WATO EX-35 Anesthesia Machine

Service Manual

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Revision History

This manual has a revision number. This revision number changes whenever the manual is updated due to software or technical specification change. Contents of this manual are subject to change without prior notice. Revision 1.0 is the initial release of the document.

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Preface

Manual Purpose

This manual provides detailed information about the assembling, dissembling, testing and troubleshooting of the equipment to support effective troubleshooting and repair. It is not intended to be a comprehensive, in-depth explanation of the product architecture or technical implementation. Observance of the manual is a prerequisite for proper equipment maintenance and prevents equipment damage and personal injury.

This manual is based on the maximum configuration. Therefore, some contents may not apply to your monitor. If you have any question, please contact our Customer Service Department.

Intended Audience

This manual is geared for biomedical engineers, authorized technicians or service representatives responsible for troubleshooting, repairing and maintaining the anesthesia machines.

Password

A password is required to access different modes within the anesthesia machine.

- Manage Configuration: 789789
- Factory maintenance: 558188

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FOR YOUR NOTES

1 Safety

1.1 Safety Information

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

⚠ WARNING

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.**

⚠ CAUTION

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.**

NOTE

- **Provides application tips or other useful information to ensure that you get the most from your product.**

1.2 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.**
- **Use only an approved lubricant on any O-ring in contact with oxygen. Krytox® is the recommended oxygen service lubricant.**
- **For continued protection against fire hazard, replace all fuses with the specified type and rating.**
- **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).**
- **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.**
- **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.)**
- **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.**
- **Possible electric shock hazard. The machine may only be opened by authorized service personnel.**
- **Avoid exposure to respiratory gases by always directing the fresh gas flow from the fresh gas outlet to the waste gas scavenger.**

1.3 Cautions

⚠ CAUTION

- **This device uses high pressure compressed gas. When attaching or disconnecting backup gas cylinders, always turn the cylinder valves slowly. Use the 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.**
- **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 gas connection fittings.**
- **Refer to the 6.2 Maintenance Period for assistance when performing scheduled periodic maintenance.**
- **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.**
- **Use cleaning agent sparingly. Excess fluid could enter the machine, causing damage.**
- **This machine must only be operated by trained, skilled medical staff.**
- **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.**
- **After changing the CO2 absorbent, carry out a system leak test.**
- **Only Selectatec™ compatible vaporizers with Interlock-System may be used with the A5 unit.**
- **After each exchange of a vaporizer, carry out a system Leak test.**
- **Do not clean the machine while it is on and/or plugged in.**
- **Pressing “cancel” at any time during the procedure will cancel the session's settings and reload the previously-stored calibration coefficients.**
- **Depleted soda lime changes color. Replace the soda lime if approximately 2/3 of the absorber content is discolored. CO2 absorbent can be safely changed without stopping mechanical ventilation.**
- **This equipment contains parts which are easily damaged due to electrostatic discharge (ESD). Follow ESD prevention program when touching, taking out, or inserting parts or components.**

1.4 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.**

2 Theory of Operation

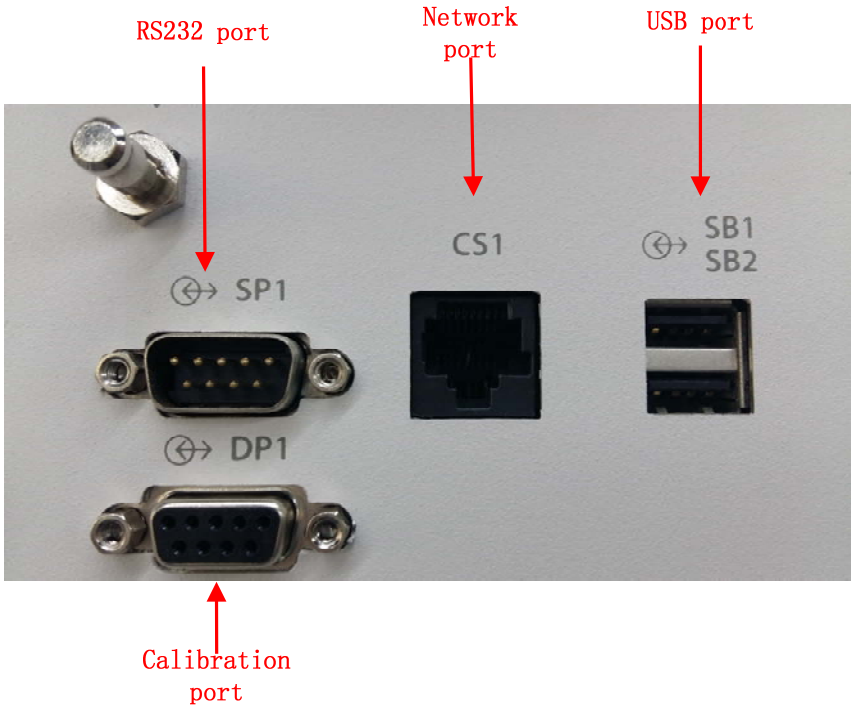
2.1 Electrical Part

The hardware system of WATO EX-35(0619) includes: mother board, power sub-system, main unit sub-system, display sub-system, gas parameters module sub-system, pneumatic accessories, and others. The introductions of the modules are as follows:

