The anesthetic ventilator provides drive gas for the patient to breathe. O2 from the gas supply inlet assembly enters the anesthetic ventilator and is outputted in three pathways: drive gas entering the breathing system, drive gas discharged through the AGSS outlet, and drive gas discharged through the PEEP outlet. The ventilator controls drive gas flow to prevent excessively high pressure inside the pneumatic circuit from injuring the patient. The following picture shows the gas flow direction and the components of the anesthetic ventilator.

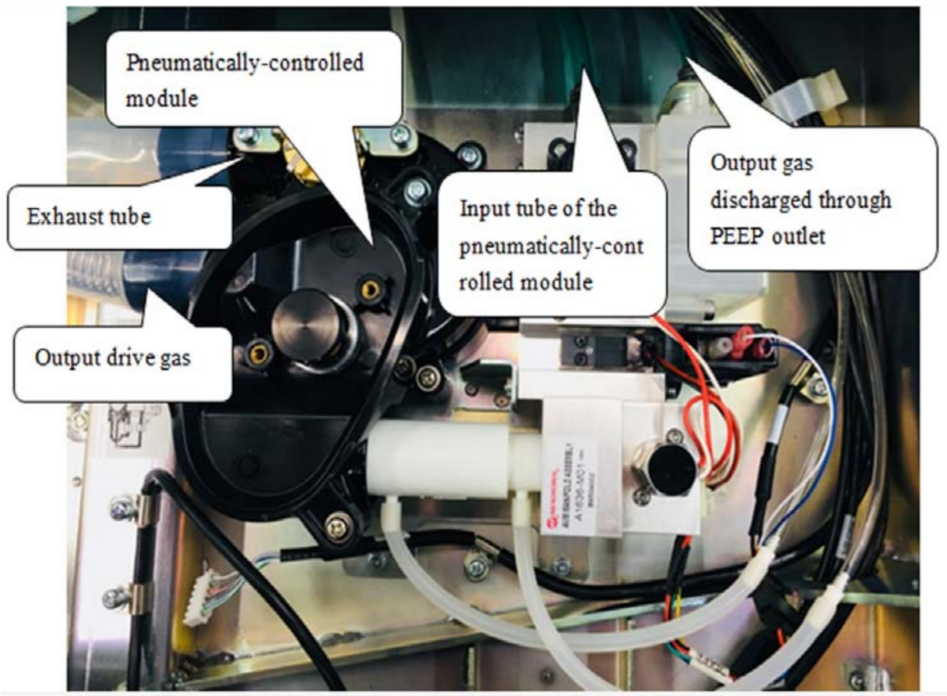


FIGURE 1-21 Anesthetic Ventilator

The following is the pneumatic circuit diagram of the anesthetic ventilator.

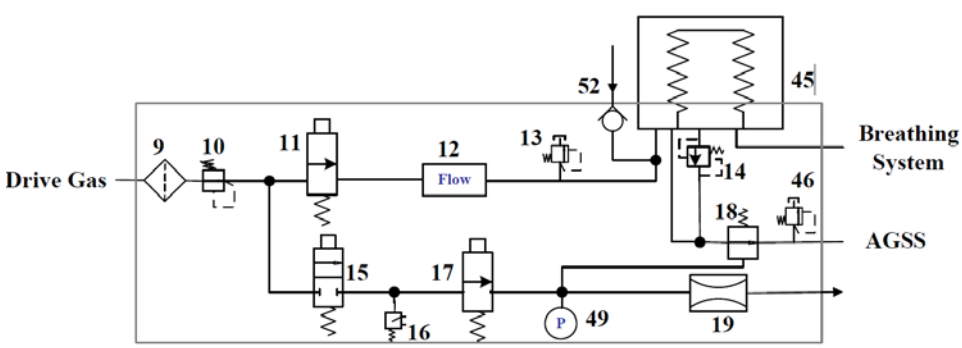


FIGURE 1-22 Anesthetic Ventilator - Pneumatic Circuit Diagram

The proportional electromagnetic valve (11) controls inlet gas flow. The filter (9) filters drive gas again. The regulator (10) regulates pressure inside the pneumatic circuit. Component 12 is a flow sensor of differential pressure type that monitors gas flow in the drive gas circuit. The Mechanical overpressure valve (13) ensures that the pressure in the drive gas circuit does not exceed safe pressure. It releases excess gas when gas pressure exceeds 11 kPa. Component 18 is the expiratory valve. During expiration, gas inside the bellows is discharged from this valve.

The PEEP function is performed through the expiratory valve. Component 15 is a low-flow proportional electromagnetic valve. When it opens, gas is bled from the pneumatic resistor (19), forming relatively stable pressure in the PEEP branch. Such pressure is exerted on the membrane of the expiratory valve (18) to form PEEP.

To prevent excessively high pressure inside the pneumatic circuit from injuring the patient and damaging the equipment, the pressure relief valve (15), which is an electromagnetic on-off valve, is placed before the gas pathway of the expiratory valve. The "16" component is a pressure switch. When the drive gas pressure is less than 140 kPa, an alarm is triggered. Component 49 is a pressure sensor that monitors the pressure at which the expiratory valve is closed. The Pressure relief valve (46) ensures the tube pressure after the expiratory valve is less than 10 cmH2O.

1.3.4.12 Breathing System

The breathing system provides a closed loop for the anesthetic gas. The expired gas from the patient can be inspired in the inspiration phase to maintain the temperature and humidity conditions of the patient's expired gas. During inspiration, the drive gas depresses the bag inside the bellows to force the inside gas to enter the patient's lung. During expiration, the patient's expired gas goes into the bag inside the bellows. The CO2 Absorber Canister (32) absorbs CO2 that the patient expires. The following figure shows the pneumatic circuit of the breathing system.

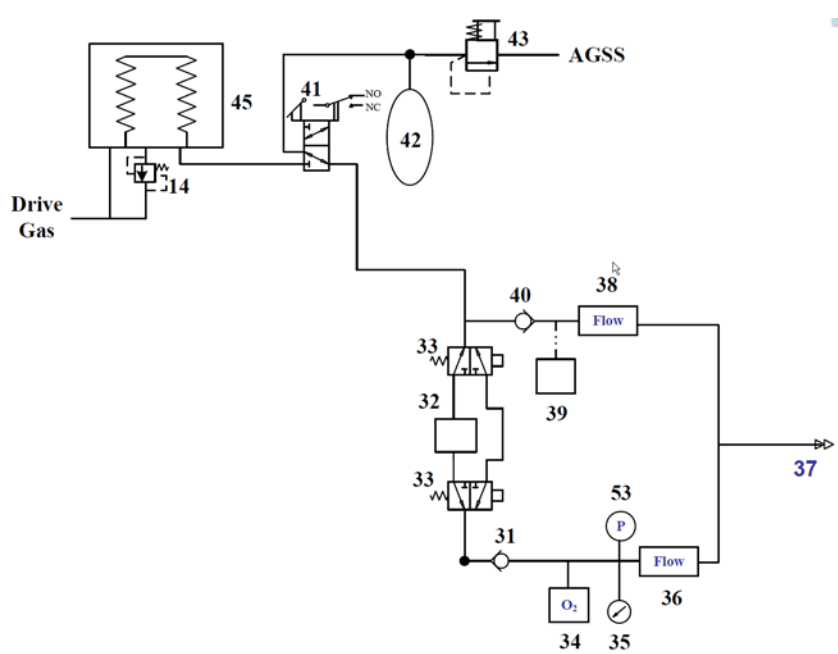


FIGURE 1-23 Breathing System Circuit Diagram

Mechanical and manual ventilation modes are selected through the Auto/Manual ventilation switch (41). When the Auto/Manual switch is placed in the Manual position, the operator squeezes the manual bag (42) to supply gas for the breathing system. The APL valve (43) is used to adjust the pressure inside the pneumatic circuit in case of manual ventilation. When the Auto/Manual switch is placed in the Auto position, the A5/A4/A3 starts its ventilator to mechanically assist or replace the spontaneous breathing of the patient. The ventilator controls the drive gas to depress the folding bag inside bellows (45) and supply gas for the breathing system according to the selected ventilation mode.

The breathing system is connected to the anesthesia machine main unit through the circuit adapter. The breathing system is highly integrated, as its tubes are all internal except the tube connected to the patient and the O2 cell cable, as shown below.

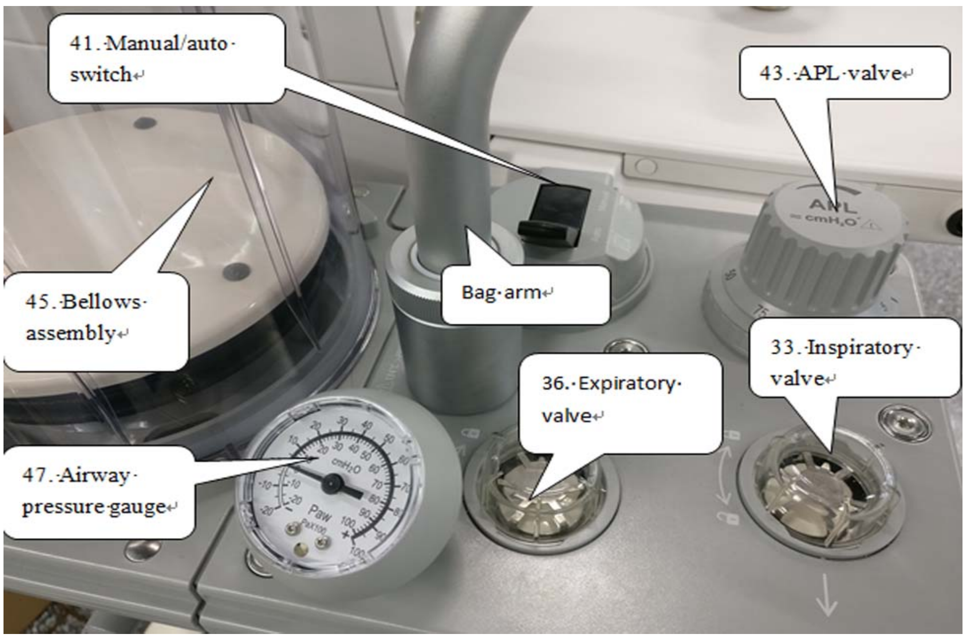


FIGURE 1-24 Breathing System (Available with the Airway Pressure Limiting Valve)

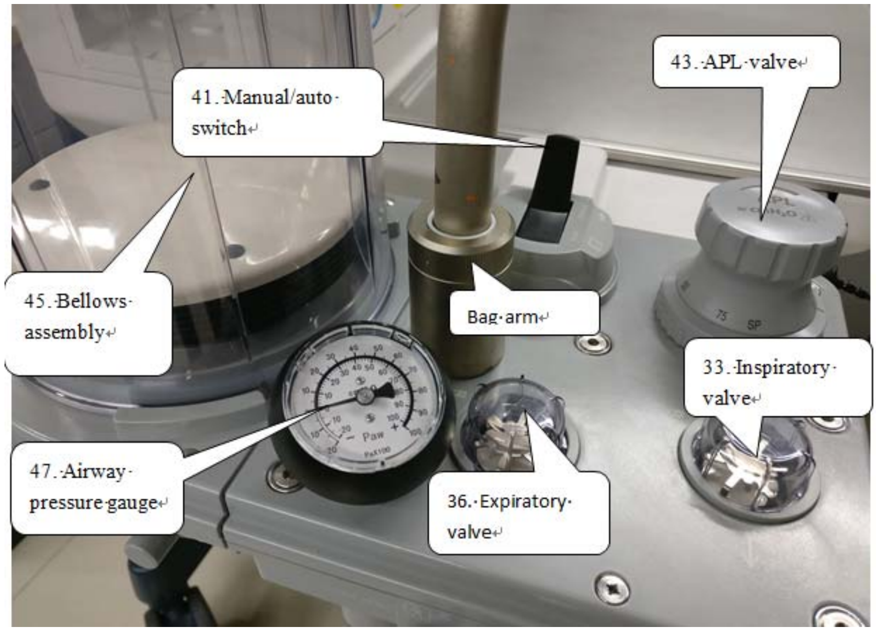


FIGURE 1-25 Breathing System (Available with the Quick Release APL Valve)

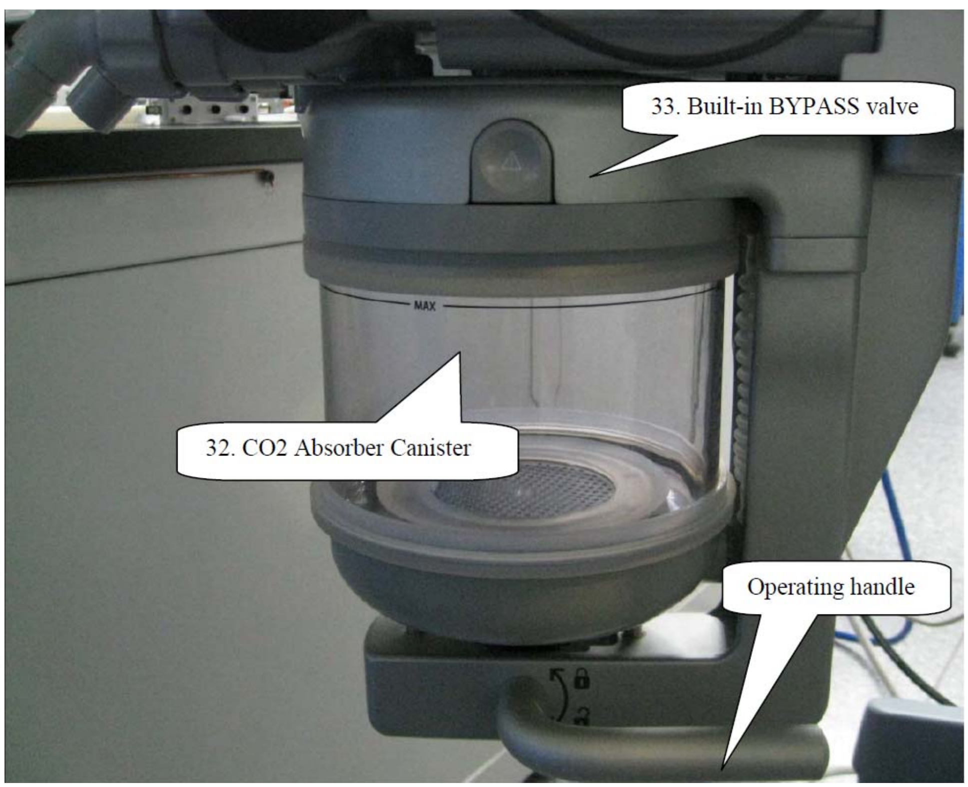


FIGURE 1-26 Absorber Canister

In case of mechanical ventilation, during inspiration, gas flows through the Auto/Manual ventilation switch (41), BYPASS valve (33) or CO2 absorber canister (32), inspiratory valve (31), O2 sensor (34), airway pressure gauge (35), and inspiratory flow sensor (36) to the patient.

During expiration, gas flows through the expiratory flow sensor (38), expiratory valve (40), and Auto/ Manual ventilation switch (41) to the folding bag. Airway pressure is monitored by the pressure sensor (53).

Excess water condensation from the exhaled gas is collected in the water collection cup, located on the bottom side of the breathing system.

The breathing system is easily disassembled and is autoclavable at 134^{O}C.(273 ^{O}F).

1.3.4.13 Anesthetic Gas Scavenging System

The Anesthetic Gas Scavenging System (AGSS) is composed of the AGSS transfer system, the AGSS receiving system, and the AGSS disposal system. Waste gas goes from the exhaust port of the anesthesia machine through the AGSS transfer system and the AGSS receiving system to the hospital's waste gas disposal system (AGSS disposal system), as shown below.

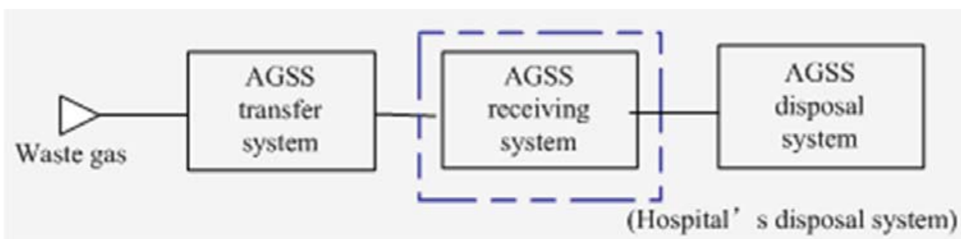


FIGURE 1-27 AGSS Diagram

The following figure shows the operational theory of the AGSS. The throttling holes reduce the effect of negative pressure at the AGSS outlet onto the flow at the entrance. The float helps the user determine if the disposal system meets the requirement for the minimum pump rate. The filter provides for filtering of foreign substances to prevent the disposal system from being occluded. The gas reservoir is connected to the air through pressure compensation openings. When positive or negative pressure occurs inside the gas reservoir, gas is inputted or outputted to ensure pressure balance inside the system.

The AGSS transfer system is a clear tube with 30 mm conical connectors at both ends. The inlet of the transfer system is a female 30 mm conical connector and the outlet a male 30 mm conical connector. The transfer system is connected to the receiving system through the male 30 mm conical connector. The receiving system is connected to the receiving hose through the 30 mm connector. The following picture shows the AGSS structure and the connections between the AGSS transfer system, receiving system, and disposal system.

FIGURE 1-28 AGSS Transfer System

1.3.4.14 Dynamic Gas Scavenging System

The Dynamic Gas Scavenging System (DGSS) is composed of the DGSS transfer system, the DGSS receiving system, and the DGSS disposal system. Waste gas goes from the exhaust port of the anesthesia machine through the DGSS transfer system and the DGSS receiving system to the hospital's waste gas disposal system (DGSS disposal system), as shown below.

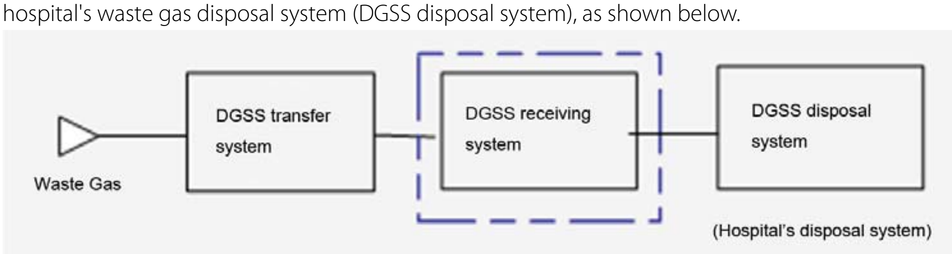


FIGURE 1-29 DGSS Diagram

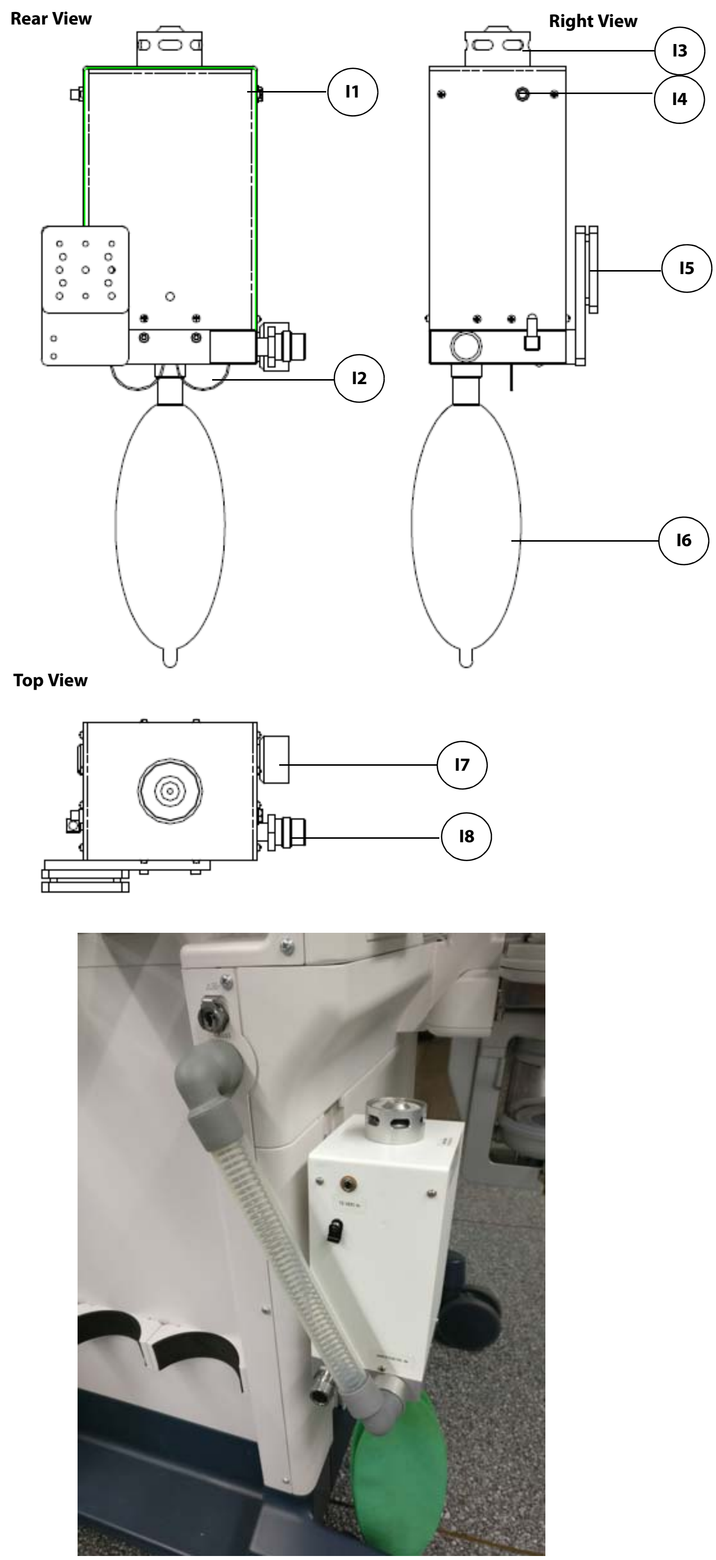


FIGURE 1-30 DGSS

PART(S)		DESCRIPTION
I1	**Power Supply Port**	Connects the DGSS to 12 V DC power supply.
I2	**Negative Pressure Valve**	Ensure there is no great negative pressure in the system.
I3	**Positive Pressure Valve**	Ensure there is no great positive pressure in the system. The positive pressure valve turns on when the pressure exceeds the setting pressure.
I4	**Power Supply Indicator**	Lit when the power supply is connected. Extinguished when the power supply is not connected.
I5	**Mounting Rail Attachment**	Allows the DGSS to be mounted on the side rail.
I6	**Reservoir Bag**	The exhaust gases flow to the reservoir bag. The exhaust gases are evacuated from the reservoir bag when the pressure is up to a threshold.
I7	**Inlet Port**	Intake for exhaust gases from the breathing system**.** The waste gas transfer hose connects the inlet port and the waste gas scavenging connector (see FIGURE 1-3) to transfer the exhaust gases.
I8	**Exhaust Port**	Exhaust port to the hospital's waste gas disposal system.

1.4 Anesthesia System Components

1.4.1 Auxiliary Outlets

The A3 and A4 anesthesia system has three 125V 15A Hospital Grade auxiliary outlets. Each outlet has one 250V 3A breaker.

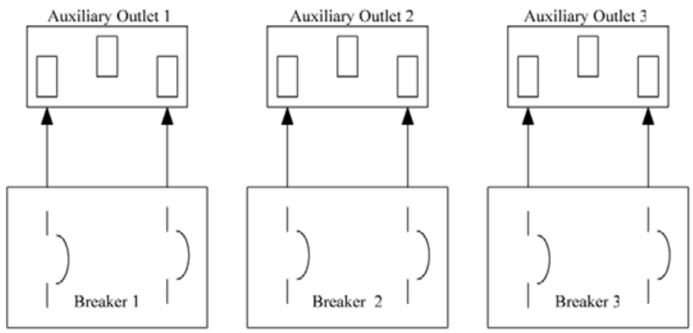


FIGURE 1-31 Auxiliary Outlet Diagram for the A3 and A4

The A5 anesthesia system has four 125V 15A Hospital Grade auxiliary outlets. Each outlet has one 250V 3A breaker. Additionally, a main breaker limits the combined current of the four outlets to 10A.

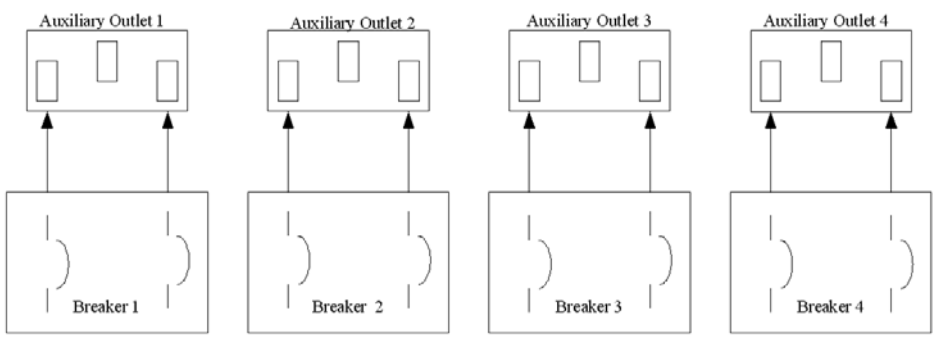


FIGURE 1-32 Auxiliary Outlet Diagram for the A5

1.4.2 Work Light Board

1.4.2.1 Top lighting board

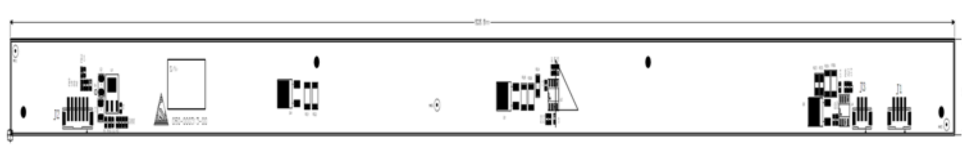


FIGURE 1-33 Top Lighting Board, Top View

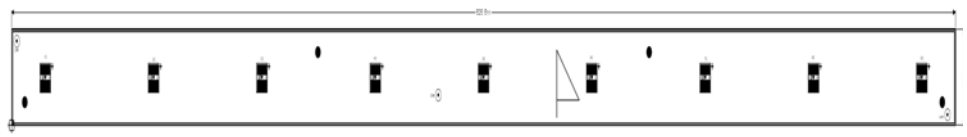


FIGURE 1-34 Top Lighting Board, Bottom View

The Flow Meter Lighting Board Interface, J1

PIN	NAME	FUNCTION
1	12V	The 12V Power Supply of the Flow Meter Lighting Board
2	GND	Ground
3	GND	Ground
4	LIGHT_OUT	Flow Meter Lighting Control

Lighting Grade Option Switch Interface, J2

PIN	NAME	FUNCTION
1	HIGH_BRIGHTNESS	High Brightness Grade
2	HIGH_BRIGHTNESS	High Brightness Grade
3	OFF	Close Light Grade
4	OFF	Close Light Grade
5	LOW_BRIGHTNESS	Low Brightness Grade
6	LOW_BRIGHTNESS	Low Brightness Grade

Power Supply Interface, J3

PIN	NAME	FUNCTION
1	12V	12V Power Supply of the Top Lighting Board
2	GND	Ground
3	12V_AUX	The 12V Power Supply of the Flow Meter Lighting Board

1.4.2.2 Flow Meter Lighting Board

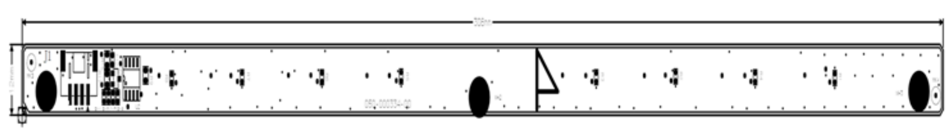


FIGURE 1-35 Flow Meter Lighting Board, Top View

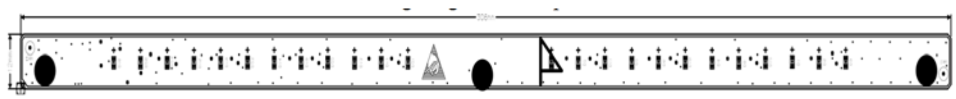


FIGURE 1-36 Flow Meter Lighting Board, Bottom View

Flow Meter Lighting Board Interface, J1

PIN	NAME	FUNCTION
1	12V	12V Power Supply of the Flow Meter Lighting board
2	GND	Ground
3	GND	Ground
4	LIGHT_IN	Flow Meter Lighting Control Signal

1.5 The Breathing System

1.5.1 Brief Introduction

The A5/A4/A3 Breathing System supports three types of operational modes: mechanical ventilation, manual ventilation, and standby. These modes allow the operator to apply proper ventilation strategy based on the patient's needs.

The types of flow paths through the breathing system vary with the operating mode or status.

1.5.2 Automatic Mode, Inspiration

When the Auto/Manual switch is positioned at Auto, the system closes the manual ventilation path. Drive gas pushes down on the bellows. Gas flows from the bellows, through the CO2 absorber canister, and through the inspiratory check valve to the patient.

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

In volume mode, tidal volume is compensated for variations in fresh gas flow to ensure that the volume delivered to the patient meets the set value.

In pressure mode, the inspiratory pressure is regulated both in gas flow and airway pressure to ensure the airway pressure is held at the set inspiratory pressure during the patient inspiration.

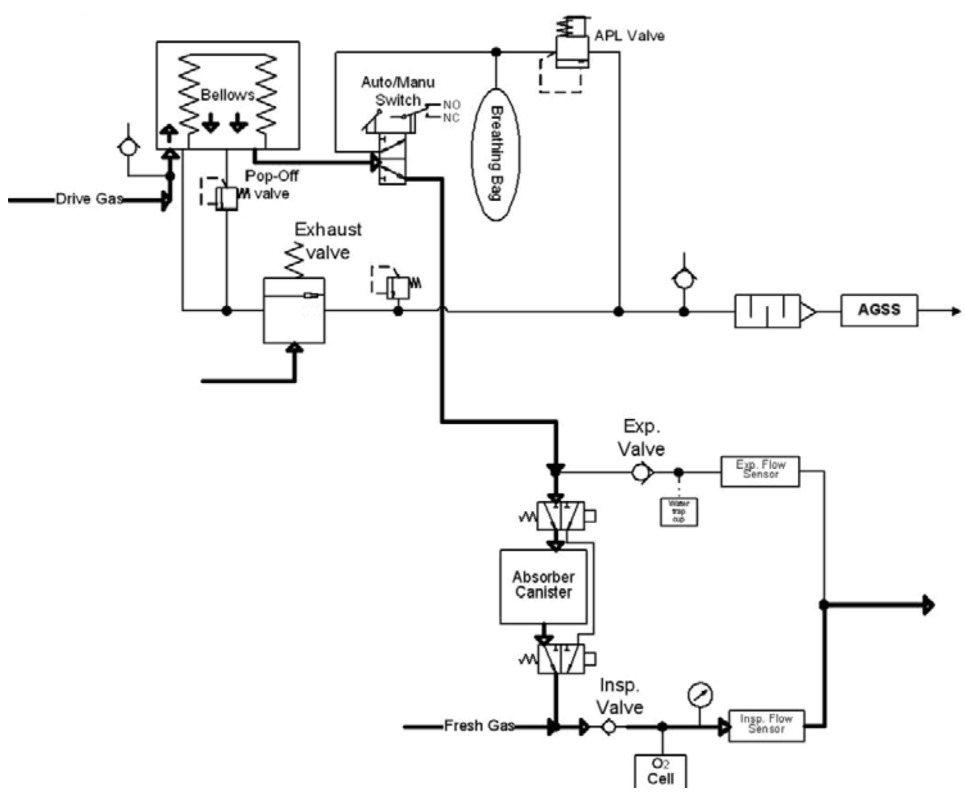


FIGURE 1-37 Automatic Mode, Inspiration Diagram

1.5.3 Automatic Mode, Expiration

When the Auto/Manual switch is set to Auto, the system closes the manual ventilation path. Drive-gas flow stops and the exhaust valve opens. Exhaled gas flows from the patient, through the expiratory check valve, and into the bellows.

Residual drive gas flows out of the bellows dome through the exhaust valve to the scavenging system (AGSS).

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

During exhalation, fresh gas flows backwards through the CO2 absorber into the expiratory limb, downstream of the expiratory check valve.

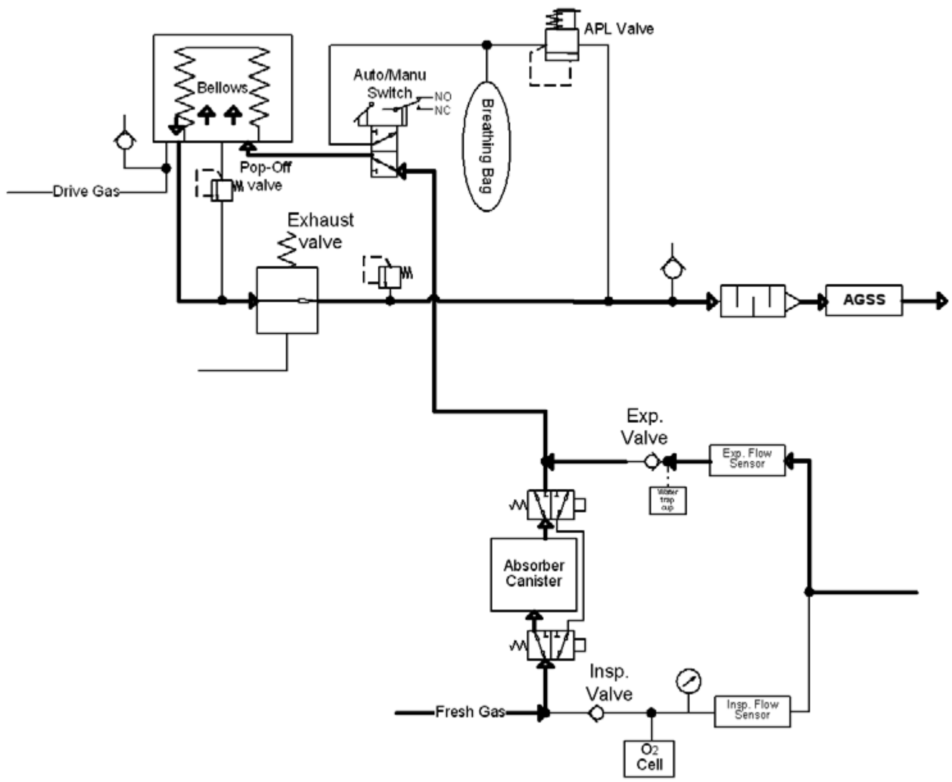


FIGURE 1-38 Automatic Mode, Expiration Diagram

1.5.4 Manual Mode, Inspiration

When the Auto/Manual switch is set to Manual, the system closes the Auto ventilation path. Gas flows from the breathing bag when compressed, through the CO2 absorber canister, into the breathing circuit, and through the inspiratory check valve to the patient.

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

If airway pressure exceeds the set value of the APL Valve, the residual gas will pass through the APL Valve to the scavenging system (AGSS).

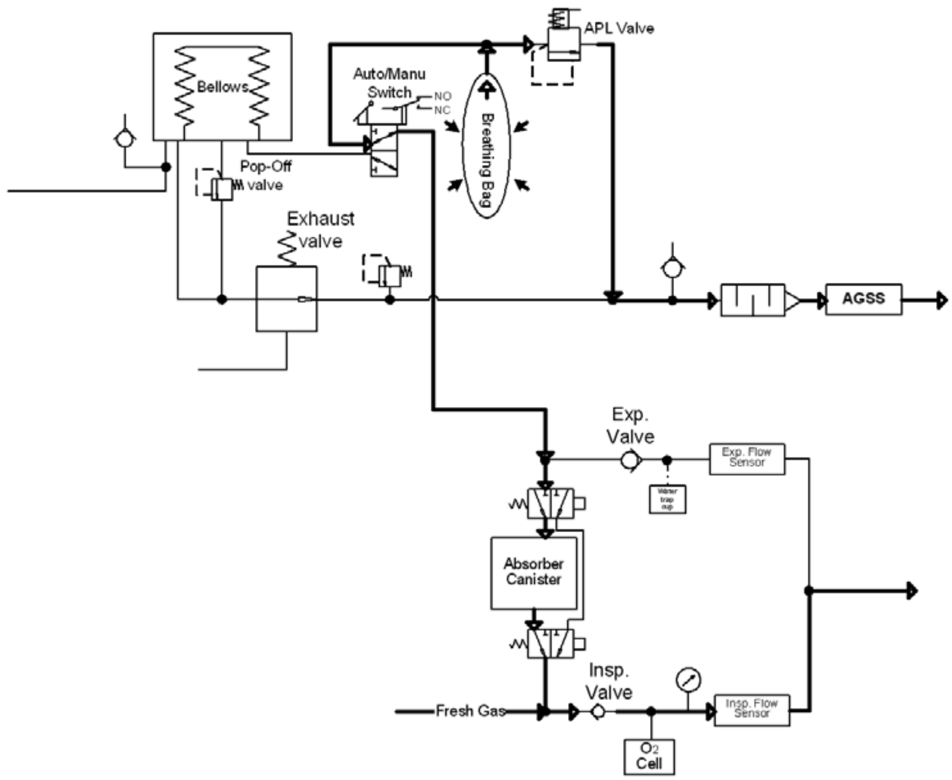


FIGURE 1-39 Manual Mode, Inspiration Diagram

1.5.5 Manual Mode, Expiration

When the Auto/Manual switch is set to Manual, the system closes the Auto ventilation path. Gas flows from the patient, through the expiratory check valve, and into the breathing bag. During exhalation, fresh gas enters the Breathing System. Residual fresh gas passes through the APL valve to the AGSS.

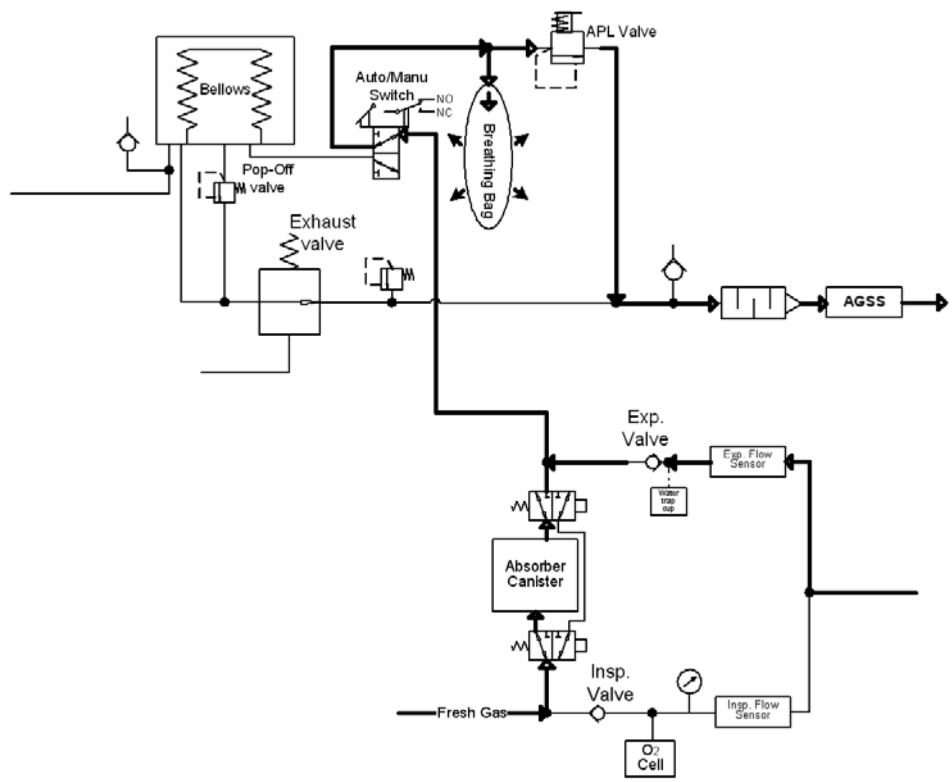


FIGURE 1-40 Manual Mode, Expiration Diagram

1.5.6 Pneumatic PEEP

The PEEP valve regulates the pressure at which the exhaust valve opens. Therefore, if PEEP is selected, static pressure on the pilot port of the exhalation valve sets the PEEP level during the automatic ventilation.

1.5.7 Ventilator in Standby

When the anesthesia system is in standby mode, monitoring will be inactive, and automatic ventilation will be unavailable. The patient should not be ventilated when the system is in standby mode.

1.5.8 Breathing System Components

1.5.8.1 Ventilation Bellows System

The ventilator's driving system is a flow generator. Driving gas fills the bellows dome to compress the bellows. The breathing gas is pressed out of the bellows into the patient breathing circuit. The bellows is refilled with fresh gas and the expired gas from the patient.

1.5.8.2 Manual Breathing Bag

In manual mode, this device acts as a normal breathing bag, enabling the user to ventilate the patient manually.

1.5.8.3 CO2 Absorber Canister

The sodalime inside the CO2 absorber canister absorbs the carbon dioxide from the exhaled gas. The CO2 absorber canister accommodates standard sized Pre-paks or loose-fill CO2 absorbent.

1.5.8.4 Inspiratory and Expiratory Valves

To ensure correct gas flow direction to and from the patient, check-valves are integrated in the inspiratory and expiratory limb of the Breathing System.

1.5.8.5 APL (Airway Pressure Limiting) Valve

In manual mode, the APL Valve acts as a normal spring-loaded pressure relief valve, limiting the maximum pressure in the Breathing System.

1.6 Ventilator UI

1.6.1 Display

1.6.1.1 Display Interface Board

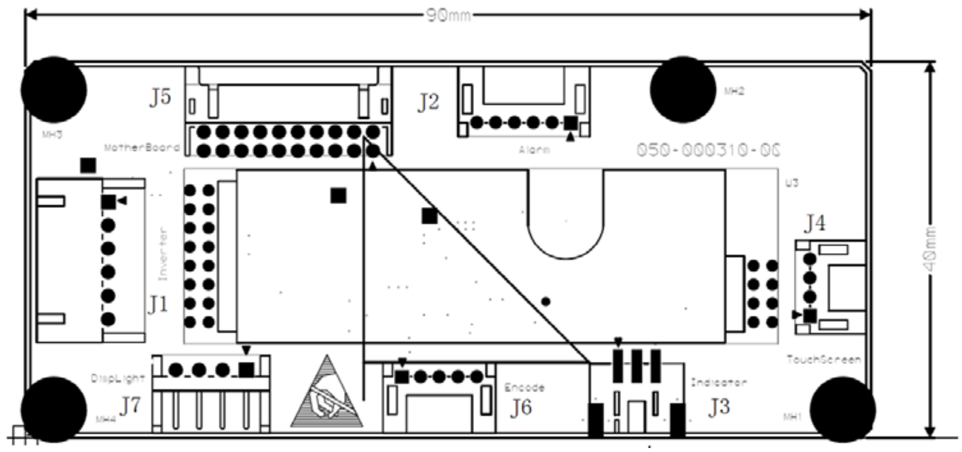


FIGURE 1-41 Display Interface Board, Top View

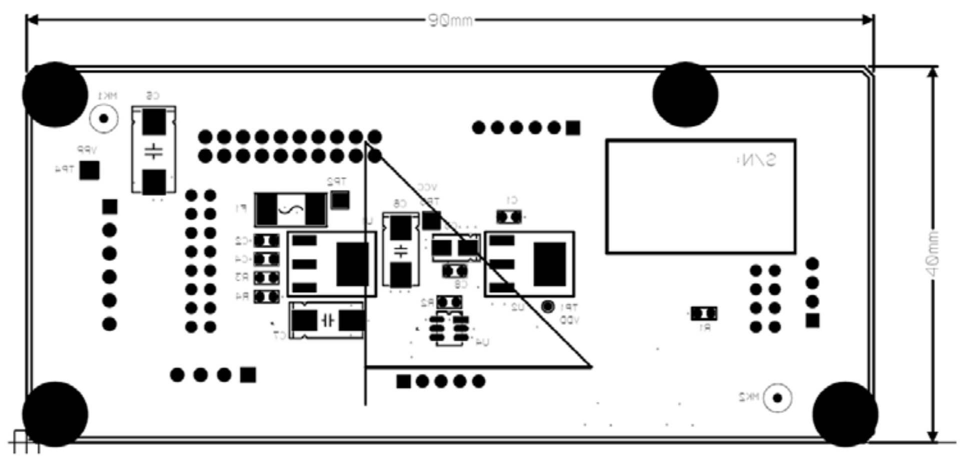


FIGURE 1-42 Display Interface Board, Bottom View

Inverter interface, J1

PIN	NAME	FUNCTION
1	12V	Inverter 12V Power Supply
2	12V	Inverter 12V Power Supply
3	GND	Ground
4	GND	Ground
5	LCD_EN	LCD Backlight Enable
6	LCD_BR	LCD Backlight Brightness Control

Warning Light Board Interface, J2

PIN	NAME	FUNCTION
1	12V	Warning Light Board 12V Power Supply
2	GND	Ground
3	SDA_CPU	CPU Board I2C Data Signal
4	SCL_CPU	CPU Board I2C Clock Signal
5	3_3V	3.3V Power Supply
6	GND	Ground

Touch Screen Control Board interface, J4

PIN	NAME	Function
1	5V	5V Power Supply
2	RXD_TOUCH_PANEL	Touch Screen Control Board Serial Port Receive Signal
3	TXD_TOUCH_PANEL	Touch Screen Control Board Serial Port Transmit Signal
4	GND	Ground

Display Control Signal Interface, J5

PIN	Name	Function
1	LCD_EN	LCD Backlight Enable
2	LCD_BR	LCD Backlight Brightness Control
3	RXD_TOUCH_PANEL	Touch Screen Control Board Serial Port Receive Signal
4	TXD_TOUCH_PANEL	Touch Screen Control Board Serial Port Transmit Signal
5	GND	Ground
6	LED_AC	AC Indicator Light Drive Signal
7	LED_BAT	Battery Indicator Light Drive Signal
8	SDA_CPU	CPU Board I2C Signal
9	SCL_CPU	CPU Board I2C Signal
10	RSVD	Reserved
11	RSVD	Reserved
12	RSVD	Reserved
13	RSVD	Reserved
14	RSVD	Reserved
15	RSVD	Reserved
16	12V	12V Power Supply
17	12V	12V Power Supply
18	GND	Ground
19	GND	Ground
20	GND	Ground

1.6.1.2 Backlight Inverter Board

NOTE: **System will have a Backlight Inverter Board or a Screen Backlight Board.**

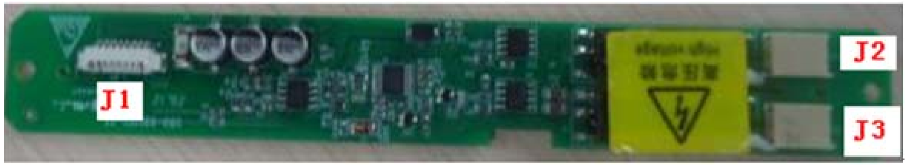


FIGURE 1-43 Backlight Inverter Board, Top View

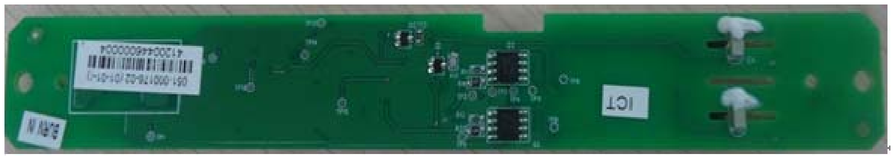


FIGURE 1-44 Backlight Inverter Board, Bottom View

Inverter Board Interface, J1

PIN	NAME	FUNCTION
1	GND	Ground
2	GND	Ground
3	GND	Ground
4	BL_ADJ	Display Brightness Control Signal
5	BL_ON/OFF	Inverter Enable Signal
6	12V	12V Power Supply
7	12V	12V Power Supply
8	12V	12V Power Supply

Inverter Board Interface, J2 and J3

PIN	NAME	FUNCTION
1	High_Voltage	High-Voltage Output of the Inverter
2	Low_Voltage	Low-Voltage Output of the Inverter

1.6.1.3 Screen Backlight Board

NOTE: **System will have a Backlight Inverter Board or a Screen Backlight Board.**

FIGURE 1-45 Screen Backlight Board, Top View

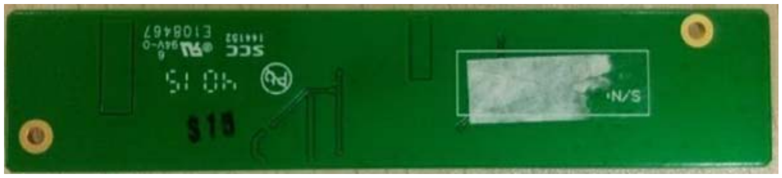


FIGURE 1-46 Screen Backlight Board, Bottom View

Screen Backlight Board Interface, J1

PIN	NAME	FUNCTION
1	VPP	12V Power Supply
2	GND	Ground
3	BCON	Screen Backlight Enable Signal
4	DIMMING	Screen Backlight Control Signal
5	NC	None Connection

Screen Backlight Board Interface, J2

PIN	NAME	FUNCTION
1	GND	Ground
2	PWM	Screen Backlight Control PWM Signal
3	LED_EN	Screen Backlight Enable Signal
4	VPP	12V Power Supply

1.6.1.4 Warning Light Board

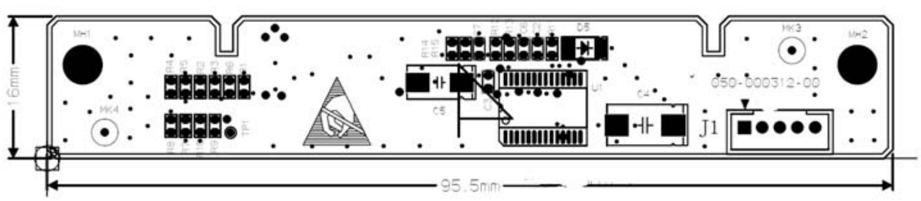


FIGURE 1-47 Warning Light Board, Top View

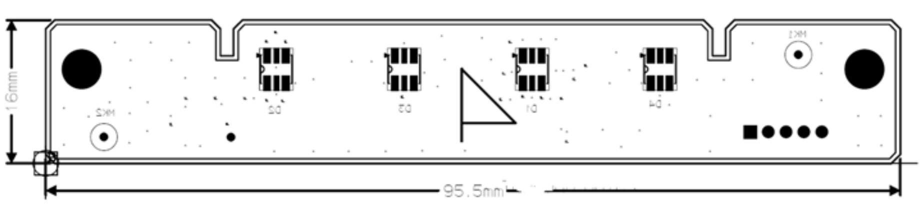


FIGURE 1-48 Warning Light Board, Bottom View

Warning Light Board Interface, J1

PIN	NAME	FUNCTION
1	12V	12V Power Supply
2	GND	Ground
3	MAIN_BRD_SDA	CPU Board I2C Data Signal
4	MAIN_BRD_SCL	CPU Board I2C Clock Signal
5	3_3V	3.3V Power Supply

1.6.1.5 Display

The anesthesia system display is a 15-inch, 24-bit, 1024x768 LVDS touch screen. Its LCD backlight brightness can be adjusted by the inverter.

1.6.1.6 Flow Control Board

FIGURE 1-49 Flow Control Board, Top View

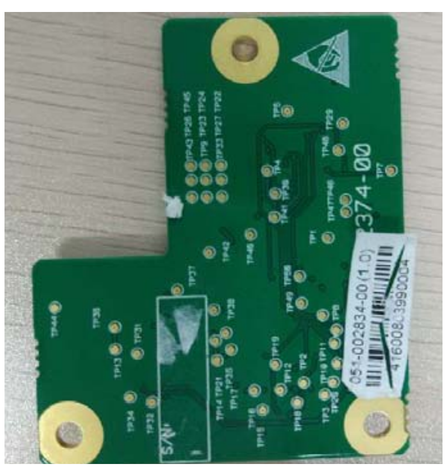


FIGURE 1-50 Flow Control Board, Bottom View

Flow Control Board Interface, J1

PIN	NAME	FUNCTION
1	TXD_FLOW_BRD	Flow Control Board Serial Port Transmit Signal
2	RXD_FLOW_BRD	Flow Control Board Serial Port Receive Signal
3	GND	Ground
4	12V	Flow Control Board 12V Power Supply

1.6.1.7 Indicator Light Board

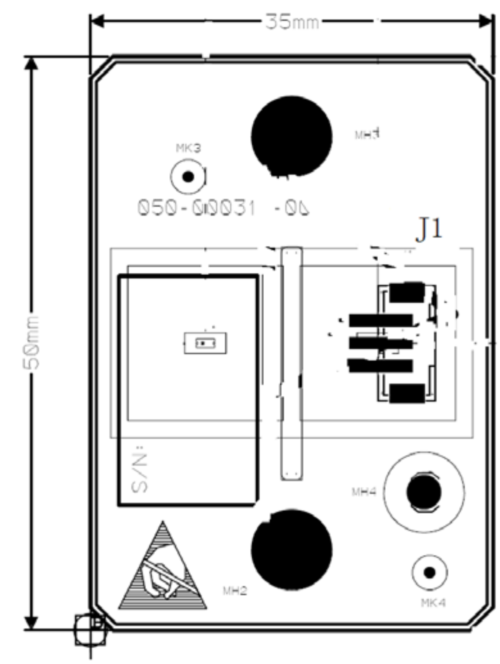


FIGURE 1-51 Indicator Light Board, Top View

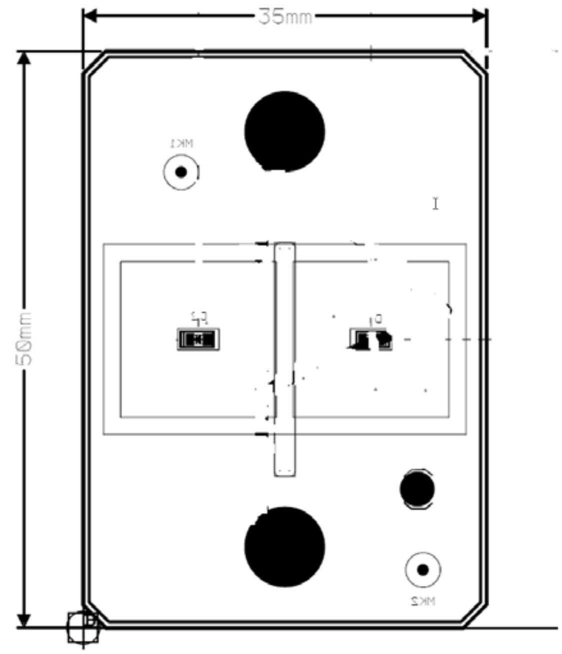


FIGURE 1-52 Indicator Light Board, Bottom View

Indicator Light Board interface, J1

PIN	NAME	FUNCTION
1	LED_AC	AC Indicator Light Drive Signal
2	LED_BAT	Battery Indicator Light Drive Signal
3	GND	Ground

1.6.2 CPU Board

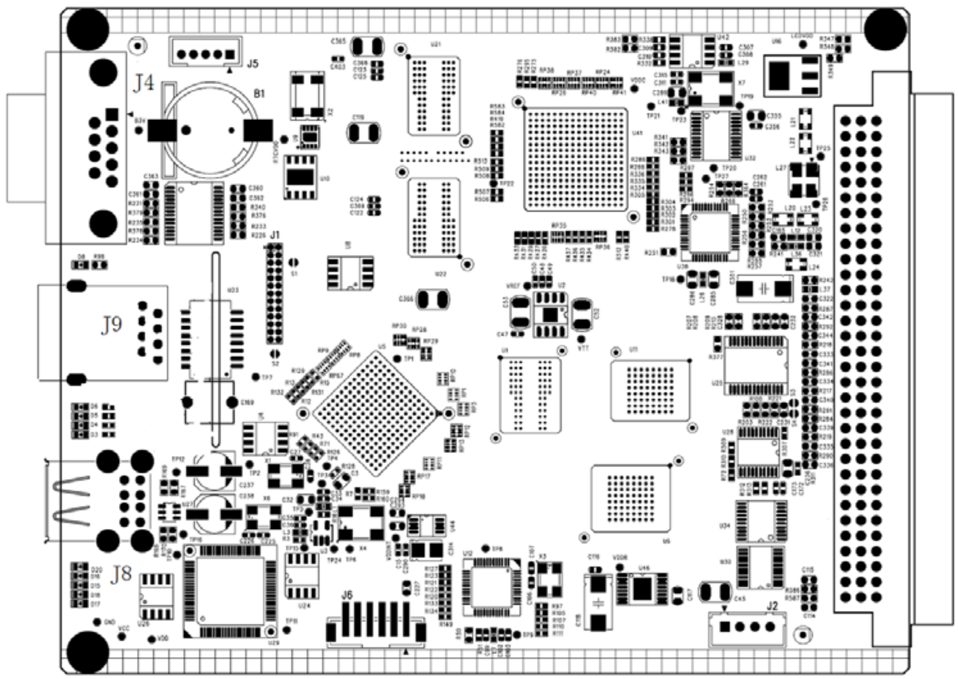


FIGURE 1-53 CPU Board, Top View

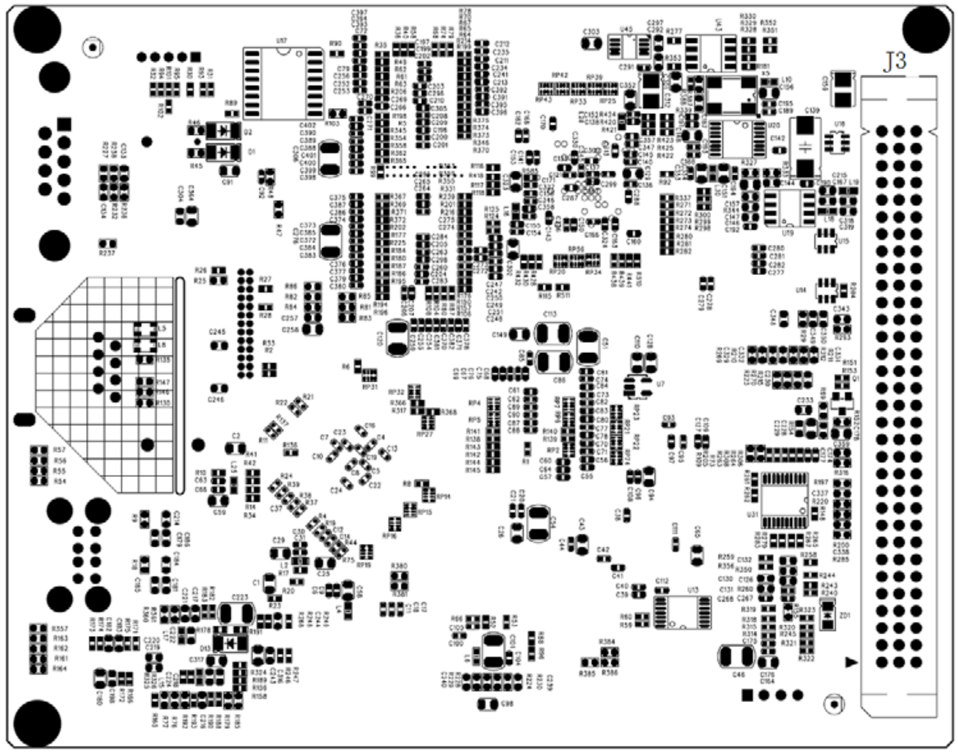


FIGURE 1-54 CPU Board, Bottom View

Network Port, J9

PIN	NAME	FUNCTION
1	TX+	Positive End of Transmit Signal
2	TX-	Negative End of Transmit Signal
3	RX+	Positive End of Receive Signal
4	CT1	No Definition
5	CT1	No Definition
6	RX-	Negative End of Receive Signal
7	CT2	No Definition
8	CT2	No Definition

USB Interface, J8

PIN	NAME	FUNCTION
1	VCC	USB Power Supply
2	DM0	USB Data Signal – (Negative)
3	DP0	USB Data Signal + (Positive)
4	GND	Ground
5	VCC	USB Power Supply
6	DM1	USB Data Signal – (Negative)

PIN	NAME	FUNCTION
7	DP1	USB Data Signal + (Positive)
8	GND	Ground

RS-232 Interface, J4

PIN	NAME	FUNCTION
1	NC	No Connection
2	RXD	RS-232 Receive Signal
3	TXD	RS-232 Transmit Signal
4	NC	No Connection
5	GND	Ground
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

1.7 Ventilator Control and Drive

1.7.1 Mother Board

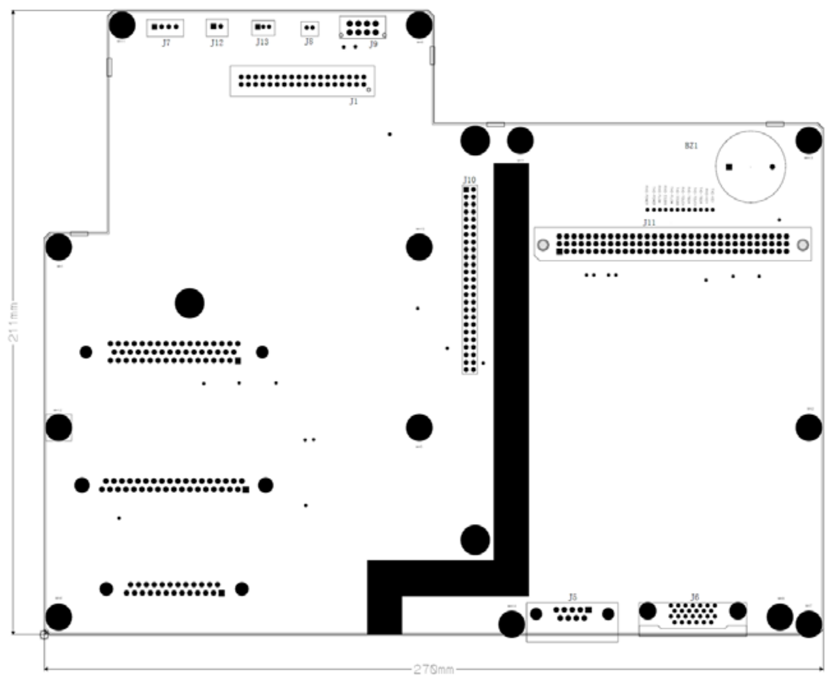


FIGURE 1-55 Mother Board, Top View

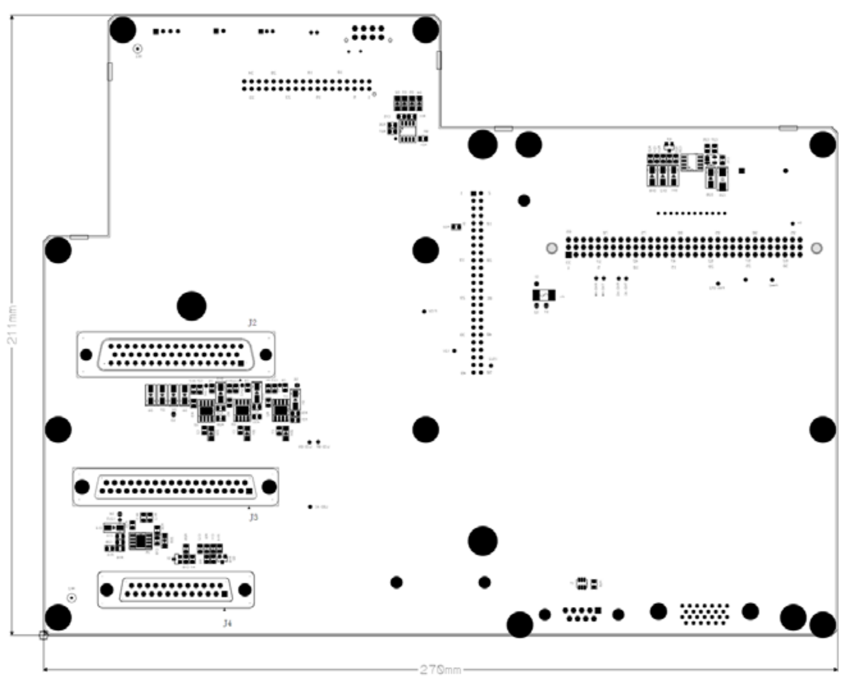


FIGURE 1-56 Mother Board, Bottom View

VCM Interface, J1

PIN	NAME	FUNCTION
1	SAFE_VALVE	Pressure Relief Valve Drive Signal
2	7VIN	Inspiration Valve Drive Signal
3	INSP_VALVE	Inspiration Valve Drive Signal
4	7VIN	PEEP Valve Drive Signal
5	PEEP_VALVE	PEEP Valve Drive Signal
6	SOLENOID_VALVE1	Three-way Valve 1
7	SOLENOID_VALVE2	Three-way Valve 2
8	SOLENOID_VALVE3	Three-way Valve 3
9	SOLENOID_VALVE4	Three-way Valve 4
10	PNEUM_PRES_SW	Pneumatic Block Pressure Switch Signal
11	NC	No Connection
12	NC	No Connection
13	O2_PRE_SW	O2 Pressure Switch Signal at Gas Supply Inlet
14	MANU_AUTO_SW	Auto/Manual Switch Signal
15	GND	Ground
16	CO2_BYPASS_SW	Circuit CO2 Absorber Canister Signal
17	O2+	O2 Concentration Signal
18	O2-	O2 Concentration Signal
19	TXD_AUX_BRD	VPM Serial Port Transmit Signal
20	RXD_AUX_BRD	VPM Serial Port Receive Signal
21	GND	Ground
22	RSVD	Reserved
23	RSVD	Reserved
24	RSVD	Reserved
25	VF	Differential Pressure Sensor Flow Signal
26	GND	Ground
27	TXD_MON_BRD	VCM Serial Port Transmit Signal
28	RXD_MON_BRD	VCM Serial Port Receive Signal
29	12V	12V Power Supply
30	GND	Ground
31	5V	VCM Close Pressure Relief Valve Signal
32	5V	5V Power Supply
33	TXD_CALIBRATE	Calibration Serial Port Transmit Signal
34	RXD_CALIBRATE	Calibration Serial Port Receive Signal
35	GND	Ground
36	12V	12V Power Supply

Pneumatic Assembly Interface, J2

PIN	NAME	FUNCTION
1	7Vout	Pressure Relief Valve Power Supply
2	SAFE_VALVE	Pressure Relief Valve Drive Signal

PIN	NAME	FUNCTION
3	7Vout	Inspiration Valve Power Supply
4	INSP_VALVE	Inspiration Valve Drive Signal
5	7Vout	PEEP Valve Power Supply
6	PEEP_VALVE	PEEP Valve Drive Signal
7	12V	Three-way Valve Power Supply
8	SOLENOID_VALVE1	Three-way Valve Drive Signal 1
9	12V	Three-way Valve Power Supply
10	SOLENOID_VALVE2	Three-way Valve Drive Signal 2
11	12V	Three-way Valve Power Supply
12	SOLENOID_VALVE3	Three-way Valve Drive Signal 3
13	12V	Three-way Valve Power Supply
14	SOLENOID_VALVE4	Three-way Valve Drive Signal 4
15	RSVD	Reserved
16	RSVD	Reserved
17	RSVD	Reserved
18	VF	Thermal Mass Sensor Flow Sensor
19	12V	Sensor Board 12V pPower Supply
20	GND	Ground
21	NC	No Connection
22	NC	No Connection
23	NC	No Connection
24	GND	Ground
25	O2_PRE_SW	O2 Pressure Switch Signal at Gas Supply Inlet
26	GND	Ground
27	PNEUM_PRES_SW	Pneumatic Block Pressure Switch Signal
28	GND	Ground
29	MANU_AUTO_SW	Auto/Manual Switch Signal
30	GND	Ground
31	CO2_BYPASS_SW	Circuit CO2 Absorber Canister Signal
32	GND	Ground
33	NC	No Connection
34	GND	Ground
35	O2+	O2 Concentration Signal
36	O2-	Ground
37	LOOP_SW	Circuit Switch
38	GND	Ground
39	NTC_R11	Signal of Thermistor 1
40	NTC_R12	Signal of Thermistor 2
41	NTC_R21	Signal of Thermistor 1
42	NTC_R22	Signal of Thermistor 2
43	HEA_PWR_15V	Heater Drive Voltage Signal
44	HEA_PWR_15V	Heater Drive Voltage Signal
45	GND	Ground

PIN	NAME	FUNCTION
46	GND	Ground
47	12V	Electronic Flowmeter Power Supply
48	GND	Ground
49	RXD_FLOW_BRD	Electronic Flowmeter Serial Port Receive Signal
50	TXD_FLOW_BRD	Electronic Flowmeter Serial Port Transmit Signal

Display Interface, J3

PIN	NAME	FUNCTION
1	LCD_EN	Inverter Enable Signal
2	LCD_BR	Inverter Brightness Adjustment Signal
3	RXD_TOUCH_PANEL	Touch Screen Control Board Serial Port Receive Signal
4	TXD_TOUCH_PANEL	Touch Screen Control Board Serial Port Transmit Signal
5	NC	No Connection
6	LED_AC	AC Indicator Light Drive Signal
7	LED_BAT	Battery Indicator Light Drive Signal
8	MAIN_BRD_SDA	CPU Board I2C Signal
9	MAIN_BRD_SCL	CPU Board I2C Signal
10	NC	No Connection
11	NC	No Connection
12	NC	No Connection
13	NC	No Connection
14	NC	No Connection
15	NC	No Connection
16	12V	12V Power Supply
17	GND	Ground
18	GND	Ground
19	VCC_LCD	Optional Backplane Power Supply or CPU Board Power Supply for Display
20	VCC_LCD	Optional Backplane Power Supply or CPU Board Power Supply for Display
21	GND	Ground
22	GND	Ground
23	LVDS_DATA0+	LVDS Data Difference to Positive Signal 0
24	LVDS_DATA0-	LVDS Data Difference to Negative Signal 0
25	GND	Ground
26	LVDS_DATA1+	LVDS Data Difference to Positive Signal 1
27	LVDS_DATA1-	LVDS Data Difference to Negative Signal 1
28	GND	Ground
29	LVDS_DATA2+	LVDS Data Difference to Positive Signal 2
30	LVDS_DATA2-	LVDS Data Difference to Negative Signal 2
31	GND	Ground
32	LVDS_DATA3+	LVDS Data Difference to Positive Signal 3
33	LVDS_DATA3-	LVDS Data Difference to Negative Signal 3

PIN	NAME	FUNCTION
34	GND	Ground
35	LVDS_CLK+	LVDS Clock Difference to Positive Signal
36	LVDS_CLK-	LVDS Clock Difference to Negative Signal
37	GND	Ground

Infrared Module Rack Interface for Patient Monitor, J4

PIN	NAME	FUNCTION
1	LED_AC	AC Indicator Light Drive Signal
2	3V3	3.3V Power Supply
3	12V	12V Power Supply
4	12V	12V Power Supply
5	GND	Ground
6	GND	Ground
7	RXD_Infrared Comm Board	Infrared Comm Board Serial Port Receive Signal
8	TXD_Infrared Comm Board	Infrared Comm Board Serial Port Transmit Signal
9	12V	12V Power Supply
10	Fan_PWM	PWM Driver Signal for Fan
11	Fan_State	State Detection Signal for Fan
12	GND	Ground
13	LED_BAT	Battery Indicator Light Drive Signal
14	PCON-_NON	Power ON/OFF Inverse Phase Signal
15	GND	Ground
16	PCON+	Power ON/OFF Circuit 3.3V
17	PCON-	Power ON/OFF Signal
18	TOUCHPAD_5V	5V Power Supply
19	TOUCHPAD_GND	Ground
20	TOUCHPAD_USB+	TOUCHPAD_USB Difference to Positive Signal
21	TOUCHPAD_USB-	TOUCHPAD_USB Difference to Negative Signal
22	12V	12V Power Supply
23	GND	Ground
24	RSVD	Reserved
25	RSVD	Reserved

Calibration Interface, J5

PIN	NAME	FUNCTION
1	NC	No Connection
2	NC	No Connection
3	NC	No Connection
4	NC	No Connection
5	NC	No Connection

PIN	NAME	FUNCTION
6	12V	12V Power Supply
7	RXD_CALIBRATE	Calibration Serial Port Receive Signal
8	TXD_CALIBRATE	Calibration Serial port Transmit Signal
9	GND	Ground

Anesthetic Ventilator Cooling Fan Interface, J7

PIN	NAME	FUNCTION
1	12V3	12V Power Supply
2	RSVD	Reserved
3	FAN1_STATE	Fan Status Signal
4	GND	Ground

Speaker Interface, J8

PIN	NAME	FUNCTION
1	Speak+	Speaker Positive End
2	Speak-	Speaker Negative End

Battery Adaptation Board Interface, J9

PIN	NAME	FUNCTION
1	BAT1+	Battery Voltage
2	NTC1	Battery Internal Thermistor
3	BC1	Battery In-position Signal
4	GND	Ground
5	BAT2+	Battery Voltage
6	NTC2	Battery Internal thermistor
7	BC2	Battery In-position Signal
8	GND	Ground

Power Board Interface, J10

PIN	NAME	FUNCTION
1	PLAM	Buzzer Drive Signal (drives the buzzer directly)
2	RXD_PWR_BRD	Power Board Serial Port (receives signal)
3	LOOP_SW	Circuit Switch (reflects if the circuit is in position)
4	TXD_PWR_BRD	Power Board Serial Port (transmits signal)
5	NC	Power Board Cooling Fan Drive
6	GND	Ground
7	LED-BAT	Battery Status Indicator Light Drive Output
8	LCD_EN	Backlight Enable Signal
9	LED-AC	AC Status Indicator Light Drive Output
10	LCD_BR	Backlight Brightness Control Voltage

PIN	NAME	FUNCTION (Continued)
11	PCON-	Power ON/OFF Signal, LVTTL Pulse Signal. If this signal is high level, the system is turned on; if this signal is low level, the system is turned off.
12	3.3VBF	3.3V only used for power ON/OFF the machine
13	BAT2+	2# Battery Input, connect to battery positive end
14	GND	Ground
15	BC2F	2# Battery Availability Signal. Low level indicates battery available; high level indicates battery unavailable
16	NTC2	2# Lithium-ion Battery Internal Thermistor Signal
17	BAT1+	1# Battery Input, connect to battery positive end
18	GND	Ground
19	BC1F	1# Battery Availability Signal. Low level indicates battery available; high level indicates battery unavailable
20	NTC1	1# Lithium-ion Battery Internal Thermistor Signal
21	GND	Ground
22	GND	Ground
23	HEA_PWR_15V	Heat Wire Drive Voltage Output
24	HEA_PWR_15V	Heat Wire Drive Voltage Output
25	NTC_R12	Thermistor (for controlling heat wire) Pin 1
26	NTC_R22	Thermistor (for controlling heat wire) Pin 2
27	NTC_R11	Thermistor (for controlling heat wire) Pin 1
28	NTC_R21	Thermistor (for controlling heat wire) Pin 2
29	GND	Ground
30	GND	Ground
31	3V3	3.3V Supply Voltage Output
32	3V3	3.3V Supply Voltage Output
33	5V	5V Supply Voltage Output
34	GND	Ground
35	GND	Ground
36	GND	Ground
37	NC	No Connection
38	GND	Ground
39	NC	No Connection
40	NC	No Connection
41	GND	Ground
42	GND	Ground
43	12V	12V Power Supply Output
44	GND	Ground
45	12V	12V Power Supply Output
46	12V	12V Power Supply Output
47	NC	No Connection
48	15V2	15.2V Supply Voltage Output
49	NC	No Connection
50	15V2	15.2V Supply Voltage Output

CPU Board Interface, J11

PIN	NAME	FUNCTION
A1	LCD_VDD	LCD Power Supply
A2	GND	LCD Ground
A3	NC	No Connection
A4	NC	No Connection
A5	RSVD	Serial Port Transmit Signal
A6	RSVD	Serial Port Receive Signal
A7	GND	Ground
A8	RSVD	Serial Port Transmit Signal
A9	RSVD	Serial Port Receive Signal
A10	GND	Ground
A11	UIVCC_USB	USB Power Supply
A12	TOUCHPAD_USB+	TOUCHPAD_USB Data Signal +
A13	TOUCHPAD_USB-	TOUCHPAD_USB Data Signal -
A14	GND	Ground
A15	SCL	CPU Board I2C Clock
A16	SDA	CPU Board I2C Data
A17	GND	Ground
A18	NC	No Connection
A19	NC	No Connection
A20	NC	No Connection
A21	NC	No Connection
A22	FAN1_STATE	Fan Status Detected Signal
A23	NC	No Connection
A24	GND	Ground
A25	3V3	CPU Board Main Power Supply
A26	3V3	CPU Board main Power Supply
A27	GND	Ground
A28	GND	Ground
A29	5V	CPU Board Interface Chip Power Supply
A30	5V	CPU Board Interface Chip Power Supply
A31	GND	Ground
A32	GND	Ground
B1	NC	Not Connected
B2	NC	Not Connected
B3	NC	Not Connected
B4	SPK_OUT+	Speaker Drive Signal +
B5	SPK_OUT-	Speaker Drive Signal -
B6	GND	Ground
B7	NC	No Connection
B8	NC	No Connection
B9	NC	No Connection
B10	NC	No Connection

PIN	NAME	FUNCTION (Continued)
B11	NC	No Connection
B12	GND	Ground
B13	TXD_PWR_BRD	Power Board Serial Port Transmit Signal
B14	RXD_PWR_BRD	Power Board Serial Port Receive Signal
B15	GND	Ground
B16	TXD_FLOW_BRD	Fresh Flow Sensor Board Serial Port Transmit Signal
B17	RXD_FLOW_BRD	Fresh Flow Sensor Board Serial Port Receive Signal
B18	GND	Ground
B19	TXD_TOUCH_PANEL	Touch Screen Controller Serial Port Transmit Signal
B20	RXD_TOUCH_PANEL	Touch Screen Controller Serial Port Receive Signal
B21	RSVD	Reserved
B22	RSVD	Reserved
B23	GND	Ground
B24	NC	No Connection
B25	NC	No Connection
B26	NC	No Connection
B27	GND	Ground
B28	NC	No Connection
B29	NC	No Connection
B30	NC	No Connection
B31	NC	No Connection
B32	NC	No Connection
C1	GND	Ground
C2	LVDS-TO0+	LVDS Data Signal
C3	LVDS-TO0-	LVDS Data Signal
C4	GND	Ground
C5	LVDS-TO1+	LVDS Data Signal
C6	LVDS-TO1-	LVDS Data Signal
C7	GND	Ground
C8	LVDS-TO2+	LVDS Data Signal
C9	LVDS-TO2-	LVDS Data Signal
C10	GND	Ground
C11	LVDS-TO3+	LVDS Data Signal
C12	LVDS-TO3-	LVDS Data Signal
C13	GND	Ground
C14	LVDS-TOC+	LVDS Clock Signal
C15	LVDS-TOC-	LVDS Clock Signal
C16	GND	Ground
C17	TXD_MON_BRD	Ventilator Control Board Serial Port Transmit Signal
C18	RXD_MON_BRD	Ventilator Control Board Serial Port Receive Signal
C19	GND	Ground
C20	TXD_AUX_BRD	Auxiliary Ventilator Control Board Serial Port Transmit Signal
C21	RXD_AUX_BRD	Auxiliary Ventilator Control Board Serial Port Receive Signal

PIN	NAME	FUNCTION (Continued)
C22	GND	Ground
C23	NC	No Connection
C24	NC	No Connection
C25	GND	Ground
C26	TP_PWR_CTRL	Touch Pad Power Supply Control Signal
C27	RSVD	Reserved
C28	RSVD	Reserved
C29	RSVD	Reserved
C30	RSVD	Reserved
C31	NC	No Connection
C32	NC	No Connection

Debugging Power ON/OFF Interface, J12

PIN	NAME	FUNCTION
1	PCON+	Power ON/OFF Signal
2	PCON-	Power ON/OFF Signal

Test Point Definition

DESIGNATOR	NAME	FUNCTION	RANGE (Unit: V)
T1	BAT1	Lithium-ion Battery Voltage 1	Fully charged 12.6±5%
T2	BAT2	Lithium-ion Battery Voltage 2	Fully charged 12.6±5%
T3	LED_BAT	Battery Indicator Light Drive Signal	With battery: 2.5~3.5; Without battery: 0~0.4
T4	TXD_7024	Auxiliary Ventilator Control Board Serial Port Transmit Signal	High level 2.4~5; Low level 0~0.4
T5	TXD_TOUCH	Touch Screen Controller Serial Port Transmit Signal	High level 2.4~5; Low level 0~0.4
T6	RXD_7024	Auxiliary Ventilator Control Board Serial Port Receive Signal	High level 2.4~5; Low level 0~0.4
T7	RXD_TOUCH	Touch Screen Controller Serial Port Receive Signal	High level 2.4~5; Low level 0~0.4
T8	TXD_33209	VPM Serial Port Transmit Signal	High level 2.4~5; Low level 0~0.4
T9	TXD_FLOW	Fresh Flow Sensor Board Serial Port Transmit Signal	High level 2.4~5; Low level 0~0.4
T10	RXD_33209	VPM Serial Port Receive Signal	High level 2.4~5; Low level 0~0.4
T11	RXD_FLOW	Fresh Flow Sensor Board Serial Port Receive Signal	High level 2.4~5; Low level 0~0.4
T12	TXD_POWER	Power Board Serial Port Transmit Signal	High level 2.4~5; Low level 0~0.4
T13	RXD_POWER	Power Board Serial Port Receive Signal	High level 2.4~5; Low level 0~0.4
T14	5V	5V Power Supply	4.75~5.25
T15	3.3V	3.3V Power Supply	3.135~3.465

DESIGNATOR	NAME	FUNCTION	RANGE (Unit: V)
T16	15V2	15.2V Power Supply	14.44~15.96
T17	12V	12V Power Supply	11.4~12.6
T18	P15V	Heater Power Supply	0~15
T19	LED_AC	AC Indicator Light Drive Signal	With AC: 5~3.5; Without AC: 0~0.4
T20	12V1	12V Power Supply	11.4~12.6
T21	12V2	12V Power Supply	11.4~12.6
T22	12V3	12V Power Supply	11.4~12.6
T23	7V	7V Power Supply	6.65~7.35
T24	LCD_EN	LCD Backlight Enable Signal	High level 3.145~3.465; Low level 0~0.3
T25	LCD_BR	LCD Backlight Brightness Adjustment Signal	Brightest 0~1.5; least bright 4.75~5.25

1.7.2 Ventilator Control and Drive Board

The monitor subsystem performs pressure and flow detection of the anesthetic ventilator and anesthetic breathing system, valve control, status monitoring collection, O2 concentration reading, accuracy monitoring of pressure and flow inside the circuit, and accuracy control of tidal volume. For EPSON system, the monitor subsystem is composed of four boards: monitor signal detection board, valve drive board, ventilator sensor interface board, and VPM (auxiliary ventilator control board). For DSP systems, the monitor subsystem is composed of two boards: monitor signal detection board and valve drive board.

1.7.2.1 Monitor Signal Detection Board

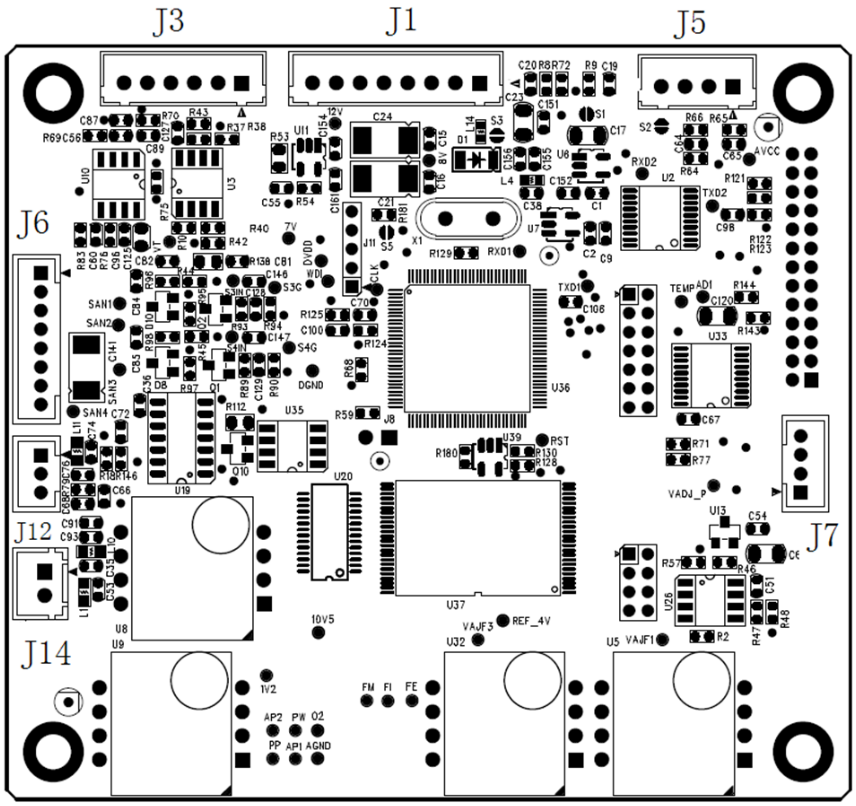


FIGURE 1-57 Monitor Signal Detection Board, Top View

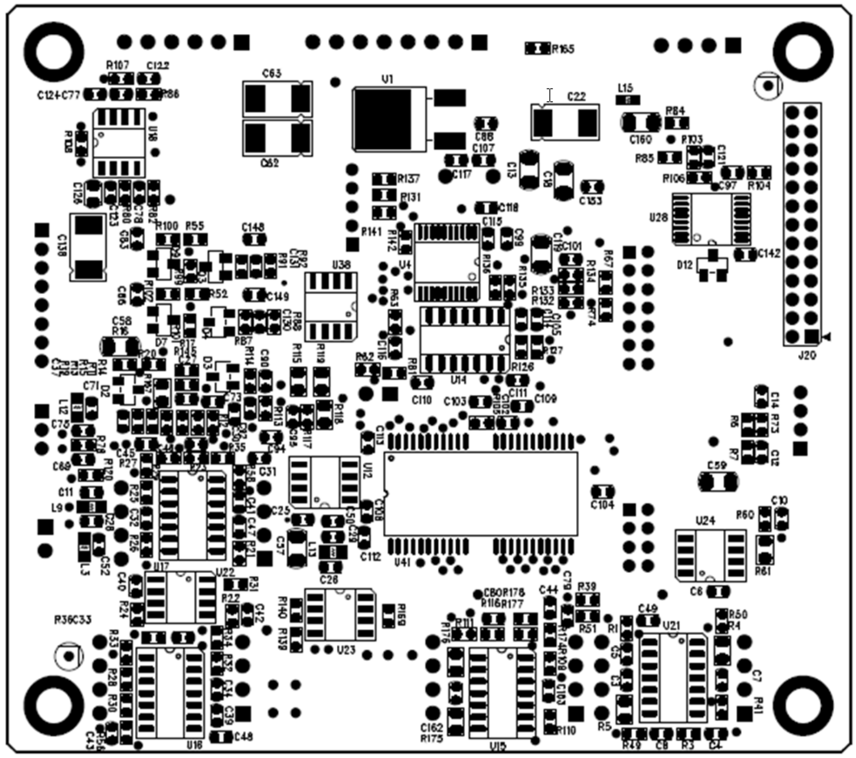


FIGURE 1-58 Monitor Signal Detection Board, Bottom View

Monitor Signal Detection Board Communication Interface, J1

PIN	NAME	FUNCTION
1	TXD	Serial Port Transmit
2	RXD	Serial Port Receive
3	12V	12V Power Supply
4	GND	Ground
5	GND	Ground
6	12V	12V Power Supply
7	PRST	Pressure Relief Valve Control Signal
8	5V	5V Power Supply

Ventilator Sensor Interface, J3

PIN	NAME	FUNCTION
1	SDA	I2C Data Signal
2	SCL	I2C Clock Signal
3	VT	Thermal Mass Flow Sensor Temperature Signal
4	VF	Thermal Mass Flow Sensor Flow Signal
5	12V	Sensor Power Supply
6	GND	Ground

VT Calibration Communication Interface, J7

PIN	NAME	FUNCTION
1	TXD_CALIBRATE	Calibration Serial Port Transmit Signal
2	RXD_CALIBRATE	Calibration Serial Port Receive Signal
3	GND	Ground
4	12V	12V Power Supply

Three-way Valve Control Interface, J6

PIN	NAME	FUNCTION
1	12V	Three-way Valve Power Supply
2	SOLENOID_VALVE1	Three-way Valve Control 1
3	12V	Three-way Valve Power Supply
4	SOLENOID_VALVE2	Three-way Valve Control 2
5	12V	Three-way Valve Power Supply
6	SOLENOID_VALVE3	Three-way Valve Control 3
7	12V	Three-way Valve Power Supply
8	SOLENOID_VALVE4	Three-way Valve Control 4

VPM Communication Interface, J5

PIN	NAME	FUNCTION
1	TXD_AUX_BRD	VPM Serial Port Transmit Signal
2	RXD_AUX_BRD	VPM Serial Port Receive Signal
3	GND	Ground
4	12V	12V Power Supply

O2 Cell Detection Interface, J12

PIN	NAME	FUNCTION
1	O2+	O2 Cell +
2	O2-	O2 Cell -
3	GND	Ground

Test Point Definition

DESIGNATOR	NAME	FUNCTION	RANGE (unit: V)
T1	O2	O2 Concentration Voltage	0~3.5
T2	PP	PEEP Pressure	0.2~4.5
T3	PW	Airway Pressure	0.2~4.5
T6	FM	Ventilator Flow Detection	0.21~5.25
T8	FE	Expiratory Flow Value	0.2~5.5
T9	VAJF3	Offset Voltage	0.602~0.622
T10	10V5	10.5V	10.25~10.75

DESIGNATOR	NAME	FUNCTION	RANGE (unit: V)
T11	REF_4V	4.096V Baseline Power Supply	3.096~4.196
T12	1V2	1.2V Baseline Power Supply	1.1~1.3
T13	VADJ_P	Offset Voltage	0.602~0.622
T14	FI	Inspiratory Flow Value	0.2~5.5
T15	VADJ_FI	Offset Voltage	0.602~0.622
T16	TXD1	Serial Port Transmit Signal (to CPU Board)	0~3.3
T17	RXD1	Serial Port Receive Signal (from CPU board)	0~5
T18	TXD2	Serial Port Transmit Signal (for calibration)	0~3.3
T19	RXD2	Serial Port Receive Signal (for calibration)	0~5
T20	VD	7V	6.8~7.6
T21	DVDD	3.3V Digital Voltage	3.15~3.45
T22	AVCC	5V Analog Voltage	4.75~5.25
T23	WDI	Watchdog Signal	0~3.3
T24	RST	Reset Signal	0~3.3
T25	CLK	Clock Signal	0~3.3
T26	SAN1	Signal of Three-way Valve 1	0~12
T27	SAN2	Signal of Three-way Valve 2	0~12
T28	SAN3	Signal of Three-way Valve 3	0~12
T29	SAN4	Signal of Three-way Valve 4	0~12

1.7.2.2 Valve Drive Board

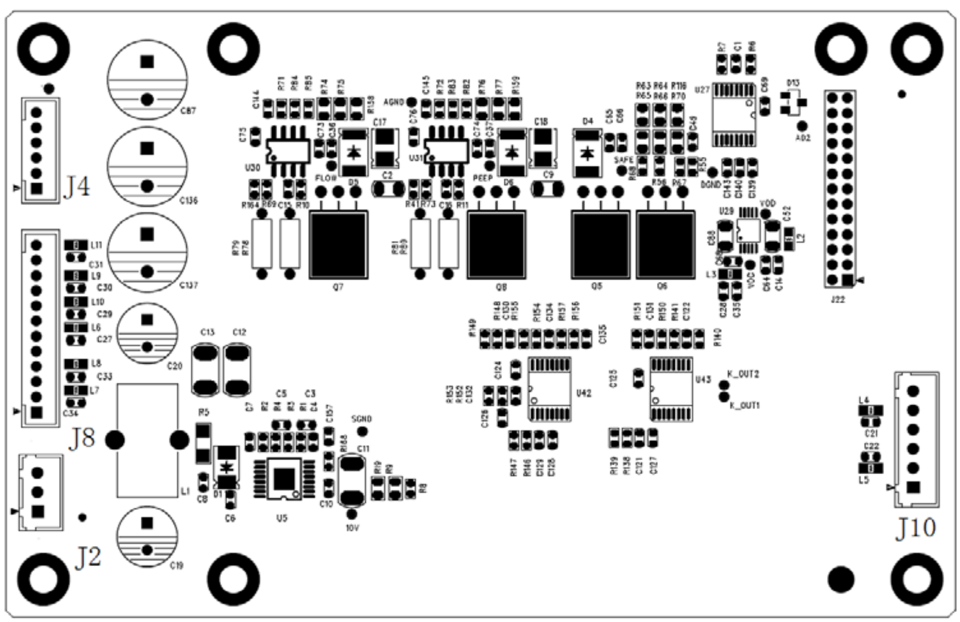


FIGURE 1-59 Valve Drive Board, Top View

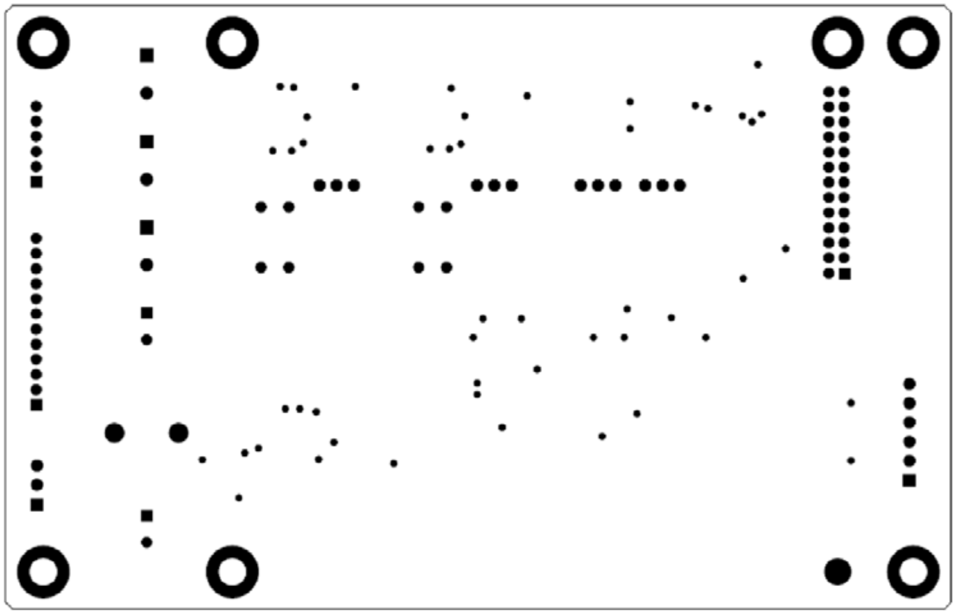


FIGURE 1-60 Valve Drive Board, Bottom View

Proportional Valve and Pressure Relief Valve Drive Interface, J4

PIN	NAME	FUNCTION
1	7V	Pressure Relief Valve Power Supply
2	SAFE_VALVE	Pressure Relief Valve Control Signal
3	7V	Inspiration Valve Power Supply
4	INSP_VALVE	Inspiration Valve Control Signal
5	7V	PEEP Valve Power Supply
6	PEEP_VALVE	PEEP Valve Control Signal

Power Supply Interface, J2

PIN	NAME	FUNCTION
1	GND	Ground
2	GND	Ground
3	12V	12V Power Supply

Status Monitor Detection Interface, J8

PIN	NAME	FUNCTION
1	GND	Ground
2	PNEUM_PRE_SW	Circuit block pressure Switch Signal
3	GND	Ground
4	NC	/
5	GND	Ground

PIN	NAME	FUNCTION
6	QUICK_O2_SW	O2 Flushing Pressure Switch Signal
7	GND	Ground
8	CGO_PRE_SW	CGO Switch Signal
9	GND	Ground
10	O2_PRE_SW	O2 Pressure Switch Signal at Gas Supply Inlet
11	GND	Ground
12	MANU_AUTO_SW	Auto/Manual Switch Signal

Test Point Definition

DESIGNATOR	NAME	FUNCTION	RANGE (unit: V)
T1	K_OUT1	Status Monitor Signal	0~3.45
T2	K_OUT2	Status Monitor Signal	0~3.45
T3	SAFE	Pressure Relief Valve Signal	0~7
T4	VOC	Reserved DA Output Signal	0~1.2
T5	AD2	Analog Channel Output Signal	0~5
T6	FLOW	Inspiration Valve Control Signal	0~7
T7	PEEP	PEEP Valve Control Signal	0~7
T8	10V	12V Input Signal	10~14
T9	7V	Valve Power Supply	6.65~7.35
T10	SGND	Ground	0

1.7.2.3 Sensor Interface Board

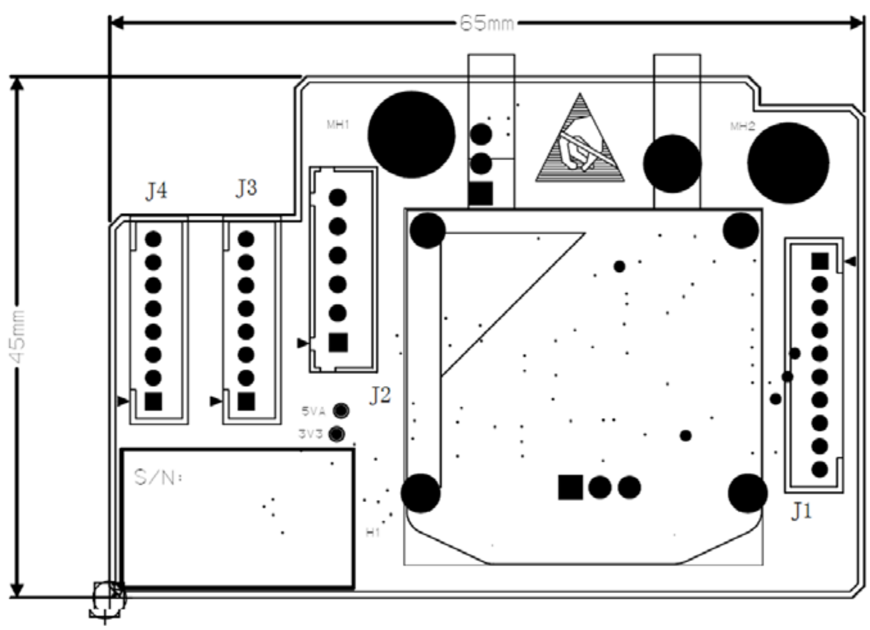


FIGURE 1-61 Sensor Interface Board, Top View

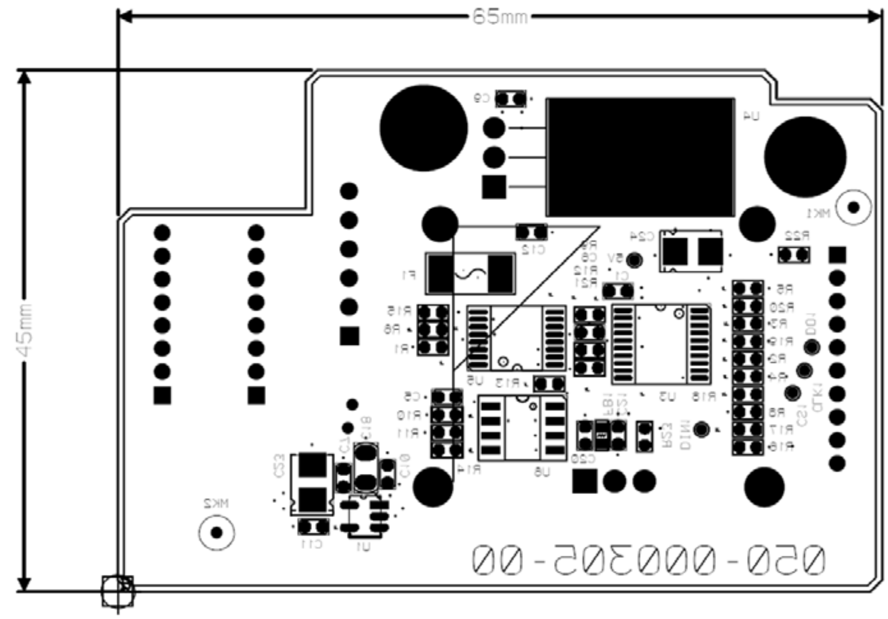


FIGURE 1-62 Sensor Interface Board, Bottom View

Sensor Interface Board Interface, J2

PIN	NAME	FUNCTION
1	MON_BRD_SDA	VCM I2C Data Signal
2	MON_BRD_SCL	VCM I2C Clock Signal
3	VT	Thermal Mass Flow Sensor Temperature Signal
4	VF	Thermal Mass Flow Sensor Flow Signal
5	12V	12V Power Supply
6	GND	Ground

Test Point Definition

PIN	NAME	FUNCTION
TP1	3V3	Test 3.3V Power Supply
TP2	5V	Test 5V Power Supply
TP3	5VA	Test Analog 5V Power Supply

1.7.3 Battery

1.7.3.1 Battery Power

For A3 and A4 anesthesia system:

Battery: 11.1V, 4.5Ah×1 Lithium-ion battery (sealed)

Battery running time: 75 minutes (new battery)

Battery charge time: 8 hours max from an initial charge of 10%

For A5 anesthesia system:

Battery: 11.1V, 4.5Ah×2 Lithium-ion Battery (sealed)

Battery Run Time: 150 minutes (new battery)

Battery Charge Time: 8 hours max from an initial charge of 10%.