1) Mother board: connects to the related parts of cards and hardwares, and transfers related signals to corresponding cards and components.
2) Power sub-system: includes power board, battery adapter board, lithium battery, AC input, auxiliary electrical outlet, etc. It supplies power to anesthesia machine and its external equipments.
3) Main unit sub-system: includes main control board and monitoring module. Main control board realizes the human-machine interaction function of the anesthesia machine and the data exchange with monitoring module and gas parameters module sub-system, and it extends with USB, network port, RS-232 series port, calibration port, etc. Monitoring module controls the parameters of the anesthesia machine and realizes monitoring function, and it includes ventilation control board and ventilation protection board.
4) Display sub-system: includes key control board, encoder board, alarm light board, screen, touchscreen, etc. Key control board realizes the functions of encoder recognition, touchscreen recognition, touch key recognition, backlight control, etc, and it also transfers the signal of alarm light controlled by main control board and send datd to main control board through series port.
5) Gas parsmeters module sub-system: includes infrared communication board, parameter module and fan of module rack.

Except the modules and cards above, the hardware system of WATO EX-35 (0619) also includes several components related to hardware, for example, valve, position switch, heater, speaker, heat-sink fan, etc.

2.1.1 Outside Ports

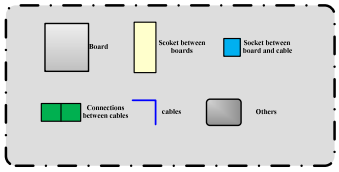


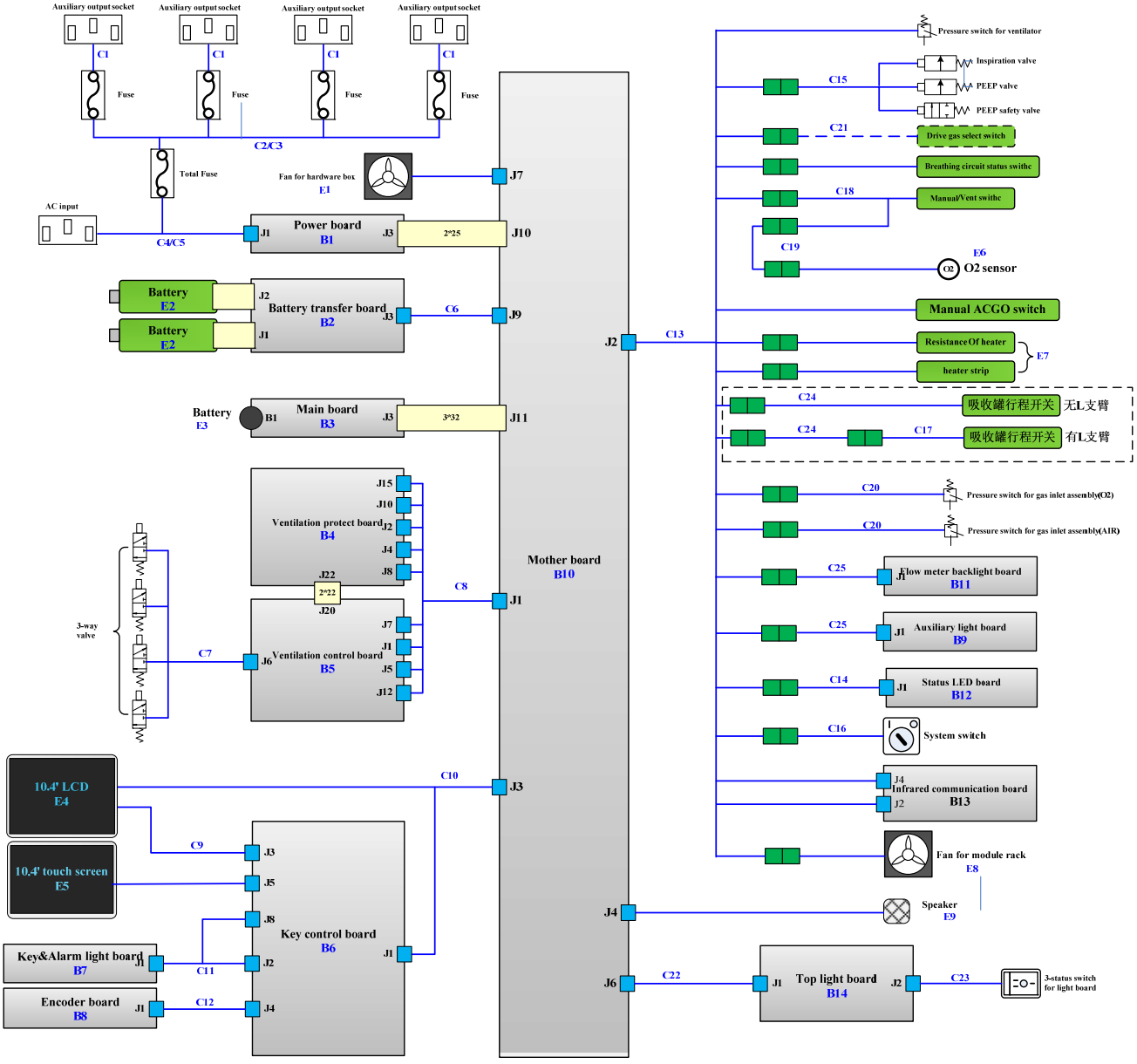
Name	Located card	Property	Function
Network port	Main control board	RJ-45	online upgrade; data outport
USB port	Main control board	Dual A type receptacle	data outport; connects to mouse
Calibration port	Mother board	DB-9, female	connects to calibration device
RS232 port	Main control board	DB-9, male	connects to patient monitor