1.7.3.2 Battery Adaptation Board

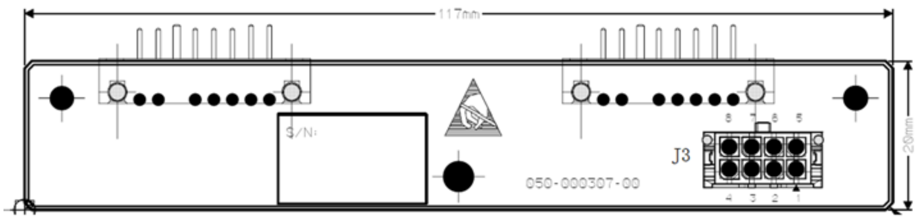


FIGURE 1-63 Battery Adaptation Board, Top View

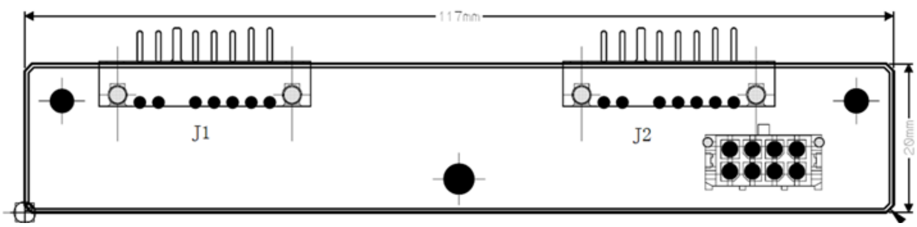


FIGURE 1-64 Battery Adaptation Board, Bottom View

Battery Interface, J1 and J2

PIN	NAME	FUNCTION
1	BAT+	Battery+
2	BAT+	Battery+
3	BC	Battery In-position Signal
4	BAT-	Battery-
5	NTC	Temperature Signal
6	BAT-	Battery-
7	BAT-	Battery-

Battery Cable Interface, J3

PIN	NAME	FUNCTION
1	VBAT1	Battery Voltage
2	NTC1	Battery Internal Thermistor
3	BC1	Battery In-position Signal
4	GND	Ground
5	VBAT2	Battery Voltage
6	NTC2	Battery Internal Thermistor

PIN	NAME	FUNCTION
7	BC2	Battery In-position Signal
8	GND	Ground

1.7.4 Infrared Communication Board

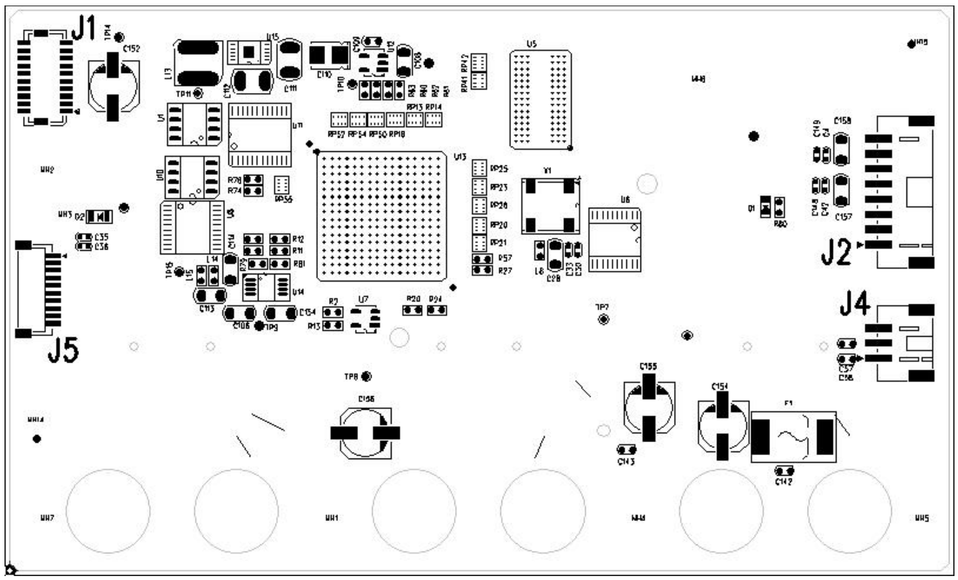


FIGURE 1-65 Infrared Communication Board, Top View

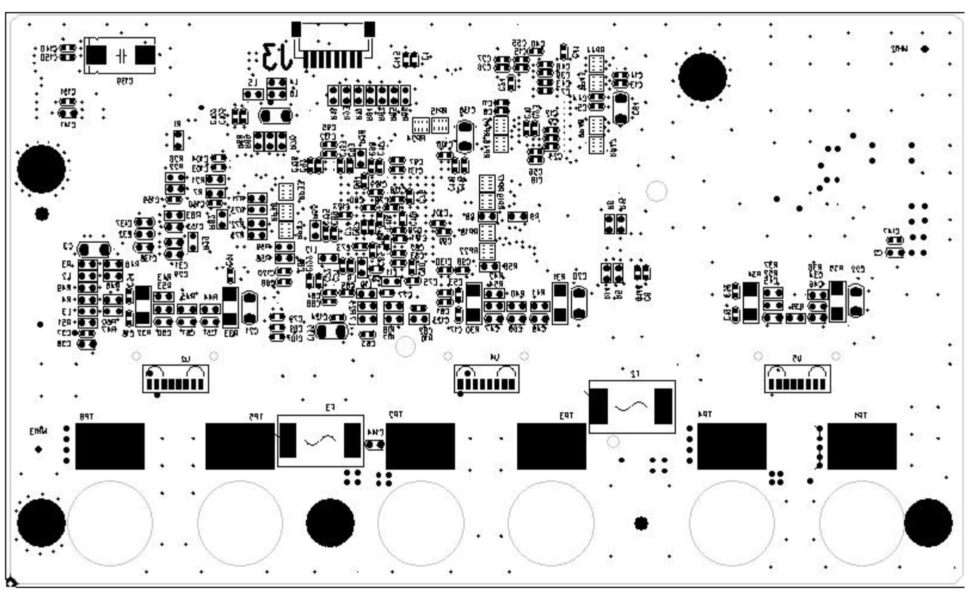


FIGURE 1-66 Infrared Communication Board, Bottom View

Power Supply Interface, J2

PIN	NAME	FUNCTION
1	12V	12V Power Supply
2	12V	12V Power Supply
3	GND	Ground
4	GND	Ground
5	VDD	3.3V Power Supply
6	VDD	3.3V Power Supply
7	GND	Ground
8	GND	Ground

Coomunication Interface, J4

PIN	NAME	FUNCTION
1	TXD_Infrared Comm Board	Infrared Communication Board Serial Port Transmit Signal
2	RXD_Infrared Comm Board	Infrared Communication Board Serial Port Receive Signal
3	GND	Ground

1.7.5 Breathing System Heater

The anesthesia system heater provides software and hardware dual-protection from overheating. The heater can switch over its operating mode automatically according to the change in ambient temperature.

1.8 Ventilator Pneumatic- O2 Drive Gas

1.8.1 Ventilator Pneumatic Drive

Oxygen is the driving gas for the ventilator. In addition to the flow meter block, a high pressure regulator reduces the supply pressure to 200 kPa (29 psi). This pressure represents the drive gas for the ventilator.

The drive pressure regulator is placed ahead of the proportional valve that generates the driving gas flow during the inspiratory phase. This flow fills the bellows dome that surrounds the bellows.

1.8.2 Drive Pressure-High Pressure Regulator (200 kPa, 29 psi)

The drive pressure regulator stabilizes the supply pressure provided to the proportional valve. The flow generated by the proportional valve is therefore independent of pressure variations at the supply.

Setting the drive pressure regulator at 200 kPa (29 psi) allows for a maximum inspiratory flow of 110 L/min at the ventilator.

1.8.3 Drive Gas Assembly

The manifold assembly module mainly consists of the inspiratory circuit and PEEP circuit. The inspiratory circuit goes through the normally closed proportional solenoid valve, which generates a gas flow of 0 to 110 L/min by the valve drive board. The gas flow of the PEEP circuit goes through the normally closed proportional solenoid valve, which also generates a gas pressure of 3 to 30 cmH2O by the valve drive board.

1.8.4 Tube Color Coding

All the pneumatic tubes used in the anesthesia system are color coded for use in the United States only.

GAS	US STANDARD
O2	GREEN
N2O	BLUE
AIR	ORANGE

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2.0 Installation Guide

2.1 Preparation - Additional Material Required

The following additional material are required before installation. The customer is responsible for supplying this material. Missing items may result in delays, incomplete installations, and/or additional service visits.

- Compatible emergency O2, N2O, and AIR cylinders
- Agent vaporizers and key fillers (if not purchased with the anesthesia system)
- Liquid agent medication
- CO2 absorbent Pre-Paks or loose fill
- Active O2, N2O, and AIR lines (280 to 600 kPa (40 to 87 psi))
- Dropdown hoses for ceiling-mounted medical gas utilities that are compatible with quick-disconnect hoses (if not purchased with the anesthesia system)

2.2 Assembly

NOTE: The Anesthesia Machine is matched with its Breathing System Block via calibration of its Flow Sensors. If the Breathing System Block is removed, ensure that it is reinstalled on its matching Anesthesia Machine. If a different Breathing System Block is reinstalled, then the Flow Sensors must be recalibrated.

NOTE: Forward going the breathing system will have a serial number label on it. On the back of the machine, next to the serial number label, there is a serial number label of the breathing system that the unit was calibrated and shipped with.

2.2.1 Unpacking and Setup

1. When the A5/A4/A3 is delivered, IMMEDIATELY inspect the box for any damage.

a. If there is NO damage and ALL tip indicators on the box exterior are intact, then sign and date the bill of lading or airway bill to indicate safe receipt of the anesthesia system.

b. If there is DAMAGE or ANY of the tip indicators on the box exterior have activated, then conditionally accept the delivery and clearly describe the damages on the bill of lading or airway bill. BOTH the carrier and recipient must sign and date the bill of lading or airway bill. Save all damaged factory packaging until further instructed by Mindray. The receiver should immediately contact Mindray Customer Service at 877.913.9663 or 650.316.3199.

NOTE: When unpacking the unit, keep as much of the plastic covering on the unit as possible. When all parts are unpacked, return the packing material to its original box. Place the smaller box inside the larger box.

2. Cut, remove, and discard the white shipping straps from the box.

FIGURE 2-1

3. Pull the box top straight up off the box and place on the floor near the unit. The box top will be used later as a ramp when rolling down the A5/A4/A3 onto the floor.

FIGURE 2-2

4. Pull the box straight up and over the unit.

FIGURE 2-3

5. Remove the top foam piece on the A5/A4/A3.

FIGURE 2-4

6. Cut the plastic tie wrap as shown below. Roll down the plastic bag from the unit.

FIGURE 2-5

7. Using a pair of scissors, cut the plastic wrap from the A5/A4/A3 near the back of the unit, using care to not scratch or otherwise damage the unit. Remove and discard the plastic wrap. Remove the empty box on the tray from the unit.

FIGURE 2-6

8. Remove the foam covering up the display and the tray.

FIGURE 2-7

9. After removing the plastic wrap and foam, check that there is a box on the side of the unit, as shown below.

FIGURE 2-8

10. At the base of the box platform, remove both sets of orange straps.

FIGURE 2-9

11. Remove the piece of wood at the front of the A5/A4/A3. Then, remove the foam packing material from around the front of the unit.

FIGURE 2-10

12. Remove the foam packing material from around the back of the unit.

FIGURE 2-11

13. Create a ramp for the unit by placing the top of the container next to the base of the container as shown. The flat side of the wood should be facing up. The other side of the wood has support to hold up the ramp. Secure the ramp to the container using the hook-and-loop straps.

FIGURE 2-12

NOTE: **Check that there are green beads in the desiccant pack and that they have not turned pink.**

14. Rotate the casters 90° and carefully roll the A5/A4/A3 unit down the ramp. Remove the bag from the unit. Save the bag in case repacking is needed.

15. Open the bottom drawer and remove the Breathing Assembly and the Bag Arm Assembly.

FIGURE 2-13

16. Install the Breathing Assembly on the side of the A5/A4/A3. Align the Assembly carefully, and then push it firmly towards the A5/A4/A3 until the Assembly clicks into place.

FIGURE 2-14

17. Carefully open the small box that contains the Folding Bag Assembly (Bellows) (P/N: 0601-30-78968) and Bellows Dome (P/N: 043-001134-00). Remove the plastic bags from the Assembly. Place the foam pieces and plastic bags in the box.

18. Install the bellows on the Breathing System. Ensure that the bellows is stretched completely around the lip on the breathing system when installed.

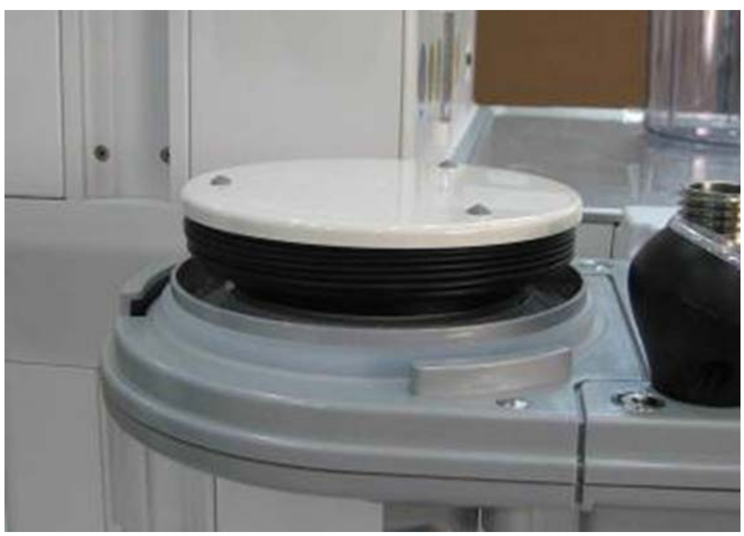


FIGURE 2-15

19. Install the bellows dome by placing it down on the breathing system and turning it clockwise to lock it in place (the gradation markings on the bellows dome should face front and be visible to the operator).

FIGURE 2-16

20. Install the Bag Arm Assembly, aligning the keyed features as shown below.

FIGURE 2-17

21. Then, push the Bag Arm Assembly into the Breathing System and tighten the knurled collar as shown below. Install the Paw gauge and the water trap on the breathing system.

FIGURE 2-18

22. Open the middle and bottom drawers and carefully remove the Removable Absorber Assembly (P/N: 115-036371-00), Waste Gas Scavenger Hose (P/N: 115-006557-00) and the Waste Gas Scavenger Assembly (P/N: 115-023157-00).

FIGURE 2-19

23. Install the white Absorber hose on the Absorber Assembly. Then, install the Absorber Assembly without the canister in place. Install the lower part first, line up the pins with the holes, and then align the top part. Push the top part in (upward) until both the front and back latches click into place.

FIGURE 2-20

24. Add CO_2 absorbent Pre-Pak or loose fill to the canister. Slide the canister into the Absorber Assembly. Turn the locking lever 90° counter-clockwise to lock the canister in place.

FIGURE 2-21

25. Slide the Scavenger Assembly in the track on the lower left side (i.e., same side as the Breathing Assembly) of the A5/A4/A3 and tighten the thumbscrew on the Scavenger Assembly to lock it in place. Install one side of the Scavenger Hose to the Scavenger Assembly and the other side of the Hose to the A5/A4/A3 as shown below.

NOTE: **If a passive scavenger system was ordered with the unit, connect the passive scavenger to the instead of the Scavenger Hose. Follow the installation instructions that come with the passive scavenge.**

NOTE: **If a DGSS was ordered with the unit, install that in place of the scavenger assembly.**

FIGURE 2-22

26. Open the top drawer and check that it contains the following contents:

- Auxiliary O2/Air Reference Card (PN: 0046-002591-00)
- Preoperative Checkout List (PN: 046-002590-00)
- Exhaust Emission Pipe (PN: 115-008426-00)
- Inspiratory Flow Sensor & Expiratory Flow Sensor (PN: 115-008264-00)
- O2 Cable Assembly (PN: 115-006551-00) (Some unit may not include this assembly)
- Gas Cylinder Wrench (PN: 115-033063-00)
- Wired USB Mouse (PN: 023-000361-00) (A3 and A4)
- Drawer Keys(PN: 034-000353-00)
- A Series Cleaning Quick Reference Card (PN: 046-009638-00)
- Seal Washer (PN: 0348-00-0185)

FIGURE 2-23

27. Open the rear panel and unscrew the thumbscrews to open the battery compartment. Install one or two batteries with the proper polarity. Close the compartment and tighten the thumbscrews.

28. On the back of the unit, verify the order of the cylinder yokes are from left to right: O2, Air, and N2O (A4 does not have a N2O cylinder yoke).

29. Verify the order of the pipeline fittings are from top to bottom: N2O, Air, and O2.

30. Install the tank washers.

31. Install the gas cylinders. Ensure that the cylinders are secured to their matching cylinder supply connections, which are labeled "O2," "Air," and "N2O" (A4 does not have a N2O cylinder yoke).

32. Connect each gas supply by connecting the hose connectors to the gas supply sockets (DISS type). Turn the connectors clockwise to fasten them securely to the sockets. Verify that the pressure of the gas supply is within the specifications of the machine.

33. Connect a manual ventilation bag (supplied by the user) to the bag arm on the breathing system.

34. Connect a patient breathing circuit (supplied by the user) to the inspiratory and expiratory connections.

WARNING: **Use breathing circuits and manual bags in accordance with ASTM F1208 and compatible with standard 22mm male conical fittings per ASTM specifications F 1054.**

35. Connect the hose from the gas scavenger to the operating room's EVAC connector. At the AGSS tank, turn the knob on top of the scavenger until the float is between the Min and Max markings.

NOTE: The knob on the top of the scavenger is meant to adjust the flow from the EVAC. When the knob is fully closed it does not need to completely shut off flow.

36. Install the O2 Sensor Cover Assebly instead of the O2 sensor (P/N: 115-016523-00) if customer prefers not to use O2 sensor.

37. Install the oxygen sensor (from Topfill) into the stainless steel housing. The O2 Cell should be tightened only enough to compress the o-ring about a 1/4 turn.

38. Screw the O2 Cable housing onto the stainless steel housing until it is snug. Do not overtighten.

39. Connect the oxygen sensor external cable between the oxygen sensor and the side of the A5/A4/A3, aligning the yellow marks on the cable and connector.

40. Plug the mains cable into a grounded socket. Power up the A5/A4/A3 by turning the main power switch (located on the front of the A5/A4/A3) to the ON position. Wait until the LCD display provides information about the leak test. Observe that the start-up self-test is successful. Do not connect, disconnect or move the breathing circuits or breathing bags while the self-test is in process.

41. Mount the monitors and arms per instructions in the monitoring kit.

WARNING: Use only Mindray-approved monitors and arms with the A5/A4/A3.

42. Install the gas module into the module rack on the left side of the unit (optional).

FIGURE 2-24

43. Connect Hose (P/N: 115-052160-00 or P/N: 115-008426-00) to the outlet of the gas module and to the Colder fitting at the back of the A5/A4/A3. Place the unused hose in the bottom drawer.

44. Place the following parts into the bottom drawer:

- A5/A3 or A5/A4 Operating Instruction
- Washer, Seal (P/N: 0348-00-0185)

NOTE: The Operating Instructions will either be a paper copy or as a PDF file on a CD.

45. Hang the Pre-operative Checkout List and the Auxiliary O2/AIR Reference Card to the handle of the A5/A4/A3 unit.

2.2.2 Breathing System and Breathing System Accessories and Checkout Procedures

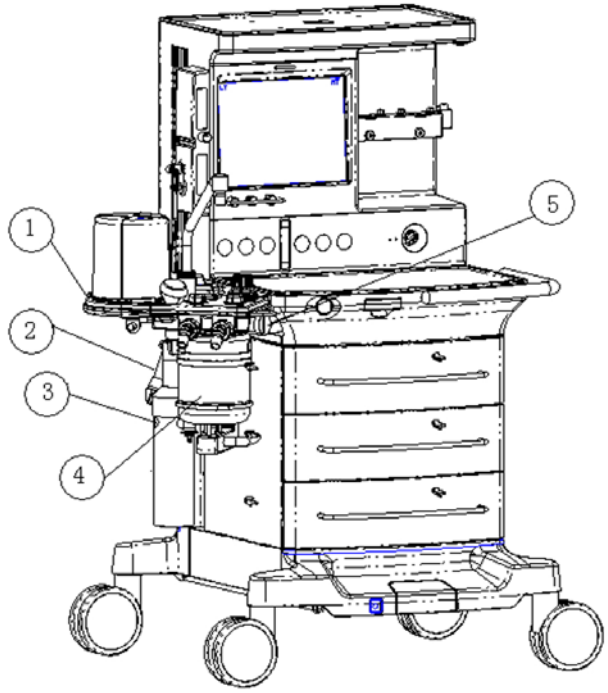


FIGURE 2-25

1. Breathing System
2. AGSS Transfer Hose
3. AGSS
4. CO2 Absorbent
5. O2 sensor cable with sensor(Systems without AG module only)

2.2.2.1 Tank Wrench and Pre-operation

1. Mount the tank wrench on the rear of the A5/A4/A3 so that it can be used to open or close each cylinder without disconnecting it from the machine.

2.2.3 Vaporizers (if available)

WARNING: If the vaporizer is incompatible with the A5/A4/A3 Anesthesia System, the vaporizer will not work at all. Use vaporizers with Selectatec mounting system that are compliant to ISO 8835-4. Refer to the vaporizer manufacturer's Instructions For Use for filling or draining the vaporizer and other information.

WARNING: The A5/A4/A3 Anesthesia System has a Selectatec mount system which will only allow vaporizers to be mounted that have an interlock system which prevents more than one vaporizer simultaneously being turned on. Do not attempt to override this safety feature.

WARNING: **Use care in lifting and manipulating vaporizers during the mounting process as their weight may be greater than expected, based on their size and shape.**

NOTE: **The barometric pressure may differ from the calibration pressure of the anesthetic vaporizer. This may cause an inaccurate output of the anesthetic agent. The operator should continuously monitor the concentration of anesthetic agent during system use.**

FIGURE 2-26

2.2.3.1 Mount the Vaporizer(s)

1. Mount the vaporizer onto the manifold.
2. Push and turn the locking lever clockwise to lock the vaporizer in position.
3. Ensure that the top of the vaporizer is horizontal. If not, remove the vaporizer and reinstall it.
4. When reinstalling the vaporizer, lift each vaporizer straight up off the manifold rather than pulling forward. Do not rotate the vaporizer on the manifold.
5. If a vaporizer unintentionally lifts off the manifold, install it again and complete steps 1 through 3. If the vaporizer lifts off a second time, do not use the system.

NOTE: **A Desflurane vaporizer may be mounted similarly as other vaporizers, but may require a power cord. For more detailed instructions on installation and proper use, refer to the specific manufacturer's Instructions for Use of the Desflurane vaporizer.**

2.2.3.2 Fill the Vaporizer

NOTE: **The A5/A4/A3 should use vaporizers with Selectatec mounting system that are compliant to ISO 8835-4. Refer to the vaporizer manufacturer's Instructions For Use for filling or draining the vaporizer and other information.**

WARNING: **Ensure that the correct anesthetic agent is used. The vaporizer is designed with the specific anesthetic agent named on it and further indicated by color coded label. The concentration of the anesthetic agent actually output will vary if the vaporizer is filled with the wrong agent.**

2.2.3.3 Drain the Vaporizer

WARNING: **Do not reuse the agent drained from the vaporizer. Treat as a hazardous chemical and follow local regulations for proper disposal.**

NOTE: **The A5/A4/A3 should use vaporizers with Selectatec mounting system that are compliant to ISO 8835-4. Refer to the vaporizer manufacturer's Instructions For Use for filling or draining the vaporizer.**

2.2.4 Monitoring Products Mounting and Electrical Connection (if available)

1. Mount the monitor (if available) according to the manufacturer's monitor assembly instructions.

NOTE: **Use of other monitors and mounting hardware is the responsibility of the installer.**

2. After mounting a monitor to the A5/A4/A3, connect it to one of the AC outlets located on the rear of the A5/A4/A3.
3. Turn on each monitor one at a time. Verify that the circuit breaker holds without tripping.
4. Dress each line cord neatly along the side of the anesthesia machine or tucked inside the monitor arm. An optional cable routing kit is available. The cable routing kit contains three (3) clips, screws, and two (2) ethernet cables. The clips attach to three (3) sets of holes on the rear door of the A5/A4/A3. Ethernet and power cables can be routed through the clips.

.If a Passport 12M / 17M is mounted on the A5/A4 and the user wants to use the AG in the patient monitor, the anesthesia system can get the CO_2 data from the patient monitor. To initiate this data transfer, perform the following procedure:

1. Connect the network port of the patient monitor to the network port of the A5/A4 using the Ethernet Cable.

FIGURE 2-27 Network Port of Anesthesia System

FIGURE 2-28 Network Port of Passport 12M Patient Monitor

FIGURE 2-29 Network Port of Passport 17M Patient Monitor

2. Select the **Setup** softkey > **System** tab (system password needed) > **Network** button.
3. Select the **Optimizer Source** button and set the **IP Address** and **Multicast Address**.

NOTE: The IP addresses of the Anesthesia machine and the Patient Monitor must be on the same subnet.

4. Select the **Accept** button to confirm the change.
5. Ensure the connection is successful. If the connection is successful, the anesthesia system displays the patient monitor's name beside the **Optimizer Source** button. If the connection is failed, the anesthesia system displays **NOT CONNECTED** beside the **Optimizer Source** button.

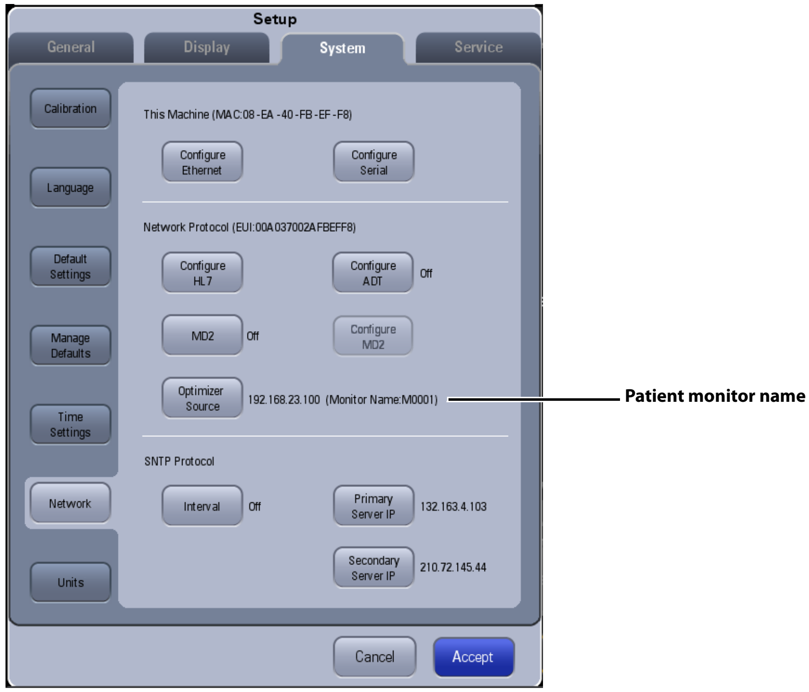


FIGURE 2-30 Optimizer Source (Patient Monitor Connected)

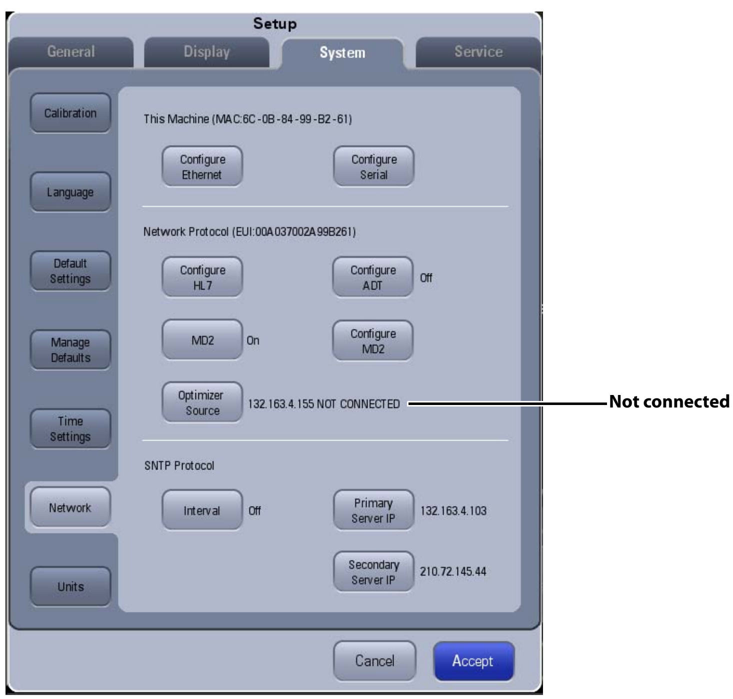


FIGURE 2-31 Optimizer Source (Patient Monitor Not Connected)

2.3 Software and License Key Installation

1. Upload software to the desired software if required. See section 5.6 (page 5-76) "Software Update and Software Configuration Activation" for instructions.
2. For DSP systems, install license files as required. See section 5.6 (page 5-76) "Software Update and Software Configuration Activation" for instructions.

2.4 Functional Tests

Refer to Chapter 4.0 Calibration if any values are out of specification.

NOTE: The A5/A4/A3 system must be powered on (AC power, not battery) and the Breathing System Warmer set to ON (software bundle version 01.00.00 and higher) at least an hour before performing the Ventilation Tests described in "VCV Adult Ventilation Mode Test" on page 2-50.

2.4.1 Breathing System Leak Test

NOTE: Always perform a leak test after servicing the anesthesia machine, replacing the components, or reconnecting the tubes.

2.4.1.1 Breathing System Leak Test in Mechanical Ventilation Mode

This test checks the pneumatic circuit for leaks in mechanical ventilation mode. Test items include the bellows, drive gas circuit, CO2 absorber canister, patient tubes, flow sensors, and flow sensor connectors.

To perform the breathing system leak test in mechanical ventilation mode:

1. You can access the automatic circuit leak test screen after the Power-On Self Test has passed. You can also open the Setup in Standby and select Test Leak/Compliance on the General menu to access the automatic circuit leak test screen.The automatic circuit leak test screen is shown below. Set up the machine as per the instructions on the screen. Then, select Continue to execute automatic circuit leak test. You can select Skip to access the Standby screen directly.

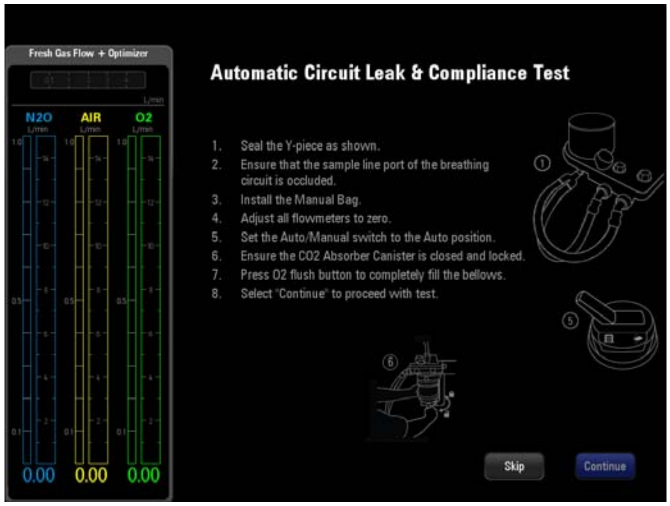


FIGURE 2-32 Automatic Circuit Leak and Compliance Test

The ongoing automatic circuit leak test is as shown below. You can select Cancel to cancel the ongoing leak test.

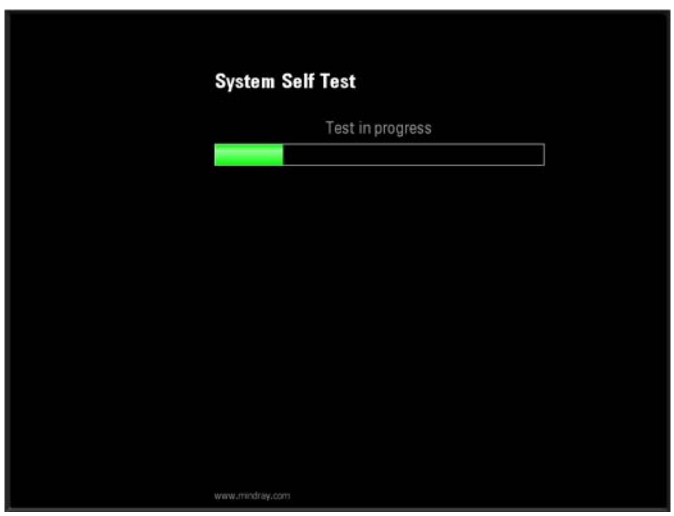


FIGURE 2-33 Automatic Circuit Leak and Compliance Test In Progress

During the automatic circuit leak test, the safety valve control test is also being conducted. The automatic circuit leak test results are listed in the following table.

Test results	System Limitation
Safety valve control failed	The machine cannot be used.
Automatic circuit leak test failed Leak ≥200 mL/min and ≤1000 mL	The user can acknowledge the leak and continue with automatic ventilation

Test results	System Limitation
Automatic circuit leak test failed Leak >1000 mL	Only manual ventilation can be applied
Compliance test failed	Both automatic ventilation and manual ventilation can still be applied using the previous compliance value in the A5/A4/A3 system memory, but may not meet the accuracy of the delivered volume.

The following screen is displayed if the safety valve control test is failed. You can select Service Access and enter the required service password to access service mode. You can select Retry to perform automatic circuit leak test again.

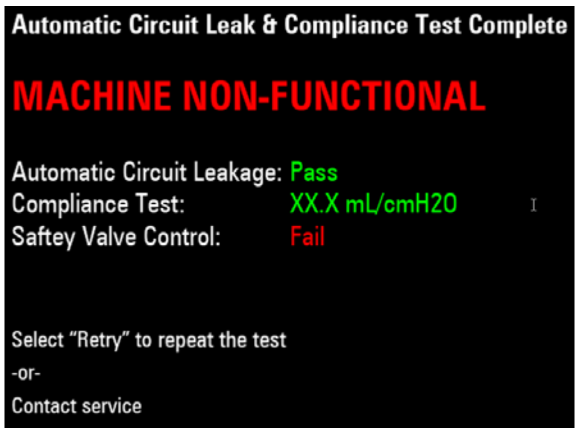


FIGURE 2-34 Machine Non-Functional Screen

The following screen is displayed if the automatic circuit leak test is failed and the Leak ≥200 mL/min and ≤1000 mL. You can select Retry to perform the automatic circuit leak test again or accept the result continue with automatic ventilation.

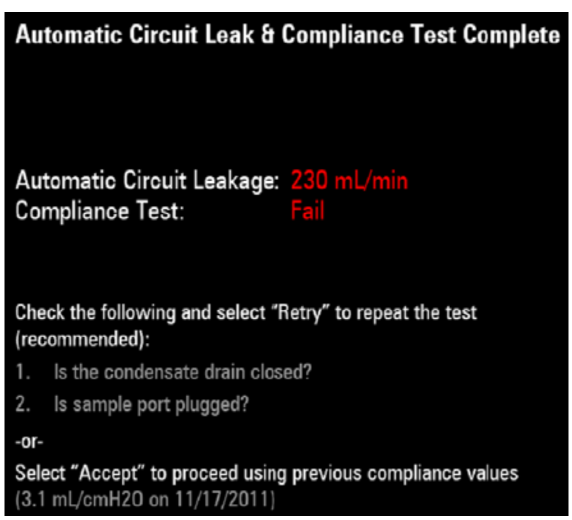


FIGURE 2-35 Automatic Circuit Leak and Compliance Test: Fail

The following screen is displayed if the automatic circuit leak test is failed and the leak >1000 mL. You can select Override to enter Standby mode. But mechanical ventilation is disabled. You can select Retry to perform automatic circuit leak test again.

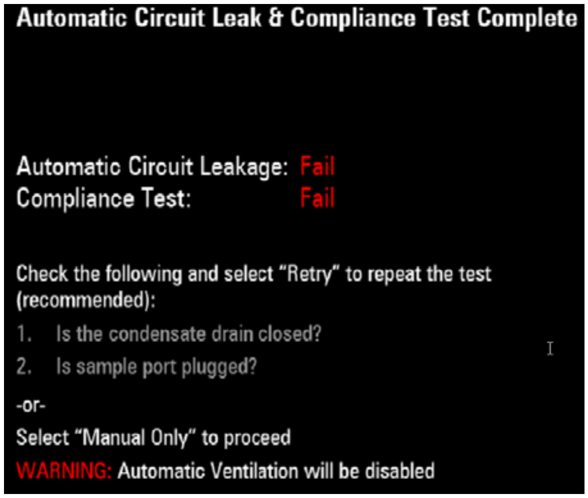


FIGURE 2-36 Automatic Circuit Leak and Compliance Test: Fail

The following screen is displayed if the compliance test is failed. You can select Override to enter Standby mode.You can select Retry to perform automatic circuit leak test again.

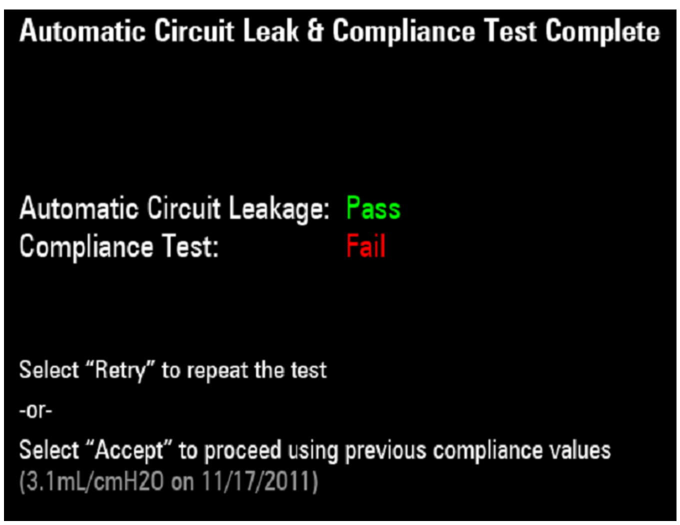


FIGURE 2-37 Compliance Test: Fail

The following screen is displayed if the automatic circuit leak test is completed. Select Continue to enter Standby mode.

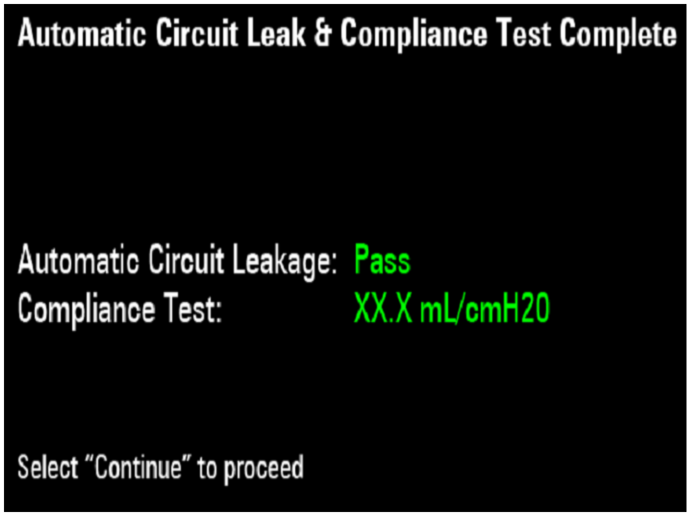


FIGURE 2-38 Automatic Circuit Leak Test Completed

NOTE: **If the leak test fails, check all of the possible leak sources, including the bellows, breathing system tubes, and CO2 absorber canister. Check that they are correctly connected and their connectors are not damaged.**

NOTE: **If there is a leak, check the pneumatic circuit system for leakage and troubleshoot the problems as described in 5.3.4 Breathing System. After the leak has been resolved, repeat the leak test.**

2.4.1.2 Breathing System Leak Test in Manual Ventilation Mode

This test checks the pneumatic circuit for leaks in manual ventilation mode. Test items include the APL valve, check valve, CO2 absorber canister, patient tubes, flow sensors, and flow sensor connectors.

To perform the breathing system leak test in manual ventilation mode:

1. You can access the manual circuit leak test screen after the automatic circuit leak test has passed. The manual circuit leak test screen is shown below.

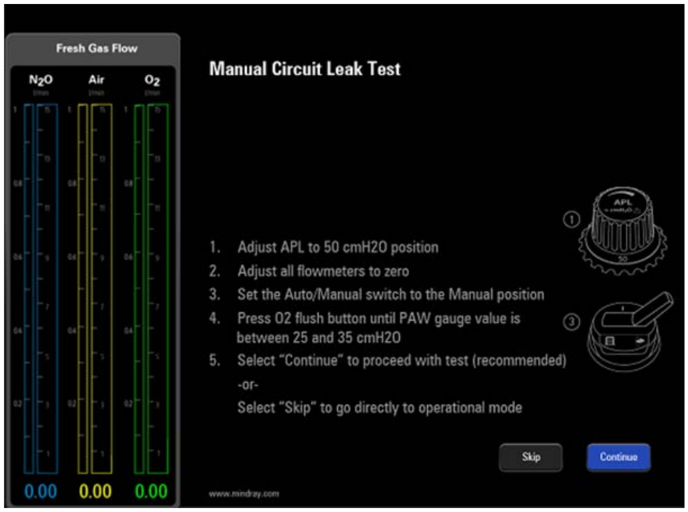


FIGURE 2-39 Automatic Circuit Leak Test Completed

2. Set up the machine as per the instructions on the screen. Then, select Continue to execute manual circuit leak test.
3. The ongoing manual circuit leak test is as shown below. You can select Cancel to cancel the ongoing leak test.

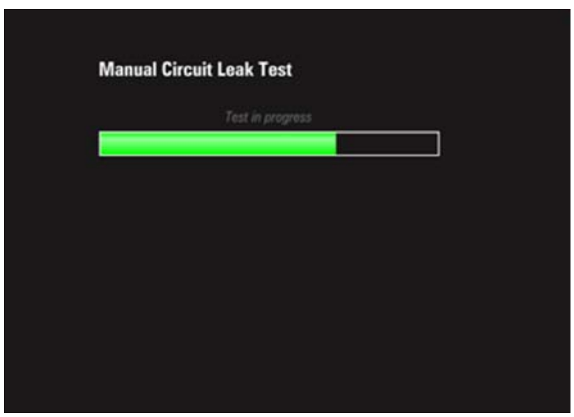


FIGURE 2-40 Manual Circuit Leak Test In Progress

The following screen is displayed if the manual circuit leak test is failed. If so, you must perform the test again.

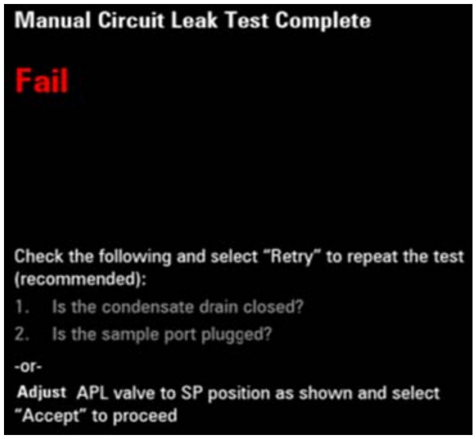


FIGURE 2-41 Manual Circuit Leak Test: Fail

The following screen is displayed if the manual circuit leak test is completed. Select Continue to enter automatic circuit leak test.

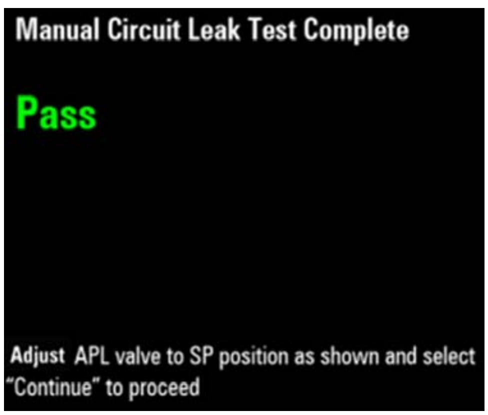


FIGURE 2-42 Manual Circuit Leak Test: Passed

NOTE: **If there is a leak, check the pneumatic circuit system for leakage and troubleshoot the problems as described in 5.3 Pneumatic Circuit System Problems. Repeat the leak test after the source of the failure has been resolved.**

2.4.1.3 Troubleshooting: Leak Test

The following table lists the commonly-encountered problems and recommends actions for the Breathing System Leak Test in Manual Ventilation Mode.

Failure description	Possible cause	Recommended action
Leak test failure is prompted immediately after [Start] is selected (typically, the leak test requires at least 3 minutes).	The Auto/Manual ventilation switch is set to the bag position and the message [Manual Vent.] is prompted.	Set the Auto/Manual ventilation switch to the mechanical ventilation position.
	The reading on the drive gas (O2) pressure gauge indicates drive gas pressure low (lower than 200 kPa) and the alarm of [Drive Gas Pressure Low] is produced.	Replace or connect gas supplies and make sure that the drive gas pressure is at 350 to 450 kPa.
During leak test, the pressure indicated by the airway pressure gauge fails to reach 30 cmH2O.	1. Before the leak test, the bellows is not fully inflated. 2. The Y piece on the breathing tube is not connected to the test plug. 3. The bellows housing is not properly installed.	Check the connections of the pneumatic circuit and re-install the pneumatic circuit.

2.4.2 Display Setup Check

Touch Continue to advance to the Standby screen display. For the A5, check that the screen displays the main screen, as shown in the figure below.

NOTE: The GAS window will not appear on A5s without a gas module installed.

For A5 EPSON systems (Software Bundle Version earlier than 03.01.00) verify that the ventilation modes are VCV, SIMV-VC, PCV (with VG), SIMV-PC, PS and Manual. Make sure in manual mode the following buttons appear: Alarms, Bypass, Monitor (if AG module is installed), and CO2 Alarms (if AG module is installed). Make sure that the Spirometry tab is present.

FIGURE 2-43 Display Setup Check, A5 (EPSON)

For A5 DSP systems (Software Bundle Version 03.01.00 and later), check that the standard ventilation modes VCV, SIMV-VC, PCV, PCV-VG, SIMV-PC, CPAP/PS, and Manual are present. Make sure in manual mode the following buttons appear: Alarms, Monitor (if AG module is installed), and CO2 Alarms (if AG module is installed).   Verify that the options that were activated with the license keys are present.

FIGURE 2-44 Display Setup Check, A5 (DSP with all options enabled)

FFor A3 EPSON systems (Software Bundle Version earlier than 03.01.00) verify that the ventilation modes are VCV, SIMV-VC, PCV, PS and Manual. Make sure in manual mode the following button appears: Alarms.

FIGURE 2-45 Display Setup Check, A3 (EPSON)

For A4 DSP systems (Software Bundle Version 03.01.00and later), check that the standard ventilation modes VCV, CPAP/PS, and Manual are present. Make sure in manual mode the following buttons appear: Alarms, Monitor (if AG module is installed), and CO2 Alarms (if AG module is installed). Verify that the options that were activated with the license keys are present.

FIGURE 2-46 Display Setup Check, A4 (DSP with all options enabled)

2.4.3 O2 Sensor Calibration (Only for Systems without an AG module)

NOTE: **Both a 21% and 100% O2 calibration MUST BE performed before first use of the A5/A4/A3. The O2 sensor is not calibrated with the machine at the factory.**

NOTE: **Calibrate the O2 sensor when a great deviation of O2 concentration monitored value occurs or when the O2 sensor or ventilator control board is replaced or when prompted by the anesthesia system.**

NOTE: **Before calibration, observe if the O2 sensor displays numerics on the measure screen. If not, check the O2 sensor connection line, or replace the O2 sensor until measure numerics are displayed.**

2.4.3.1 21% O2 Calibration

Follow these steps to calibrate the O2 sensor at 21% O2:

1. Select Setup > System > Calibration >O2 Sensor or Setup > Service > Calibration > O2 Sensor to access the screen as shown below. The General tab shows only 21% O2 Sensor calibration; the System and Service tabs require passwords and show both 21% and 100% O2 Sensor calibration. Set up the machine as per the instructions on the screen. Select Begin to start calibration.

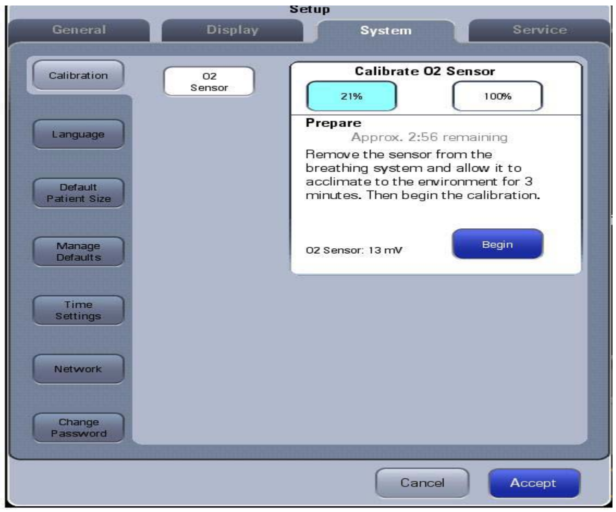


FIGURE 2-47 O2 Sensor Calibration

2. The calibration screen as shown below is displayed when Begin is selected. During the calibration, you can select Cancel to cancel the calibration.

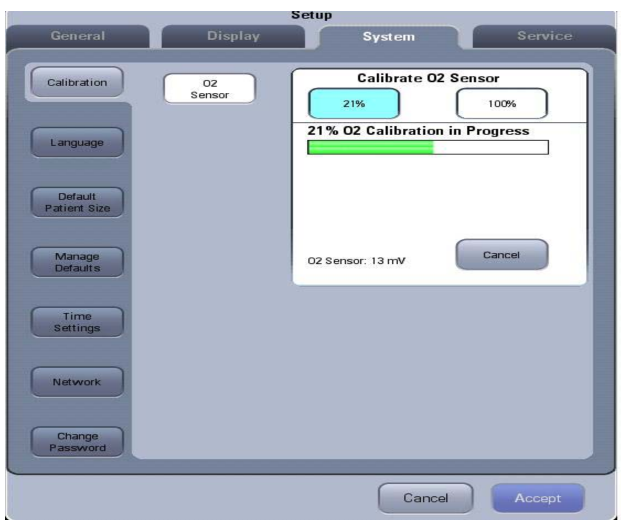


FIGURE 2-48 O2 Sensor Calibration in Progress

3. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to repeat the calibration. Select Done to exit the calibration screen.

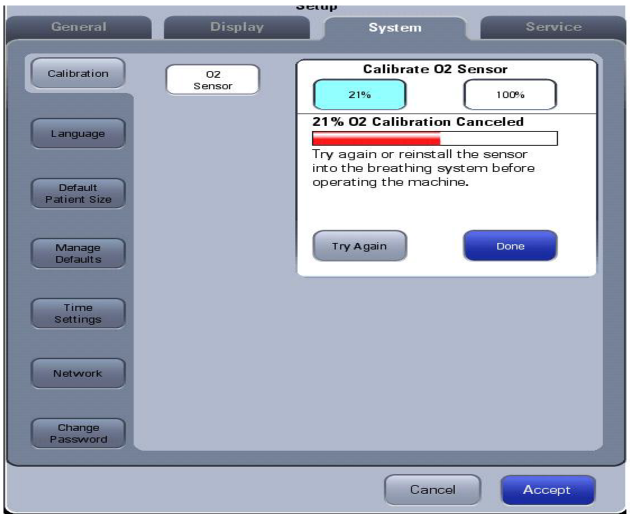


FIGURE 2-49 O2 Sensor Calibration Canceled

4. The screen shown below is displayed if the calibration has failed. A Fail code is displayed in red. Select Try Again to repeat the calibration. Select Done to exit the calibration screen.

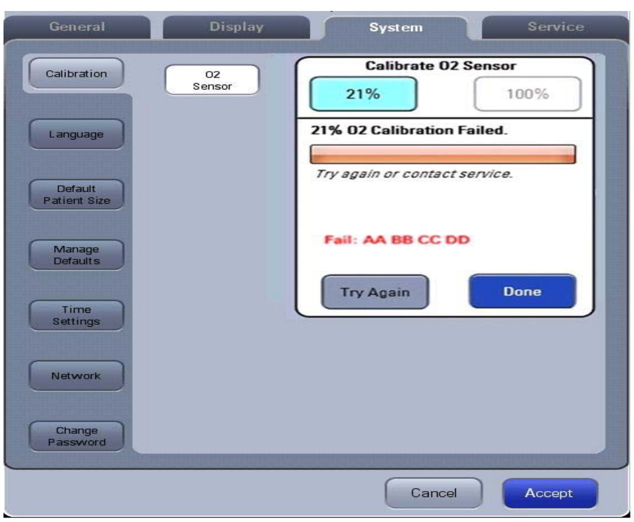


FIGURE 2-50 O2 Sensor Calibration Failed

5. The screen shown below is displayed after a successful calibration. Select Done to exit the calibration screen.

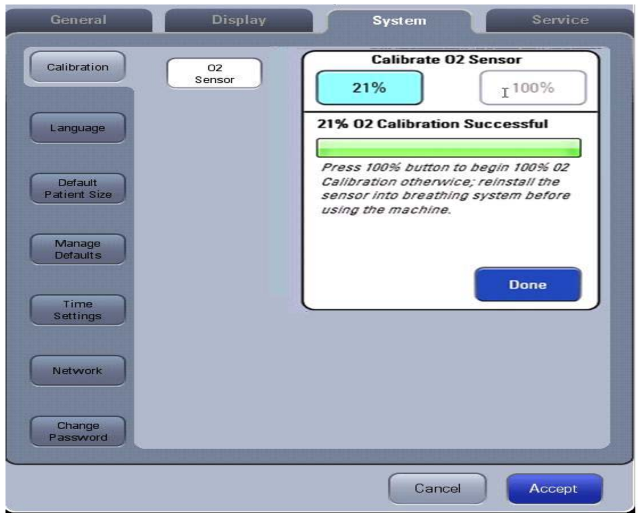


FIGURE 2-51 O2 Sensor Calibration Successful

2.4.3.2 100% O2 Calibration

NOTE: 100% O2 calibration must be performed in standby mode.

NOTE: 100% O2 calibration can be performed only after a successful 21% O2 calibration.

NOTE: Make sure that the manual bag is in position in manual mode. Otherwise, put the Manual/Auto lever to Auto position.

Follow these steps to calibrate O2 sensor at 100% O2:

1. Enter Standby.
2. Select Setup > System > Calibration > O2 Sensor or Setup > Service > Calibration > O2 Sensor. The System and Service tabs require passwords and shows both 21% and 100% O2 Sensor calibration. The calibration screen shown below is displayed when 100% is selected. Set up the machine as per the instructions on the screen and select Next.

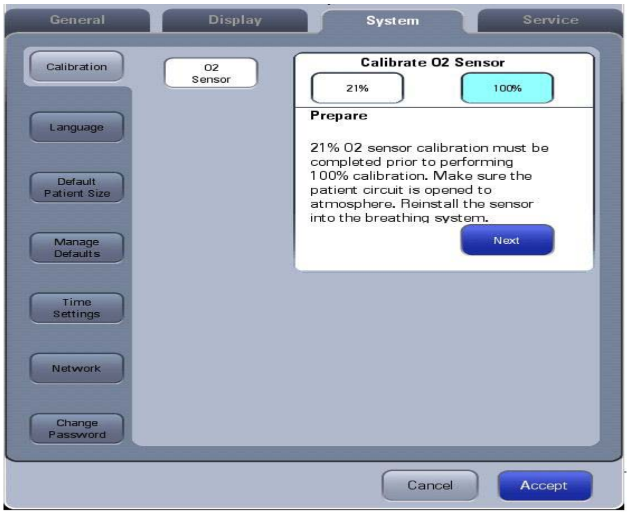


FIGURE 2-52 100% O2 Sensor Calibration

3. The calibration screen shown below is displayed when Next is selected.

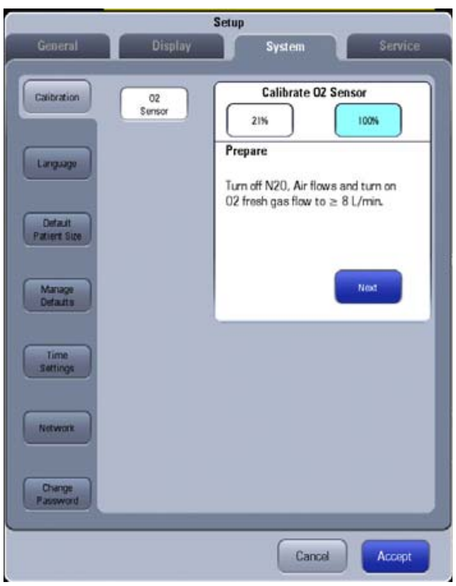


FIGURE 2-53 100% O2 Sensor Calibration

4. The calibration screen shown below is displayed when Next is selected. Set up the machine as per the instructions on the screen. Wait 2 minutes to ensure that the O2 cell voltage has stabilized at the maximum value for at least 30s. Select Begin.

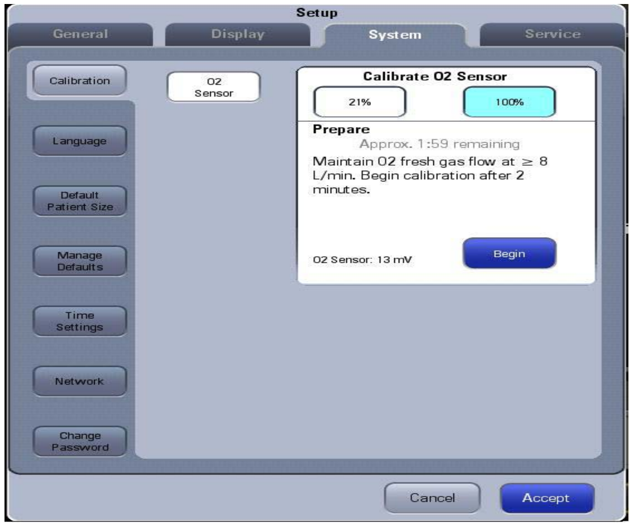


FIGURE 2-54 100% O2 Sensor Calibration Preparation

5. The calibration screen as shown below is displayed when Begin is selected. During the calibration, you can select Cancel to cancel the calibration.

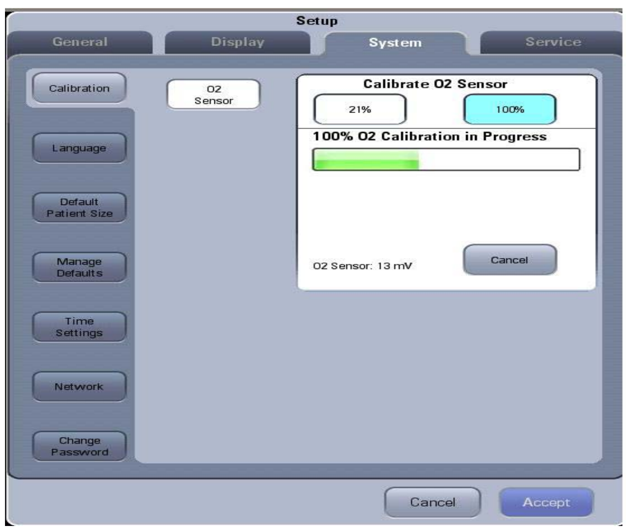


FIGURE 2-55 100% O2 Sensor Calibration in Progress

6. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to repeat the calibration. Select Done to exit the calibration screen.

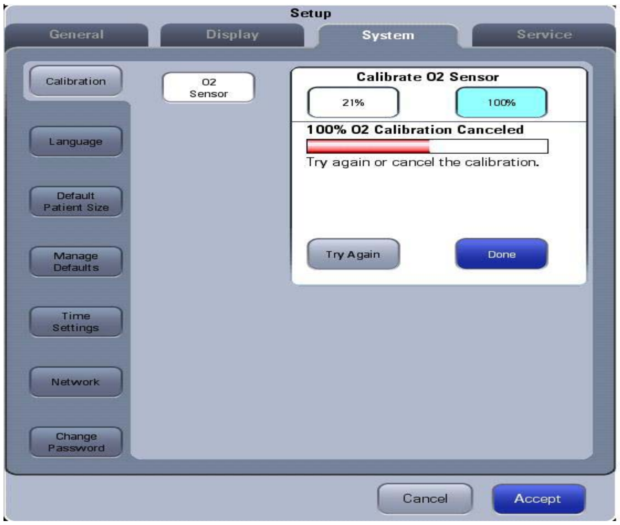


FIGURE 2-56 100% O2 Sensor Calibration Canceled

7. The screen shown below is displayed if the calibration has failed. A Fail code is displayed in red. Select Try Again to repeat the calibration. Select Done to exit the calibration screen.

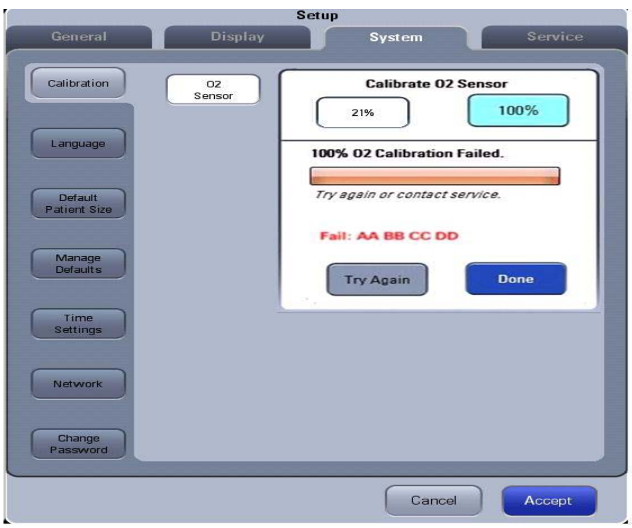


FIGURE 2-57 100% O2 Sensor Calibration Failed

8. The screen as shown below is displayed after a successful calibration. Select Done to exit the calibration screen.

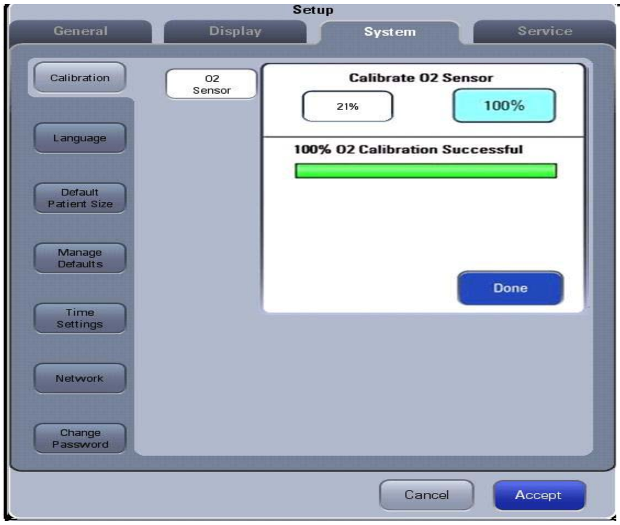


FIGURE 2-58 100% O2 Sensor Calibration Successful

2.4.3.3 Troubleshooting: O2 Sensor Calibration

Failure Description	Possible Cause	Recommended Action
After [Start] is selected, calibration failure is prompted very soon.	If the alarm [O2 Sensor Unconnected] is displayed, it indicates that O2 sensor is not connected.	Connect the O2 sensor.
	O2 supply pressure is insufficient (lower than 200 kPa).	Change or connect the gas supply and make sure that O2 supply pressure is sufficient.
	21% O2 calibration is not completed before 100% O2 calibration.	Perform 21% O2 calibration followed by 100% O2 calibration.
Calibration failure is prompted about 3 minutes after calibration is started.	The O2% sampling value is not within the normal range. Namely, the sampling value of 21% O2 concentration is outside the range of 150~500 and the sampling value of 100% O2 concentration is outside the range of 800~2028. Access Setup → Service → Data Monitors → VCV to check the O2% sampling value.	Replace the O2 sensor.

Error Code	Description	Recommended Action
00 00 00 02	O2 supply pressure is low. During 100% calibration process, O2 supply pressure was not sufficient.	. Check that the O2 sensor is connected to the cable correctly. . Check the O2 supply pressure. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.
00 00 00 04	O2 sensor is disconnected. Sampled data is greater than 2900 (AD value).	. Check that the O2 sensor is connected to the cable correctly. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.

Error Code	Description	Recommended Action
00 00 00 08	21% calibration value is outside of the expected range (150~500) (AD value).	. Check that the O2 sensor is connected to the cable correctly. . Check that the O2 sensor is in 21% O2. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.
00 00 00 10	100% calibration value is outside of the expected range (800~2028) (AD value).	. Check that the O2 sensor is connected to the cable correctly. . Check that the O2 sensor is in 100% O2. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.
00 00 00 20	Error writing to EEPROM.	. Repeat the calibration. . Replace the O2 sensor. . Replace the CPU board.

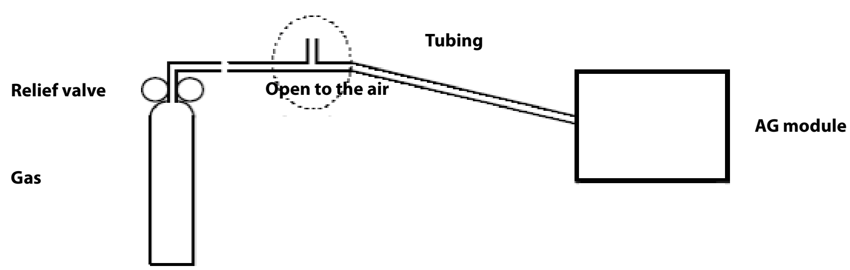
2.4.4 Calibrate the AG Module (A5/A4 with Gas Module)

Prepare the following before doing the calibration:

- Gas cylinder, with a certain standard gas or mixture gas. Gas concentration should meet the following requirements: AA≥1.5%, CO2≥1.5%, N2O≥40%, O2≥40%, of which AA represents an anesthetic agent. a/c≤0.01 (a is the gas absolute concentration accuracy; c is the gas concentration).
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Connect the test system as follows.



2. Ensure that the system is **Standby** mode. If not, select the **Discharge** button in the Manual tab and follow the on-screen prompts to discharge the patient and enter **Standby** mode.
3. Select **Setup** softkey> **System** tab (system password needed).
4. Select the **Calibration** button.
5. Select the **External AG Module** button.
6. Wait for the AG module to be fully warmed up
7. Enter the actual concentration of the calibration gas.
8. Turn on the calibration gas canister and the system displays the real-time concentration of calibration gas.
9. Select the **Calibrate** button to start to calibrate the AG Module. The system will display the results of the calibration status when the process is completed.
10. After calibration, select **Done** to close the **Calibration** window.
11. Select Accept to close the Setup window.

2.4.5 Gas Module Verification

1. Remove and re-insert the AG Module into the module rack.
2. Touch the screen to start the manual ventilation mode and make sure that the gas test screen and CO2 waveform and parameter area are displayed on the screen and that the prompt message **External AG Loaded Successfully** is displayed at the top of the screen.
3. After the AG module is inserted, remove the watertrap, make sure that the alarm **AG No Watertrap** appears. After the watertrap is connected to the module, make sure that the alarm disappears.
4. Wait until the AG module warmup is finished and then use your hand or other objects to completely block the gas inlet of the AG module. An alarm message **AG Airway Occluded** will appear on the screen.
5. Block the gas inlet for another 30 s. If the alarm message does not disappear, it indicates that the module does not leak.

2.4.6 Gas Delivery System Tests

2.4.6.1 O2 Flush Verification

1. Using a breathing hose, connect the bag arm to the expiratory port.
2. Put the Manual/Auto lever to the manual position.
3. Set the APL Valve to 75.
4. Connect a flow meter to the inspiratory port.
5. Verify that the O2 flush flow is between 35 to 50 L/min when pressing the O2 flush valve.

2.4.6.2 O2:N2O Ratio System

1. Set the O2 and N2O Flow Control Valves to minimum.
2. Turn on the N2O flow control and adjust N2O flow to maximum.
3. Adjust O2 flows according to the following table.
4. Verify that the corresponding N2O flows are according to the following table.

O2 Flow Setting	N2O Flow
0 L/min	0 L/min
0.3 L/min	≤ 1.0 L/min
0.8 L/min	between 2.0 L/min and 2.5 L/min
1.0 L/min	between 2.5 L/min and 3.2 L/min
2.0 L/min	between 4.9 L/min and 6.3L/min
3.0 L/min	between 7.4 L/min and 9.5 L/min
4.0 L/min	≤ 12.7 L/min
5.0 L/min	≤ 15.8 L/min
6.0 L/min	≤ 19.0 L/min
0 L/min	0 L/min

5. Lower the N2O flow to minimum.
6. Lower the O2 flow to minimum.

2.4.6.3 Vaporizer Leak Test

1. Set the ventilation Auto/Manual ventilation switch to Manual.
2. Set the APL valve to the SP position.
3. Connect one end of the breathing circuit to the bag arm, one end to the inspiratory port and the Y-piece to the test port:

FIGURE 2-59

4. Mount and lock the vaporizer onto the vaporizer mount. (Certain vaporizers need to be set to at least 1% for correct testing. See the vaporizer manufacturer's manual for details.)
5. Set the fresh gas flow to 200 mL/min.
6. Set the APL valve to 75 and verify that the pressure on the airway pressure gauge increases above 30 cmH2O within 2 minutes.
7. Turn off the vaporizer and set the APL valve to the SP position.
8. Repeat Steps 4, 5, 6, and 7 for the other vaporizer.

2.4.6.4 Check Valve Test

1. Set the ventilation Auto/Manual ventilation switch to Manual.
2. Set the APL valve to 75.
3. Connect the breathing bag to the Inspiratory port.
4. Plug the bag arm.
5. Press the FLUSH button until the pressure on the airway pressure gauge reaches 35 cmH2O.
6. Set the APL valve to SP.
7. Verify that the pressure does not drop below 30 cmH2O after 10 seconds.

2.5 Pneumatic Leak Tests

Turn all fresh gas flows to 0 L/min.

2.5.1 N2O Cylinder Leak Test (A5 and A3 only)

1. Remove the N2O line pressure hose from the line pressure inlet on the anesthesia system.
2. Mount a full N2O cylinder to the rear panel yoke. If necessary, place a new clean tank washer between the cylinder and the yoke to minimize any leaks at the yoke connection.
3. Open the N2O cylinder until its pressure gauge indicates cylinder pressure.
4. Close the N2O cylinder.

The N2O cylinder pressure gauge should not drop more than 10% of its initial pressure over 1 minute.

2.5.2 O2 Cylinder Leak Test

1. Remove the O2 line pressure hose from the line pressure inlet on the anesthesia system.
2. Mount a full O2 cylinder to the rear panel yoke. If necessary, place a new clean tank washer between the cylinder and the yoke to minimize any leaks at the yoke connection.
3. Open the O2 cylinder until its pressure gauge indicates cylinder pressure.
4. Close the O2 cylinder.

The O2 cylinder pressure gauge should not drop more than 10% of its initial pressure over 1 minute.

2.5.3 AIR Cylinder Leak Test

1. Remove the AIR line pressure hose from the line pressure inlet on the anesthesia system.
2. Mount a full AIR cylinder to the rear panel yoke. If necessary, place a new clean tank washer between the cylinder and the yoke to minimize any leaks at the yoke connection.
3. Open the AIR cylinder until its pressure gauge indicates cylinder pressure.
4. Close the AIR cylinder.

The AIR cylinder pressure gauge should not drop more than 10% of its initial pressure over 1 minute.

2.5.4 Line Pressure Leak Tests

1. Remove the O2, AIR and N2O cylinder from the anesthesia system.
2. Connect the O2, AIR and N2O line pressure hoses to the line pressure inlet on the anesthesia system.
3. Turn the unit on.
4. Disconnect hose #26 from the back pressure valve.
5. Plug the output of the back pressure valve.
6. Open the O2, AIR and N2O needle valve fully.
7. Pinch the O2 and N2O line pressure hoses.
8. Remove the O2 and N2O line pressure hoses from the line source while keeping the hoses pinched. The pressure measured on the line pressure gauge on the front of the unit should not fall more than 10 psi per 100 seconds (2 psi per 20 sec).
9. Release the O2 and N2O line pressure hoses.
10. Pinch the AIR line pressure hose.
11. Remove the AIR line pressure hoses from the line source while keeping the hose pinched.
12. The pressure measured on the line pressure gauge on the front of the unit should not fall more than 10 psi per 100 seconds (2 psi per 20 sec).
13. Remove the plug from the back pressure valve and reconnect hose #26.
14. Close the O2, AIR and N2O needle valves.
15. Reconnect the O2, AIR and N2O line pressure hoses and remove the pinch in the hose.

2.5.5 Line Pressure Gauges Accuracy Test

1. Open the rear panel and disconnect the pipe supply for all 3 gases (O2, AIR and N2O).

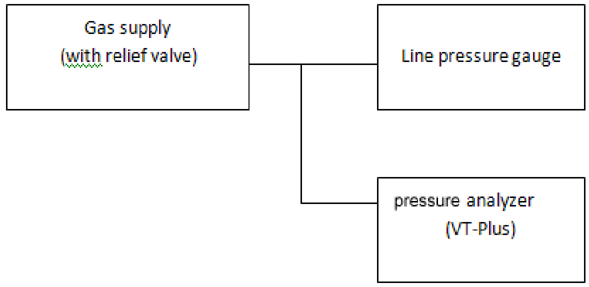


FIGURE 2-60

2. Disconnect hose # 47 from the regulator assembly and connect it to your high pressure meter.
3. Reconnect the O2 Pipeline supply.
4. Verify the reading on your pressure meter and the reading on the O2 pipeline pressure gauge are within 5 psi of each other.
5. Disconnect the O2 Pipeline supply and reconnect hose # 47 to the regulator assembly.
6. Disconnect hose # 37 from the regulator assembly and connect it to your high pressure meter.
7. Reconnect the AIR Pipeline supply.
8. Verify the reading on your pressure meter and the reading on the AIR pipeline pressure gauge are within 5 psi of each other.
9. Disconnect the AIR Pipeline supply and reconnect hose # 37 to the regulator assembly.
10. Disconnect hose # 35 from the regulator assembly and connect it to your high pressure meter.
11. Reconnect the N2O Pipeline supply.
12. Verify the reading on your pressure meter and the reading on the N2O pipeline pressure gauge are within 5 psi of each other.
13. Disconnect the N2O Pipeline supply and reconnect hose # 35 to the regulator assembly.
14. Reconnect the pipe supply for all 3 gases (O2, AIR and N2O).

2.6 Breathing System Checks

2.6.1 Waste Gas Scavenger Test (if available)

1. Connect one end of the low pressure waste gas hose to the port on the Waste Gas Scavenger Assembly. Connect the other end of the hose to the EVAC port.

NOTE: If operating the anesthesia system with other types of waste gas scavenging, ensure that waste gases are directed from the EVAC port to that scavenging system.

2. Connect the respiratory gas monitor exhaust output to the Colder fitting port on the Waste Gas Scavenger Assembly.
3. Ensure that the waste gas scavenger flow adjustment is able to be set between the MIN and MAX line markings.

For Units with a DGSS:

1. Ensure that all waste anesthetic connections are secure, unused inlets are capped, and that the DGSS® power cord is NOT connected.
2. Set the Auto/Manual ventilation switch to Manual.
3. Set fresh gas flow to 0 and fully open the APL.
4. Occlude the patient end of the circuit and observe the circuit pressure gauge. A value of less than -2 cm H_2O indicates a malfunction.
5. While keeping the patient end of the circuit occluded, press the oxygen flush button on the anesthesia machine for approximately 3 seconds while observing the circuit pressure gauge.
6. Circuit pressures should not exceed 15cm H_2O during this test.
7. Apply power to the DGSS® and repeat steps 2 through 6.
8. Frequent clicking sounds from the DGSS® may be heard during normal operation as the reservoir bag fills and empties.

2.6.2 Internal Gas Connections Test

1. Close and remove all gas cylinders from the anesthesia system.
2. Connect only the AIR line pressure hose to the anesthesia system from the wall supply. Leave all other line pressure hoses disconnected.
3. With the A5/A4/A3 powered ON, rotate the AIR flow control knob to ensure a continuous flow increase throughout its full range.
4. Fully rotate the N2O flow control knob and verify that there is no flow.
5. Fully rotate the O2 flow control knob and verify that there is no flow.
6. Disconnect the AIR line pressure hose from the anesthesia system, and connect the O2 line pressure hose from the wall supply, rotate the O2 flow control knob to ensure a continuous flow increase throughout its full range.
7. Fully rotate the N2O flow control knob and verify that there is no flow.
8. Fully rotate the AIR flow control knob and verify that there is no flow.
9. Connect the N2O line pressure hose from the wall supply. With the O2 flow control knob fully opened, rotate the N2O flow control knob to ensure a continuous flow increase throughout its full range.

NOTE: **Make sure that the flow of N2O is at least 10 L/min.**

10. Fully rotate the AIR flow control knob and verify that there is no flow.
11. Close all 3 flow control knobs and reconnect the AIR line pressure hose.

2.6.3 Drive Gas Pressure Loss Alarm, N2O Cutoff Test

1. Set the O2 flow to 2 L/min using the flow control valve.
2. Set the N2O flow to 2 L/min using the flow control valve.
3. Set the AIR flow to 2 L/min using the flow control valve.
4. Interrupt the O2 supply to the anesthesia system.
5. Verify that the flow of N2O and O2 stops within 2 minutes and that the flow of AIR (if available) continues to flow at 2 L/min.
6. Verify the following alarms are activated:
   - O2 Supply Failure appears on the screen
   - An alarm tone sounds.
7. Reconnect the O2 supply to the anesthesia system.
8. Close all 3 flow control knobs.

2.7 Performance Verification

NOTE: **Set the Gas Flow Analyzer Correction Mode to BTPS (Body Temperature and Pressure, Saturated). For EPSON systems the mode can be set to ambient temperature and pressure or BTPS.**

2.7.1 Manual Ventilation Test

1. Ensure that the gas pressure for O2, N2O, and AIR is within specifications.
2. Attach a breathing circuit and test lung to the Y-fitting of the breathing circuit.

NOTE: **For testing purposes, always use a reusable breathing circuit.**

3. Power OFF the anesthesia system.
4. Set the mechanical Auto/Manual switch to MANUAL.
5. Set the APL Valve to approximately 30 cmH2O.
6. Set the AIR flow to approximately 5 L/min using the flow control valve. Use O2 if AIR is not available. This will require turning the main switch to the ON position.
7. Squeeze the breathing bag once every 10 seconds to inflate and deflate the test lung to approximately 20 cmH2O of pressure.
8. Verify the inflation and deflation of the test lung.

2.7.2 Manual Mode Ventilation Test

1. Power ON the anesthesia system.
2. Attach a breathing circuit .

NOTE: For testing purposes, always use a reusable breathing circuit.

3. Attach a test lung to the Y-fitting of the breathing circuit.
4. Perform the start up tests per the on-screen instructions. Ensure successful completion.
5. Set the mechanical Auto/Manual switch to MANUAL. Press the screen for the screen to change to manual Mode.
6. Set the APL Valve to approximately 25 cmH2O. Push the O2 Flush button to fill the breathing bag.
7. Set the AIR flow to 1 L/min using the flow control valve. This will change the screen to manual Mode.
8. Squeeze the breathing bag once every 3 seconds.
9. Verify the inflation and deflation of the test lung.
10. Verify that an airway pressure waveform and all numeric values appear on screen during bag compressions.
11. Stop squeezing the breathing bag and set the APL Valve to the open position (SP).

2.7.3 APNEA Alarm Test

1. While in the Manual Ventilation Mode, stop ventilating the test lung.
2. Verify that the following APNEA alarm signals activate at approximately 30 seconds from the last bag compression.
   - APNEA appears on the screen.
   - An alarm tone sounds.

2.7.4 Alarm Silence Test

1. While the APNEA alarm is sounding, press the Silence soft key.
2. Verify the audio portion of the alarm stops and resumes after 2 minutes or when an additional alarm message appears.

2.7.5 VCV Adult Ventilation Mode Test

1. Set the O2 flow to 2 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the mechanical Auto/Manual switch to AUTO.
3. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	VCV
Vt	500
Rate	4
I:E	1:3
Tpause	30
PEEP	Off
Plimit	50

4. If necessary, press Set Mode button to begin ventilation.
5. Verify that the pressure waveform, Tidal Volume, Mean or Plateau Pressure, Resp. rate and minute volume values appear on the screen.
6. Verify the Tidal Volume display on the Vent Tester is within 7% (±35 mL) of the set value within approximately 1 minute from the start of ventilation.
7. Verify the Tidal Volume display is within 9% (±45 mL) of the set value within approximately 1 minute from the start of ventilation.
8. Verify the PEEP on the display and on that the Vent Tester is between 0 and 4 cmH2O.
9. Verify the measured O2 concentration is at least 97% after 5 minutes.
10. Set the AIR flow to 3 L/min and set the N2O and O2 flow rates to minimum flow.
11. Verify the measured O2 concentration is 21% ±3% vol. % after 5 minutes.

2.7.6 VCV Adult Ventilation Mode Test 2

1. Set the O2 flow to 10 L/min and set the N2O and Air flow rates to 0 flow.
2. Set the mechanical Auto/Manual switch to AUTO.
3. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	VCV
Vt	700
Rate	10
I:E	1:3
Tpause	60
PEEP	OFF
Plimit	80

4. Set the high PEAK Alarm to 80 cmH_2O.
5. Press the Set Mode button to begin ventilation.
6. Verify that the pressure waveform, Tidal Volume, Mean or Plateau Pressure, Resp. rate and minute volume values appear on the screen.
7. Verify the Tidal Volume display on the Vent Tester is within 7% (+/- 49 mL) of the set value within approximately 1 minute from the start of ventilation.
8. Verify the Tidal Volume display is within 9% (+/-63 mL) of the set value within approximately 1 minute from the start of ventilation.
9. Verify the PEEP on the display and on the Vent Tester is between 0 and 4 cmH20.

2.7.7 VCV Child Ventilation Mode Test

NOTE: **Limit the volume in the test lung to provide sufficient airway pressure to satisfy the Low Peak Pressure alarm. Or reduce the Peak Pressure alarm limit to a lower value to prevent the alarm when using an adult test lung.**

1. Set the O2 flow to 1 L/min and set the N2O and AIR flow rates to 0 flow.
2. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	VCV
Vt	200
Rate	15
I:E	1:2
Tpause	Off
PEEP	Off
Plimit	80

3. Verify that the pressure waveform, Tidal Volume, Mean or Plateau Pressure, Resp. rate and minute volume values appear on the screen.
4. Verify the Tidal Volume display is within 18ml of the set value within approximately 1 minute from the start of ventilation.
5. Verify the delivered volume as measured by a Vent Tester at the expiratory port, is within 15ml of the set value within approximately 1 minute from the start of ventilation.

2.7.8 Airway Disconnect Alarm Test

1. While the ventilator is running, disconnect the expiratory limb from the Expiratory Port on the Breathing System.
2. Verify the following airway pressure disconnect alarm signals activate:
   - Paw Too Low message appears on the screen.
   - An alarm tone sounds.
3. Reconnect the expiratory limb to the expiratory port.

2.7.9 PCV Adult Ventilation Mode Test

1. Set the O2 flow to 3 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	PCV
VtG (A5 only, EPSON platform)	Off
Pinsp	15
Rate	8
I:E	1:2
PEEP	Off
Tslope	0.2
PlimVG	NA

3. Press Set Mode button to begin ventilation.
4. Verify the Peak Pressure reading of the display is within ±2 cmH2O of the set Pinsp.
5. Verify that the pressure waveform, Tidal Volume, Resp. Rate and minute volume values appear on the screen.
6. Verify that the PEAK Value measured with the Vent Tester reaches 15 ±2.5 cmH2O within five breaths from the start of ventilation.

2.7.10 Pressure Support (PS) Ventilation Mode Test

1. Set the O2 flow to 1 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	PS
Min Rate	4
ΔP	20
Trigger	3
PEEP	Off
Tslope	0.2
ΔP apnea	15.0 (DSP only)
Apnea Ti	5.0

3. Press Set Mode button to begin ventilation.
4. Begin triggering breaths by slightly squeezing the test lung and releasing. Maintain a continuous breath rate.
5. Verify that a pressure waveform and all ventilation parameters appear on the screen.
6. Verify that the Peak Pressure reading on the display is ±2 the value of ΔP + PEEP.
7. Stop triggering breaths.
8. Verify that after 15 seconds the ventilator delivers a breath and displays the message Apnea Ventilation.
9. Verify the system ventilates with a frequency of 4 bpm.

2.8 Alarms and Fail safe Functions

2.8.1 Set Up

1. Set the O2 flow to 2 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	VCV
Vt	600
Rate	8
I:E	1:2
Tpause	10
PEEP	Off
Plimit	50

3. Press Set Mode button to begin ventilation.

2.8.2 Low FiO2 Alarm Test

NOTE: **For A5s with an installed gas module, disconnect the sample tube from the Y-piece and breath into it until you see a CO2 reading on the screen. Then reconnect the sample tube to the Y-piece. This will activate the gas module alarms.**

1. Set the Low FiO2 Alarm limit to 50%.
2. Set the AIR flow control valve to 5 L/min.
3. Set the O2 flow control to minimum flow.
4. Verify the following Low FiO2 alarm signals activate, within three ventilation cycles:
   - FiO2 Too Low message appears on the screen.
   - An alarm tone sounds.
5. Set the Low FiO2 alarm limit to 18%.
6. Verify the FiO2 Too Low message disappears.

2.8.3 High FiO2 Alarm Test

1. Set the high FiO2 Alarm limit to 50%.
2. Set the O2 flow control valve to 5 L/min.
3. Set the AIR flow controller to minimum.
4. Verify the following High FiO2 alarm signals activate:
   - FiO2 Too High message appears on the screen.
   - An alarm tone sounds.
5. Set the high FiO2 alarm limit to the max setting.
6. Verify the FiO2 Too High message disappears.

2.8.4 Peak Pressure Alarms Test

1. Set the PEAK low alarm to the lowest setting.
2. Set the PEAK high alarm limit set point about 5 to 8 digits below the Peak Pressure displayed on the screen.
3. Verify the following (high) peak pressure alarms activate:
    - Paw Too High message appears on the screen.
    - An alarm tone sounds.
    - Inspiration ends and expiration begins as the pressure meets the high alarm limit.
4. Set the PAW high alarm limit set point to 65 (cmH2O).
5. Verify the Paw Too High message disappears.
6. Set the PAW low alarm limit set point to 50 (cmH2O).
7. Verify the following (low) peak pressure alarms activate:
    - Paw Too Low message appears on the screen.
    - An alarm tone sounds.
8. Set the PAW low alarm limit to 12 (cmH2O).
9. Verify the Paw Too Low message disappears

2.8.5 Minute Volume Alarm Test

1. Set the MV Low alarm limit set point to the highest value.
2. Verify the following alarms activate:
    - MV Too Low message appears on the screen.
    - An alarm tone sounds.
3. Set the MV Low alarm limit to minimum setting.
4. Verify the MV Too Low message disappears.
5. Set the MV High alarm limit set point to the lowest value.
6. Verify the following alarms activate:
    - MV Too High message appears on the screen.
    - An alarm tone sounds.
7. Set the MV High alarm limit set point to the highest value
8. Verify that the MV Too High message disappears.
9. Set the mechanical Auto/Manual switch to MANUAL.
10. Set all fresh gas flows to 0.
11. Press "discharge" to enter the standby mode.

2.9 Miscellaneous Tests

2.9.1 Test the Line Voltage Alarm

1. Interrupt AC line voltage.
2. Verify that the following alarms activate:
   - An alarm tone sounds.
   - Battery in use message appears on the screen.
3. Plug the anesthesia system into AC line voltage.
4. Verify that the alarm signals cease.
5. Verify the presence of the battery charging icon in the upper right corner of the screen.

2.9.2 Top Light and Auxiliary Light Test

1. Turn on the Top light located on the bottom side of the top panel.
2. Verify that it lights in both on positions.

2.9.3 Touchpad /USB Mouse Test

For A5 units: Verify that the touchpad is functional.

For A3/A4 units: Verify that the USB mouse can be used to operate the unit.

2.10 Vaporizer Interlock Test

1. Attach two vaporizers to the Vaporizer Mounting Manifold and lock them in place.
2. Rotate either of the vaporizer dial to 3% agent.
3. Verify that the other vaporizer dial cannot be rotated to a setting.
4. Set both vaporizer dials to 0.
5. Rotate the other vaporizer dial to 3%.
6. Verify that the first vaporizer dial cannot be rotated.
7. Rotate both vaporizer dials to T and remove both vaporizers.
8. Verify that the locking spring is intact.
9. Reconnect both vaporizers to the Vaporizer Mounting Manifold.

2.11 Vaporizer Accuracy Test

1. Set the APL Valve to 70 cmH2O.
2. Put the AUTO / MANUAL lever in the MANUAL position.
3. Connect one end of a breathing hose to the expiratory port. Connect the other end to the bag arm.
4. Connect the sampling tee of the Gas analyzer to the inspiratory port.
5. Use a breathing hose to connect the output of the sampling tee to the scavenger.

FIGURE 2-61 Vaporizer Accuracy Test Setup

6. Verify the scavenger is connected at the wall and the floater is between MIN and MAX.
7. Mount the vaporizers and fill with anesthetic agent (if necessary).

NOTE: **Do not fill past the indicator line on the vaporizer.**

8. Turn on the Unit
9. Test the vaporizer accuracy per the manufacturer's instructions.
10. Test each vaporizer in turn.
11. Test any vaporizer on the Vaporizer Storage Mount.
12. Remove the measuring equipment.
13. Reconnect the Waste Gas Scavenger Hose.

NOTE: **The deviation of the vaporizers due to change of barometric pressure (high altitude) and the deviation of the Riken F-211 gas analyzer are the same. When testing the Vaporizers using the Riken F-211 gas analyzer, the altitude can be ignored as the deviations cancel each other out. If using a different gas analyzer, check the effect of change of barometric pressure before using in high elevations.**

2.12 Electrical Tests

NOTE: Perform electrical safety inspection after servicing or routine maintenance. Before the electrical safety inspection, make sure all the covers, panels, and screws are correctly installed.

NOTE: The electrical safety inspection should be performed once a year.

2.12.1 Auxiliary Electrical Outlet Test

Verify the mains voltage is present at each auxiliary outlet when the anesthesia machine is connected with power.

2.12.2 Electrical Safety Inspection Test

1. Perform protective earth resistance test:
   a. Plug the probes of the analyzer into the protective earth terminal and equipotential terminal of the AC power cord.
   b. Test the earth resistance with a current of 25 A.
   c. Verify the resistance is less than 0.1ohms (100 mohms).
   d. Plug the probes of the analyzer into the protective earth terminal of the AC power cord and the protective earth terminal of any auxiliary outlet. Repeat steps b and c.
   e. If the resistance is larger than 0.1ohms (100 mohms) but less than 0.2ohms (200 mohms), disconnect the AC power cord and plug the probe that is previously plugged in the protective earth terminal of the AC power cord into the protective earth contact of the power outlet. Repeat steps a to d.
2. Perform the following earth leakage current tests:
   - normal polarity;
   - reverse polarity;
   - normal polarity with open neutral; and
   - reverse polarity with open neutral.
3. Verify the maximum leakage current does not exceed 300 µA (0.3 mA) in the first two tests. While for the last two tests, verify that the maximum leakage current does not exceed 1000 µA (1 mA).

NOTE: Make sure the safety analyzer is authorized by certificate organizations (UL, CSA, or AAMI etc.). Follow the instructions of the analyzer manufacturer.

2.12.3 Electrical Safety Inspection Form

Location:				Technician:	
Equipment:				Control Number:	
Manufacturer:		Model:		SN:	
Measurement equipment /SN:				Date of Calibration:	
INSPECTION AND TESTING				Pass/Fail	Limit
1	Auxiliary mains socket outlets				
2	Protective Earth Resistance		Ω		Max 0.1 Ω
3	Earth Leakage	Normal condition(NC)	_____μA		Max: NC: 300μA SFC: 1000μA
		Single Fault condition(SFC)	_____μA		

TABLE 2-1

For periodically performance, all the test items included in the ELECTRICAL SAFETY INSPECTION FORM shall be performed. The following table specifies test items to be performed after the equipment is repaired with main unit disassembled.

When neither power supply PCBA, transformer nor patient electrically-connected PCBA is repaired or replaced	Test items: 1, 2
When power supply PCBA or transformer is repaired or replaced	Test items: 1, 2, 3

TABLE 2-2

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3.0 Periodic Maintenance

3.1 Maintenance Schedule

The following is a list of activities required for periodic maintenance of the A5/A4/A3 Anesthesia System. Physical inspection, replacement of consumables, and performance checks should be periodically performed per the schedule listed below. The manufacturer is not responsible for component failure or loss resulting from the use of stated consumables beyond their recommended replacement interval. These are noted in the Periodic Maintenance Schedule (See “Periodical Maintenance Schedule” on page 3-2).Make records of the parts that have been replaced before the periodical replacement.

NOTE: **To avoid equipment damage or personal injury, replace the parts which need to be replaced periodically even if they are not worn or damaged when the due date arrives.**

3.2 Periodical Maintenance Consumable Parts Kits

Consumable parts are available in the periodical maintenance kits listed below:

- Periodic maintenance kit (12 month), P/N: 801-0631-00084-00
- A3 Periodic maintenance kit (36 months), P/N: 121-001072-00
- A5/A4 Periodic maintenance kit (36 months), P/N: 121-001061-00

NOTE: **Touch Screen (P/N: 801-0631-00014-00) is not included in the Consumable Parts Kits. It must be ordered separately.**

3.3 Periodical Maintenance Schedule

Required action	After each service	Every 12 months	Every 36 months
Checklist before surgery		x	x
Visual inspection checklist		x	x
Replacement of consumable parts		x	x
Battery maintenance and replacement			x
Functional tests		x	x
Preoperative checklist	x	x	x

3.4 Checklist before surgery

Before the anesthesia machine at the client end is maintained, some routine tests are required to check if the current status of the anesthesia machine is normal. The following table lists the routine tests.

SN	Test item	Functional description	Test interval
1	Check the mechanical ventilation mode	1. Check if mechanical ventilation is provided normally and if an alarm occurs. 2. Check if the preset values of pressure and TV are same to the measured values. 3. Check if the pressure measured by the pressure sensor is same to that indicated by the airway pressure gauge and if the TV measured by the flow sensor is same to that indicated by the graduation on the bellows housing. 4. Roughly judge if the breathing system has a significant leak by observing how much fresh gas is compensated and observing if the folding bag collapses.	After each service or at the time of return visit
2	Breathing system leak test in mechanical ventilation mode	1. Check the pneumatic circuit in mechanical ventilation mode for leaks, including bellows, drive gas circuit, sodalime canister, patient tubes, flow sensors and their connectors. 2. Check the control effectiveness of main control board and auxiliary control board over PEEP safety valve. 3. Check the monitoring effectiveness of auxiliary control module over airway pressure and PEEP path pressure.	After each service or at the time of return visit
3	Breathing system leak test in manual ventilation mode	Check the pneumatic circuit in manual ventilation mode for leaks, including APL valve, check valve, sodalime canister, patient tubes, flow sensors and their connectors.	After each service or at the time of return visit
4	Check the sensors' zero points	Check if the zero points of all the flow sensors and pressure sensors inside the machine are within the normal range so as to determine when to replace the monitor board.	After each service or at the time of return visit
5	Check the flow sensor accuracy	1. Check if the measurements made by the flow sensors inside the machine are the same. 2. Check if the measurement made by any flow sensor inside the machine is accurate. 3. Check the effectiveness of flow calibration (factory) result.	After each service or at the time of return visit
6	Check the pressure sensor accuracy	1. Check if the measurements made by the pressure sensors inside the machine are the same. 2. Check if the measurement made by any pressure sensor inside the machine is accurate. 3. Check the effectiveness of pressure calibration (factory) result.	After each service or at the time of return visit
7	Check the electronic flowmeter accuracy	1. Check if the measurement made by the electronic flowmeter is normal. 2. Check the effectiveness of electronic flowmeter calibration result.	After each service or at the time of return visit
8	Check the AG module accuracy	1. Check if the measurement made by the AG module is normal. 2. Check the effectiveness of AG module calibration result.	After each service or at the time of return visit

3.5 Visual Inspection Checklist

1. Verify that the anesthesia system has no physical damage that would prevent operation.
2. Verify that the breathing circuit and Pre-pak absorber canister are present.
3. Verify that the vaporizers are filled but not overfilled.
4. Verify that the Preoperative Checkout List is attached.
5. Verify that the tank wrench is attached.
6. Verify that the transfer tube of the AGSS is not damaged. Drain any moisture.
7. Verify that the AC power cord is not damaged.

3.6 List of Periodic Maintenance Parts to be Replaced and Checked

The following table lists the parts to be checked or replaced periodically inside the consumable parts kits. The replacement date starts from the date when the machine is assembled. The filter (part number:082-000423-00) is not needed for FDA A3/A4/A5.

No.	Consumable Part	Amount	12 Month	36 Month	Part Number
1	Lithium-ion battery	2 (A5/A4) 1 (A3)	Check	Replace	115-018012-00
2	Cell battery Lithium 3V35mAh D12.5*2.0 (for main control board)	1	Check	Replace	M05-010R03---
3	Bellows assembly	1	Check	Replace	0601-30-78968
4	O-ring (for airway pressure gauge)	1	Check	Replace	082-001524-00
5	O-ring 15.54X2.62 (for bag arm)	2	Check	Replace	082-000673-00
6	Gasket, bellows canister base	1	Replace	Replace	049-000243-00
7	O-ring 15.54X2.62 (for O2 cell cover)	1	Replace	Replace	082-000673-00
8	O-ring 14X2.65 (for Vaporizer mount)	6	Replace	Replace	082-000934-00***
9	AGSS filter	1	Clean	Replace	082-000506-00
10	O-ring 8.5X2 (for rotating block of breathing circuit)	2	Check	Replace	082-000665-00
11	O-ring 4.7X1.8 (for rotating block of breathing circuit)	4	Check	Replace	082-000667-00
12	O-ring 16X2 (for rotating block of breathing circuit)	2	Check	Replace	M6M-010058---
13	O-ring 27X1.5 (for Check valve dome)	2	Replace	Replace	082-001501-00
14	O-ring 20X1.5 (for Check valve)	2	Replace	Replace	082-001503-00
15	O-ring 6X1 (for Auto/Manual ventilation switch)	2	Check	Check	082-000669-00
16	O-ring 23.47X2.95 (for Water Collection Cup)	1	Replace	Replace	082-001504-00
17	CO2 Absorber Hose	1	Check	Replace	049-000146-00
18	Gasket, absorber canister exterior	1	Check	Replace	049-000143-00

No.	Consumable Part	Amount	12 Month	36 Month	Part Number
19	Gasket, absorber canister interior	1	Check	Replace	049-000145-00
20	Gasket, CO2 bypass assembly	1	Check	Replace	049-000142-00*
21	Seal, valve port (for CO2 Bypass shaft)	4	Check	Check	049-000140-00
22	O-ring 23.47X2.95 (for CO2 Bypass Assembly)	2	Check	Replace	082-001504-00
23	O-ring 4.47X1.78 (for CO2 Bypass shaft)	8	Check	Check	082-000679-00
24	Tank Washer	3 (A5/A3) 2 (A4)	Replace	Replace	0348-00-0185
25	O-Ring 52X2 Auto/Manual ventilation switch	1	Check	Check	082-001505-00
26	O-Ring 40X2.2 Auto/Manual ventilation switch	2	Check	Check	082-001520-00
27	O-Ring 30X2 bag arm base	1	Check	Check	082-001499-00
28	O-Ring 8.5X2.0 O2 cell port	1	Check	Replace	082-001525-00
29	Inspiratory Flow Sensor	1	Check	Check	801-0631-00060-00
30	Expiratory Flow Sensor	1	Check	Check	801-0631-00056-00
31	O-ring 18X2.5 Breathing system base	2	Check	Check	049-000813-00
32	Bellow check valve membrane	1	Check	Replace	049-000240-00**
33	O-Ring 20.29X2.62 Bellows base	1	Check	Check	082-001508-00
34	O-Ring 29.82X2.62 APL valve	1	Check	Check	082-001515-00
35	O-Ring 25X2 APL valve	1	Check	Check	082-001500-00
36	Dust filter	1	Check	Replace	045-000241-00
37	O-ring, 20.35X1.78 FKM A70	1	Check	Check	082-000676-00
38	Sealed gasket of breathing connector	2	Check	Check	049-000235-00
39	O-ring, 75.87X2.62 A50	1	Check	Check	082-001509-00
40	O-ring, 61.6X2.62 A50	2	Check	Check	082-001511-00
/	Touch screen	1	Check	Replace	801-0631-00014-00

*The gasket comes with extensions on the barbed nibs with are there for as an installation help. The extensions need to be cut off after the gasket has been installed.
**The gasket comes without the metal weight. The metal weight needs to be transferred from the previous gasket.
***The 6 O-Rings are for the 3 vaporizer option. Units with the 2 Vaporizer mount will only require 4 of the 6 O-Rings.

NOTE: **To be compatible with additional models, the kit contains additional parts not required on the A3/A4/A5 anesthesia systems.**

The locations of the O-rings / Gaskets are shown in FIGURE 3-1.

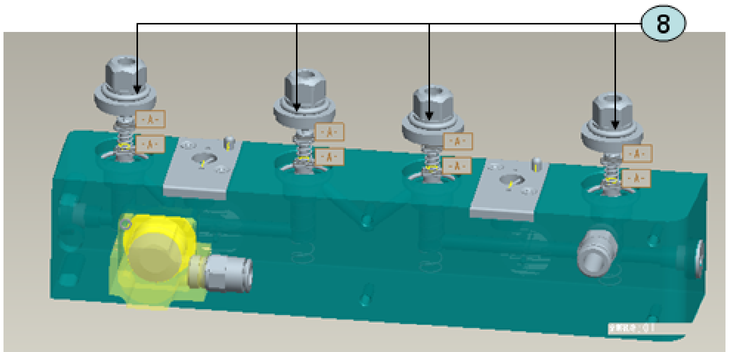


FIGURE 3-1 Locations of the O-rings / gaskets

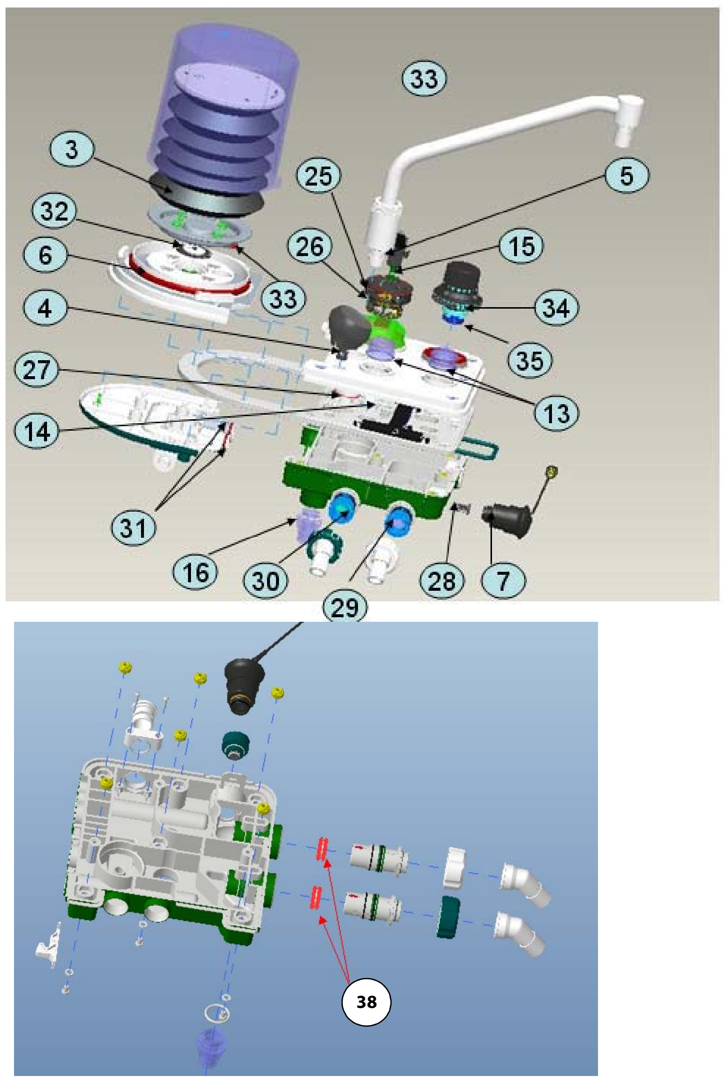


FIGURE 3-2 Breathing System

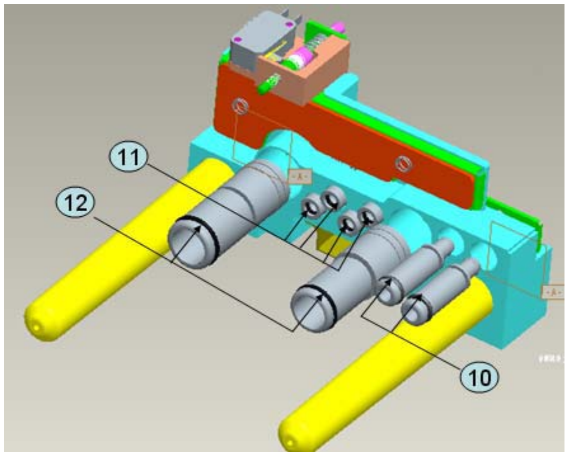


FIGURE 3-3 Breathing System Adapter

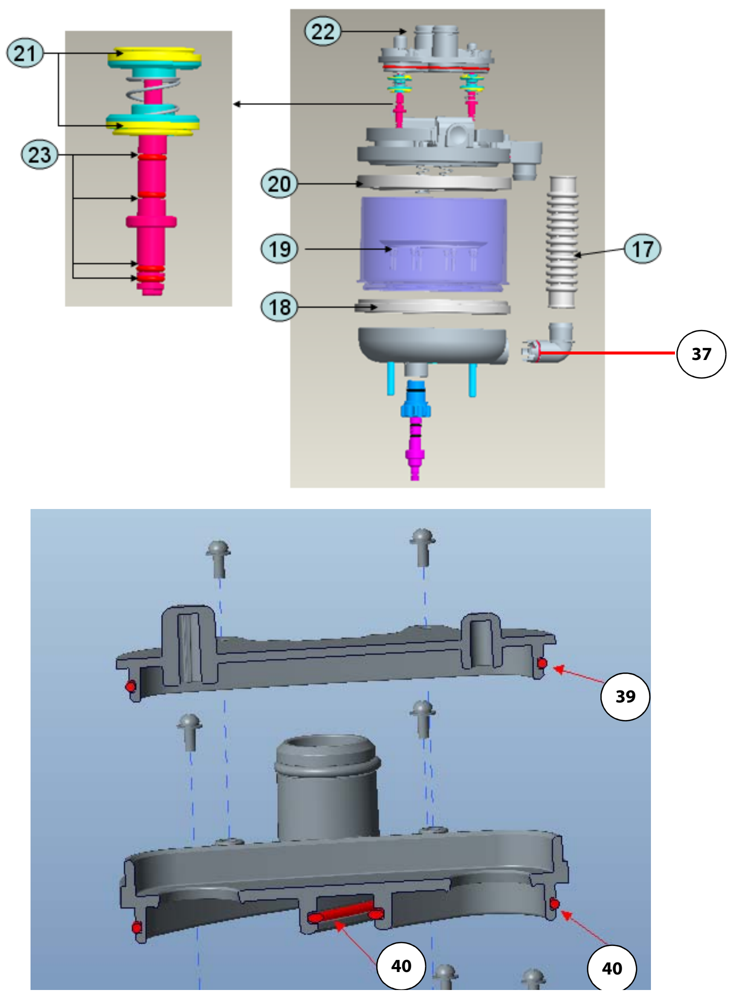


FIGURE 3-4 CO2 Bypass Shaft and CO2 Absorber Assembly

FIGURE 3-5 Dust Filter

3.7 Battery Maintenance and Replacement

If the battery supply does not function normally, replace it as follows:

1. Open the rear cover of the anesthesia system.
2. Open the battery box of the anesthesia system.
3. Remove the old battery.
4. Install the new battery.
5. Close the battery box.
6. Close the rear cover.
7. Use only Mindray approved batteries (P/N 115-018012-00).

3.8 Functional Tests

Refer to Chapter 4.0 Calibration if any values are out of specification.

NOTE: **The A5/A4/A3 system must be powered on (AC power, not battery) and the Breathing System Warmer set to ON (software bundle version 01.00.00 and higher) at least an hour before performing the Ventilation Tests described in “VCV Adult Ventilation Mode Test” on page 2-50.**

3.8.1 Breathing System Leak Test

NOTE: **Always perform the leak test after servicing the anesthesia machine, replacing the components, or reconnecting the tubes.**

3.8.1.1 Breathing System Leak Test in Mechanical Ventilation Mode

This test checks the pneumatic circuit for leaks in mechanical ventilation mode. Test items include the bellows, drive gas circuit, CO2 absorber canister, patient tubes, flow sensors, and flow sensor connectors.

To perform the breathing system leak test in mechanical ventilation mode:

1. You can access the automatic circuit leak test screen after the Power-On Self Test has passed. You can also open the Setup in Standby and select Test Leak/Compliance on the General menu to access the automatic circuit leak test screen.The automatic circuit leak test screen is shown below. Set up the machine as per the instructions on the screen. Then, select Continue to execute automatic circuit leak test.

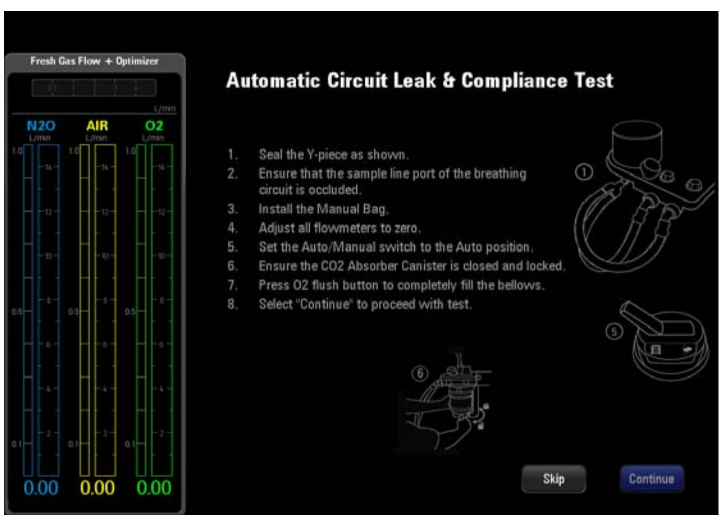


FIGURE 3-6 Automatic Circuit Leak and Compliance Test Screen

2. The ongoing automatic circuit leak test is as shown below. You can select Cancel to stop the ongoing leak test.

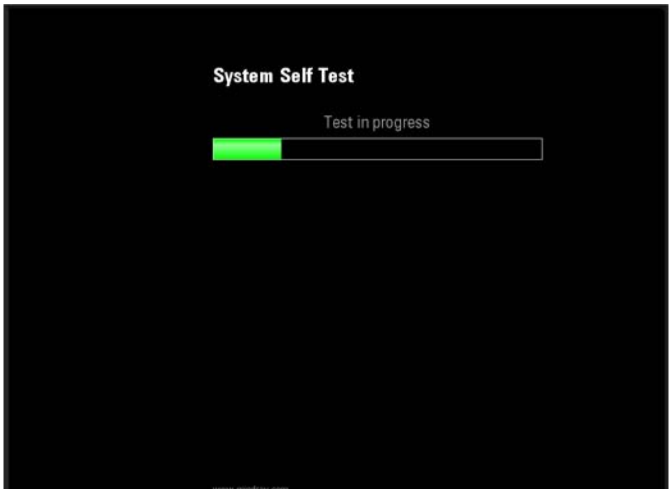


FIGURE 3-7 Automatic Circuit Leak and Compliance Test In Progress

3. During the automatic circuit leak test, the safety valve control test is also being conducted. The automatic circuit leak test results are listed in the following table.

Test Result	System Limitation
Safety valve control failed	The machine cannot be used.
Automatic circuit leak test failed Leak ≥200 mL/min and ≤1000 mL	The user can acknowledge the leak and continue with automatic ventilation.
Automatic circuit leak test failed Leak >1000 mL	Only manual ventilation can be applied.
Compliance test failed	Both automatic ventilation and manual ventilation can still be applied using the previous compliance value in the A5/A4/A3 system memory, but may not meet the accuracy of the delivered volume.

The following screen is displayed if the safety valve control test is failed. You can select Service Access and enter the required service password to access service mode. You can select Retry to perform automatic circuit leak test again.

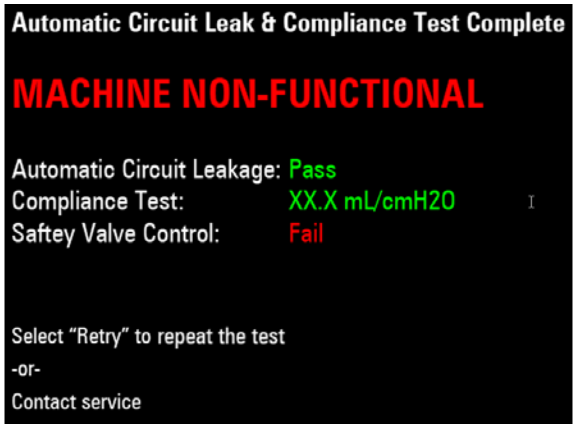


FIGURE 3-8 Machine Non-Functional Screen

The following screen is displayed if the automatic circuit leak test is failed and the Leak ≥200 mL/min and ≤1000 mL. You can select Retry to perform the automatic circuit leak test again or accept the result continue with automatic ventilation.

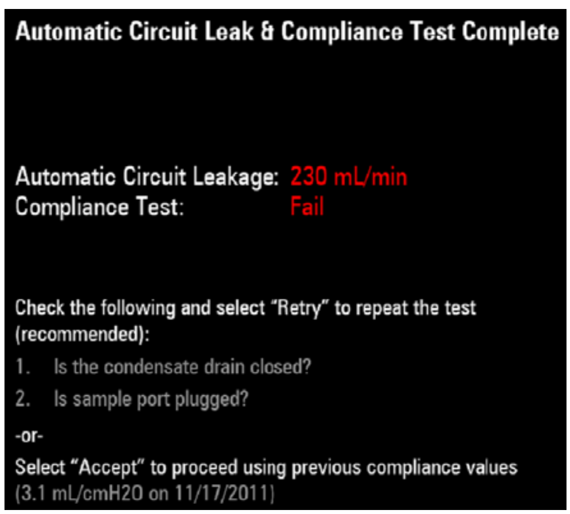


FIGURE 3-9 Automatic Circuit Leak and Compliance Test: Fail

The following screen is displayed if the automatic circuit leak test is failed and the leak >1000 mL. You can select Override to enter Standby mode. But mechanical ventilation is disabled. You can select Retry to perform automatic circuit leak test again.

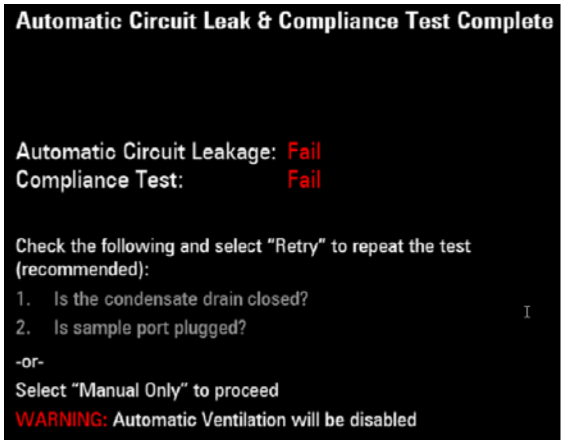


FIGURE 3-10 Automatic Circuit Leak and Compliance Test: Fail

The following screen is displayed if the compliance test is failed. You can select Override to enter Standby mode.You can select Retry to perform automatic circuit leak test again.

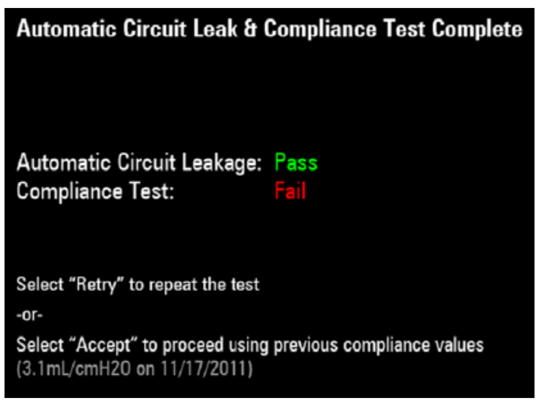


FIGURE 3-11 Compliance Test: Fail

The following screen is displayed if the automatic circuit leak test is completed. Select Continue to enter Standby mode.

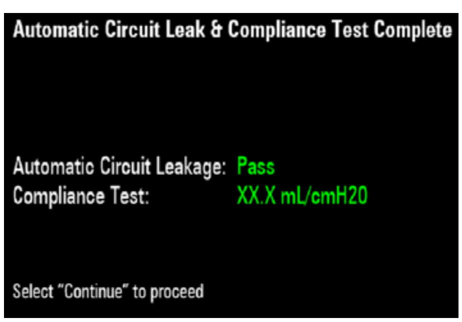


FIGURE 3-12 Automatic Circuit Leak Test Completed

NOTE: **If the leak test fails, check all of the possible leak sources, including the bellows, breathing system tubes, and CO2 absorber canister. Check that they are correctly connected and their connectors are not damaged.**

NOTE: **If there is a leak, check the pneumatic circuit system for leakage and troubleshoot the problems as described in 5.3.4 Breathing System. After the leak has been resolved, repeat the leak test.**

3.8.1.2 Breathing System Leak Test in Manual Ventilation Mode

This test checks the pneumatic circuit for leaks in manual ventilation mode. Test items include the APL valve, check valve, CO2 absorber canister, patient tubes, flow sensors, and flow sensor connectors.

To perform the breathing system leak test in manual ventilation mode:

1. You can access the manual circuit leak test screen after the automatic circuit leak test has passed. The manual circuit leak test screen is shown below

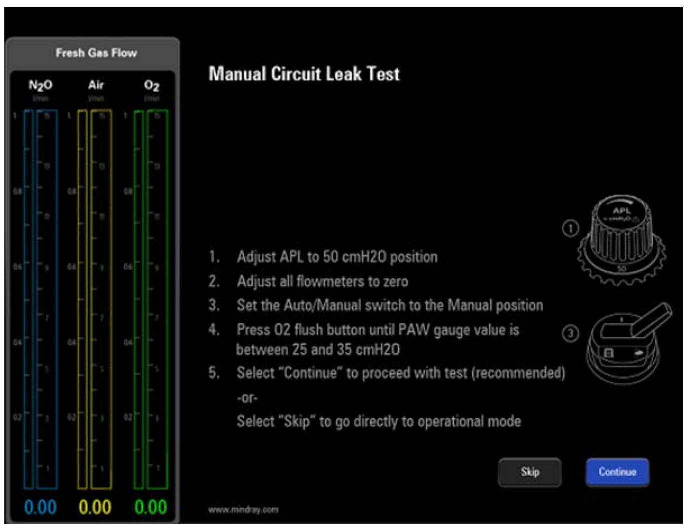


FIGURE 3-13 Automatic Circuit Leak Test Completed

2. Set up the machine as per the instructions on the screen. Then, select Continue to execute manual circuit leak test.
3. The ongoing manual circuit leak test is as shown below. You can select Cancel to cancel the ongoing leak test.

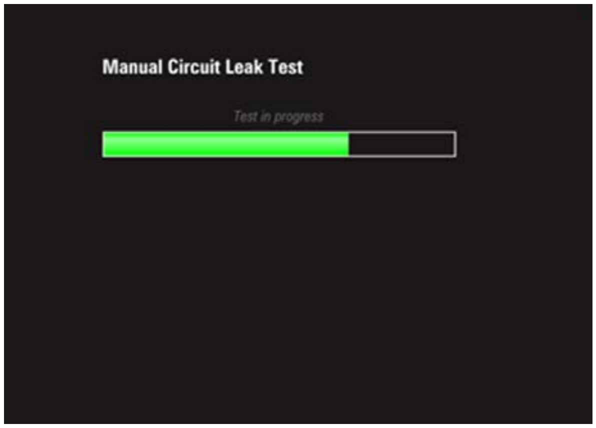


FIGURE 3-14 Manual Circuit Leak Test In Progress

The following screen is displayed if the manual circuit leak test is failed. If so, you must perform the test again.

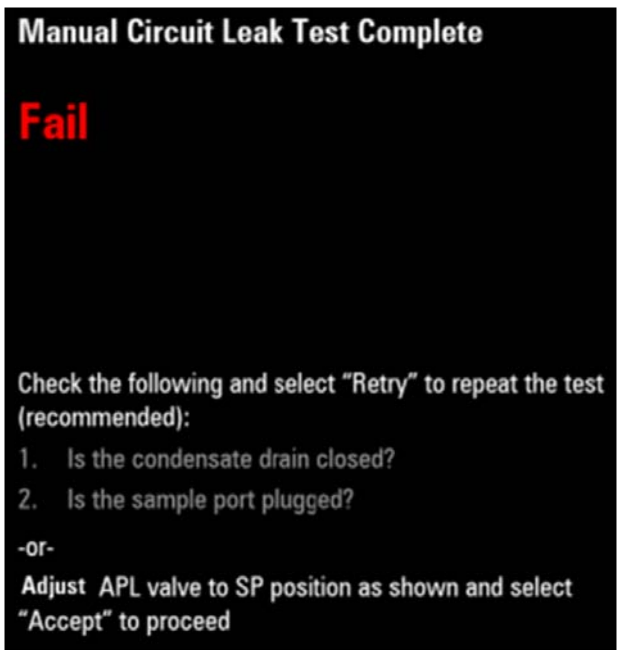


FIGURE 3-15 Manual Circuit Leak Test: Fail

The following screen is displayed if the manual circuit leak test is completed. Select Continue to enter automatic circuit leak test.

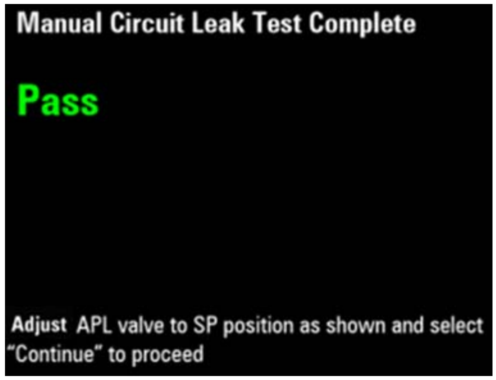


FIGURE 3-16 Manual Circuit Leak Test: Passed

NOTE: **If there is a leak, check the pneumatic circuit system for leakage and troubleshoot the problems as described in 5.3 Pneumatic Circuit System Problems. Repeat the leak test after the source of the failure has been resolved.**

3.8.1.3 Troubleshooting: Leak Test

The following table lists the commonly-encountered problems and recommended actions for Section 3.8.1.2 Breathing System Leak Test in Manual Ventilation Mode.

Failure Description	Possible Cause	Recommended Action
Leak test failure is prompted immediately after [Start] is selected (typically, the leak test requires at least 3 minutes).	The Auto/Manual ventilation switch is set to the bag position and the message [Manual Vent.] is prompted.	Set the Auto/Manual ventilation switch to the mechanical ventilation position.
	The reading on the drive gas (O2) pressure gauge indicates drive gas pressure low (lower than 200 kPa) and the alarm of [Drive Gas Pressure Low] is produced.	Replace or connect gas supplies and make sure that the drive gas pressure is at 350 to 450 kPa.
During leak test, the pressure indicated by the airway pressure gauge fails to reach 30 cmH2O.	1. Before the leak test, the bellows is not fully inflated. 2. The Y piece on the breathing tube is not connected to the test plug. 3. The bellows housing is not properly installed.	Check the connections of the pneumatic circuit and re-install the pneumatic circuit.
During leak test, the pressure indicated by the airway pressure gauge fails to reach 30 cmH2O.	1. Before the leak test, the bellows is not fully inflated. 2. The Y piece on the breathing tube is not connected to the test plug. 3. The bellows housing is not properly installed.	Check the connections of the pneumatic circuit and re-install the pneumatic circuit.

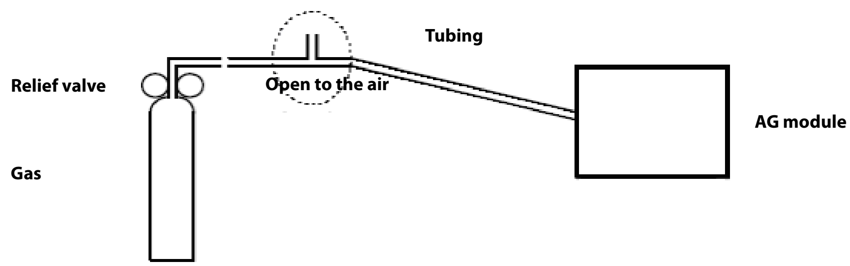
3.8.2 Check the AG Module Accuracy

Prepare the following before checking the AG module accuracy:

- Gas cylinder, with a certain standard gas or mixture gas. Gas concentration should meet the following requirements: AA≥1.5%, CO_2≥1.5%, N_2O≥40%, O_2≥40%, of which AA represents an anesthetic agent. a/c≤0.01 (a is the gas absolute concentration accuracy; c is the gas concentration).
- T-shape connector
- Tubing

Follow this procedure to perform checking:

1. Connect the test system as follows.



2. Ensure that the system is **Standby** mode. If not, select the **Discharge** button in the Manual tab and follow the on-screen prompts to discharge the patient and enter **Standby** mode.
3. Select **Setup** softkey> **System** tab (system password needed).
4. Select the **Calibration** button.
5. Select the **External AG Module** button.
6. Wait for the AG module to be fully warmed up
7. Enter the actual concentration of the calibration gas.
8. Turn on the calibration gas canister and the system displays the real-time concentration of calibration gas.
9. Verify gases are within tolerances below when compared to the compressed gas mixture onthe gas cylinder label (allow the gas to flow for sixty seconds before taking the reading.) N2O within 3%,CO2 = within 0.3%,O2 = within 2%,Desflurane within 0.2%.
10. Select Accept to close the Setup window.

3.8.3 Gas Module Verification

1. Remove and re-insert the AG Module into the module rack.
2. Touch the screen to start the manual ventilation mode and make sure that the gas test screen and CO2 waveform and parameter area are displayed on the screen and that the prompt message **External AG Loaded Successfully** is displayed at the top of the screen.
3. After the AG module is inserted, remove the watertrap, make sure that the alarm **AG No Watertrap** appears. After the watertrap is connected to the module, make sure that the alarm disappears.
4. Wait until the AG module warmup is finished and then use your hand or other objects to completely block the gas inlet of the AG module. An alarm message **AG Airway Occluded** will appear on the screen.
5. Block the gas inlet for another 30 s. If the alarm message does not disappear, it indicates that the module does not leak.

3.8.4 Gas Delivery System Tests

3.8.4.1 O2 Flush Verification

1. Using a breathing hose, connect the bag arm to the expiratory port.
2. Put the Manual/Auto lever to the manual position and set the APL valve to 75.
3. Connect a flow meter to the inspiratory port.
4. Verify that the O2 flush flow is between 35 to 50 L/min when pressing the O2 flush valve.

3.8.4.2 O2:N2O Ratio System

1. Set the O2 and N2O Flow Control Valves to minimum.
2. Turn on the N2O flow control and adjust N2O flow to maximum.
3. Adjust O2 flows according to the following table.
4. Verify that the corresponding N2O flows are according to the following table.

O2 Flow Setting	N2O Flow
0 L/min	0 L/min
0.3 L/min	≤ 1.0 L/min
0.8 L/min	between 2.0 L/min and 2.5 L/min
1.0 L/min	between 2.5 L/min and 3.2 L/min
2.0 L/min	between 4.9 L/min and 6.3L/min
3.0 L/min	between 7.4 L/min and 9.5 L/min
4.0 L/min	≤ 12.7 L/min
5.0 L/min	≤ 15.8 L/min
6.0 L/min	≤ 19.0 L/min
0 L/min	0 L/min

5. Lower the N2O flow to minimum.
6. Lower the O2 flow to minimum.

3.8.4.3 Vaporizer Leak Test

1. Set the ventilation Auto/Manual ventilation switch to Manual.
2. Set the APL valve to the SP position.
3. Connect one end of the breathing circuit to the bag arm, one end to the inspiratory port and the Y-piece to the test port:

FIGURE 3-17 Vaporizer Leak Test Setup

4. Mount and lock the vaporizer onto the vaporizer mount. (Certain vaporizers need to be set to at least 1% for correct testing. See the vaporizer manufacturer's manual for details.)
5. Set the fresh gas flow to 200 mL/min.
6. Set the APL valve to 75 and verify that the pressure on the airway pressure gauge increases above 30 cmH2O within 2 minutes.
7. Turn off the vaporizer.
8. Repeat Steps 4, 5, 6, and 7 for the other vaporizer.

3.8.4.4 Check Valve Test

1. Set the ventilation Auto/Manual ventilation switch to Manual.
2. Set the APL valve to 75.
3. Connect the breathing bag to the Inspiratory port.
4. Plug the bag arm.
5. Press the FLUSH button until the pressure on the airway pressure gauge reaches 35 cmH2O.
6. Set the APL valve to SP.
7. Verify that the pressure does not drop below 30 cmH2O after 10 seconds

3.8.5 Check the Sensor Zero Point

To check the sensor zero point:

1. Turn off all fresh gases and expose the breathing system to ambient pressure.
2. Make sure that the system is in Standby mode.
3. Select Setup-> Service-> Data Monitors-> Component-> Zero Sensor to access the following menu.

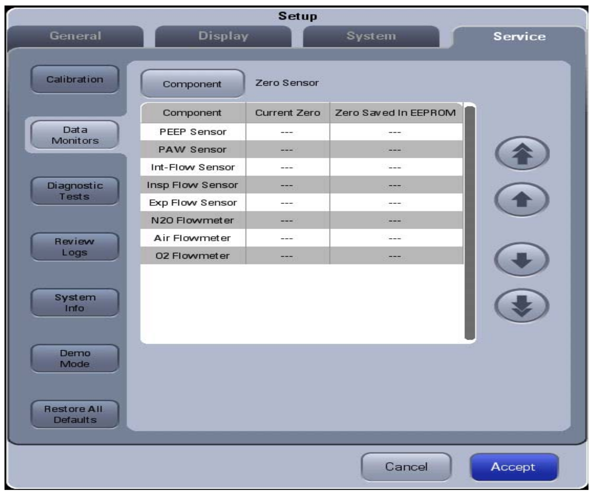


FIGURE 3-18 Data Monitors Menu

4. The second column is the current reading of the sensors and the third column is the zero that is saved in the EEPROM.

DSP Platform (Software Bundle 03.00.00 and Higher) Zero Point Range

The following table lists the normal range of the zero point of A5/A4 pressure and flow sensors.

Sensor Name	Normal Range of Zero Point
Paw sensor	7432 to 16206 **AD Counts**
PEEP pressure sensor	7432 to 16206 **AD Counts**
Inspiratory flow sensor	554 to 26457 **AD Counts**
Expiratory flow sensor	554 to 26457 **AD Counts**
Ventilator internal flow sensor	554 to 26457 **AD Counts**
N2O Flow Sensor	-0.2 to +0.2 L/min
Air Flow Sensor	-0.2 to +0.2 L/min
O2 Flow Sensor	-0.2 to +0.2 L/min

The zero point A/D value of the PAW sensor and PEEP pressure sensor should fall within the normal range of 7432 to 16206.

The zero point A/D value of the inspiratory flow sensor and expiratory flow sensor should fall within the normal range of 554 to 26457.

If there is a great deviation between the current zero point and the factory calibration zero point, it indicates that the sensor is aging but it does not mean that normal measurement cannot be performed.

If the current zero point exceeds the specified normal range, normal measurement is affected and you need to calibrate the zero point again. If the zero point of the flow sensor is not within 554 to 26457, or the zero point of the pressure sensor is not within 7432 to 16206, replace the VCM. For the internal flow sensor, replace the flow sensor interface board.

For the flowmeter sensors (N2O, Air, O2): If the zero point is out of the normal range [-0.2, +0.2], it indicates that the sensor needs to be recalibrated

EPSON Plateau Zero Point Range

The following table lists the normal range of the zero point of the A5/A3 pressure and flow sensors.

Sensor Name	Normal Range of Zero Point (AD Counts)
Paw sensor	200~800
PEEP pressure sensor	200~800
Inspiratory flow sensor	50~1800
Expiratory flow sensor	50~1800
Ventilator internal flow sensor	100~400

The zero point A/D value of the PAW sensor and PEEP pressure sensor should fall within the normal range of 200 to 800.

The zero point A/D value of the inspiratory flow sensor and expiratory flow sensor should fall within the normal range of 50 to 1800.

The zero point A/D value of the internal flow sensor should fall within the normal range of 100 to 400. If there is a great deviation between the current zero point and the factory calibration zero point, it indicates that the sensor is aging but it does not mean that normal measurement cannot be performed.

If the current zero point exceeds the specified normal range, normal measurement is affected and you need to calibrate the zero point again. If the zero point of the flow sensor is not within 0 to 2000, or the zero point of the pressure sensor is not within 0 to 1200, replace the VCM. For the internal flow sensor, replace the flow sensor interface board.

3.8.6 Check the Flow Sensor Accuracy

NOTE: **You can use any flow meter that has an accuracy of at least ±2% for the accuracy measurement of the flow sensors.**

NOTE: **Set the Gas Flow Analyzer Correction Mode to BTPS (Body Temperature and Pressure, Saturated). For EPSON systems the mode can be set to ambient temperature and pressure or BTPS.**

To check the measurement accuracy of flow sensors:

1. Remove the bellows dome,then the Bellows and re-install the bellows dome.
2. Remove the water trap.
3. Put the AUTO / MANUAL Lever in the AUTO position.
4. The pneumatic connections between the anesthesia machine and calibration device are as shown in the following picture. You can connect the tube to a high-flow connector or low-flow connector based on the requirements.

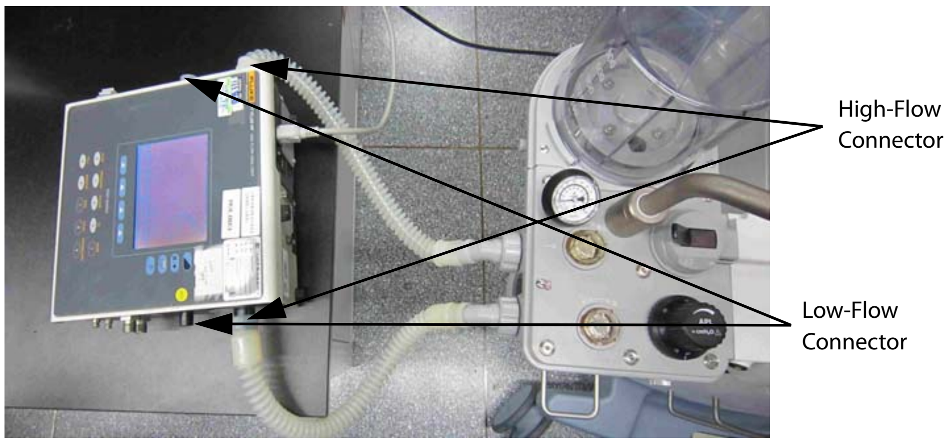


FIGURE 3-19 Pneumatic Connections Between Anesthesia Machine and Calibration Device

5. Setting up the flow meter:

Calibration Device (Fluke VT Plus)

a. Setup the calibration device as described below:
b. Flow Setting: Press the Flow button on the front control panel of the calibration. You can set Range to High Flow or Low Flow as required.

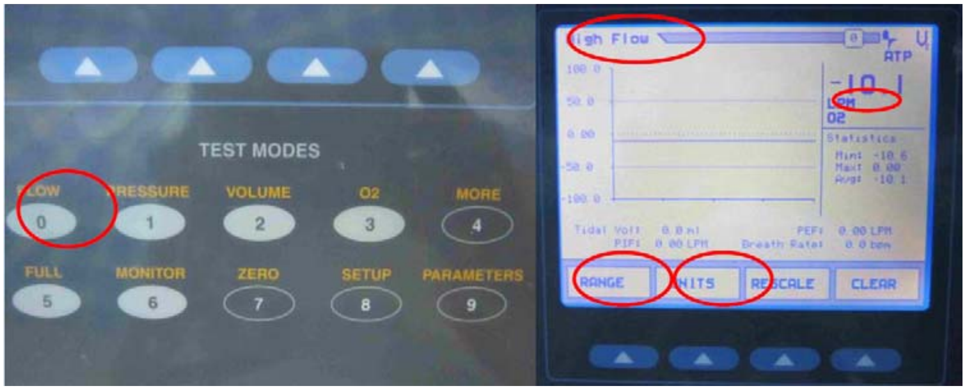


FIGURE 3-20 Calibration Front Control Panel - Flow Setting

c. Gas Settings: Press the Setup button, select Setting->ENTER->Gas Settings->MODIFY->Gas Type->O2.

d. Correction mode: Press the Setup button, select Setting->ENTER->Correction Mode->MODIFY->Correction Mode->BTPS.

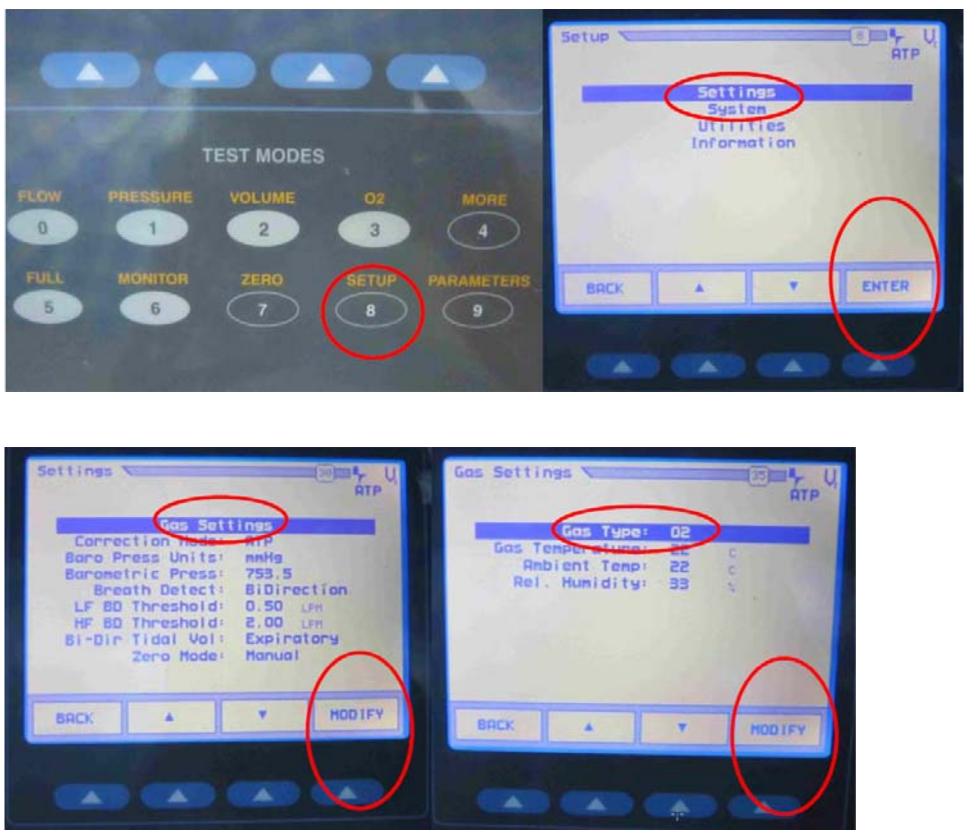


FIGURE 3-21 Calibration Front Control Panel - Gas Settings

e. Select BACK->BACK-> BACK.

FIGURE 3-22 Calibration Front Control Panel - High Flow

Calibration Device (TSI Certifier 4070, Cannot be Used for DSP Units)

a. Setup the calibration device as described below.

b. Flow Setting: Press the to line select key until the top display reads LPM or SLPM. If the display reads SLPM, press the DISPLAY UNITS key until the top display reads LPM.

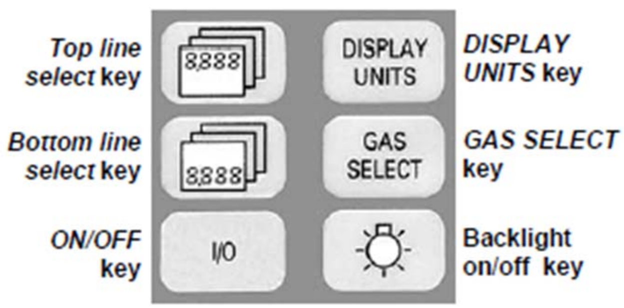


FIGURE 3-23 TSI Certifier 4070 Menu

c. Gas Settings: Press the GAS SELECT key until the bottom left corner reads O2.

Calibration Device (CERTIFIER FA PLUS)

a. Touch on the following active areas of the Parameter Screen.

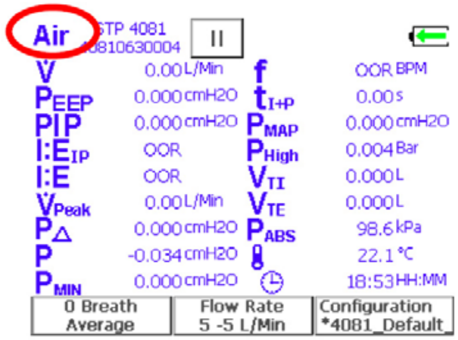


FIGURE 3-24

b. The following window will pop up.

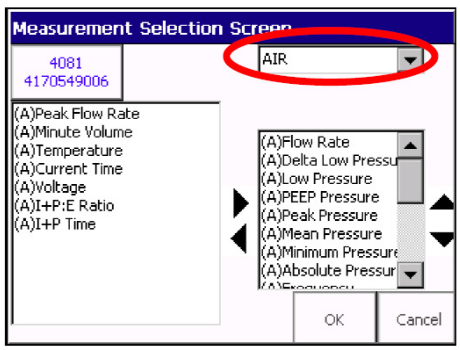


FIGURE 3-25

c. Select O2.

d. Select OK.

e. Touch on the following active areas of the Parameter Screen.

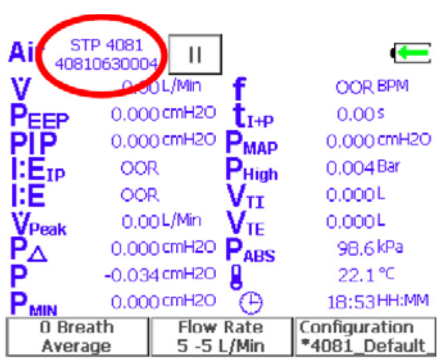


FIGURE 3-26

f. The following window will pop up.

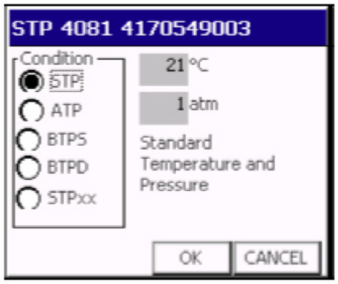


FIGURE 3-27

g. Select BTPS.

h. Select OK.

6. When the system is in Standby, select the Setup-> Service-> Diagnostic Tests->Valves to access the following menu.

FIGURE 3-28 Diagnostic Tests > Valves Menu

7. Set safety valve to [ON].

8. Set the PEEP valve pressure to 30 cmH2O.

9. Set the Insp Valve Flow to the following values:
3L/min, 10L/min, 20L/min, 30L/min, 60L/min.

Make sure that the deviation between the measured data of the Flow Sensor, Insp Flow Sensor and Exp Flow Sensor does not exceed 1 L/min or 5% of the measured value of the calibration device, whichever is greater. Otherwise, refer to "If measurement deviations are not corrected after multiple flow sensor calibrations, the user is recommended to replace the flow sensor and then perform calibration. If the problem persists, factory maintenance is necessary." on page 4-18 to perform flow calibration again. When testing the flow accuracy of (60±3)L/min, only compare the accuracy of the Insp Flow Sensor and Exp Flow Sensor. It is no need to compare the int-Flow Sensor.

10. When finished, reinstall the bellows and the water trap.

3.8.7 Check the Pressure Sensor Accuracy

NOTE: Generally, measurement deviations do not easily occur to pressure sensors. However, in case of replacing the Ventilator Control Board, Solenoid Valve Assembly, or Drive Gas Assembly, you need to perform pressure calibration and check the flow sensors accuracy so as to confirm the effectiveness of calibration.

NOTE: You can use any pressure meter that has an accuracy of at least ±2% for the accuracy measurement of the pressure sensors.

To check the measurement accuracy of pressure sensors:

1. Perform pneumatic connections as follows:
   The following pictures show the four-way device:

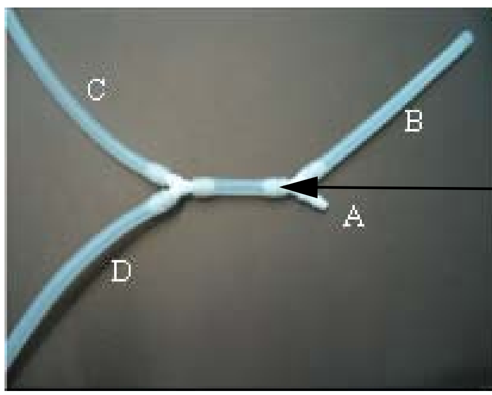


FIGURE 3-29 Pneumatic Connections for Four-Way Device

1. Remove the top cover (3 captive screws).
2. Remove the two tubes marked as #72 and #9 from the pressure sensors (refer to figure below).
3. Connect the four way tube to the pressure sensor P1 of monitor board, pressure sensor P2 of PEEP, the tube marked as #72, and the low pressure port of Fluke VT-Plus. The tube marked as #9 will remain unconnected for this calibration.

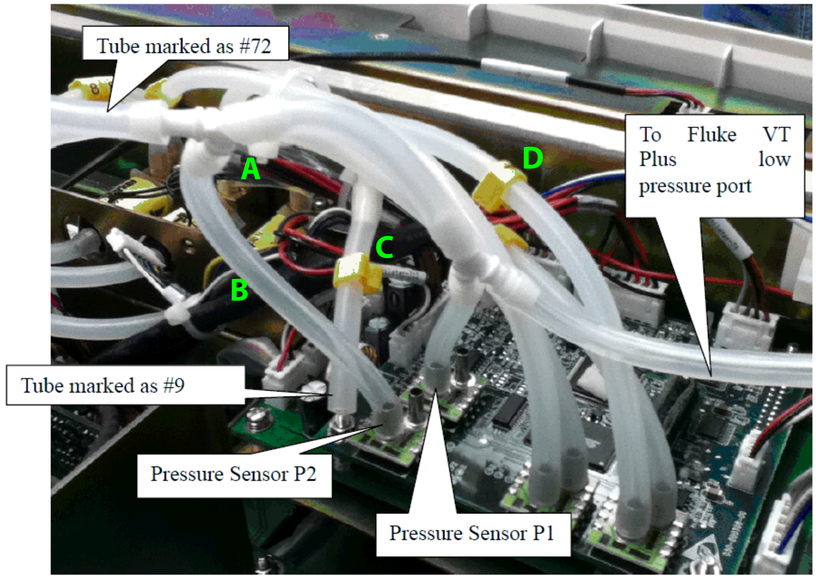


FIGURE 3-30 Pneumatic Connections to Monitor Board

FIGURE 3-31 Calibration Device (VT Plus)

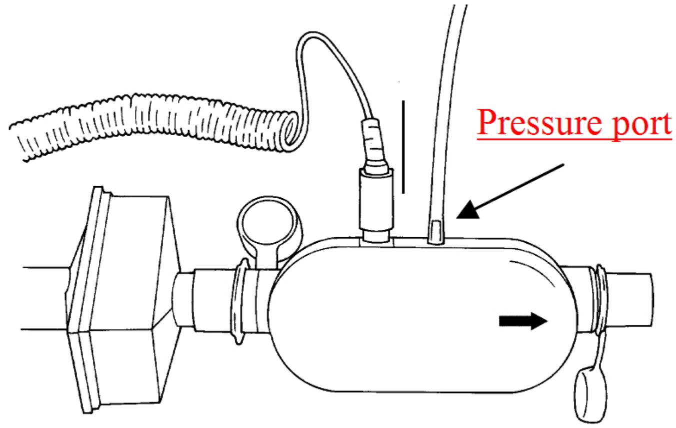


FIGURE 3-32 TSI Certifier 4070

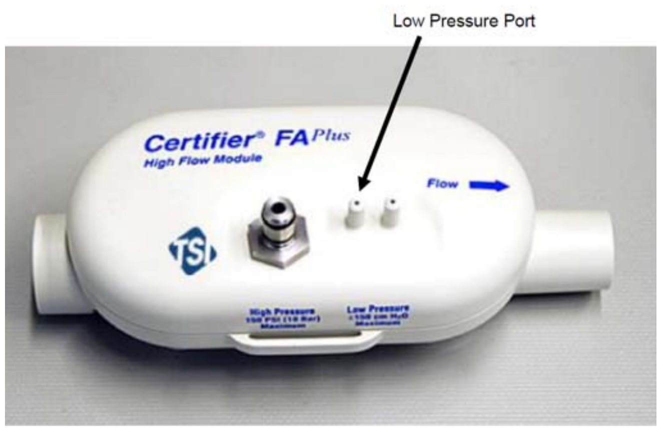


FIGURE 3-33 CERTIFIER FA PLUS

2. Set up the calibration device as described below.

To set the Fluke VT-Plus:

a. Pressure Setting: Press the PRESSURE button on the front control panel of the calibration, select Range and then set it to Low Press.

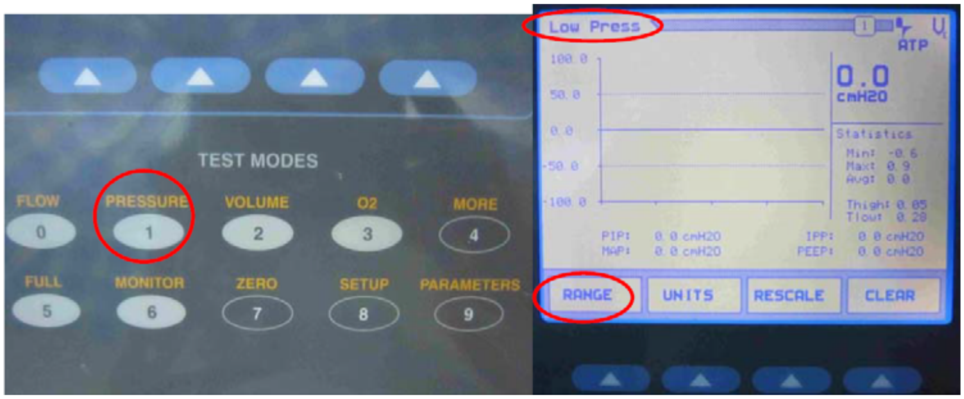


FIGURE 3-34 Calibration Front Control Panel - Pressure Button

b. Gas Settings: Press the Setup button, select Setting->ENTER->Gas Settings->MODIFY->Gas Type->O2.

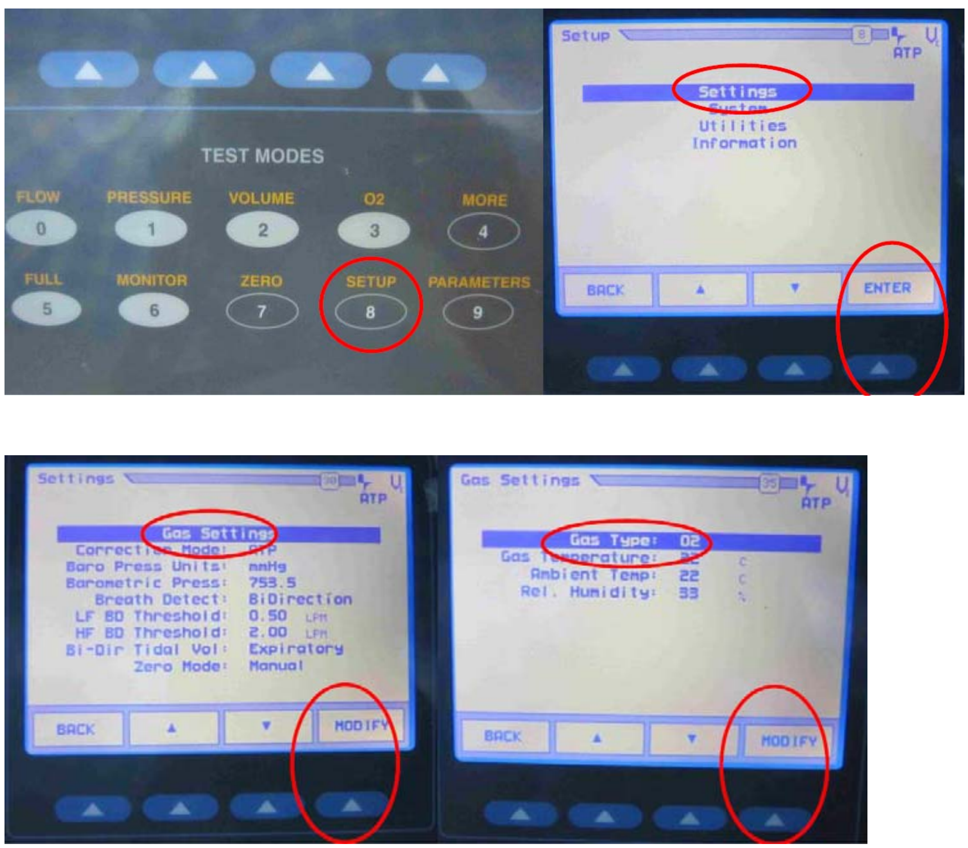


FIGURE 3-35 Calibration Front Control Panel - Gas Settings

c. Select BACK->BACK-> BACK.

FIGURE 3-36 Calibration Front Control Panel - Gas Settings

3. When the system is Standby, select the Setup->Service-> Diagnostic Tests-> Valves to access the following menu.

FIGURE 3-37 Calibration Front Control Panel - Gas Settings

4. Set safety valve to ON.
5. Set the PEEP valve pressure to the following values:
   5 cmH2O, 20 cmH2O, 50 cmH2O, 70 cmH2O, 90 cmH2O.
6. Make sure that the deviation between the measured data of the PAW Sensor, PEEP pressure sensor and that of the anesthesia machine calibration device must not exceed 1 cmH2O or 2% of the measured value of the calibration device, whichever is greater. Otherwise, refer to Section 4.3.4 Pressure Calibration (Service) to perform pressure calibration again.
7. Reconnect hoses #9 and #72.

3.8.8 Check the electronic flowmeter accuracy

NOTE: Set the Gas Flow Analyzer Correction Mode to Standard settings (21 °C, 101.3 kPa)

To check the measurement accuracy of electronic flowmeter:

1. Remove the breathing circuit module and expose the fresh gas supply connector.
2. Connect the Circuit adapter test fixture.
3. Connect the fresh gas supply connector to the low-flow gas inlet of calibration device using the Breathing tube adapter connector and a 6mm tube.
4. Connect the gas outlet of calibration device to the scavenger.
5. Connect pipeline gas supplies (O2, N2O and Air) for the anesthesia machine, and set the anesthesia macnine to Standby mode.

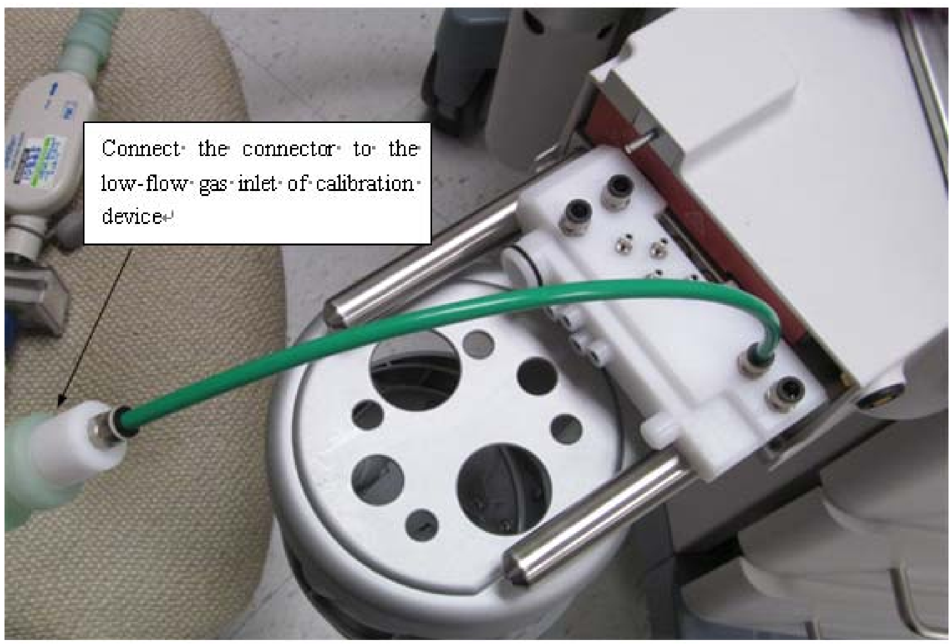


FIGURE 3-38

6. Setup the calibration device as described below:

Calibration Device (Fluke VT Plus):

a. Flow Settings: Press the Flow button on the front control panel of the calibration. You need set Range to Low Flow (when Gas Type is N2O bal O2, you need set Range to High Flow).

FIGURE 3-39 Flow Settings

b. Gas Settings: Press the Setup button, select Setting->ENTER->Gas Settings->MODIFY->Gas Type->O2 or Air or N2O bal O2.

c. Correction mode: Press the Setup button, select Setting->ENTER->Correction Mode->MODIFY->Correction Mode->STPD21.

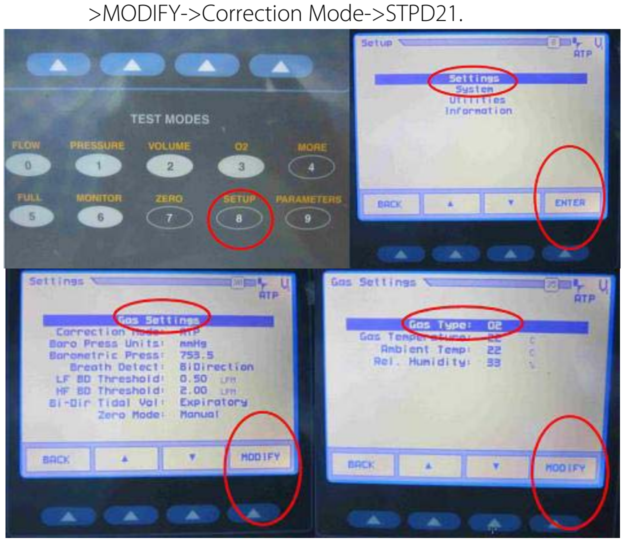


FIGURE 3-40 Gas Settings

d. Select BACK->BACK-> BACK.

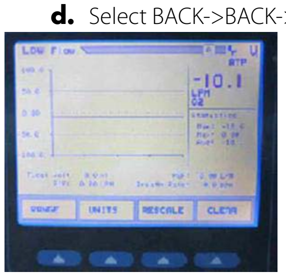


FIGURE 3-41 Settings

Calibration Device (TSI Certifier 4070, Cannot be Used for DSP Units):

- **a.** Setup the calibration device as described below.
- **b.** Flow Setting: Press the to line select key until the top display reads LPM or SLPM. If the display reads LPM, press the DISPLAY UNITS key until the top display reads SLPM.

Calibration Device (CERTIFIER FA PLUS)

- **a.** Touch on the following active areas of the Parameter Screen.

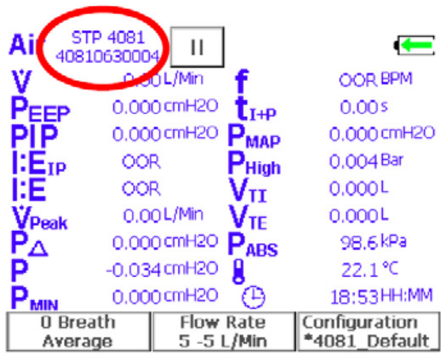


FIGURE 3-42

- **b.** The following window will pop up.

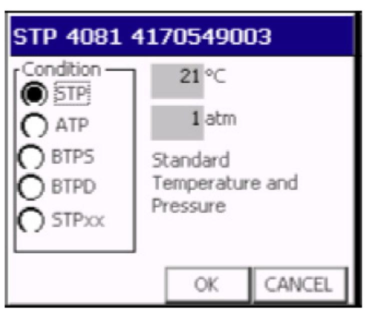


FIGURE 3-43

- **c.** Select STP.
- **d.** Select OK.

7. O2 flowmeter test. Adjust the O2 flowmeter to 0.5L/min, 1L/min, 3 L/min, 6L/min, 10L/min and 15L/min in turn. Make sure that the measured flow is within 10% of the set value or 0.12 L/min, whichever is greater.

8. N2O flowmeter test. Adjust the O2 flowmeter and N2O flowmeter each to 0.5L/min, 1L/min, 3L/min, 6L/min and 10L/min in turn. Make sure that the measured flow is within 10% of the set value or 0.12 L/min, whichever is greater.

9. AIR flowmeter test. Adjust the AIR flowmeter to 0.5L/min, 1L/min, 3 L/min, 6L/min, 10L/min and 15L/min in turn. Make sure that the measured flow is within 10% of the set value or 0.12 L/min, whichever is greater.

10. Re-install the breathing circuit module.

3.9 Pneumatic Leak Tests

Turn all fresh gas flows to 0 L/min.

3.9.1 N2O Cylinder Leak Test (A5 and A3 only)

1. Remove the N2O line pressure hose from the line pressure inlet on the anesthesia system.
2. Mount a full N2O cylinder to the rear panel yoke. If necessary, place a new clean tank washer between the cylinder and the yoke to minimize any leaks at the yoke connection.
3. Open the N2O cylinder until its pressure gauge indicates cylinder pressure.
4. Close the N2O cylinder.
5. The N2O cylinder pressure gauge should not drop more than 10% of its initial pressure over 1 minute.

3.9.2 O2 Cylinder Leak Test

1. Remove the O2 line pressure hose from the line pressure inlet on the anesthesia system.
2. Mount a full O2 cylinder to the rear panel yoke. If necessary, place a new clean tank washer between the cylinder and the yoke to minimize any leaks at the yoke connection.
3. Open the O2 cylinder until its pressure gauge indicates cylinder pressure.
4. Close the O2 cylinder.
5. The O2 cylinder pressure gauge should not drop more than 10% of its initial pressure over 1 minute.

3.9.3 AIR Cylinder Leak Test

1. Remove the AIR line pressure hose from the line pressure inlet on the anesthesia system.
2. Mount a full AIR cylinder to the rear panel yoke. If necessary, place a new clean tank washer between the cylinder and the yoke to minimize any leaks at the yoke connection.
3. Open the AIR cylinder until its pressure gauge indicates cylinder pressure.
4. Close the AIR cylinder.
5. The AIR cylinder pressure gauge should not drop more than 10% of its initial pressure over 1 minute.

3.9.4 Line Pressure Leak Tests

1. Remove the O2, AIR and N2O cylinder from the anesthesia system.
2. Connect the O2, AIR and N2O line pressure hoses to the line pressure inlet on the anesthesia system.
3. Turn the unit on.
4. Disconnect hose #26 from the back pressure valve.
5. Plug the output of the back pressure valve.
6. Open the O2, AIR and N2O needle valve fully.
7. Pinch the O2 and N2O line pressure hoses.
8. Remove the O2 and N2O line pressure hoses from the line source while keeping the hoses pinched. The pressure measured on the line pressure gauge on the front of the unit should not fall more than 10 psi per 100 seconds (2 psi per 20 sec).
9. Release the O2 and N2O line pressure hoses.
10. Pinch the AIR line pressure hose.
11. Remove the AIR line pressure hoses from the line source while keeping the hose pinched.
12. The pressure measured on the line pressure gauge on the front of the unit should not fall more than 10 psi per 100 seconds (2 psi per 20 sec).
13. Remove the plug from the back pressure valve and reconnect hose #26.
14. Close the O2, AIR and N2O needle valves.
15. Reconnect the O2, AIR and N2O line pressure hoses and remove the pinch in the hose.

3.9.5 Line Pressure Gauges Accuracy Test

1. Open the rear panel and disconnect the pipe supply for all 3 gases (O2, AIR and N2O).

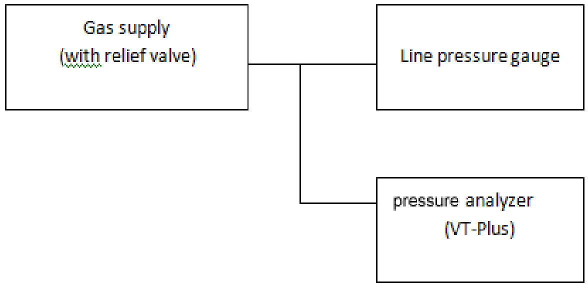


FIGURE 3-44

2. Disconnect hose # 47 from the regulator assembly and connect it to your high pressure meter.
3. Reconnect the O2 Pipeline supply.
4. Verify the reading on your pressure meter and the reading on the O2 pipeline pressure gauge are within 5 psi of each other.
5. Disconnect the O2 Pipeline supply and reconnect hose # 47 to the regulator assembly.
6. Disconnect hose # 37 from the regulator assembly and connect it to your high pressure meter.
7. Reconnect the AIR Pipeline supply.
8. Verify the reading on your pressure meter and the reading on the AIR pipeline pressure gauge are within 5 psi of each other.
9. Disconnect the AIR Pipeline supply and reconnect hose # 37 to the regulator assembly.
10. Disconnect hose # 35 from the regulator assembly and connect it to your high pressure meter.
11. Reconnect the N2O Pipeline supply.
12. Verify the reading on your pressure meter and the reading on the N2O pipeline pressure gauge are within 5 psi of each other.
13. Disconnect the N2O Pipeline supply and reconnect hose # 35 to the regulator assembly.
14. Reconnect the pipe supply for all 3 gases (O2, AIR and N2O).

3.10 Breathing System Checks

3.10.1 Waste Gas Scavenger Test (if available)

1. Connect one end of the low pressure waste gas hose to the port on the Waste Gas Scavenger Assembly. Connect the other end of the hose to the EVAC port.

NOTE: If operating the A5/A4/A3 with other types of waste gas scavenging, ensure that waste gases are directed from the EVAC port to that scavenging system.

2. Connect the respiratory gas monitor exhaust output to the barbed fitting port on the Waste Gas Scavenger Assembly.
3. Ensure that the waste gas scavenger flow adjustment is able to be set between the MIN and MAX line markings.

For Units with a DGSS:

1. Ensure that all waste anesthetic connections are secure, unused inlets are capped, and that the DGSS® power cord is NOT connected.
2. Set the Auto/Manual ventilation switch to Manual.
3. Set fresh gas flow to 0 and fully open the APL.
4. Occlude the patient end of the circuit and observe the circuit pressure gauge. A value of less than -2 cm H_2O indicates a malfunction.
5. While keeping the patient end of the circuit occluded, press the oxygen flush button on the anesthesia machine for approximately 3 seconds while observing the circuit pressure gauge.
6. Circuit pressures should not exceed 15cm H_2O during this test.
7. Apply power to the DGSS® and repeat steps 2 through 6.
8. Frequent clicking sounds from the DGSS® may be heard during normal operation as the reservoir bag fills and empties.

3.10.2 Internal Gas Connections Test

1. Close and remove all gas cylinders from the A5/A4/A3.
2. Connect only the AIR line pressure hose to the A5/A4/A3 from the wall supply. Leave all other line pressure hoses disconnected.
3. With the A5/A4/A3 powered ON, rotate the AIR flow control knob to ensure a continuous flow increase throughout its full range
4. Fully rotate the N2O flow control knob and verify that there is no flow.
5. Fully rotate the O2 flow control knob and verify that there is no flow.
6. Disconnect the AIR line pressure hose from the A5/A4/A3, and connect the O2 line pressure hose from the wall supply, rotate the O2 flow control knob to ensure a continuous flow increase throughout its full range (0 to 15 L/min).
7. Fully rotate the N2O flow control knob and verify that there is no flow.
8. Fully rotate the AIR flow control knob and verify that there is no flow.
9. Connect the N2O line pressure hose from the wall supply. With the O2 flow control knob fully opened, rotate the N2O flow control knob to ensure a continuous flow increase throughout its full range.

NOTE: Make sure that the flow of N2O is at least 10 L/min.

10. Fully rotate the AIR flow control knob and verify that there is no flow.
11. Close all 3 flow control knobs and reconnect the AIR line pressure hose.

3.10.3 Drive Gas Pressure Loss Alarm, N2O Cutoff Test

1. Set the O2 flow to 2 L/min using the flow control valve.
2. Set the N2O flow to 2 L/min using the flow control valve.
3. Set the AIR flow to 2 L/min using the flow control valve.
4. Interrupt the O2 supply to the A5/A4/A3.
5. Verify that the flow of N2O and O2 stops within 2 minutes and that the flow of AIR (if available) continues to flow at 2 L/min.
6. Verify the following alarms are activated:
   • O2 Supply Failure appears on the screen
   • An alarm tone sounds
7. Reconnect the O2 supply to the anesthesia system.
8. Close all 3 flow control knobs.

3.11 Performance Verification

NOTE: Set the Gas Flow Analyzer Correction Mode to BTPS (Body Temperature and Pressure, Saturated). For EPSON systems the mode can be set to ambient temperature and pressure or BTPS.

3.11.1 Manual Ventilation Test

1. Ensure that the gas pressure for O2, N2O, and AIR is within specifications.
2. Attach a breathing circuit and test lung to the Y-fitting of the breathing circuit.

NOTE: For testing purposes always use a reusable breathing circuit.

3. Power OFF the anesthesia system.
4. Set the mechanical Auto/Manual switch to MANUAL.
5. Set the APL Valve to approximately 30 cmH2O.
6. Set the AIR flow to approximately 5 L/min using the flow control valve. Use O2 if AIR is not available.This will require turning the main switch to the ON position.
7. Squeeze the breathing bag once every 10 seconds to inflate and deflate the test lung to approximately 20 cmH2O of pressure.
8. Verify the inflation and deflation of the test lung.

3.11.2 Manual Mode Ventilation Test

1. Power ON the anesthesia system.
2. Attach a breathing circuit.

NOTE: For testing purposes always use a reusable breathing circuit.

3. Attach a test lung to the Y-fitting of the breathing circuit.
4. Perform the start up tests per the on-screen instructions. Ensure successful completion.
5. Set the mechanical Auto/Manual switch to MANUAL. Press the screen for the screen to change to manual Mode.
6. Set the APL Valve to approximately 25 cmH2O. Push the O2 Flush button to fill the breathing bag.
7. Set the AIR flow to 1 L/min using the flow control valve. This will change the screen to manual Mode
8. Squeeze the breathing bag once every 3 seconds.
9. Verify the inflation and deflation of the test lung.
10. Verify that an airway pressure waveform and all numeric values appear on screen during bag compressions.
11. Stop squeezing the breathing bag and set the APL Valve to the open position (SP).

3.11.3 APNEA Alarm Test

1. While in the Manual Ventilation Mode, stop ventilating the test lung.
2. Verify that the following APNEA alarm signals activate at approximately 30 seconds from the last bag compression.
   - APNEA appears on the screen.
   - An alarm tone sounds.

3.11.4 Alarm Silence Test

1. While the APNEA alarm is sounding, press the Silence soft key.
2. Verify the audio portion of the alarm stops and resumes after 2 minutes or when an additional alarm message appears.

3.11.5 VCV Adult Ventilation Mode Test

1. Set the O2 flow to 2 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the mechanical Auto/Manual switch to AUTO.
3. Connect a Vent Tester to the breathing system. Unidirectional Vent Testers need to be connected to the expiratory limb
4. Set the ventilator controls to the following:

Ventilator Controls	Ventilator Settings
Ventilation Mode	VCV
Vt	600
Rate	8
I:E	1:2
Tpause	10
PEEP	Off
Plimit	50

5. If necessary, press Set Mode button to begin ventilation.
6. Verify that the pressure waveform, Tidal Volume, Mean or Plateau Pressure, Resp. rate and minute volume values appear on the screen.
7. Verify the Tidal Volume display on the Vent Tester is within 7% (±42 mL) of the set value within approximately 1 minute from the start of ventilation.
8. Verify the Tidal Volume display is within 9% (±54 mL) of the set value within approximately 1 minute from the start of ventilation.
9. Verify the measured O2 concentration is at least 97% after 5 minutes.
10. Set the AIR flow to 3 L/min and set the N2O and O2 flow rates to minimum flow.
11. Verify the measured O2 concentration is 21% ±3% vol. % after 5 minutes.

3.11.6 VCV Child Ventilation Mode Test

1. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	VCV
Vt	120
Rate	15
I:E	1:2
Tpause	10
PEEP	Off
Plimit	40

2. Press Set Mode button to begin ventilation.
3. Verify that the pressure waveform, Tidal Volume, Mean or Plateau Pressure, Resp. rate and minute volume values appear on the screen.
4. Verify the Tidal Volume display is within 18ml of the set value within approximately 1 minute from the start of ventilation.
5. Verify the delivered volume, as measured by a Vent Tester at the expiratory port, is within 15ml of the set value within approximately 1 minute from the start of ventilation.

3.11.7 Airway Disconnect Alarm Test

1. While the ventilator is running, disconnect the expiratory limb from the Expiratory Port on the Breathing System.
2. Verify the following airway pressure disconnect alarm signals activate:
   • Paw Too Low message appears on the screen.
   • An alarm tone sounds.

3.11.8 PCV Adult Ventilation Mode Test

1. Set the O2 flow to 3 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	PCV
VtG (A5 only, EPSON platform)	Off
Pinsp	15
Rate	8
I:E	1:2
PEEP	Off
Tslope	0.2
PlimVG	NA

3. Press Set Mode button to begin ventilation.
4. Verify the Peak Pressure reading of the display is within ±2 cmH2O of the Peak Pressure measured with the Vent Tester.
5. Verify that the pressure waveform, Tidal Volume, Resp. Rate and minute volume values appear on the screen.
6. Verify that the PEAK Value reaches 15 ±2.5 cmH2O within five breaths from the start of ventilation.

3.11.9 Pressure Support (PS) Ventilation Mode Test

1. Set the O2 flow to 1 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	PS
Min Rate	4
ΔP	20
Trigger	3
PEEP	Off
Tslope	0.2
ΔP apnea	15.0 (DSP only)
Apnea Ti	5.0

3. Press Set Mode button to begin ventilation.
4. Begin triggering breaths by slightly squeezing the test lung and releasing. Maintain a continuous breath rate.
5. Verify that a pressure waveform and all ventilation parameters appear on the screen.
6. Verify that the Peak Pressure reading on the display is ±2 the value of ΔP + PEEP.
7. Stop triggering breaths.
8. Verify that after 15 seconds the ventilator delivers a breath and displays the message Apnea Ventilation.
9. Verify the system ventilates with a frequency of 4 bpm.

3.12 Alarms and Fail safe Functions

3.12.1 Set Up

1. Set the O2 flow to 2 L/min and set the N2O and AIR flow rates to minimum flow.
2. Set the ventilator controls to:

Ventilator Controls	Ventilator Settings
Ventilation Mode	VCV
Vt	600
Rate	8
I:E	1:2
Tpause	10
PEEP	Off
Plimit	50

3. Press Set Mode button to begin ventilation.

3.12.2 Low FiO2 Alarm Test

NOTE: For A5s with an installed gas module, disconnect the sample tube from the Y-piece and breath into it until you see a CO2 reading on the screen. Then reconnect the sample tube to the Y-piece. This will activate the gas module alarms.

1. Set the Low FiO2 Alarm limit to 50%.
2. Set the AIR flow control valve to 5 L/min.
3. Set the O2 flow control to minimum flow.
4. Verify the following Low FiO2 alarm signals activate, within three ventilation cycles:
   • FiO2 Too Low message appears on the screen.
   • An alarm tone sounds.
5. Set the Low FiO2 alarm limit to 18%.
6. Verify the FiO2 Too Low message disappears.

3.12.3 High FiO2 Alarm Test

1. Set the high FiO2 Alarm limit to 50%.
2. Set the O2 flow control valve to 5 L/min.
3. Set the AIR flow controller to minimum.
4. Verify the following High FiO2 alarm signals activate:
   - FiO2 Too High message appears on the screen.
   - An alarm tone sounds.
5. Set the high FiO2 alarm limit to the max setting.
6. Verify the FiO2 Too High message disappears.

3.12.4 Peak Pressure Alarms Test

1. Set the PEAK low alarm to the lowest setting.
2. Set the PEAK high alarm limit set point about 5 to 8 digits below the Peak Pressure displayed on the screen.
3. Verify the following (high) peak pressure alarms activate:
    a. Paw Too High message appears on the screen.
    b. An alarm tone sounds.
    c. Inspiration ends and expiration begins as the pressure meets the high alarm limit.
4. Set the PAW high alarm limit set point to 65 (cmH2O).
5. Verify the Paw Too High message disappears
6. Set the PAW low alarm limit set point to 50 (cmH2O).
7. Verify the following (low) peak pressure alarms activate:
    a. Paw Too Low message appears on the screen.
    b. An alarm tone sounds.
8. Set the PAW low alarm limit to 12 (cmH2O).
9. Verify the Paw Too Low message disappears.

3.12.5 Minute Volume Alarm Test

1. Set the MV Low alarm limit set point to the highest value.
2. Verify the following alarms activate:
   • MV Too Low message appears on the screen.
   • An alarm tone sounds.
3. Set the MV Low alarm limit to minimum setting.
4. Verify that the MV Too Low message disappears.
5. Set the MV High alarm limit set point to the lowest value.
6. Verify the following alarms activate:
   • MV Too High message appears on the screen.
   • An alarm tone sounds.
7. Set the MV High alarm limit set point to the highest value
8. Verify that the MV Too High message disappears
9. Set the mechanical Auto/Manual switch to MANUAL.
10. Set all fresh gas flows to 0.
11. Press "discharge" to enter the standby mode.

3.13 Miscellaneous Tests

3.13.1 Test the Line Voltage Alarm

1. Interrupt AC line voltage.
2. Verify that the following alarms activate:
    - An alarm tone sounds.
    - Battery in use message appears on the screen.
3. Plug the anesthesia system into AC line voltage.
4. Verify that the alarm signals cease.
5. Verify the presence of the battery charging icon in the upper right corner of the screen.

3.13.2 Top Light and Auxiliary Light Test

1. Turn on the Top light located on the bottom side of the top panel.
2. Verify that it lights in both on positions.

3.13.3 Touchpad /USB Mouse Test

For A5 units: Verify that the touchpad is functional.

For A3/A4 units: Verify that the USB mouse can be used to operate the unit.

3.14 Vaporizer Interlock Test

3.14.1 For 2 vaporizer Mount

1. Attach two vaporizers to the Vaporizer Mounting Manifold and lock them in place.
2. Rotate either of the vaporizer dial to 3% agent.
3. Verify that the other vaporizer dial cannot be rotated to a setting.
4. Set both vaporizer dials to 0.
5. Rotate the other vaporizer dial to 3%.
6. Verify that the first vaporizer dial cannot be rotated.
7. Rotate both vaporizer dials to T and remove both vaporizers.
8. Verify that the locking spring is intact.
9. Reconnect both vaporizers to the Vaporizer Mounting Manifold.

3.14.2 For 3 vaporizer Mount

1. Attach three vaporizers to the Vaporizer Mounting Manifold and lock them in place.
2. Rotate left vaporizer dial to 3% agent.
3. Verify that the other two vaporizers dial cannot be rotated to a setting.
4. Set all vaporizer dials to 0.
5. Rotate the middle vaporizer dial to 3% agent.
6. Verify that the other two vaporizers dial cannot be rotated to a setting.
7. Set all vaporizer dials to 0.
8. Rotate the right vaporizer dial to 3% agent.
9. Verify that the other two vaporizers dial cannot be rotated to a setting.
10. Rotate the right vaporizer dial to 0.
11. Rotate the center vaporizer dial to T.
12. Remove the center vaporizer leaving 2 vaporizers on the outer positions with the center position being empty.
13. Rotate either of the vaporizer dial to 3% agent.
14. Verify that the other vaporizer dial cannot be rotated to a setting.
15. Set both vaporizer dials to 0.
16. Rotate both vaporizer dials to T and remove all vaporizers.
17. Verify that the locking spring is intact.
18. Reconnect all vaporizers to the Vaporizer Mounting Manifold.

3.15 Vaporizer Accuracy Test

1. Set the APL Valve to 70 cmH2O.
2. Put the AUTO / MANUAL lever in the MANUAL position.
3. Connect one end of a breathing hose to the expiratory port and the other end to the bag arm.
4. Connect the sampling tee of the Gas analyzer to the inspiratory port
5. Use a breathing hose to connect the output of the sampling tee to the scavenger.

FIGURE 3-45 Breathing Hose Connection from Sampling Tee to Scavenger

6. Verify the scavenger is connected at the wall and the floater is between MIN and MAX.
7. Mount the vaporizers and fill with anesthetic agent (if necessary).

NOTE: **Do not overfill by filling past the indicator line on the vaporizer.**

8. Turn on the unit.
9. Test the vaporizer accuracy per the manufacturer's instructions.
10. Test each vaporizer in turn.
11. Test any vaporizer on the Vaporizer Storage Mount.
12. Remove the measuring equipment.
13. Reconnect the Waste Gas Scavenger Hose.

NOTE: **The deviation of the vaporizers due to change of barometric pressure (high altitude) and the deviation of the Riken F-211 gas analyzer are the same. When testing the Vaporizers using the Riken F-211 gas analyzer, the altitude can be ignored as the deviations cancel each other out. If using a different gas analyzer, check the effect of change of barometric pressure prior to use when working in high elevations.**

3.16 Electrical Tests

NOTE: Perform electrical safety inspection after servicing or routine maintenance. Before the electrical safety inspection, make sure all the covers, panels, and screws are correctly installed.

NOTE: The electrical safety inspection should be performed once a year.

3.16.1 Auxiliary Electrical Outlet Test

Verify the mains voltage is present at each auxiliary outlet when the anesthesia machine is connected with power.

3.16.2 Electrical Safety Inspection Test

1. Perform protective earth resistance test:
   a. Plug the probes of the analyzer into the protective earth terminal and equipotential terminal of the AC power cord.
   b. Test the earth resistance with a current of 25 A.
   c. Verify the resistance is less than 0.1ohms (100 mohms).
   d. Plug the probes of the analyzer into the protective earth terminal of the AC power cord and the protective earth terminal of any auxiliary outlet. Repeat steps b and c.
   e. If the resistance is larger than 0.1ohms (100 mohms) but less than 0.2ohms (200 mohms), disconnect the AC power cord and plug the probe that is previously plugged in the protective earth terminal of the AC power cord into the protective earth contact of the power outlet. Repeat steps a to d.
2. Perform the following earth leakage current tests:
   - normal polarity;
   - reverse polarity;
   - normal polarity with open neutral; and
   - reverse polarity with open neutral.
3. Verify the maximum leakage current does not exceed 300 µA (0.3 mA) in the first two tests. While for the last two tests, verify that the maximum leakage current does not exceed 1000 µA (1 mA).

NOTE: Make sure the safety analyzer is authorized by certificate organizations (UL, CSA, or AAMI etc.). Follow the instructions of the analyzer manufacturer.

3.16.3 Electrical Safety Inspection Form

Location:				Technician:	
Equipment:				Control Number:	
Manufacturer:		Model:		SN:	
Measurement equipment /SN:				Date of Calibration:	
INSPECTION AND TESTING				Pass/Fail	Limit
1	Auxiliary mains socket outlets				
2	Protective Earth Resistance		Ω		Max 0.1 Ω
3	Earth Leakage	Normal condition(NC)	_____μA		Max: NC: 500μA SFC: 1000μA
		Single Fault condition(SFC)	_____μA		

TABLE 3-1

For periodically performance, all the test items included in the ELECTRICAL SAFETY INSPECTION FORM shall be performed. The following table specifies test items to be performed after the equipment is repaired with main unit disassembled.

When neither power supply PCBA, transformer nor patient electrically-connected PCBA is repaired or replaced	Test items: 1, 2
When power supply PCBA or transformer is repaired or replaced	Test items: 1, 2, 3

TABLE 3-2

4.0 Calibration

4.1 Introduction

This section provides detailed information required to properly test and calibrate the A5/A4/A3 anesthesia system. Calibration consists of making mechanical and electrical adjustments with the proper test equipment. The instrument should be tested and calibrated after repairs have been completed or at regular intervals as part of a periodic maintenance procedure.

NOTE: **Both calibration and a functional test must be performed to verify complete and proper operation.**

Ensure that all testing materials, including drive gas, breathing circuits, test fixtures, tools and documents are available and current, calibrated and in good working order prior to beginning.

4.2 Calibration Warnings, Precautions, and Notes

4.2.1 Warnings

WARNING: For continued protection against fire hazard, replace all fuses with the specified type and rating.

WARNING: In order to prevent an electric shock, the machine (protection class I) may only be connected to a correctly grounded mains connection (socket outlet with grounding contact).

WARNING: Remove all accessory equipment from the shelf before moving the anesthesia machine over bumps or on any inclined surface. Heavy top loading can cause the machine to tip over causing injury.

WARNING: Possible explosion hazard. Do not operate machine near flammable anesthetic agents or other flammable substances. Do not use flammable anesthetic agents (i.e., ether or cyclopropane.)

WARNING: The use of anti-static or electrically conductive respiration tubes, when utilizing high frequency electric surgery equipment, may cause burns and is therefore not recommended in any application of this machine.

WARNING: Possible electric shock hazard. The machine may only be opened by authorized service personnel.

WARNING: Compressed gasses are considered Dangerous Goods/Hazardous Materials per I.A.T.A. and D.O.T. regulations. It is a violation of federal and international law to offer any package or over pack of dangerous goods for transportation without the package being appropriately identified, packed, marked, classified, labeled and documented according to D.O.T. and I.A.T.A. regulations. Please refer to the applicable I.A.T.A. Dangerous Goods Regulations and /or the Code of Federal Regulations 49 (Transportation, Parts 171-180) for further information.

4.2.2 Cautions

CAUTION: Refer to the "Periodical Maintenance Schedule" on page 3-2 for assistance when performing scheduled periodic maintenance.

CAUTION: Do not leave gas cylinder valves open if the pipeline supply is in use and the system master switch is turned to 'ON'. If used simultaneously, cylinder supplies could be depleted, leaving an insufficient reserve supply in the event of pipeline failure.

CAUTION: Use cleaning agent sparingly. Excess fluid could enter the machine, causing damage.

CAUTION: This machine must only be operated by trained, skilled medical staff.

4.2.3 Notes

NOTE: Only bacterial filters with a low flow resistance must be connected to the patient module and/or the patient connection.

NOTE: **Use surgical gloves whenever touching or disassembling valves or other internal components of the Breathing System.**

NOTE: **Ensure that the gas supply of the machine always complies with the technical specification.**

NOTE: **The APL Valve and PAW gauge marker are for reference only. Calibrated patient airway pressure is available on the ventilator screen.**

NOTE: **If the machine should show faults during the initial calibration or testing, the machine should not be operated until the fault has been repaired by a qualified service technician.**

NOTE: **After servicing, functional, sensor and system tests must be carried out before clinical use.**

NOTE: **To accommodate additional monitors and other equipment the anesthesia offers up to two vertical mounting tracks. Use of unauthorized mounting accessories is not recommended.**

NOTE: **Always secure any equipment placed on the top shelf of anesthesia**

4.3 System Calibration

NOTE: The anesthesia machine drive gas and calibration device drive gas type setttings should be consistent with the actual drive gas type configured for the anesthesia machine.

NOTE: Perform the corresponding calibration if any test item of the system test about measurement accuracy is failed.

NOTE: Fluke VT Plus: The zero reading (offset) of the pressure measurements may drift slightly with time and temperature. A zeroing function is provided for the user to zero the offset drift. Typically, this is done when a non-zero reading occurs when there is zero applied pressure. However, it is good practice to zero the respective signal before any measurement is taken.

NOTE: You can select VT Plus to perform automatic calibration of pressure sensors or flow sensors, or any other calibration devices that fulfills the accuracy requirements to perform manual calibration.

The anesthesia machine provides the function of monitoring volume, pressure, FiO2 and etc. When these measured values have great deviations, it is very likely that measurement offset occurs to the relevant measurement parts. In this case, you need to perform calibration again. After equipment service, such as replacing the ventilator control board, expiratory valve assembly or solenoid valve assembly, you need to calibrate the flow sensors or pressure sensors.

The following table lists the possible calibration items and calibration time.

SN	Calibration item	Functional description	Calibration time
1	Flow calibration (user)	Calibrate the flow sensors of the breathing system.	1. The TV measurement deviation is greater (more than 9% compared with the setting value) after the flow sensors in the patient circuit have been used for a long time. 2. The flow sensor in the patient circuit has been replaced.
2	Flow calibration (Service)	Calibrate the flow sensors and inspiratory valve of the anesthesia machine.	1. The expiratory valve assembly is replaced. 2. The ventilator control board is replaced. 3. The deviation between the measured value of the ventilator flow sensor and that of the flow measurement device exceeds more than 5% of the reading or 1 L/min, whichever is greater.
3	Pressure calibration (Service)	Calibrate the pressure sensors and PEEP valve of the anesthesia machine.	1. The ventilator control board is replaced. 2. The expiratory valve assembly is replaced. 3. The deviation between the measured value of the machine's pressure sensor and that of the standard pressure gauge exceeds more than 5% of the reading or 2 cmH2O, whichever is greater.
4	Pressure and flow zeroing (Service)	Calibrate the deviation from zero point of the ventilator control board and auxiliary ventilator control board.	Flow or Paw waveforms deviates from the baseline.

SN	Calibration item	Functional description	Calibration time
5	Electronic flowmeter zeroing (user)	Calibrate the deviation from zero point of the fresh flow sensor board.	The electronic flowmeter has a zero point error. The electronic flowmeter still displays flow when fresh gases are all turned off.
6	O2 sensor calibration (user)	Calibrate the accuracy of O2 sensor at 21% and 100% O2.	1. The measured value of the O2 sensor has a great deviation. The deviation exceeds 3% both in Air and pure O2. 2. The O2 sensor is replaced. 3. The ventilator control board is replaced.

4.3.1 O2 Sensor Calibration

NOTE: **Calibrate the O2 sensor again when a great deviation of O2 concentration monitored value occurs or when the O2 sensor or ventilator control board is replaced.**

NOTE: **Before calibration, observe if the O2 sensor displays numerics on the measure screen. If not, confirm that the O2 measure switch is turned on, check the O2 sensor connection line, or replace the O2 sensor until measure numerics are displayed.**

NOTE: **Perform O2 sensor calibration only for units with galvanic O2 cell.**

4.3.1.1 21% O2 Calibration

Follow these steps to calibrate O2 sensor at 21% O2.

1. Select Setup > General > Calibrate O2 Sensor or Setup > System > Calibration> O2 Sensor or Setup > Service > Calibration > O2 Sensor to access the screen as shown below. The General tab shows only 21% O2 Sensor calibration; the System and Service tabs require passwords and show both 21% and 100% O2 Sensor calibration. Set up the machine as per the instructions on the screen. Select Begin to start calibration.

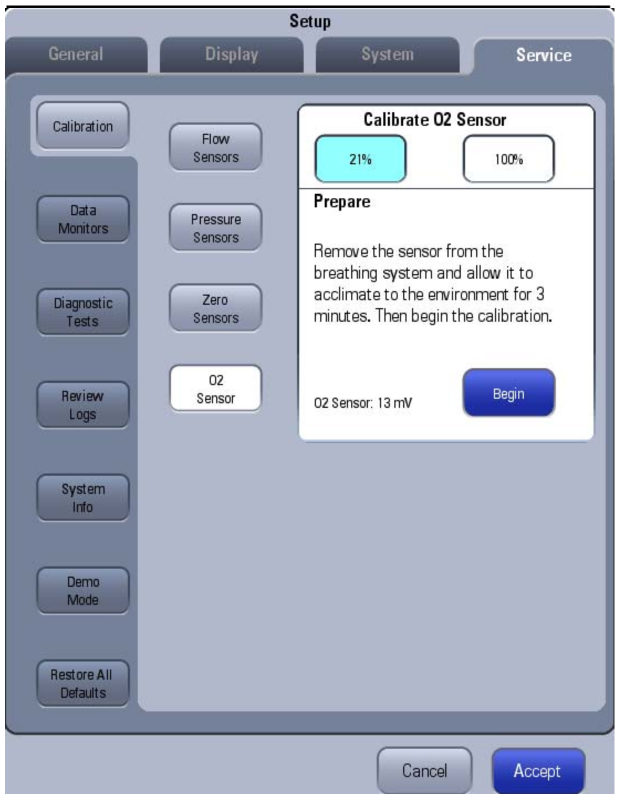


FIGURE 4-1

2. The calibration screen shown below is displayed when Begin is selected. During the calibration, you can select Cancel to cancel the calibration.