2.1.2 Electrical Theory

2.1.2.1 Theory Diagram

AC stanard	AC output（socket）	C1（cables）	Auxiliary output fuse socket	Auxiliary output fuse
GB	M39-000207---	009-005461-XX	509B-10-06194	M07-00131F---
EU	M39-000208---	009-005324-XX	509B-10-06194	M07-00131F---
AU	009-000067-XX（With socket）		509B-10-06194	M07-00131F---
BS	008-000027-00	009-000068-XX	509B-10-06194	M07-00131F---
Indian	008-000060-00	009-000068-XX	509B-10-06194	M07-00131F---
B stanard220V	009-000127-XX（with socket）		509B-10-06194	M07-00131F---
Brazil	008-000229-00	009-005325-XX	509B-10-06194	M07-00131F---
Australian	M39-000207---	009-005461-XX	509B-10-06194	M07-00131F---
（Big）South Africa	008-000487-00	009-003179-XX	509B-10-06194	M07-00131F---





2.1.2.2 Hardware Components List

List of hardware boards:

NO	P/N	Spare parts description
B1	051-000685-00	0631 Power board
B2	051-000768-00	0623 Battery adapter board PCBA
B3	051-002376-00	0619 Main control board PCBA
B4	051-002364-00	0619 Ventilater&Protect PCBA（Parker）
B5	051-001078-00	V01A Ventilation control board
B6	051-002365-00	0619 Keypad Control Board PCBA
B7	051-002163-00	0619 Key and Alarm Light Board PCBA
B8	0010-30-43089	Copper spool encoder board
B9	051-002386-00	0619 auxiliary lighting board PCBA
B10	051-002165-00	0619 Mother Board PCBA
B11	051-000040-00	0616 Flow meter back light PCBA
B12	051-001934-00	0625 Indicator light board PCBA
B13	051-000259-01	0621 Infrared communication board PCBA
B14	051-001866-00	0625 Top light board PCBA

List of hardware wires:

NO	P/N	Spare parts description
C1	009-005461-00	0625 Domestic standard connection line
C1	009-005324-00	0625 European standard connection line
C1	009-000067-00	American standard receptacle and connection line
C1	009-000068-00	British standard connection line
C1	009-000127-00	B specification 220V receptacle and connection line
C1	009-005325-00	0625 Brazilian standard connection line
C1	009-003179-00	0623 Big South African connection line
C2	009-006243-00	0619 auxiliary output cable
C3	009-006300-00	DC Output Power Wire
C4	009-006245-00	0619 AC power filter cable(auxiliary)
C5	009-006331-00	0619 AC power filter cable(no auxiliary)
C6	009-006241-00	0619 battery cable
C7	009-002592-00	0631 Three-way valve connection line (ACGO)
C8	009-006214-00	0619 ventilate&controlling module cable
C9	009-006244-00	0619 LCD backlight cable(10.4")
C10	009-006212-00	0619 display module data cable (10.4")
C11	009-006213-00	0619 keyboard&alarm board cable
C12	009-006242-00	0619 encoder cable
C13	009-006211-00	0619 breathing system cable

NO	P/N	Spare parts description
C14	009-000977-00	0631 Indicator light connection line
C15	009-000066-00	NORGER pneumatic block connection line
C16	0621-20-69494	system switch cable B
C17	009-000987-00	0631 soda absorber switch cable
C18	0621-20-78593	Switch (inside circuit) connection line
C19	0601-21-78956	2Pin female socket integrative object
C20	0621-20-69588	O2 pressure switch line at gas source inlet
C21	009-004713-00	0625 Drive gas selector valve connection line
C22	009-004711-00	0625 Top light board connection line
C23	009-000981-00	0631 top lighting switch cable
C24	009-001491-00	0623 CO2absorbent canister connection line
C25	009-002931-00	0632 Total flowmeter backlight board connection line

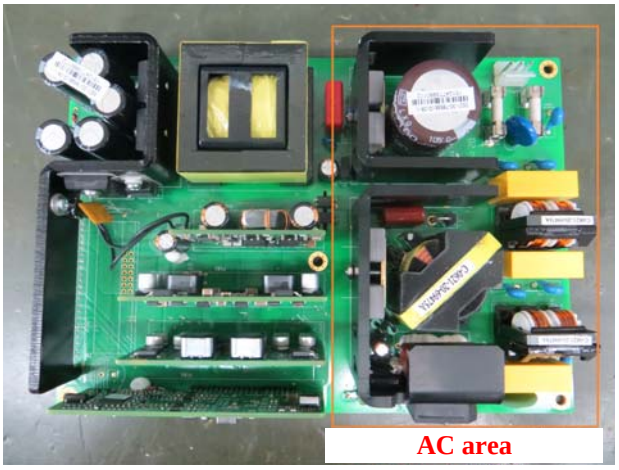
List of other hardware parts:

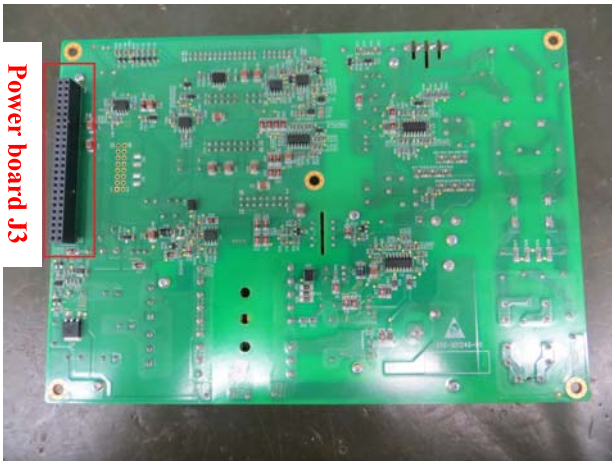
No.	P/N	Description	Note
E1	024-000125-00	FAN 12V 60*60*25mm 22.9CFM 36.5dB 380mm	Module rack fan
E2	022-000008-00	Lithium battery, Li-ion11.1V4500mAh LI23S002A	/
E3	M05-010R03---	Button battery, Lithium 3V35mAh D12.5*2.0	used on main control board
E4	021-000171-00	LCD screen, TFT 10.4 " , 1024*768 3.3v LED backlight	10.4″ LCD screen
E5	021-000221-00	LCD screen, TFT 12.1 " ,1024*768 3.3v LED backlight	10.4″ touch screen
E6	040-000898-00	O2 sensor	/
E7	024-000185-00	BC heater for 0616	Breathing circuit heat module
E8	024-000407-00	FAN, 12V, 40*40*20mm, 6.3CFM 18dB, Ffeedback, special terminal	Module rack fan
E9	9200-21-10633	2.25 speaker and connection line	Speaker

2.1.3 Power System

After the total AC mains inlet enters the anesthesia machine, it will be divided into two. One is supplied to power board to transfer into the AC supply of the anesthesia machine; the other is supplied to auxiliary output to supply the external devices of anesthesia machine.

2.1.3.1 Power Board

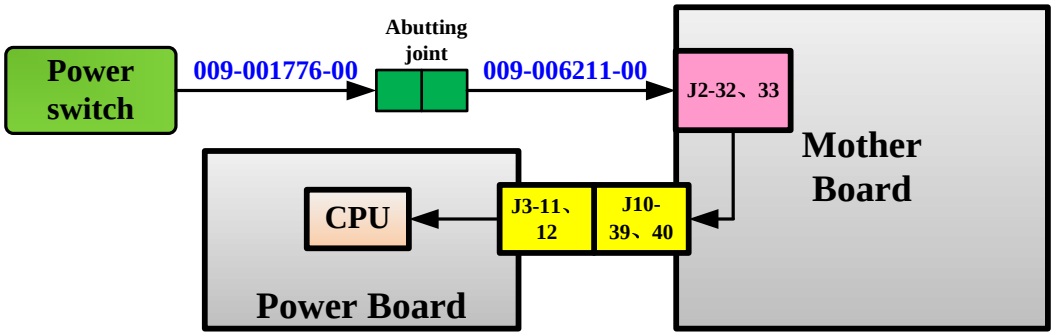




The power board can be divided into two parts: AC-DC, DC-DC. AC-DC part transforms the network source into 15.2V direct voltage. DC-DC part transforms the 15.2V direct voltage outputted by AC-DC part or lithium battery supply into several direct voltages needed by the system: 12V, 5.0V and 3.3V. In addition, power board also realizes functions including power-on/off control, AC indicator light, heating module drive, backlight switch control, and lithium battery charging management, etc.

When powering on the system, power board CPU detectes the power-on signal, and control the powering up of 3.3V, 5V, and 12V orderedly. When powering off the system, power down 12V, 5V, and 3.3V orderedly.

Signal flow when powering on:



Definition of power board J3

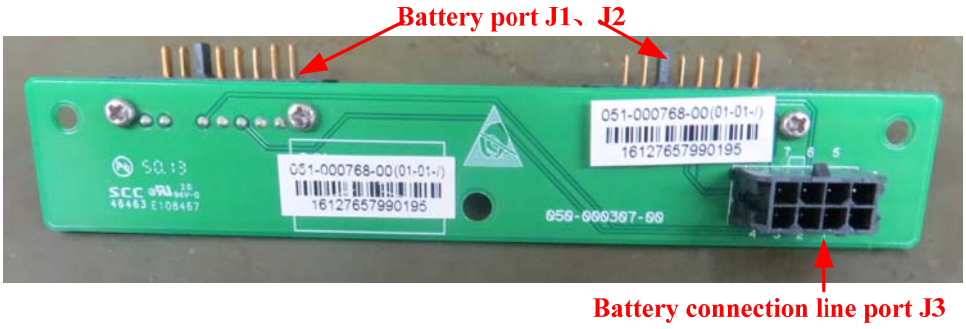
Pin No.	Signal name	Description
1)	RXD	received through the communication of power board series port
2)	TXD	send through the communication of power board series port
3)	GND	ground
4)	LCD-EN	LCD backlight enable signal
5)	LCD-BR	LCD backlight brightness control voltage
6)	3.3VBF	only used for the 3.3V when powering on/off
7)	GND	ground
8)	NTC2	Lithium battery 2, connecting to thermistor signal inside
9)	GND	ground
10)	NTC1	Lithium battery 1, connecting to thermistor signal inside
11)	GND	ground
12)	P15V	Heating wire drive voltage output (Range:12.42V to 15.18V)
13)	HRT22	Pin 1 of heating wire thermistor
14)	HRT21	Pin 2 of heating wire thermistor
15)	GND	ground