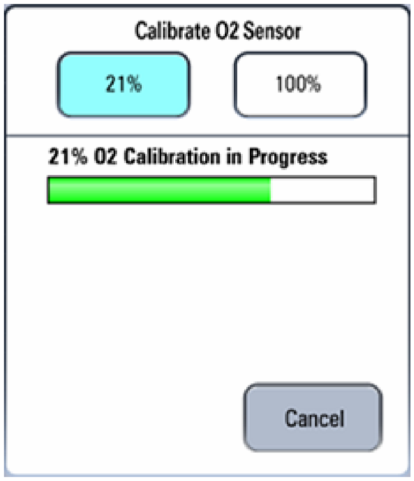


FIGURE 4-2

3. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to do the calibration again.Select Done to exit the calibration screen.

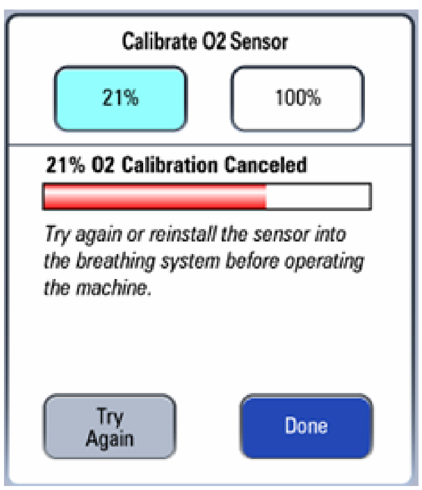
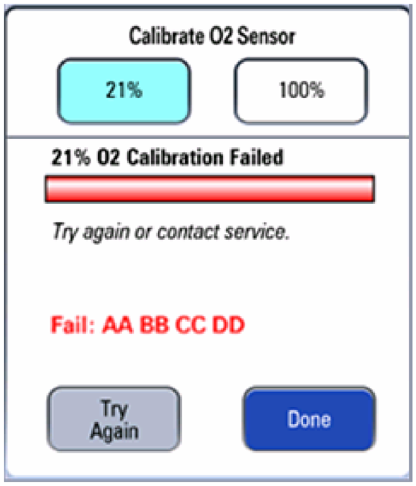


FIGURE 4-3

4. The screen shown below is displayed if the calibration has failed. Select Try Again to do the calibration again.Select Done to exit the calibration screen.



5. The screen shown below is displayed after a successful calibration . Select Done to exit the calibration screen.

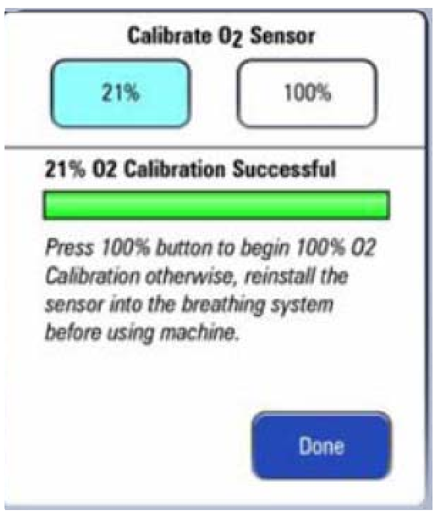


FIGURE 4-4

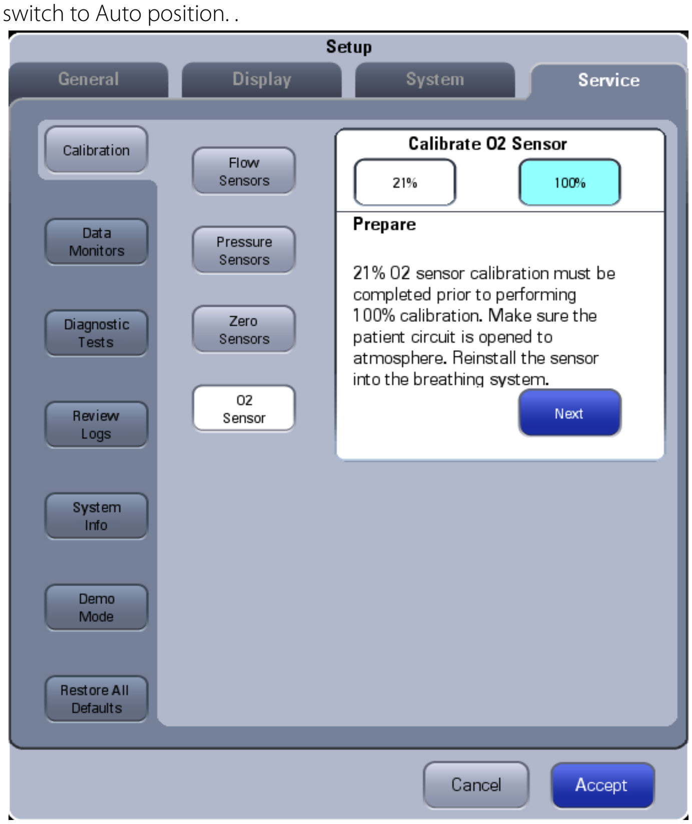
4.3.1.2 100% O2 Calibration

NOTE: 100% O2 calibration must be performed in standby mode.

NOTE: 100% O2 calibration can be performed only after a successful 21% O2 calibration.

Follow these steps to calibrate O2 sensor at 100% O2.

1. Enter Standby.
2. Access the 100% O2 Calibration screen via Setup > System > Calibration >O2 Sensor or Setup > Service > Calibration > O2 Sensor. The System and Service tabs require passwords and shows both 21% and 100% O2 Sensor calibration. The calibration screen shown below is displayed when 100% is selected. Set up the machine as per the instructions on the screen and select Next. In case of manual mode, make sure that the manual bag is in position. Otherwise, set the switch to Auto position. .



3. Select Next and the calibration screen as shown below is displayed. Set up the machine as per the instructions on the screen.

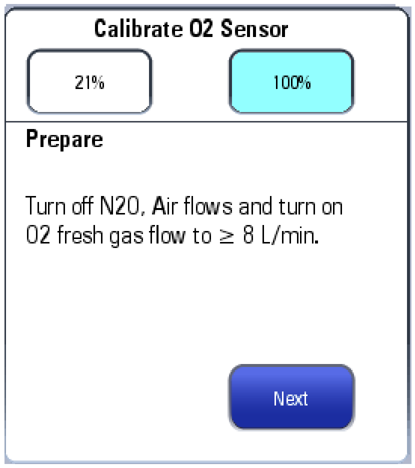


FIGURE 4-5

4. Select Next and the calibration screen as shown below is displayed. Set up the machine as per the instructions on the screen. Wait at least 2 minutes and ensure that O2 cell voltage has stabilized at the maximum value for at least 30s. Select Begin.

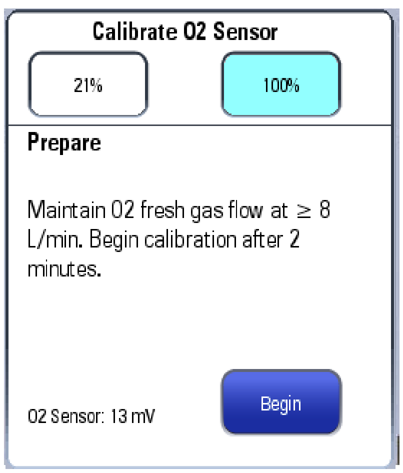


FIGURE 4-6

5. The calibration screen shown below is displayed when Begin is selected. During the calibration, you can select Cancel to cancel the calibration.

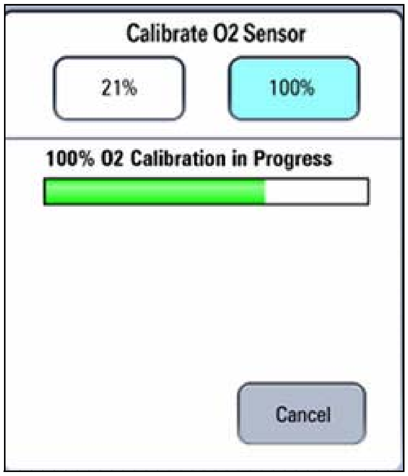


FIGURE 4-7

6. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to do the calibration again.Select Done to exit the calibration screen.

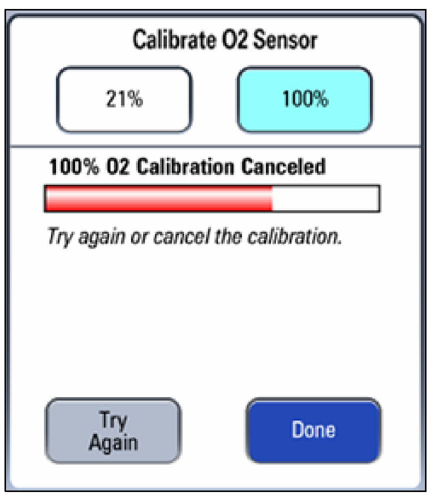


FIGURE 4-8

7. The screen shown below is displayed if the calibration has failed. Select Try Again to do the calibration again.Select Done to exit the calibration screen.

Software bundle version 01.00.00 – A Fail code (e.g., AA BB CC DD) is displayed if 100% O2 Calibration has failed.

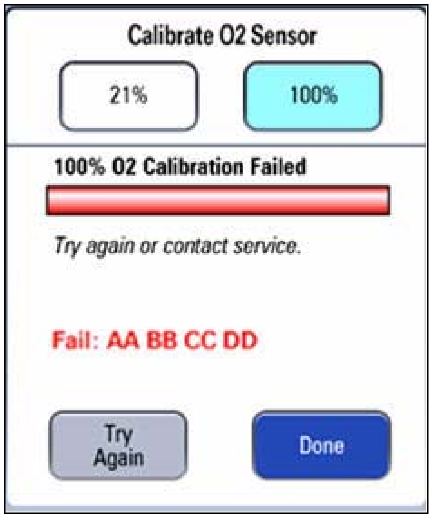


FIGURE 4-9

8. The screen shown below is displayed after a successful calibration. Select Done to exit the calibration screen.

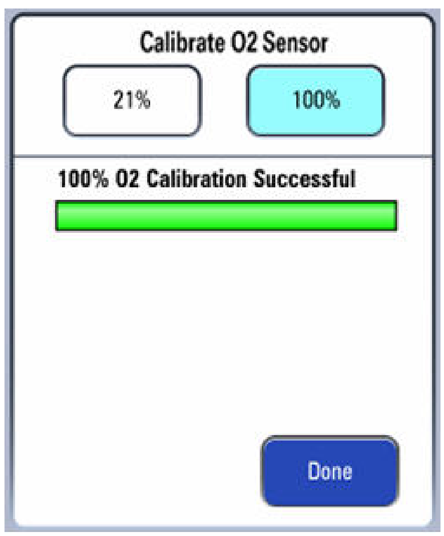


FIGURE 4-10

4.3.1.3 Commonly-encountered Problems and Recommended Actions

Failure Description	Possible Cause	Recommended Action
After [Start] is selected, calibration failure is prompted very soon.	If the alarm [O2 Sensor Unconnected] is displayed, it indicates that O2 sensor is not connected.	Connect the O2 sensor.
	O2 supply pressure is insufficient (lower than 200 kPa).	Change or connect the gas supply and make sure that O2 supply pressure is sufficient.
	21% O2 calibration is not completed before 100% O2 calibration.	Perform 21% O2 calibration followed by 100% O2 calibration.
Calibration failure is prompted about 3 minutes after calibration is started.	The O2% sampling value is not within the normal range. Namely, the sampling value of 21% O2 concentration is outside the range of 150~500 and the sampling value of 100% O2 concentration is outside the range of 800~2028. Access Setup?Service?Data Monitors?VCM to check the O2% sampling value.	Replace the O2 sensor.

Error Code	Description	Recommended Action
00 00 00 02	O2 supply pressure is low. During 100% calibration process, O2 supply pressure was not sufficient.	. Check that the O2 sensor is connected to the cable correctly. . Check the O2 supply pressure. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.
00 00 00 04	O2 sensor is disconnected. Sampled data is greater than 2900 (AD value).	. Check if the alarm [O2 Sensor Disconnected] is displayed. If yes, Check that the O2 sensor is connected to the cable correctly. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.
00 00 00 08	21% calibration value is outside of the expected range (150~500) (AD value).	. Check that the O2 sensor is connected to the cable correctly. . Check that the O2 sensor is in 21% O2. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.
00 00 00 10	100% calibration value is outside of the expected range (800~2028) (AD value).	. Check that the O2 sensor is connected to the cable correctly. . Check that the O2 sensor is in 100% O2. . Check that the O2 sensor output voltage in the calibration menu is steady. . Replace the O2 sensor.
00 00 00 20	Error writing to EEPROM.	. Repeat the calibration. . Replace the O2 sensor. . Replace the CPU board.

4.3.2 Flow Calibration (User)

NOTE: The flow sensors must be recalibrated after replacing or reinstalling the flow sensors.

NOTE: This calibration is only intended for the user. A trained technician should always perform the flow calibration in the service mode when a calibration is required.

NOTE: The measurements performed by the flow sensors may be affected by the environment where the sensors are used. After the sensors have been used for a long time, great deviations may occur to the measurement results and tidal volume control as well. This problem can be fixed through flow sensor calibration.

NOTE: Before calibration, perform leak test of the breathing system in mechanical ventilation mode first and make sure that the test is passed.

NOTE: During calibration, make sure that the drive gas pressure is kept within specifications. Failure to do so may lead to calibration failure.

This calibration is only intended for the flow sensors in the breathing circuit. The inspiratory flow sensor and expiratory flow sensor in the breathing system are calibrated through the built-in flow measurement reference.

When great deviations (more than 9% compared with the setting value) occur to tidal volume measurement due to sensor ageing or environmental factors or the user replaces flow sensors, you need to re-calibrate flow sensors.

Follow these steps to calibrate flow sensors.

1. Enter Standby.
2. Select Setup-> Calibrate-> Calibrate Flow Sensor (software bundle versions earlier than 01.00.00) or Setup-> General-> Calibrate Flow Sensor (software bundle version 01.00.00 and higher) to access the screen shown below.

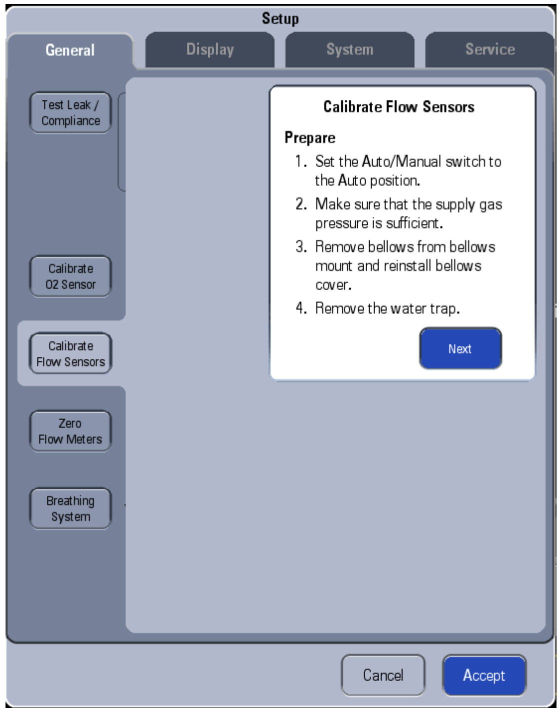


FIGURE 4-11

3. Set up the machine as per the instructions on the screen and select Next to open the menu shown below.

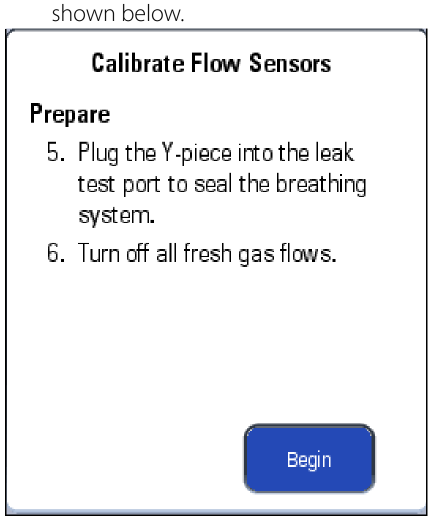


FIGURE 4-12

4. Select Begin to calibrate flow sensors. During the calibration, you can select Cancel to cancel the calibration.

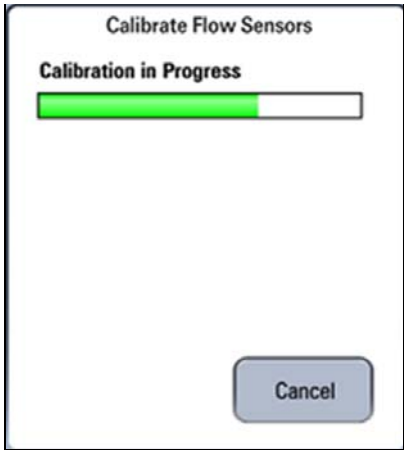


FIGURE 4-13

5. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to do the calibration again. Select Done to exit the calibration screen.

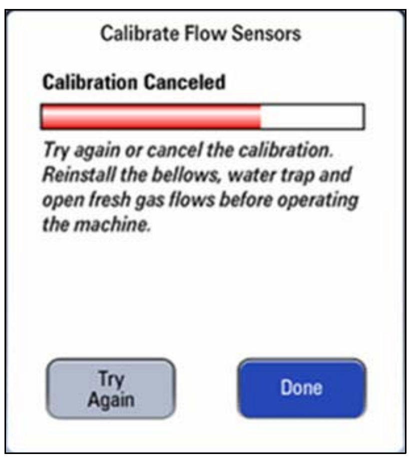


FIGURE 4-14

6. The screen shown below is displayed if the flow sensor calibration is failed. Select Try Again to do the calibration again. Select Done to exit the calibration screen.

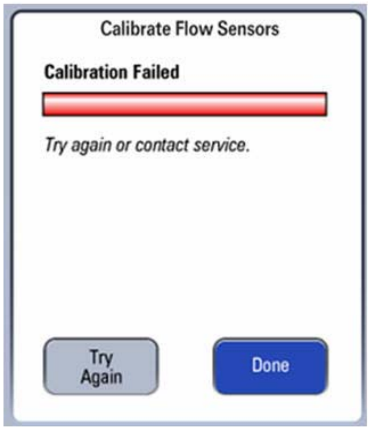


FIGURE 4-15

7. The screen shown below is displayed after a successful flow sensor calibration. Select Done to exit the calibration screen.

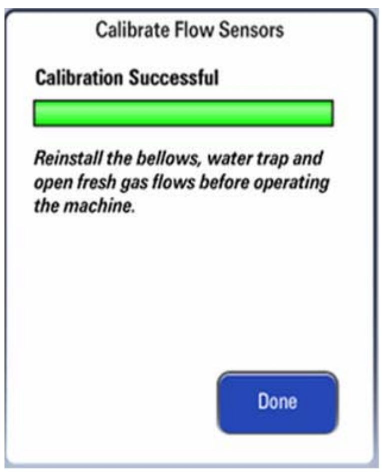


FIGURE 4-16

NOTE: **If measurement deviations are not corrected after multiple flow sensor calibrations, the user is recommended to replace the flow sensor and then perform calibration. If the problem persists, factory maintenance is necessary.**

4.3.3 Flow Calibration (Service)

NOTE: **Flow Calibration (Service) is necessary in case of replacing the ventilator control board, drive gas assembly or solenoid valve assembly.**

NOTE: **When a great deviation is detected between the measured value of the built-in flow sensor and that of the standard flow measurement device, you need to perform Flow Calibration (Service).**

This calibration is intended for the flows sensors in the breathing circuit, ventilator flow sensor, and also inspiratory valve. The standard flow measurement device is used to calibrate the flow sensors and inspiratory valve.

4.3.3.1 Calibration Procedures

NOTE: Make sure that the tubes are not leaking when connected.

NOTE: Do not move or press the tubes during calibration.

NOTE: When connecting calibration tubes, make sure that gas flows in the correct direction, which is from the inspiration connector of the breathing system, through high flow inlet of the anesthesia machine calibration device, anesthesia machine calibration device, high flow outlet of the anesthesia machine calibration device, and to the expiration connector of the breathing system.

NOTE: Before calibration, make sure that no sensor or valve related technical alarms occurred.

NOTE: During calibration, make sure that the drive gas pressure is enough. Failure to do so may lead to calibration failure.

NOTE: You can select VT Plus for auto calibration. You can also select flow calibration device which satisfies the accuracy requirement for manual calibration.

NOTE: For calibration device with high flow channel and low flow channel, flow channel switch over is required during auto or manual calibration. Manual calibration is available in software bundle version 01.00.00 and higher.

4.3.3.2 Auto Calibration

For EPSON Platform (Software Bundle 02.12.01 and below)

Follow these steps to calibrate flow sensors.

1. Enter Standby.
2. Select Setup-> Service-> Calibration-> Flow Sensors to access the screen as shown.

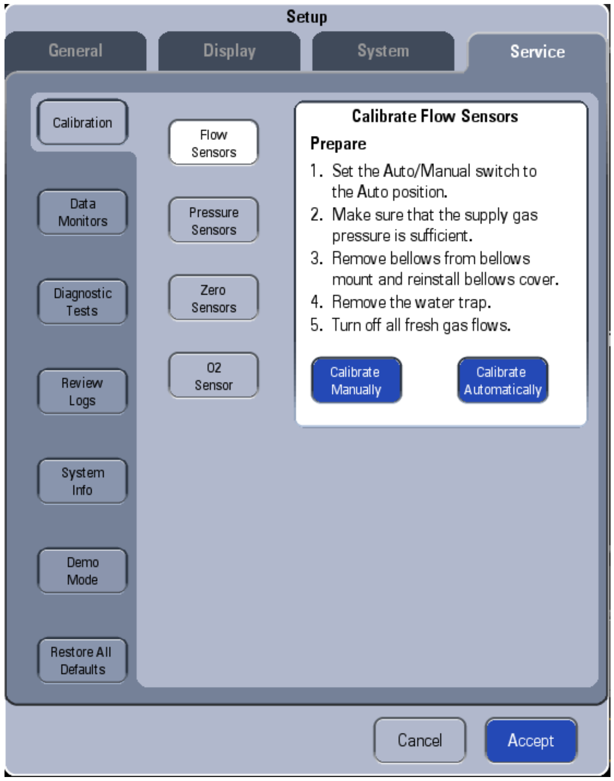


FIGURE 4-17

3. Select Calibrate Automatically button to open the menu shown below. Then select the desired calibration device.

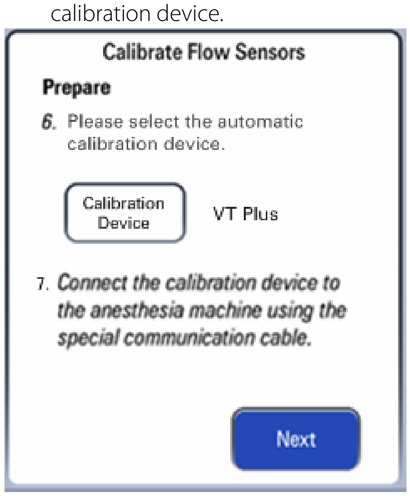


FIGURE 4-18

4. Connect the calibration device with the anesthesia machine using a communication cable (P/N: 801-0631-00121-00).

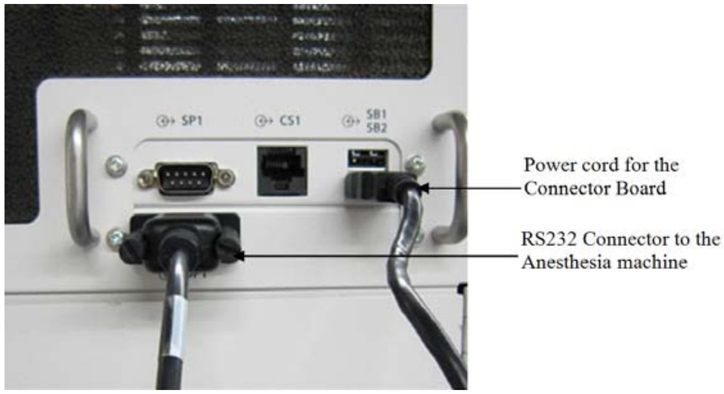


FIGURE 4-19 Cable connections at the anesthesia machine end

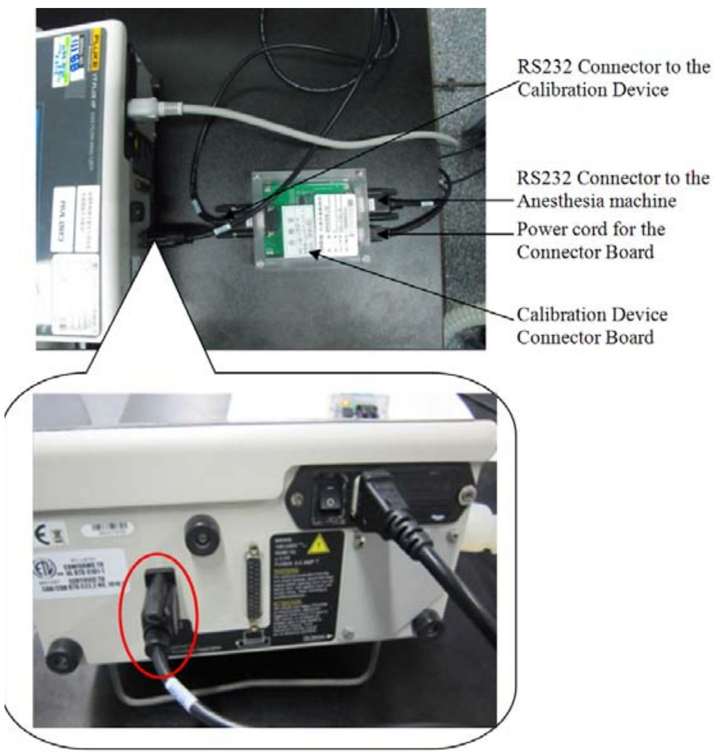


FIGURE 4-20 Cable connections at the calibration device (VT Plus) end

5. Set up the calibration device as described below.

To set the VT-Plus:

a. Gas Settings: Press the Setup button, select Setting->ENTER->Gas Settings->MODIFY->Gas Type->O2->BACK->BACK.

FIGURE 4-21

b. Correction mode: Press the Setup button, select Setting->ENTER->Correction Mode->MODIFY->Correction Mode->BTPS.

FIGURE 4-22

c. Zero Mode Settings: Press the Setup button, select Setting->ENTER->Zero Mode->Manual->BACK->BACK.

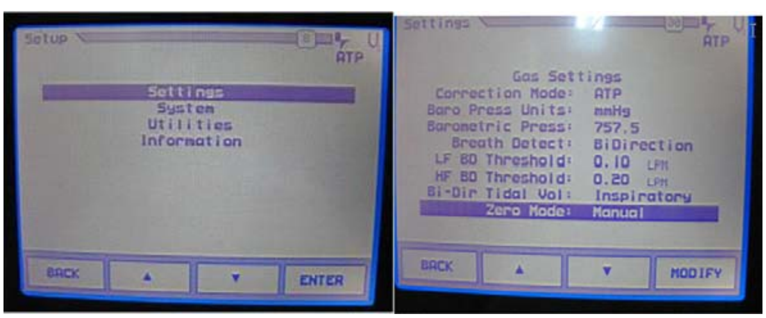


FIGURE 4-23

d. Serial Mode Settings: Press the Setup button, select Setting->System->Enter->Serial Mode ->OTIS Ctrl->BACK->BACK.

FIGURE 4-24

e. After setting up the calibration device, the calibration enters the serial mode screen shown below.

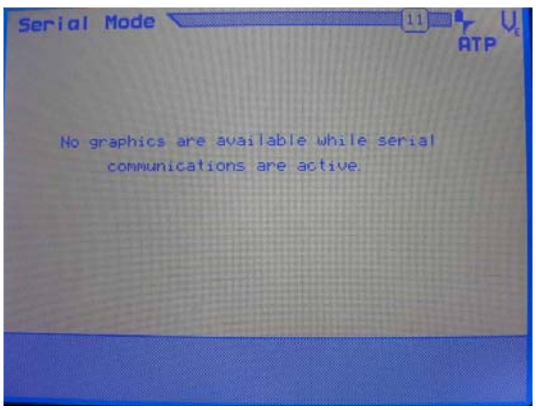


FIGURE 4-25

6. Press the Next button to open the menu shown below.

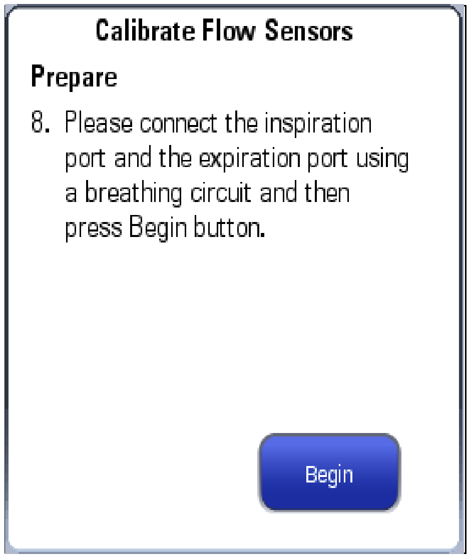


FIGURE 4-26

7. Connect the inspiration port and expiration port of the anesthesia machine following the on-screen instructions, shown below.

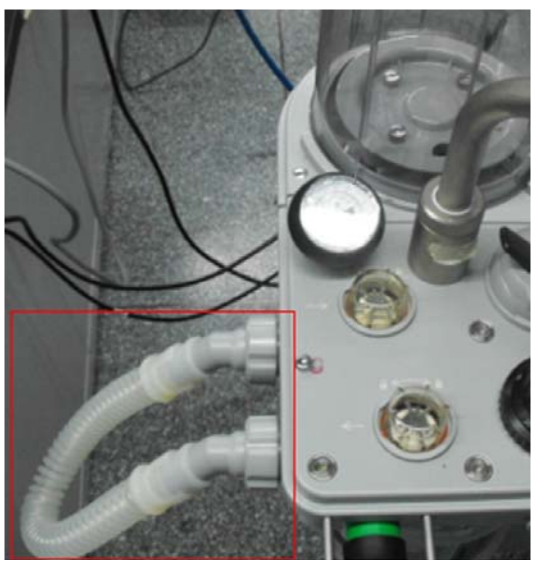


FIGURE 4-27

8. Press the Begin button to open the menu shown below.

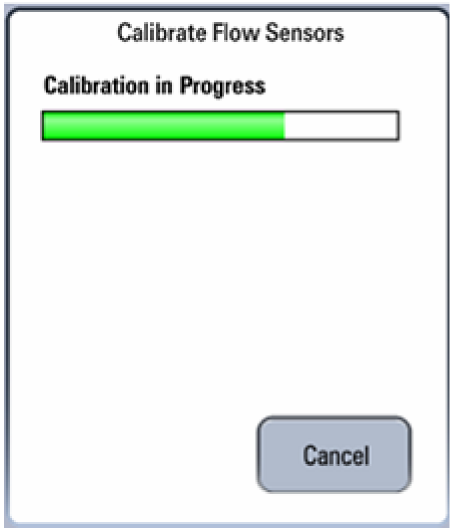


FIGURE 4-28

9. The menu shown below is displayed after the above steps are completed.

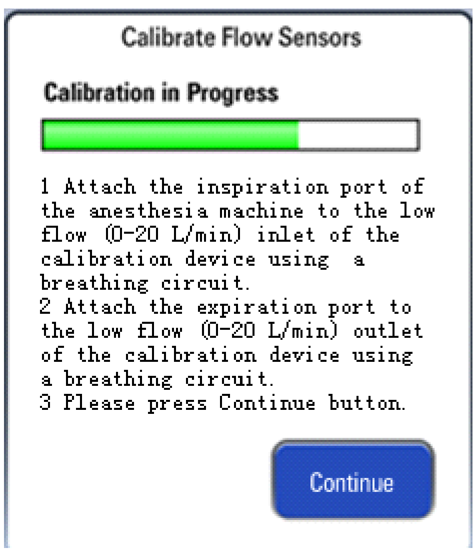


FIGURE 4-29

10. Connect the pneumatic circuit of calibration device with that of anesthesia machine following the on-screen instructions. Connect the low flow channel of the calibration device first, shown below.

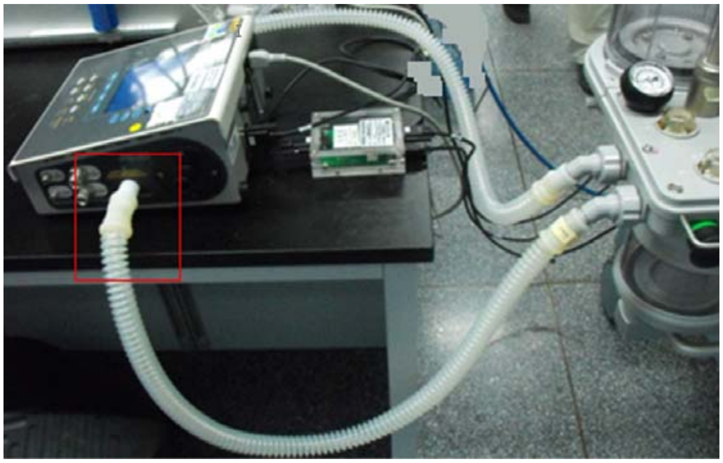


FIGURE 4-30 Pneumatic connection with the calibration device (VT Plus)

11. Press the Continue button to open the menu shown below.

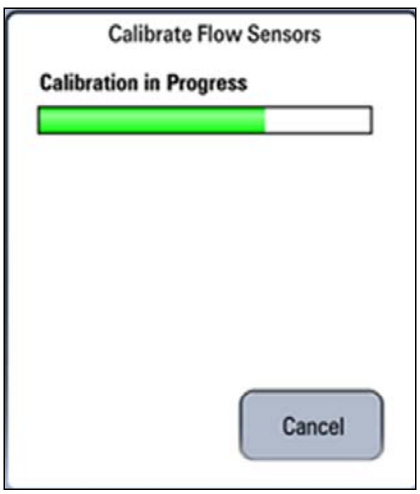


FIGURE 4-31

12. The menu shown below is displayed after the low flow channel calibration is completed.

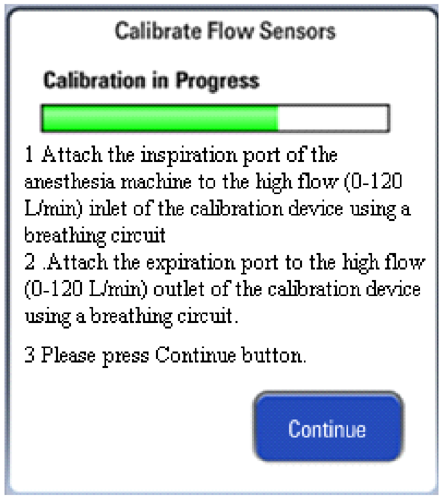


FIGURE 4-32

13. Connect the high flow channel of the calibration device following the on-screen instructions shown below.

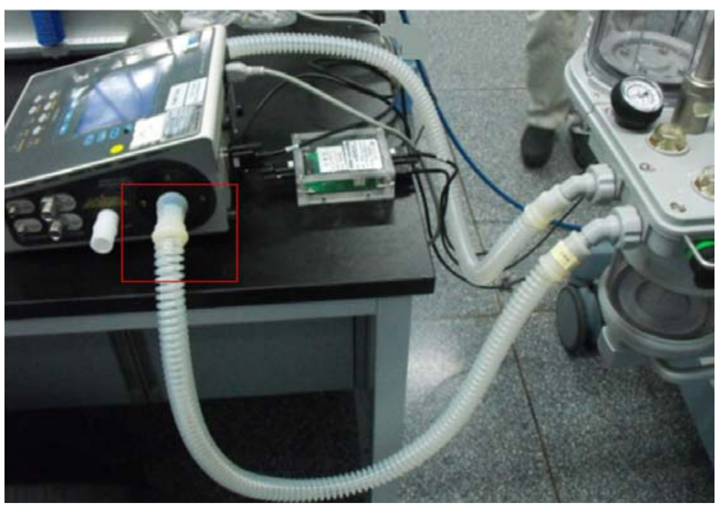


FIGURE 4-33 Pneumatic connection with the calibration device (VT Plus)

14. Press the Continue button to open the menu shown below.

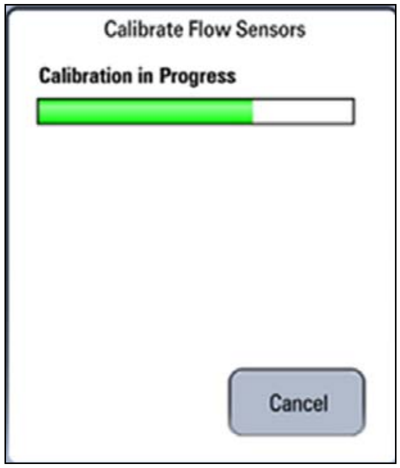


FIGURE 4-34

15. The screen shown below is displayed after the calibration is completed.

- The screen shown below is displayed if the flow sensor calibration has failed. When the calibration has failed, read the screen of the calibration device for further information on the cause of the failure. Select Try Again to do the calibration again. Select Done to exit the calibration screen.

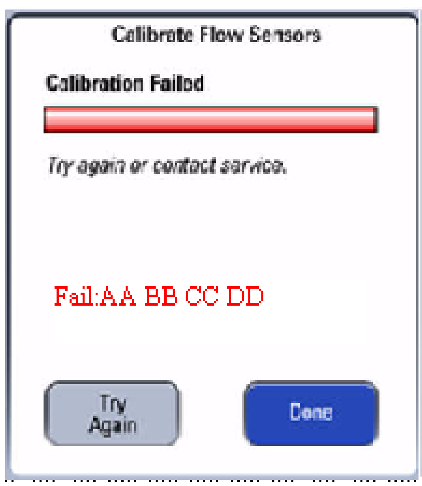


FIGURE 4-35

- The screen shown below is displayed after a successful flow sensor calibration. Select Done to exit the calibration screen.

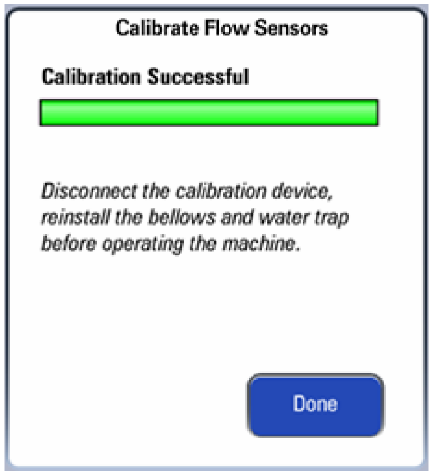


FIGURE 4-36

16. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to do the calibration again. Select Done to exit the calibration screen.

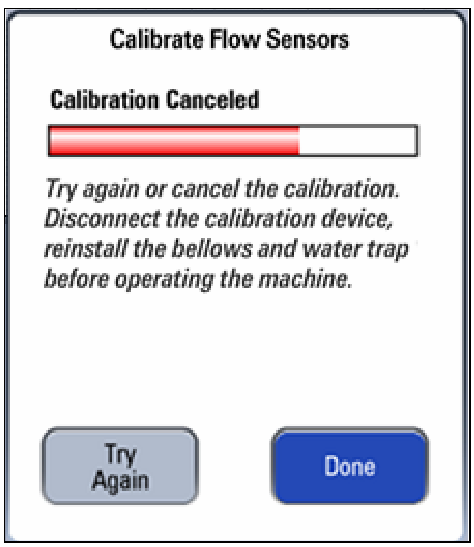


FIGURE 4-37

For DSP Platform (Software Bundle 03.00.00 and Higher)

Follow these steps to calibrate flow sensors.

1. Enter Standby.
2. Select Setup-> Service-> Calibration-> Flow Sensors to access the screen as shown.

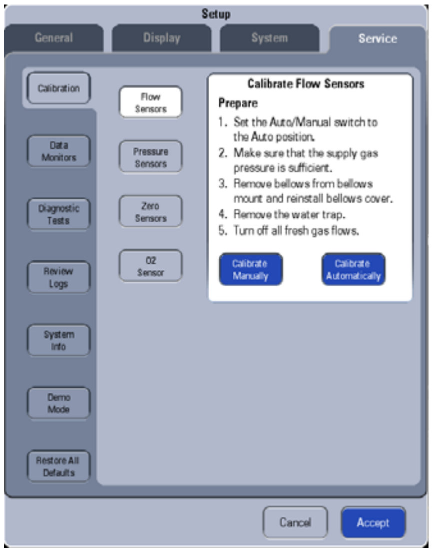


FIGURE 4-38

3. Select Calibrate Automatically button to open the menu shown below. Then select the desired calibration device.

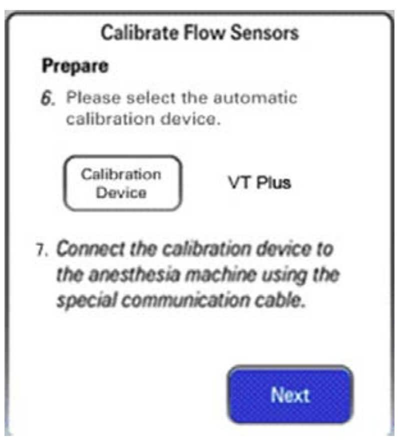


FIGURE 4-39

4. Connect the calibration device with the anesthesia machine using a communication cable (P/N: 801-0631-00121-00).

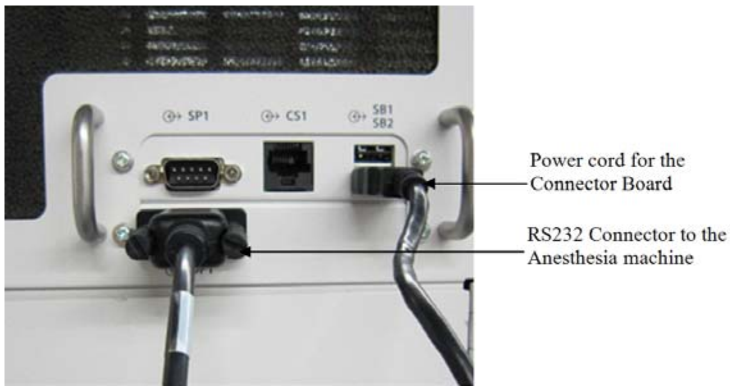


FIGURE 4-40 Cable connections at the anesthesia machine end

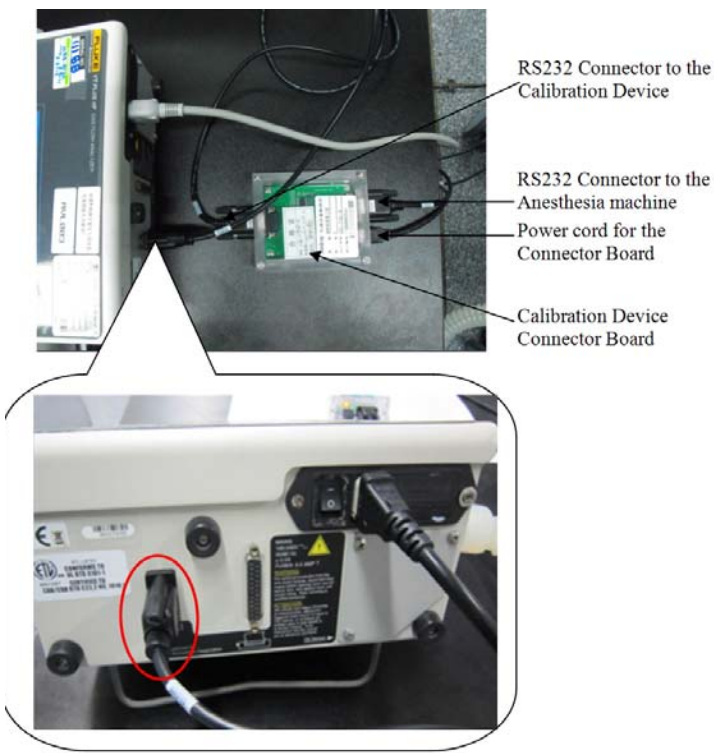


FIGURE 4-41 Cable connections at the calibration device (VT Plus) end

5. Set up the calibration device as described below.

To set the VT-Plus:

a. Gas Settings: Press the Setup button, select Setting->ENTER->Gas Settings->MODIFY->Gas Type->O2->BACK->BACK.

FIGURE 4-42

b. Correction mode: Press the Setup button, select Setting->ENTER->Correction Mode->MODIFY->Correction Mode->BTPS.

FIGURE 4-43

c. Zero Mode Settings: Press the Setup button, select Setting->ENTER->Zero Mode->Manual->BACK->BACK.

FIGURE 4-44

d. Serial Mode Settings: Press the Setup button, select Setting->System->Enter->Serial Mode ->OTIS Ctrl->BACK->BACK.

FIGURE 4-45

e. After setting up the calibration device, the calibration enters the serial mode screen shown below.

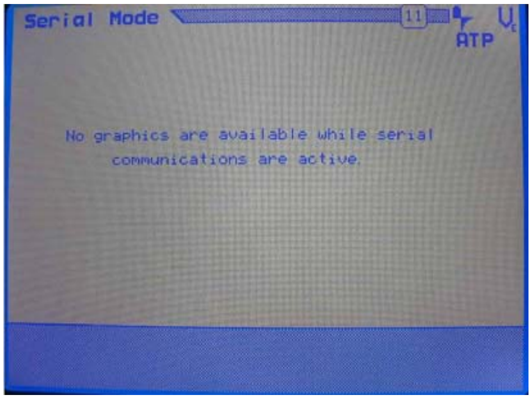


FIGURE 4-46

6. Press the Next button to open the menu shown below.

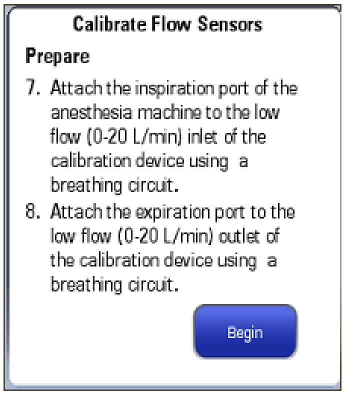


FIGURE 4-47

7. Connect the pneumatic circuit of calibration device with that of anesthesia machine following the on-screen instructions. Connect the low flow channel of the calibration device first, shown below.

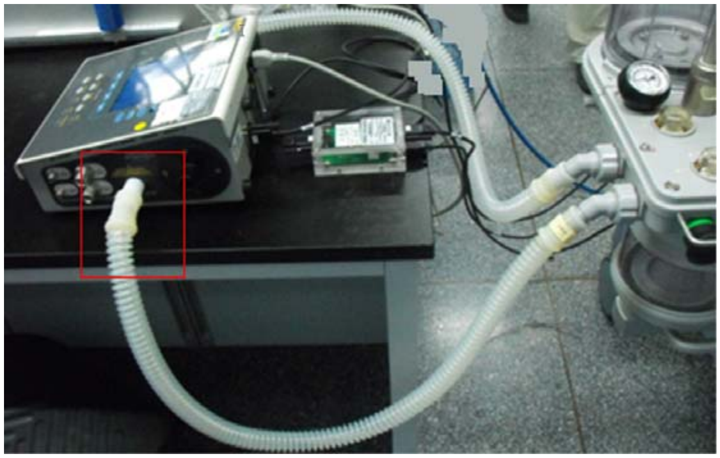


FIGURE 4-48 Pneumatic connection with the calibration device (VT Plus)

8. Press the Begin button to open the menu shown below.

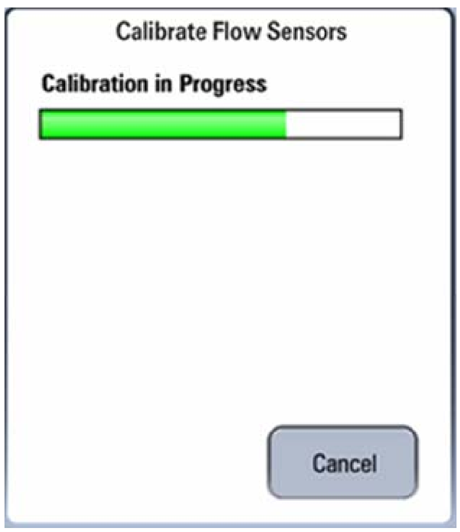


FIGURE 4-49

9. The menu shown below is displayed after the low flow channel calibration is completed.

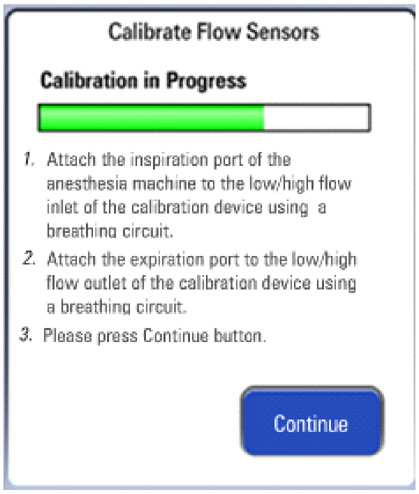


FIGURE 4-50

10. Connect the high flow channel of the calibration device following the on-screen instructions shown below.

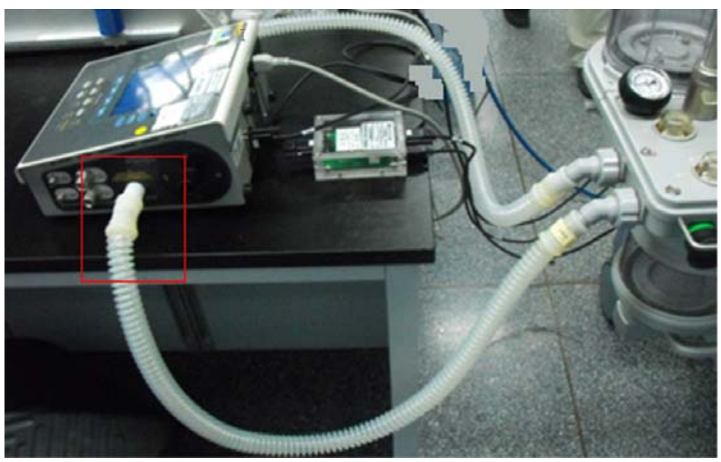


FIGURE 4-51 Pneumatic connection with the calibration device (VT Plus)

11. Press the Continue button to open the menu shown below.

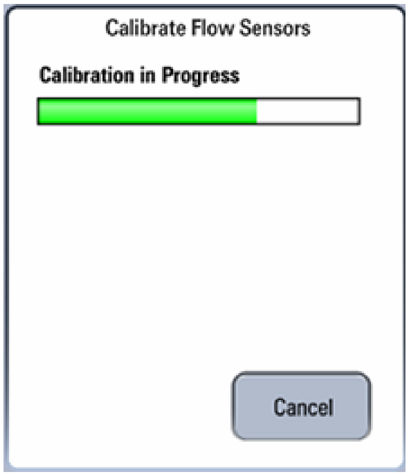


FIGURE 4-52

12. The screen shown below is displayed after the calibration is completed.

- The screen shown below is displayed if the flow sensor calibration has failed. When the calibration has failed, read the screen of the calibration device for further information on the cause of the failure. Select Try Again to do the calibration again. Select Done to exit the calibration screen.

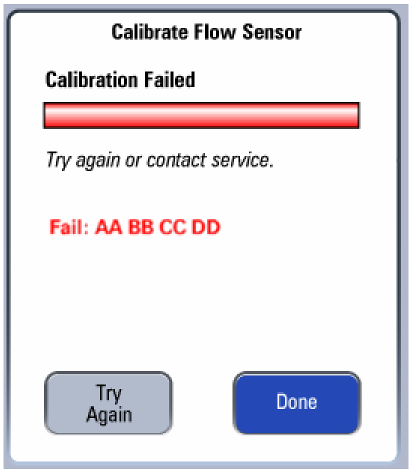


FIGURE 4-53

- The screen shown below is displayed after a successful flow sensor calibration. Select Done to exit the calibration screen.

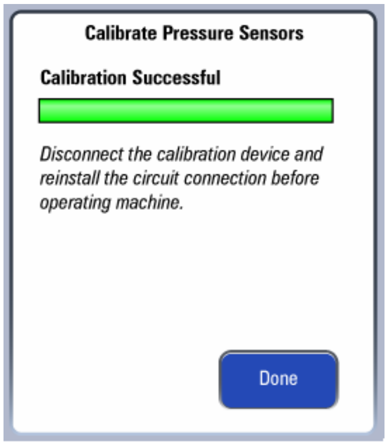


FIGURE 4-54

13. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to do the calibration again. Select Done to exit the calibration screen.

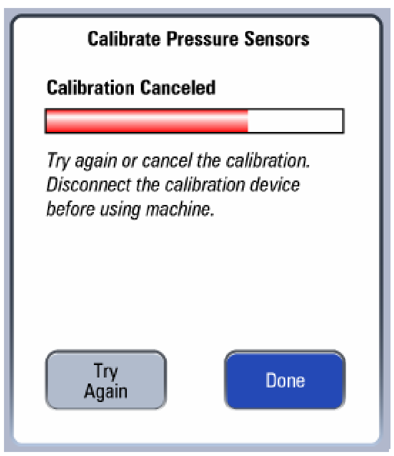


FIGURE 4-55

4.3.3.3 Manual Calibration (Software Bundle Version 01.00.00 and Later)

Set the Gas Flow Analyzer Correction Mode to BTPS (Body Temperature and Pressure, Saturated). For EPSON systems the mode can be set to ambient temperature and pressure or BTPS (Body Temperature and Pressure, Saturated).

Follow these steps to calibrate the flow sensors.

1. Enter Standby.
2. Select Setup-> Service-> Calibration-> Flow Sensors to access the screen as shown.

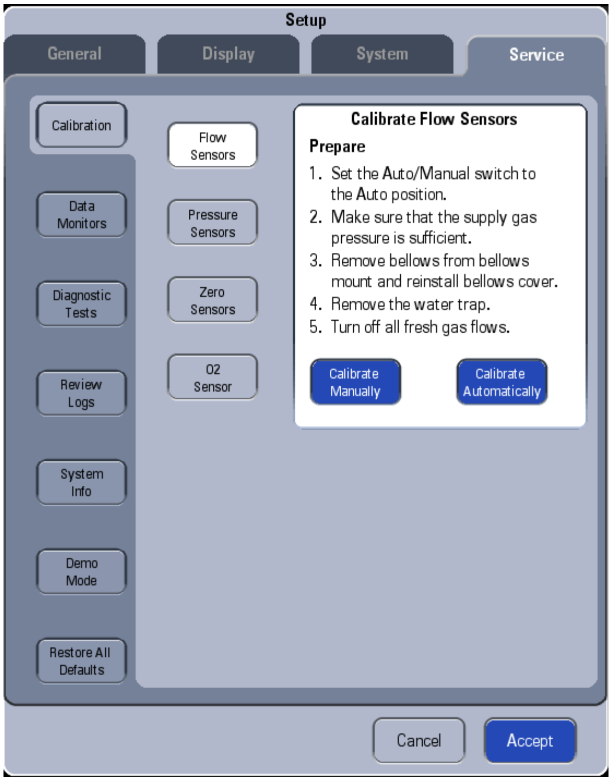


FIGURE 4-56

3. Select Calibrate Manually button to open the menu shown below.

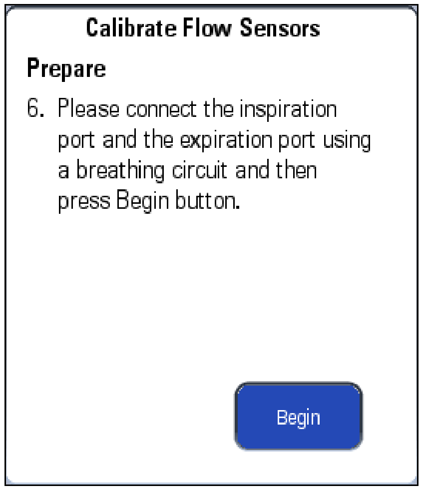


FIGURE 4-57

4. Connect the inspiration port and expiration port of the anesthesia machine following the on-screen instruction as shown below.

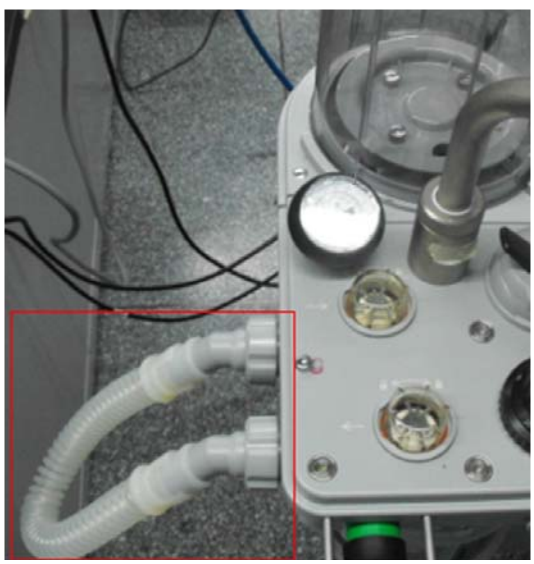


FIGURE 4-58

5. Press the Begin button to open the menu shown below.

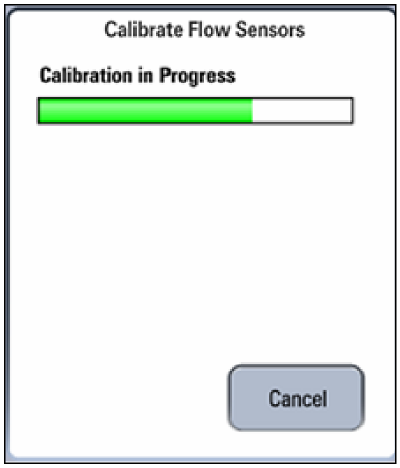


FIGURE 4-59

6. The menu shown below is displayed after the first step of manual calibration is completed.

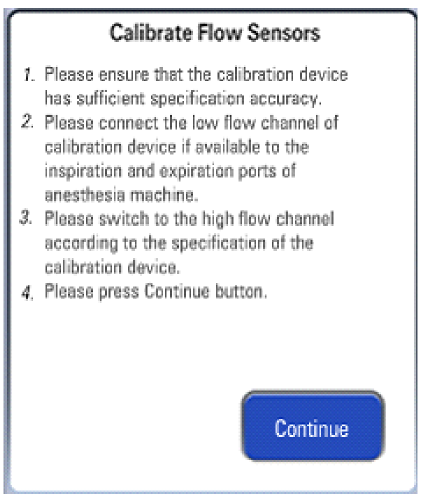


FIGURE 4-60

7. Calibration Device Setup (TSI Certifier 4070, Cannot be Used for DSP Units):
a. Flow Setting: Press the to line select key until the top display reads LPM or SLPM. If the display reads SLPM, press the DISPLAY UNITS key until the top display reads LPM.
b. Gas Settings: Press the GAS SELECT key until the bottom left corner reads O2.

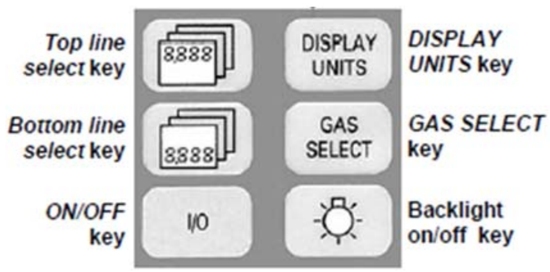


FIGURE 4-61

Calibration Device (CERTIFIER FA PLUS)

a. Touch on the following active areas of the Parameter Screen.

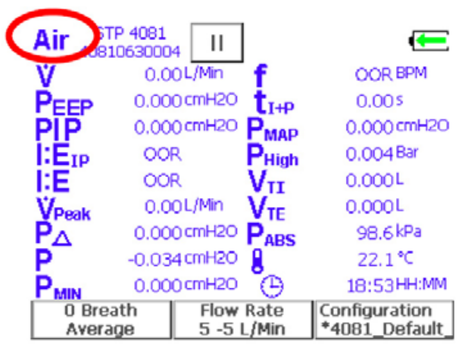


FIGURE 4-62

b. The following window will pop up.

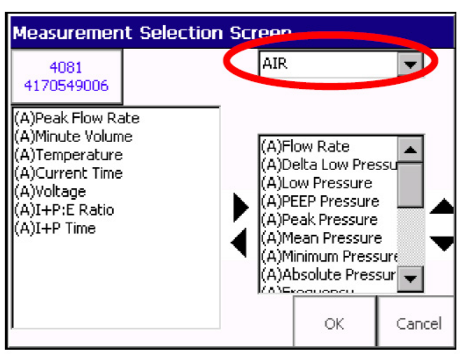


FIGURE 4-63

c. Select O2.

d. Select OK.

e. Touch on the following active areas of the Parameter Screen.

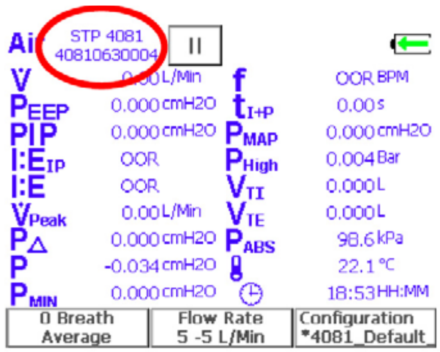


FIGURE 4-64

f. The following window will pop up.

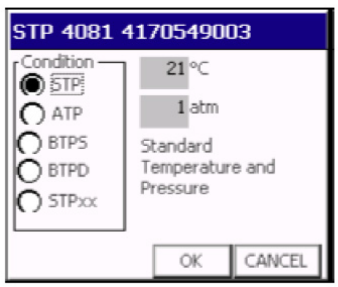


FIGURE 4-65

g. Select BTPS.

h. Select OK.

8. Connect the low flow channel (If available) of calibration device with the pneumatic circuit of anesthesia machine following the on-screen instructions.

FIGURE 4-66 Pneumatic connection with the calibration device (TSI Certifier 4070)

9. If applicable, determine when to switch to the high flow channel of calibration device.

NOTE: **If the flow meter has more than one channel, refer to the manufacturer's specification for when to change from one channel to the other.**

10. Select Continue to access the menu shown below. The system will calibrate the 32 calibration points one by one. When Waiting is displayed in the cell, wait for the system to control flow. When Input Cal Value is displayed in the cell, input the standard flow value displayed by the calibration device. During the calibration, you can select to re-calibrate any calibration point. After having inputted the standard flow values of all the 32 calibration points, select Accept to check and save the calibration data.

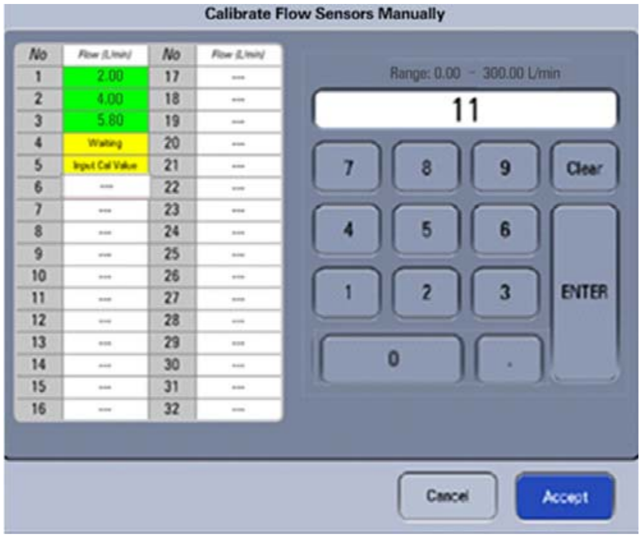


FIGURE 4-67 Manual Flow Sensor Calibration

11. Press the Accept button and the screen shown below is displayed.

- The screen shown below is displayed after a successful flow sensor calibration.

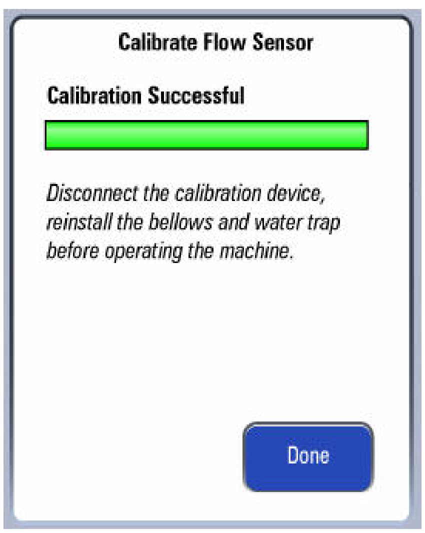


FIGURE 4-68

- The screen shown below is displayed if the flow sensor calibration has failed.

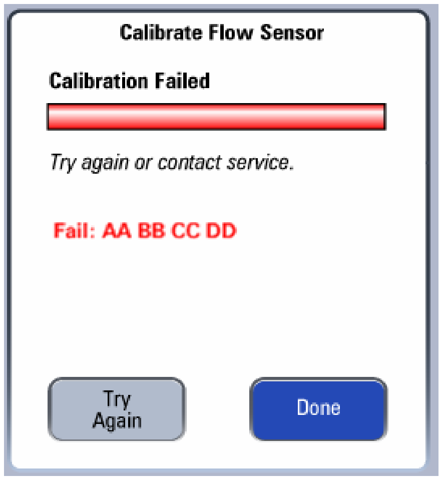


FIGURE 4-69

12. Select Cancel and the screen shown below is displayed.

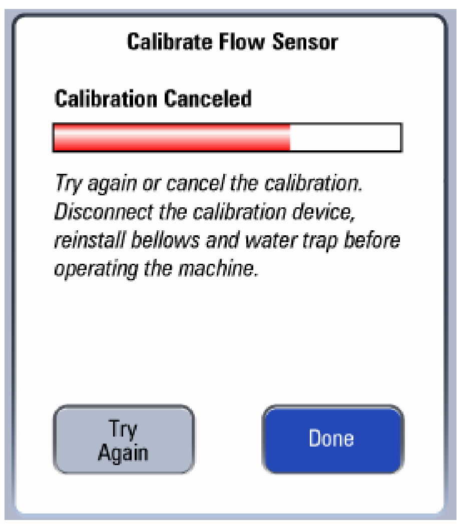


FIGURE 4-70

NOTE: **After flow calibration, check the accuracy of flow sensors by referring to Section 3.8.6 Check the Flow Sensor Accuracy.**

NOTE: **In case of calibration failure, first fix the problem and then perform flow calibration again.**

4.3.3.4 Commonly-encountered Problems and Recommended Actions

Failure description	Possible cause	Recommended action
After [Begin] is selected, no ventilation sound is heard. Very soon, the prompt message of [Calibration Failure! Please try again.] is displayed.	[Manual Vent.] is prompted. The Auto/Manual ventilation switch is set to the bag position.	Set the Auto/Manual ventilation switch to the mechanical ventilation position.
	[Drive Gas Pressure Low] is alarmed. The pressure indicated by the drive gas (O2) pressure gauge is lower than 200 kPa.	Replace or connect the gas supplies to make sure that drive gas pressure is within specifications.
	Zero point error occurs to the inspiratory/expiratory flow sensor.	Replace the ventilator control board.
After [Start] is selected, ventilation sound is heard. Very soon, the prompt message of [Calibration Failure! Please try again.] is displayed.	The sampling line of at least one out of the inspiratory flow sensor, expiratory flow sensor and ventilator flow sensor is not connected or is connected in the reverse order.	Re-connect the sensor sampling line.
	The maximum flow to open the inspiratory valve is less than 90 L/min.	Replace the expiratory valve assembly.
	1. The pneumatic circuit connection between the anesthesia machine calibration device and the ventilator control board has an error. 2. The communication connection between the anesthesia machine calibration device and the anesthesia machine has an error. 3. The settings of the anesthesia machine calibration device have an error.	1. Check the pneumatic circuit connection between the anesthesia machine calibration device and the ventilator control board. Re-connect the pneumatic circuit if necessary. 2. Check the communication connection between the anesthesia machine calibration device and the anesthesia machine. Or re-connect them to ensure normal communication. If the problem persists, replace the communication cable. 3. Check the settings of the anesthesia machine calibration device. Make settings again if necessary.
About 15 minutes after calibration is started, the prompt message of [Calibration Failure! Please try again.] is displayed.	Calibration data are not correct.	Replace the inspiratory and expiratory flow sensors and perform calibration again. If calibration still fails, replace the ventilator control board.
	When flow reaches 90 L/min, the counts value of the inspiratory or expiratory flow sensor is above3900, which is outside of the normal range.	1. Replace the flow sensor in the circuit. 2. Replace the ventilator control board.
[00 00 00 02] is displayed.	The drive gas pressure is too low.	1. Check the drive gas supply. 2. If there is no problem on the gas supply, check the gas supply pressure switch.
[00 00 00 04] is displayed.	The Auto/Manual switch is on Manual position.	1. Check if the operations are performed as directed. 2. If so, check the Auto/Manual switch.

Failure description	Possible cause	Recommended action
[00 00 00 08] is displayed.	Zero point error occurs to the inspiratory flow sensor. (For EPSON platform, zero point AD is greater than or equal to 2000, or is less than 0. For DSP platform, zero point AD is greater than or equal to 26457 or is less than 554)	1. Check if fresh gas is turned off. 2. Check if the inspiratory valve has closed the flow in the valve diagnostic tools, when valve closing DA is zero, AD of the ventilator sensor is basically unchanged when disconnecting and connecting the gas supply (the change is not more than 1% of the reading), indicating that the then valve is indeed fully closed. 3. Check the zero point. 4. Replace the board.
[00 00 00 10] is displayed.	Zero point error occurs to the expiratory flow sensor. (For EPSON platform, zero point AD is greater than or equal to 2000, or is less than 0. For DSP platform, zero point AD is greater than or equal to 26457 or is less than 554)	1. Check if fresh gas is turned off. 2. Check if the inspiratory valve has closed the flow in the valve diagnostic tools, when valve closing DA is zero, AD of the ventilator sensor is basically unchanged when disconnecting and connecting the gas supply (the change is not more than 1% of the reading), indicating that the then valve is indeed fully closed. 3. Check the zero point. 4. Replace the board.
[00 00 00 20] is displayed.	Zero point error occurs to the internal flow sensor. (For EPSON platform, zero point AD is greater than or equal to 2000, or is less than 0. For DSP platform, zero point AD is greater than or equal to 26457 or is less than 554)	1. Check the zero point. 2. Check if the inspiratory valve has closed the flow?in the valve diagnostic tools, when valve closing DA is zero, AD of the ventilator sensor is basically unchanged when disconnecting and connecting the gas supply (the change is not more than 1% of the reading), indicating that the then valve is indeed fully closed. 3. Replace the board.

Failure description	Possible cause	Recommended action
[00 00 00 40] is displayed.	Measurement range error occurs to the inspiratory flow sensor.	1. Check if the sampling line is properly connected. 2. Diagnose by using the valve diagnotic tools: keep the pneumatic connection environment for calibraiton. Access the valve diagnostic tools. Occlude the expiration valve with 4000DA. Open the inspiraiton valve from small values to bigger values. Observe the measured value of the calibration device under different valve opening DA. If the inspiratory flow sensor sampling AD corresponding to the point of measured value of calibration device close to (less than 90) 90 L/min is greater than 3900 (EPSON platform) or 60000 (DSP platform), the measurement range of inspiratory flow sensor has an error. In this case, replace the inspiratory flow sensor ? 3. Replace the board.
[00 00 00 80] is displayed.	Measurement range error occurs to the expiratory flow sensor.	1. Check if the sampling line is properly connected. 2. Diagnose by using the valve diagnotic tools: keep the pneumatic connection environment for calibraiton. Access the valve diagnostic tools. Occlude the expiration valve with 4000DA. Open the inspiration valve from small values to bigger values. Observe the measured value of the calibration device under different valve opening DA. If the inspiratory flow sensor sampling AD corresponding to the point of measured value of calibration device close to (less than 90) 90 L/min is greater than 3900 (EPSON platform) or 60000 (DSP platform), the measurement range of expiratory flow sensor has an error. In this case, replace the expiratory flow sensor. 3. Replace the board.

Failure description	Possible cause	Recommended action
[00 00 01 00] is displayed.	Measurement range error occurs to the internal flow sensor.	1. Check if the sampling line is properly connected. 2. Diagnose by using the valve diagnotic tools: keep the pneumatic connection environment for calibraiton. Access the valve diagnostic tools. Occlude the expiration valve with 4000DA. Open the inspiration valve from small values to bigger values. Observe the measured value of the calibration device under different valve opening DA. If the inspiratory flow sensor sampling AD corresponding to the point of measured value of calibration device close to (less than 45) 45 L/min is greater than 3900 (EPSON platform) or 60000 (DSP platform), the measurement range of ventilator flow sensor has an error. In this case, replace the ventilator flow sensor. 3. Replace the board.
[00 00 02 00] is displayed.	The calibration data of the inspiratory flow sensor is not unidirectional.	1. Check if the check valve is properly connected. 2. Check if the sampling line is properly connected. 3. Replace the inspiratory flow sensor. 4. Replace the board.
[00 00 04 00] is displayed.	The calibration data of the expiratory flow sensor is not unidirectional.	1. Check if the check valve is properly connected. 2. Check if the sampling line is properly connected. 3. Replace the expiratory flow sensor. 4. Replace the board.
[00 00 08 00] is displayed.	The calibration data of the internal flow sensor is not unidirectional.	1. Check if the sampling line is properly connected. 2. Replace the internal flow sensor. 3. Replace the board.
[00 00 10 00] is displayed.	Resolution error occurs to the inspiratory flow sensor.	1. Check the sampling line and air-tight connection. 2. Check the supply gas pressure. 3. Check the settings of the calibration device. 4. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 5. Replace the inspiratory flow sensor. 6. Replace the board.

Failure description	Possible cause	Recommended action
[00 00 20 00] is displayed.	Resolution error occurs to the expiratory flow sensor.	1. Check the sampling line and air-tight connection. 2. Check the supply gas pressure. 3. Check the settings of the calibration device. 4. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 5. Replace the expiratory flow sensor. 6. Replace the board.
[00 00 40 00] is displayed.	Resolution error occurs to the internal flow sensor.	1. Check if the sampling line is properly connected. 2. Replace the internal flow sensor. 3. Replace the board.
[00 00 80 00] is displayed.	The output flow of the valve is low.	1. Check if there is enough gas supply for the whole calibration process. 2. Check if the maximum output flow of the valve is more than 90 L/Min. If not, replace the inspiratory valve.
[00 01 00 00] is displayed.	The resolution of the valve is not enough.	1. Check if there is enough gas supply for the whole calibration process. 2. Check if the calibration device works well. 3. Replace the inspiratory valve.
[00 02 00 00] is displayed.	The change of flow is not unidirectional.	1. Check if the tubes are connected as directed. 2. Check if there is enough gas supply for the whole calibration process. 3. Check if the calibration device is working well.
[00 04 00 00] is displayed.	Communication with the calibration device is interrupted.	1. Check the connection between the calibration device and the communication cable. 2. Replace the calibration device and then perform calibration again.
[00 08 00 00] is displayed.	The system fails to write EEPROM.	1. Perform calibration again. 2. Replace the monitoring board.
[00 10 00 00] is displayed.	ACGO switch is on "ON" position.	1. Check if ACGO is positioned to "OFF". 2. Check the ACGO identification switch.

Failure description	Possible cause	Recommended action
[00 20 00 00] is displayed.	The maximum value cannot be found.	1. Diagnose by using the valve diagnostic tools: (1) open the inspiration valve with 4000DA. The flow measured by the calibration device can reach at least 90L/min. (2) close the inspiration valve. Increase the opening of inspiration valve with certain DA. When the flow measured by the calibration device is approximately 80L/min, based on this DA, increase valve opening by 10 DA. The flow increase does not exceed 5L/Min. It indicates that the point of maximum value is possible (not found by the software). Re-calibration is recommended. 2. Replace the inspiration valve.
[00 40 00 00] is displayed.	The minimum value cannot be found.	1. Diagnose by using the valve diagnostic tools: open the inspiration valve within the range of 0~2000DA. The AD value collected by the inspiratory flow sensor has the tendency of becoming bigger. Re-calibration is recommended. 2. Replace the inspiration valve.
[00 80 00 00] is displayed.	Only available for DSP platform. The time of finding DA, which cause flow is between 9L/min and 25L/min, is longer than 50 seconds.	1. Check if there is enough gas supply for the whole calibration process. 2. Check if the maximum output flow of the valve is between 9L/min and 25L/min. If not, replace the inspiratory valve.
[01 00 00 00] is displayed.	Only available for DSP platform. The zero point of calibration device is over range.	1.Check the calibration device.is working normally. 2.Check the inspiratory valve doesn't have leakage. If not, replace the inspiratory valve.
[02 00 00 00] is displayed.	Only available for DSP platform. Tube is disconnected.	Check the tube connection.
[04 00 00 00] is displayed.	Only available for DSP platform. When inspiratory valve close, the flow measured by inspiratory sensor is over 1L/min.	Check the inspiratory valve doesn't have leakage. If not, replace the inspiratory valve.
[FF FF FF FF] is displayed.	Communication error occurs.	1. Restart the machine. 2. Check the communication cable. 3. Check for communication error alarm messages. Replace the board.

4.3.4 Pressure Calibration (Service)

NOTE: Pressure Calibration (Service) is necessary in case of replacing the ventilator control board, drive gas assembly or solenoid valve assembly.

NOTE: When a great deviation is detected between the measured value of the built-in pressure sensor and that of the standard pressure measurement device, you need to perform Pressure Calibration (Service).

This calibration is intended for the airway pressure sensor in the breathing circuit, PEEP pressure sensor and the PEEP valve of the expiratory valve assembly. The standard pressure measurement device is used to calibrate the pressure sensors and the PEEP valve.

4.3.4.1 Calibration Procedures

NOTE: **Before pressure calibration, make sure that the tubes are not leaky when connected.**

NOTE: **Do not move or press the tubes during calibration.**

NOTE: **You can select VT Plus for auto calibration. You can also select pressure calibration device which satisfies the accuracy requirement for manual calibration. Manual calibration is available in software bundle version 01.00.00 and higher.**

4.3.4.1.1 Auto Calibration

Follow these steps to calibrate pressure sensors and the PEEP valve.

1. Make sure that the anesthesia machine is in standby mode.
2. Select Setup-> Service-> Calibration-> Pressure Sensors to access the screen shown below.

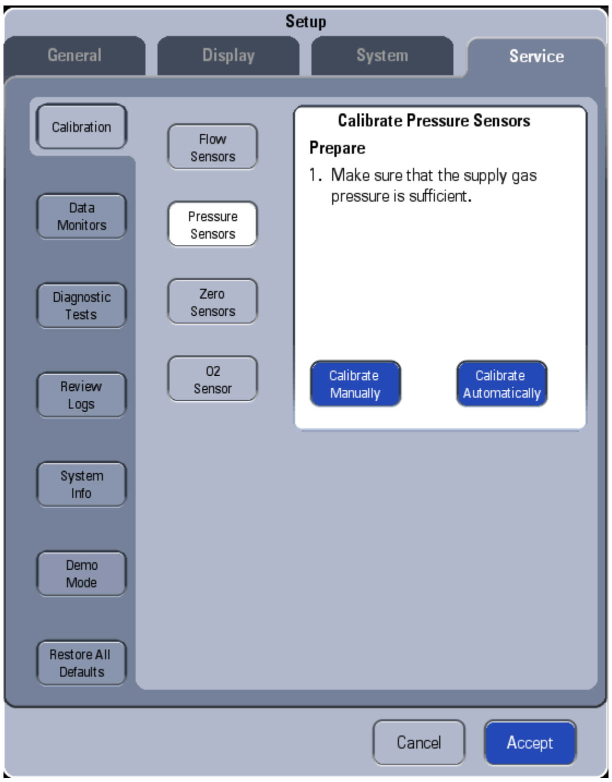


FIGURE 4-71

3. Select Calibrate Automatically button to open the menu shown below.

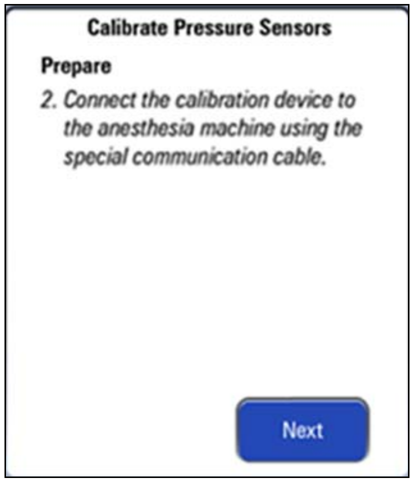


FIGURE 4-72

4. Connect the calibration device with the anesthesia machine using communication cable by referring to step 4. of "Auto Calibration" on page 4-19
5. Press the Next button to open the menu shown below.

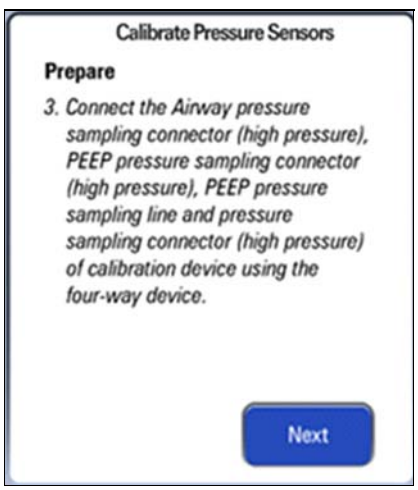
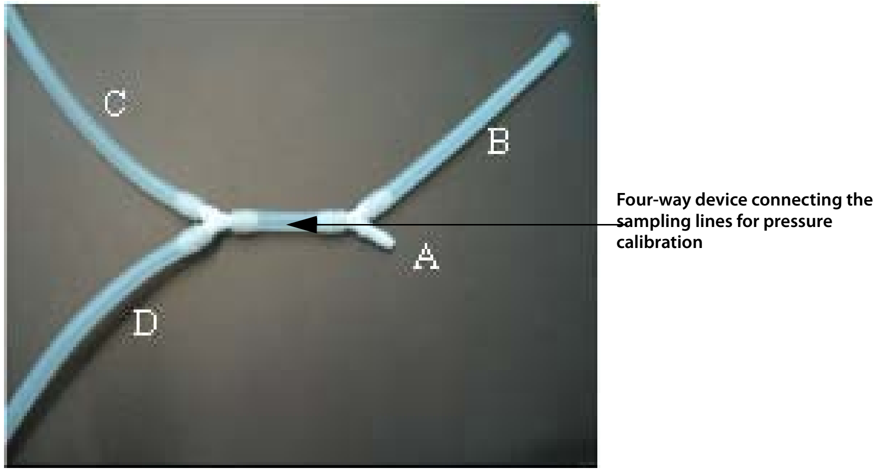


FIGURE 4-73

A four-way device is required to connect the sampling lines for pressure calibration. The following pictures show the four-way device, connectors on the calibration device and ventilator control board involved for pressure calibration.



a. Remove the two tubes marked as #72 and #9 from the pressure sensors (refer to the figure below).

b. Connect the four way tube to the pressure sensor P1 of monitor board, pressure sensor P2 of PEEP, the tube marked as #72, and the low pressure port of Fluke VT-Plus. The tube marked as #9 will remain unconnected for this calibration.

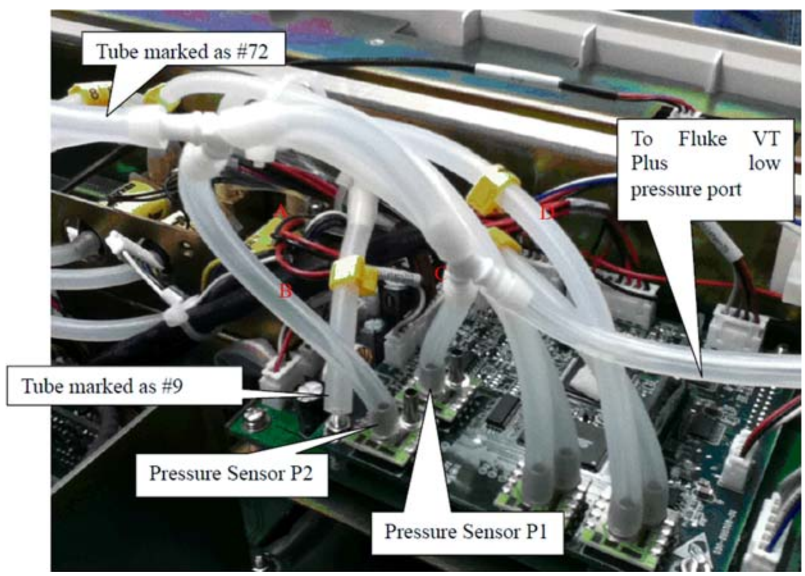


FIGURE 4-74

FIGURE 4-75 Pneumatic connections with the calibration device (VT-Plus)

6. Let the anesthesia machine calibration device be powered and manually zero the calibration device first.
7. Set up the calibration device.
   Refer to step 5. of "Auto Calibration" on page 4-19
8. Press the Next button to open the menu shown below.

FIGURE 4-76

9. After selecting the desired auto calibration device, select Begin to access the calibration screen shown below. During the calibration, you can select Cancel to stop the calibration.

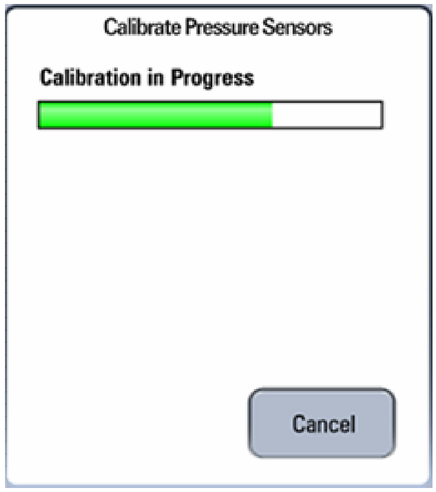


FIGURE 4-77

10. The screens shown below are displayed after the calibration is completed.

- The screen shown below is displayed if the pressure sensor calibration has failed. Select Try Again to do the calibration again.Select Done to exit the calibration screen.

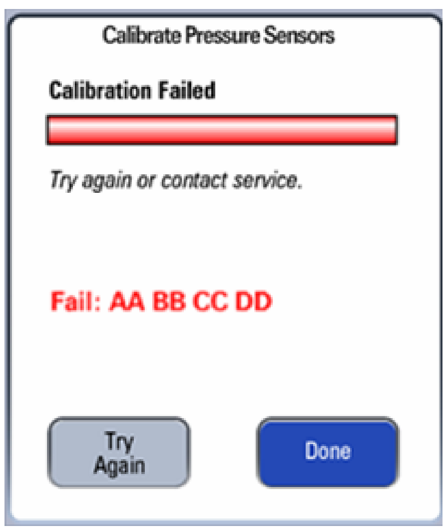


FIGURE 4-78

- The screen shown below is displayed after a successful pressure sensor calibration. Select Done to exit the calibration screen.

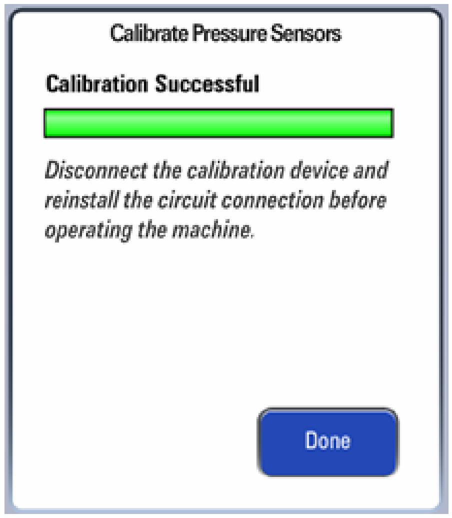


FIGURE 4-79

11. The screen shown below is displayed if the ongoing calibration is canceled. Select Try Again to do the calibration again. Select Done to exit the calibration screen.

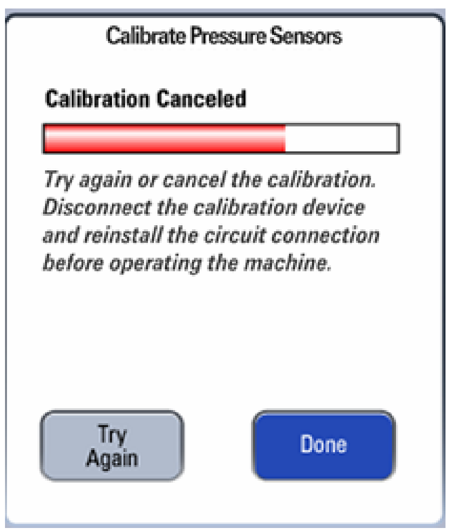


FIGURE 4-80

4.3.4.1.2 Manual Calibration

NOTE: **Manual calibration is available in software bundle version 01.00.00 and higher.**

Follow these steps to calibrate pressure sensors and the PEEP valve.

1. Make sure that the anesthesia machine is in standby mode.
2. Select Setup-> Service-> Calibration-> Pressure Sensors to access the screen shown below.

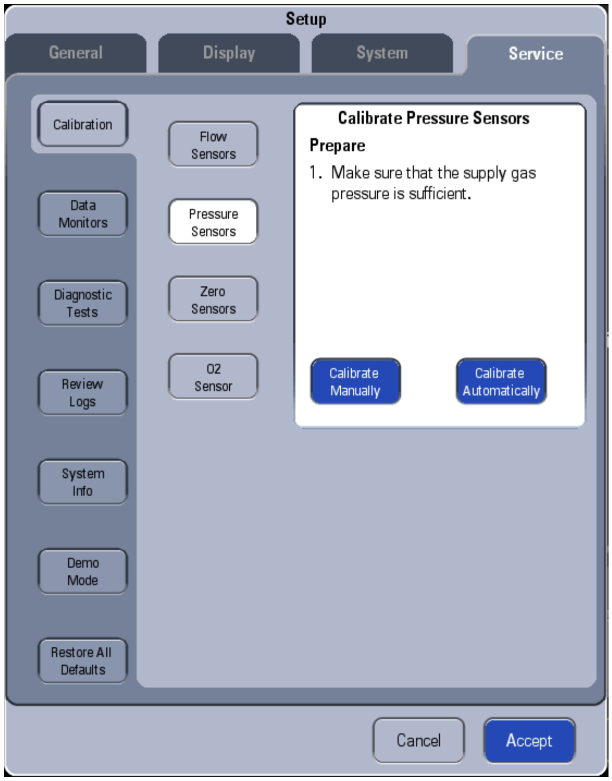


FIGURE 4-81

3. Select Calibrate Manually button to open the menu shown below.

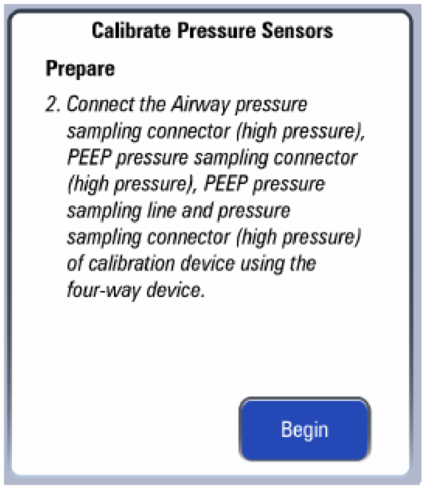


FIGURE 4-82

4. Perform pneumatic connections:

   1. A four-way device is required to connect the sampling lines for pressure calibration. The following pictures show the four-way device, connectors on the calibration device and ventilator control board involved for pressure calibration.

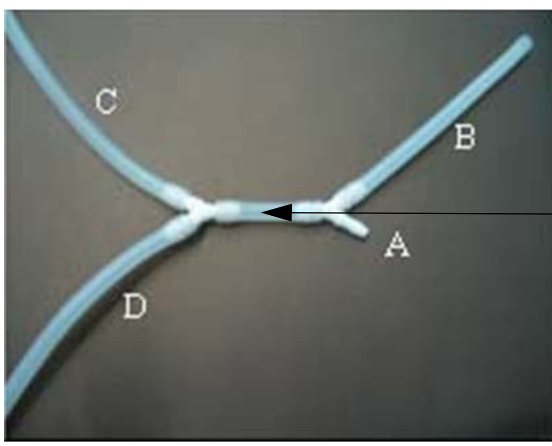


FIGURE 4-83

   2. Remove the two tubes marked as #72 and #9 from the pressure sensors (the figure below).

   3. Connect the four way tube to the pressure sensor P1 of monitor board, pressure sensor P2 of PEEP, the tube marked as #72, and the low pressure port of Fluke VT-Plus. The tube marked as #9 will remain unconnected for this calibration.

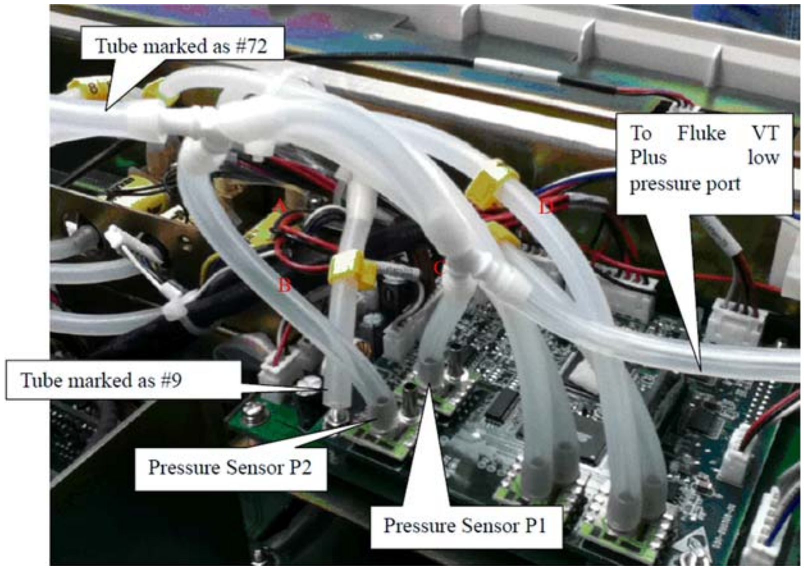


FIGURE 4-84

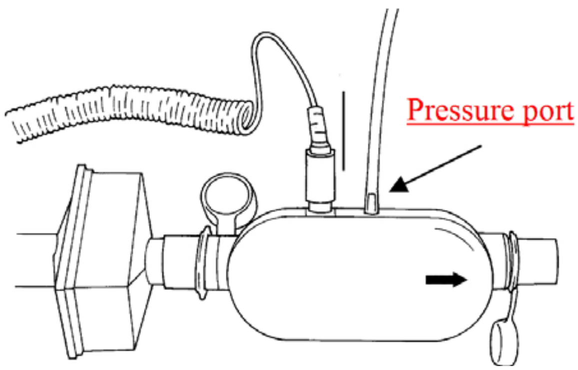


FIGURE 4-85 TSI Certifier 4070

FIGURE 4-86 CERTIFIER FA PLUS

5. Press the Begin button to open the menu shown below.

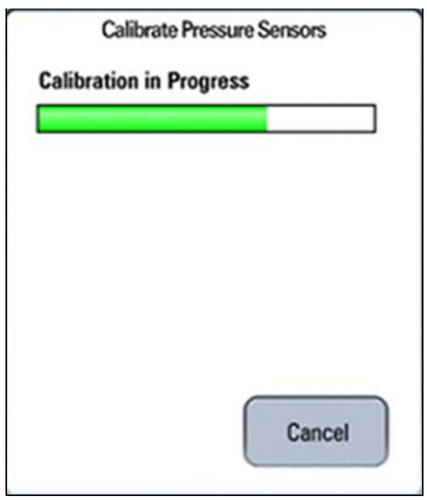


FIGURE 4-87

6. The menu shown below is displayed after the first step of manual calibration is completed.

FIGURE 4-88

7. For EPSON: Select Continue to access the menu shown below. The system will calibrate the 32 calibration points one by one. Of the 32 calibration points, points 1 to 16 correspond to the rising curve while points 17-32 correspond to the falling curves. During the calibration, you can select to re-calibrate any calibration point. When calibrating the point corresponding to falling curve, you cannot change the point corresponding to rising curve. When Waiting is displayed in the cell, wait for the system to control pressure. When Input Cal Value is displayed in the cell, input the standard pressure value displayed by the calibration device. After having inputted the standard pressure values of all the 32 calibration points, select Accept to check and save the calibration data.
For DSP: Select Continue to access the menu shown below. The system will calibrate the 16 calibration points one by one. When Input Cal Value is displayed in the cell, input the standard pressure value displayed by the calibration device. After having inputted the standard pressure values of all the 16 calibration points, select Accept to check and save the calibration data.

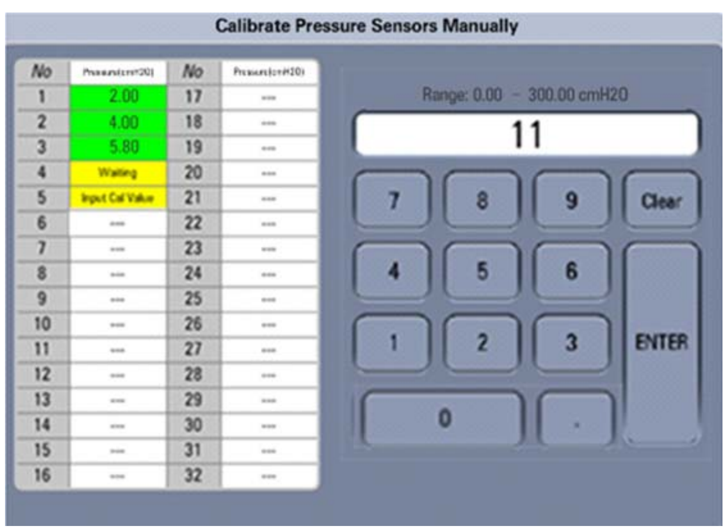


FIGURE 4-89 EPSON platform

FIGURE 4-90 DSP platform

8. Press the Accept button and the screen shown below is displayed.

- The screen shown below is displayed after a successful pressure sensor calibration.

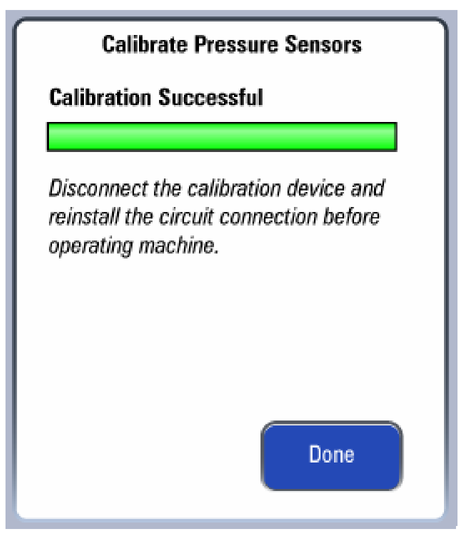


FIGURE 4-91

- The screen shown below is displayed if the pressure sensor calibration has failed.

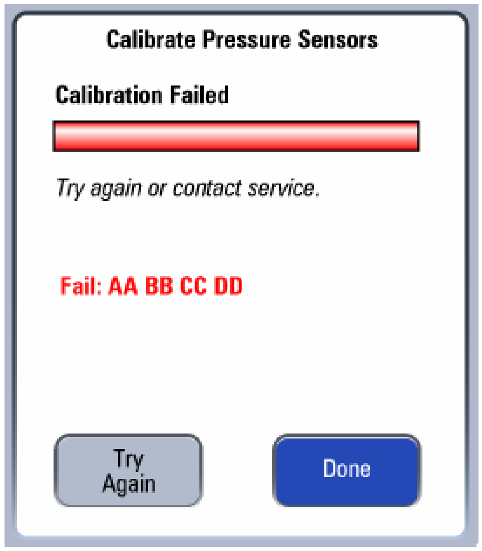


FIGURE 4-92

9. Select Cancel and the screen shown below is displayed.

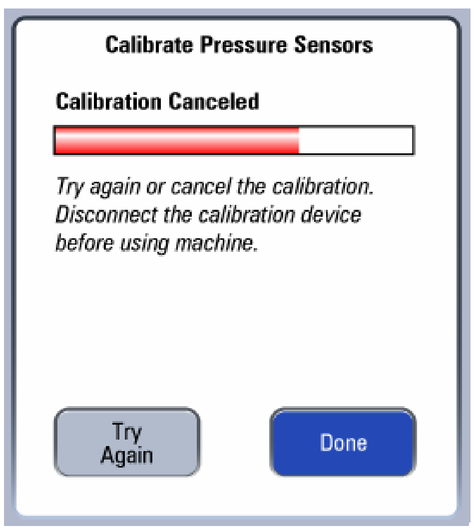


FIGURE 4-93

NOTE: **After pressure calibration, test the accuracy of pressure sensors by referring to 3.7.5 Check the Pressure Sensor Accuracy.**

NOTE: **In case of calibration failure, first fix the problem and then perform pressure calibration again.**

4.3.4.2 Commonly-encountered Problems and Recommended Actions

Failure description	Possible cause	Recommended action
After [Begin] is selected, no ventilation sound is heard. Very soon, the prompt message of [Calibration Failure! Please try again.] is displayed.	[Drive Gas Pressure Low] is alarmed. The pressure indicated by the drive gas (O2) pressure gauge is lower than 200 kPa.	Replace or connect the gas supplies to make sure that drive gas pressure is enough.
	Zero point error occurs to the airway pressure gauge or PEEP pressure sensor. Refer to “Check the Sensor Zero Point” on page 3-19.	Replace the ventilator control board.
After [Begin] is selected, ventilation sound is heard. Very soon, the prompt message of [Calibration Failure! Please try again.] is displayed.	The sampling line of at least one out of the airway pressure sensor and PEEP pressure sensor is not connected or is connected improperly. Refer to “Sensors and Valves Problems” on page 5-68.	Re-connect the sensor sampling line.
	The maximum pressure which the PEEP valve produces is less than 95 cmH2O. Refer to “Sensors and Valves Problems” on page 5-68.	Replace the expiratory valve assembly.
	1. The pneumatic circuit connection between the anesthesia machine calibration device and the ventilator control board has an error. 2. The communication connection between the anesthesia machine calibration device and the anesthesia machine has an error. 3. The settings of the anesthesia machine calibration device have an error.	1. Check the pneumatic circuit connection between the anesthesia machine calibration device and the ventilator control board. Re-connect the pneumatic circuit if necessary. 2. Check the communication connection between the anesthesia machine calibration device and the anesthesia machine. Or re-connect them to ensure normal communication. If the problem persists, replace the communication cable. 3. Check the settings of the anesthesia machine calibration device. Make settings again if necessary.
About 15 minutes after calibration is started, the prompt message of [Calibration Failure! Please try again.] is displayed.	Calibration data are not correct. Refer to “Check the Pressure Sensor Accuracy” on page 3-26.	Replace the ventilator control board.
[00 00 00 02] is displayed.	The drive gas pressure is too low.	1. Check the drive gas supply. 2. If there is no problem on the gas supply, check the gas supply pressure switch.
[00 00 00 04] is displayed.	The Auto/Manual switch is on Manual position.	1. Check if the operations are performed as directed. 2. If so, check the Auto/Manual switch.
[00 00 00 08] is displayed.	Zero point error occurs to the airway pressure sensor.	1. Check the zero point. 2. Replace the board.
[00 00 00 10] is displayed.	Zero point error occurs to the PEEP pressure sensor.	1. Check the zero point. 2. Replace the board.
[00 00 00 20] is displayed.	Measurement range error occurs to the airway pressure sensor.	1. Check the tube and air-tight connection. 2. Check the supply gas pressure. 3. Check the settings of the calibration device. 4. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 5. Replace the board.

Failure description	Possible cause	Recommended action
[00 00 00 40] is displayed.	Measurement range error occurs to the PEEP pressure sensor.	1. Check the tube and air-tight connection. 2. Check the supply gas pressure. 3. Check the settings of the calibration device. 4. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 5. Replace the board.
[00 00 00 80] is displayed.	The calibration data of the airway pressure sensor is not unidirectional.	1. Check the tube and air-tight connection. 2. Check the supply gas pressure. 3. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 4. Replace the board.
[00 00 01 00] is displayed.	The calibration data of the PEEP pressure sensor is not unidirectional.	1. Check the tube and air-tight connection. 2. Check the supply gas pressure. 3. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 4. Replace the board.
[00 00 02 00] is displayed.	Resolution error occurs to the airway pressure sensor. (The difference between the maximum AD and the minimum AD is less than or equal to 500AD (EPSON platform) or 30000AD (DSP platform). When the difference between one point and its previous pressure value is greater than or equal to 1 cmH2O, the resolution is less than 1cm H20 ~2AD (EPSON platform) or 20AD (DSP platform)).	1. Check the tube and air-tight connection. 2. Check the supply gas pressure. 3. Check the settings of the calibration device. 4. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 5. Replace the board.
[00 00 04 00] is displayed.	Resolution error occurs to the PEEP pressure sensor. (The difference between the maximum AD and the minimum AD is less than or equal to 500AD (EPSON platform) or 30000AD (DSP platform). When the difference between one point and its previous pressure value is greater than or equal to 1 cmH2O, the resolution is less than 1cm H20 ~2AD (EPSON platform) or 20AD (DSP platform)).	1. Check the tube and air-tight connection. 2. Check the supply gas pressure. 3. Check the settings of the calibration device. 4. See section 5.4 (pg. 5-68) "Sensors and Valves Problems". 5. Replace the board.
[00 00 08 00] is displayed.	The output pressure of the valve is low.	1. Check if there is enough gas supply for the whole calibration process. 2. Check if the maximum output pressure of the PEEP valve is more than 90 cmH2O. If not, replace the airway module.
[00 00 10 00] is displayed.	The change of flow is not unidirectional.	1. Check if the sampling line is properly connected. 2. Replace the board.
[00 00 20 00] is displayed.	Communication with the calibration device is interrupted.	1. Check the connection between the calibration device and communication cable. 2. Replace the calibration device and then perform calibration again.
[00 00 40 00] is displayed.	The system fails to write EEPROM.	1. Perform calibration again. 2. Replace the monitoring board.
[00 00 80 00] is displayed.	ACGO switch is on "ON" position.	1. Check if ACGO is positioned to "OFF". 2. Check the ACGO identification switch.

Failure description	Possible cause	Recommended action
[00 01 00 00] is displayed.	The resolution of the valve is not enough.	1. Check if there is enough gas supply for the whole calibration process. 2. Check if the calibration device works well. 3. Replace the PEEP valve.
[00 02 00 00] is displayed.	The maximum value cannot be found.	1. Diagnose by using the valve diagnostic tools: (1) open the PEEP valve with 4000DA. The pressure measured by the VT can reach at least 90cmH2O. (2) close the PEEP valve. Increase the opening of PEEP valve with certain DA. The AD value collected by the airway pressure sensor has the tendency of becoming bigger. Re-calibration is recommended if the above two conditions are satisfied. 2. Replace the PEEP valve.
[00 04 00 00] is displayed.	The minimum value cannot be found.	1. Diagnose by using the valve diagnostic tools: open the PEEP valve within the range of 0~2000DA. The AD value collected by the inspiratory pressure sensor has the tendency of becoming bigger. Re-calibration is recommended. 2. Replace the PEEP valve.
[00 08 00 00] is displayed.	Only available for the DSP platform. When PEEP valve is close, the calibration device value is over 3 cmH2O.	Check that the peep valve doesn't have leakage. If not, replace the inspiratory valve.
[00 10 00 00] is displayed.	Only available for the DSP platform.The sampling lines has leakage or disconnection.	Check the connection of sampling lines.
[FF FF FF FF] is displayed.	Communication error occurs.	1. Restart the machine. 2. Check the communication cable. 3. Check for communication error alarm messages. Replace the board.

4.3.5 Pressure and Flow Zeroing (Service)

During the operation of the anesthesia machine, pressure and flow are zeroed automatically at a specific interval. You can also zero pressure and flow manually in the factory maintenance menu. Manual zeroing can eliminate the measurement deviations caused by zero offset immediately. The anesthesia machine system provides the function of automatic flow and pressure zeroing at a specific interval. Zeroing is performed automatically at 5min, 15min, 30min, and 60min respectively after ventilation starts. After that, automatic zeoring is performed once every 120 minutes. During mechanical ventilation, before automatic zeroing, the three-way valve is opened and closed for flushing valve. During zeroing or three-way valve opening and closing, the waveform will be depressed.

4.3.5.1 Zeroing Procedures

Follow these steps to zero pressure and flow sensors.

1. Select Setup-> Service-> Calibration-> Zero Sensors to access the screen shown below.

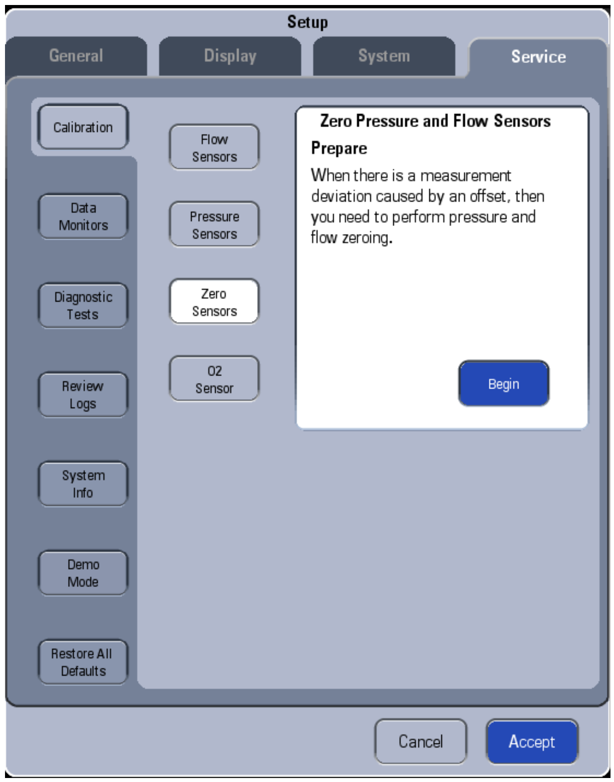


FIGURE 4-94

2. Select Begin to access the zeroing screen as show below. During the zeroing, you can select Cancel to cancel the zeroing.

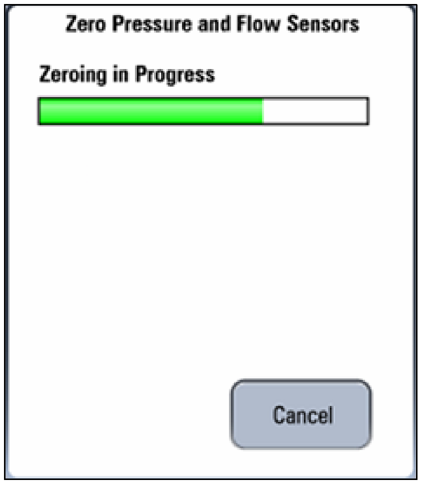


FIGURE 4-95

3. The screen shown below is displayed if the ongoing zeroing is canceled. Select Try Again to do the zeroing again.Select Done to exit the zeroing screen.

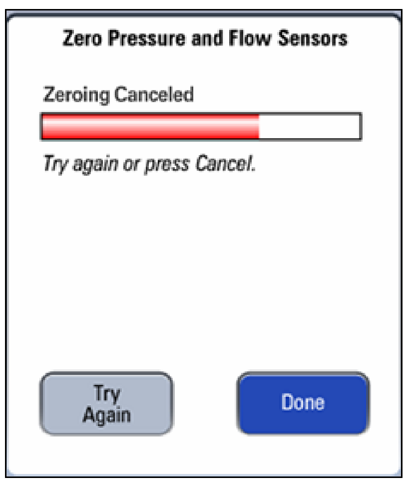


FIGURE 4-96

4. The screen shown below is displayed if the zeroing has failed. Select Try Again to do the zeroing again.Select Done to exit the zeroing screen.

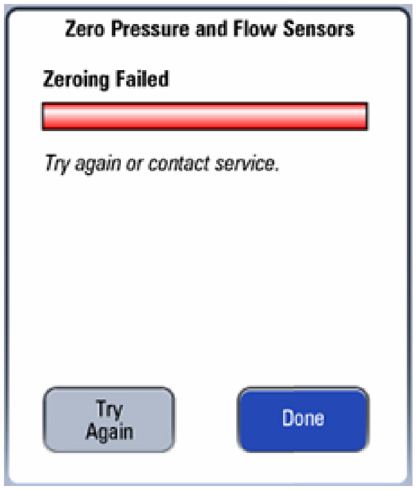


FIGURE 4-97

5. The screen shown below is displayed after a successful zeroing. Select Done to exit the zeroing screen.

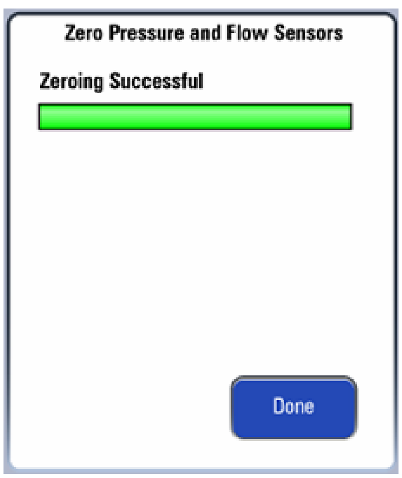


FIGURE 4-98

NOTE: **In case of zeroing failure, other faults may exist. You must isolate and eliminate the problem.**

4.3.5.2 Troubleshoot Pressure and Flow Zeroing Failure

In case of zeroing failure, troubleshoot as follows:

1. Set the anesthesia machine to manual ventilation or standby mode. Turn off fresh gas. Unplug the breathing tubes in the breathing system, causing the inspiration and expiration connectors to open to the air. Bleed the residual gas inside the bellows. Make sure that there is no flow or pressure entering the flow or pressure sensors inside the machine.
2. Check if the zero points of the sensors are normal by referring to 3.7.3 Check the Sensor Zero Point.
3. If a zero point error is detected, unplug the sensor sampling line to eliminate the effects caused by sampling line occlusion or three-way valve. If zero point is still out of the range, the ventilator control board is faulty. Replace the ventilator control board.
4. If zero points of the sensors are correct but zeroing is still failed, the solenoid valve assembly is faulty. Replace the solenoid valve assembly.

4.3.6 Electronic Flowmeter Zeroing (user)

After the gas supply is disconnected, if the pointer of the pressure gauge returns to zero but the electronic flowmeter still displays flow, it is possible that zero offset occurs to the electronic flowmeter's sensor. Generally, you can zero the flowmeter manually to eliminate the measurement deviation caused by zero offset immediately.

4.3.6.1 Zeroing Procedures

Follow these steps to zero the electronic flowmeter.

1. Select Setup-> General-> Zero Flow Meters to access the screen shown below. Set up the machine as per the instructions on the screen and select Begin to start zeroing.

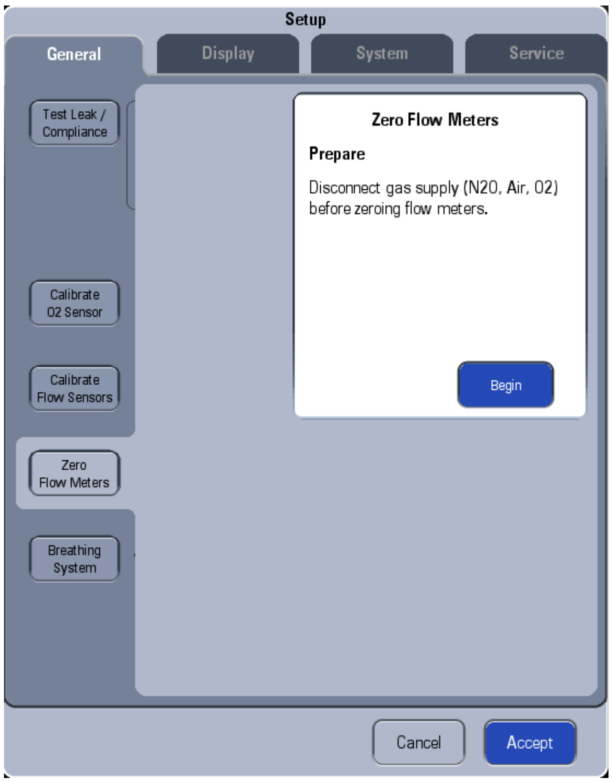


FIGURE 4-99

2. The zeroing screen shown below is displayed when Begin is selected. During the zeroing, you can select Cancel to cancel the zeroing.

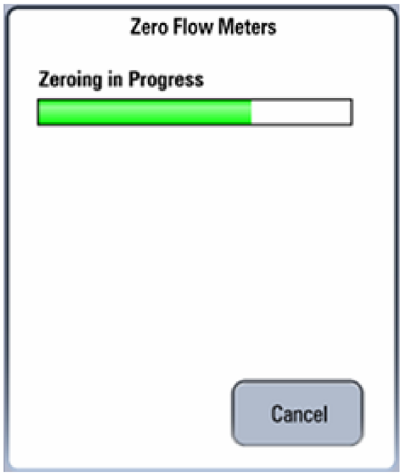


FIGURE 4-100

3. The screen shown below is displayed if the ongoing zeroing is canceled. Select Try Again to do the zeroing again.Select Done to exit the zeroing screen.

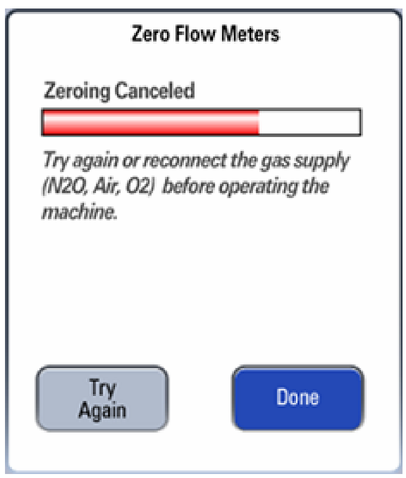


FIGURE 4-101

4. The screen shown below is displayed if the zeroing has failed. Select Try Again to do the zeroing again.Select Done to exit the zeroing screen.

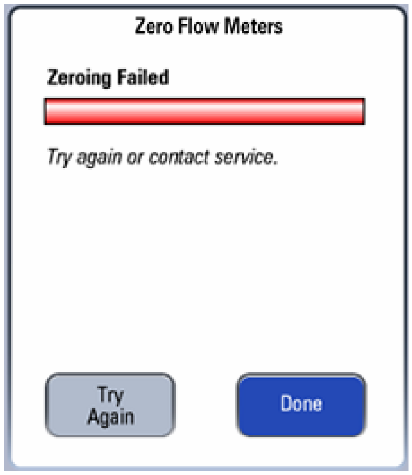


FIGURE 4-102

5. The screen shown below is displayed after a successful zeroing. Select Done to exit the zeroing screen.

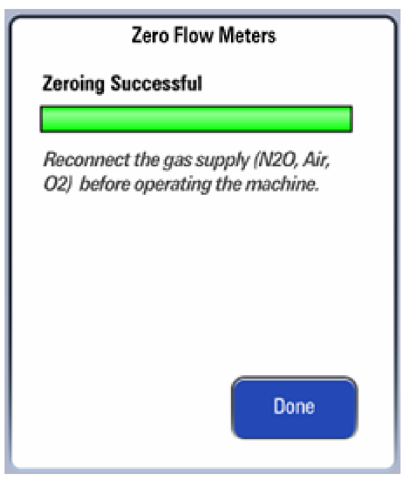


FIGURE 4-103

NOTE: **In case of zeroing failure, other faults may exist. You must isolate and eliminate the problem.**

4.3.6.2 Troubleshoot Electronic Flowmeter Zeroing Failure

In case of zeroing failure, troubleshoot as follows:

1. Disconnect the gas supplies. After bleeding the residual gas inside the machine (or after adjusting the flowmeter to cause the pointer of the pressure gauge to go to zero), perform zeroing again.
2. If zeroing is completed, we can conclude that zeroing failure is caused by the three-way valve mechanical fault. Replace the solenoid valve assembly.
3. If zeroing is still failed, we can conclude that zeroing is caused by the three-way valve hardware circuit fault or fresh flow sensor board fault. Replace the solenoid valve assembly or fresh flow sensor board.

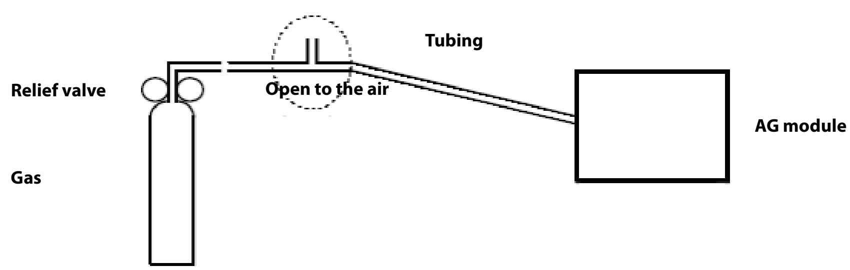
4.3.7 Calibrate the AG Module (A5/A4 with Gas Module)

Prepare the following before doing the calibration:

- Gas cylinder, with a certain standard gas or mixture gas. Gas concentration should meet the following requirements: AA≥1.5%, CO2≥1.5%, N2O≥40%, O2≥40%, of which AA represents an anesthetic agent. a/c≤0.01 (a is the gas absolute concentration accuracy; c is the gas concentration).
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Connect the test system as follows.



2. Ensure that the system is **Standby** mode. If not, select the **Discharge** button in the Manual tab and follow the on-screen prompts to discharge the patient and enter **Standby** mode.
3. Select **Setup** softkey> **System** tab (system password needed).
4. Select the **Calibration** button.
5. Select the **External AG Module** button.
6. Wait for the AG module to be fully warmed up
7. Enter the actual concentration of the calibration gas.
8. Turn on the calibration gas canister and the system displays the real-time concentration of calibration gas.
9. Select the **Calibrate** button to start to calibrate the AG Module. The system will display the results of the calibration status when the process is completed.
10. After calibration, select **Done** to close the **Calibration** window.
11. Select Accept to close the Setup window.

4.3.8 ORC Calibration

Follow these steps to perform ORC calibration:

1. Connect the anesthesia machine to the O2, AIR and N2O supplies. Close the O2, AIR and N2O needle valves. Switch the screen to Standby.

FIGURE 4-104

2. Turn the N2O needle valve to the maximum position. Slowly turn the O2 needle valve to produce O2 flow of 0.3 L/min. If there is N2O flow displayed, turn the O2 resistor on the ORC anti-clockwise with the flathead screwdriver until there is no N2O flow. If there is no NO2 flow displayed, turn the O2 resistor on the ORC clockwise with the flathead screwdriver until the N2O flow just begins.

FIGURE 4-105

FIGURE 4-106

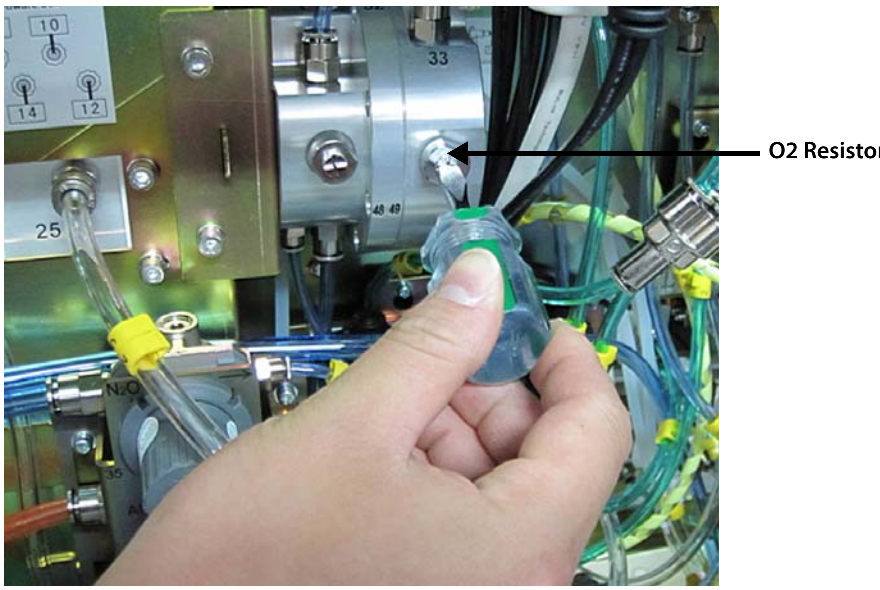


FIGURE 4-107

FIGURE 4-108

3. Keep the N2O needle valve at the maximum position. Close the O2 needle valve knob and then slowly open the O2 needle valve. Observe if the O2 flow falls within 0.25 to 03 L/min when the N2O flow begins. If not, repeat step 2 until the requirement is satisfied.
4. Keep the N2O needle valve at the maximum position. Turn O2 flow to 3 L/min and observe N2O flow. If the N2O flow is less than 8.3 L/min, turn the N2O resistor on the ORC anti-clockwise with the flathead screwdriver until the N2O flow is 8.3 L/min. If the N2O flow is more than 8.3 L/min, turn the N2O resistor on the ORC clockwise with the flathead screwdriver until the N2O flow is 8.3 L/min.

FIGURE 4-109

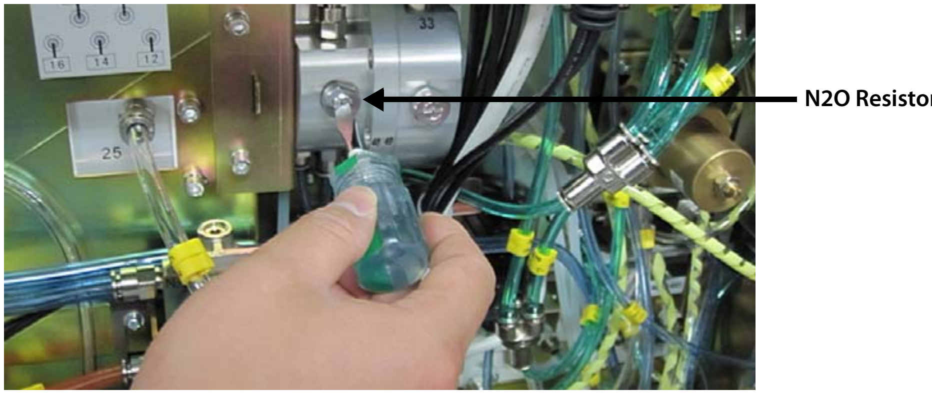


FIGURE 4-110

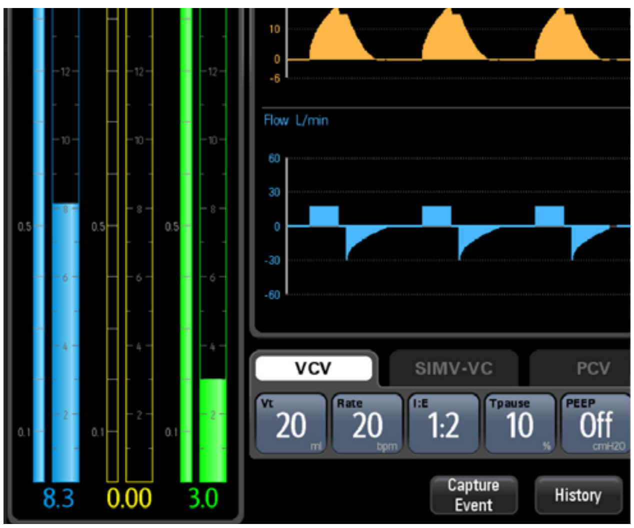


FIGURE 4-111

5. Turn the O2, AIR and N2O needle valves to the maximum positions. Turn the AIR resistor on the pneumatic resistor block assembly to cause the AIR flow to fall within 15 to 15.5 L/min.

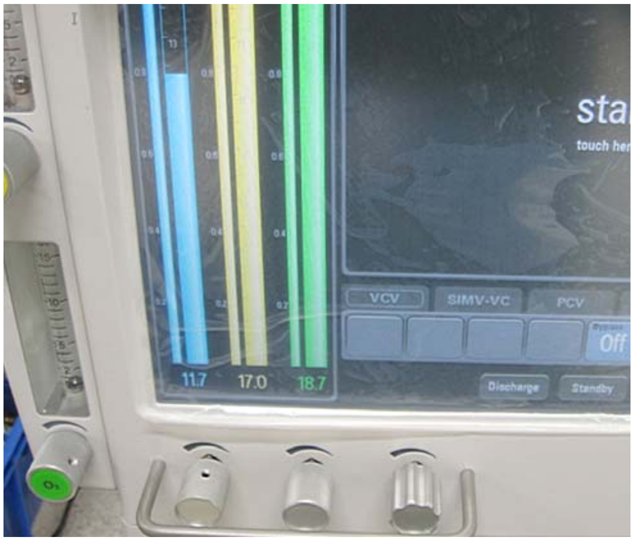


FIGURE 4-112

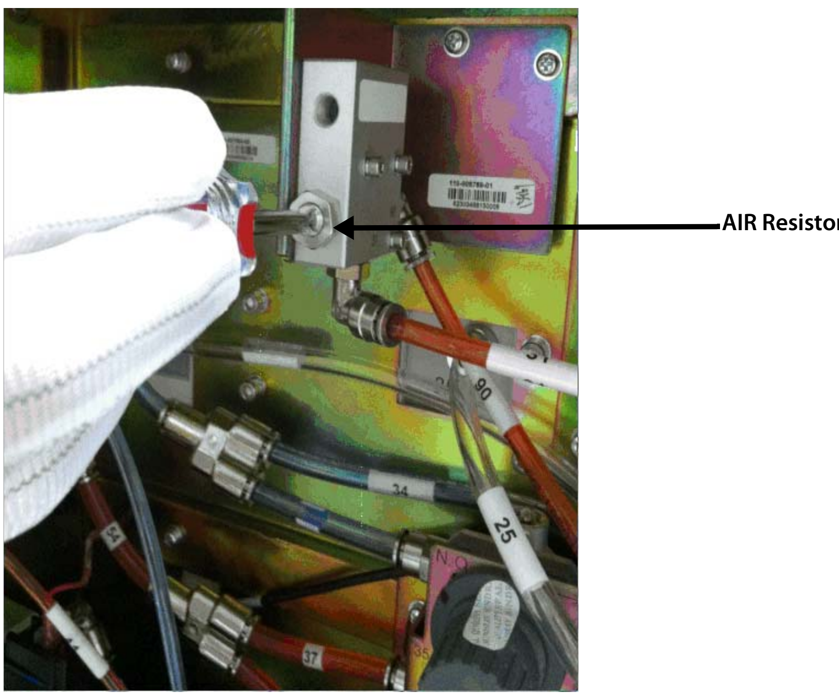


FIGURE 4-113


N2O
L/min
AIR
L/min
O2
L/min
11.9
15.2
18.8
VCV
SIMV-VC
PCV
Off
Discharge
Standby
AIR
touch here to

FIGURE 4-114

FIGURE 4-115

4.3.9 Cylinder Yoke Regulator Calibration

Follow these steps to perform cylinder yoke regulator calibration (the following takes N2O cylinder yoke assembly as an example. The calibration steps of O2 and Air cylinder yoke regulators are same to those of N2O). N2O cylinder yoke is not available for A4 anesthesia system.

For O2 and Air, the pressure in the cylinder must be at least 1000 psi. For N2O, the pressure in the cylinder must be at least 500 psi.

For O2 and AIR, set the output pressure using the table below. For N2O, set the output pressure to 58 psi.

cylinder pressure (psi)	regulator pressure (psi)
1000	52.2
1250	50.6
1500	49
1750	47.4
2000	47.1
2250	46.8

1. Turn off the power supply and all gas supplies. Open the service door.

FIGURE 4-116

2. Remove the sheet metal at the rear of the equipment (for A5).
Remove the upper rear panel (for A3/A4).

FIGURE 4-117 A5

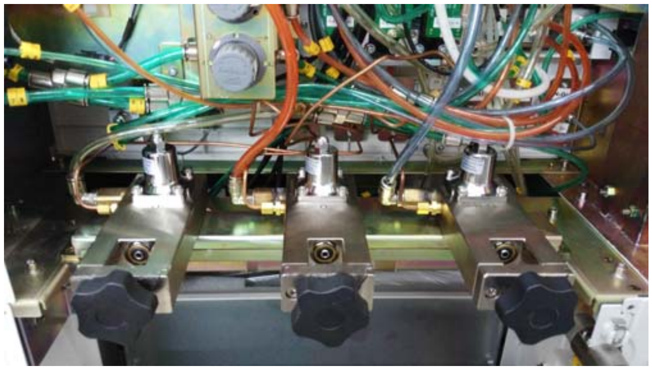


FIGURE 4-118 A3/A4 (N2O cylinder yoke is not available for A4)

3. Disconnect the hose connected to the pipeline assembly and attach it to the pressure meter (For O2 hose #59; for AIR hose #54; for N2O hose #62).

FIGURE 4-119

4. Set the fresh gas flow of the gas being adjusted to 1 L/min.
5. Remove the self-locking acorn nut at the head of the regulator. Install the cylinder.

FIGURE 4-120 A5

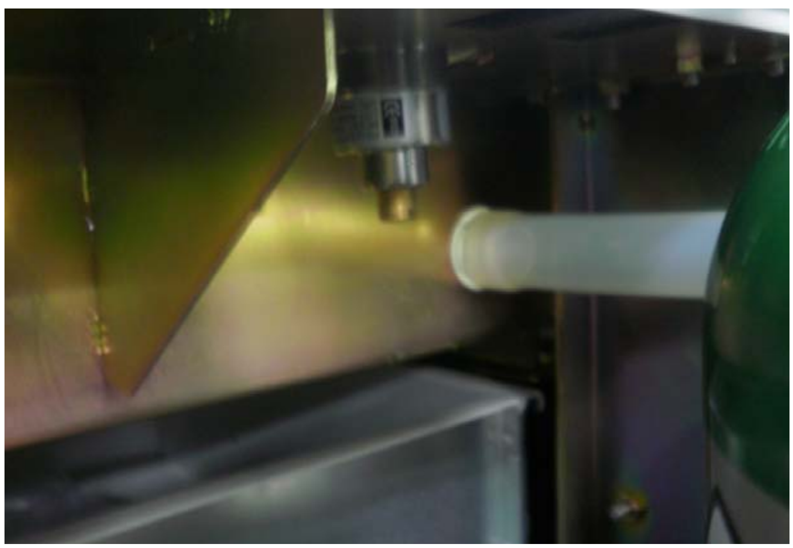


FIGURE 4-121 A5

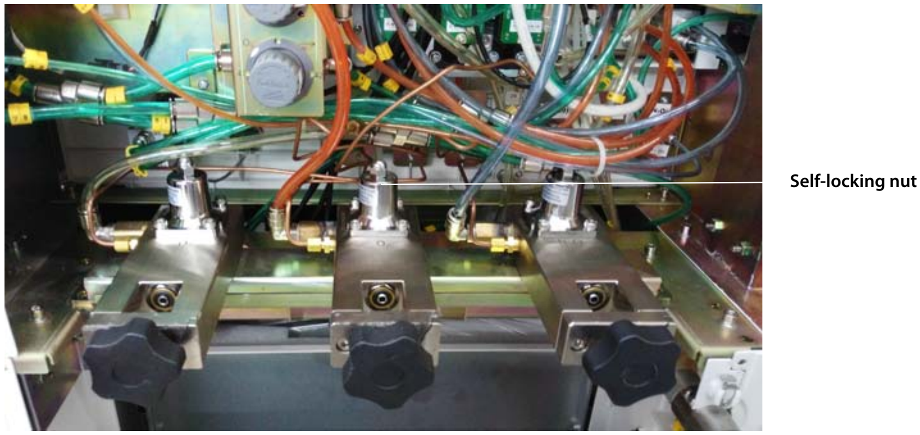


FIGURE 4-122 A3/A4(N2O cylinder yoke is not available for A4)

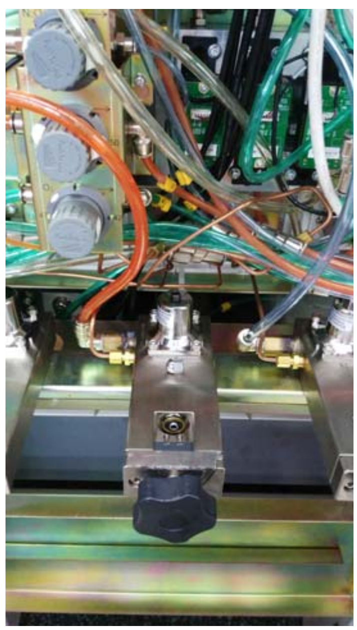


FIGURE 4-123 A3/A4

6. Turn on the gas supply. Rotate the regulator screw at the head slowly with a flathead screwdriver (for A5) or a allen wrench (for A3/A4) to adjust the pressure range (rotate clockwise to increase pressure value and counterclockwise to decrease pressure value) until the pressure after adjustment is within the range specified by the table (±5%). After adjusting the pressure, reinstall and tighten the self-locking acorn nut.

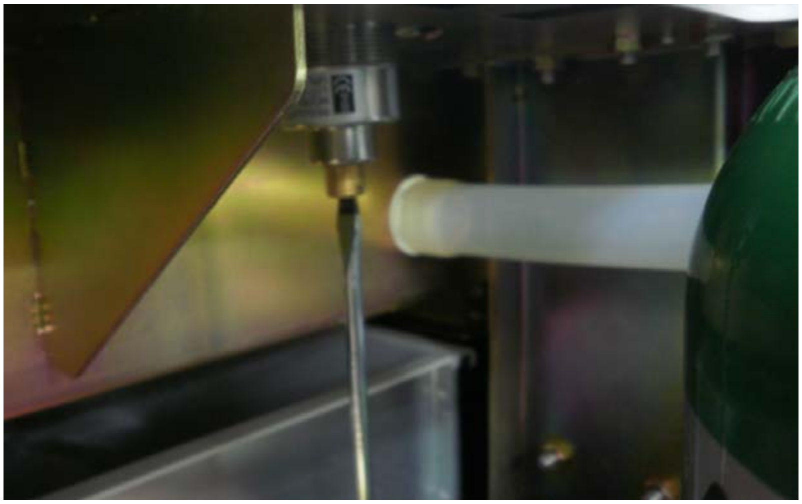


FIGURE 4-124 A5

FIGURE 4-125 A3/A4

7. Turn off the gas supply and restore the equipment tube connections.

4.3.10 Adjust the back pressure valve

1. Connect Anesthesia machine calibration to the front end of the back pressure valve by 3140-08-00 Y piec e and 3106-10-00 adapter connector to monitor and measure the pressure of the front end of the back pressure valve. The connection diagram and connecting ports are shown as follows.

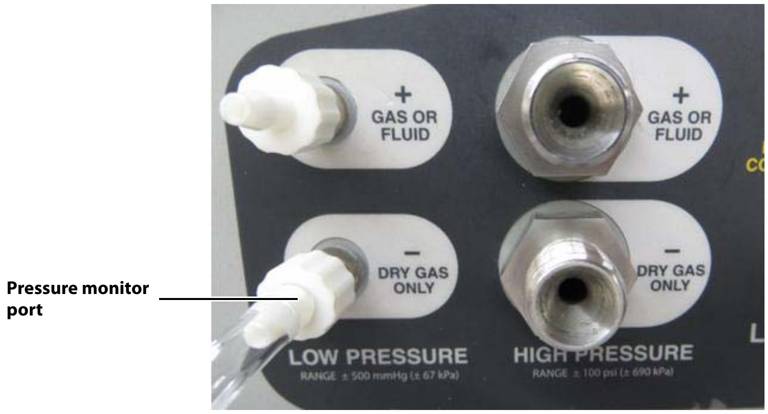


FIGURE 4-126

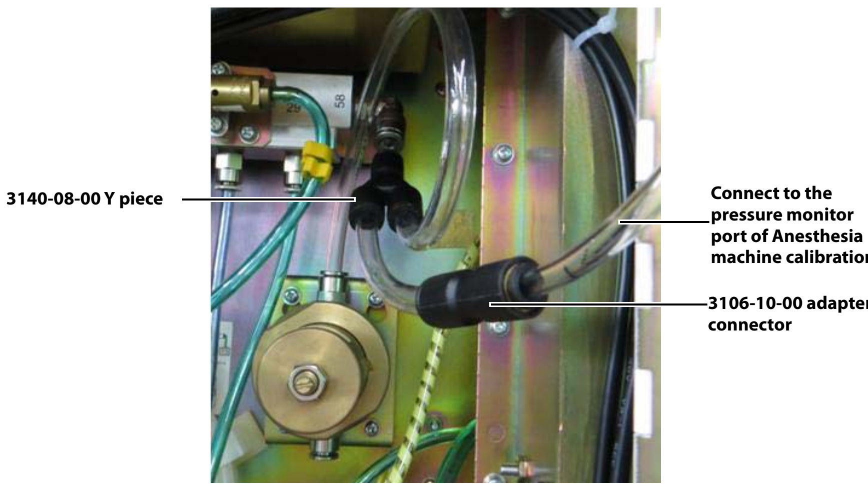


FIGURE 4-127

2. Disconnect the pipeline on the back end of the back pressure valve.
3. Connect to O2 source, and adjust O2 needle valve, while observing the flowmeter on the system interface of A5, to set the O2 flow rate to 5±0.1L/min.
4. Loose the nut of the back pressure valve.
5. Adjust the bolt of the back pressure valve, while observing the displaying pressure value of Anesthesia machine calibration device, to set the pressure value to 33±2kPa.
6. Lock the Nut, as shown in the following figure.

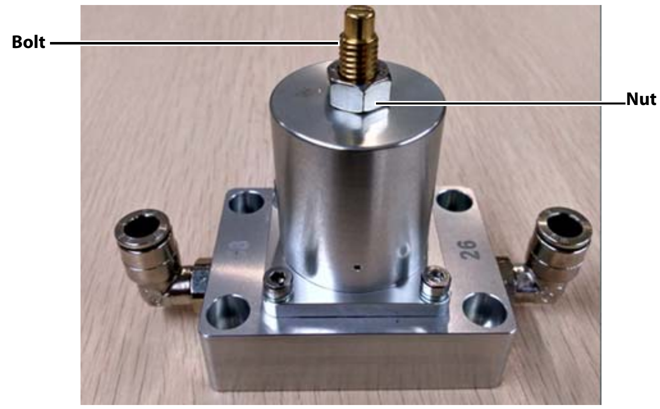


FIGURE 4-128

7. Take off 3140-08-00 Y piece and 3106-10-00 adapter connector, and reconnect the pipeline.

5.0 Repair and Troubleshooting

5.1 Troubleshooting Guidelines

5.1.1 Identify the problem

Due to the wide variety of potential symptoms, certain problems may be more subtle than others. Following the guidelines of the tests will help determine the problem, if one exists.

5.1.2 Avoid shorting component leads together

During repair procedures, it can be tempting to make a quick series of measurements. Always turn the power off before connecting and disconnecting the test leads and probes. The accidental shorting of leads can easily stress the components and cause a second failure (aside from the safety risk).

5.1.3 Use the proper equipment

During repair procedures, the following tools may be required:

- Metric Allen wrench es (2.5, 3, 4, 5, 8 mm)
- Phillips screwdriver (#1 and #2)
- Diagonal pliers
- Flathead screwdriver
- Metric M3 and M4 socket screwdriver
- Adjustable wrench
- Tweezers
- Krytox Lubricant (P/N:0510-00-0020)

It is imperative to use the designated equipment in order to ensure proper results of any and all test procedures.

5.1.4 Clean up the repair area

After any repair, clean off the repair area.

5.2 Technical Alarms Check

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

- Startup alarm Messages
- CPU Board Runtime Alarm
- Power Board Runtime Alarm
- Fresh Flow Sensor Board Alarm
- Ventilation Control Board Runtime Alarm
- AG module real-time alarm

Before troubleshooting the anesthesia machine, check for technical alarm message. If an alarm message is presented, eliminate the alarm first.

The following sections detail how to troubleshoot technical alarms related to the modules mentioned above.

For detailed information on possible causes and actions for other alarm and prompt messages, refer to the Operator's Manual.

5.2.1 Startup Alarm Messages

Message	Priority	Cause	Solution
Bundle Version Error Bundle Version: Time out	High	The software versions are not compatible.	1. Update to the compatible software version again.
Flowmeter Voltage Error	High	DVCC, AVDD or VC voltage error	1. Restart the machine. 2. Measure the 12V input voltage (voltage on the power cable) of the electronic flowmeter to see if it is within specifications. Check if the cable is defective. If the input voltage is out of specification, replace the power board or cable. 3. If the problem persists, replace the fresh flow sensor board.
Flowmeter Selftest Error 'Flowmeter Self Test: Time out	High	1.CPU, Flash or WTD error. 2.After power on, the CPU board can't communicate with the fresh flow sensor board.	1. Restart the machine. 2. Re-plug or replace the communication cable between the CPU Board and the fresh flow sensor board. 3. If the problem persists, replace the fresh flow sensor board. 4. If the problem persists, replace the CPU board.
Aux Control Module Selftest Error Aux Control Module Self Test: Time out	High	1.CPU, Flash, WTD error 2.After power on, the CPU board can't communicate with the auxiliary control module.	1. Restart the machine. 2. Re-plug or replace the communication cable between the CPU Board and the auxiliary control module. 3. If the problem persists, replace the auxiliary control module. 4. If the problem persists, replace the CPU board.
Ventilator Selftest Error Ventilator Self Test: Time out	High	1.CPU, TIMER, RAM, WTD, EEPROM or AD error 2.After power on, the CPU board can't communicate with the ventilator control board.	1. Restart the machine. 2. Re-plug or replace the communication cable between the CPU Board and the ventilator control board. 3. If the problem persists, replace the ventilator control board. 4. If the problem persists, replace the CPU board.

Message	Priority	Cause	Solution
Ventilator Voltage Error	High	5V or 12V voltage error	1. Restart the machine. 2. Measure the input voltage (voltage on the power cable) of the ventilator control module to see if it is within specifications. Check if the cable is defective. 3. If the input voltage is out of specification, replace the power board or cable. 4. If the problem persists, replace the ventilator control board.
PEEP Valve Failure	Med	1. PEEP valve voltage error. 2. PEEP valve pressure error.	1. Check if the pressure sensor on the PEEP circuit is within specifications. Perform pressure sensor calibration in the service menu or replace the sensor on the PEEP circuit when the pressure error. 2. Measure the voltage at the corresponding test point 3. Check the connection between power supply and expiratory valve assembly 4. Replace the Ventilator Control Board when necessary. 5. Replace the expiratory valve assembly. 6. Replace the power board when necessary
Insp Valve Failure	Med	1. Insp valve voltage error. 2. Insp valve flow error.	1. Check if the Inspiratory flow sensor is within specifications. Perform flow sensor calibration in Service menu or replace the flow sensor when flow error occurs. 2. Measure the voltage at the corresponding test point 3. Check the connection between power supply and expiratory valve assembly 4. Replace the Ventilator Control Board when necessary. 5. Replace the expiratory valve assembly. 6. Replace the power board when necessary
PEEP Safety Valve Failure	Med	PEEP safety valve voltage error.	1. Measure the voltage at the corresponding test point 2. Check the connection between power supply and expiratory valve assembly 3. Replace the Ventilator Control Board when necessary. 4. Replace the expiratory valve assembly. 5. Replace the power board when necessary
Flow Sensor Failure	Low	Ventilator flow is out of range.	1. Check if the zero point of the flow sensor is within specifications. 2. Check if the measurement performed by the flow sensor is within specifications. 3. Replace the flow sensor and perform calibration. 4. Replace the ventilator control board and perform calibration.
Calibrate Flow Sensor and Insp Valve	Low	1.Cal. Table isn't found in EEPROM. 2.Checksum of Cal. Table don't match.	Perform service calibration. Refer to section 4.3.3 Flow Calibration (Service).
Calibrate Pressure Sensor and PEEP Valve	Low	1.Cal. Table isn't found in EEPROM. 2.Checksum of Cal. Table don't match.	Perform service calibration. Refer to section 4.3.4 Pressure Calibration (Service).
Calibrate O2 Sensor	Low	1.Cal. Table isn't found in EEPROM. 2.Checksum of Cal. Table don't match.	1. Calibrate the O2 sensor again. 2. Replace the O2 sensor.
Ventilator Initialization Error Ventilator Initialization: Time out	High	After power on, the CPU board can't send the parameter settings to ventilator board.	1. Restart the machine. 2. Re-plug or replace the communication cable between the CPU Board and ventilator control board. 3. If the problem persists, replace the ventilator control board. 4. If the problem persists, replace the CPU Board.

Message	Priority	Cause	Solution
Drive Gas Pressure Low	High	Drive Gas Pressure Low	1. Check the status of actual gas supply to confirm if the alarm is in compliance with the actual status. 2. Short circuit the pressure switch and the alarm regarding outputted signals should disappear. Otherwise, it indicates that the pressure switch is defective. Replace the pressure switch. Otherwise, check the connection between the pressure switch and the ventilator control board and check the socket. 3. If the above two items are within specifications, replace the ventilator control board.
O2 Supply Failure	High	O2 Supply Failure	Use the same method to drive gas pressure low to check the O2 pressure switch.
Power Supply Voltage Error	High	3.3V, 5V, 12V voltage error	1. Measure the voltage at the corresponding test point. 2. If the problem persists, replace the power board.
RT Clock Needs Battery	High	There is no button cell available in the system, or the battery is empty.	1. Replace with a new button cell on the CPU board. 2. If the problem persists, replace the CPU board.
RT Clock Failure	High	RT chip malfunction.	1. Restart the machine. 2. If the problem persists, replace the CPU board.
Keyboard Self Test Error Keyboard Self Test: Time out	High	Keyboard malfunciton.	1. Check the cable connection between the keyboard and main control board. 2. Restart the machine and perform selftest. 3. If the problem persists, replace the keyboard.
External AG Self Test Error External AG: Time out	Low	External AG module selftest malfunction.	1. Re-plug the external AG module. Restart the machine and perform selftest. 2. Check the cable connection between the module rack and CPU board. 3. Check if the module rack works normally. 4. Replace the external AG module.

5.2.2 CPU Board Runtime Alarm

Message	Priority	Cause	Solution
IP Address Conflict	Med	The IP address is same with other machine in the local network.	1. Set the IP address again. 2. If the problem persists, update the system software code or replace the CPU Board.
Fan Failure	Med	The speed of the fan is 20% off of the nominal value.	1. Check if the fan stops running or runs slowly (around 4000 rounds normally). 2. Plug in and out the fan power cable again. 3. If the problem persists, check if 12V for fan power supply on the power board is within specifications. If not, check the power board. 4. If the problem persists, replace the fan. 5. If the problem persists, replace the CPU board.
Fan Failure 02	Med	The speed of module rack fan is less than 3640 rounds/min.	1. Check if the fan stops running or runs slowly (around 4000 rounds per minute normally). 2. Plug in and out the fan power cable again. 3. If the problem persists, check if 12V for fan power supply is within specifications. If not, check the power board. 4. If the problem persists, replace the fan. 5. If the problem persists, replace the CPU board.

5.2.3 Power Board Runtime Alarm

Message	Priority	Cause	Solution
Power System Comm Stop	High	Lost communication with CPU board for 10 seconds.	1. Restart the machine. 2. Re-plug the communication cable. 3. Disconnect the battery from the AC mains. After the power board processor is powered off for 5 minutes, power it on again. 4. Replace with a new communication cable. 5. Check if the power board software is correct. Update the power board software again when necessary. 6. If the problem persists, replace the Power Board. 7. If the problem persists, replace the CPU Board.
Power Supply Voltage Error	High	3.3V, 5V, 12V voltage error	1. Measure the voltage at the corresponding test point. 2. Disconnect the battery from the AC mains. After the power board processor is powered off for 5 minutes, power it on again. Repeat Step 1 3. If the problem persists, replace the Power Board. 4. If the problem persists, contact the technical support.
Low Battery Voltage!	High	Battery voltage is less than 10.6V for 5 seconds.	1. Check the connection to the AC mains. Re-connect the AC mains immediately. 2. Check if the battery voltage is within specifications. 3. Check if the charging circuit is working correctly. If not, replace the Power Board.
System going DOWN, Battery depleted!	High	Battery voltage is less than 10.2V.	1. Restart the machine. 2. If the problem persists, connect to the normal mains supply. Make sure that the AC indicator is lit and charges the battery for 20 minutes. 3. If the problem persists, replace the battery. 4. If the problem persists, replace the power module.
Battery Undetected	Med	Battery Undetected	1. Check if the battery voltage is within specifications. 2. Check if the cable is connected correctly. 3. Replace the battery. 4. If the problem persists, replace the power board.

Message	Priority	Cause	Solution
Battery in Use	Low	AC power fail	1. Check the connection to the AC mains. 2. If the AC mains supply is connected correctly and the voltage is within specifications, check the connection between the AC mains and the power board. Check the AC mains inlet. 3. If the problem persists, replace the power board.
Power Board High Temp	High	The temperature of the power board is greater than 95 C for 10s continuously.C	1. Check the fan for the power module. 2. Stop using the machine for a period of time. If the problem persists after the machine is restarted, replace the power board.
Heating Module Failure	Low	1. Both resistance temps are greater than 106 C for 20 seconds. 2. One of resistance temp is greater than 110 C for 15 seconds.	1. Restart the machine. 2. If the problem persists, check if the heating temperature and voltage are within specifications. If not, replace the power board. 3. If the problem persists, update the SW of the CPU board and replace the CPU board if necessary.
Breathing Circuit Not Mounted	High	Breathing Circuit Not Mounted	1. Check that the circuit is installed in place. 2. Test the connection between the connection line and the connector. 3. Replace the power board.

5.2.4 Fresh Flow Sensor Board Alarm

Message	Priority	Cause	Solution
Flowmeter Voltage Error	High	DVCC, AVDD or VC voltage error	1. Restart the machine. 2. Measure the 12V input voltage (voltage on the power cable) of the electronic flowmeter to see if it is within specifications. Check if the cable is defective. If the input voltage is out of specification, replace the power board or cable. 3. If the problem persists, replace the fresh flow sensor board.
N2O Flow Too High	Low	N2O flow is greater than 15L/min for 1 second.	1. Turn off other gas flow. Compare the concerned gas flow with the measurement result displayed on the total flowmeter. 2. Use test tools. Turn Auto/Manual to Manual, Set APL valve at Max value. Measure fresh gas flow at the inspiration connector. Check the measurement error of electronic flowmeter. 3. If the problem persists, replace the flowmeter relative subassembly.
O2 Flow Too High	Low	O2 flow is greater than 25L/min for 1 second.	Use the same method as "N2O Flow Too High" to "O2 Flow Too High" to check the O2 flowmeter.
Air Flow Too High	Low	Air flow is greater than 20L/min for 1 second.	Use the same method as "N2O Flow Too High" to "Air Flow Too High" to check the Air flowmeter.
O2-N2O Ratio Error	High	N2O flow is greater than 0.5 L/min and greater than 4 times O2 flow, this condition last for 1.6 seconds.	1. Restart the machine. 2. Check the measurement correctness of O2 and N2O flow sensors. If measurement error occurs, replace the flow sensor. 3. Check the ORC for leakage. Connect the tubes again. If an error occurs, replace the ORC. 4. If the problem persists, replace the fresh flow sensor board.
Flowmeter Comm Stop	High	Lost communication with CPU board for 10 seconds.	1. Restart the machine. 2. Re-plug or replace the communication cable between the CPU board and the fresh flow sensor board. 3. If the problem persists, replace the fresh flow sensor board. 5. If the problem persists, replace the CPU board.
NO Fresh Gas	Med	Fresh gas flow is less than 50 mL/min	1.Check if the fresh gas knob is opened. 2. Check the measurement correctness of flow sensors. If measurement error occurs, replace the flow sensor. 3. Check the ORC for leakage. Connect the tubes again. If an error occurs, replace the ORC. 4. If the problem persists, replace the fresh flow sensor board.
Internal N2O Flow Failure	Low	Communication failure between the electronic flowmeter CPU and N2O flow sensor for 3s continuously	1. Restart the machine. 2. Check the measurement correctness of flow sensors. If measurement error occurs, replace with the new flow sensor and upgrade the software bundle version to 02.12.00 and later. 3. If the problem persists, replace the fresh flow sensor board.

Message	Priorit y	Cause	Solution
Internal O2 Flow Failure	Low	Communication failure between the electronic flowmeter CPU and O2 flow sensor for 3s continuously	Handle in the similar way to handling "Internal N2O Flow Failure".
Internal Air Flow Failure	Low	Communication failure between the electronic flowmeter CPU and N2O flow sensor for 3s continuously	Handle in the similar way to handling "Internal N2O Flow Failure".

5.2.5 Ventilator Control Board Runtime Alarm

Message	Priority	Cause	Solution
Aux Control Module Comm Stop	High	Lost communication with CPU board for 10 seconds.	1. Restart the machine. 2. Re-plug or replace the communication cable between the CPU Board and the ventilator control board. 3. If the problem persists, replace the auxiliary control module. 4. If the problem persists, replace the CPU Board.
Ventilator Voltage Error	High	5V or 12V voltage error	1. Restart the machine. 2. Measure the input voltage (voltage on the power cable) of the ventilator control module to see if it is within specifications. Check if the cable is defective. 3. If the input voltage is out of specification, replace the power board or cable. 4. If the problem persists, replace the ventilator control board.
PEEP Valve Failure	Med	1. PEEP valve voltage error. 2. PEEP valve pressure error.	1. Check if the pressure of pressure sensor on the PEEP circuit is within specifications. Perform pressure sensor calibration in the service menu or replace the sensor on the PEEP circuit when the pressure error. 2. Measure the voltage at the corresponding test point 3. Check the connection between power supply and expiratory valve assembly 4. Replace the ventilator control board when necessary. 5. Replace the expiratory valve assembly. 6. Replace the power board when necessary
Insp Valve Failure	Med	1. Insp valve voltage error. 2. Insp valve flow error.	1. Check if the inspiratory flow sensor is within specifications. Perform flow sensor calibration in the service menu or replace the flow sensor when the flow error. 2. Measure the voltage at the corresponding test point. 3. Check the connection between power supply and expiratory valve assembly. 4. Replace the ventilator control board when necessary. 5. Replace the expiratory valve assembly. 6. Replace the power board when necessary.
PEEP Safety Valve Failure	Med	PEEP safety valve voltage error.	1. Measure the voltage at the corresponding test point. 2. Check the connection between power supply and expiratory valve assembly. 3. Replace the ventilator control board when necessary. 4. Replace the expiratory valve assembly. 5. Replace the power board when necessary.
Flow Sensor Failure	Low	1.Insp flow is out of range. 2.Exp flow is out of range. 3.Internal Flow sensor is disconnected	1. Check if the zero point of the flow sensor is within specifications. 2. Check if the measurement performed by the flow sensor is within specifications. 3. Replace the flow sensor and perform calibration. 4. Check cable connection between the ventilator inside sensors. Plug in and out the cables again. Replace the sensor when necessary. 5. Replace the ventilator control board and perform calibration.
Check Flow Sensors	High	1.Insp reverse flow 2.Exp reverse flow	1. Check the check valve. 2. Check if the sampling lines of the sensor are connected in correct order. 3. Test the measurement status of the sensor in the valves test tool.

Message	Priority	Cause	Solution
Pinsp Not Achieved	Low	In pressure mode, Pinsp is less than 2/3 of its setting value (setting value is greater than 9cmH2O) or less than setting value-3cmH2O (setting value is less than 9cmH20) for 6 cycles continuously.	1. Check for breathing circuit leakage. 2. Check the measurement accuracy of the pressure sensor. 3. Perform calibration in case of measurement failure. 4. Replace the ventilator control board and perform calibration.
Vt Not Achieved	Low	TVi is less than TV setting value for 6 cycles continuously for over 20% or 50ml, whichever is greater.	1. Check for breathing circuit leak. 2. Check the measurement accuracy of the pressure sensor. 3. Perform calibration in case of measurement failure.
Patient Circuit Leak	Med	1. Pressure less than 2cmH20 for 30s continuously during mechanical ventilation. 2. Patient not connected.	1. Check the breathing circuit connections and flow sensor connections. 2. Check the tidal volume measurement accuracy of the sensor. 3. Check for breathing system leakage.
CO2 A bsorber Canister Not Locked	High	CO2 Ca nister Not Mounted	1. Re-mount the CO2 absorber canister. 2. Check the cable connected between the CO2 absorber canister and the ventilator control board. Replace the cable if necessary. 3. If the problem persists, replace the ventilator control board. 4. If the problem persists, replace the switch on the CO2 abso rber canister.
O2 Sensor Disconnected	Low	O2 Sensor Disconnected	1. Make sure that the O2 sensor is connected to the cable correctly. 2. Check the voltage O2 sensor outputted in calibration menu. 3. Replace the O2 sensor.
Replace O2 sensor	Med	The O2 value is less than 5%	1. Check the voltage O2 sensor outputted in calibration menu. 2. Calibrate the O2 sensor again. 3. Replace the O2 sensor.
Calibrate O2 Sensor	Low	O2 value is greater than 110% or between 5% and 15% for 3 seconds.	1. Calibrate the O2 sensor again. 2. Replace the O2 sensor.
Ventilator Comm Stop	High	Lost communication with CPU board for 10 seconds.	1. Restart the machine. 2. Re-plug or replace the communication cable between the CPU board and the ventilator control board. 3. If the problem persists, replace the ventilator control board. 4. If the problem persists, replace the CPU board.
Drive Gas Pressure Low	High	Drive Gas Pressure Low	1. Check the status of actual gas supply to confirm if the alarm is in compliance with the actual status. 2. Short circuit the pressure switch and the alarm regarding outputted signals should disappear. Otherwise, it indicates that the pressure switch is defective. Replace the pressure switch. Otherwise, check the connection between the pressure switch and the ventilator control board and check the socket. 3. If the above two items are within specifications, replace the ventilator control board.
O2 Supply Failure	High	O2 Supply Failure	Use the same method to drive gas pressure low to check the O2 pressure switch. If this message occurs when using tanks as the gas supply source, check that the O2 regulator is within specifications and calibrate it as required.

Message	Priority	Cause	Solution
3-way Valve Failure	Low	Error of Solenoid valve electrical signal control status	1. Check the Solenoid valve connection line. 2. Replace the Solenoid valve assembly. 3. Replace the ventilator control board.
Auto Ventilation Disabled	Low	System self test failure. Manual Only.	1. Restart the machine. 2. If the problem persists, check the relevant module based on the system selftest result. 3. If the problem persists, replace the relevant module based on the system selftest result.
Auto Ventilation Disabled - Leak Test Failed	Low	Automatic circuit leak test failure	1. Check if the circuit and tubes are correctly installed (if the sampling port is occluded and if the drain valve is occluded) 2. Do leak test again.
Auto Ventilation is Non-Functional	High	Manual Only. But the Auto/Manual switch is in Auto position.	1. Place the Auto/Manual switch in Manual position.

5.2.6 Real-time Alarms of External AG Module

Message	Priority	Cause	Solution
AG Hardware Error	Med	AG hardware error.	Replace the AG module.
O2 Sensor Error	Med	O2 sensor error.	Replace the AG module.
External AG Self Test Error	Low	AG self-test failure.	Replace the AG module.
AG Hardware Malfunction module	High	The AG module was installed improperly or malfunctioned.	Replace the AG.
AG Init Error	High	AG initialization error.	Replace the AG module.
AG No Watertrap	Low	The AG module watertrap was disconnected from the anesthesia machine.	1. Check the AG module watertrap. 2. Replace the AG module watertrap. 3. Replace the AG module.
AG Watertrap Type Wrong	Low	When the patient type was infant, the watertrap type was adult.	Replace with a neonatal watertrap.
AG Change Watertrap	Med	The AG watertrap was required to be changed.	1. Check the AG module watertrap. 2. Replace the AG module watertrap. 3. Replace the AG module.
AG Comm Stop	High	AG module malfunction or communication failure.	1. Replace the AG module communication cable. 2. Replace the AG module.
AG Airway Occluded High	High	The actual pump rate of the AG module was less than 20ml/min for more than one second.	1. Check the AG module sampling. 2. Replace the AG module watertrap. 3. Replace the AG module.
AG Data Limit Error	Med	AG module malfunction.	Replace the AG module.
AG Zero Failed Low	Low	AG module zeroing failure.	1. Re-zero the AG module. 2. Replace the AG module.
AG Cal. Failed	High	AG module calibration failure.	1. Re-calibrate the AG module. 2. Replace the AG module.
O2 Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.
N2O Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.
CO2 Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.
Enf Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.

Iso Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.
Sev Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.
Hal Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.
Des Accuracy Unspecified	Low	The measured value exceeded the module accuracy range.	1. Re-calibrate the AG module. 2. Replace the AG module.
Mixed Agent	Low	The AG module supported monitoring and calculation of two kinds of halogenated anesthetic agents, and the measured MAC was less than 3.	Use only one halogenated anesthetic agent.
Mixed Agent	Med	The AG module supported monitoring and calculation of two kinds of halogenated anesthetic agents, and the measured MAC was less than 3. And the monitored value of one agent was invalid.	Use only one halogenated anesthetic agent.
Mixed Agent and MAC≥3	Med	The AG module supported monitoring and calculation of two kinds of halogenated anesthetic agents, and the measured MAC was greater than or equal to 3.	Use only one halogenated anesthetic agent.
External AG Module Disconnected	High	FDA version had external AG module in standard configuration, but the external AG module was not connected.	Load the external AG module.
Incompatible AG Software Version	High	AG module software version was lower than 1.7.3.	1.Replace with AG module of high version software. 2.Return to the factory to update the low-version AG module of low version.
EtCO2 Overrange	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiCO2 Overrange	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.

EtO2 Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiO2 Overrange	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
EtN2O Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiN2O Overrange	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
EtHAL Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiHAL Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
EtENF Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiENF Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
EtISO Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiISO Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
EtSEV Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiSEV Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.

EtDES Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
FiDES Overrange Low	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.
Rate Overrange	Low	The monitored value exceeded the module measurement range.	1. Reduce the concentration of the monitored gas to the normal range. 2. Re-calibrate the AG module. 3. Replace the AG module.

5.3 Pneumatic Circuit System Problems

The pneumatic circuit system is mainly composed of anesthetic gas delivery system, anesthetic agent delivery device (vaporizer), anesthetic ventilator, breathing system and anesthetic gas scavenging system. This chapter details possible failures regarding the pneumatic circuit system and how to troubleshoot them.

5.3.1 Tools for on-site Maintenance

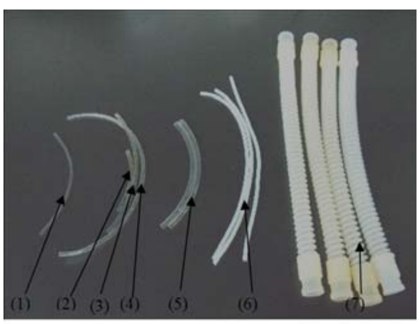
The tools required for troubleshooting are listed below.

<table>
<tr><th>Name</th><th>Quantity</th><th>P/N</th></tr>
<tr><td>Negative pressure ball</td><td>1</td><td>040-000814-00*</td></tr>
<tr><td>Injector (100m)</td><td>1</td><td>040-000040-00*</td></tr>
<tr><td>Circuit adapter test fixture</td><td>1</td><td>115-002452-00*</td></tr>
<tr><td>Flow sensor pressure sampling pipeline test fixture</td><td>1</td><td>115-002456-00*</td></tr>
<tr><td>Vaporizer manifold test fixture</td><td>1</td><td>115-002453-00*</td></tr>
<tr><td>1 MPa (10 bar) Test pressure gauge</td><td>1</td><td>0611-30-67602*</td></tr>
<tr><td>T-shaped Allen wrench (4*100)</td><td>1</td><td>M90-100111---*</td></tr>
<tr><td>3106-04-06adapter connector</td><td>1</td><td>M6Q-030068---*</td></tr>
<tr><td>3106-06-08adapter connector</td><td>1</td><td>M6Q-030051---*</td></tr>
<tr><td>3106-10-00adapter connector</td><td>2</td><td>082-000021-00*</td></tr>
<tr><td>3106-06-00adapter connector</td><td>1</td><td>M6Q-030059---*</td></tr>
<tr><td>Breathing tube adapter connector</td><td>1</td><td>115-002454-00*</td></tr>
<tr><td>3126-04-00 tube plug</td><td>2</td><td>082-000023-00*</td></tr>
<tr><td>3126-06-00 tube plug</td><td>3</td><td>M6Q-120001---*</td></tr>
<tr><td>3126-08-00 tube plug</td><td>4</td><td>M6Q-120002---*</td></tr>
<tr><td>3126-10-00 tube plug</td><td>3</td><td>082-000022-00*</td></tr>
<tr><td>Y piece</td><td>2</td><td>M90-100030---*</td></tr>
<tr><td>Breathing tube Y piece</td><td>1</td><td>M6Q-030028---*</td></tr>
<tr><td>3140-08-00 Y piece</td><td>1</td><td>M6Q-030025---*</td></tr>
<tr><td>PU tube (4X200)</td><td>1</td><td>M6G-020046---*</td></tr>
<tr><td>PU tube (6X100)</td><td>1</td><td rowspan="3">M6G-020026---*</td></tr>
<tr><td>PU tube (6X200)</td><td>1</td></tr>
<tr><td>PU tube (6X300)</td><td>1</td></tr>
<tr><td>PU tube (8X200)</td><td>2</td><td>M6G-020014---*</td></tr>
<tr><td>Breathing tube</td><td>4</td><td>M6G-020017---*</td></tr>
<tr><td>Ø6 silicone tube</td><td>3</td><td>A21-000007---*</td></tr>
<tr><td>A5/A4/A3 Service Manual</td><td>\</td><td>046-001141-00</td></tr>
<tr><td>Test Lung, Adult</td><td>\</td><td>0138-00-0012</td></tr>
<tr><td>Tank Wrench</td><td>\</td><td>0367-00-0080</td></tr>
<tr><td>Y-Fitting 15 mm connection</td><td>\</td><td>0103-00-0508</td></tr>
<tr><td>Respiration Tube, 0.6 meter silicone, 15mm</td><td>2</td><td>0004-00-0076</td></tr>
<tr><td>Breathing Bag 2.3 L silicone</td><td>\</td><td>0992-00-0139</td></tr>
<tr><td>Regulator Calibration Hose</td><td>\</td><td>0453-00-1216</td></tr>
</table>

Name	Quantity	P/N
A5/A4/A3 troubleshooting kit	\	115-009450-00
Vaporizer Instruction Manual	\	\
Safety Analyzer Dempsey 430 or equivalent	\	\
Digital Volt Meter 3 1/2 digit	\	\
Agent (and NO2) Analyzer ±0.3 V/V%+5% of reading	\	\
Digital Pressure Meter BC Biomedical DPM-2301751 NMC Digital Pressure Meter or equivalent	\	\
Central supplied O2,NO2,AIR Minimum of 35 psi, DISS connections.	\	\
Cylinder gases O2,NO2,AIR Full PISS yoke connections	\	\
Hand tools, Allen wrench set Metric	\	\
Gas Flow Analyzer with 2% accuracy	\	\
A Series Calibration Set (required if using Fluke VT Plus Gas Flow Analyzer)	\	801-0631-00121-00
Ethernet Crossover Cable	\	0012-00-1392-06
USB flash drive	\	0992-00-0297-04
Regulator	\	0119-00-0235**
AG Calibration gas	\	0075-00-0048-01**

* = is part of the 115-009450-00 A5/A4/A3 troubleshooting kit.
** = for units with a AG gas module only

The following pictures show the tools listed above.



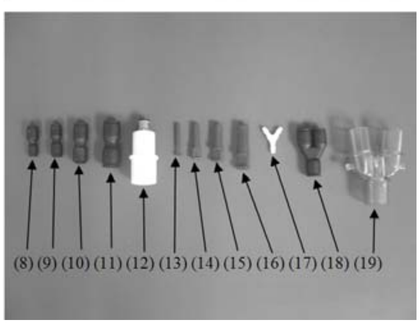


FIGURE 5-1 (1) PU tube (4X200), (2) PU tube (6X100), (3) PU tube (6X200), (4) PU tube (6X300), (5) PU tube (8X200), (6) Ø6 silicone tube, (7) Breathing tube, (8) 3106-04-06 adapter connector, (9) 3106-06-00 adapter connector, (10) 3106-06-08 adapter connector, (11) 3106-10-00 adapter connector, (12) Breathing tube adapter connector, (13) 3126-04-00 tube plug, (14) 3126-06-00 tube plug, (15) 3126-08-00 tube plug, (16) 3126-10-00 tube plug, (17) Y piece, (18) 3140-08-00 Y piece, (19) Breathing tube Y piece

Negative pressure ball:

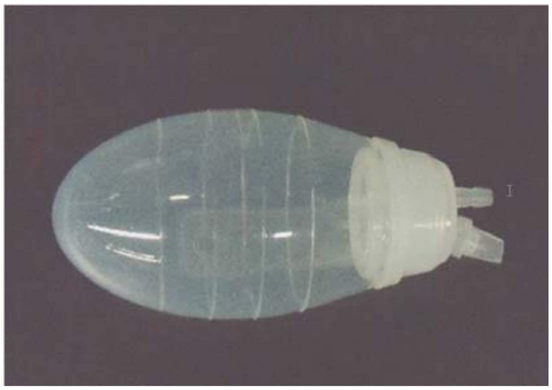


FIGURE 5-2

Circuit adapter test fixture:

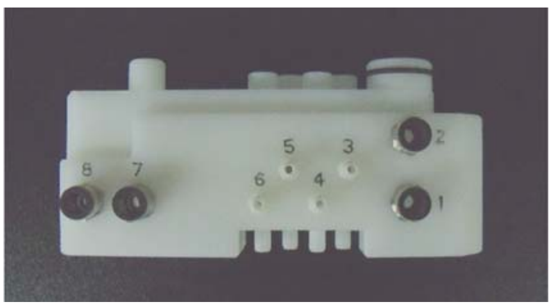


FIGURE 5-3

Flow sensor pressure sampling pipeline test fixture:

FIGURE 5-4

Vaporizer manifold test fixture:

FIGURE 5-5

Anesthesia machine calibration device (fluke VT plus):

FIGURE 5-6

Anesthesia machine calibration device (TSI Certifier 4070):

FIGURE 5-7

Anesthesia machine calibration device (Certifier FA Plus):

FIGURE 5-8

1 MPa (10bar) test pressure gauge:

FIGURE 5-9

5.3.1.1 Precautions for Use of Circuit Adapter Test Fixture

There are four connectors for pressure sampling lines and four Ø6 quick plug-in connectors with number marked on the circuit adapter test fixture, as shown below.

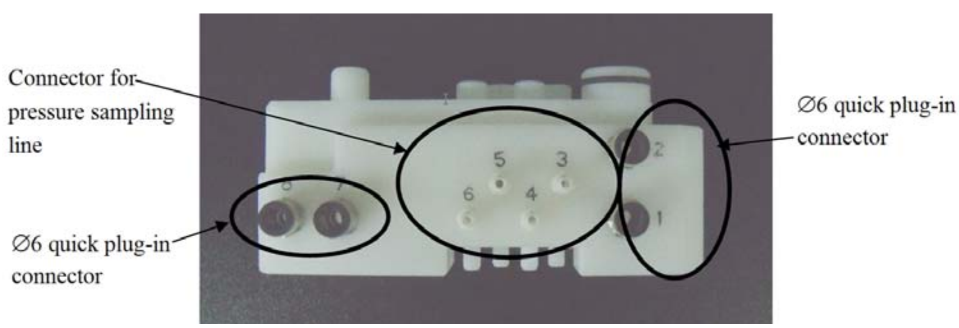


FIGURE 5-10

The connectors for pressure sampling lines can be connected with Ø6 silicone tubes and the Ø6 quick plug-in connectors with PU tube (6X100), PU tube (6X200) and PU tube (6X300), as shown below.

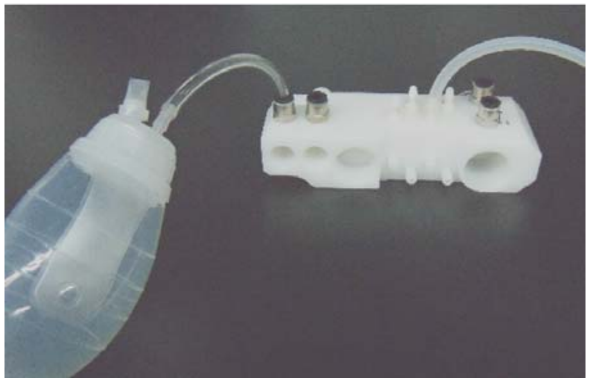


FIGURE 5-11

The circuit adapter test fixture can be mounted either onto the circuit adapter or onto the removed breathing system. The following pictures show the test fixture mounted in position.

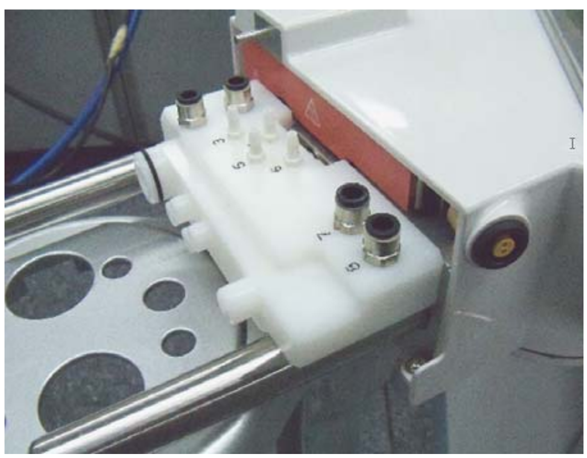


FIGURE 5-12

FIGURE 5-13

If it is hard to install and remove the test fixture, apply a layer of KRYTOX lubricant to the seals (as shown below).

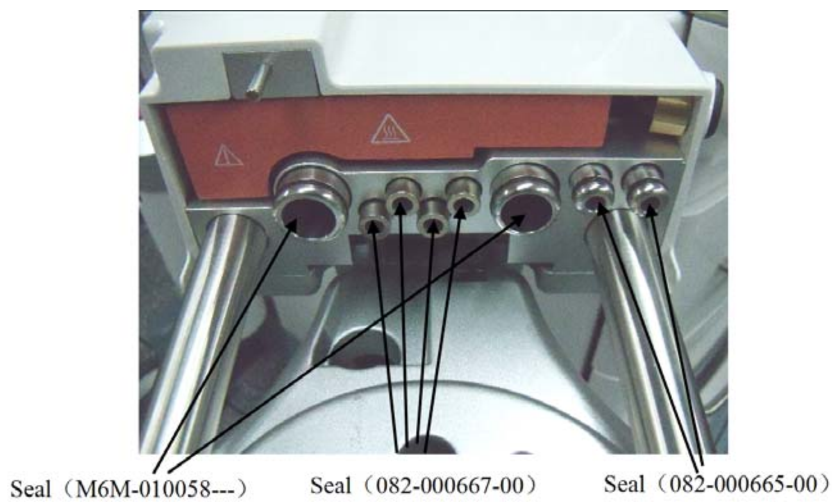


FIGURE 5-14

5.3.1.2 Precautions for Use of Flow Sensor Pressure Sampling Pipeline Test Fixture

There are two connectors for pressure sampling lines on the flow sensor pressure sampling pipeline test fixture, as shown below.

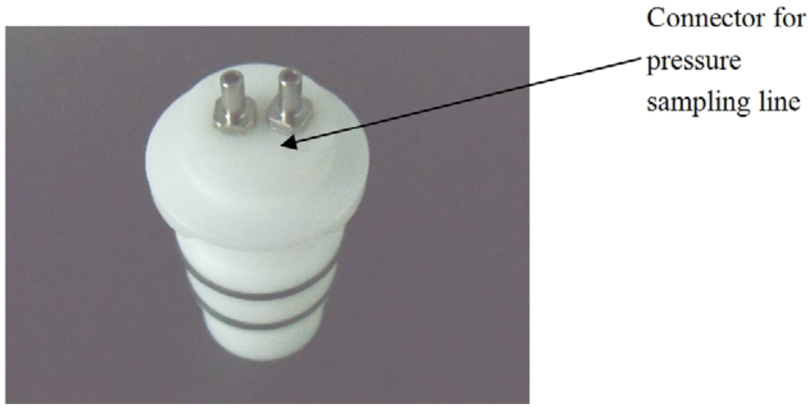


FIGURE 5-15

The connector for pressure sampling line can be connected with Ø6 silicone tubes. When using the flow sensor pressure sampling pipeline test fixture, remove the expiratory or inspiratory flow sensor from the breathing system first. Then mount the flow sensor pressure sampling pipeline test fixture onto the position where the expiratory or inspiratory flow sensor was originally mounted and tighten the Inspiration/Expiration Connector Coupling, as shown below. Perform test after connecting the Ø6 silicone tube to the connector for pressure sampling line.

FIGURE 5-16

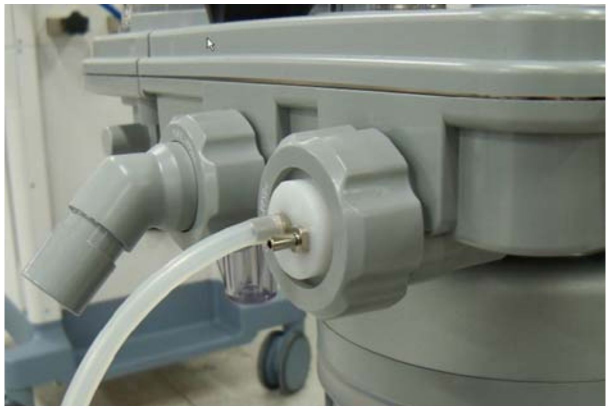


FIGURE 5-17

5.3.1.3 Precautions for Use of Vaporizer Manifold Test Fixture

When using the vaporizer manifold test fixture, remove the o-ring seal on the vaporizer manifold assembly. Then slide the test fixture onto the connector, as shown below.

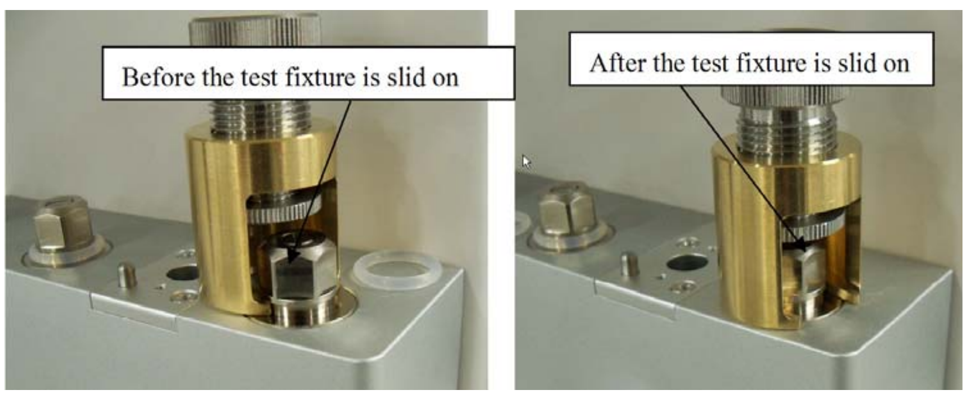


FIGURE 5-18

Turn the knob clockwise until the bottom surface of the pressure head is in contact with the top surface of the connector, as shown below.

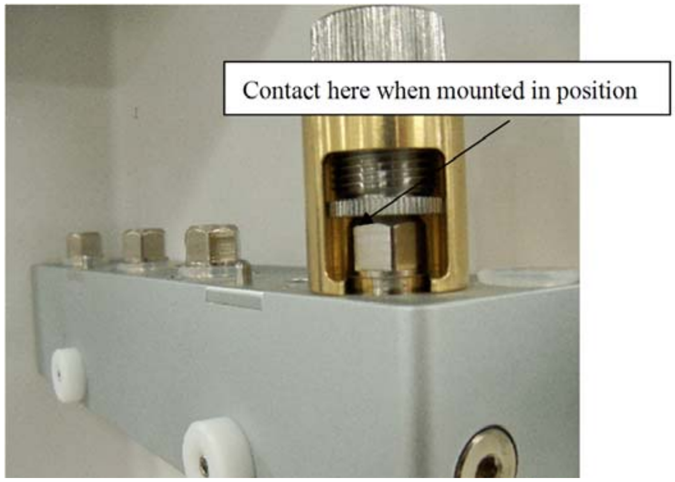


FIGURE 5-19

5.3.1.4 Precautions for Use of Negative Pressure Ball

Besides one sealing cover, the negative pressure ball also has two one-way valves at its front end, as shown below. The built-in one is connected with the gas inlet of the ball which permits the gas come in only, and the exterior one only permits the gas come out. If the front sealing cover is removed or loosened, the sealing performance of the negative pressure ball will compromise. In this case, you need to tighten the sealing cover.

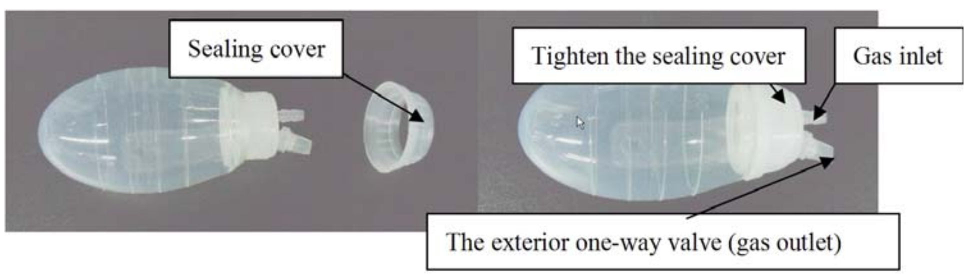


FIGURE 5-20

When the negative pressure ball is connected with the tested component, the ball permits the gas in only, but meanwhile it's free to release air when it's pressed.

FIGURE 5-21

Before using the negative pressure ball, make sure that it is not leaky. Check if the front sealing cover is tightened. Then flatten the negative pressure ball to remove the gas inside. Install the gas outlet plug properly. Block the front gas inlet with your finger then release the ball. Ball should not visibly inflate for at least 30 seconds. If it does, replace the ball.

5.3.2 Gas Supplies and Drive Gas

The following table lists gas supplies and drive gas related failures.

Failure description	Possible cause	Recommended action
Leak	The gas supply tube is damaged or the seal at the connection is damaged.	Replace the gas supply tube or the seal at the connection.
	The quick plug-in connector leaks.	Replace the quick plug-in connector or PU tube (when the PU tube is not damaged, if the tube is long enough, cut off a small segment of the tube where the quick plug-in connector is met, and then insert the tube into position).
	The pipeline gas supply inlet assembly leaks.	Check if the check valve of the pipeline gas supplies inlet assembly leaks in the reverse direction. Replace it if necessary. Check and replace the damaged seal of the pipeline gas supplies inlet assembly. If the problem persists, replace the pipeline gas supplies inlet assembly.
	The drive gas pipeline leaks.	Check and repair the expiratory valve assembly as per the procedures described in "Leak Test of Low-pressure Pneumatic Circuit System" on page 5-54,
Pipeline pressure gauge shows inaccurate readings or no readings.	The pipeline pressure gauge is damaged.	Replace the pipeline pressure gauge.

Failure description	Possible cause	Recommended action
The readings on the pipeline pressure gauge fluctuate greatly.	The filter of pipeline gas supply inlet assembly or the PU tube of the pipeline pressure gauge is occluded or the pressure gauge is damaged.	1. After confirming that the pipeline gas pressure is stable, check the PU tube of the pipeline pressure gauge and filter of the pipeline gas supply inlet assembly. If the tube or the filer is occluded, replace it. 2. If the problem persists, replace the pipeline pressure gauge.
No "O2 Supply Failure" alarm occurs when the O2 pressure is low or this alarm occurs when the O2 supply pressure is within specifications.	The gas pressure switch of the O2 supply inlet assembly is ineffective.	Adjust the pressure switch of the O2 supply inlet assembly to cause O2 supply pressure to approach 0.2 MPa as much as possible within the range of 0.15 to 0.25 MPa when this alarm occurs. If the adjustment fails, replace the pressure switch (refer to "Adjust the Pressure Switch" on page 5-35.).
No "Drive Gas Pressure Low" alarm occurs when the drive gas pressure is low or this alarm occurs when the drive gas pressure is within specifications.	The pressure switch on the integrated pneumatic circuit of the expiratory valve assembly or the PEEP safety valve is ineffective. Or, the filter on the integrated pneumatic circuit of the expiratory valve assembly is occluded.	Adjust the pressure switch on the integrated pneumatic circuit of the expiratory valve assembly to cause drive gas pressure to approach 0.14 MPa as much as possible within the range of 0.05 to 0.2 MPa when this alarm occurs. If the adjustment fails, replace the pressure switch. If the problem persists after the pressure switch is replaced, replace the integrated pneumatic circuit of the expiratory valve assembly (refer to "Adjust the Pressure Switch" on page 5-35)

5.3.2.1 Test the Pipeline Pressure Gauge and Correct the Regulator

Use the following tools to test the pipeline pressure gauge and regulator of the pipeline gas supply inlet assembly:

- 1 MPa (10bar) test pressure gauge (before the test, make sure that the 1 MPa (10bar) test pressure gauge is in good condition) (quantity: 1)
- 3106-04-06 adapter connector (quantity: 1)
- PU tube (4X200) (quantity: 1)
- PU tube (6X200) (quantity: 1)

Test procedures:

I O2 supply inlet assembly:

1. Turn off the pipeline gas supply and bleed the residual pressure through O2 flushing.
2. Disconnect tube 57. The end of the tube which connects the auxiliary O2 supply is not pulled out but the end to Y piece is pulled out.Connect 1MPa test pressure gauge to the above Y piece through "3106-04-06 adapter connector".

FIGURE 5-22

3. Turn on O2 pipeline supply and record the reading on the O2 pipeline pressure gauge. Observe the test pressure gauge. If the reading on the test pressure gauge is not within the range of 0.15 to 0.25 MPa (namely 1.5 to 2.5bar), adjust the regulator of the O2 supply inlet assembly to cause the reading on the test pressure gauge to reach 0.2 MPa (namely, 2bar). For operations of the regulator, refer to "Adjust the Regulator of the Pipeline Gas Supply Inlet Assembly" on page 5-35.
4. Turn off the pipeline gas supply and bleed the residual pressure through O2 flushing.
5. Reconnect tube 57.
6. Disconnect tube 39 which connects the O2 supply inlet assembly to the O2 pipeline pressure gauge. Remove the end of tube to the O2 supply inlet assembly.
7. Connect 1MPa test pressure gauge to the outlet of O2 supply inlet assembly through "3106-04-06 adapter connector".

FIGURE 5-23

8. Turn on the pipeline gas supply and record the reading on the test pressure gauge. If the difference between this reading and the reading on the O2 pipeline pressure gauge is more than 0.1 MPa (1bar), it indicates that the O2 pipeline pressure gauge is damaged. Handle this problem as described in the troubleshooting table.

9. Reconnect tube 39.

NOTE: **For numbers of all PU tubes, refer to sections 1.2.3 and 1.2.4 Pneumatic Connections.**

II N2O supply inlet assembly:

1. Turn off the pipeline gas supply. Open the needle valve to bleed the residual pressure and close the needle valve. Disconnect tube 49. The end of the tube which connects the ORC is pulled out but the other end is not pulled out.

2. Connect 1MPa test pressure gauge, the pulled-out end of tube 49, and ORC N2O outlet through "3106-04-06 adapter connector" and Y piece (17).

FIGURE 5-24

3. Turn on N2O and O2 pipeline supplies. Adjust the regulator of the N2O supply inlet assembly to the same value as measured/set for the O2 supply inlet assembly (see step 4 of O2 supply inlet assembly) Record the reading on the N2O pipeline pressure gauge.
4. Turn off N2O pipeline supply and bleed the residual pressure by opening the N2O flow regulator.
5. Reconnect tube 49.
6. Pull out No.40 PU tube which connects the N2O supply inlet assembly to the N2O pipeline pressure gauge. Remove the tube end which connects N2O supply inlet assembly.
7. Connect 1MPa test pressure gauge to the outlet of N2O supply inlet assembly through "3106-04-06 adapter connector".

FIGURE 5-25

8. Turn on the N2O pipeline supply and record the reading on the test pressure gauge. If the difference between this reading and the reading on the N2O pipeline pressure gauge is more than 0.1 MPa (1bar), it indicates that the N2O pipeline pressure gauge is damaged. Handle this problem as described in the troubleshooting table.
9. Reconnect tubing to pressure gauge. Reconnect tube 40.

III AIR supply inlet assembly:

1. Turn off the pipeline gas supply. Disconnect tube 67. The end of the tube which connects auxiliary gas supply is not pulled out but the other end which connects the Y piece is pulled out.
2. Connect 1MPa test pressure gauge to the above Y piece through "3106-04-06 adapter connector".

FIGURE 5-26

3. Turn on AIR pipeline supply. If the reading on the test pressure gauge is not within the range of 0.2±0.05 MPa (2.0±0. 5bar), adjust the regulator to cause the reading on the test pressure gauge to reach 0.2 MPa (2.0bar). Record the reading on the AIR pipeline pressure gauge.
4. Turn off AIR pipeline supply and bleed the residual pressure by opening the AIR flow regulator.
5. Reconnect PU tube No.50 into the "Y" fitting. Reconnect tube 67.
6. Pull out No.41 PU tube which connects the AIR supply inlet assembly to the AIR pipeline pressure gauge. Remove the tube end which connects AIR supply inlet assembly.
7. Connect 1MPa test pressure gauge to the outlet of AIR supply inlet assembly through "3106-04-06 adapter connector".

FIGURE 5-27

8. Turn on the AIR pipeline supply and record the reading on the test pressure gauge. If the difference between this reading and the reading on the AIR pipeline pressure gauge is more than 0.1 MPa (1.0 bar), it indicates that the AIR pipeline pressure gauge is damaged. Handle this problem as described in the troubleshooting table.
9. Reconnect PU tube No.41 to the pressure gauge.

5.3.2.2 Test the Pressure Switch

Use the following tools to verify the pressure switches of the O2 supply inlet assembly and the expiratory valve assembly are within specifications:

- 1 MPa (1.0 bar) test pressure gauge (quantity:1)
- 3106-04-06 adapter connector (quantity:1)
- 3106-06-08 adapter connector (quantity:1)
- 3140-08-00 Y piece (quantity:1)
- PU tube (8X200) (quantity:2)
- PU tube (6X200) (quantity:1)
- PU tube (4X200) (quantity:1)

Test procedures:

1. Turn off the pipeline gas supply and bleed the residual pressure by pushing the O2 flush button.
2. Disconnect tube 47. The end of the tube which connects pressure regulator assembly is pulled out but the other end is not pulled out.
3. Connect one PU tube (8X200) to the O2 inlet of pressure regulator assembly and connect the other end of the PU tube and also the pulled-out end of tube 47 to the two connectors of "3140-08-00 Y piece" respectively.
4. Connect the test pressure gauge to the third connector of "3140-08-00 Y piece" through "3106-06-08 adapter connector" and "3106-04-06 adapter connector".