Pin No.	Signal name	Description
16)	3.3V	3.3V supply valtage output (Range: 3.135V to 3.465V)
17)	GND	ground
18)	GND	ground
19)	GND	ground
20)	12V2	Second 12V supply valtage output (Range: 0V to 0.4V)
21)	GND	ground
22)	GND	ground
23)	12V1	First 12V supply valtage output (Range: 10.8V to 13.2V)
24)	15.2VB	15.2V supply valtage output (Range:14.44V to 15.96V)
25)	15.2VB	15.2V supply valtage output (Range:14.44V to 15.96V)
26)	PLAM	Audio buzzer drive signal which drives audio buzzer directly
27)	SWITCH	Circuit switch indicating whether the circuit is in place
28)	P-FAN+	Drive of heat-sink fan of power board
29)	LED-BAT	Drive output of battery status indicator light
30)	LED-AC	Drive output of AC status indicator light
31)	PCON	Power on/off signal, LVTTL signal. When this signal is high level, the system is on; when this signal is low level, the system is off.
32)	BAT2+	Lithium battery 2 input, connecting to the anode of the battery
33)	BC2	With/without Lithium battery 2 signal. High level indicates it is with battery; low level indicates it is without battery.
34)	BAT1+	Lithium battery 1 input, connecting to the anode of the battery
35)	BC1	With/without Lithium battery 1 signal. High level indicates it is with battery; low level indicates it is without battery.

Pin No.	Signal name	Description
36)	GND	ground
37)	P15V	Heating wire drive voltage output (Range:12.42V to 15.18V)
38)	HRT12	Pin 1 of heating wire thermistor
39)	HRT11	Pin 2 of heating wire thermistor
40)	GND	ground
41)	3.3V	3.3V supply valtage output (Range: 3.135V~3.465V)
42)	5.0V	5.0V supply valtage output (Range: 4.75V~5.25V)
43)	GND	ground
44)	12V2	Second 12V supply valtage output (Range: 0V to 0.4V)
45)	12V2	Second 12V supply valtage output (Range: 0V to 0.4V)
46)	GND	ground
47)	12V1	First 12V supply valtage output (Range: 10.8V to 13.2V)
48)	12V1	First 12V supply valtage output (Range:10.8V to 13.2V)
49)	NC	No connection inside
50)	NC	No connection inside

2.1.3.2 Battery Adapter Board

Battery adapter board realizes transferring function: to transfer the signal of lithium battery to mother board, and to transfer most of the signals to power board.



Battery port, J1 and J2

Pin	Name	Function
1)	BAT+	Battery voltage +
2)	BAT+	Battery voltage +
3)	BC	Battery in-place signal
4)	BAT-	Battery voltage -
5)	NTC	Thermistor inside battery
6)	BAT-	Battery voltage -
7)	BAT-	Battery voltage -

Battery connection line port, J3

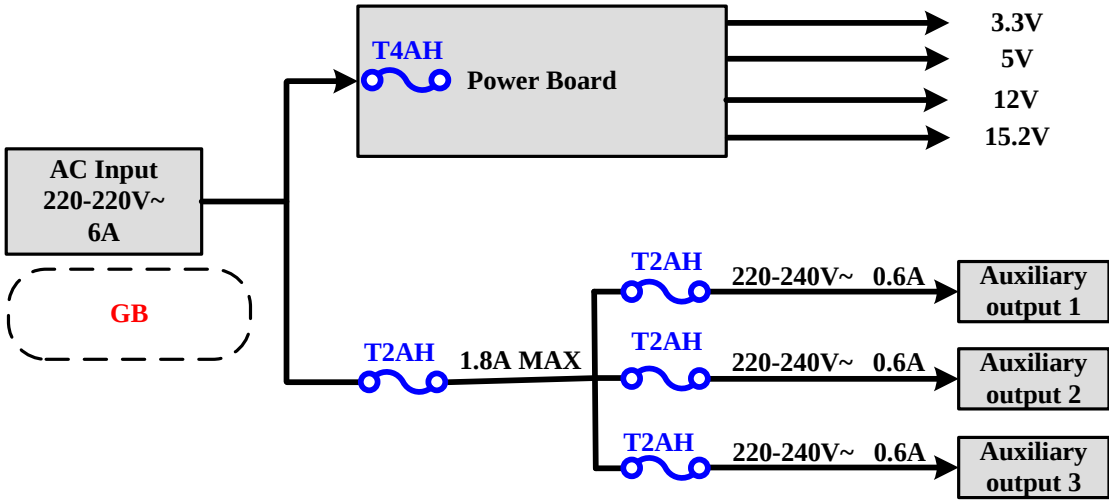
Pin	Name	Function
1)	VBAT1	Battery voltage
2)	NTC1	Thermistor inside battery
3)	BC1	Battery in-place signal
4)	GND	Ground
5)	VBAT2	Battery voltage
6)	NTC2	Thermistor inside battery
7)	BC2	Battery in-place signal
8)	GND	Ground