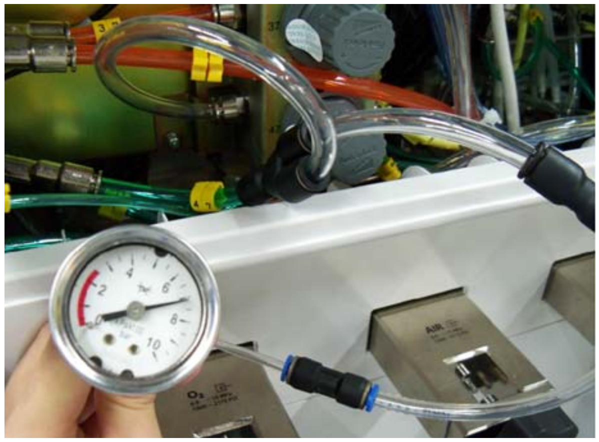


FIGURE 5-28

5. Turn on the O2 pipeline supply.
6. Turn on the machine to enter Standby.
7. Turn off all flow regulators.
8. Turn off the pipeline gas supply (if the reading on the test pressure gauge begins to fall dramatically and continuously after the gas supply is turned off, it indicates that there are one or more leaks in the O2 supply inlet assembly, expiratory valve assembly, O2 flush button assembly, system switch assembly, and/or the O2 flow regulator. Perform the subsequent operations after the leaks are serviced. Failures can be located by using the methods described in "Anesthetic Gas Delivery System" on page 5-36. and "Breathing System" on page 5-51.Breathing System except O2 supply inlet assembly related failures).
9. Manually adjust the O2 flow regulator until O2 flow is approximately 1 L/min, causing the reading on the test pressure gauge to fall gradually to 0.25 MPa (2.5bar).
10. Turn off O2 flow to cause the reading on the test pressure gauge not to fall. If the "O2 Supply Failure" alarm occurs 10 seconds later, it indicates that the pressure switch of the O2 supply inlet assembly is defective. Troubleshoot this problem as described in the relevant failure table.
11. Adjust the O2 flow regulator until O2 flow is approximately 0.5 L/min, causing the reading on the test pressure gauge to fall gradually to 0.2 MPa (2bar).
12. Turn off O2 flow to cause the reading on the test pressure gauge not to fall. If the "Drive Gas Pressure Low" alarm occurs 10 seconds later, it indicates that the pressure switch on the integrated pneumatic circuit of the expiratory valve assembly is defective. Troubleshoot this problem as described in the relevant failure table.
13. Adjust the O2 flow regulator until O2 flow is approximately 0.3 L/min, causing the reading on the test pressure gauge to fall gradually to 0.15 MPa (1.5bar).
14. Turn off O2 flow to cause the reading on the test pressure gauge not to fall. If the "O2 Supply Failure" alarm does not occur 10 seconds later, it indicates that the pressure switch of the O2 supply inlet assembly is defective. Troubleshoot this problem as described in the relevant failure table.
15. Adjust the O2 flow regulator until O2 flow is approximately 0.3 L/min, causing the reading on the test pressure gauge to fall gradually to 0.05 MPa (0.5bar).
16. Turn off O2 flow to cause the reading on the test pressure gauge not to fall. If the "Drive Gas Pressure Low" alarm does not occur 10 seconds later, it indicates that the pressure switch on the integrated pneumatic circuit of the expiratory valve assembly is defective. Troubleshoot this problem as described in the relevant failure table.

5.3.2.3 Adjust the Pressure Switch

Adjust the O2 supply pressure switch and drive gas pressure switch as described below.

Use a flathead screwdriver to adjust the O2 supply pressure switch as shown below. Turn for small degrees each time such as 30 degrees. Note that turning the pressure switch clockwise will decrease its alarm limits and counterclockwise increase its alarm limits. Test the assembly after each pressure adjustment is made. Repeat until the pressure switch is properly adjusted and is within specification (nominal 220 kPa +/- 10 kPa).

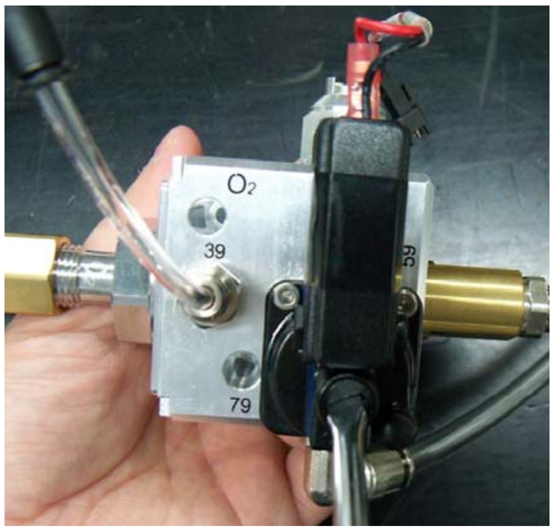


FIGURE 5-29

5.3.2.4 Adjust the Regulator of the Pipeline Gas Supply Inlet Assembly

Pull up the knob cover of the regulator. Turn the cover clockwise to increase pressure or counterclockwise to decrease pressure, as shown below. Bleed the inside pressure of the pipeline gas supply inlet assembly after each pressure adjustment is made, using the Regulator Calibration hose (PN 0453-00-1216). Then, turn on the pipeline gas supply again. Observe the adjusted pressure through the test pressure gauge. Adjust to 200kPa.

FIGURE 5-30

5.3.3 Anesthetic Gas Delivery System

The following table lists anaesthetic gas delivery system related failures.

Failure description	Possible cause	Recommended action
Leak	The O2 flush button assembly leaks.	Replace the seal on the O2 flush button assembly or replace the O2 flush button assembly.
	The system switch assembly leaks.	Replace the seal on the system switch assembly or replace the systems switch assembly.
	The vaporizer is installed improperly, which results in leak.	Re-install the vaporizer.
	The seal between the vaporizer manifold assembly and the vaporizer is damaged.	Clean or replace the seal. The seal should be replaced at least once per year as required.
	The seal between the vaporizer manifold inside and the connection or the rubber plain washer between the vaporizer manifold inside and the spring is damaged or dirty.	Clean the sealing part or replace the damaged seal and rubber plain washer.
	The vaporizer manifold assembly is damaged.	Replace the vaporizer manifold assembly.
	The total flowmeter leaks.	Replace the total flowmeter.
	The ORC assembly leaks.	Replace the ORC assembly.
	The flow regulator leaks.	Replace the flow regulator.
	The restrictor leaks.	Re-calibrate after the restrictor is replaced.
	The pressure relief valve at the breathing connection leaks.	Check and replace the defective pressure relief valve.
	The CGO assembly leaks.	Replace the CGO assembly.

Failure description	Possible cause	Recommended action
	The fresh gas connections of the circuit adapter assembly leak.	Check the seals and tubes at the fresh gas connections. Replace the defective parts and re-install the parts.
The gas supplies cannot be turned off after the machine is turned off.	The seal inside the system switch assembly is damaged.	Replace the system switch.
The machine cannot be powered on after turned on.	The contact switch is ineffective.	Replace the contact switch of the system switch assembly.
The flowmeter float indicates inaccurate value or remains unmoved.	The total float rotameter is damaged.	Replace the total float rotameter.
The knob of the flow regulator gets loose.	The flow regulator is damaged.	Replace the flow regulator.
N2O supply cannot be cut off in case of O2 supply failure.	The ORC assembly is damaged.	Replace the ORC assembly.

5.3.3.1 Leak Test of the O2 Flush Button Assembly

Perform a leak test of the O2 flush button assembly by using the following tools:

- Negative pressure ball (quantity:1)
- 3106-06-00 adapter connector (quantity:1)
- PU tube (6X100) (quantity:1)

Test procedures:

1. Turn off the pipeline gas supplies and bleed the residual pressure through O2 flushing.
2. Remove the work surface. Pull out No.52 PU tube which connects the O2 flush button assembly to the CGO assembly. Disconnect at the CGO end.
3. Connect the inlet of the negative pressure ball to PU No.52 through 3106-06-00 adapter connector and then flatten the negative pressure ball to remove the gas inside.
4. Release the negative pressure ball as shown below. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the O2 flush button assembly is damaged.

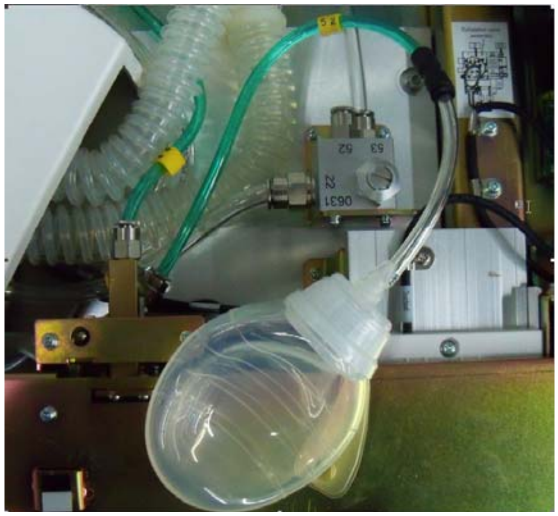


FIGURE 5-31

5.3.3.2 Leak Test of the Flowmeter Related Assembly

Perform a leak test of the flowmeter related assembly (from flow regulator to total flowmeter) by using the following tools:

- Negative pressure ball (quantity:1)
- 3106-06-00 adapter connector (quantity:1)
- 3106-06-08 adapter connector (quantity:1)
- 3126-06-00 tube plug (quantity:3)
- 3126-08-00 tube plug (quantity:1)
- PU tube (6X100) (quantity:1)

Test procedures:

1. Turn off the pipeline gas supplies and turn on the system switch. Bleed the residual pressure by opening the flow regulators.
2. Turn off the system switch. Turn on the flow regulators and turn them counterclockwise for more than half a circle.
3. Pull out No.25 PU tube which connects the total flowmeter to the vaporizer manifold assembly. Disconnect at the vaporizer manifold end.
4. Pull out No.46, 49 and 51 PU tubes which connect with the flow regulator. Disconnect at flow regulator end.
5. Occlude the pulled-out tube end on the flow regulator by using three 3126-06-00 tube plugs.

FIGURE 5-32

6. Connect the other end of the negative pressure ball to the pulled-out end of No.25 PU tube through 3106-06-08 adapter connector, as shown below, and then flatten the negative pressure ball to remove the gas inside.

FIGURE 5-33

7. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the total flowmeter assembly is damaged. In this case, pull out the tube plug at the inlet of needle valve and perform the following operations.
8. Pull out No.26 PU tube which connects the back pressure regulator to the total flowmeter. Disconnect at the total flowmeter end.
9. Occlude the pulled-out tube end on the total flowmeter by using 3126-08-00 tube plug.

FIGURE 5-34

10. Compress the negative pressure ball still connected to tube 25 to bleed the air inside.

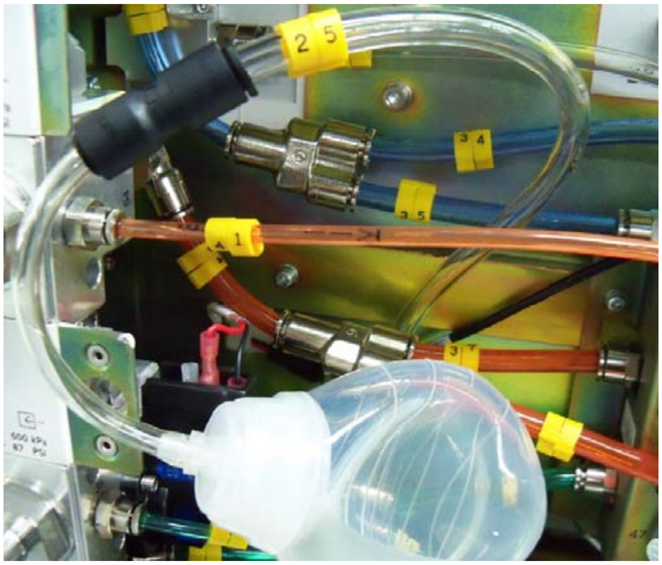


FIGURE 5-35

11. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the total flowmeter leaks.

12. Re-connect tube 25. Disconnect tube 58 and pull out its end connecting the back pressure valve. Disconnect tube 26 and pull out its end connecting the total flowmeter.

13. Occlude the pulled-out tube end on the back pressure regulator by using one 3126-08-00 tube plug and connect the negative pressure ball to the pulled-out end of No.26 PU tube through 3106-06-08 adapter connector.

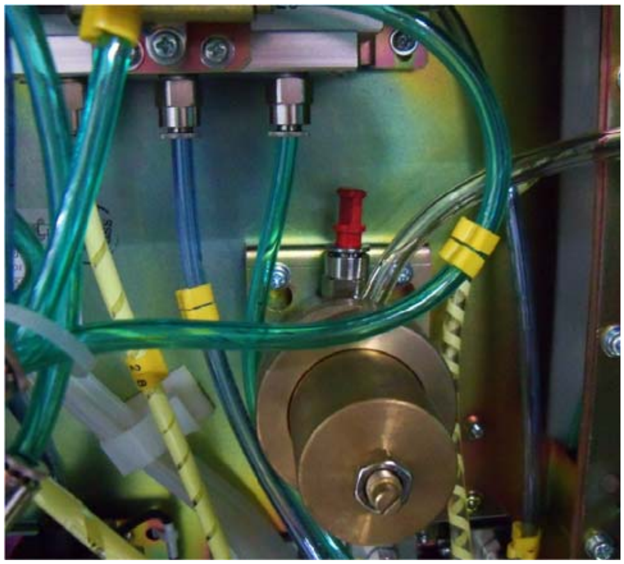


FIGURE 5-36

14. Compress the negative pressure ball to bleed the air inside.

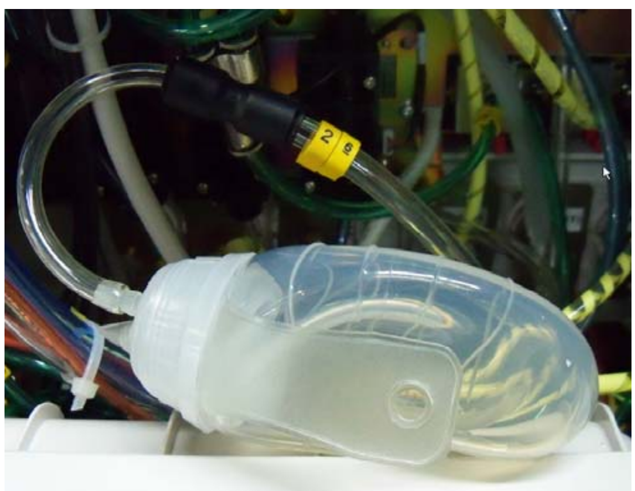


FIGURE 5-37

15. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the back pressure regulator leaks.

16. Pull out No.27, 28 and 29 PU tubes which connect the flow sensor to the gas mixer. Disconnect at the gas mixer end.

17. Occlude the pulled-out tube end on the gas mixer by using three 3126-06-00 tube plugs.

18. Disconnect tube 58 and plug out its end connecting the back pressure valve. Connect the negative pressure ball to the pulled-out end of tube 58 through "3106-06-08 adapter connector".

19. Flatten the negative pressure ball to remove the gas inside.

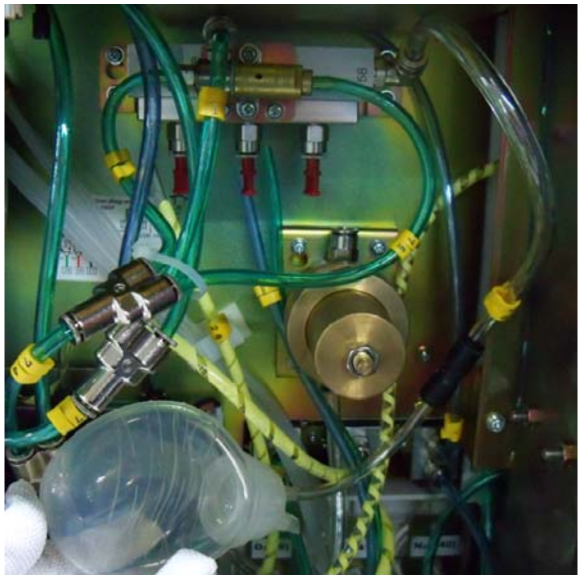


FIGURE 5-38

20. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the gas mixer leaks.

21. For N2O branch, disconnect tube 32 and pull out its end connecting the sensor (disconnect tube 31 for AIR branch and tube 78 for O2 branch.

22. Occlude the pulled-out tube end on the flow sensor by using 3126-06-00 tube plug.

23. For N2O branch, disconnect tube 27, pull out its end connecting gas mixer and connect it to the gas inlet of the negative pressure ball through "3106-06-00 adapter connector" (disconnect tube 28 for AIR branch and tube 29for O2 branch). Compress the negative pressure ball to bleed the gas inside.

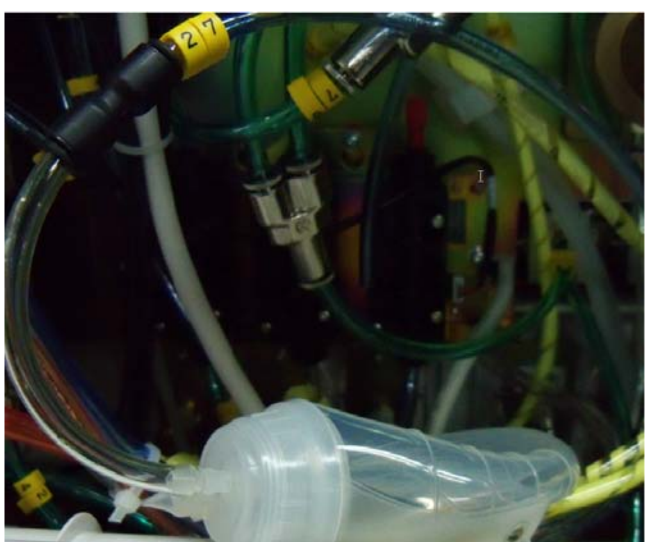


FIGURE 5-39

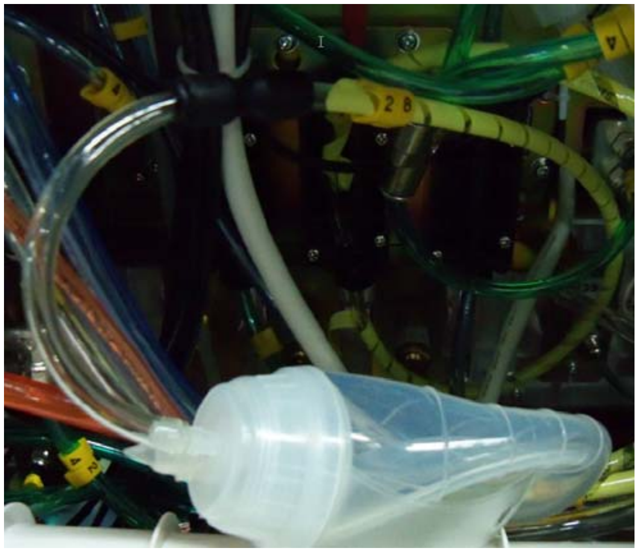


FIGURE 5-40

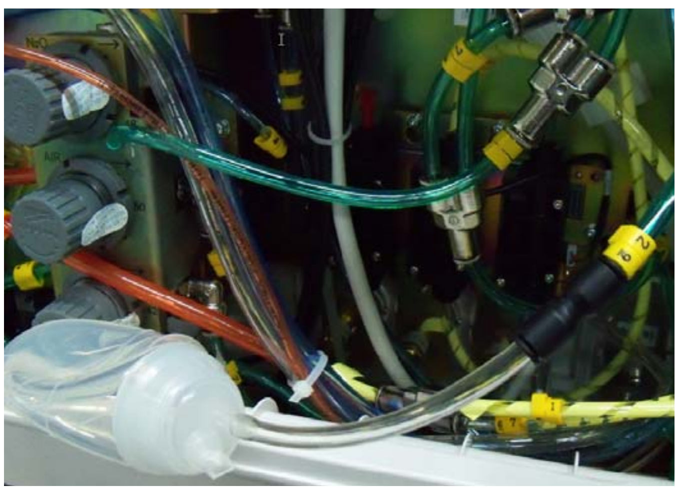


FIGURE 5-41

24. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the flow sensor leaks.

25. For N2O branch, disconnect tube 49 and pull out its end connecting the needle valve (disconnect tube 51 for AIR branch and tube 45 for O2 branch).

26. Occlude the pulled-out tube end on the needle valve by using 3126-06-00 tube plug.

27. For N2O branch, disconnect tube 91, pull out its end connecting the needle valve, and connect the gas inlet of the negative pressure ball to the gas outlet of the needle valve through "3106-06-00 adapter connector" and PU tube (6X200) (disconnect tube 90 for AIR branch and tube 73 for O2 branch). Compress the negative pressure ball to bleed the gas inside.

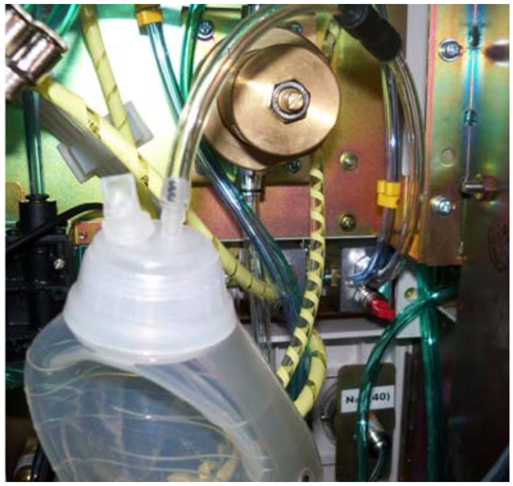


FIGURE 5-42

FIGURE 5-43

FIGURE 5-44

28. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the needle valve leaks.

5.3.3.3 Leak Test of the System Switch Assembly

Perform a leak test of the system switch assembly by using the following tools:

- Negative pressure ball (quantity:1)
- 3106-06-00 adapter connector (quantity:1)
- 3106-06-08 adapter connector (quantity:1)
- 3126-08-00 tube plug (quantity:1)
- PU tube (6X100) (quantity:1)

Test procedures:

1. Turn off the pipeline gas supplies and turn on the system switch. Bleed the residual pressure by opening the flow regulators.
2. Pull out No.45 which connects the system switch assembly to the flow regulator. Disconnect at the flow regulator end and connect the pulled-out tube end to the negative ball through one 3106-06-00 adapter connector.
3. Pull out No.43 which connects the system switch assembly to the Y piece. Disconnect at the Y piece end and occlude the pulled-out tube end through one 3106-06-08 adapter connector and one 3126-08-00 tube plug.
4. Flatten the negative pressure ball to remove the gas inside.

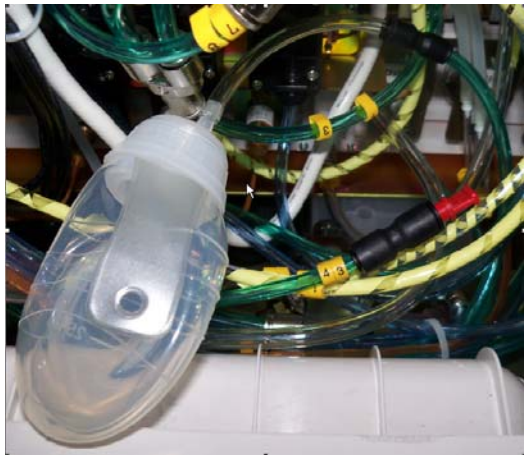


FIGURE 5-45

5. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that tube connected with the system switch assembly is damaged.
6. Turn off the system switch.
7. Pull out the 3126-08-00 tube plug which was used to occlude tube No.43 before.
8. Flatten the negative pressure ball to remove the gas inside.

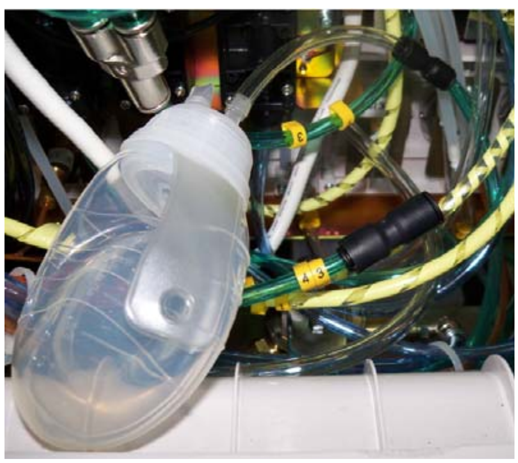


FIGURE 5-46

9. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds during one of the two tests, it indicates that the system switch assembly is damaged.

5.3.3.4 Leak Test of the Oxygen Ratio Controller (ORC)

Perform a leak test of the ORC assembly by using the following tools:

- Negative pressure ball (quantity:1)
- 3106-06-00 adapter connector (quantity:1)
- 3126-06-00 tube plug (quantity:2)
- 3126-04-00 tube plug (quantity:1)
- PU tube (6X100) (quantity:1)

Test procedures:

1. Disconnect tube 3 and pull out the end of the tube which connects to the Y piece. Occlude the pulled-out end with "3106-06-00 adapter connector and 3126-06-00 tube plug.
2. Disconnect tube 46 and pull out the end of the tube which connects to the Y piece. Connect the pulled- out end to the negative pressure ball directly.
3. Flatten the negative pressure ball to remove the gas inside.

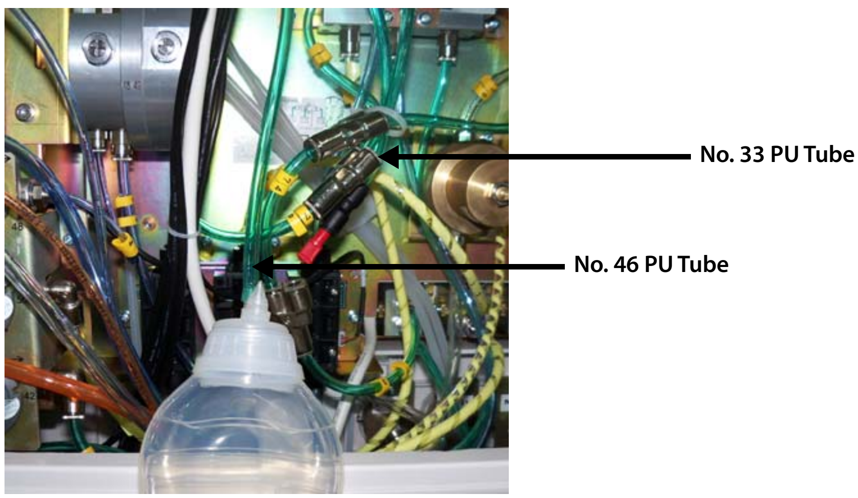


FIGURE 5-47

4. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the Oxygen Ratio Controller is damaged. Handle this problem as described in the troubleshooting table. If not, continue the following test.
5. Re-connect the tube.
6. Disconnect tubes 48, 49, and 32. Pull out the tube ends which connect the ORC. Occlude the pulled-out ends with two 3126-06-00 tube plugs and one 3126-04-00 tube plug. Disconnect tube 30. The end of the tube which connects the ORC is not pulled out but the other end is pulled out and is connected to the negative pressure ball through "3106-06-00 adapter connector".

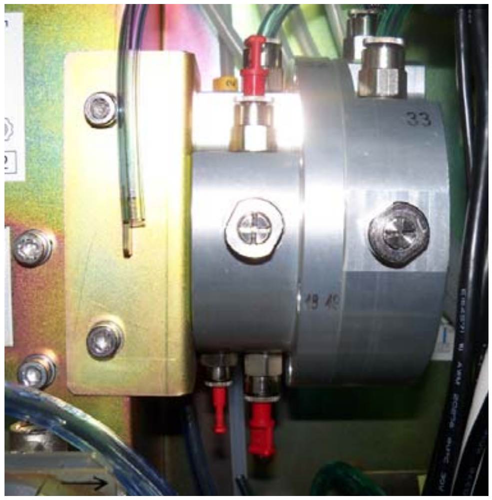


FIGURE 5-48

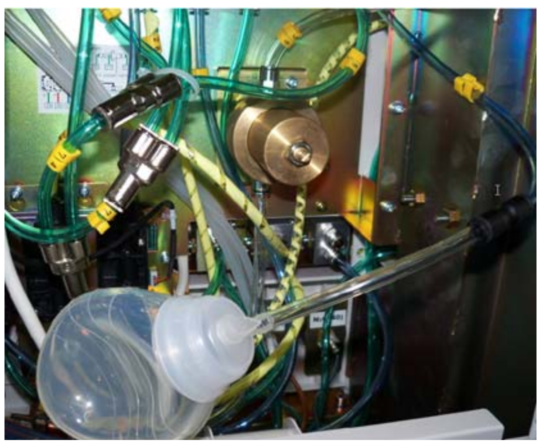


FIGURE 5-49

7. Flatten the negative pressure ball to remove the gas inside.
8. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the Oxygen Ratio Controller is damaged. Handle this problem as described in the troubleshooting table.

5.3.3.5 Leak Test of the Vaporizer Manifold Assembly

Perform a leak test of the vaporizer manifold assembly by using the following tools:

- Negative pressure ball (quantity:1)
- 3106-06-08 adapter connector (quantity:1)
- 3126-06-00 tube plug (quantity:1)
- PU tube (6X100) (quantity:1)
- PU tube (8X200) (quantity:1)
- Vaporizer manifold test fixture (quantity:1)

Test procedures:

1. Turn off the system switch.

2. Remove the vaporizer.

FIGURE 5-50

3. Pull out No.25 PU tube which connects the total flowmeter to the vaporizer manifold assembly. Disconnect at the vaporizer manifold end and occlude it with 3126-08-00 tube plug

4. Pull out No.53 PU tube which connects the vaporizer manifold assembly to the CGO assembly. The end of the tube which connects the vaporizer manifold assembly is pulled out, and connected with the negative ball through one 3106-06-08 adapter connector

5. Flatten the negative pressure ball to remove the gas inside.

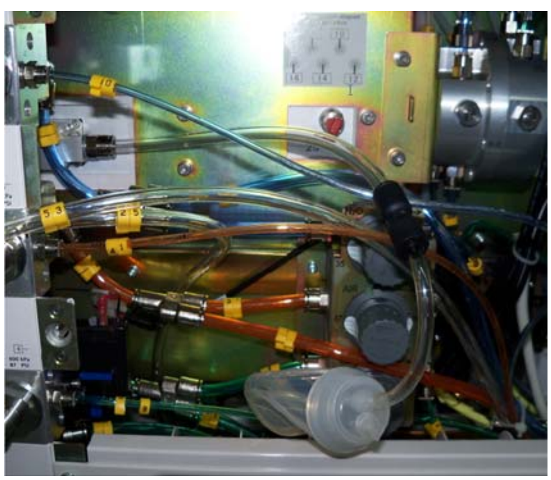


FIGURE 5-51

6. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30s, it indicates that the rubber plain washers or its upper surface contacted mechanical surface are damaged. Handle this problem as described in the troubleshooting table. If not, continue the following tests.

7. Remove the seal ring, and mount the vaporizer manifold test fixture onto the connector of the vaporizer manifold assembly (remove the seal between the connector and the vaporizer when mounting the test fixture)

FIGURE 5-52

8. Repeat step 5 and step 6 every time when the vaporizer manifold test fixture is transferred to the next position. Once the negative pressure ball is fully expanded within 30s, it indicates that the rubber plain washers or its lower surface contacted mechanical surface are damaged. Handle this problem as described in the troubleshooting table. If the four tests are all past, then continue the following tests.

9. Put the seal ring back, mount the vaporizer and turn it on.

FIGURE 5-53

10. Repeat step 5 and step 6 every time when the vaporizer manifold test fixture is transferred to the next position. Once the negative pressure ball is fully expanded within 30s, it indicates that the seal rings are damaged. If the two tests are both past, then the vaporizer manifold assembly and the four seal rings are OK.

5.3.4 Breathing System

The following table lists breathing system related failures.

Failure description	Possible cause	Recommended action
Leak	The CO2 absorber canister is not installed properly.	Re-install the CO2 absorber canister. Remove the sodalime at the sealing connection. Ensure the correct installation of sadalime canister.
	The sealing piece for the absorbent canister assembly is damaged, including the two sealing cushions (049-000142-00 and 049-000145-00), which are in direct contact with the absorbent canister and the two sealing rings (082-001504-00) on the bypass upper cover which are in contact with the circuit bottom housing.	Replace the sealing component of the CO2 absorber canister assembly. It is required to replace the seal once a year.
	The seal for the bag arm is damaged.	Replace the seal for the bag arm. It is required to replace the seal once a year.
	The water collection cup gets loose.	Check and tighten the water collection cup.
	The seal for the water collection cup assembly is damaged.	Replace the seal for the water collection cup assembly. It is required to replace the seal once a year.
	The seal for the circuit adapter assembly is damaged.	Replace the seal, which is required to be replaced once a year.
	The bellows housing or bellows is not installed properly.	Re-install the bellows housing or bellows. Ensure their correct installation.
	The bellows sealing cushion falls off or is damaged.	Replace the bellows sealing cushion, which is required to be replaced once a year.
	The valve cover of the breathing valve assembly is not installed properly.	Re-install the valve cover and ensure its correct installation.
	The seal for the valve cover of the breathing valve assembly is damaged.	Replace the seal.
	The O2 sensor is not installed properly.	Re-install the O2 sensor and ensure its correct installation.
	The seal for the O2 sensor or the seal for the O2 sensor plug is damaged.	Replace the seal.
	The breathing tube connecting the patient is damaged.	Replace the breathing tube.
	The bellows is damaged.	Replace the bellows, which is required to be replaced once a year.
	The sealing connection of other parts of the breathing system is damaged.	Repair or replace the sealing connection as per the procedures described in "Adjust the Regulator of the Pipeline Gas Supply Inlet Assembly" on page 5-35
	The condensate valve of the canister assembly is not installed properly or the seal inside is damaged.	Re-install the condensate valve or replace the damaged seal inside.

Failure description	Possible cause	Recommended action
O2 concentration measurement fails or has great deviations.	There is water built up on the measurement surface of O2 sensor.	Remove the built-up water and allow the O2 sensor to air dry.
	The O2 sensor is not calibrated.	Calibrate the O2 sensor as per section 4.3.1 O2 Sensor Calibration.
	The O2 sensor is damaged.	Replace the O2 sensor.
The airway pressure gauge shows inaccurate reading or its pointer cannot move.	The airway pressure gauge is damaged.	Replace the airway pressure gauge.
The flow wave is displayed irregularly.	The flow sensor assembly is not installed properly.	Re-install the flow sensor assembly.
	There is water built up inside the flow sensor assembly.	Remove the flow sensor assembly and clear its inside water build-up.
	The membrane of the flow sensor assembly is distorted, dirty or its inside resistance changes. Zero drift occurs to the pressure sensor of the fresh flow sensor board.	Enter the service mode and calibrate the flow sensor as per the procedures described in "If measurement deviations are not corrected after multiple flow sensor calibrations, the user is recommended to replace the flow sensor and then perform calibration. If the problem persists, factory maintenance is necessary." on page 4-18.
	The flow sensor is damaged.	Replace the flow sensor assembly.
	The pressure sensor on the fresh flow sensor board is defective.	Replace the fresh flow sensor board.
	The flow sensor pressure sampling pipeline leaks.	Repair the flow sensor pressure sampling pipeline after checking as per the procedures described in "Leak Test of Flow Sensor Pressure Sampling Pipeline" on page 5-52.

5.3.4.1 Leak Test of Flow Sensor Pressure Sampling Pipeline

If the flow waveform is displayed irregularly, the flow sensor pressure sampling pipeline may be leaky. Perform the leak test by using the following tools:

- Anesthesia machine calibration device (quantity:1)
- Flow sensor pressure sampling pipeline test fixture (quantity:1)
- Circuit adapter test fixture (quantity:1)
- Injector (quantity:1)
- Ø6 silicone tube (quantity:3)
- Y piece (quantity:1)

Test procedures:

A. Leak test of the flow sensor pressure sampling pipeline (the four sampling pipelines of the expiratory and inspiratory flow sensors are all tested)

1. Turn off the system switch.
2. Install the breathing system properly.
3. Remove the flow sensor assembly.
4. Mount the flow sensor pressure sampling pipeline test fixture onto the position where the flow sensor assembly was originally mounted. Tighten the breathing connector rotary cap.
5. Connect the Ø6 silicone tubes to the pressure sensor connector (positive pressure end) on the anesthesia machine calibration device), injector (before mounting, pull out the push rod of the injector) connector and the connector for the flow sensor pressure sampling pipeline test fixture by using a Y piece, as shown below.

FIGURE 5-54

6. Push in the push rod of the injector to let the pressure reading on the anesthesia machine calibration device rise to 70 to 90 cmH2O and then stop pushing. Keep the relative position between the push rod and the injector unchanged. If the pressure reading on the anesthesia machine calibration device does not fall more than 5cmH2O within 15 s, this test is passed.

B. Leak test of the flow sensor pressure sampling pipeline inside the main unit (perform this test if test "A" fails)

7. Mount the circuit adapter test fixture onto the circuit adapter assembly.
8. Connect the Ø6 silicone tubes to the pressure sensor connector (positive pressure end) on the anesthesia machine calibration device), injector (before mounting, pull out the push rod of the injector) connector and the connector (one connector out of No.3 through 6 connectors on the test fixture) for the circuit adapter test fixture by using a Y piece, as shown below.

FIGURE 5-55

9. Push in the push rod of the injector to let the pressure reading on the anesthesia machine calibration device rise to 70 to 90 cmH2O and then stop pushing. Keep the relative position between the push rod and the injector unchanged. If the pressure reading on the anesthesia machine calibration device does not fall more than 5cmH2O within 15s, this test is passed.

If test "A" is failed and "B" passed, it indicates that the flow sensor pressure sampling pipeline on the breathing system is damaged. In this case, replace the breathing system. If both tests "A" and "B" are failed, check the sampling lines and connectors inside the main unit, seals and solenoid valve of the circuit adapter assembly until test "B" is passed. Then perform test "A". If test "A" is still failed, it indicates the flow sensor pressure sampling pipeline on the breathing system is damaged. In this case, replace the breathing system.

5.3.4.2 Leak Test of Low-pressure Pneumatic Circuit System

After making sure that the flow sensor pressure sampling pipeline is not leaky, perform leak tests of the low-pressure pneumatic circuit system as shown in the following figures.

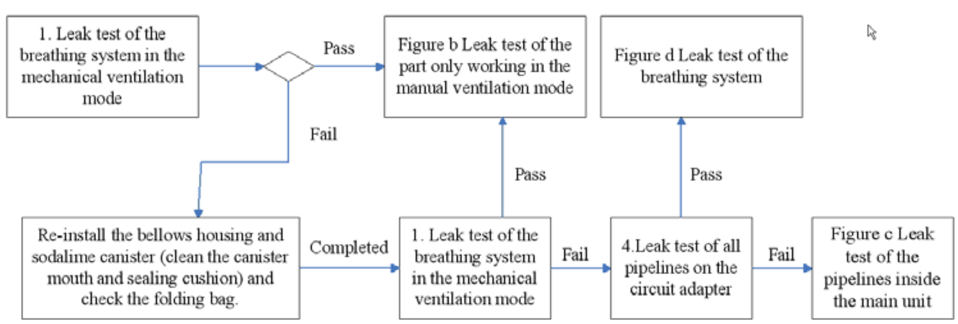


FIGURE 5-56 System Leak Test

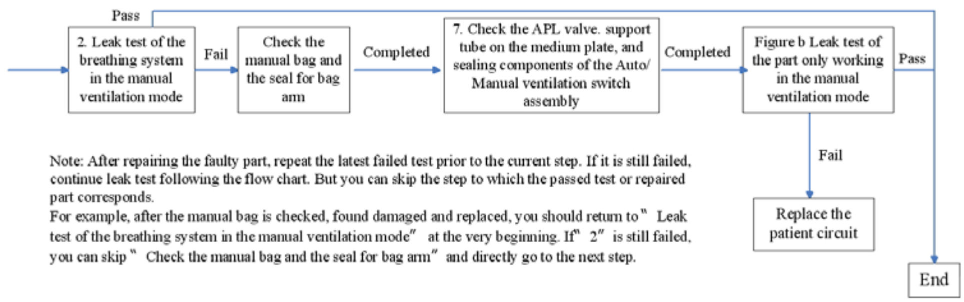


FIGURE 5-57 Leak test of the part only working in the manual ventilation mode

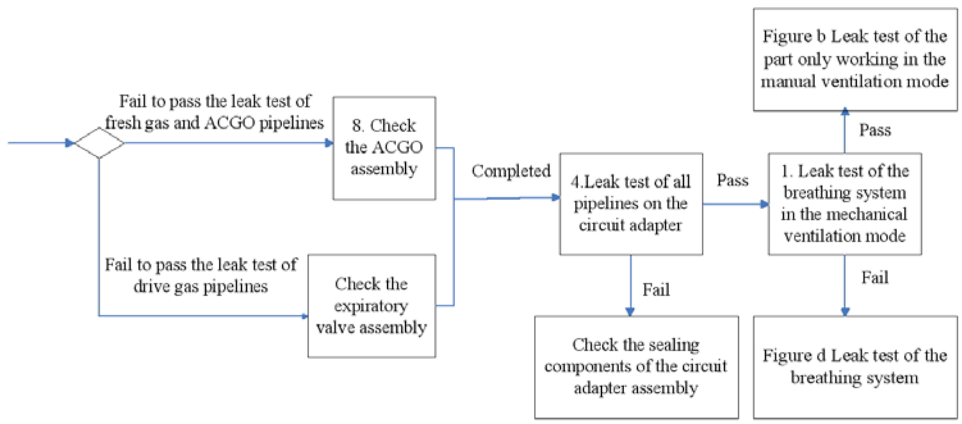


FIGURE 5-58 Leak test of the pipelines inside the main unit

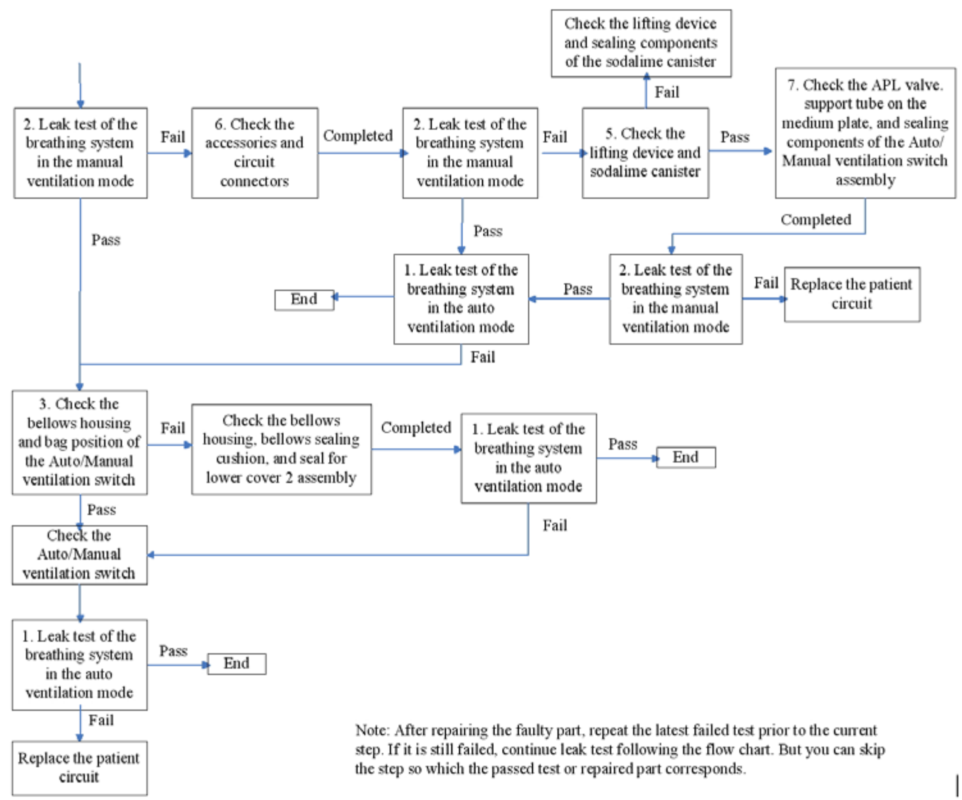


FIGURE 5-59 Leak test of the breathing system

1. Leak test of the breathing system in the mechanical ventilation mode Perform the test as described in"Breathing System Leak Test in Mechanical Ventilation Mode" on page 2-22.
2. Leak test of the breathing system in the manual ventilation mode

Tools required:

- Breathing tube (quantity: 3)
- Breathing tube Y piece (quantity: 1)

Test procedures:

1. Let the system enter Standby.
2. Mount the breathing system properly.
3. Set the Auto/Manual ventilation switch to the Manual position.
4. Set the pressure of the APL valve to maximum.
5. Occlude the inspiratory and expiratory ports and bag arm port by using three breathing tubes and one breathing tube Y piece as shown below.

FIGURE 5-60

6. Turn on the O2 flow regulator and adjust O2 flow to 0.2L/min,
7. Push the O2 flush button to let the reading on the Paw pressure gauge rise to 30cmH2O.
8. Stop O2 flushing. If the reading on the Paw pressure gauge falls under 30cmH2O, this test is failed.
9. If the reading on the Paw pressure gauge rises rapidly, to prevent defective APL valve from damaging the Paw pressure gauge, note to turn off the O2 flow regulator timely to prevent the over range of the Paw pressure gauge (The test which involves O2 flow regulator turned off due to this reason is considered to be passed).

3. Check the bellows housing and the Manual position of the Auto/Manual ventilation switch

Tools required:

- Anesthesia machine calibration device (quantity: 1)
- Circuit adapter test fixture (quantity: 1)
- Injector (quantity: 1)
- Ø6 silicone tube (quantity: 2)
- PU tube (6X300) (quantity: 1)
- Y piece (quantity: 1)

Test procedures:

1. Remove the bellows.
2. Mount the bellows housing properly.
3. Set the Auto/Manual ventilation switch to the Manual position
4. Remove the breathing system.
5. Mount the circuit adapter test fixture onto the breathing system.
6. Connect the Ø6 silicone tubes and PU tube (6X300) to the injector connector, pressure sensor (of the anesthesia machine calibration device) connector (positive pressure end), and No.2 connector to which drive gas corresponds on the circuit adapter test fixture by using a Y piece, as shown below.

FIGURE 5-61

7. Push in the push rod of the injector to let the pressure reading on the anesthesia machine calibration device rise to 30 to 35 cmH2O and then stop pushing. Keep the relative position between the push rod and the injector unchanged. If the pressure reading on the anesthesia machine calibration device falls more than 10cmH2O within 30s, this test is failed. It indicates that the bellows housing or the Manual position of the Auto/Manual ventilation switch is leaky. (Removing the bag arm indicated in the picture has no impact upon the test because the drive gas does not pass through the bag arm.)

4. Leak test of all pipelines on the circuit adapter

Tools required:

- Negative pressure ball (quantity: 1)
- Circuit adapter test fixture (quantity: 1)
- PU tube (6X100) (quantity: 1)

Test procedures:

1. Turn off the system switch.
2. Turn off the flow regulators.
3. Remove the breathing system.
4. Mount the circuit adapter test fixture onto the circuit adapter.
5. Flatten the negative pressure ball to remove the gas inside. Then re-install the plug to seal the ball. Connect the other end of the negative pressure ball to the No.7 connector (on the circuit adapter test fixture) fresh gas pipeline of the circuit adapter test fixture, as shown below.

FIGURE 5-62

6. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the test of fresh gas pipeline has failed. Locate the leak inside the main unit as per the method described in “Anesthetic Gas Delivery System” on page 5-36..
7. Turn on the system switch and let the systems enter Standby.
8. Select [Setup] >[Service] > [Diagnostic Tests] > [Valves] to set the A/D value of the PEEP valve to make PEEP exceed 50 cmH2O. Set the A/D value of the inspiratory valve to “0” to produce 0 L/min of flow. Set PEEP safety valve to ON, as shown below.

FIGURE 5-63

9. Flatten the negative pressure ball to remove the gas inside. Then re-install the plug to seal the ball. Connect the other end of the negative pressure ball to No.1 connector to which drive gas pipeline of the circuit adapter test fixture corresponds, as shown below.

10. Release the negative pressure ball. If the negative pressure ball is fully expanded within 30 seconds, it indicates that the test of the drive gas pipeline has failed. Check the expiratory valve assembly and the drive gas related pipeline inside the main unit.

5. Check the absorb canister assembly

Tools required:

- VT PLUS (quantity: 1)
- Lucer adapter connector (quantity: 1)
- Injector (quantity: 1)
- Ø6 silicone tube (quantity: 2)
- PU tube (6X300) (quantity: 1)
- Breathing tube (quantity: 3)
- Y piece (quantity: 1)
- Breathing tube Y piece (quantity: 1)
- Breathing tube adapter connector (quantity: 1)
- T-shaped Allen wrench (quantity: 1)

Test procedures:

1. Turn off the system switch.
2. Disassemble the pre-pak assembly and remove the patient circuit.
3. Mount the pre-pak assembly.
4. Remove the seals on the two connectors of the absorb canister assembly. Connect the two connectors of the lifting device by using two breathing tubes and one breathing tube Y piece. The other end of the breathing tube Y piece is connected to the breathing tube adapter connector through another breathing tube. Connect the injector connector, pressure sensor (of the anesthesia machine calibration device) connector (positive pressure end), and the breathing tube adapter connector to a Y piece, as shown below.
5. Push in the push rod of the injector to cause the pressure reading on the anesthesia machine calibration device rise to 30 to 35 cmH2O and then stop pushing. Keep the relative position between the push rod and the injector unchanged. If the pressure reading on the anesthesia machine calibration device falls more than 10cmH2O within 30 seconds, it indicates that absorb canister assembly are leaky. The test is failed. This step is required when the absorbent canister assembly is in bypass on or bypass off status.

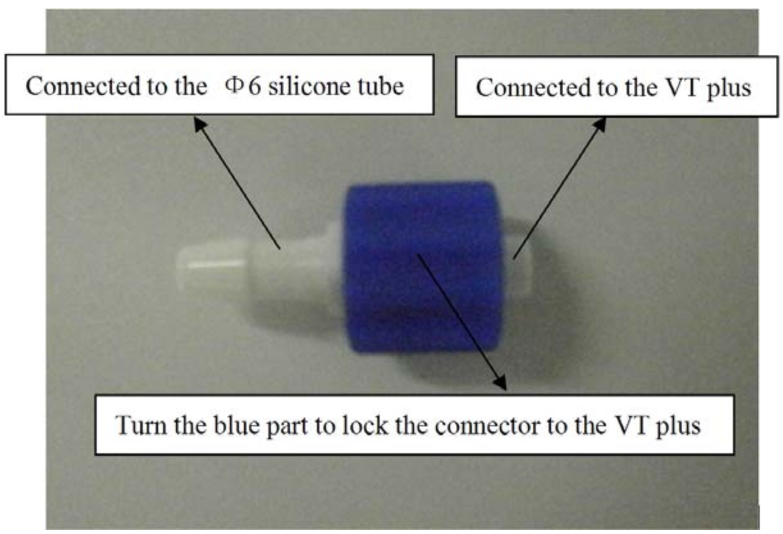


FIGURE 5-64 Lucer adapter connector

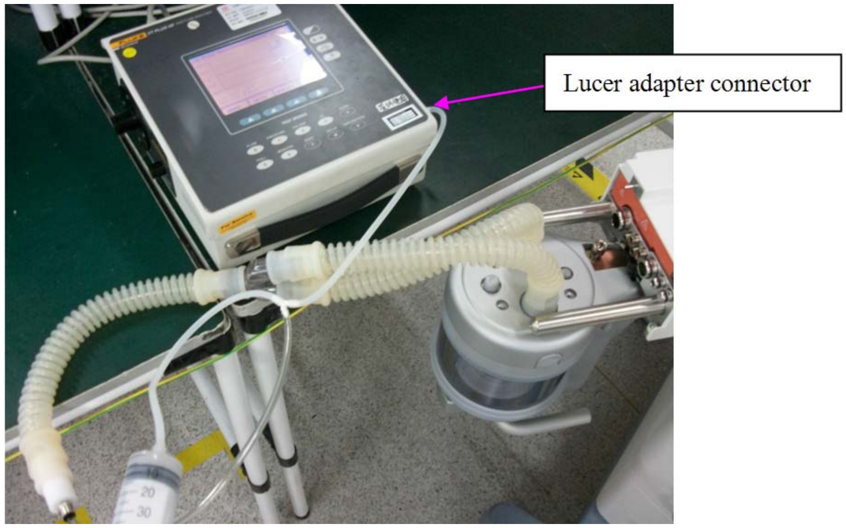


FIGURE 5-65 Bypass Off

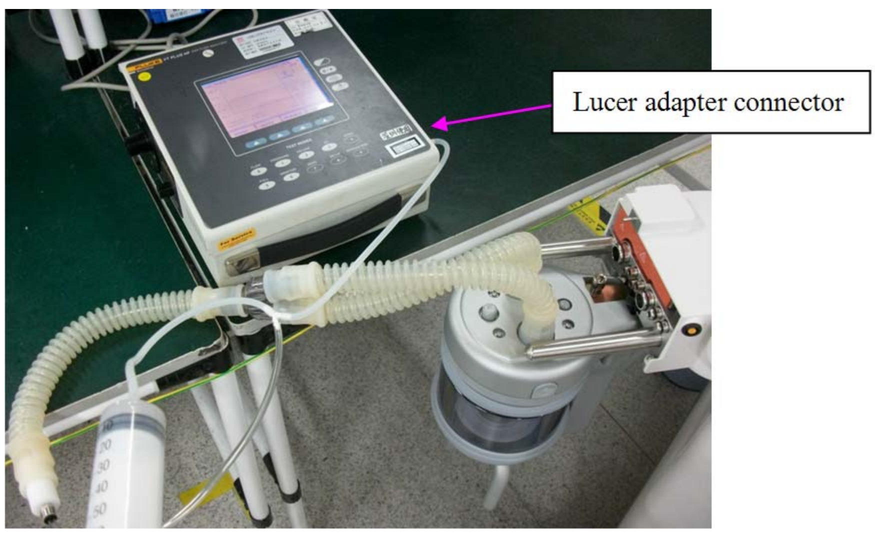


FIGURE 5-66 Bypass On

6. Check the seals on the two connections of the lifting device. It they are damaged, replace the seal and then re-mount the lifting device onto the breathing system.

6. Check the accessories and circuit inspiratory and expiratory parts

Test procedures:

1. Turn off the system switch.
2. Check the manual bag and replace if damaged.
3. Check the breathing tube and replace if damaged.
4. Remove the Paw pressure gauge. Check the seal and replace if found damaged.
5. Remove the water collection cup. Check the seal and replace if found damaged.
6. Remove the O2 sensor (if there is no O2 sensor, remove the plug where the O2 sensor should be installed). Check the seal and replace if damaged.
7. Remove the check valve dome. Check the seal and replace if damaged.
8. Remove the bag arm. Check the seal and replace if damaged.
9. Remove the prepak assembly as shown below. Check the seal and replace if damaged.

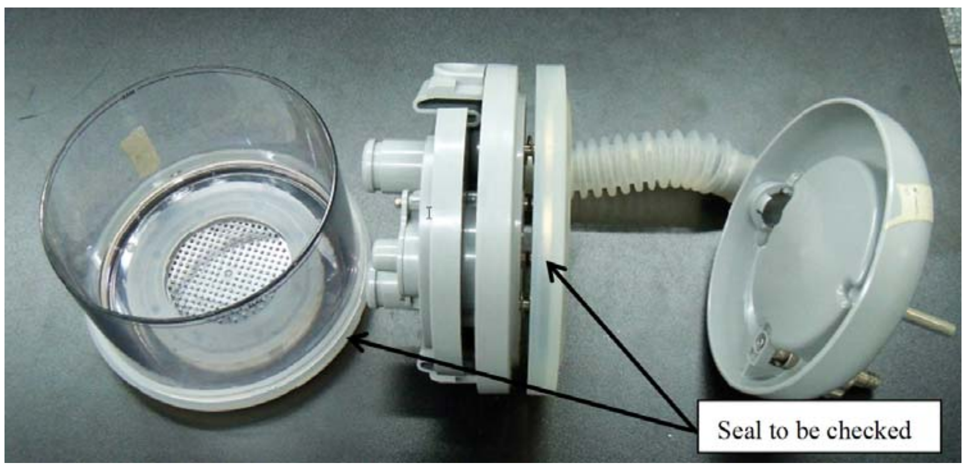


FIGURE 5-67

7. Check the APL valve, support tube on the median plate, and sealing components of the Auto/ Manual ventilation switch assembly

The test requires a T-shaped Allen wrench.

Test procedures:

1. Turn off the system switch.
2. Remove the APL valve. Check all seals and replace the defective ones.
3. Remove the support tube on the median plate. Check the seals and replace the defective ones.
4. Remove the Auto/Manual ventilation switch. Check the seals and replace the defective ones.

8. Check the CGO assembly

Tools required:

1. Negative pressure ball (quantity: 1)
2. 3126-06-00 tube plug (quantity: 1)
3. 3126-08-00 tube plug (quantity: 1)
4. 3126-10-00 tube plug (quantity: 1)
5. 106-10-10 adapter connector (quantity: 1)

Test procedures:

1. Turn off the system switch.
2. Pull out No.22 PU tube which connects the CGO assembly to the circuit adapter assembly. The end of the tube which connect the CGO assembly is pulled out but the other end is not, as shown below.
3. Occlude the pulled-out tube end by using one 3106-10-00 adapter connector and one 3126-10-00 tube plug.

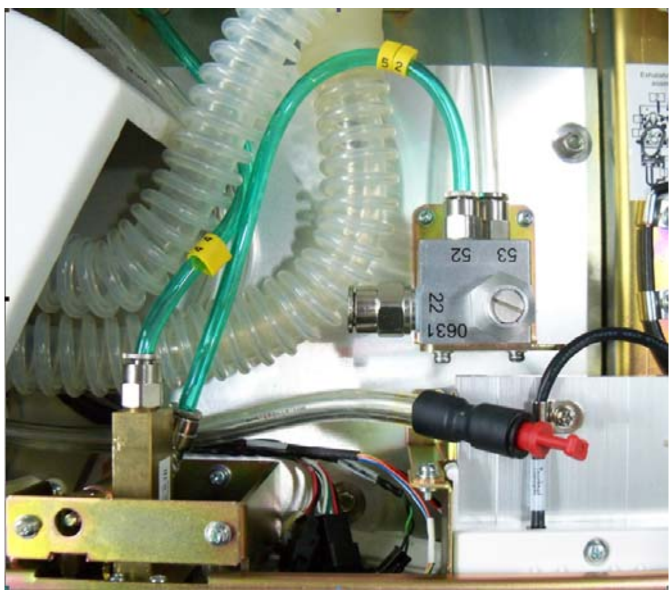


FIGURE 5-68

4. Repeat steps 3 through 7 in "4 Leak test of all pipelines on the circuit adapter". If the test is failed, it indicates that the connectors of the circuit adapter or seals are damaged. If there is no leak, insert the pulled-out tubes into the CGO assembly.
5. Pull out No.52 and 53 PU tubes which connect the O2 flush button assembly and the vaporizer manifold assembly to the CGO assembly. Disconnect at CGO assy. end.
6. Occlude the pulled-out tube ends by using 3126-06-00 and 3126-08-00 tube plugs, as shown below.

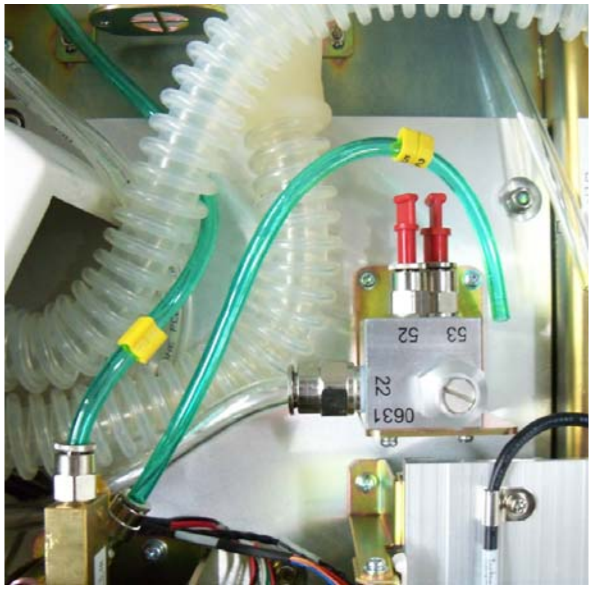


FIGURE 5-69

7. Repeat steps 3 through 7 in "4 Leak test of all pipelines on the circuit adapter". If the test fails, it indicates the CGO assembly is damaged. Check the seals in the CGO assembly and replace any damaged seals.

5.3.5 Tidal Volume

The following table lists tidal volume inaccuracy related failures.

Failure description	Possible cause	Recommended action
Inaccurate tidal volume	The flow sensor is not installed properly.	Re-install the flow sensor.
	The setting of fresh gas flow is inappropriate.	Adjust the fresh gas flow.
	There are significant leaks in the breathing system and the fresh gas flow is too low.	Repair the leaking points after checking as per the procedures described in "Anesthetic Gas Delivery System" on page 5-36. and "Breathing System" on page 5-51.
	* There is water build-up inside the flow sensor.	Remove the flow sensor and clear its inside water build-up.
	*The membrane of the flow sensor assembly is distorted, dirty or its inside resistance changes. Zero drift occurs to the pressure sensor on the ventilator control board.	Enter the service mode and calibrate the flow sensor as described in "If measurement deviations are not corrected after multiple flow sensor calibrations, the user is recommended to replace the flow sensor and then perform calibration. If the problem persists, factory maintenance is necessary." on page 4-18..
	*The flow sensor pressure sampling pipeline is leaky.	Repair the leaking points after checking as per the procedures described in "Leak Test of Flow Sensor Pressure Sampling Pipeline" on page 5-52..

Failure description	Possible cause	Recommended action
	*The flow sensor is damaged.	Replace the flow sensor.
	*The pressure sensor on the ventilator control board is defective.	Replace the ventilator control board.
	The inlet gas flow regulator on the integrated pneumatic circuit of the expiratory valve assembly is defective.	Replace the integrated pneumatic circuit of the expiratory valve assembly or replace the expiratory valve assembly.
	The current Plimit is set too low, which causes expiration to start in advance.	Set Plimit to a higher value to cause Paw not to exceed the limit.
	The displayed TVe and TVi are not the same.	In the valves test tool, compare the measurement error made by three sensors and judge whether to perform calibration as per 4.3.2 Flow Calibration (Service).

In the above table, possible causes marked "*" are related to inaccurate measured values by flow sensors. Do the following to detect if tidal volume inaccuracy results from "*" marked causes.

1. Turn off the flow regulators.
2. Make sure that the patient is disconnected from the system and that the Auto/Manual ventilation switch is set to the mechanical ventilation position.
3. Remove the bellows and then install the bellows housing properly.
4. Remove the water collection cup.
5. Connect the inspiration and expiration connectors together by using a breathing tube, as shown below.

FIGURE 5-70

6. Turn on gas supplies and enter Standby.
7. Select [Setup] > [Service] > [Diagnostic Tests] > [Valves] to set the A/D value of the PEEP valve to make PEEP exceed 40 cmH2O. Set PEEP safety valve to ON, as shown below.

FIGURE 5-71

Set the A/D value of the inspiratory valve to cause the flow of inspiratory valve to reach a certain value. In this case, the flows measured by the ventilator flow sensor, inspiratory flow sensor, and expiratory flow sensor should be the same. Test multiple points by setting the A/D value of the inspiratory valve. For each point, the flows measured by the three sensors should be the same. If not, the measured value by the flow sensor is inaccurate. Troubleshoot the possible causes marked "*" in the above table.

5.4 Sensors and Valves Problems

To use Diagnostic Tests to troubleshoot the sensors or valves related failures, you must be familiar with the one-to-one correspondence between the menu options on the Diagnostic Tests screen and the actual pneumatic circuit and hardware components.

5.4.1 Correspondence with Pneumatic Circuit Components

The following figure shows the one-to-one correspondence between the sensors & valves on the valves-test tool screen and the actual components in the pneumatic circuit diagram.

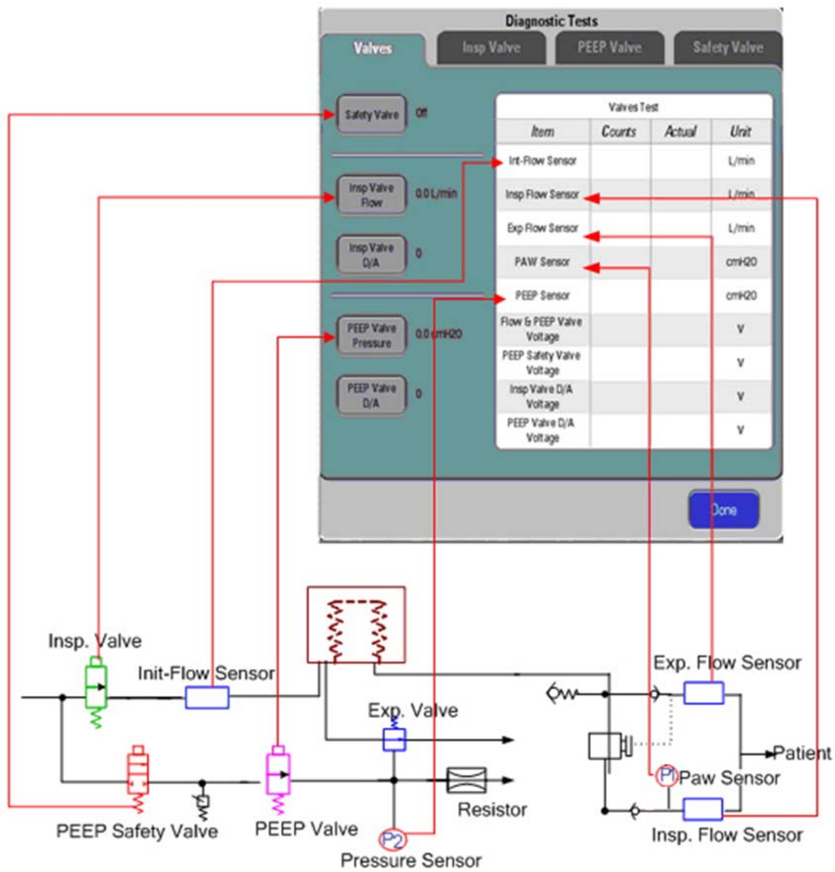


FIGURE 5-72

5.4.2 Correspondence with Hardware Components

The following figure shows how the sampling lines of the sensors are actually connected on the ventilator control board.

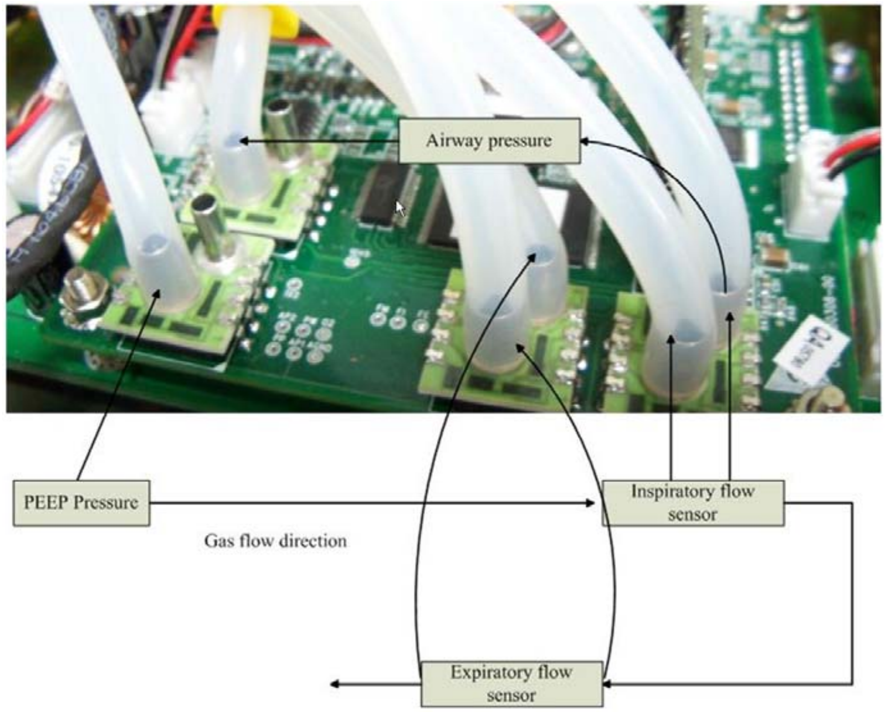


FIGURE 5-73 EPSON Platform

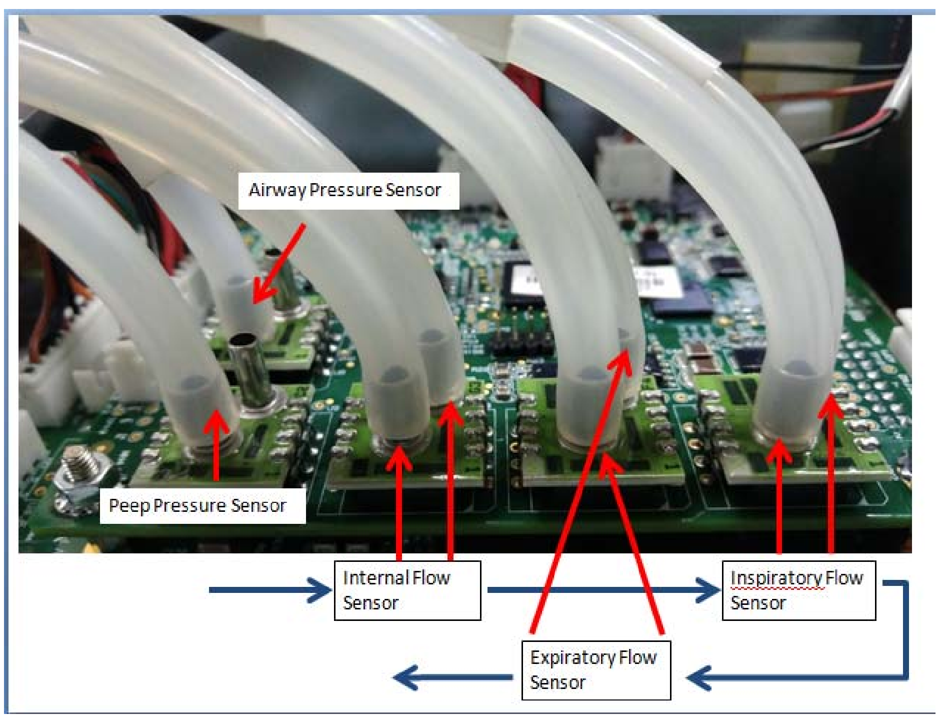


FIGURE 5-74 DSP Platform

5.4.3 Preparations before Using Diagnostic Tests

Make the following preparations before using the valves-test tool to locate the valves or sensors related failures:

1. Connect the pneumatic circuit according to the type of sensor or valve to be checked.

   Before using the Diagnostic Tests Menu: connect the tubes of the anesthesia machine following the constant-flow connection method to check the flow sensors and inspiratory valve. For details, refer to "If measurement deviations are not corrected after multiple flow sensor calibrations, the user is recommended to replace the flow sensor and then perform calibration. If the problem persists, factory maintenance is necessary." on page 4-18.
2. Make sure that the supply gas pressure is within specifications.
3. When the system is in Standby, select the [Setup] shortcut key > [Service] > [Diagnostic Tests] to access the [Diagnostic Tests] menu.

5.4.4 Zero Points of Flow & Pressure Sensors Problems

By using the [Diagnostic Tests], you can easily detect if the zero points of all the pressure and flow sensors are within specifications.

To diagnose the zero points of the sensors:

1. Disconnect all gas supplies and make sure that the actual values of the sensors are "0".
2. Check the A/D counts of the sensors in the valve-test tool menu, which are the zero points of the sensors.
3. If the zero point of one sensor is outside of specifications, it indicates that the ventilator control board is defective. You need to replace the board.

You can also detect the zero points of the sensors by referring to 3.7.3 Check the Sensor Zero Point.

NOTE: For the normal range of sensors' zero points, refer to "Check the Sensor Zero Point" on page 3-19.

5.4.5 Connections and Measurement of the Flow Sensors Problems

The flow sensor has two sampling lines. Connection errors include:

- The two sampling lines are connected backward.
- One sampling line is not connected.
- Both sampling lines are not connected.

By using the Diagnostic Tests tool, you can detect if the sampling lines are connected correctly.

To diagnose the sampling line connection of the flow sensor:

1. Connect the tubes of the anesthesia machine following the constant-flow connection method. Refer to “Preparations before Using Diagnostic Tests” on page 5-70.
2. Make sure that gas supplies are within specifications. In the [Diagnostic Tests], PEEP safety valve to ON and the D/A value of the PEEP valve to more than “1500”, making sure that the PEEP valve closes at above 30 cmH2O.
3. Increase the D/A value of the inspiratory valve gradually and the A/D value of the flow sensor should also increase. With the gradual increase of gas supplied,
   - If the A/D value of one sensor decreases gradually, it is possible that the two sampling lines of the sensor are connected backward.
   - If the A/D value of one sensor stays unchanged, it is possible that the two sampling lines of the sensor are broken or not connected.
   - If the A/D value of one sensor nears saturation (above “4000”) quickly, it is possible that the sampling line at the low pressure end (gas outlet end) of the sensor is not connected.
4. If sampling line connection errors are detected, re-connect all sampling lines and verify proper connection of lines.

To diagnose the measurement error of the flow sensors:

1. After confirming that both the zero points of the sensors and the sampling line connections of the sensors are correct, check the flow sensor accuracy:
   - With the gradual increase of actual flow, the measured value of the flow sensor should also increase. Otherwise, the calibration data have errors. You need to calibrate the flow sensor again.
   - Compared with the measured value of the standard flow measurement device (anesthesia machine calibration device), the measured value of the flow sensor should be accurate. Otherwise, the calibration data have errors. You need to calibrate the flow sensor again.

For details, refer to “Check the Flow Sensor Accuracy” on page 3-20..

5.4.6 Connections and Measurement of the Pressure Sensors Problems

The pressure sensor has one sampling line. Connection errors include:

- The sampling line is not connected.
- The sampling line is connected incorrectly.

By using the Diagnostic Tests tool, you can detect if the sampling lines are connected correctly.

To diagnose the sampling line connection of the pressure sensor:

- During normal ventilation, if a sampling line connection error occurs, it is easily detected through the Paw waveform and technical alarms. If with the increase of actual pressure, pressure waveform data decreases and the alarm of “Paw Too Low” or “Patient Circuit Leak” occurs simultaneously, it is possible that the sampling line of the airway pressure sensor is connected incorrectly.
- You can enter the [Diagnostic Tests] menu to set the PEEP safety valve to ON. Gradually increase the D/A value of the PEEP valve and observe if the A/D value of the PEEP pressure sensor also increases gradually. If not, it further indicates that the PEEP pressure sensor may be connected incorrectly.

To diagnose the sampling line connection of the pressure sensor in case of pressure calibration failure:

1. Connect the tubes of the anesthesia machine just like described in "Preparations before Using Diagnostic Tests" on page 5-70.
2. Make sure to mount the water collection cup again
3. Make sure that gas supplies are within specifications. In the [Diagnostic Tests] menu, set the PEEP safety valve to ON. Set the Insp. Valve at 5 L/min.
4. Increase the D/A value of the PEEP valve gradually and the A/D value of the pressure sensor should also increase due to the gradual increase of actual pressure,
   - If the A/D value of one sensor decreases gradually, it is possible that the sampling line of the sensor is connected incorrectly.
   - If the A/D value of one sensor remains unchanged, it is possible that the sampling line of the sensor is not connected.
   - The pressure of the airway pressure gauge should increase. If not, it is possible that the airway pressure gauge is defective.
5. If sampling line connection errors are detected, re-connect the sampling lines and verify proper connection of all lines.

To diagnose the measurement error of the flow sensors:

1. With the gradual increase of actual pressure, the measured value of the pressure sensor should also increase. Otherwise, the calibration data have errors. You need to calibrate the pressure sensor again.
2. Compared with the measured value of the standard pressure measurement device (anesthesia machine calibration device), the measured value of the pressure sensor should be accurate. Otherwise, the calibration data have errors. You need to calibrate the pressure sensor again.

For details, refer to "Check the Flow Sensor Accuracy" on page 3-20.

5.4.7 Opening State of the Inspiratory Valve Problems

By using [Diagnostic Tests], you can detect if the opening state of the inspiratory valve is correct.

1. The methods for tube connections and settings of the anesthesia machine are the same as those for sampling line connections of the flow sensors. For details, refer to 5.4.3 on page 5-70.
2. In the [Diagnostic Tests] menu, gradually increase the D/A value of the inspiratory valve. If the measured values of the ventilator flow sensor, inspiratory flow sensor, and expiratory flow sensor change very little and low gas flow is felt at the connector of water collection cup, it indicates that the inspiratory valve or the D/A on the Ventilator Control Board is defective.
3. Normally, when the D/A value of the inspiratory valve is set to "2500", the flow measured by the standard flow measurement device can reach 90 L/min.
4. If when the D/A value of the inspiratory valve is set to more than "4000", the flow measured by the standard flow measurement device fails to reach 90 L/min, flow calibration will fail. In this case, you need to replace the expiratory valve assembly or the ventilator control board.
5. To locate if the DA on the Ventilator Control Board is defective, you can use a multimeter to measure the output of DA on the Ventilator Control Board corresponding to the inspiratory valve. If voltage also increases with the increase of D/A value, and voltage nears 6V when D/A value is set to more than "4000", it indicates that the DA on the Ventilator Control Board corresponding to the inspiratory valve may be correct.
6. After the expiratory valve assembly or the Ventilator Control Board is replaced, you can use the similar method to check if the problem is fixed.

5.4.8 Opening States of the PEEP Safety Valve Problems

When the PEEP safety valve is permanently OFF and the gas supplies are within specifications, the [Drive Gas Pressure Low] is alarmed.

By using Diagnostic Tests, you can detect if the opening states of the PEEP safety valve and PEEP valve are correct.

To diagnose the opening state of the PEEP safety valve:

1. Make sure that gas supplies are within specifications.
2. In the [Diagnostic Tests] menu, when the PEEP safety valve is switched on, a subtle click is heard.
3. Adjust the D/A value of the PEEP valve to cause the pressure measured by the PEEP pressure sensor to exceed 0 cmH2O.
4. Switch off the PEEP safety valve. The pressure measured by the PEEP pressure sensor should drop to 0 cmH2O immediately. Switch on the PEEP safety valve again. The measured value of the PEEP pressure sensor rapidly restores almost the same value to that before PEEP safety valve is switched off. During this period, gas flow and also change of gas flow when the PEEP safety valve is switched on or off can be felt at the PEEP outlet, which helps to judge if the PEEP safety valve can be switched on or off correctly.
5. If an error is detected, it is possible that the PEEP safety valve or the safety valve drive voltage on the ventilator control board is defective. You can use a multimeter to measure the drive signals on the ventilator control board corresponding to the PEEP safety valve (measurement can be performed at the corresponding socket). When the PEEP safety valve is turned on, the drive voltage should near 6V. When the PEEP safety valve is turned off, the drive voltage should near 0V. If these two conditions are met simultaneously, the ventilator control board is normal.
6. If the PEEP safety valve is defective, replace the expiratory valve assembly. After replacement, you can use the similar method to check if the problem is fixed.

5.4.9 Opening State of the PEEP Valve Problems

When the PEEP valve is defective, pressure related alarms occur in mechanical ventilation modes.

By using Diagnostic Tests, you can detect if the opening states of the PEEP valve is correct.

To diagnose the opening state of the PEEP valve:

1. Make sure that gas supplies are within specifications. In the [Diagnostic Tests] menu, set the PEEP safety valve to ON.
2. With the increase of D/A value of the PEEP valve, the measured value of the PEEP pressure sensor (or the anesthesia machine calibration device) should also rise. Note that there is a non-response area for the PEEP valve when the D/A value is relatively small. When the D/A value is less than this range, the PEEP valve cannot be opened and the output is "0" continuously. When the D/A value is greater than this range, the pressure output will increase with the increase of D/A value. This phenomenon also exists for the inspiratory valve.
3. For subsequent diagnosis rules, refer to 5.4.7 on page 5-72.

5.5 Hardware and Electrical Problems

Failure description	Possible cause	Recommended action
When switch ON, AC and battery indicator lamps are not lit, the machine can not ventilate and the screen is not lit.	AC power supply is not connected and the batty capacity is insufficient.	Check and make sure that the AC power supply is connected properly.
	The breaker of AC input is tripped and the battery capacity is insufficient.	Reset the breaker. If the breaker is still tripped when powered on after reset, it indicates the machine inside is short-circuited.
	The fuse of power board is burned and the battery capacity is insufficient.	Replace the fuse. If the fuse is replaced, the machine still can not be started up. It indicates there exists internal shorting in the machine.
The auxiliary AC electrical outlet has no voltage output.	The breaker of auxiliary outlet is tripped.	If there is still no voltage output after the breaker is reset, it indicates the auxiliary A/C electrical outlet is shorted.
Anesthesia machine can not be started.	The system switch is damaged.	Replace the system switch.
	The cable connected to system switch falls off.	Check and make sure that the cable is connected properly.
	The power board hardware circuit failure results in no power output of 15.2V, 3.3V, 5V, and 12V.	Replace the power board.
	The power board software code error results in no power output of 15.2V, 3.3V, 5V, and 12V.	Update the software.
The screen of anesthesia machine can not be lit.	The cable connected to the inverter falls off.	Check and make sure that the cable is connected properly.
	Screen Backlight Board is damaged.	Replace the Screen Backlight Board.
	The power board hardware failure causes improper output.	Replace the power board.
	The power board software failure causes improper output.	Update the power board software.
The screen of anesthesia machine can be lit, but without any content.	The screen power supply fuse is burned out, which results in no 3.3V output.	Replace the fuse.
	The main control board failure results in no display output.	Replace the main control board.
The screen of anesthesia machine can be lit and shows content, but the screen flashes.	The failure of power board causes power fluctuations	Replace the power board.
	The time sequence of main control board LVDS is abnormal.	Update the software of main control board. If the screen persists flashing, replace the main control board.
The heater is ineffective.	The heater driver and control circuit of power board are damaged.	Replace the power board.
	The heater is damaged.	Replace the heater.
	The internal sensor of heater is ineffective.	
	The cable connected to heater falls off.	Check and make sure that the cable is connected properly.

Failure description	Possible cause	Recommended action
The touch panel is ineffective.	The touch panel is damaged.	Replace the touch screen.
	The controller of touch panel is damaged.	
	The cable connected to touch panel falls off.	Check and make sure that the cable is connected properly.
During the operation of the anesthesia machine, ventilation stops all of a sudden but the display and buttons work normally.	The ventilator control board or valve is damaged.	Select [Setup] > [Service] > [Diagnostic Tests] > [Valves] Test the status of each valve and reference power supply in the valves-test tool window. If valve malfunction or reference power supply error is detected, replace the valve or ventilator control board.
Exiting Standby fails.	The ventilator control board hardware self-test is failed.	Replace the ventilator control board.
Alarm messages are displayed on the screen but without alarm sound.	The speaker is damaged.	Replace the speaker.
	The speaker cable is disconnected	Check and make sure that the cable is properly connected.
Network connection is failed.	The cables connected to the network connection board get loose.	Properly insert the cables.
	The network cable is too long.	Shorten the network cable. Recommended cable length is approximately 1.5 m.
	The network cable is used incorrectly.	The network cable has two linear orderings that should be differentiated.
No gas is outputted through the valve in mechanical ventilation mode.	The Auto/Manual ventilation switch is defective.	Check the screen to see if the anesthesia machine is in mechanical ventilation mode and if there is an alarm triggered.
	The valve cannot be opened.	1. Set tidal volume to maximum. 2. Switch between standby and mechanical statuses or between manual and mechanical statuses repeatedly. 3. Replace the pneumatic circuit block.
Communication between CPU board and infrared communication board fails.	The cables between CPU board and infrared communication board get loose.	Properly insert the cables.
	The communication board or CPU board is damaged.	Replace the communication board or CPU board.

5.6 Software Update and Software Configuration Activation

NOTE: Software upgrade may by required when replacing the CPU Board (P/N: 801-0631-00026-00 (A5 EPSON), 801-0633-00004-00 (A3 EPSON), 115-052902-00 (A5 DSP), or 115-052901-00 (A4)), the Ventilator Control Board (P/N: 801-0631-00027-00 (EPSON), or 115-058771-00 (A5/A4 DSP, only PCBA)), the Power Board (P/N: 801-0631-00025-00) or the Electronic Flowmeter Assembly (P/N: 115-046746-00).

1. Connect the Ethernet port of the PC to the Ethernet port of the A5/A4/A3 using the Ethernet Crossover Cable.
2. Before running Mindray Patient Monitor System Update Tool, verify that the IP address of the PC is set to 192.168.23.1., and the Subnet mask is set to 255.255.255.0. To check and set the IP address on the PC follow these instructions.
   a. On the PC click Start, Settings and then Network Connections
   b. Right click Local Area Connection and then left click Properties
   c. Scroll down to Internet Protocol (TCP/IP), click on it and then click Properties
   d. Click the radio button for "Use the following IP address:" Set the IP address and Subnet mask and then click OK.

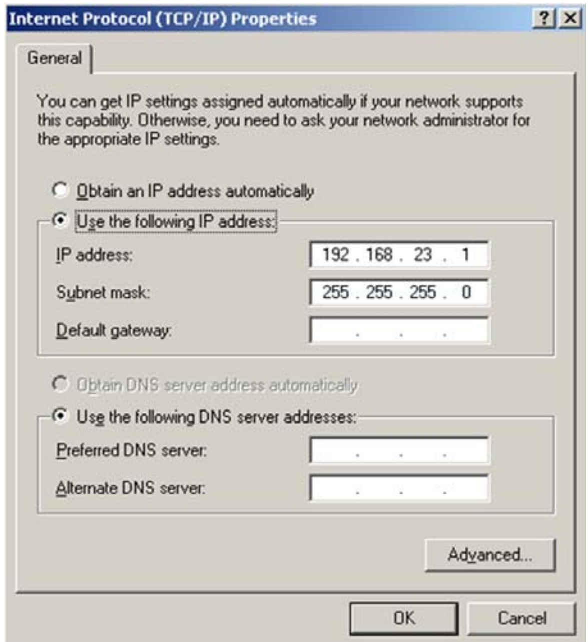


FIGURE 5-75

3. Make sure that the Mindray Patient Monitor System Update Tool has been installed to the PC. If it has not been installed then follow these steps:
    a. Run the SystemUpdateToolForService.exe file (G-110-001396-00).
    b. When prompted to setup a language select "English" and then select "OK".
    c. When the Welcome dialog window is displayed select "Next".
    d. When the Customer Information dialog window is displayed enter the following:
    e. User Name: Manufacturing
    f. Company Name: Mindray
    g. Serial Number: 366-267-2667
    h. Select "Next".
    i. When the Administrator password dialog window is displayed enter "datascope" as the password and confirm it, then select "Next".
    j. When the Destination Location dialog window is displayed select "Next" to accept the default Destination Folders.
    k. When the Select Program Folders dialog window is displayed select "Next" to accept the default Program Folder.
    l. When the Install Shield Wizard dialog window is displayed select "Finish" to complete the installation.
4. Upgrade Software:
    a. From the Desktop, run the Mindray Anesthesia Machine and Ventilator Software Upgrade Tool X.X Icon. When the "Select Product Series" dialog is displayed select A Series followed by OK. Once the System Update Tool starts perform the following to update the software:
    b. Select "Select Package" from the top tool bar.

c. When the Select Package dialog is displayed select ">>>"

d. When the Open dialog is displayed select down arrow " ▼ " for Look in.

e. If changing the CPU Board (P/N: 801-0631-00026-00), the Ventilator Control Board (P/N: 801-0631-00027-00 (EPSON),) or 115-058771-00 (A5/A4 DSP, only PCBA)) or Electronic Flowmeter Assembly (P/N: 115-046746-00), select the System VXX.XX.XX XXXX-XX-XX.mpkg

f. If changing the Power Board (P/N: 801-0631-00025-00), select the POWER VX.X.pkg

File Name	Creating Time	Module	Checksum	Version	Note
System V01.02.00 2011-03-04.mpkg	2011-03-04 01:56:24				
	BIOS	36 72 B7 0E	1.3.0.0	\	
		System Program	0F 77 D5 5F	1.2.0.8	AS3700
		Language file	\	\	\
		Startup screen file	\	\	\
		Icons resource file	\	\	\
		FPGA display drive	17 69 B2 5A	\	\
		FPGA sound drive	34 BB B8 13	\	\
		Module software	C9 D4 92 D2	\	FLOW
		Module software	A9 87 8F 7A	\	VCM
		Module software	CF A3 04 4D	\	VPM
POWER V1.3.pkg	2011-01-20 22:04:00	Module software	2C 68 E3 56	\	POWER

NOTE: **This only an example of a Software version / Checksum table. Check for Technical bulletins to find the correct table for the software version you are installing.**

g. Select "Open".

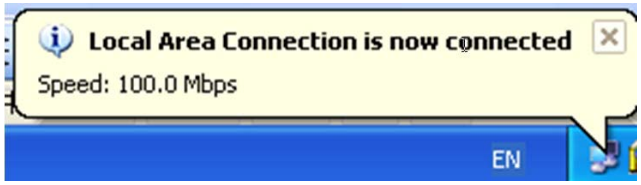
h. A dialog box will appear. Verify that for each file the Creating Time, Module, Checksum, Version and Note are correct from the table above. If they are correct then click OK.

i. Turn on the A5/A4/A3 unit on, wait at least ten seconds before proceeding to the next step.

j. Click "Start (Single)" on the Mind ray Anesthesia Machine and Ventilator Software Upgrade Tool 4.0.

k. Turn off and then turn on the A5/A4/A3 unit within one second of each other.

l. You will see that the Windows XP network icon indicate that it is connected.



m. While updating the software the A5/A4/A3 will show text which explains the progress of the software update.

n. Once the Download is complete the Mind ray Anesthesia Machine will display "succeeded". And Ventilator Software Upgrade Tool will display "update system successfully".

NOTE: **It is normal for the power board software that it will fail at the first time and it will be successful at the second time in upgrade process.**

o. Once the last file is upgraded turn off the A5/A4/A3 unit and then restart A5/A4/A3 unit.

p. Check the software version on the A5/A4/A3 by clicking Setup then Service, enter the service password followed by Enter, then go to System Info and then SW Versions. Verify that the software version on the A5/A4/A3 match the following table.

Software version V01.02.00

Module	Software Version	Date*
Host Software	01.02.00	1/19/2011
BIOS	01.03.00.00	11/29/2011
FPGA Display	1.2	\
FPGA Sound	1.0	\
Ventilator Protect Module	V1.1	11/26/2011
Ventilator Control Module	V1.3	3/04/2011
Power System	V1.3	1/19/2011
Flowmeter Software	V1.2	1/19/2011
* The Date format my differ depending on the unit setup		

NOTE: **This only an example of a Software version table. Check for Technical bulletins to find the correct table for the software version you are installing.**

After A5 EPSON software is updated (Software Bundle Version earlier than 03.01.00) verify that the ventilation modes are VCV, SIMV-VC, PCV (with VG), SIMV-PC, PS and Manual. Make sure in manual mode the following buttons appear: Alarms, Bypass, Monitor (if AG module is installed), and CO2 Alarms (if AG module is installed). Make sure that the Spirometry tab is present.

After A5 DSP software is updated (Software Bundle Version 03.01.00 and later), check that the standard ventilation modes VCV, SIMV-VC, PCV, PCV-VG, SIMV-PC, CPAP/PS, and Manual are present. Make sure in manual mode the following buttons appear: Alarms, Monitor (if AG module is installed), and CO2 Alarms (if AG module is installed). Verify that the options that were activated with the license keys are present.

After A3 EPSON software is updated (Software Bundle Version earlier than 03.01.00) verify that the ventilation modes are VCV, SIMV-VC, PCV, PS and Manual. Make sure in manual mode the following buttons appear: Alarms.

After A4 DSP software is updated (Software Bundle Version 03.01.00 and later), check that the standard ventilation modes VCV, CPAP/PS, and Manual are present. Make sure in manual mode the following buttons appear: Alarms, Monitor (if AG module is installed), and CO2 Alarms (if AG module is installed). Verify that the options that were activated with the license keys are present.

The clear package file will completely clear the contents of the CPU board and will set the system to factory defaults. This file is only used when a CPU board needs to be programmed from DSP to EPSON or from EPSON to DSP. If necessary, clear package as following order:

1. Upgraded the clear package file "Clear BIOS File For Upgrades.pkg".
2. Upgrade the BIOS.
3. Upgrade the A5 system software.
4. Upgrade the power system software.

Activate the software licenses (only for DSP systems):

1. Load the license key to the USB.
2. Insert the USB into the machine.
3. Enter Setup-> Service menu and click "license" button to open the submenu. The license menu is below:

4. After click "Install" button, the function will be activated.
5. Please contact Mindray Technical Support if Software Licenses are required for optional features.

5.7 Factory Setup

Perform the following procedure to enter the factory setup menu.

1. Ensure the anesthesia system is in Standby mode.
2. Select Setup softkey > Service tab > enter factory password.

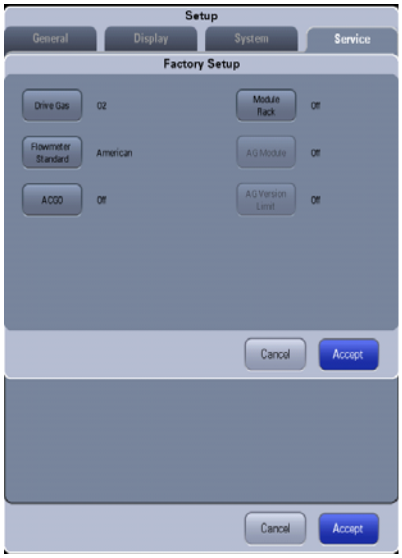


FIGURE 5-76

FACTORY SETUP	CHOICES	DEFAULT
Drive Gas	**O2, AIR**	**O2**
Flowmeter Standard	**American, Canadian**	**American**
ACGO	**Off, ACGO with 3-way Valve, Electronic ACGO**	**Off**
Module Rack	**On, Off**	**On***
AG module	**On, Off**	**On***
AG Version Limit	**On, Off**	**On***

TABLE 5-1 Factory Setup Menu Settings

* For older A5s without the module rack and A3s, the default setting is "Off".

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6.0 Repair and Disassembly

6.1 Prepare for Disassembly

6.1.1 Tools

During parts disassembly and replacement, the following tools may be required:

- Metric Allen wrenches (2.5, 3, 4, 5, 8mm)
- Phillips screwdriver (#1 and #2)
- Diagonal pliers
- Flathead screwdriver
- Metric M3 and M4 socket screwdriver
- Adjustable wrench
- Tweezers
- Krytox Lubricant (P/N: 0510-00-0020)

6.1.2 Preparations

Before disassembly:

- Make sure that the anesthesia machine is turned off and disconnected from the A/C power source.
- Bleed down the gas pressure inside the anesthesia machine as described below.
- Disconnect all pipeline and cylinder gas supplies.
- Prepare the tools required for disassembly.
- Maneuver the anesthesia machine to an appropriate location and then apply the brake.

CAUTION: The internal parts may be contaminated. Wear special gloves during disassembly and inspection.

6.1.3 Bleed Gas Pressure

Make sure to bleed down the gas pressure inside the anesthesia machine before disassembling pneumatic fittings to avoid personal injury or equipment damage. To bleed gas pressure:

1. Close other cylinder valves and disconnect pipeline gas supplies. Do not disconnect the O2 pipeline. If O2 pipeline is not available, connect O2 cylinder and open the O2 cylinder valve.
2. Set the system switch to ON.
3. Turn on all the flow controls (except O2).
4. Make sure that N2O and AIR pipeline pressure gauges read zero.
5. Disconnect the O2 pipeline supply (or close the O2 cylinder valve). Push the O2 flush button to bleed O2 from the system.
6. Set the system switch to OFF.

6.2 Disassemble the Assemblies

6.2.1 Disassemble the Internal Assemblies of the Machine Upper Half

6.2.1.1 Open the Service Door

Turn the two screws on the service door counter-clockwise one half turn to open the door.

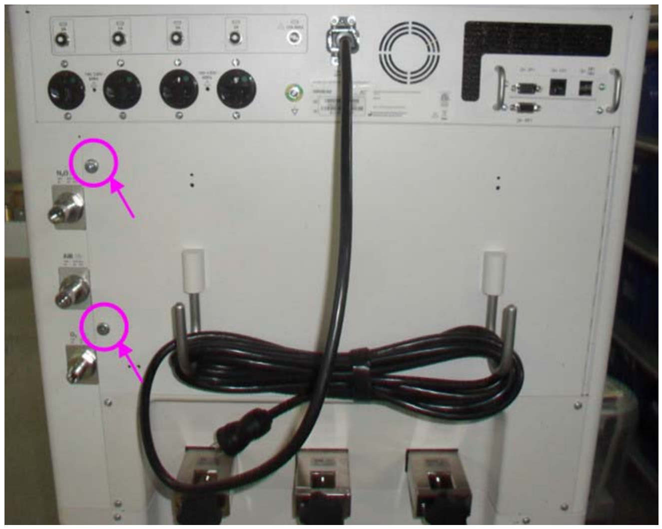


FIGURE 6-1

6.2.1.2 Remove the Gas Supply Inlet Assembly

1. Open the service door.
2. Disconnect the tubes from the N2O, AIR and O2 supply inlet assemblies.
3. Unscrew the two screws from the N2O and AIR supply inlet assemblies.
4. Unplug the related cables from O2 supply inlet assembly and unscrew the two screws to remove the assembly.

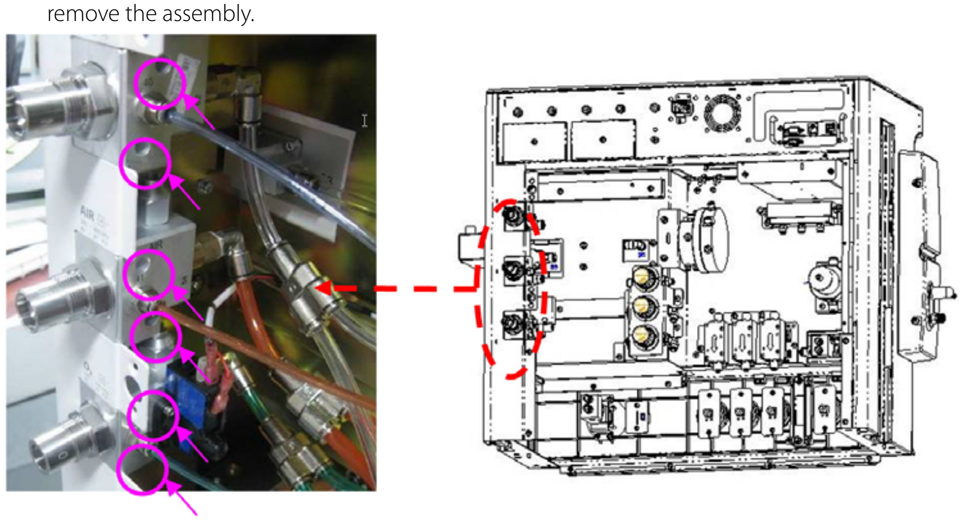


FIGURE 6-2

6.2.1.3 Remove the Pressure Regulator Assembly

1. Open the service door.
2. Unplug the tubes from the pressure regulator assembly.
3. Unscrew the four screws on the pressure regulator assembly and remove it.