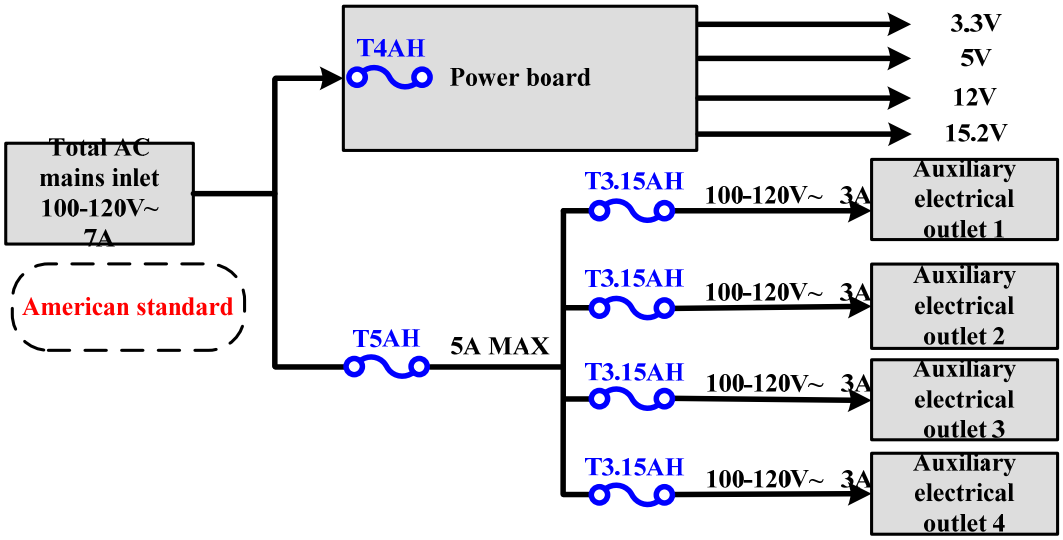
2.1.3.3 Auxiliary Electrical Outlet

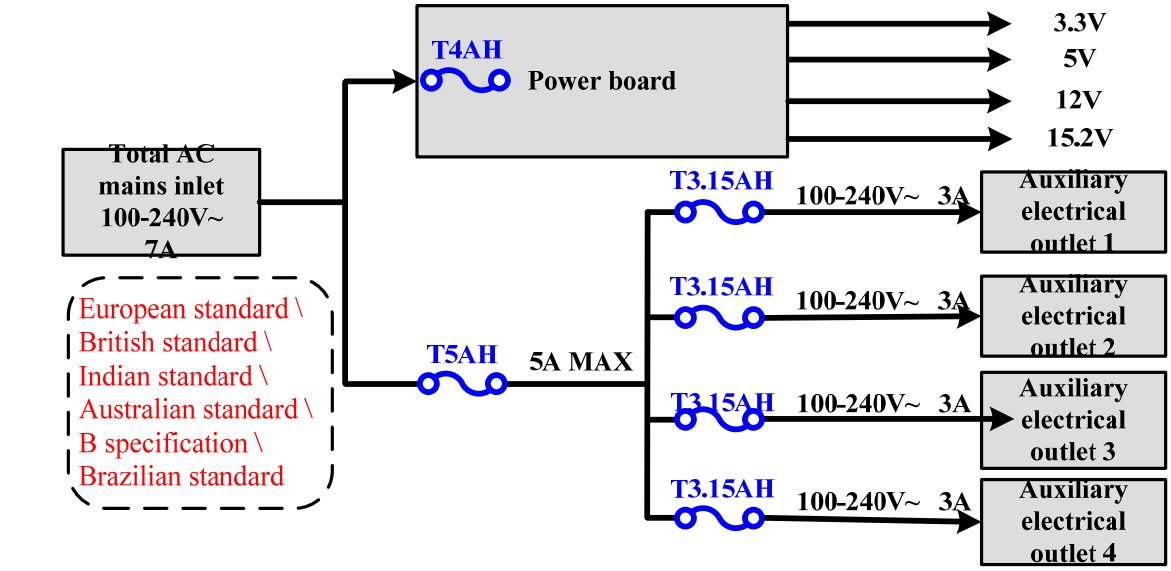
Auxiliary electrical outlet comes from total AC mains inlet, and it is to supply the external devices of anesthesia machine. The specification of auxiliary electrical outlet is decided by the lows and regulations of the sales area.