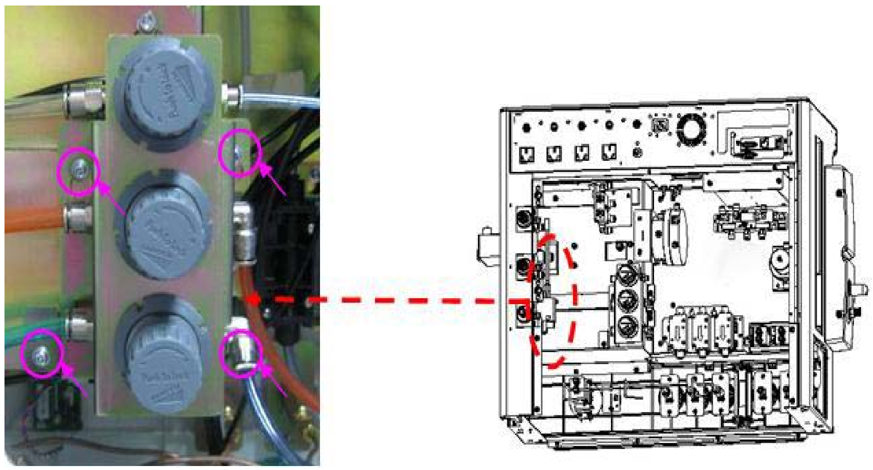


FIGURE 6-3

6.2.1.4 Remove the Electronic Flowmeter Assembly

1. Open the service door.
2. Unplug the related cables and tubes from the electronic flowmeter.
3. Unscrew the four screws and remove the electronic flowmeter.

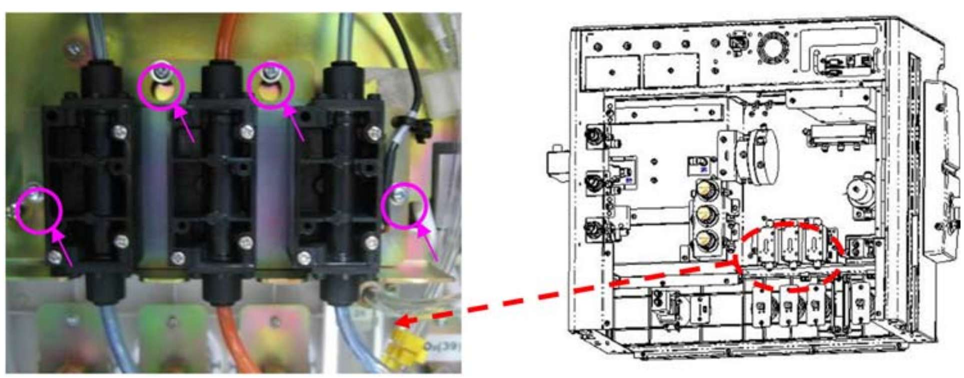


FIGURE 6-4 Electronic Flowmeter Assembly (Old Version)

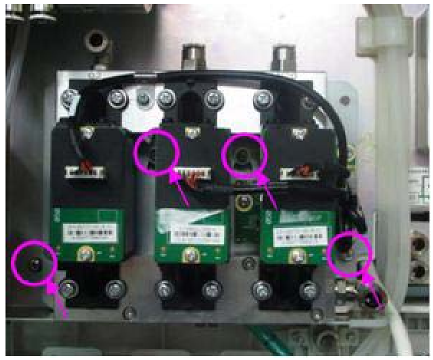


FIGURE 6-5 Electronic Flowmeter Assembly (New Version)

4. Upgrade the software bundle version to 02.12.00 and later if the flow sensor or flow sensor board is replaced,

6.2.1.5 Remove the Poppet Valve Assembly

1. Open the service door.
2. Unplug the tubes from the poppet valve assembly.
3. Unscrew the two screws on the valve to remove the poppet valve (old version).

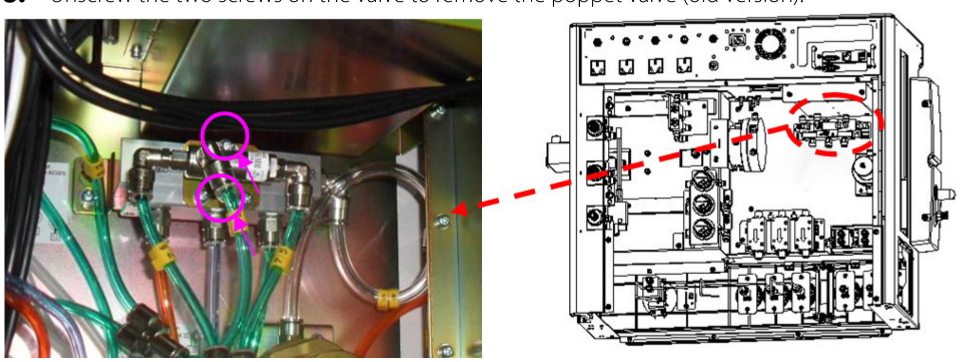


FIGURE 6-6 Poppet Valve Assembly (Old Version)

Unscrew the two screws on the valve to remove the poppet valve (new version).

FIGURE 6-7 Poppet Valve Assembly (New Version)

6.2.1.6 Remove the Gas Mixer Assembly (Only Old Electronic Flowmeter Assembly Configure with Gas Mixer Assembly)

1. Open the service door.
2. Unplug the tubes from the gas mixer assembly and the Poppet Valve Assembly.
3. Unscrew the four screws on the gas mixer assembly to remove the assembly.

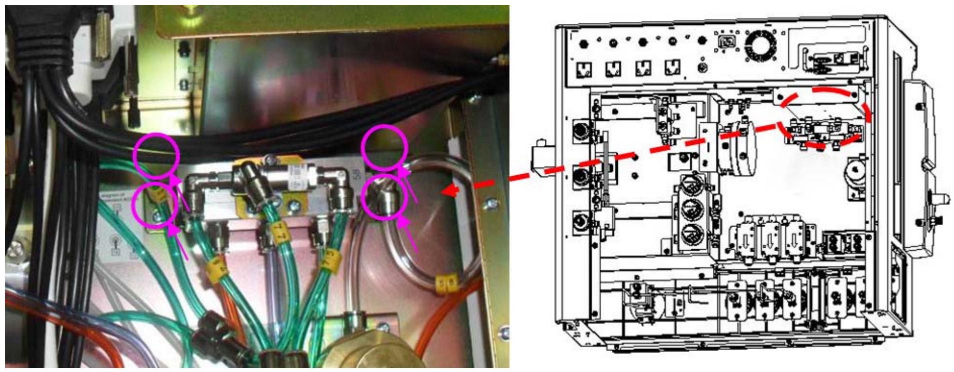


FIGURE 6-8

4. Unscrew the two screws on the support plate of the regulator to remove the gas mixer assembly.

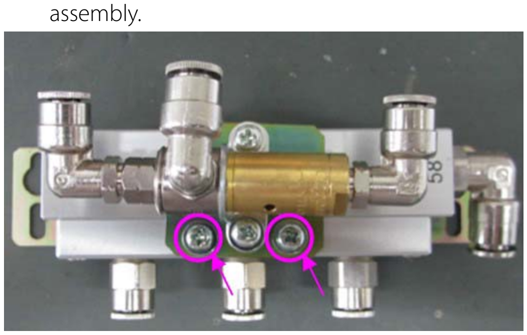


FIGURE 6-9

6.2.1.7 Remove the ORC Assembly

1. Open the service door.
2. Unplug the tubes from ORC assembly.
3. .Unscrew the two screws on the ORC assembly to remove the assembly.

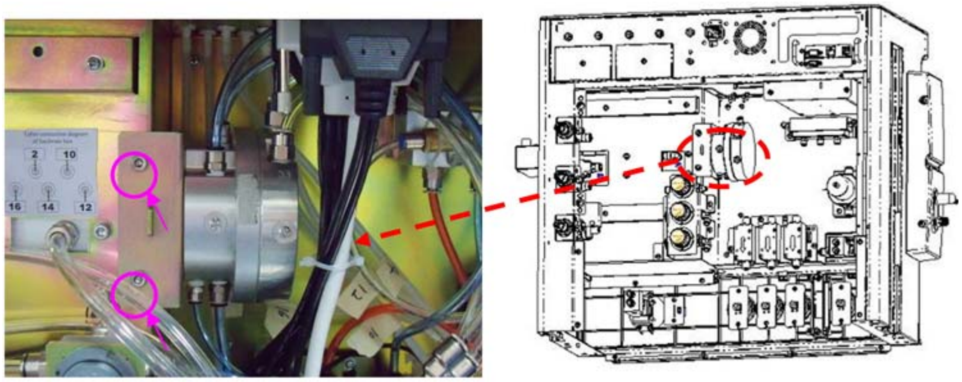


FIGURE 6-10

6.2.1.8 Remove the Back Pressure Valve Assembly

1. Open the service door.
2. Unplug the tubes from back pressure valve assembly.
3. Unscrew the four screws on the back pressure valve assembly to remove the assembly.

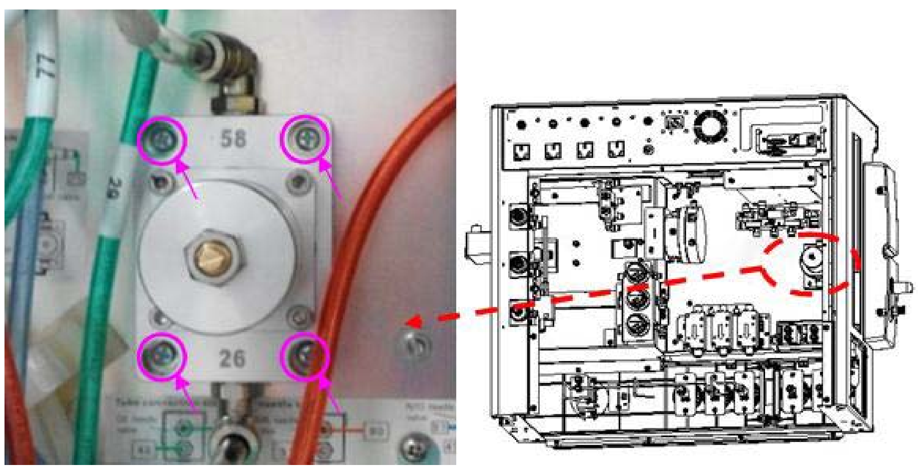


FIGURE 6-11

6.2.1.9 Replace the Lithium-ion Battery

1. Open the service door.
2. Unscrew the two screws on the battery box cover, and then you can take out the lithium-ion battery.
3. Place the new lithium-ion battery into the battery box in the original direction to complete battery replacement.

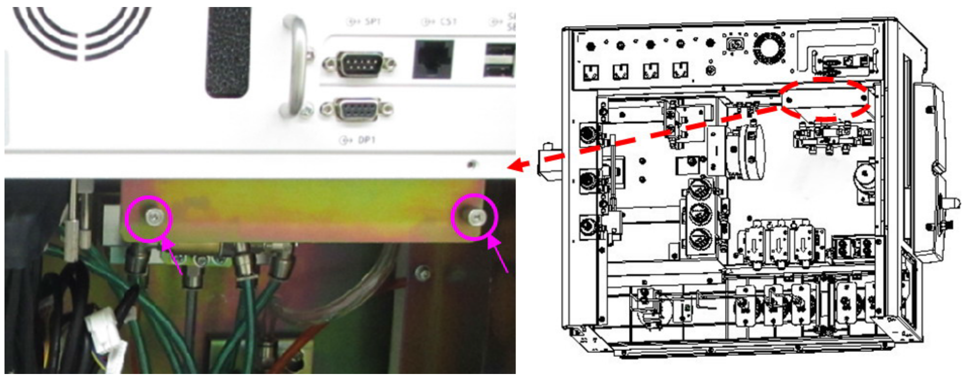


FIGURE 6-12

6.2.1.10 Remove the Vaporizer Manifold

1. Open the service door.
2. Unplug the tubes from the vaporizer manifold.
3. Unscrew the four screws and remove the vaporizer manifold.

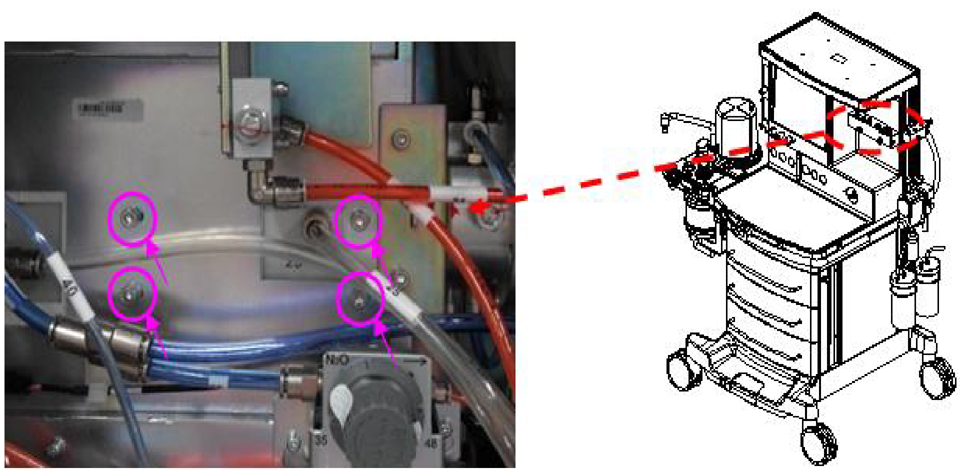


FIGURE 6-13

6.2.1.11 Remove the Pneumatic Resistor Block Assembly

1. Open the service door.
2. Unplug the tubes from the pneumatic resistor block assembly.
3. Unscrew the two screws and remove the pneumatic resistor block assembly.

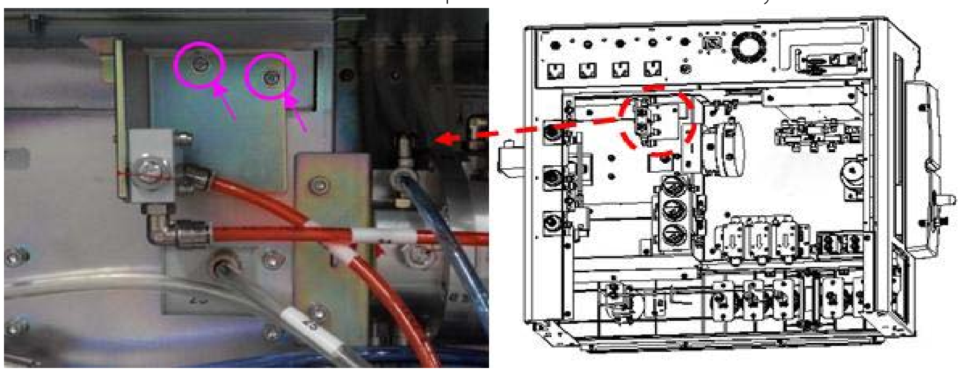


FIGURE 6-14

6.2.2 Disassemble Hardware Box

6.2.2.1 Remove the Top Plate of the Hardware Box

1. Unscrew the three screws from the top plate of the hardware box.

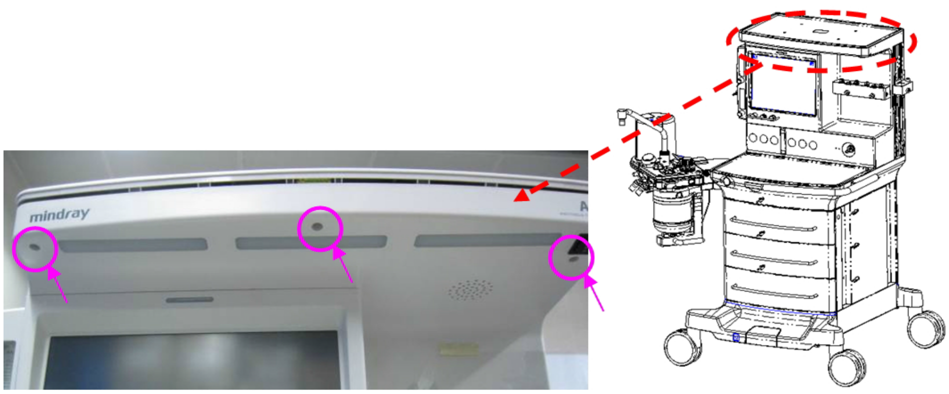


FIGURE 6-15

2. Lift off the top plate to remove it.

FIGURE 6-16

6.2.2.2 Remove the CPU Board

NOTE: **When replacing the CPU Board, software reinstallation may be required.**

1. Remove the top plate assembly.
2. Unscrew the three screws fastening the main control board to remove the board.

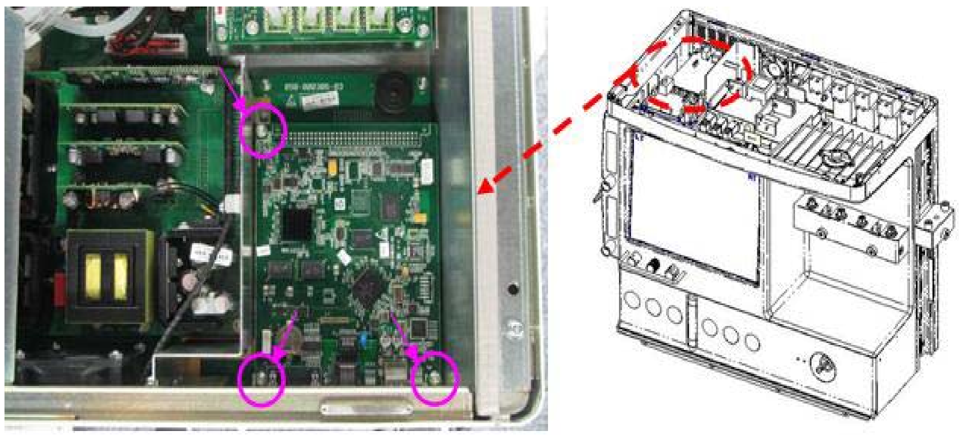


FIGURE 6-17

6.2.2.3 Remove the Ventilator Control Board

NOTE: **When replacing the Ventilator Control Board, software reinstallation may be required.**

1. Remove the top plate assembly.
2. Unplug the related cables and tubes from the ventilator control board.

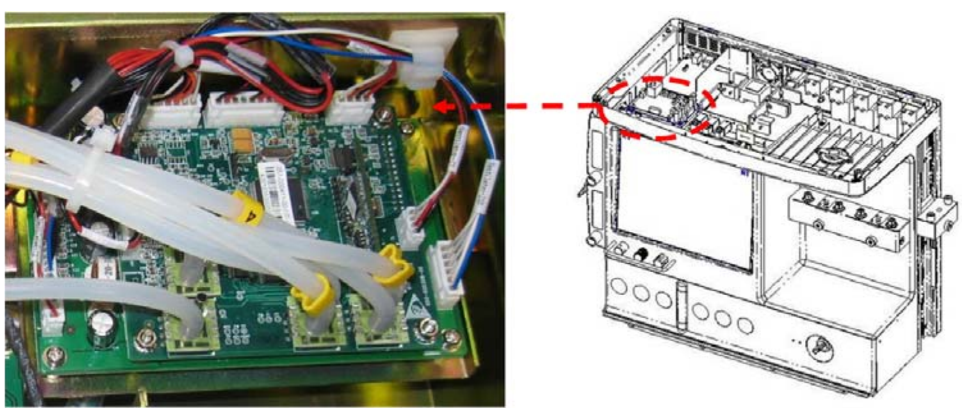


FIGURE 6-18

3. Unscrew the four screws fastening the ventilator control board to remove it.

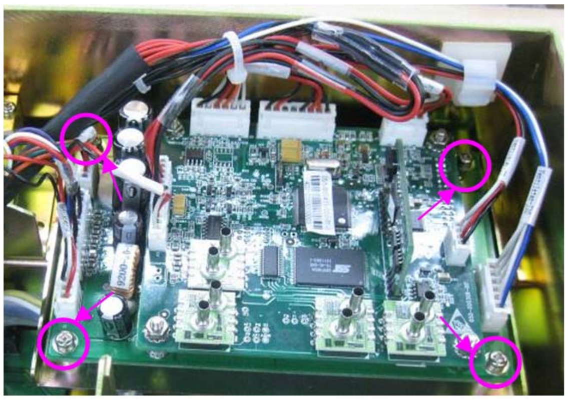


FIGURE 6-19

- The ventilator control board for the EPSON platform.

FIGURE 6-20

- The ventilator control board for the DSP platform.

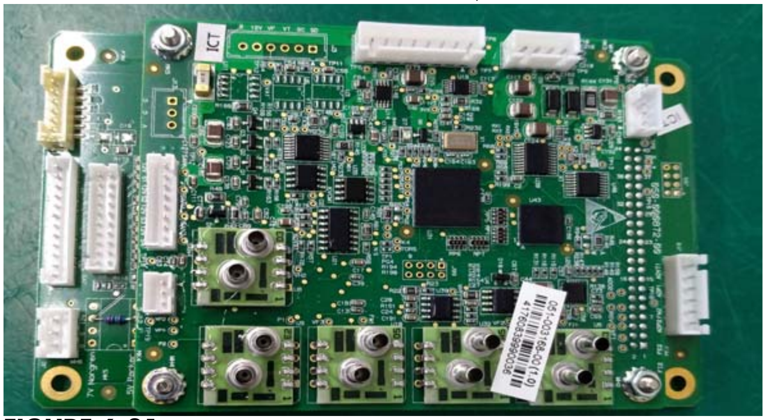


FIGURE 6-21

Refer to "Connections Between Pneumatic Circuit, Breathing System and Ventilator Control Board" on page 1-17.

6.2.2.4 Remove the Power Board

1. Disassemble the top panel assembly.
2. Unscrew the two screws fastening the high-pressure protection cover to remove the protection cover.

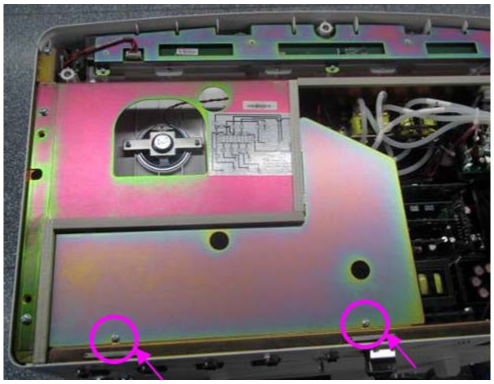


FIGURE 6-22

3. Unplug the filter cable plug. Unscrew the screw on the power board support sheet, three screws and one nut fastening the power board to remove the power board.

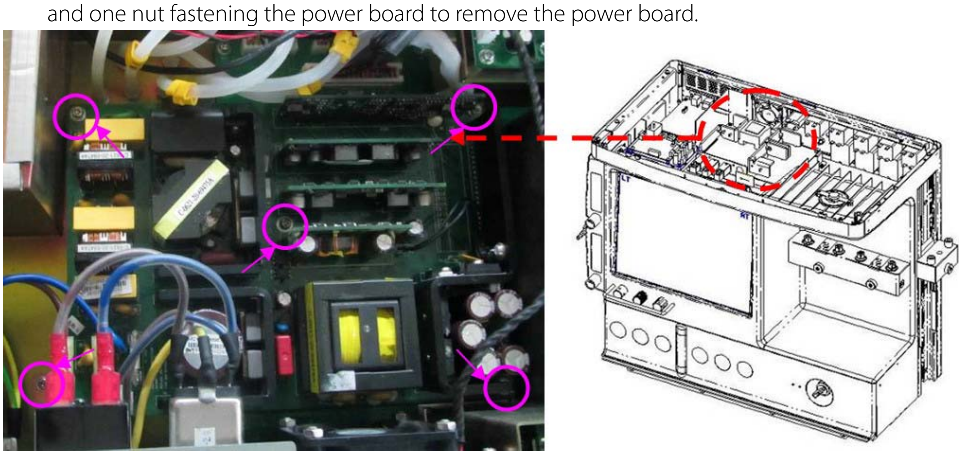


FIGURE 6-23

4. Unscrew the screw on the power board support sheet to remove the support sheet.

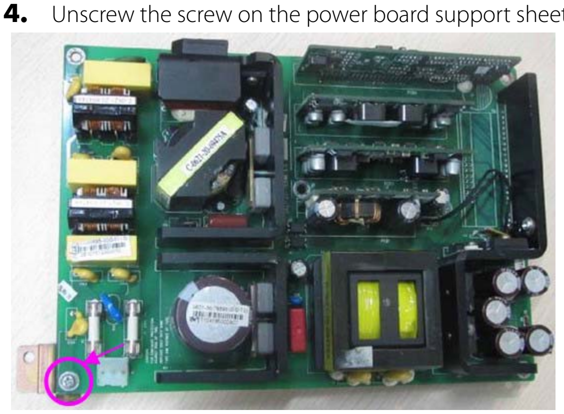


FIGURE 6-24

6.2.2.5 Remove the Solenoid Valve Assembly

1. Remove the top plate assembly.
2. Unplug the related tubes and cables from the solenoid valve assembly.

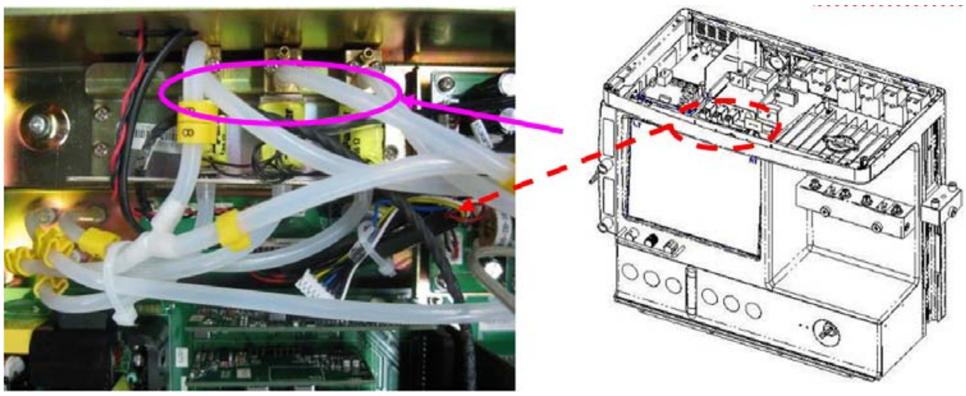


FIGURE 6-25

3. Unscrew the three screws on the three-way valve to remove the solenoid valve assembly.

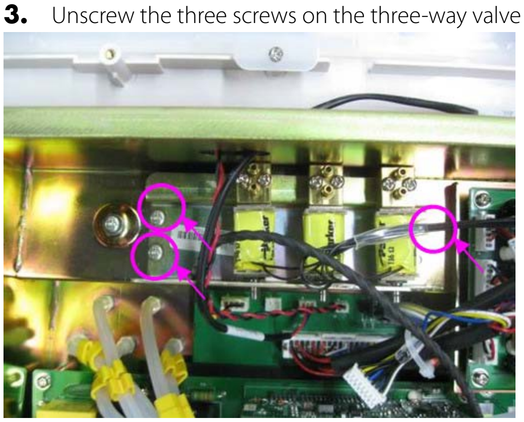


FIGURE 6-26

Refer to "Connections Between Pneumatic Circuit, Breathing System and Ventilator Control Board" on page 1-17..

6.2.2.6 Remove the Speaker

1. Remove the top plate assembly.
2. Unplug the speaker cables from the backplane.
3. Unscrew the two screws to remove the speaker.

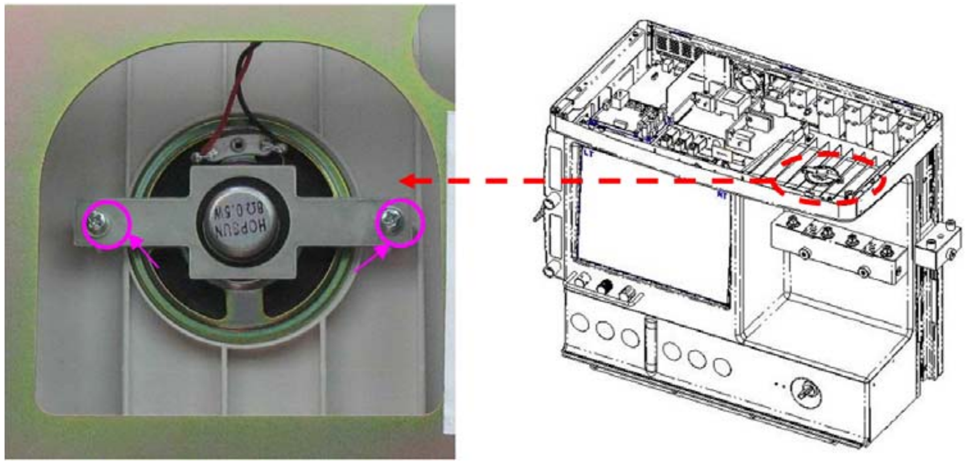


FIGURE 6-27

6.2.2.7 Disassemble the Rear Panel Assembly

1. Remove the top plate assembly.
2. Remove the cables and tubes from the hardware box assembly and other A5/A4/A3 assemblies.

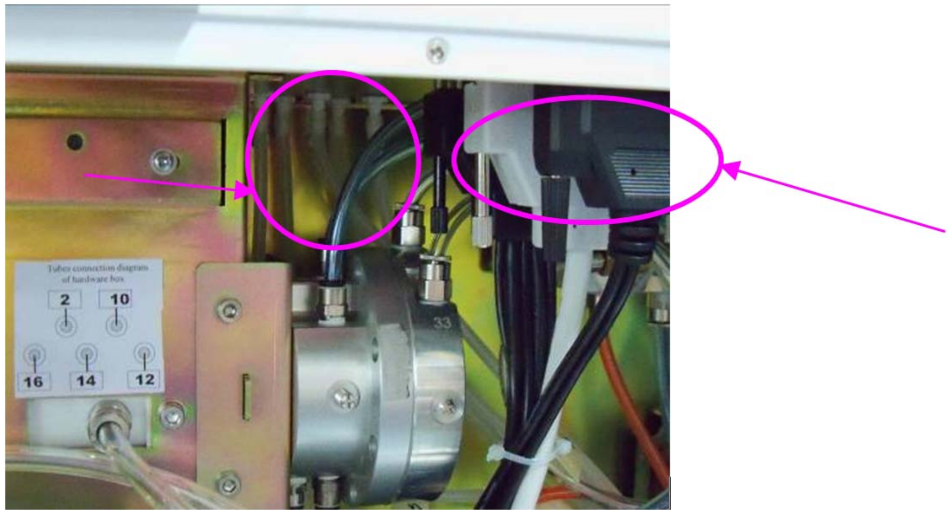


FIGURE 6-28

3. Unscrew the three screws fastening the power plug protection hook to remove the power cord and protection hook.

FIGURE 6-29

4. Unscrew the two screws fastening the high-pressure protection cover to remove the protection cover.

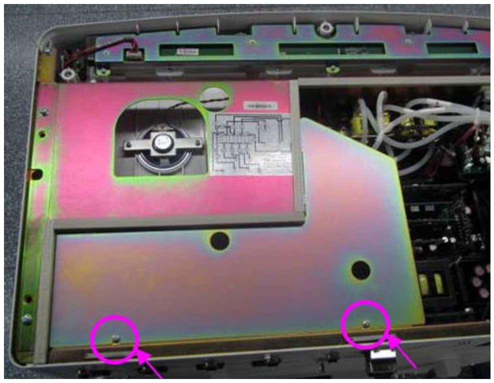


FIGURE 6-30

5. Unscrew the seven screws on the hardware box and lift off the hardware box to remove it.

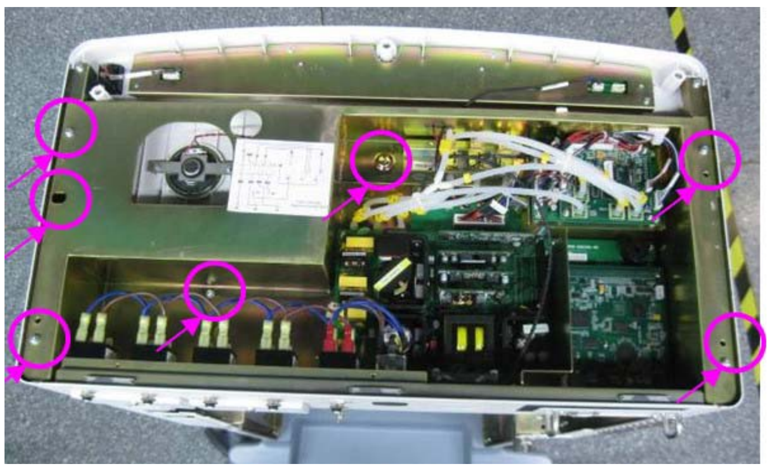


FIGURE 6-31

6. Remove related cables and tubes on the rear panel assembly from other assemblies

7. Unscrew the elevn screws on the rear panel of hardware box to remove the rear panel assembly.

FIGURE 6-32

Remove the Fan

1. Remove the rear panel of hardware box.
2. Unscrew the four screws on the fan to remove the fan.

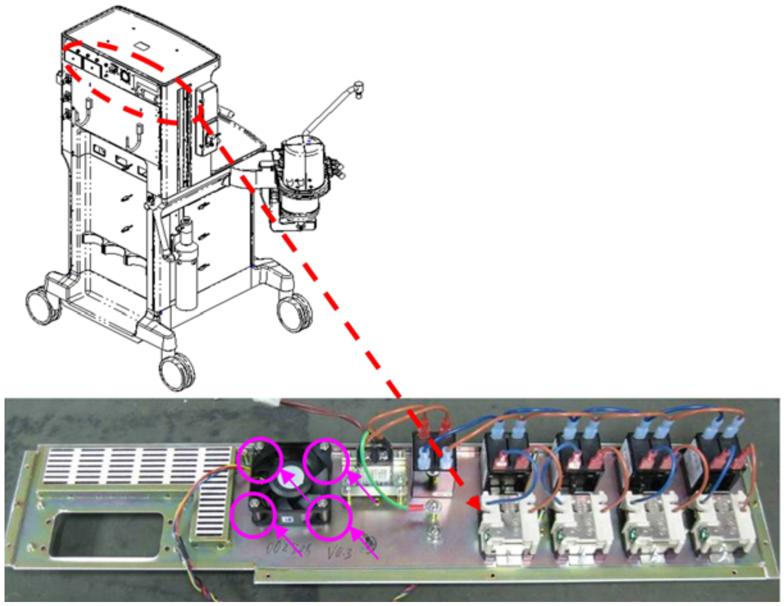


FIGURE 6-33

Remove the Filter

1. Remove the rear panel assembly of hardware box.
2. Unscrew the five screws on the filter to remove the filter.

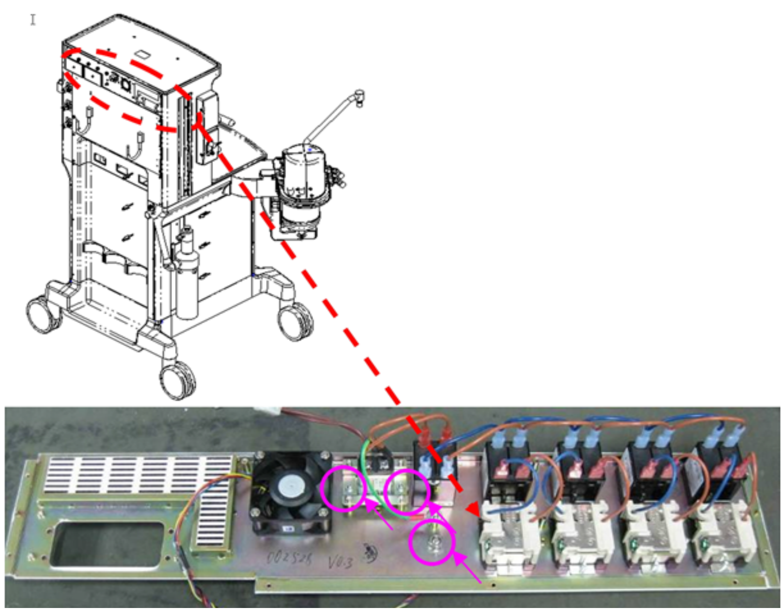


FIGURE 6-34

Remove the Auxiliary Outlet Assembly

1. Remove the rear panel assembly of the hardware box.

2. Unscrew one nut and disconnect the cable from the breaker.

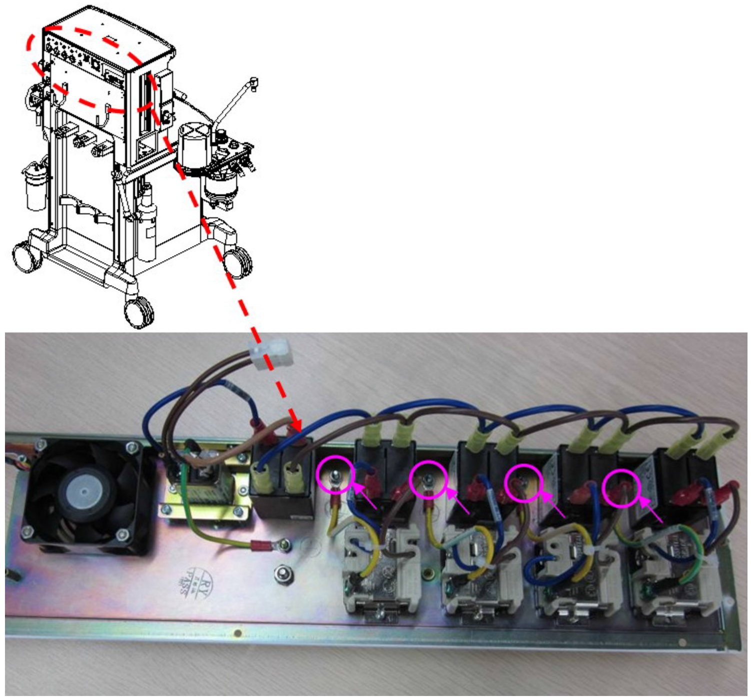


FIGURE 6-35

3. Unscrew the two screws on each auxiliary outlet to remove the auxiliary outlets. The A5 has four (4) auxiliary outlets, as shown in the photograph below. The A3 and A4 has three (3) auxiliary outlets (not shown).

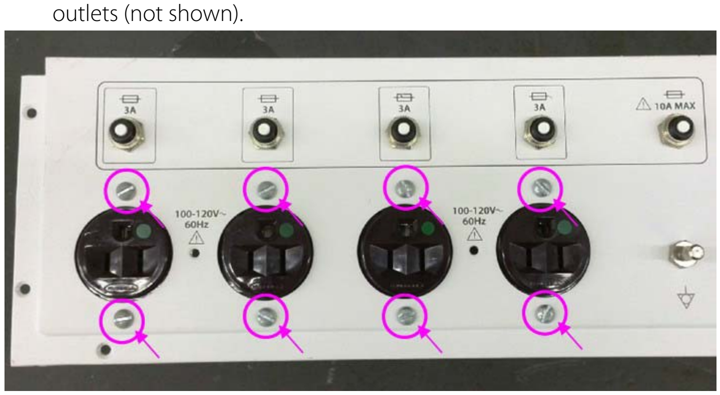


FIGURE 6-36

Remove the Breaker Assembly

1. Remove the rear panel assembly of the hardware box.
2. Unscrew the breaker screws to remove each breaker. The A5 has five (5) breakers. The A3 and A4 has three (3) breakers.

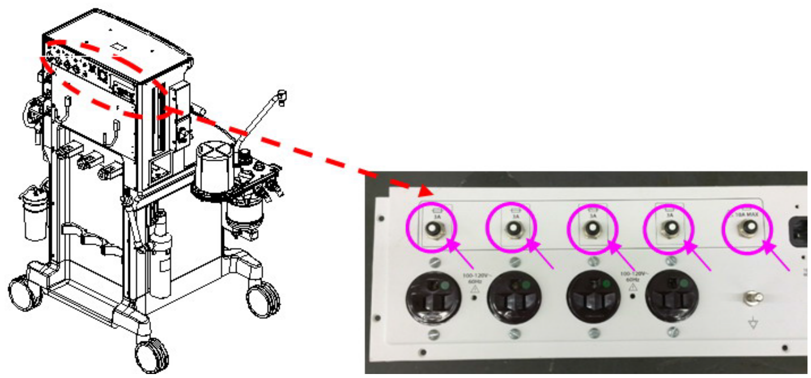


FIGURE 6-37

6.2.3 Disassemble the Work Surface

6.2.3.1 Remove the Drawer Assembly

1. Pull out the drawer until the black locking piece on the rail can be seen.
2. Lift up the locking piece on the right rail of drawer, and press down on the locking piece on the left rail at the same time.

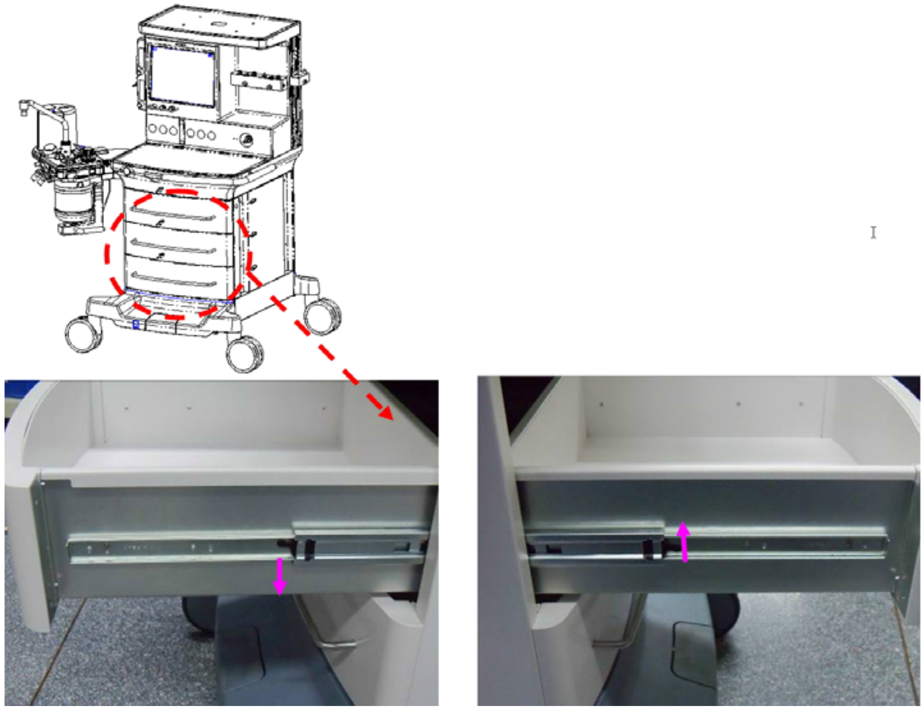


FIGURE 6-38

3. Take out the drawer.

6.2.3.2 Remove the Work Surface Cover Plate

1. Remove the first drawer.
2. Unscrew the five screws on the work surface cover plate.

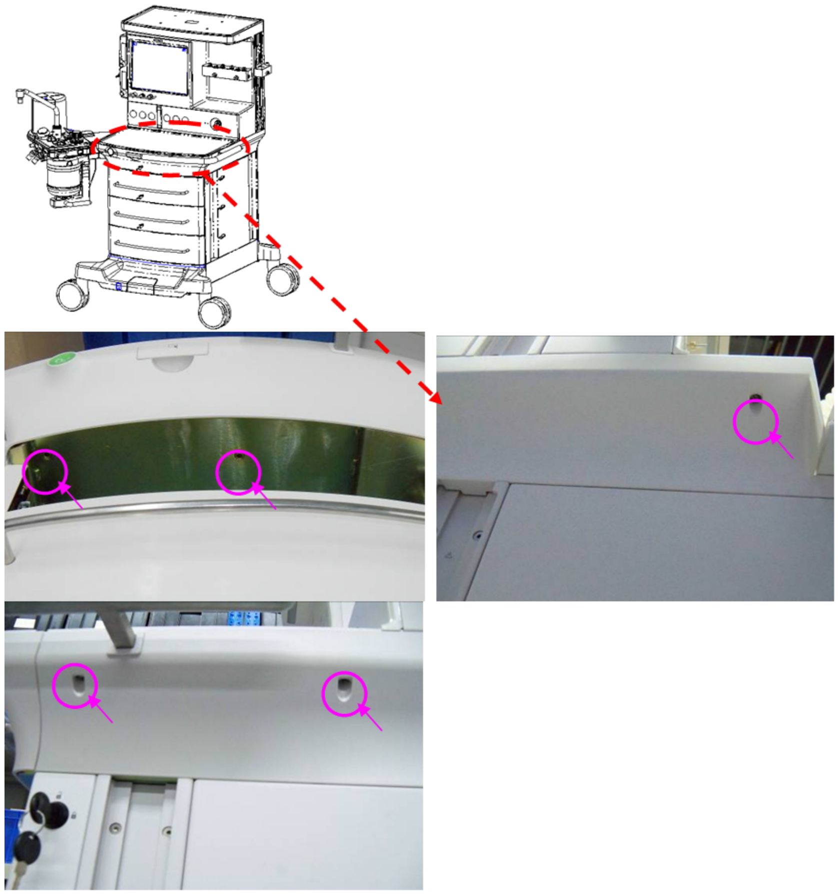


FIGURE 6-39

3. .Lift off the cover plate from the work surface. When the cover plate is removed, the internal structure of the work surface is shown as below:

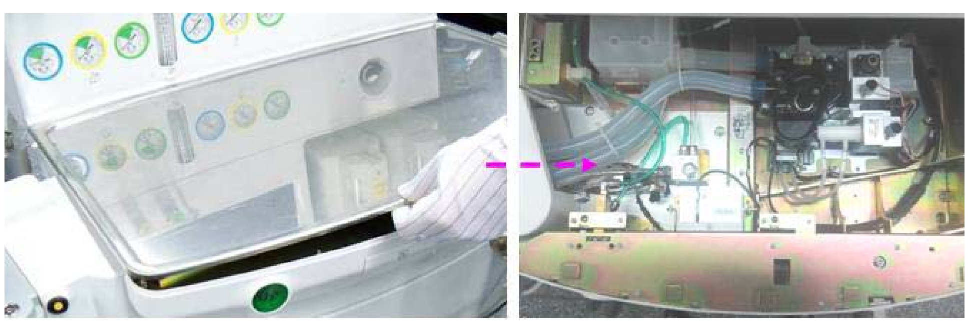


FIGURE 6-40

6.2.3.3 Remove the Metal Cover Plate

1. Remove the work surface cover plate.
2. Unscrew the eight screws on the metal cover plate to remove the cover plate.

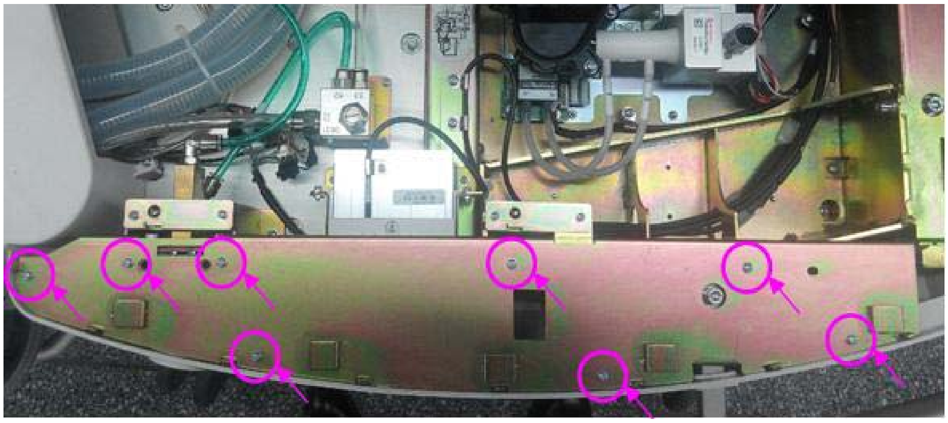


FIGURE 6-41

6.2.3.4 Remove the Rear Panel Assembly

1. Rotate the cylinder's yoke to remove the cylinder.

FIGURE 6-42

2. Unplug the AGSS transfer tube connecting to the exhaust tube and refer to "Remove the AGSS Assembly" on page 6-43..

3. Unscrew the six screws on the lower rear panel assembly to remove it.

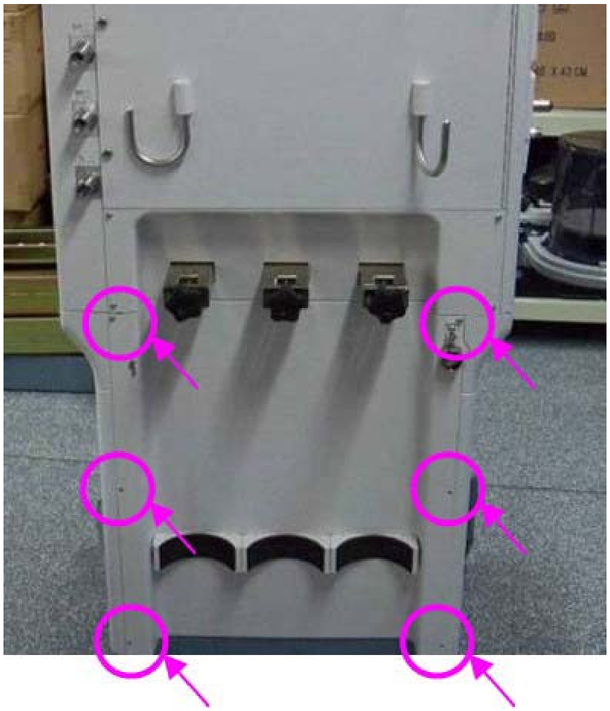


FIGURE 6-43

4. Unscrew the four screws on the upper rear panel (yoke cover) to remove it.

FIGURE 6-44

6.2.3.5 Remove the Drive Gas Assembly

1. Remove the work surface cover plate.
2. Unplug the tubes from the drive gas assembly.

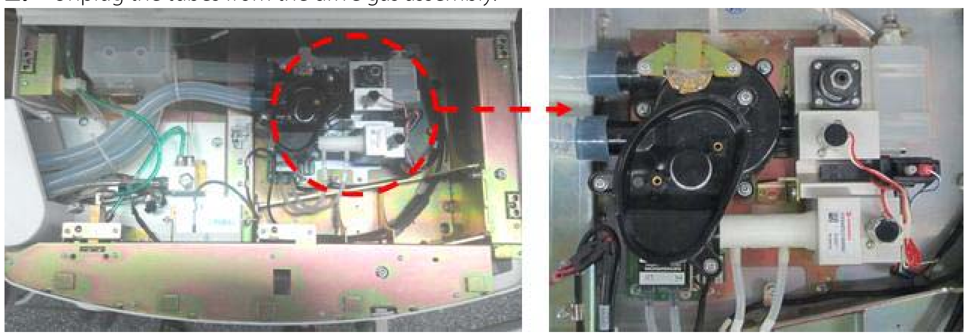


FIGURE 6-45

3. Unscrew the four screws on the drive gas assembly to remove the assembly.

FIGURE 6-46

- The drive gas assembly for the EPSON platform (distinguish EPSON platform and DSP platform according to the codes (A0901) on the proportional valve).

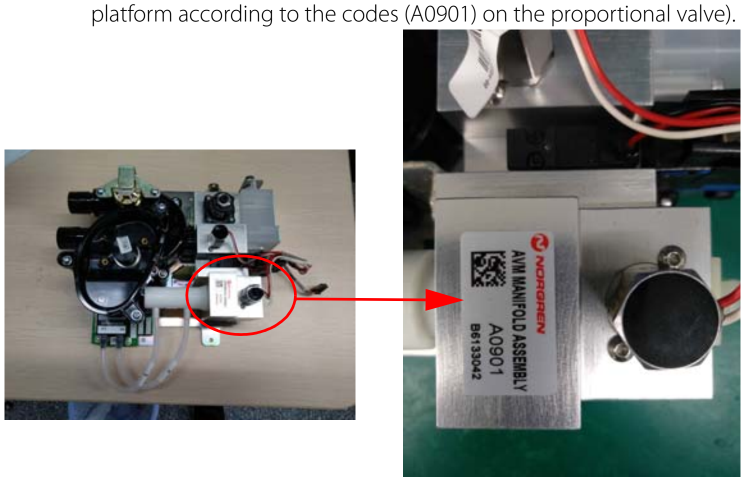


FIGURE 6-47

- The drive gas assembly for the DSP platform (distinguish EPSON platform and DSP platform according to the codes (A1636-M01) on the proportional valve).

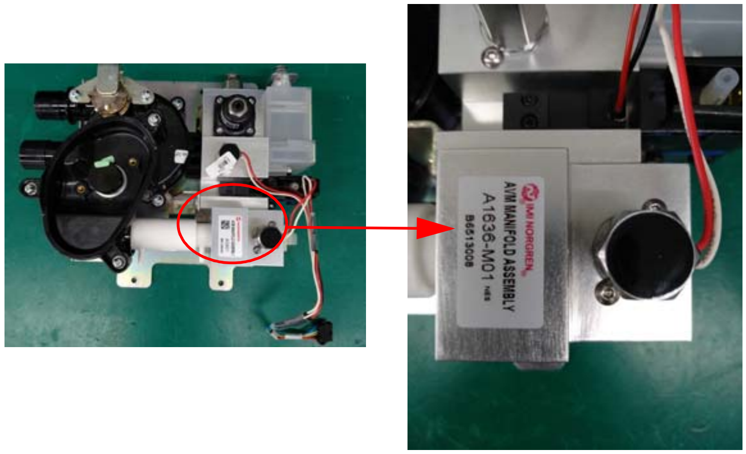


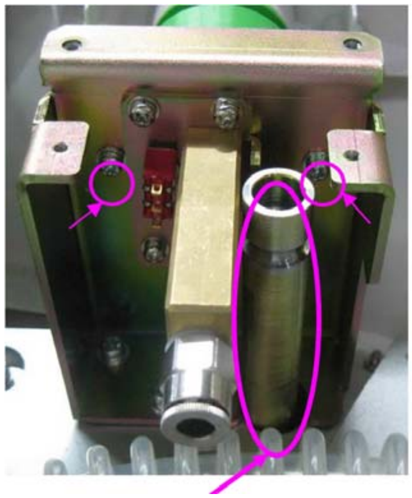
FIGURE 6-48

6.2.3.6 Remove the O2 Flush Assembly

1. Remove the work surface cover plate.
2. Remove the metal cover plate.
3. Unplug the tubes from the O2 flush assembly.
4. Unscrew the two screws on the bracket and remove it.

FIGURE 6-49

5. Remove the metal post on the right side of the O2 flush assembly.
6. Unscrew the five screws around the O2 flush assembly to remove it.



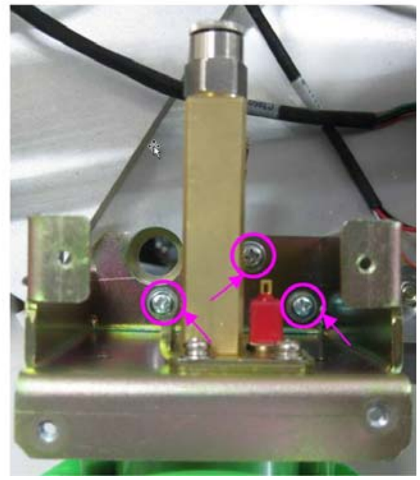


FIGURE 6-50

7. Unscrew the four screws around the O2 flush assembly to remove the assembly from the manifold.

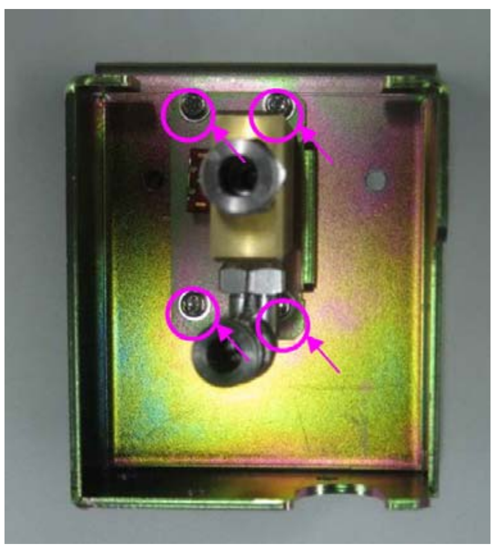


FIGURE 6-51

8. Unscrew the two screws around the O2 flush button to remove the button from the machine. If neccessory, clean the O2 flush button with a soft, lint-free cloth. The recommended cleaning agents are water and green soap tincture. Ensure thar the O2 flush button is completely dry before reinstall it.

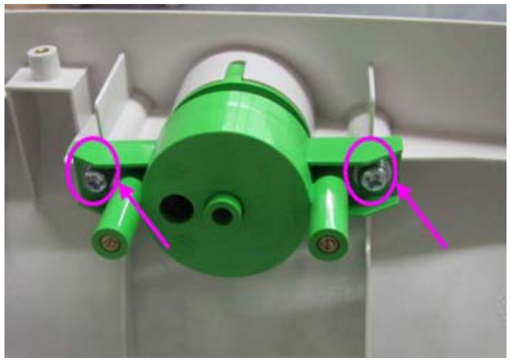


FIGURE 6-52

6.2.3.7 Remove the Touch Panel (A5 Only)

1. Remove the work surface cover plate.
2. Remove the metal cover plate.
3. Unplug the touch panel data cable.
4. Remove the six screws on the touch panel to remove the panel.

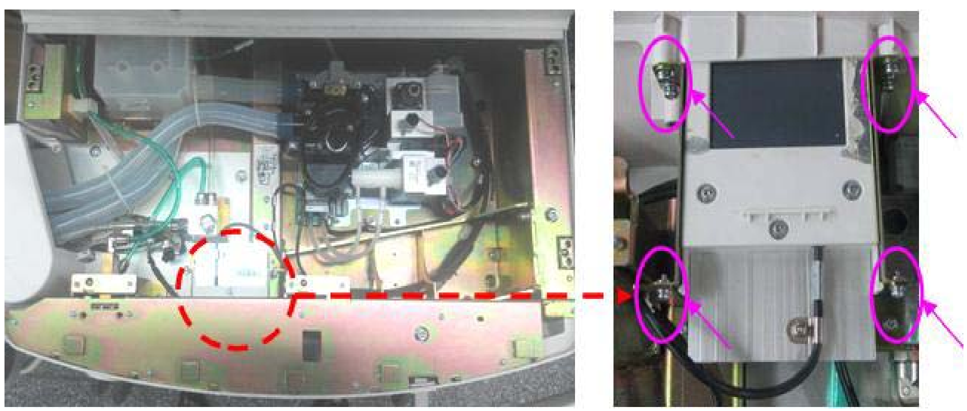


FIGURE 6-53

6.2.3.8 Remove the Common Gas Outlet Assembly

1. Remove the work surface cover plate.
2. Unplug the tubes from common gas outlet assembly.

3. Remove the two screws on the common gas outlet assembly to remove the assembly.

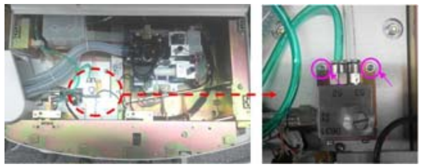


FIGURE 6-54

6.2.3.9 Remove the Cylinder Bracket Assembly

1. Open the service door and refer to"Open the Service Door" on page 6-3..
2. Remove the rear panel and refer to "Remove the Rear Panel Assembly" on page 6-22..
3. Unplug the tubes from the cylinder bracket assembly.
4. Remove the copper pipe from cylinder bracket assembly.
5. Remove the four screws on the cylinder bracket to remove the assembly.

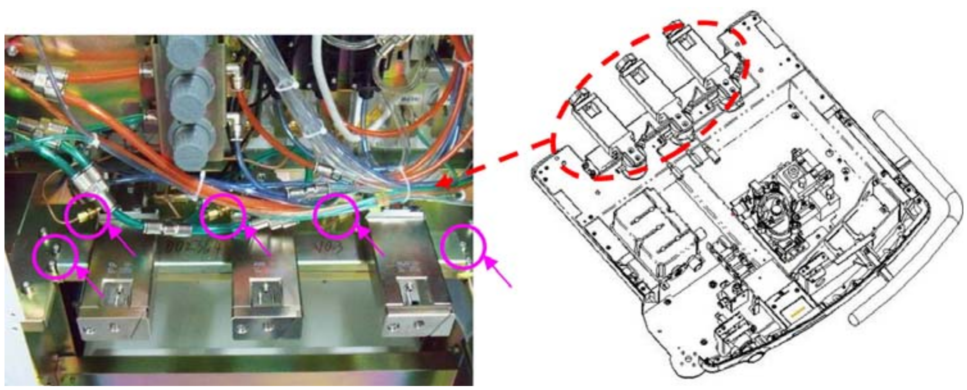


FIGURE 6-55

6. Unscrew the four screws on the cylinder bracket to remove O2, N2O and AIR cylinder bracket assemblies.

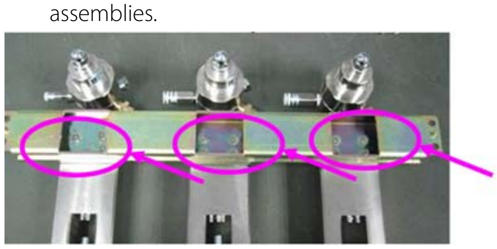


FIGURE 6-56

7. The removed cylinder bracket assembly is shown below

FIGURE 6-57

6.2.3.10 Remove the Spring Tube

1. Remove the work surface cover plate and refer to"Remove the Work Surface Cover Plate" on page 6-21..
2. Remove the rotating block of breathing circle and refer to "Remove the Rotating Block Cover of Breathing Circle" on page 6-43..
3. Cut the cable ties on the spring tubes, then disconnect the spring tubes from the connectors. Remove the spring tubes.

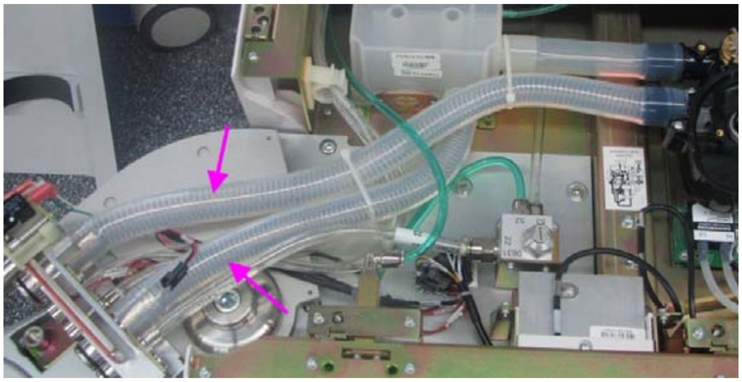


FIGURE 6-58

4. Re-install the spring tubes. Tie the spring tubes as follows:

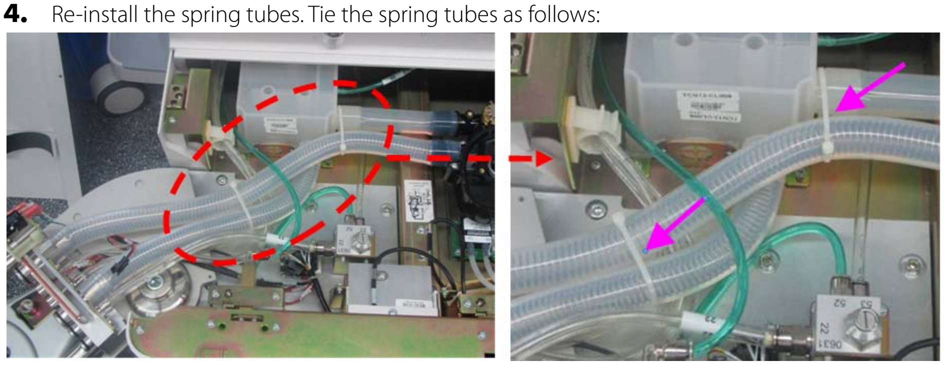


FIGURE 6-59

6.2.4 Disassemble the Display

1. Open the service door and refer to "Open the Service Door" on page 6-3..
2. Remove the related cables and tubes from hardware box and remove the four mounting screws to remove the display.

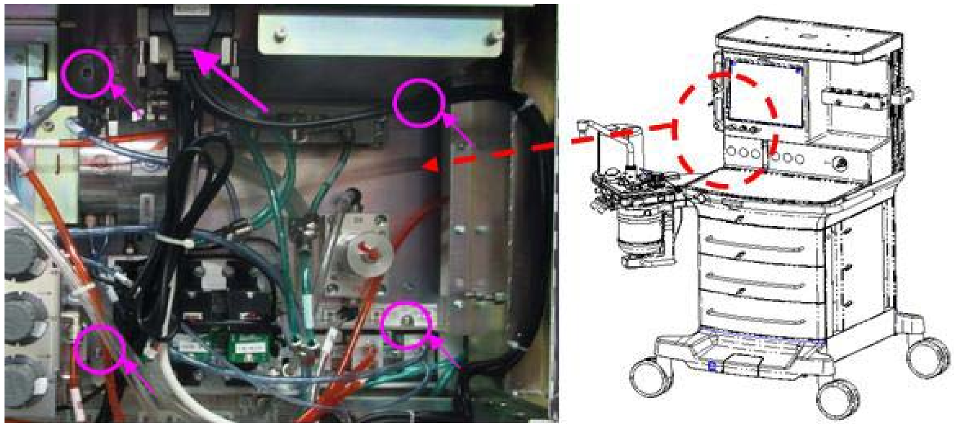


FIGURE 6-60

6.2.4.1 Remove the Alarm Lamp Board

1. Remove the display assembly.
2. Unplug the related cables from the alarm lamp board.
3. Remove the two mounting screws on the alarm lamp board to remove the board.

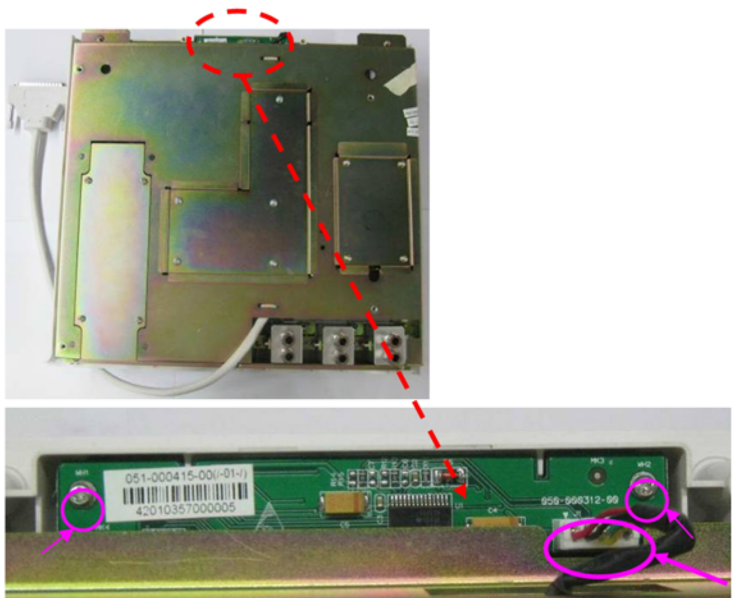


FIGURE 6-61

6.2.4.2 Remove the Display Adaptation Board

1. Remove display assembly and refer to “Disassemble the Display” on page 6-30..
2. Unscrew the five screws on the cover plate of the display mount.

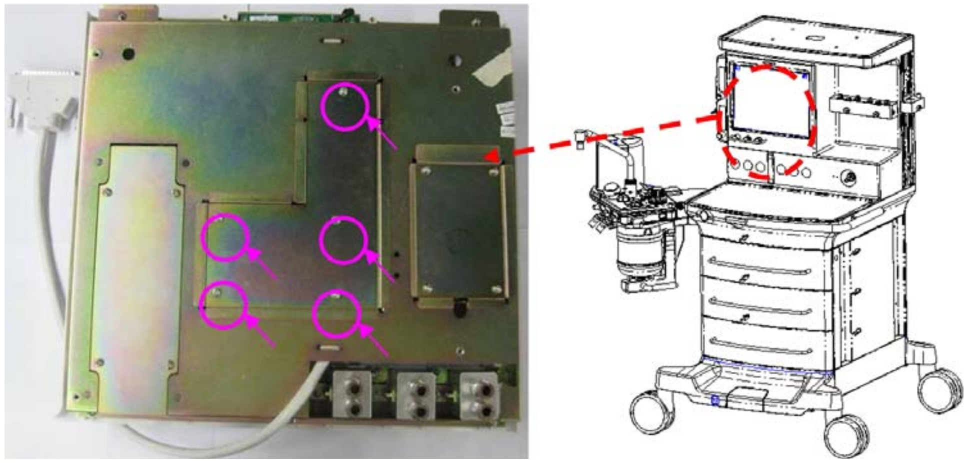


FIGURE 6-62

3. Unplug the related cables from the display interface board.
4. Remove the four screws on the display interface board and remove the board.

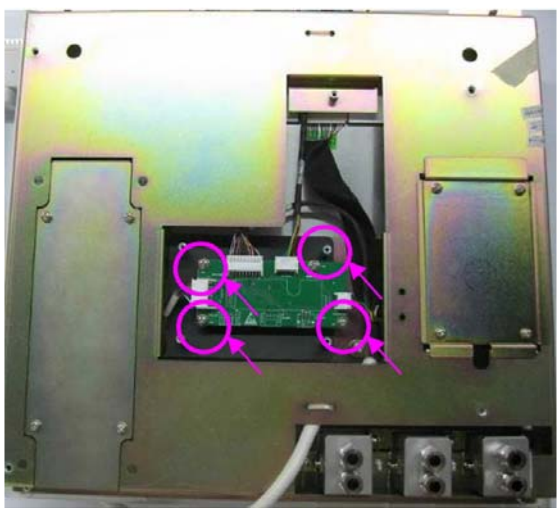


FIGURE 6-63

6.2.4.3 Remove the Touch Screen Control Board

1. Remove display assembly.
2. Remove the four screws and the cover plate of the touch screen control board.

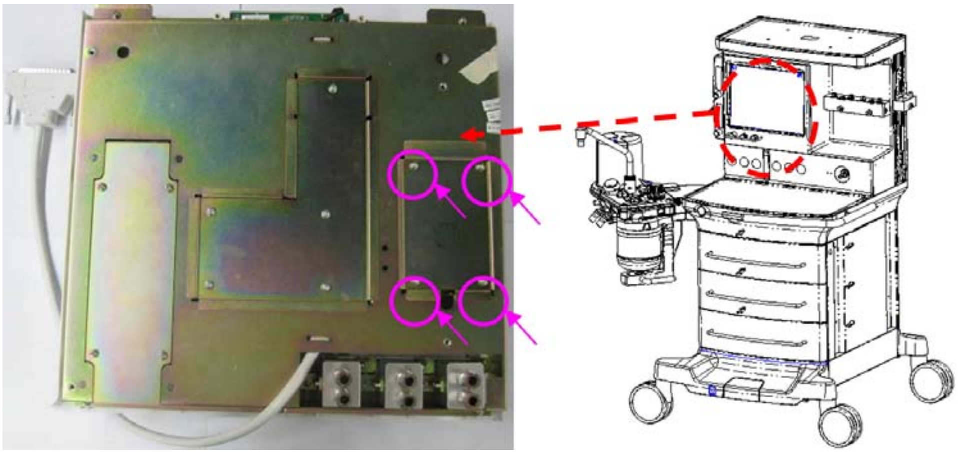


FIGURE 6-64

3. Unplug the related cables from the touch screen control board.
4. Remove the two screws on the touch screen control board to remove the board.

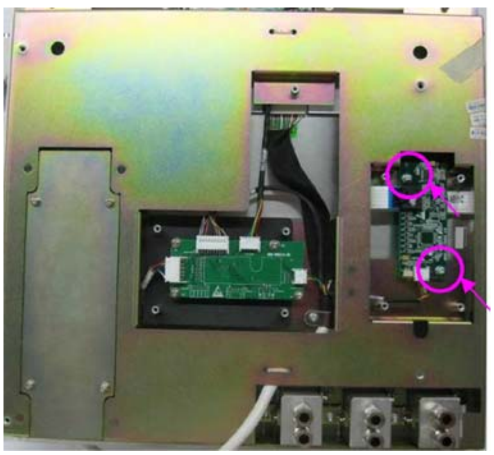


FIGURE 6-65

6.2.4.4 Remove the Backlight Inverter Board

1. Remove display assembly.
2. Remove the four screws and the cover plate of the backlight inverter board.

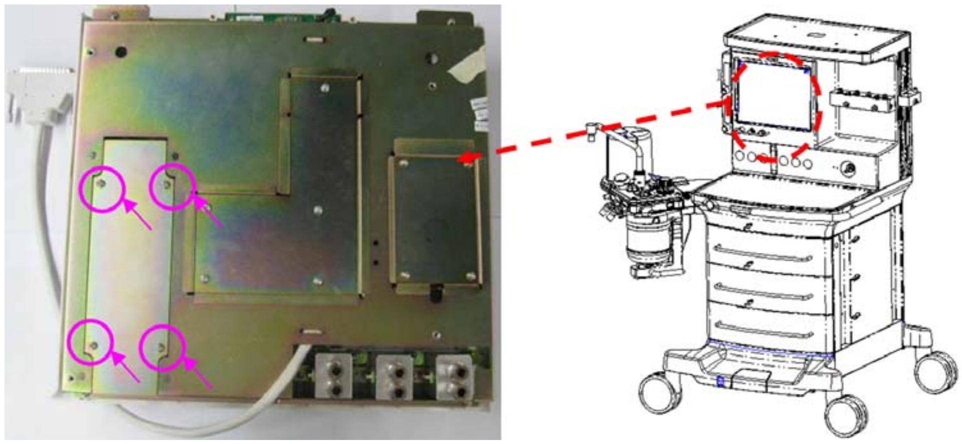


FIGURE 6-66

3. Unplug the related cables from the backlight inverter board.
4. Remove the two screws on the backlight inverter board to remove the board.

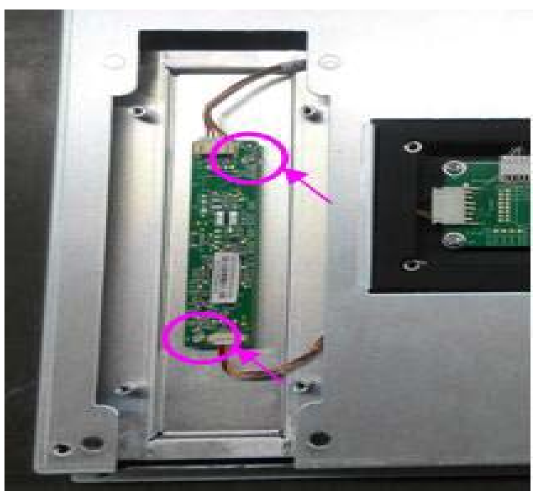


FIGURE 6-67

6.2.4.5 Remove the Needle Valve Assemblies

1. Remove display assembly and refer to “Disassemble the Display” on page 6-30..
2. Loosen the two Allen set screws on the knob of needle valve to remove the knob.

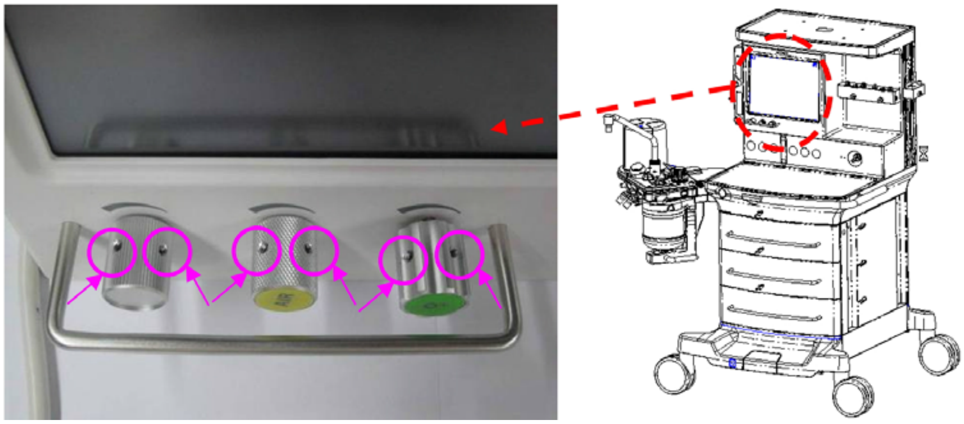


FIGURE 6-68

3. Remove the two screws on the needle valve assembly to remove the assembly.

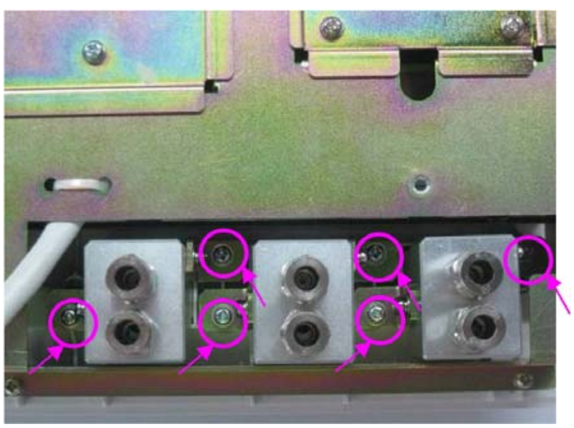


FIGURE 6-69

6.2.4.6 Remove the Touch Screen

1. Remove display assembly.
2. Unplug the related cables from the touch screen control board.

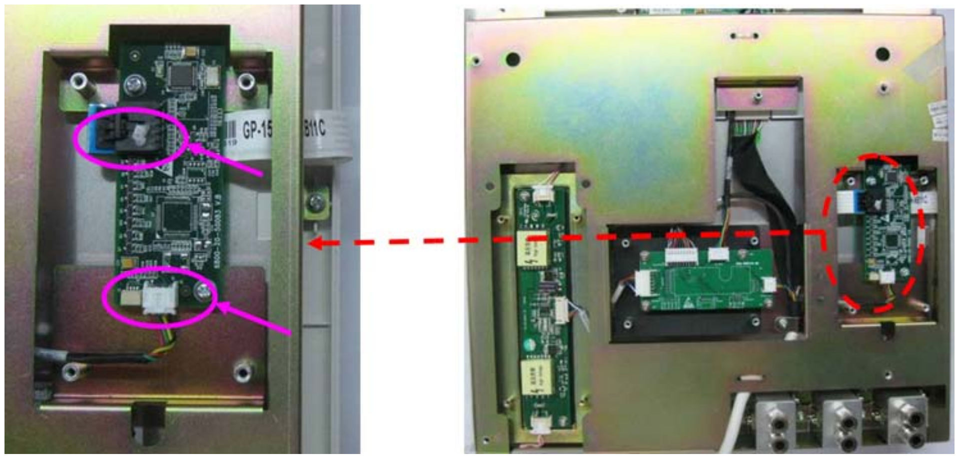


FIGURE 6-70

3. Remove the 11 screws around the display mount then remove the display front cover.

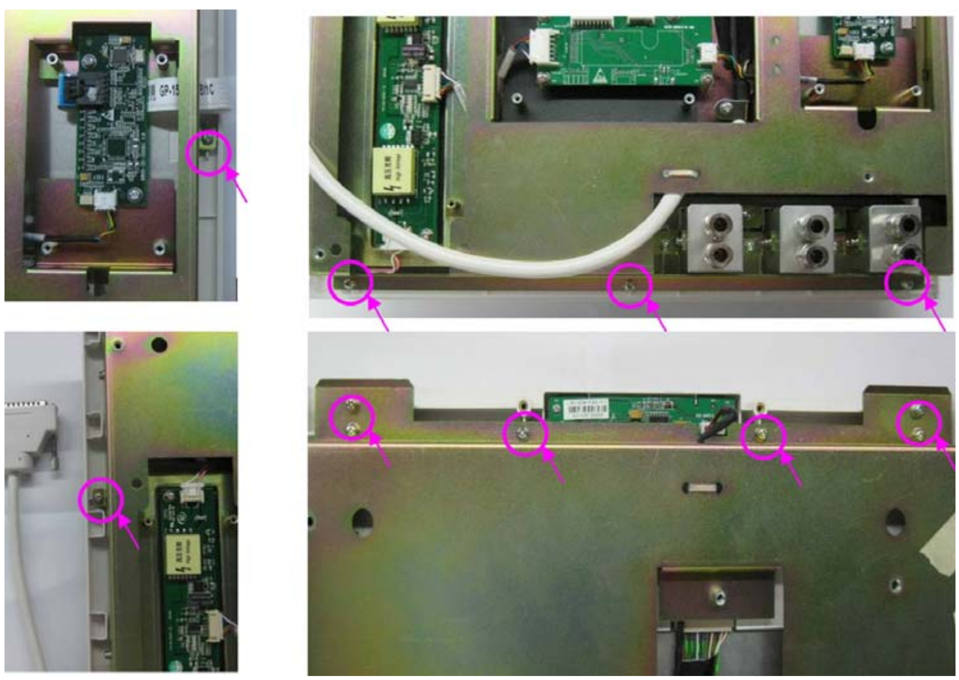


FIGURE 6-71

4. Slightly lift the touch screen off the display front cover to remove the touch screen.

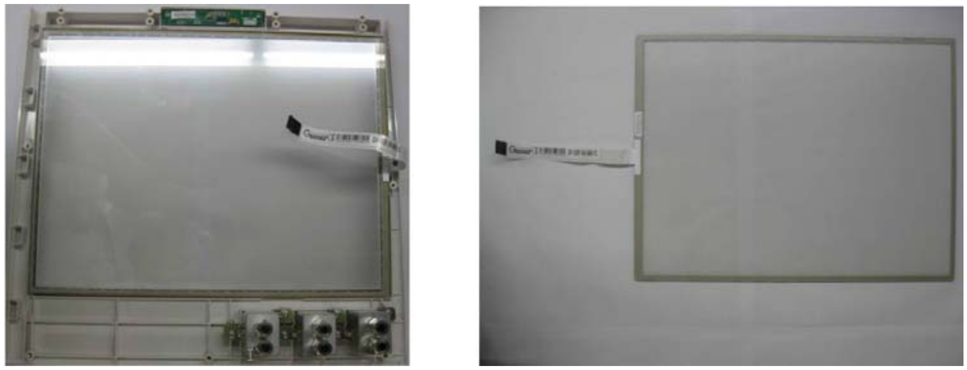


FIGURE 6-72

6.2.4.7 Remove the Display Replacement Package

1. Remove the display interface board.
2. Remove the touch screen control board.
3. Remove the touch screen.
4. When the above mentioned assemblies are removed from the display, the remaining part is considered the display replacement package.

FIGURE 6-73

6.2.5 Remove the Module Rack Assembly

1. Open the service door and refer to "Open the Service Door" on page 6-3.
1. Disassemble the rear panel and refer to "Remove the Rear Panel Assembly" on page 6-22.
2. Unplug the cable plug connecting the module rack assembly.

FIGURE 6-74

3. Unscrew the four screws to remove the module rack assembly.

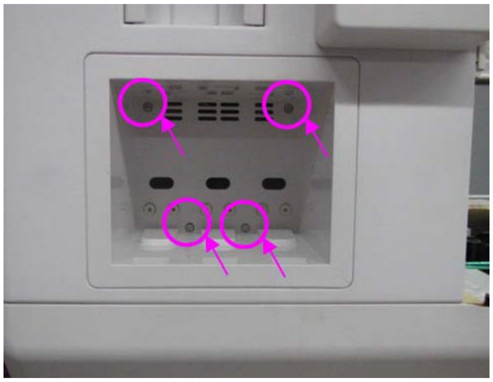


FIGURE 6-75

4. Unscrew the five screws to remove the infrared communication board.

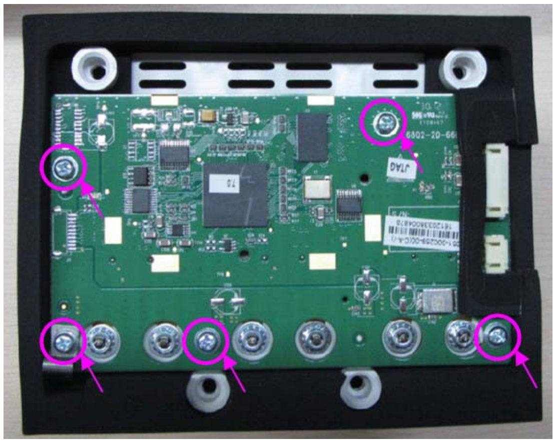


FIGURE 6-76

6.2.6 Remove the Module Rack Fan

1. Remove the module rack assembly.
2. Unplug the cable plug for module rack fan.
3. Unscrew the four screws to remove the module rack bracket assembly.

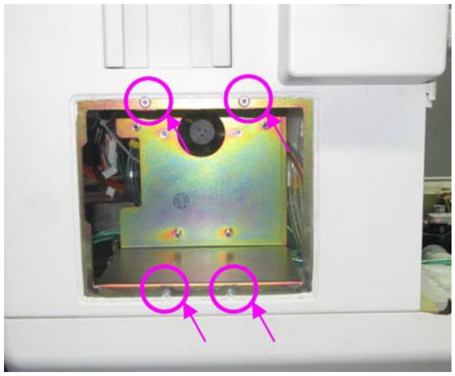


FIGURE 6-77

4. Unscrew the two screws to remove the fan and bracket.

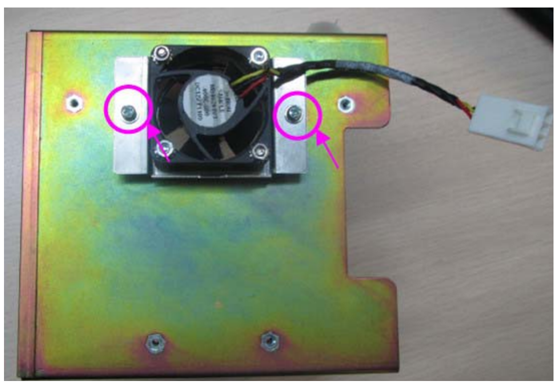


FIGURE 6-78

5. Unscrew the four screws to remove the module rack fan.

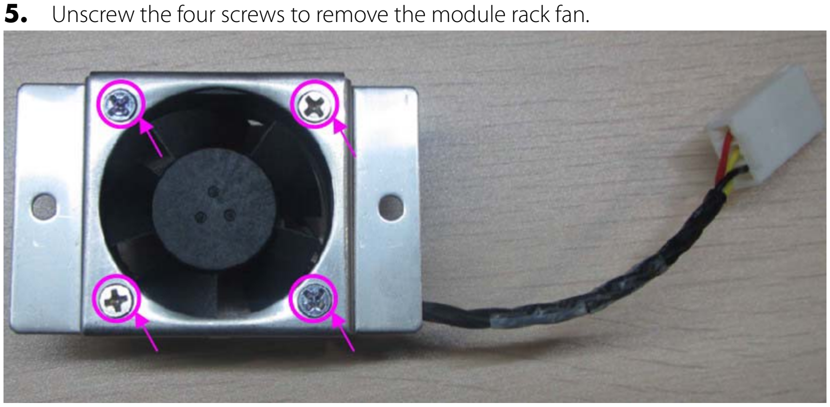


FIGURE 6-79

6.2.7 Remove the Panel of Pressure Gauges

1. Open the service door and refer to “Open the Service Door” on page 6-3.
2. Disassemble the rear panel and refer to “Remove the Rear Panel Assembly” on page 6-22.
3. Unplug the related tubes from the supply gas pressure gauges on the panel.
4. Remove the three copper pipes on the high-pressure gauges from cylinder bracket assembly and refer to “Remove the Cylinder Bracket Assembly” on page 6-28..

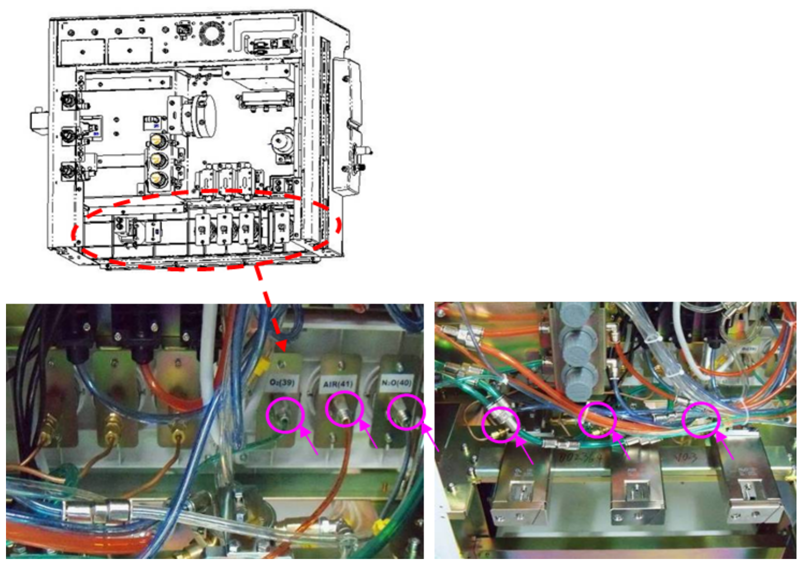


FIGURE 6-80

5. Remove the four screws on the gauge panel to remove the panel.

FIGURE 6-81

6.2.7.1 Remove the Pressure Gauges

1. Remove the pressure gauge panel.
2. Unscrew the 12 screws on the pressure gauges to remove both the supply gas gauges and the high-pressure gauges.

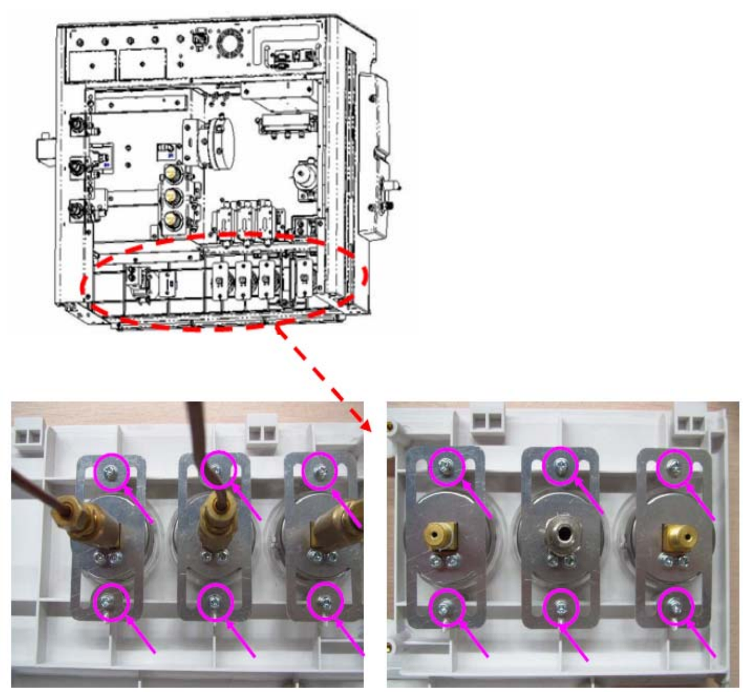


FIGURE 6-82

6.2.7.2 Remove the Total Flowmeter

1. Remove the meter panel.
2. Remove the four screws on the total flowmeter and to remove it.

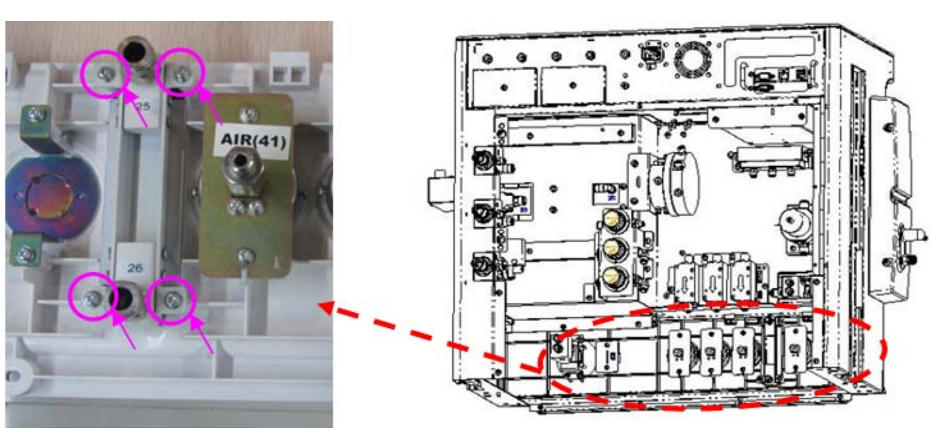


FIGURE 6-83

6.2.7.3 Remove the System Switch

1. Remove the pressure gauge panel.
2. Remove the four screws on the system switch to remove the switch.

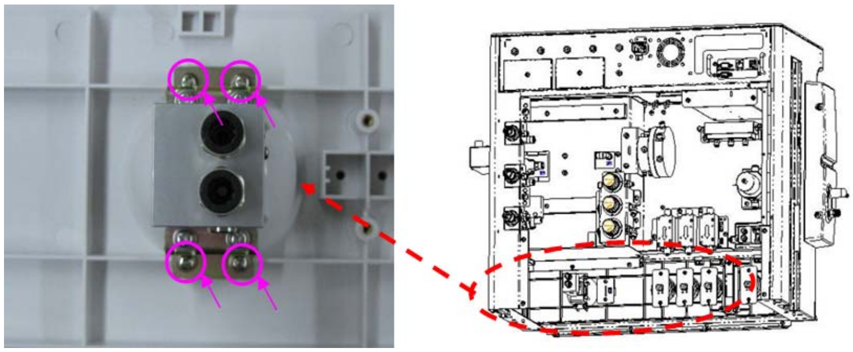


FIGURE 6-84

6.2.7.4 Remove the Indicator Light Board

1. Remove the pressure gauge panel.
2. Remove the two screws on the indicator light board to remove the board.

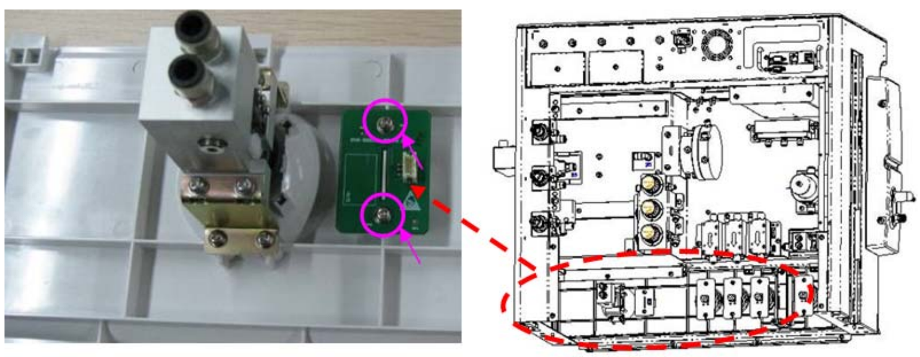


FIGURE 6-85

6.2.8 Remove the Auxiliary Gas Outlet Assembly

1. Open the service door and refer to “Open the Service Door” on page 6-3..
2. Unplug the related tubes from auxiliary gas outlet assembly.

3. Remove the two screws on the auxiliary gas outlet assembly to remove the assembly.

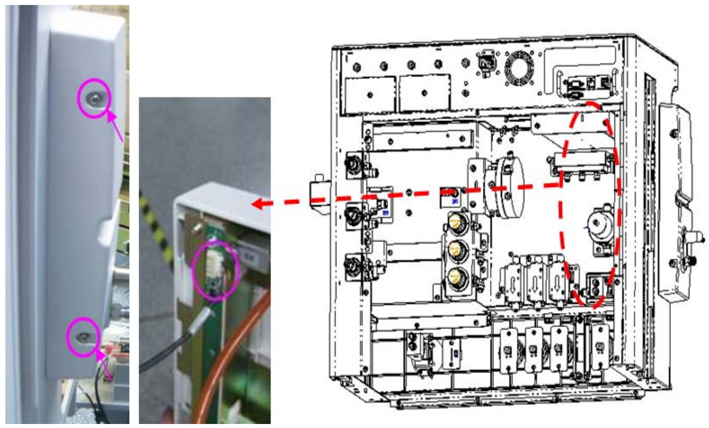


FIGURE 6-86

6.2.9 Remove the Rotating Block Cover of Breathing Circle

1. Remove the work surface cover plate and refer to "Remove the Work Surface Cover Plate" on page 6-21.
2. Unplug the breathing system assembly from the rotating block.
3. Remove the four screws and remove the rotating block cover of breathing circle.

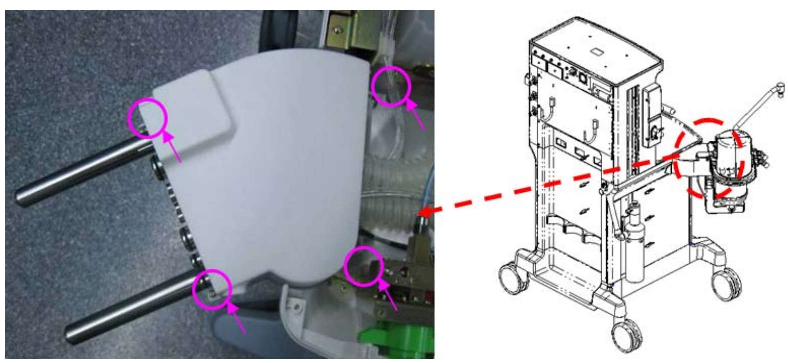


FIGURE 6-87

6.2.10 Remove the AGSS Assembly

1. Unplug the transfer tubes from AGSS assembly.
2. Loosen the AGSS rail locking knob on the AGSS assembly. Lift the AGSS assembly along the side to remove the assembly.

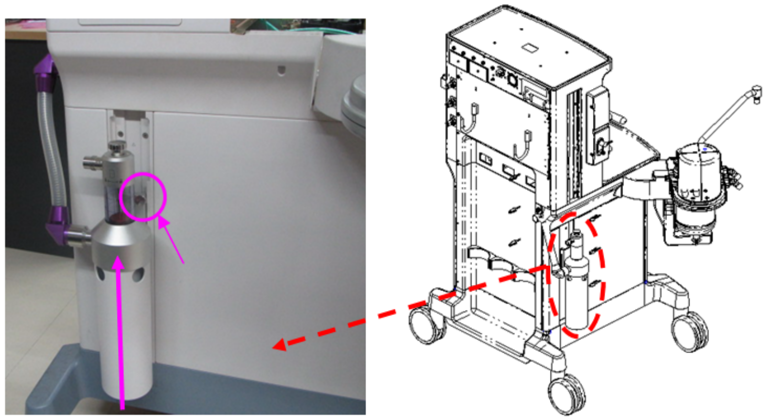


FIGURE 6-88

6.2.11 Disassemble the Base Assembly

Distinguish the new base assembly and the old base assembly: The difference between the new base assembly and the new base assembly is the installation of casters. There are four screws (M8X16 hexagon socket screws) fastening one caster of the old base assembly.