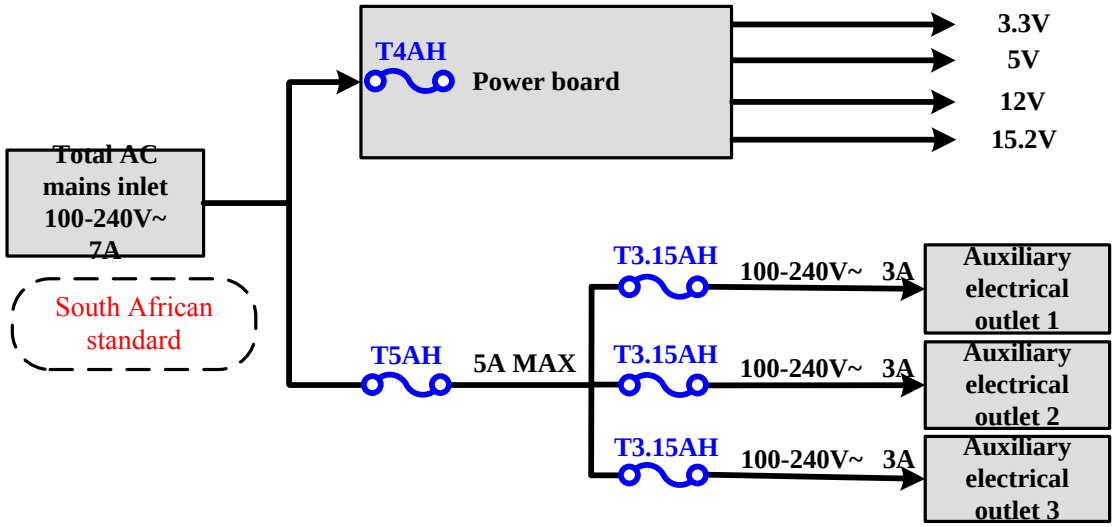
No.	Sales area	Auxiliary electrical outlet	Declaration of AC mains inlet	Declaration of total current of auxiliary electrical outlet	Declaration of singal auxiliary electrical outlet
1)	Domastic standard	3	220-240V~ 1.8A 50/60Hz	5A MAX	220-240V~ 0.6A 50/60Hz
2)	American standard	4	100-120V~ 7A 50/60Hz	5A MAX	100-120V~ 3A 50/60Hz

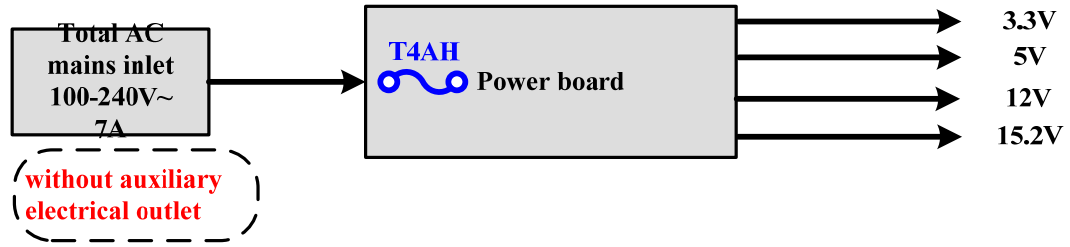
3)	European standard \ British standard \ Indian standard \ Australian standard \ B specification \ Brazilian standard	4	100-240V~ 7A 50/60Hz	5A MAX	100-240V~ 3A 50/60Hz
4)	South African standard	3	100-240V~ 7A 50/60Hz	5A MAX	100-240V~ 3A 50/60Hz
5)	without auxiliary electrical outlet configuration	None	100-240V~ 7A 50/60Hz	None	None






T4AH
Power board
3.3V
5V
12V
15.2V
Total AC mains inlet 100-240V~ 7A
T3.15AH
100-240V~ 3A
Auxiliary electrical outlet 1
T3.15AH
100-240V~ 3A
Auxiliary electrical outlet 2
T5AH
5A MAX
T3.15AH
100-240V~ 3A
Auxiliary electrical outlet 3
T3.15AH
100-240V~ 3A
Auxiliary electrical outlet 4
European standard \
British standard \
Indian standard \
Australian standard \
B specification \
Brazilian standard


T4AH
Power board
3.3V
5V
12V
15.2V
Total AC mains inlet 100-240V~ 7A
T3.15AH
100-240V~ 3A
Auxiliary electrical outlet 1
T5AH
5A MAX
T3.15AH
100-240V~ 3A
Auxiliary electrical outlet 2
T3.15AH
100-240V~ 3A
Auxiliary electrical outlet 3
South African standard


T4AH
Power board
3.3V
5V
12V
15.2V
Total AC mains inlet 100-240V~ 7A
without auxiliary electrical outlet

2.1.3.4 Others (heating module, fan, lithium battery)

Heating module, fan and lithium battery are also inside the anesthesia machine.

Heating module, drived by power board, offers temperature protection for software and hardware. The mechanism of heating is: power board heats thermistor up to 90℃ with full power, and then heats thermistor back to 70℃ with 5W, and then heats thermistor up to 90℃ with full power again; go round and begin again. The heater is supplied by AC power. If the heater is not connected to AC power, the heater does not work, and no alarm of heating module failure displays on the screen of anesthesia machine.