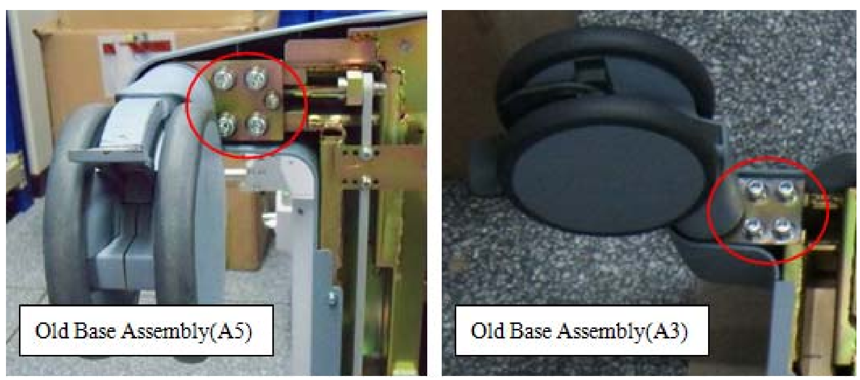


FIGURE 6-89 The Old Base Assembly(A5/A3)

FIGURE 6-90 The New Base Assembly(A5/A4/A3)

6.2.11.1 Remove the Caster Assembly (Old Base Assembly)

1. Remove the breathing system and tilt the A5/A4/A3 backward.

FIGURE 6-91

2. Remove the four screws and remove the caster assembly.

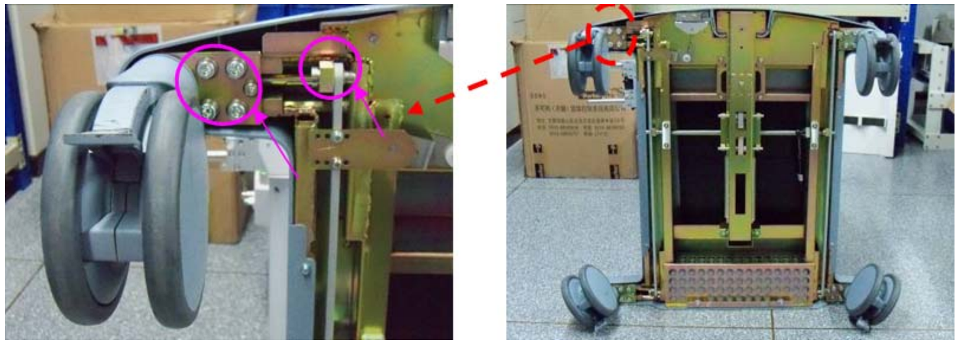


FIGURE 6-92

3. When you maintain the old base assembly with the caster (P/N: 034-000285-00), remove the parts below and install them on the new caster.
4. Unscrew the one screw and remove the transmission axis of the caster.

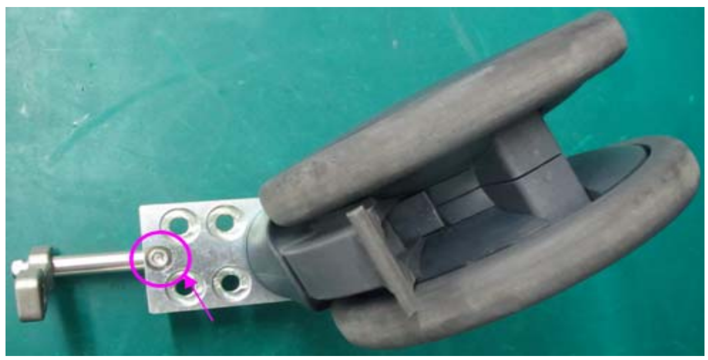


FIGURE 6-93

5. Unscrew the two screws and remove the installation block of the caster.

FIGURE 6-94

6.2.11.2 Remove the Caster Assembly (New Base Assembly)

1. Remove the drawer assembly. See section 6.2.3.1 (pg. 6-20) "Remove the Drawer Assembly".
2. Remove the lower rear panel assembly. See the step 3 in the section 6.2.3.4 (pg. 6-22) "Remove the Rear Panel Assembly".
3. Unscrew the ten screws on the left and right side panel fastening the cart and remove the upper part.

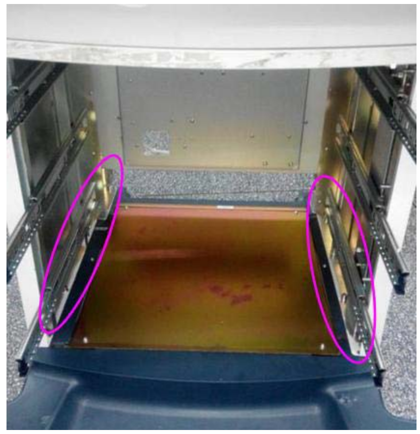


FIGURE 6-95

4. Unscrew the four screws fastening the cover of the base assembly and remove the cover.

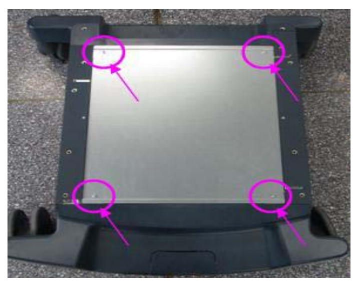


FIGURE 6-96

5. Unscrew the two screws on the left and right trim panel fasting the base assembly.

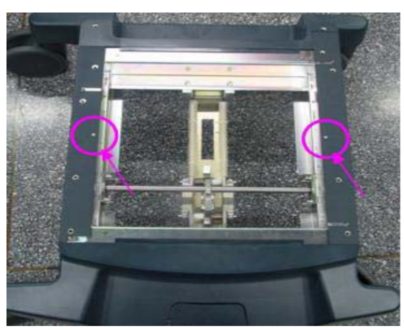


FIGURE 6-97

6. Turn over the base assembly. Unscrew the four screws on the left and right trim panel fastening

the base assembly and remove the left and right trim panel.

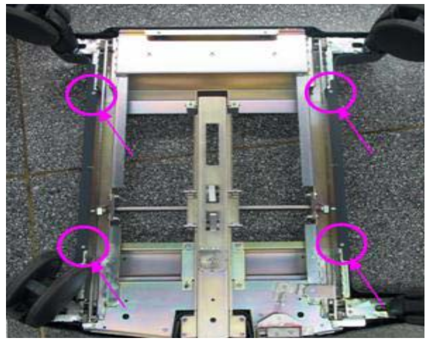


FIGURE 6-98

7. (Only for A5) According to the situation of the caster replacement, unscrew the screws fastening the front cover and the rear cover of the base assembly and remove the front cover and the rear cover.

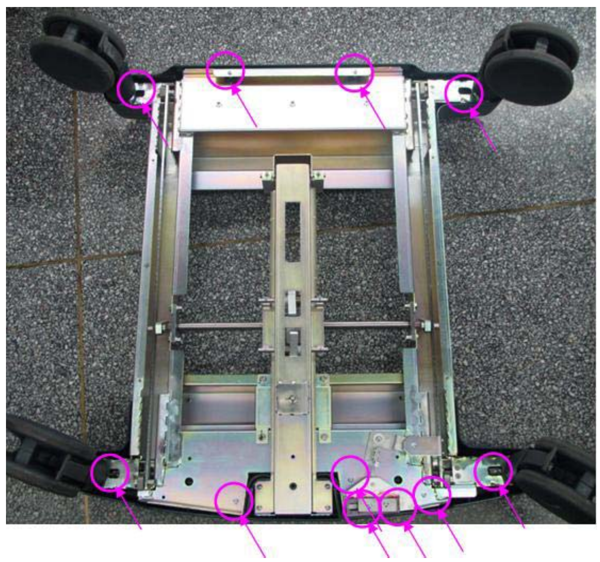


FIGURE 6-99

8. (Only for A5) Unscrew the two screws fastening the connecting rod.

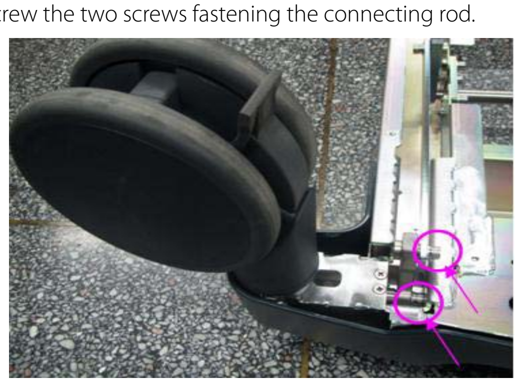


FIGURE 6-100

9. (Only for A5) Unscrew the two screws fastening the installation block of the caster, and remove the installation block and transmission axis of the caster.

FIGURE 6-101

10. (Only for A5) Unscrew the two screws fastening the caster and remove the caster.

FIGURE 6-102

11. (A3 and A4) According to the situation of the caster replacement, unscrew the screws fastening the front cover and the rear cover of the base assembly and remove the front cover and the rear cover.

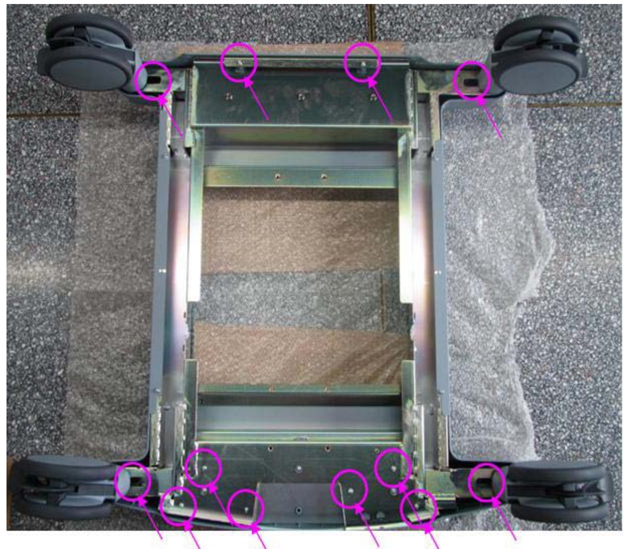


FIGURE 6-103

12. (A3 and A4) Remove the caster.

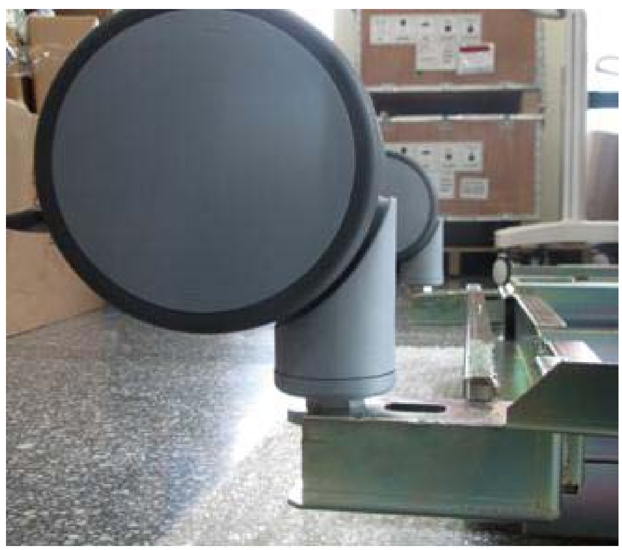


FIGURE 6-104

6.2.11.3 Remove the Brake Indicator Drive Plate I and II (A5 Only)

1. Tilt A5/A4/A3 backward.

2. Unscrew the two screws on the brake indicator drive plate I to remove the plate.

FIGURE 6-105

3. Unscrew the one screw on the brake indicator drive plate II to remove the plate.

FIGURE 6-106

6.2.11.4 Remove the Brake Assembly (A5 Only)

1. Tilt A5/A4/A3 backward.
2. Remove the six screws on the brake assembly to remove the assembly.

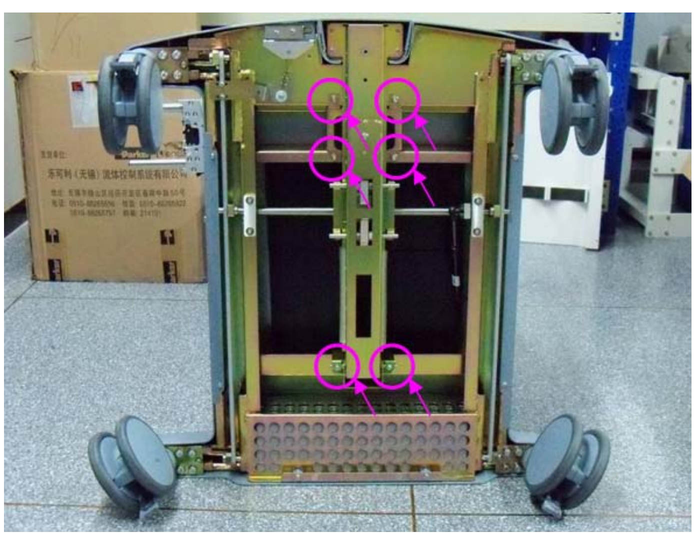


FIGURE 6-107

6.2.11.5 Remove the Brake Main Axis (A5 Only)

1. Tilt A5 backward.
2. Remove brake assembly.
3. For the old base assembly, remove the six screws and remove the brake main axis.

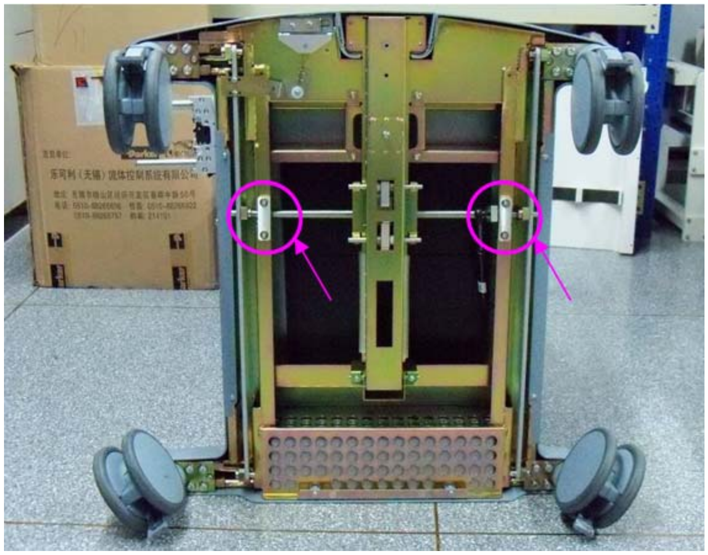
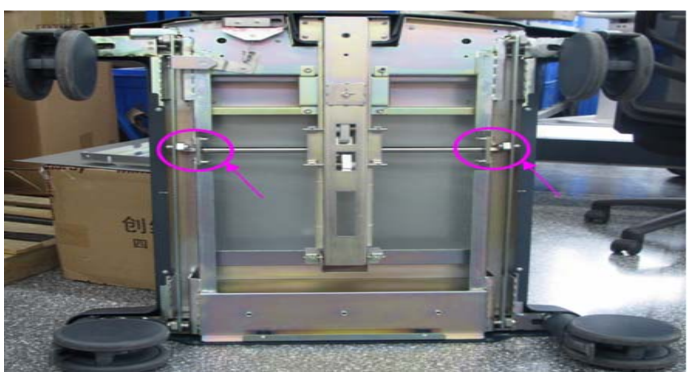


FIGURE 6-108

4. For the new base assembly, remove the ten screws and remove the brake main axis.



6.2.11.6 Remove the Principal Axis of Brake (A5 Only)

1. Tilt A5 backward.
2. Remove the brake indicator drive plate II.
3. Unscrew the six screws on the brake rod to remove the rod.

6.3 Disassemble the Breathing System

6.3.1 Remove the O2 Sensor and Cable

1. Remove one end of the O2 sensor cable from the O_2% connector on the anesthesia machine. Unplug the O2 sensor from the O_2% port on the Breathing System by pulling straight out.

FIGURE 6-109

2. Turn the black plug counterclockwise to take it out of the housing.And then turn the O2 sensor counterclockwise to take it out of the threaded cup.

FIGURE 6-110

6.3.2 Remove the Breathing Tubes

NOTE: When disassembling the breathing tube, hold the tube connectors at both ends of the tube to prevent damage to the tube.

1. Remove the filter from the Y piece.

FIGURE 6-111

2. Disconnect the breathing tubes from the inspiration/expiration connectors on the circuit.

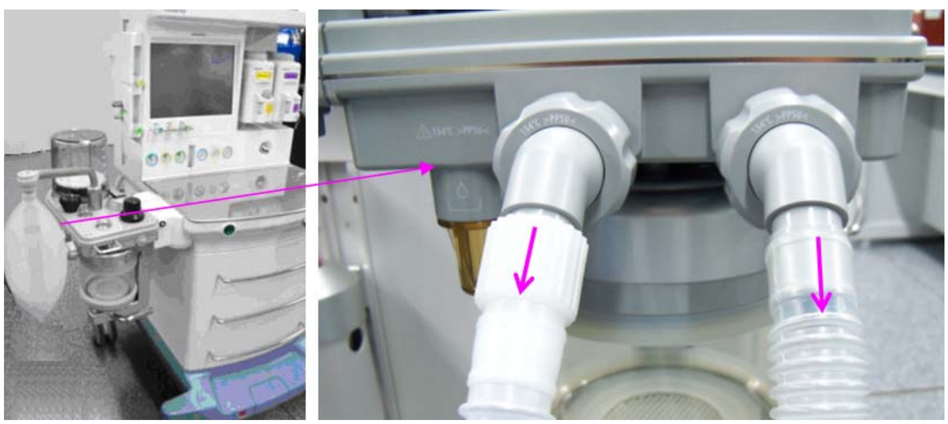


FIGURE 6-112

6.3.3 Remove the Flow Sensor

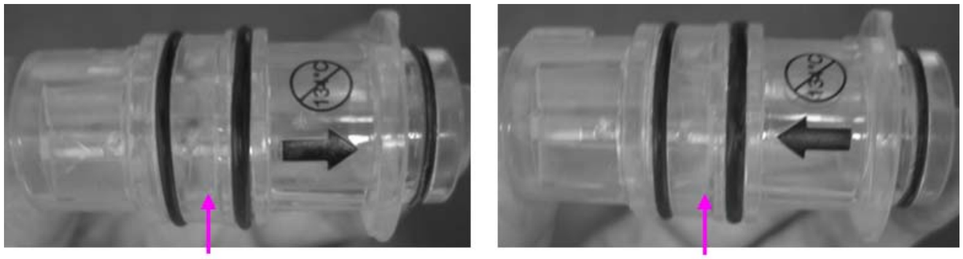
1. Turn the locking nuts counterclockwise.

FIGURE 6-113

2. Pull out the inspiration and expiration connectors together with their locking nuts. And then pull out the flow sensors horizontally.

FIGURE 6-114

3. The following pictures show the appearance of inspiratory and expiratory flow sensor assemblies.



Inspiratory flow sensor assemblies Expiratory flow sensor assemblies

FIGURE 6-115

6.3.4 Remove the Manual Bag

Remove the manual bag from the connector on the breathing system as shown below.

FIGURE 6-116

6.3.5 Remove the Absorbent Canister

1. Hold and turn the rotary handle clockwise for 45 degrees.

FIGURE 6-117

2. Pull out the absorbent canister horizontally.

FIGURE 6-118

WARNING: **Sodalime is a caustic substance and is a strong irritant to eyes, skin and respiratory system. Affected areas should be flushed with water. If irritation continues after flushing with water, seek medical assistance immediately.**

If it is necessary to replace or re-install the Pre-pak absorber sealing cushion (049-000143-00), set the internal groove of the Pre-pak absorber sealing cushion in the side flange of the Pre-pak absorber, as shown below..

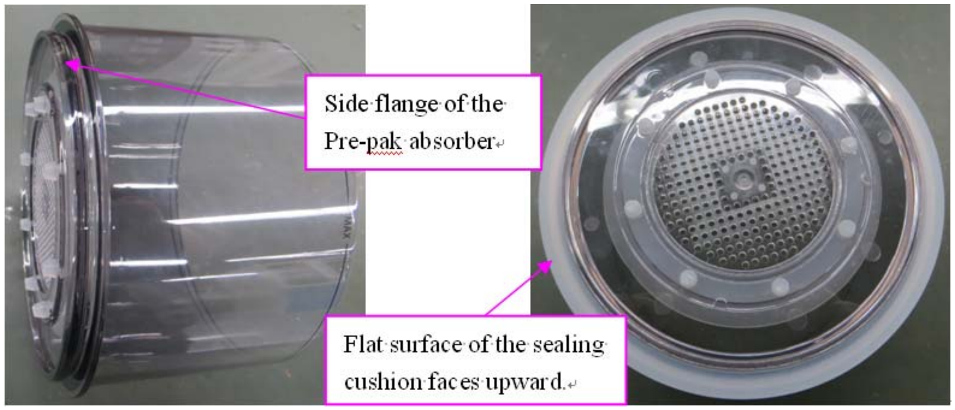


FIGURE 6-119

Make sure that the sealing cushion is correctly installed. The comparison between correct installation and incorrect installation is shown below..

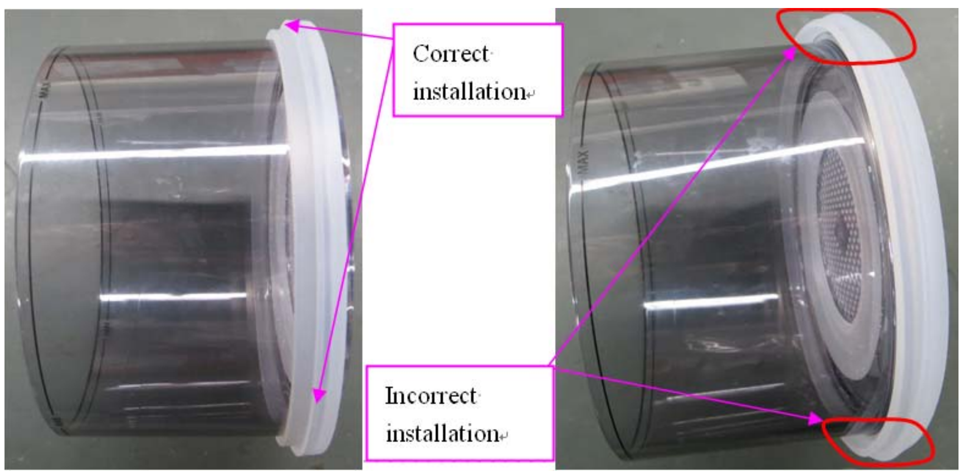


FIGURE 6-120

6.3.6 Remove the CO2 Bypass Assembly

1. Remove the absorbent canister as per section 6.3.5.
2. Press inward the fasteners on both sides and the CO2 bypass assembly will drop down for removal.

FIGURE 6-121

If it is necessary to replace or re-install the bypass trigger plate sealing cushion (049-000142-00), pay attention to the matching between the interior convex rib of the bypass trigger plate sealing cushion and the groove of the bypass trigger plate when assembling the bypass trigger plate sealing cushion onto the bypass trigger plate, as shown below.

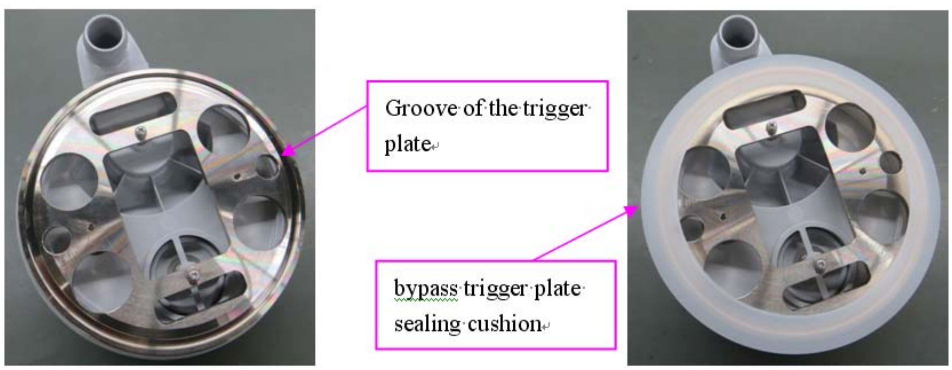


FIGURE 6-122

Make sure that the sealing cushion is correctly installed. The comparison between correct installation and incorrect installation is shown below.

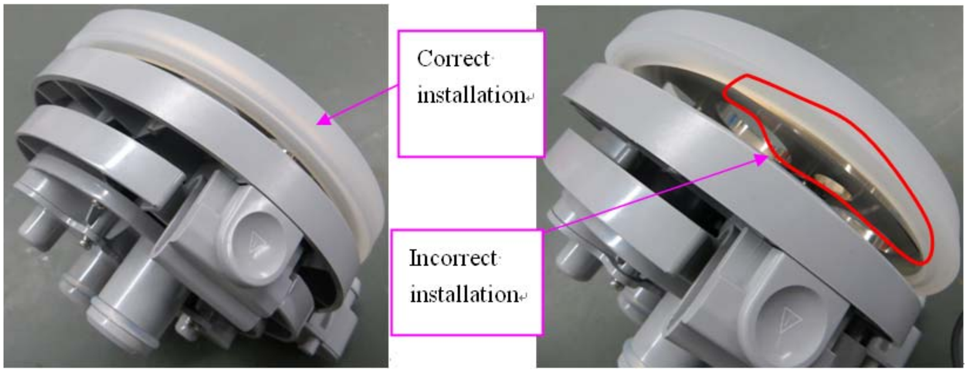


FIGURE 6-123

6.3.7 Remove the Patient Circle Assembly

1. Remove the CO2 Bypass assembly as per section 6.3.6.
2. Pull the patient circle assembly away from the rotating block assembly.

FIGURE 6-124

6.3.8 Remove the Bellows Assembly

1. Turn the bellows dome counterclockwise and lift off to remove.

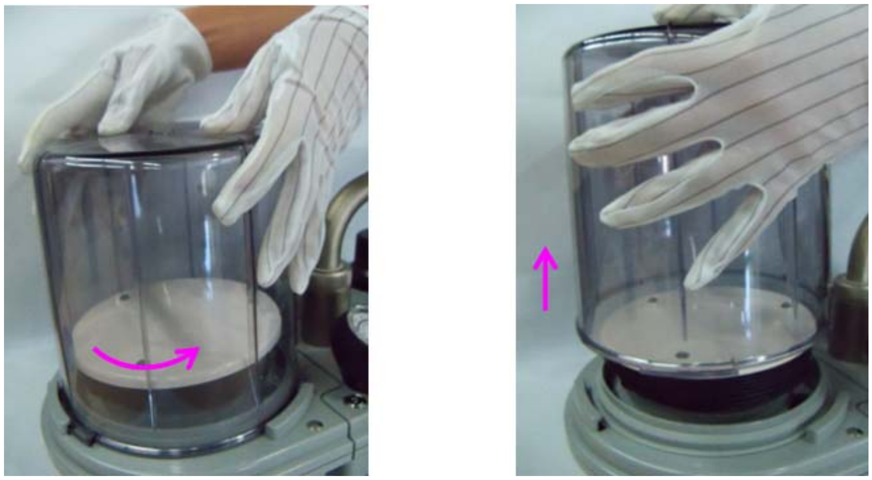


FIGURE 6-125

2. Remove the bellows from the bellows base.

FIGURE 6-126

6.3.9 Remove the Pop-off Valve Assembly

1. Remove the bellows assembly as per section 6.3.10.
2. Unscrew the four locking screws as shown in the picture. Hold and pull up the Pop-Off valve cover to remove it.

FIGURE 6-127

3. Take out the rubber and metal Pop-Off valve.

FIGURE 6-128

6.3.10 Disassemble the Expiratory/Inspiratory Check Valve Assemblies

1. Turn the check valve cover counterclockwise to remove it.

FIGURE 6-129

2. Pull out the check valve as shown in the following picture.

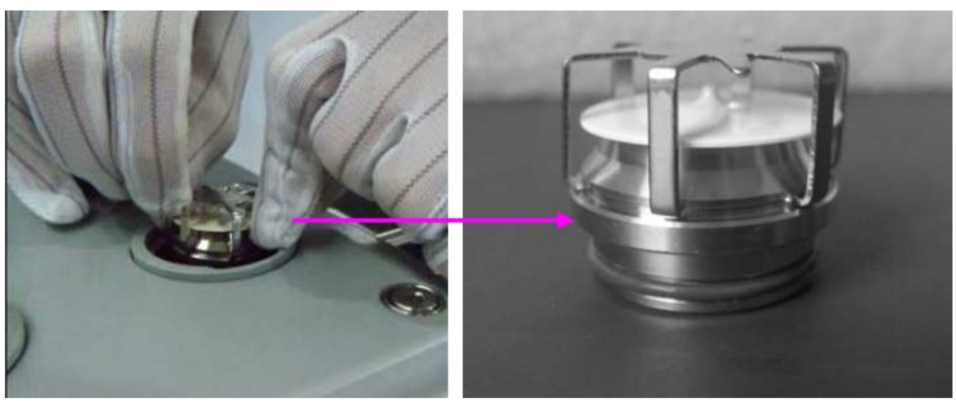


FIGURE 6-130

6.3.11 Remove the Water Collection Cup

1. Hold the water collection cup and turn it counterclockwise to remove it.

FIGURE 6-131

2. Remove the water collection cup.

FIGURE 6-132

6.3.12 Remove the Airway Pressure Gauge

Lift the airway pressure gauge straight up to remove it.

FIGURE 6-133

6.3.13 Remove the Bag Arm

1. Unscrew the locking nut counterclockwise and lift straight up to remove bag arm.

FIGURE 6-134

2. Remove the bag arm from the bag arm mount.

FIGURE 6-135

6.3.14 Remove the Back Upper Cover and Back Lower Cover Assemblies

1. Remove the O2 sensor, breathing tubes, manual bag, patient circuit assembly, bellows assembly, water collection cup, airway pressure gauge and bag arm as per sections 6.3.1,6.3.2, 6.3.4, 6.3.7, 6.3.8, 6.3.11, 6.3.12, 6.3.13.
2. Unscrew the six screws as shown in the following picture.

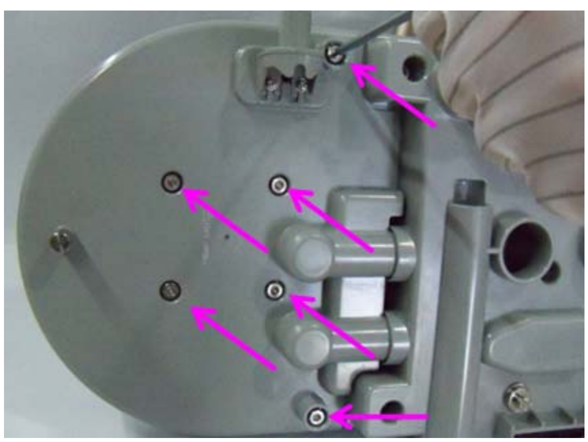


FIGURE 6-136

3. Unscrew the knurled thumb nut as shown in the following picture.

FIGURE 6-137

4. Turn over the circle. Pull up to separate the back upper cover assembly.

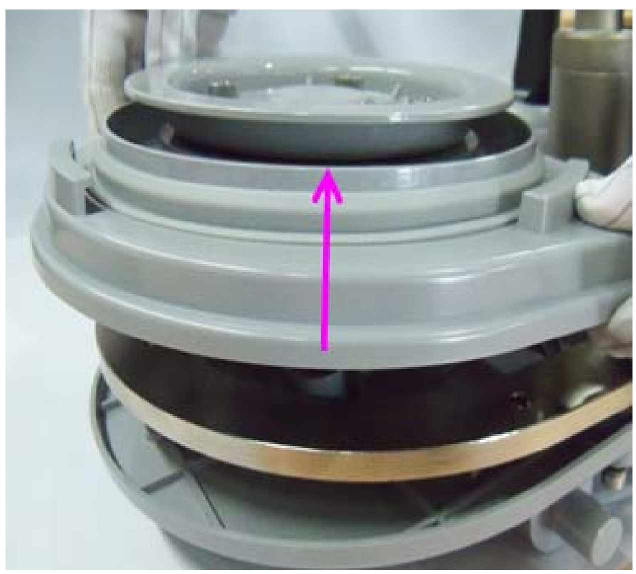


FIGURE 6-138

5. Pull leftwards to take out the back lower cover assemblies.

FIGURE 6-139

6.3.15 Remove the Front Upper Cover, Median Plate and Front Lower Cover Assemblies

1. Remove the Back Upper Cover and Back Lower Cover Assemblies as per section 6.3.16.
2. Remove the two screws (respiratory screw 041-002393-00) on the lower cover.

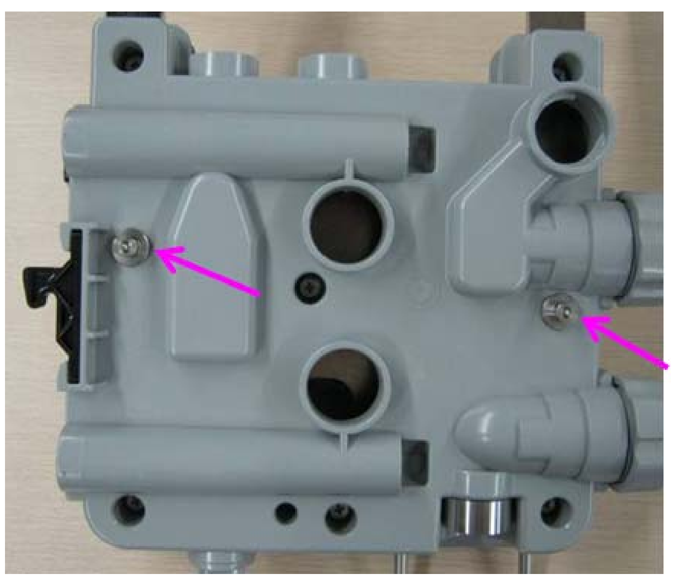


FIGURE 6-140

3. Loosen the six screws on the upper cover.

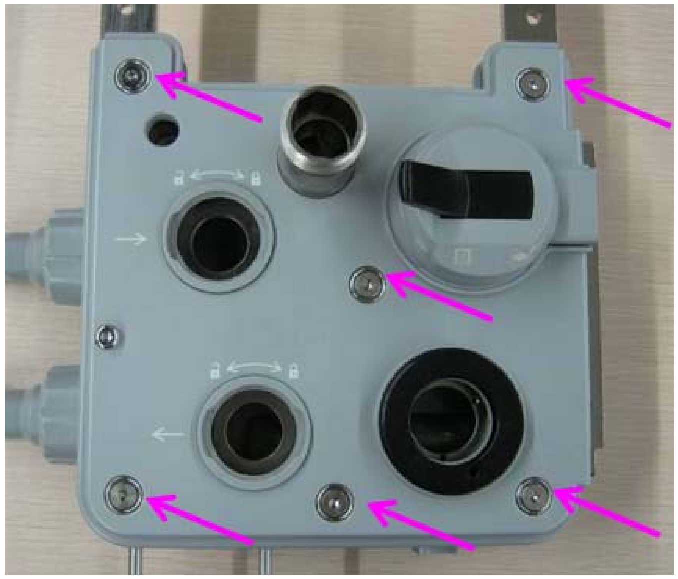


FIGURE 6-141

4. Loosen the captive screws (top cover screw 041-005001-01) on the upper cover.

FIGURE 6-142

5. Hold the upper cover assembly tightly and pull it up to remove it.

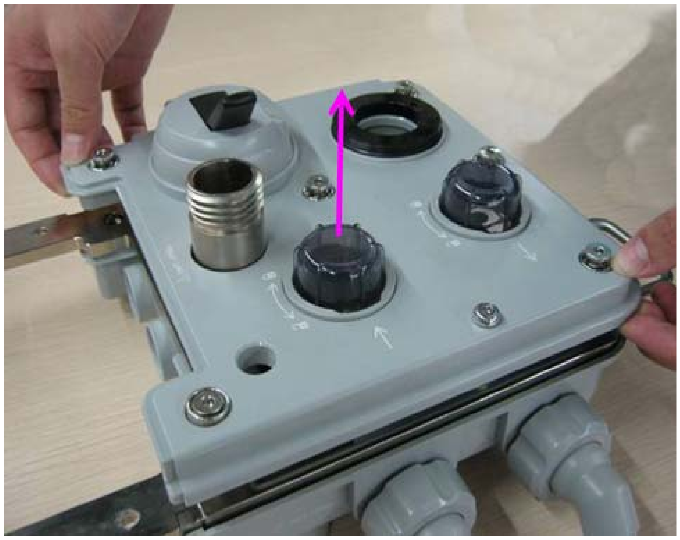


FIGURE 6-143

6. Pull up the median plate assembly to remove it.

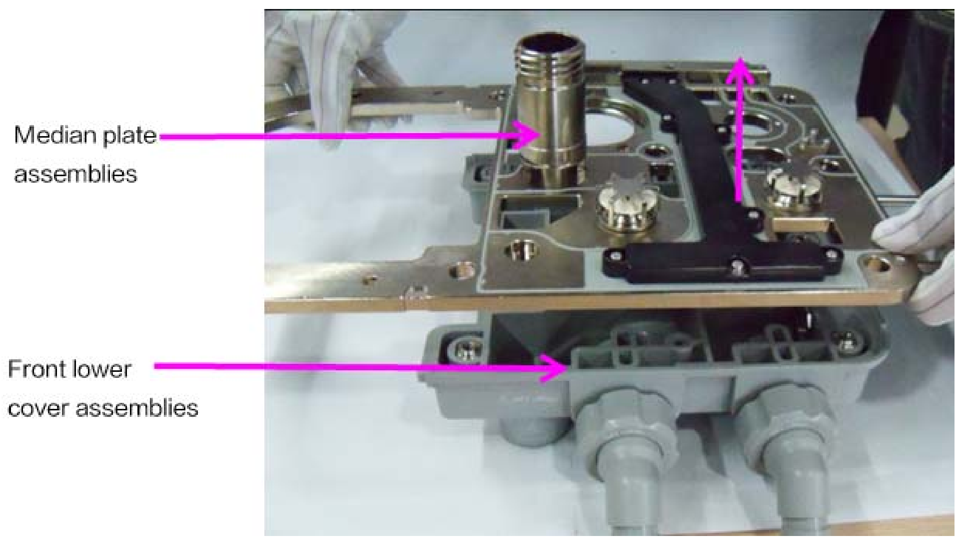


FIGURE 6-144

6.3.16 Disassemble the Automatic/Manual Ventilation Switch Assembly

1. Remove the upper cover as per section 6.3.17.

2. Turn over the upper cover assembly to access the three screws as shown in the following picture.

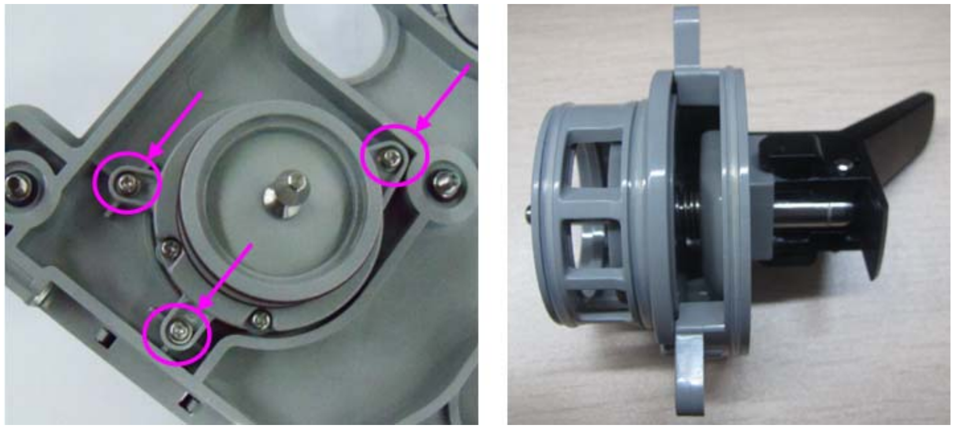


FIGURE 6-145

3. Unscrew the three screws as show in the picture.

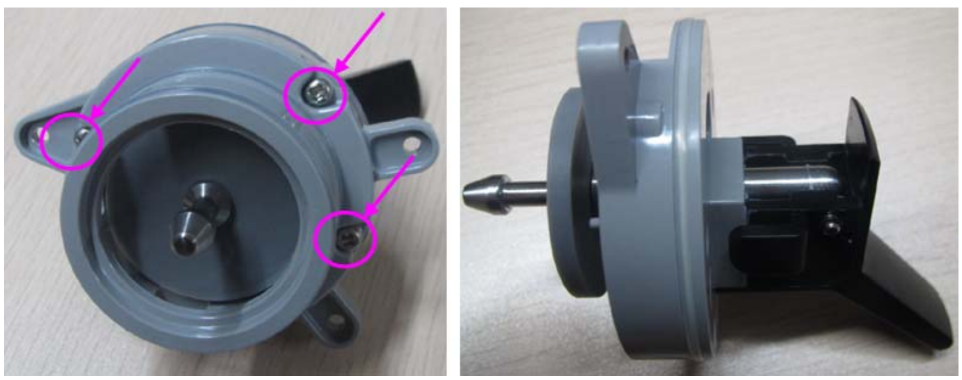


FIGURE 6-146

4. Remove the O-Ring and pull out the axis pin.

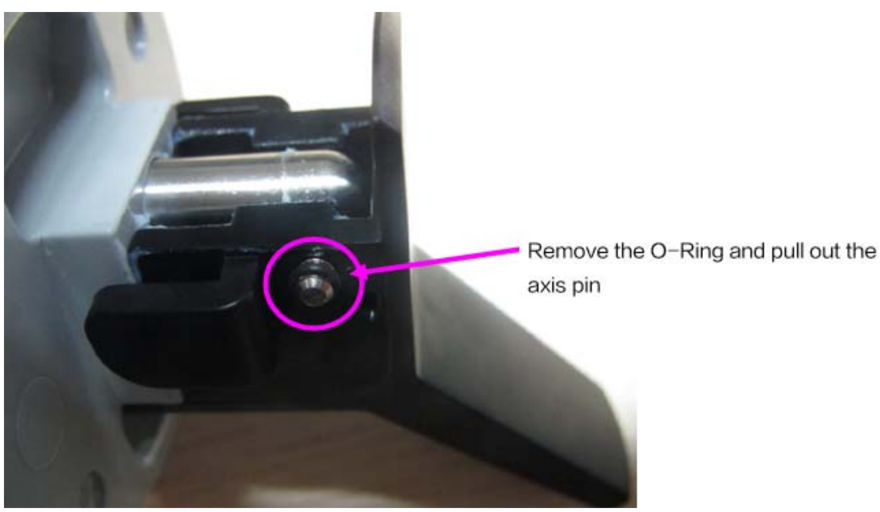


FIGURE 6-147

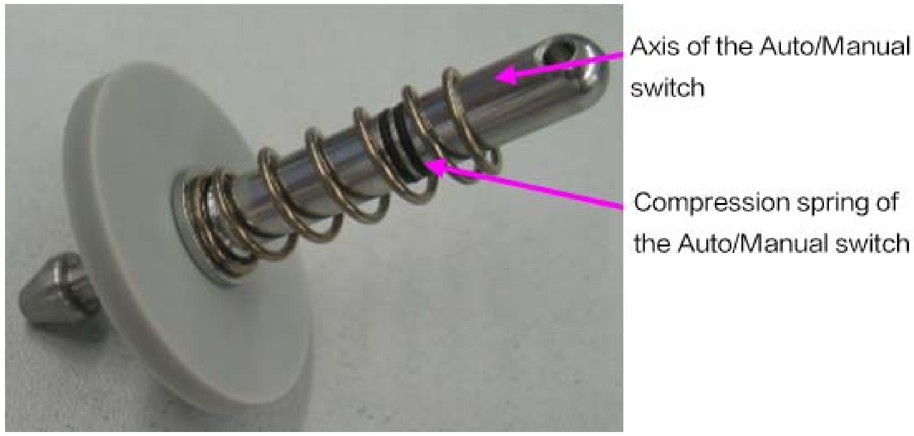


FIGURE 6-148

5. Remove the compression spring and replace the two seals (P/N 0030-10-13077)

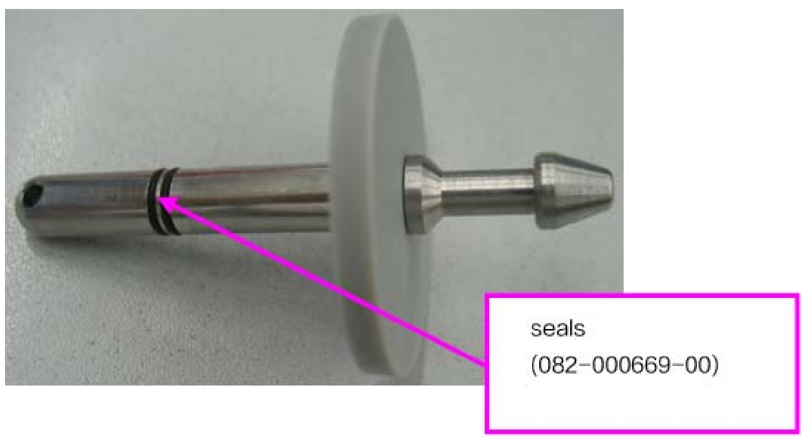


FIGURE 6-149

6.3.17 Remove the APL Valve Assembly

Turn the locking ring counterclockwise and pull the APL valve assembly straight up to remove it.

FIGURE 6-150

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7.0 Replacement Parts

7.1 Introduction

The A5/A4/A3 anesthesia system can be broken down into 18 big parts based on its structure and function. Each big part includes several replaceable parts. Tables 8-1 through 8-18 list the information about each replaceable part and Figures 8-1 through 8-14 indicate the position of each replaceable part on the A5/A4/A3. The selection of replaceable parts gives consideration to the characteristics of the parts, cost of replacement, and maintenance efficiency. When the parts whose sub components are not convenient to replace (such as the electronic component on the board) are faulty, replacing the board can improve the maintenance efficiency. For example, if a pressure gauge on the instrument panel is faulty, replacing the pressure gauge can reduce the cost.

7.1.1 Ordering Replaceable Parts

NOTE: The primary differences between New A5 and Original A5 are as follows:
1.Silkscreen difference(changed from 10C to 8C). There is little difference for most of the materials.
2. Color difference of the base, caster and display front housing: blue for Original A5 and dark blue for New A5.
3. Meter panel difference: New A5 has borders while Original A5 does not have.
4. O2 concentration monitoring difference: New A5 has module rack and its uses AG module with O2 for O2 con

Provide the following information to order replaceable parts:

FRU code of the parts;

Number of the parts in the document table;

Description of the feature of the parts.

For example: P/N: 115-018165-00 .... Auxiliary gas supply, NO.1

7.1.2 Diagrams and Tables

7.1.2.1 A5/A4/A3 Structure

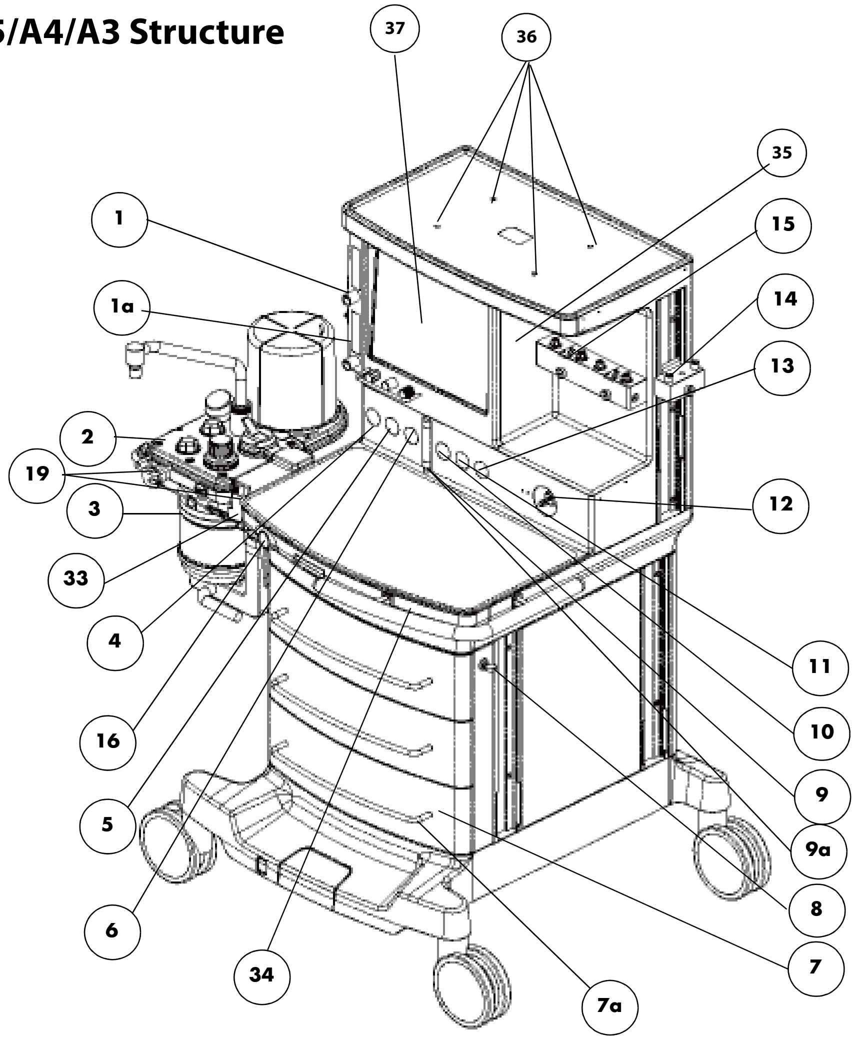


FIG.NO.	DESCRIPTION	PART NUMBER
1	Auxiliary Gas Outlet Assembly (A5 only)	115-018165-00(FDA) 115-018166-00(Canadian)
1a	Auxiliary Gas Outlet Assembly (0633) (A3/A4)	801-0633-00002-00
2	Breathing System	115-025569-00
3	CO2 Bypass Assembly, A series	115-036378-00
4	N2O High Pressure Gauge Assembly (0~3500psi) (A5/A3 only) (must be ordered together with the copper tube)	115-024845-00 and 801-0631-00125-00 (A5 and Old Yoke A3) or 115-034391-00 (New Yoke A3) Refer to FIGURE 7-2.
5	Air High Pressure Gauge Assembly (0~3500psi) (must be ordered together with the copper tube)	115-024846-00 and 801-0631-00124-00 (A5 and Old Yoke A3) or 115-034390-00 (A4 and New Yoke A3) Refer to FIGURE 7-2.

FIG.NO.	DESCRIPTION	PART NUMBER
6	O2 High Pressure Gauge Assembly (0~3500psi) (must be ordered together with the copper tube)	115-024844-00 and 801-0631-00123-00 (A5 and Old Yoke A3) or 115-034389-00 (A4 and New Yoke A3) Refer to FIGURE 7-2.
7	Drawer Assembly	115-034451-00
7a	Drawer Handle	801-0631-00140-00
8	Drawer Lock A-series (Old lock)	115-023320-00(801-0631-00077-00)
/	Drawer rail	031-000041-00
9	Total Flow meter	801-0631-00008-00
9a	Total Flowmeter Cover	043-000787-00
10	N2O Pressure Gauge Assembly (0~140psi)	115-024842-00
11	Air Pressure Gauge Assembly (0~140psi)	115-024843-00
12	System Switch Knob	801-0631-00012-00
13	O2 Pressure Gauge Assembly (0~140psi)	115-024841-00
14	Storage Mount for Vaporizer	801-0631-00076-00
15	Two Vaporizer Mounting Manifold or Three Vaporizer Mounting Manifold	801-0631-00024-00 or 115-020218-00
16	O2 Flush Button	043-001124-00(FDA) 043-001818-01(Canadian)
17	A-Series Handrail	042-002357-00
18	Pressure Gauge Panel	043-001122-01 (New A5 Only, FDA) 043-003521-00 (Canadian) 043-003538-00 (A4 and A3, FDA) For A4 system, if necessary, the pressure gauge panel should be used with the part as shown below: 042-005618-00 decoration plate for panel cover Refer to FIGURE 7-1.
19	O2 Sensor Cover (Include two covers) O2 cable plug cap (if not using O2 sensor) O2 sensor cover assembly (if not using O2 sensor)	115-016612-00 043-003033-00 (part of 115-016612-00) 115-016523-00 (part of 115-016612-00)
33	Vacuum Suction Tube Fixing Clamp	043-003125-00
34	A5 front panel under work surface	043-000794-00
	A3/A4 front panel under work surface	043-001809-00
35	Front cover of main unit	043-001120-01
36	Top cover screw paster	047-007458-00
37	Display panel	043-003173-00 (A5) 043-003534-00 (A3 and original A5)

NOTE: **For A3 system, High Pressure Gauge Assembly must be replaced together with the copper tube. New High Pressure Gauge Assembly and new copper tube can replace the original High Pressure Gauge Assembly and original copper tube. Refer to "A5/A3A5/A4/A3 Upper Half" on page 7-9 for the copper tube.**

FIGURE 7-1 Pressure Gauge Panel for A4

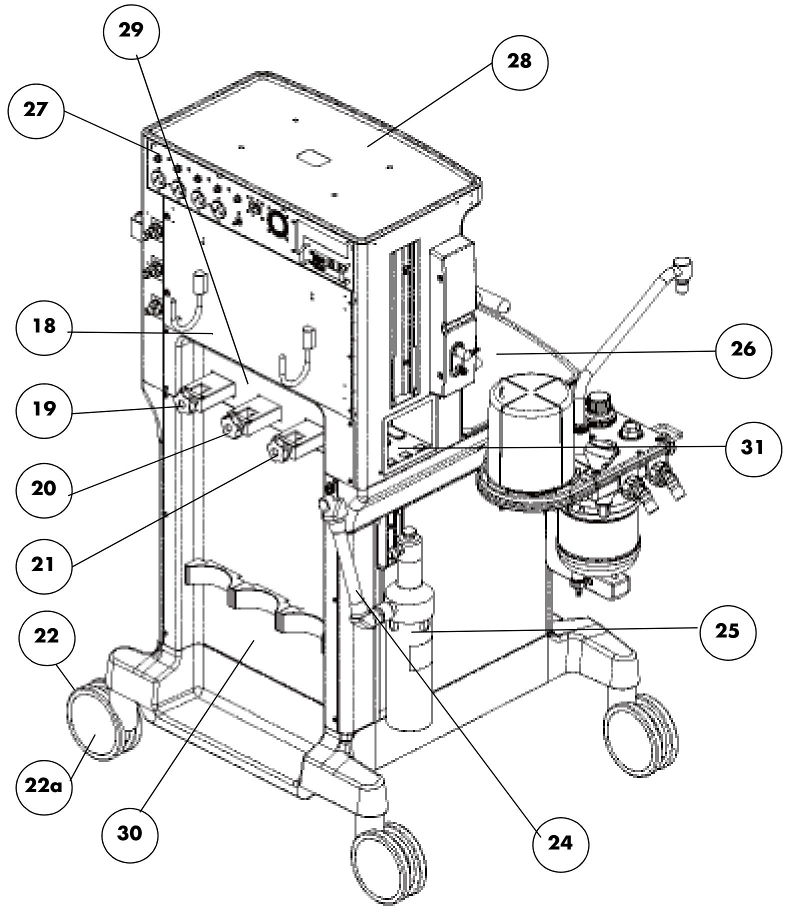
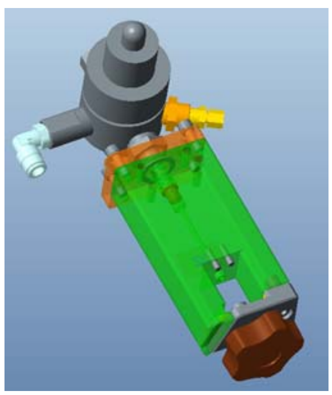
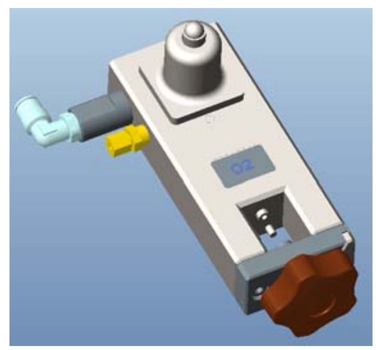


FIG.NO.	DESCRIPTION	PART NUMBER
18	Rear Door	115-046744-00
19	Oxygen Cylinder Yoke Assembly' (must be ordered together with the copper tube)	115-015777-00 (A5 Only) 115-047465-00 (A4/A3) Refer to FIGURE 7-2.
20	Air Cylinder Yoke Assembly (must be ordered together with the copper tube)	801-0631-00049-00(Original A3 and Original A5) 115-015778-00 (New A5 Only) 115-047466-00 (A4/New A3) Refer to FIGURE 7-2.
21	Nitrous Oxide Yoke Assembly (must be ordered together with the copper tube)	801-0631-00050-00(Original A3 and Original A5) 115-015779-00 (New A5 Only) 115-047467-00 (New A3) Refer to FIGURE 7-2.
22	Caster Assembly (A5 only)	034-000285-00
22a	Caster Assembly (FRU) (A3/A4)	801-0633-00001-00 (Old A3) 034-000234-00 (New A3 and A4)
24	AGSS Transfer Tube	801-0631-00074-00
25	Waste Gas Scavenger Assembly, A series or Dynamic Gas Scavenging System (DGSS)	115-017035-00 or 082-002748-00

FIG.NO.	DESCRIPTION	PART NUMBER
26	Work Surface Assembly (0631) FRU	801-0631-00120-00
27	Rear Panel of Hardware Box	042-002528-00
28	Top Deck Assembly	115-017037-00
29	Yoke Panel	043-000800-00 For A4 system, if necessary, Yoke panel should be used with the two part as shown below: 042-005446-00 back cover plate 042-005447-00 mounting plate Refer to FIGURE 7-3.
	Yoke Knobs	043-001266-00
30	Rear Panel	115-007450-00
31	Module rack case	115-016480-00
/	Gas module	6800-30-50842 (3-slot) 115-051561-00 (2-slot)



Original A3 yoke



New A3 yoke

FIGURE 7-2 A3 yoke

NOTE: **For A3 system, Cylinder Yoke Assembly must be replaced together with the copper tube. New Cylinder Yoke Assembly and new copper tube can replace the original Cylinder Yoke Assembly and original copper tube. Refer to “A5/A3A5/A4/A3 Upper Half” on page 7-9 for the copper tube.**

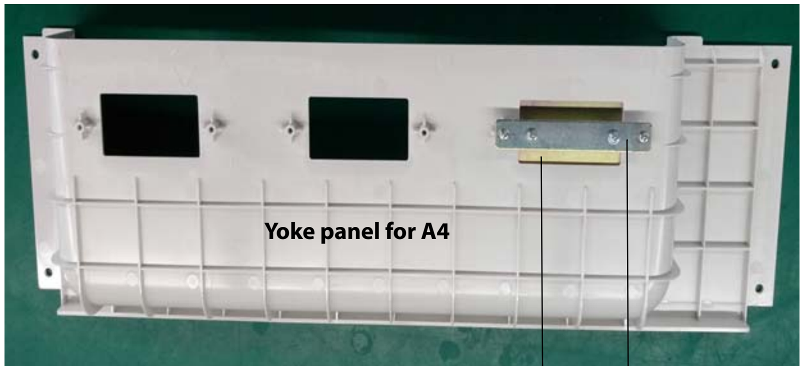
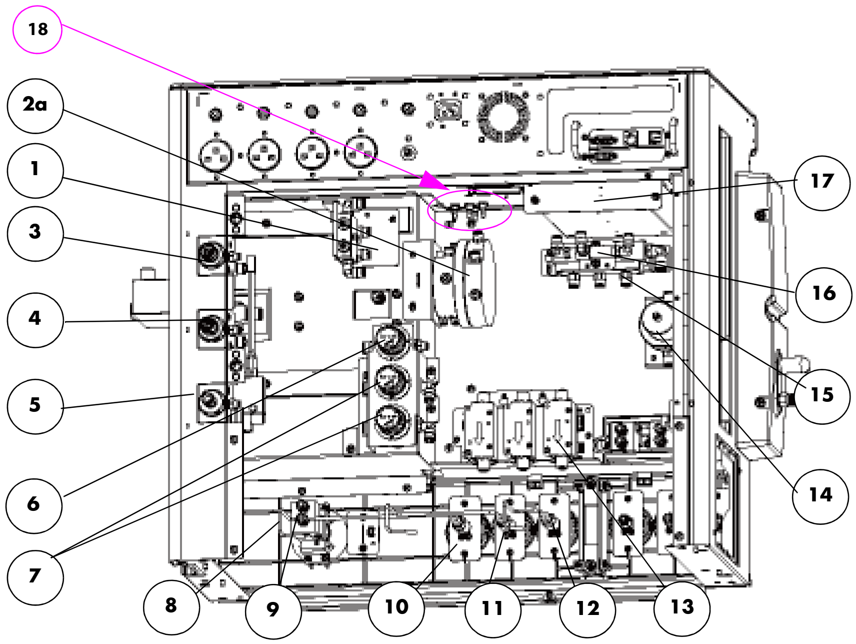


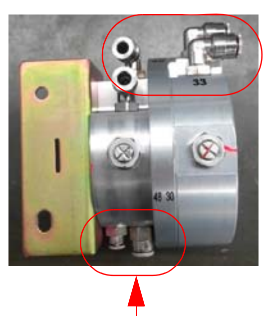
FIGURE 7-3 Yoke panel for A4

7.1.2.2 A5/A4/A3 Upper Half

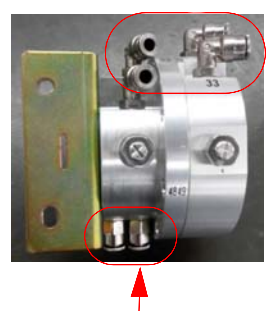


Version 1 ORC assembly | Version 2 ORC assembly | Version 3 ORC assembly

one Φ4 connector and one Φ6 connector



one Φ4 connector and one Φ6 connector



two Φ6 connectors

FIG.NO.	DESCRIPTION	PART NUMBER
1	Resister block assembly	801-0631-00119-00(include two branches) 115-008789-01 (only one branch)
2a	ORC & N2O Needle Valve maintenance kit	115-037598-00 (repair the version 1 and version 2 ORC assembly)
2b	New ORC Assembly (in which the resister block only has one branch)	115-037550-00(repair the version 3 ORC assembly)
3	Nitrous Oxide Inlet Assembly	801-0631-00034-00
4	Air Inlet Assembly	801-0631-00035-00

FIG.NO.	DESCRIPTION	PART NUMBER
5	Oxygen Inlet Assembly	115-014827-00
6	N2O Regulator Assembly	801-0631-00086-00
7	O2 & AIR Regulator Assembly	801-0631-00087-00
8	Oxygen System Switch	801-0631-00003-00
9	Indicator Light Board PCBA	801-0631-00004-00
10	Copper Tube of Pressure Gauge (Left) FRU (O2)	801-0631-00123-00 (A5 and original A3 yoke) 115-034389-00 (A4/New A3 yoke) Refer to FIGURE 7-2.
11	Copper Tube of Pressure Gauge (Middle) FRU (AIR)	801-0631-00124-00 (A5 and original A3 yoke) 115-034390-00 (A4/New A3 yoke) Refer to FIGURE 7-2.
12	Copper Tube of Pressure Gauge (Right) FRU (N2O)	801-0631-00125-00 (A5 and original A3 yoke) 115-034391-00 (New A3 yoke) Refer to FIGURE 7-2.
13	Electronic flowmeter assembly FRU O2/N2O/AIR flow sensor	115-046746-00 051-002721-00
14	Back Pressure Valve	115-039902-00
15	Gas Mixer Assembly	801-0631-00043-00
16	Poppet Valve	801-0631-00116-00
17	Lithium-ion Battery (11.1V, 4500 mAh)	115-018012-00
18	Tube connector nut Tube connector-	M90-100012- - - 082-000111-00
/	Exhaust Emission Pipe	115-052160-00

NOTE: **If the flow sensor (051-002721-00) or Electronic flowmeter assembly (115-046746-00) is replaced, upgrade the software bundle version to 02.12.00 and later.**

7.1.2.3 A5/A4/A3 Hardware Box

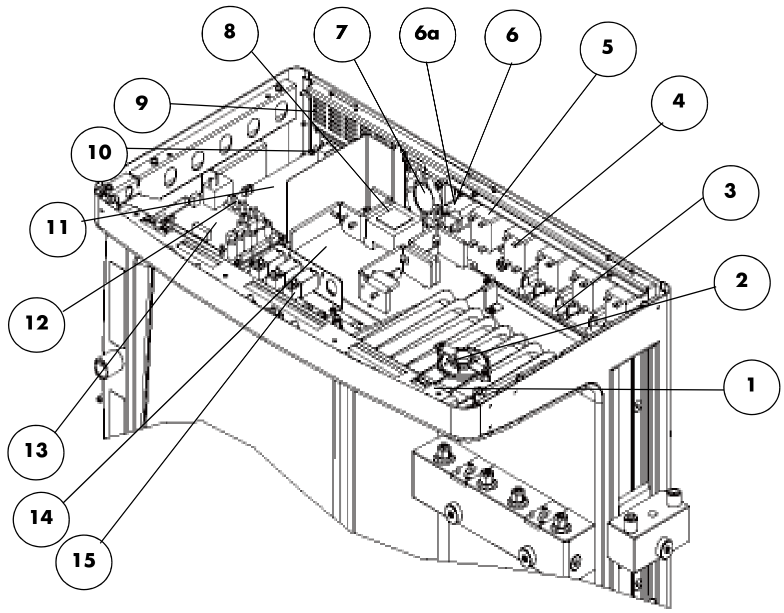


FIG.NO.	DESCRIPTION	PART NUMBER
1	Top lighting board PCBA	801-0631-00039-00
2	Speaker and Connecting Cable	801-0631-00038-00
3	Auxiliary AC Output Socket (NEMA 5-15)	801-0631-00032-00
4	Breaker (3.0A)	801-0631-00031-00
5	Breaker (10.0A) (A5 only)	801-0631-00030-00
6	Filter Power 250VAC 10A Panel Mount (A5 only)	801-0631-00029-00
6a	Filter (0633) (FRU) (A3/A4)	801-0633-00003-00
7	Fan	801-0631-00028-00
8	Power Board PCBA	801-0631-00025-00
9	Flow Channel	042-002414-00
10	Cell battery Lithium-ion 3V35mAh D12.5*2.0	M05-010R03---

FIG.NO.	DESCRIPTION	PART NUMBER
11	CPU Board	801-0631-00026-00 (A5 EPSON), for software bundle version 02.13.00 and earlier. 801-0633-00004-00 (A3 EPSON), for software bundle version 02.13.00 and earlier. 115-052902-00 (A5 DSP), for software bundle version 03.01.00 and earlier. 115-052901-00 (A4 DSP), for software bundle version 03.01.00 and earlier. 115-056938-00 (A5 EPSON, New), for software bundle version 02.13.01 and later. 115-056937-00 (A3 EPSON, New), for software bundle version 02.13.01 and later. 115-056940-00 (A5 DSP, New), for software bundle version 03.01.01 and later. 115-056941-00 (A4 DSP, New), for software bundle version 03.01.01 and later.
12	Battery Interface Board PCBA	801-0631-00109-00
13	Ventilator Control Board	801-0631-00027-00 (EPSON) 115-058771-00 (DSP)
14	Mother Board PCBA	801-0631-00108-00
15	Solenoid valve assembly	801-0631-00046-00
/	Fuse on power board	010-000087-00

7.1.2.4 A5/A4/A3 Work Surface

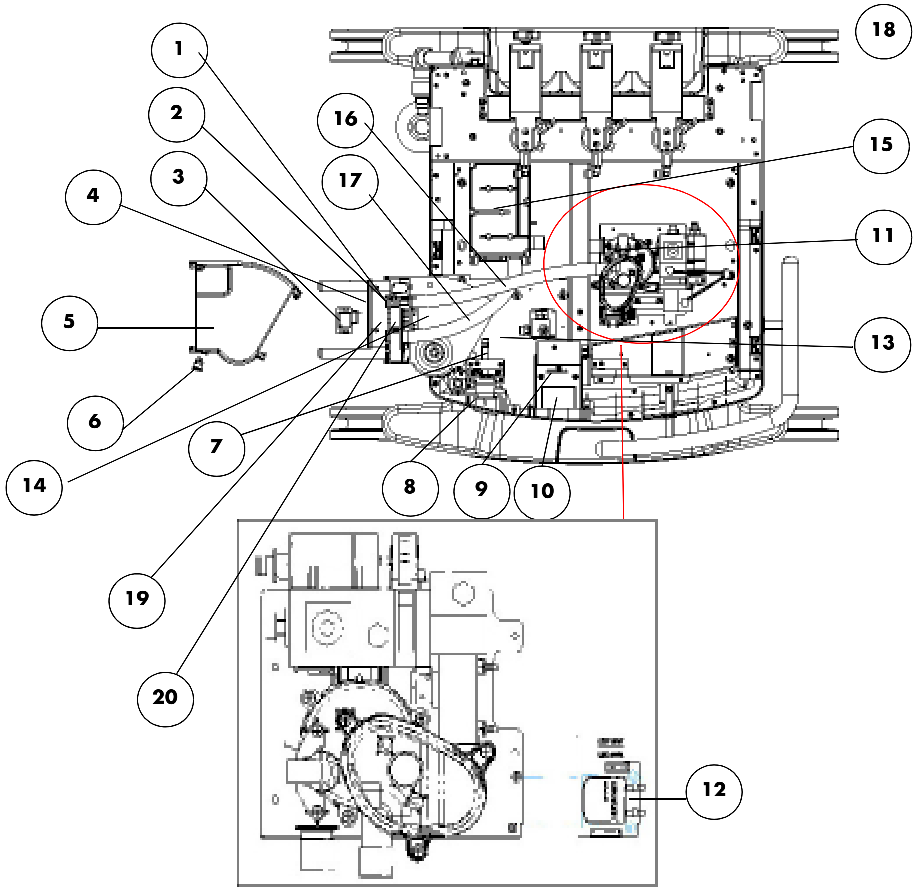


FIG.NO.	DESCRIPTION (English)	PART NUMBER
1	Docking Station Switch	801-0631-00101-00
2	Auto/Manual spring	801-0631-00114-00
3	Auto/Manual pin	801-0631-00113-00
4	Circuit Heater	115-034450-00
5	Docking Station Cover	801-0631-00068-00
6	O2 Connector	801-0631-00067-00
7	O2 Flush Assembly	801-0631-00044-00
8	Common Gas Outlet	801-0631-00045-00
9	Track Pad Module(A5 only)	115-017032-00
10	Touch Pad (A5 only)	801-0631-00052-00
11	Drive gas assembly	801-0631-00047-00 (For systems with software bundle version 02.02.02 and earlier, 120L/min) 115-020937-00(For software bundle version 02.04.00 and later, 120L/min) 115-052762-00 (DSP 180L/min)

FIG.NO.	DESCRIPTION (English)	PART NUMBER
12	Sensor interface board PCBA	801-0631-00089-00 (EPSON)
13	Docking Station Support Plate	041-007227-01
14	Docking Station Plate	041-002727-01
15	Gas Reservoir Assembly	801-0616-00007-00
16	Driving gas spring tube assembly	115-034448-00
17	APL valve spring tube assembly	115-034449-00
18	Gas reservoir tube	082-002365-00
19	Heater spring	0601-20-78922
20	The M3X8 combination Bolt	M04-051140---
/	Breathing System Switch	M90-000162---

7.1.2.5 A5/A4/A3 Patient Circuit Main Body

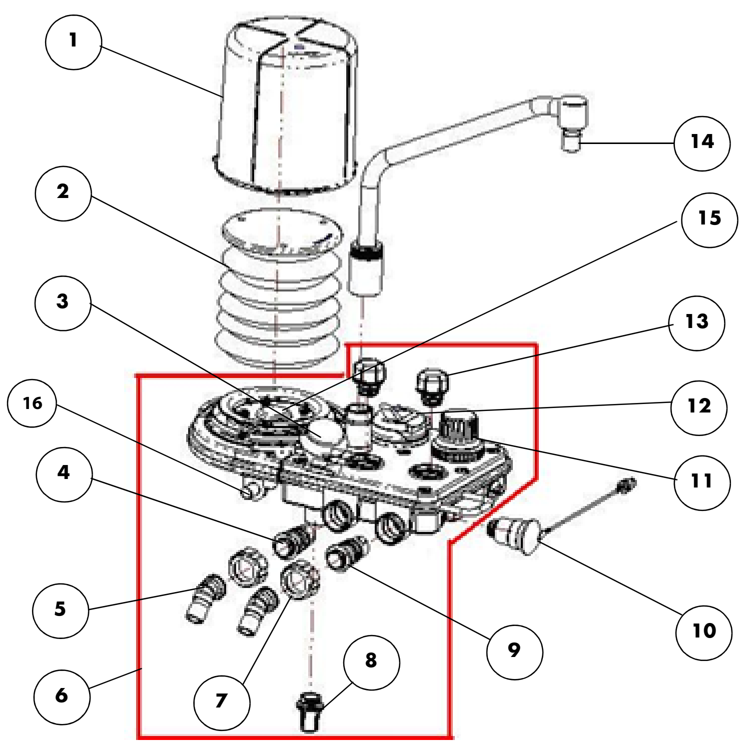
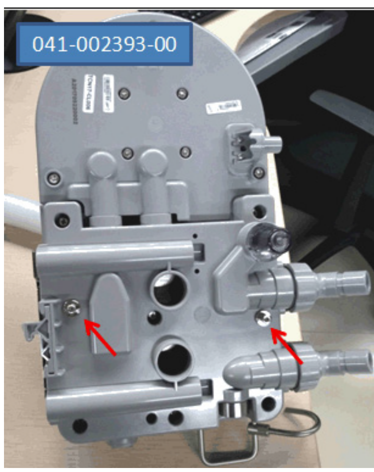


FIG.NO.	DESCRIPTION	PART NUMBER
1	Bellows Dome, A series	801-0631-00054-00
2	Bellows Assembly, A series	0601-30-78968
3	Airway pressure gauge, A series	115-051819-00
4	Expiratory Flow Sensor Assembly, A series	801-0631-00056-00
5	Inspiratory / Expiratory Connector, A series	801-0631-00057-00

FIG.NO.	DESCRIPTION	PART NUMBER
6	Breathing Circuit Unit	115-025565-00
7	Inspiratory / Expiratory Connector Rotary Cap, A series	801-0631-00059-00
8	Water Collection Cup, A series	801-0631-00058-00
9	Inspiratory Flow Sensor Assembly, A series	801-0631-00060-00
10	O2 sensor cable, A series	801-0631-00102-00
11	APL Valve Assembly or Quick release APL valve assembly	801-0631-00062-00 or 115-046756-00
12	Auto/Manual ventilation switch	801-0631-00065-00
13	One-Way Valve	801-0631-00104-00
14	Bag Arm - Fixed Height, A series or Bag Arm -Flexible arm assembly	115-048600-00 or 115-028041-00
15	Bellow check valve membrane weight	0601-20-69772
16	Test port	043-001285-00
/	Respiratory screw	041-002393-00
/	Top cover screw	041-005001-01



7.1.2.6 A5/A4/A3 Pre-pak Absorber Canister Assembly

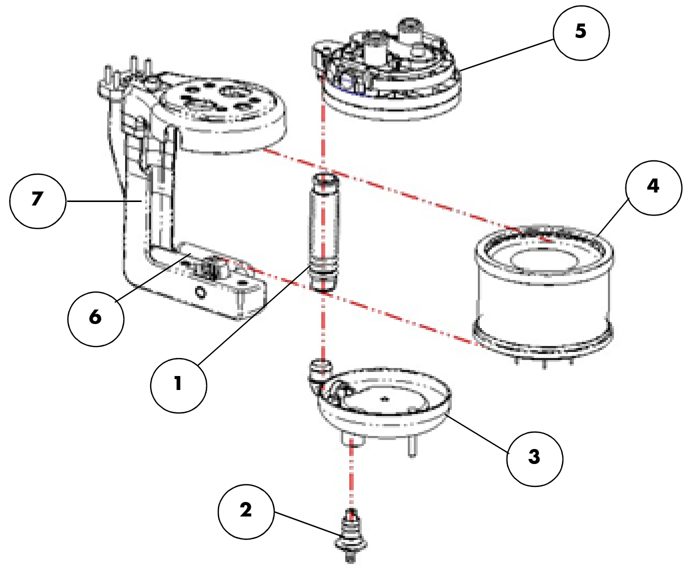


FIG.NO.	DESCRIPTION	PART NUMBER
1	CO2 Absorber Hose, A series	801-0631-00092-00
2	CO2 Absorber Base Drain Valve, A series	801-0631-00112-00
3	CO2 Absorber Base, A series	801-0631-00100-00
4	CO2 Absorbent Canister, A series	801-0631-00066-00
5	CO2 Bypass Assembly, A series	115-036378-00
6	Prepak Handle FRU	115-015765-00
7	L-shape Bracket Assembly	115-017030-00 (8 C)
/	CO2 Canister Switch	010-000024-00

7.1.2.7 A5/A4/A3 Valve assembly

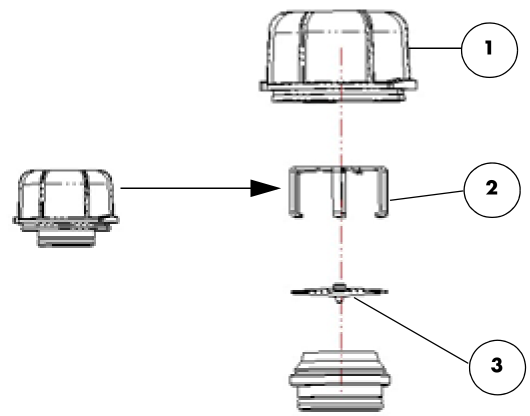


FIG.NO.	DESCRIPTION	PART NUMBER
1	Check valve dome, A series	801-0631-00061-00
2	Valve cover	801-0631-00110-00
3	Disc	801-0631-00111-00

7.1.2.8 A5/A4/A3 O2 Cable Assembly

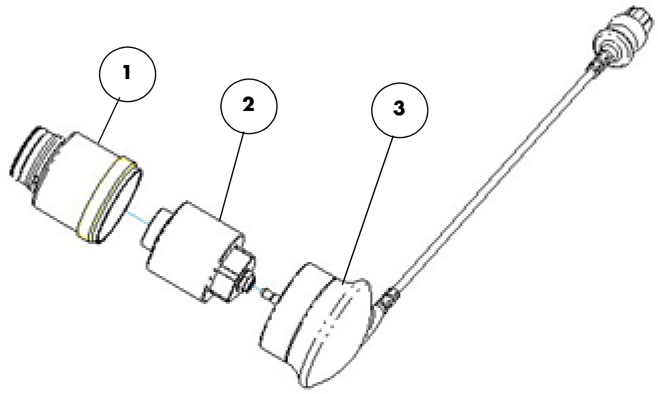
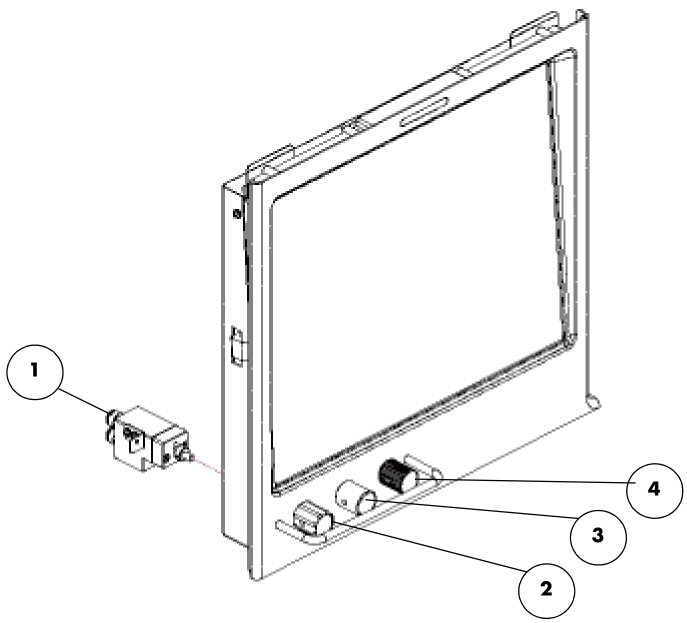


FIG.NO.	DESCRIPTION	PART NUMBER
1	O2 cell cover	801-0631-00090-00
2	Sensor Oxygen (O2 sensor) Medicel MOX-2	040-001270-00
3	O2 Cell Cable	801-0631-00091-00

7.1.2.9 A5/A4/A3 Display Assembly



two Φ6 connectors

one Φ4

Needle valve assembly (801-0631-00020-00)

Needle valve assembly (115-037561-00)

FIG. NO.	DESCRIPTION	PART NUMBER
1	Needle Valve Assembly	801-0631-00020-00(O2,Air) 115-037561-00(N2O)
2	Knob of N2O Needle Valve	801-0631-00021-00
3	Knob of Air Needle Valve	801-0631-00022-00
4	Knob of O2 Needle Valve	801-0631-00023-00
5	O2 knob overlay(US)	047-002233-00

FIG. NO.	DESCRIPTION	PART NUMBER
6	N2O knob overlay(US)	047-002234-00
7	AIR knob overlay(US)	047-002235-00
8	O2 knob overlay(Canada)	047-002230-00
9	N2O knob overlay(Canada)	047-002231-00
10	AIR knob overlay(Canada)	047-002232-00

7.1.2.10 A5/A4/A3 Display Assembly Main Body

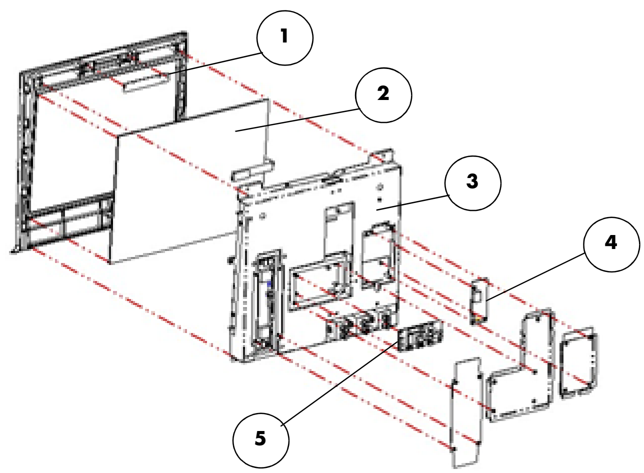


FIG.NO.	DESCRIPTION	PART NUMBER
1	Warning Light Board PCBA	801-0631-00019-00
2	Touch Screen	801-0631-00014-00
3	Display Exchange Package	801-0631-00075-00
4	Touch Screen Control Board	801-0631-00018-00
5	Display Interface Board PCBA	801-0631-00017-00
/	Display Panel	043-003173-00 (A5) 043-003534-00 (A3, A4 and original A5)

7.1.2.11 A5/A4/A3 Vaporizer Mounting Minifold

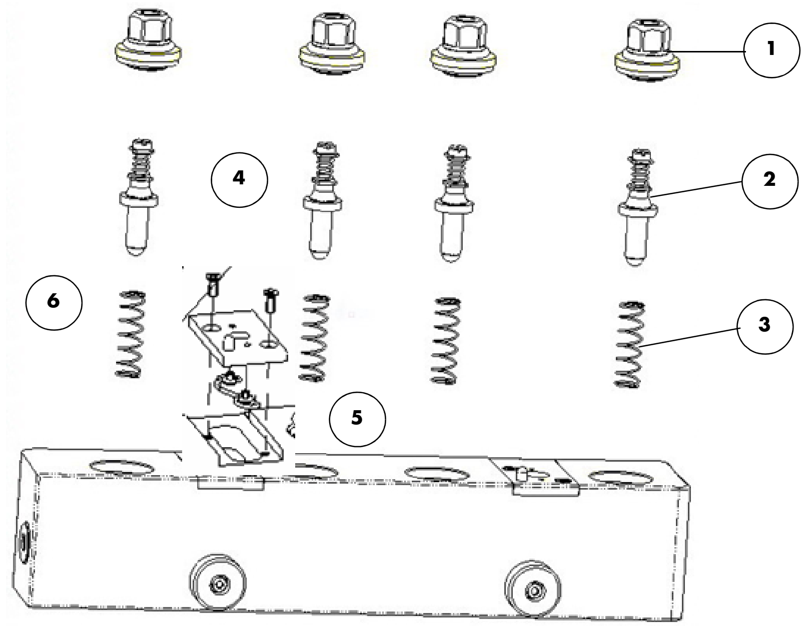


FIG.NO.	DESCRIPTION	PART NUMBER
1	Connector (Vaporizer Mount)	801-0631-00117-00
2	Valve of Vaporizer Mounting Manifold	801-0631-00106-00
3	Spring of Vaporizer Mounting Manifold	801-0631-00107-00
4	Locking plate	041-000166-00
5	Locking pin	0611-20-45417
6	Spring, special for vaporizer, S type	M6T-010009---

7.1.2.12 A5/A4/A3 Auxiliary Gas Outlet Assembly

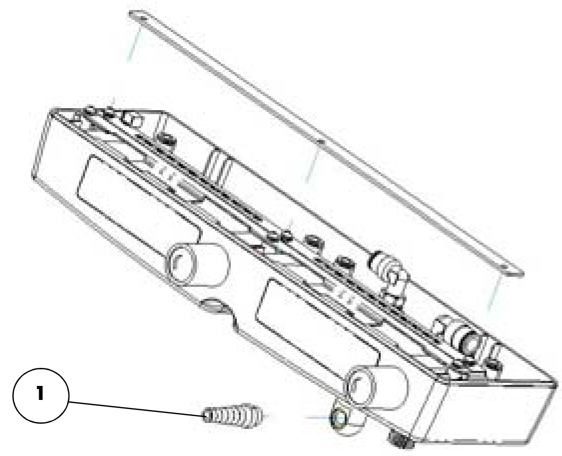
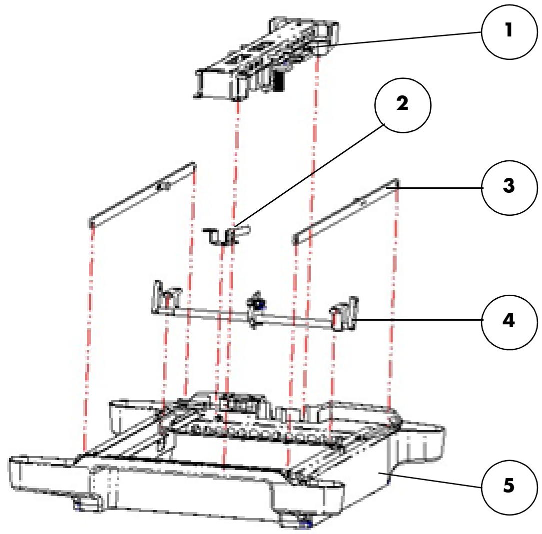


FIG.NO.	DESCRIPTION	PART NUMBER
1	Auxiliary Gas Outlet Fittings (FRU)	801-0631-00122-00

7.1.2.13 Base Assembly (A5)

Old Version



New Version

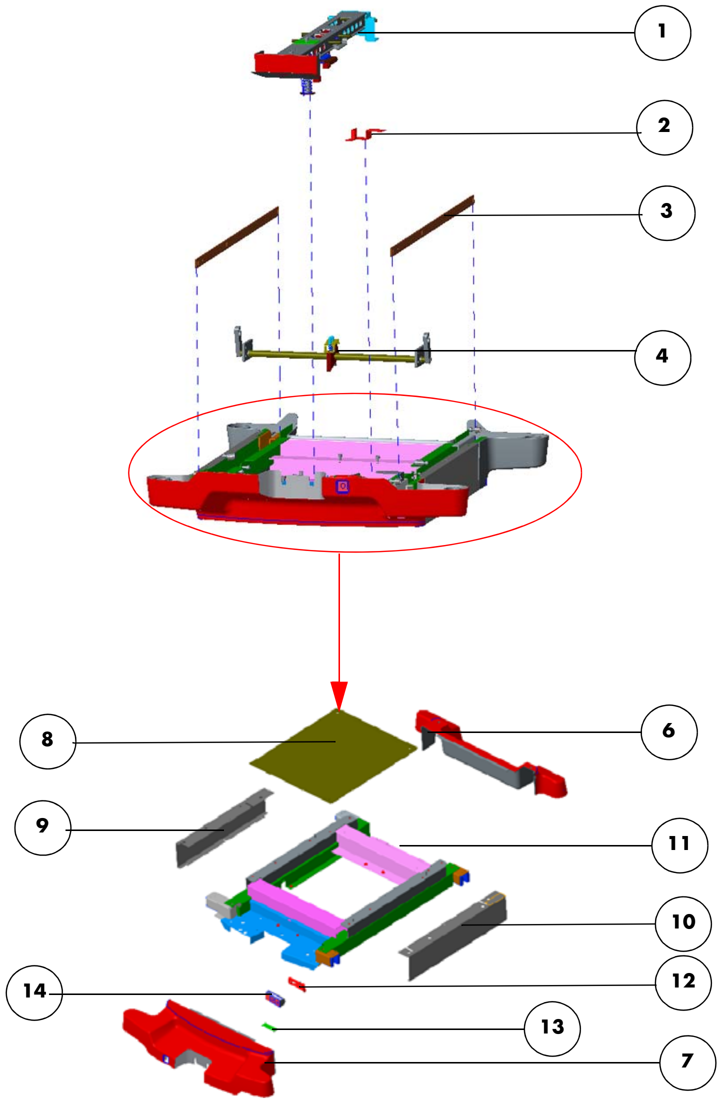


FIG.NO.	DESCRIPTION	PART NUMBER
1	Brake Assembly (A5 only)	801-0631-00094-00 (light gray) 115-016692-00 (dark gray)
2	Indicator Drive Plate	801-0631-00072-00
3	Connector of the Brake	801-0631-00095-00 (old version) 115-047451-00 (new version)
4	Principal Axis of Brake (A5 only)	801-0631-00096-00 (old version) 115-047452-00 (new version)
5	Base of Chassis Assembly (A5 only)	115-016691-00 (dark gray)
6	Rear shell of chassis	115-036463-00 (dark gray, A5) 115-047036-00 (A3/A4)
7	Front shell of chassis	115-036464-00 (dark gray, A5) 115-047037-00 (A3/A4)
8	Cover for chassis	115-047679-00

FIG.NO.	DESCRIPTION	PART NUMBER
9	Left decorative plate	115-047038-00 (dark gray, A5) 115-047040-00 (A3/A4)
10	Right decorative plate	115-047039-00 (dark gray, A5) 115-047041-00 (A3/A4)
11	Base of Chassis	115-036460-00 (new version)
12	Indicator drive plate	042-003043-00
13	Indication block of brake	043-001125-00
14	Indicator bracket	042-003044-00

NOTE: The parts 6, 7, 8, 9, and 10 are compatible with the old version chassis.

7.1.2.14 Other

FIG.NO.	DESCRIPTION	PART NUMBER
1	Waste Gas Hose for Gas module to Colder fitting	115-052160-00
2	Gas Cylinder Wrench	115-033063-00
3	Pre-Operation Checklist, English	801-0631-00081-00
4	Auxiliary O2/Air Reference Card	801-0631-00082-00
-	A series cleaning and disinfection card	115-040734-00
-	Preventative Maintenance Kit (12 months)	801-0631-00084-00
-	A3/A4 Periodic Maintenance Kit (36 months)	121-001072-00
-	A5 Periodic Maintenance Kit (36 months)	121-001061-00

7.1.2.15 Tubes (A5/A4/A3)

NO.	DESCRIPTION	PART NUMBER
1	Tube.PU (polyether) 7mmX10mm transparent	082-000519-00
2	Silicone,3/32"X7/32"X100ft	A21-000007---
3	Tubing.Soft precision PU tubing, 8mmx5.5mm, transparent	M6G-020045---
4	Silicone 20X25mm	082-002356-00
5	Transparent PU Tube 4*6	M6G-020026---
6	Tubing. Soft precision PU tubing, 4mmx2.5mm, transparent	M6G-020046---
7	Driving gas spring tube assembly	115-034448-00
8	APL valve spring tube assembly	115-034449-00
9	Hose label (AIR)	047-025129-00
10	Hose label (N2O)	047-025130-00
11	Hose label (O2)	047-025131-00
12	Hose label (neutral)	047-025253-00

7.1.2.16 O-rings (A5/A4/A3)

NO.	DESCRIPTION	PART NUMBER	REMARK
1	Seal,valve port	049-000140-00	for CO2 Bypass shaft
2	Gasket, CO2 bypass assembly	049-000142-00	\
3	Gasket, absorber canister exterior	049-000143-00	\
4	Gasket, absorber canister interior	049-000145-00	\
5	CO2 Absorber Hose	049-000146-00	\
6	Bellow check valve membrane	049-000240-00	\
8	Gasket, bellows canister base	049-000243-00	\
9	AGSS filter	082-000506-00	\
10	O-ring 14X2.65	082-000934-00	for Vaporizer mount
11	O-ring 30X2	082-000624-00	bag arm base
12	O-ring 25X2	082-000625-00	APL valve
13	O-ring 27X1.5	082-001501-00	for Check valve dome
14	O-ring 18X2.5	082-000627-00	Breathing system base
15	O-ring 20X1.5	082-001503-00	for Check valve
16	O-ring 23.47X2.95	082-001504-00	for Water Collection Cup + CO2 Bypass Assembly
17	O-ring 52X2	082-000630-00	Auto/Manual ventilation switch
18	O-ring 29X2.62	082-000633-00	Bellows base
19	O-ring 6.07X1.78	082-000641-00	Bottom of the breathing system cover screw
20	O-ring 29.82X2.62	082-000642-00	APL valve
21	O-ring 40X2.2	082-000648-00	Auto/Manual ventilation switch
22	O-ring 8.5X2.0	082-001525-00	O2 cell port
23	O-ring 8.5X2	082-000665-00	for rotating block of breathing circule
24	O-ring 4.7X1.8	082-000667-00	for rotating block of breathing circule
25	O-ring 6X1	082-000669-00	for Auto/Manual ventilation switch
26	O-ring 15.54X2.62	082-000673-00	for bag arm +O2 cell cover
27	O-ring 4.47X1.78	082-000679-00	for CO2 Bypass shaft
28	O-ring (for airway pressure gauge)	801-0631-00118-00	\
29	O-ring 16X2	M6M-010058---	for rotating block of breathing circle
30	O-ring 10.72X1.78	082-001524-00	for airway pressure gauge
31	O-ring 0.35X1.78 FKM A70	082-000676-00	\
Not Shown	Maintenance Kit for O-rings	801-0631-00141-00	\
Not Shown	O-ring 20X1.5	082-000714-00	for in-and Expiratory flow sensor
Not Shown	O-ring 23X2	082-000712-00	for in-and Expiratory flow sensor
Not Shown	O-ring 23X2.5	082-000713-00	for in-and Expiratory flow sensor
Not Shown	Sealed gasket of breathing connector	049-000235-00	\

NO.	DESCRIPTION	PART NUMBER	REMARK
Not Shown	O-ring, 75.87X2.62 A50	082-001509-00	\
Not Shown	O-ring, 61.6X2.62 A50	082-001511-00	\

7.1.2.17 Cables

NO.	DESCRIPTION	PART NUMBER
1	Cable, battery	009-000969-00
2	Cable, Patient Monitor	009-000971-00
3	Cable, Touchpad	009-000972-00
4	Cable, Display	009-000973-00
5	Cable, Inverter LED (old) Cable,Screen Backlight (new)	009-000974-00 (old) 009-006731-00 (new)
6	Cable, Alarm	009-000976-00
8	Cable, Indicator	009-000977-00
9	Cable, Touch Screen	009-000978-00
10	Cable, Ventilator	009-000979-00
11	Cable, Lighting Switch	009-000981-00
12	Filter Power 250VAC 15A Panel Mount	801-0631-00029-00 (A5) 801-0633-00003-00 (A3/A4)
13	Cable, Auxiliary Outlet	009-000984-00
14	Cable, Power, AC Internal	009-000985-01
15	Cable, Sodalime Canister Switch Cable	009-000987-00
16	Cable, Inverter Cable(old) Cable,LED Backlight Input(new)	009-000988-00 (old) 009-006382-00 (new)
17	Cable, System Switch	009-001776-00
18	Line cord	009-000094-00
19	Cable, Breathng System	009-000980-00
20	Cable, Top Lighting A	009-000982-00
21	Cable, Display Lighting	009-000986-00
22	Cable, O2 Pressure Switch	0621-20-69588
23	Cable, Circuit Switch	0621-20-78593
24	0633 AC Power Cable (only available for A3/A4)	009-002224-00

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8.0 Warranty

8.1 Disclaimers

Product Improvements - Mindray DS USA, Inc. retains the right to modify the machine and/ or operating instructions without prior notification. These operating instructions explain all features of the A5/A4/A3 system and are correct at time of manufacture. Instructions and models produced at a later stage, may contain improvements or modifications that were not included in previous models.

8.2 Manufacturer's Responsibility

The effects on safety, reliability, and performance of the equipment are the manufacturer's responsibility only if:

a. assembly operations, extensions, readjustments, modifications or repairs are carried out by authorized personnel; and

b. the electrical installation of the relevant room complies with the appropriate requirements; and

c. the equipment is used in accordance with the instructions for use

8.3 Phone Numbers and How to Get Assistance

A network of service representatives and factory-trained distributors is available. Prior to requesting service, perform a complete operational check of the instrument to verify proper control settings. If operational problems continue to exist, contact the Service Department at 877.913.9663 for Technical Support or 650.316.3199 for assistance in determining the nearest field service location.

Please include the instrument model number, the serial number, and a description of the problem with all requests for service.

Warranty questions should be directed to a local representative. A list of offices, along with their phone numbers, is provided at the end of this manual.

NOTE: **Upon request, calibration instructions or other information will be provided to assist the user's appropriately qualified technical personnel in repairing those.**

8.4 Password

A password is required to access different modes within the anesthesia system.

- System password: 1234