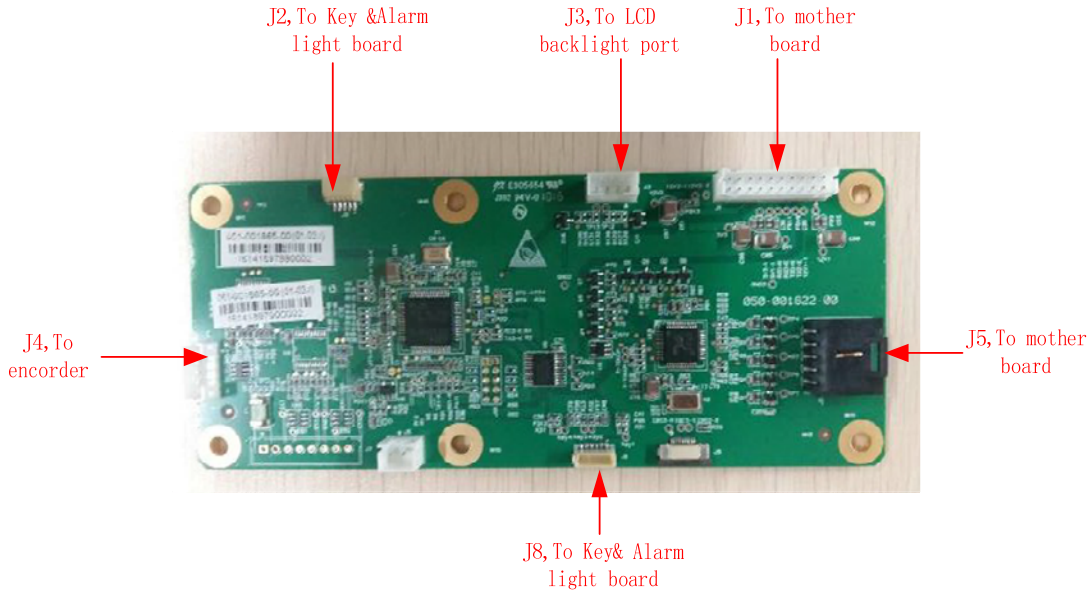
Fans include fan of hardware box and fan of module rack, cooling hardware box and module rack respectively. Lithium battery supplies the anesthesia machine without the network source, to ensure that the anesthesia machine can work normally when the network source is disabled or abnormal.

2.1.4 Display System

Display system includes key control board, screen, touchscreen, , key& alarm light board, encoder board, etc, which realize human-machine interaction.

2.1.4.1 Key Control Adapter Board

Key control realizes two functions, transferring signals and identification: one is to transfer the signals of screen backlight drive, alarm light drive, and commnulication of touchscreen series ports, etc; the other is to realize encoder identification, key identification, touchscreen identification, and screen backlight adjustment, etc.



Definition of key control board J1 (port connected with mother board)

Pin No.	Signal Name	Discription
1)	12VA_AUX_Light	Light board, 12 V supply
2)	SCL_CPU	Main control board IIC clock signal
3)	GND	Ground
4)	SDA_CPU	Main control board IIC data signal
5)	TXD_ENCODER	Flowmeter knob series port sends sigal
6)	TXD_KEY	Key board series port sends signal
7)	RXD_ENCODER	Flowmeter knob series port receives sigal
8)	RXD_KEY	Key board series port receives signal
9)	GND	Ground

Pin No.	Signal Name	Discription
10)	5V_Touch_screen	+5V supply
11)	GND	Ground
12)	3V3_Keyboard	+3.3V supply
13)	BCON	Backlight enable signal
14)	DIMMING	Backlight brightness adjustment signal
15)	12VA	12V supply
16)	GND	Ground
17)	12VA	12V supply
18)	GND	Ground
19)	12VA	12V supply
20)	GND	Ground

Definition of key control board J2 (port connected with key& alarm light board)

Pin No.	Signal Name	Discription
1)	12VA	12V supply
2)	GND	Ground
3)	SDA_CPU	Main control board IIC data signal
4)	SCL_CPU	Main control board IIC clock signal
5)	3V3_Keyboard	3.3V supply

Definition of key control board J3 (port connected with screen backlight)

Pin No.	Signal Name	Discription
1)	12VA	12V supply
2)	GND	Ground
3)	EN	Backlight enable signal

4)	PWM	Backlight brightness adjustment signal

Definition of key control board J4 (port connected with encoder board)

Pin No.	Signal Name	Discription
1)	5V_Touch_screen	5V supply
2)	A	Encoder output A
3)	B	Encoder output B
4)	S	Encoder is pressed down
5)	GND	Ground

Definition of key control board J5 (port connected with touchscreen)

Pin No.	Signal Name	Discription
1)	UR_H	Touchscreen coordinate signal
2)	LR_XL	Touchscreen coordinate signal
3)	AD3	Touchscreen coordinate signal
4)	UL_YT	Touchscreen coordinate signal
5)	LL_YB	Touchscreen coordinate signal

Definition of key control board J6 (port connected with auxiliary lighting board)

Pin No.	Signal Name	Discription
1)	12VA_AUX_Light	Light board, 12V supply
2)	GND	Ground

Definition of key control board J8 (port connected with key& alarm light board)

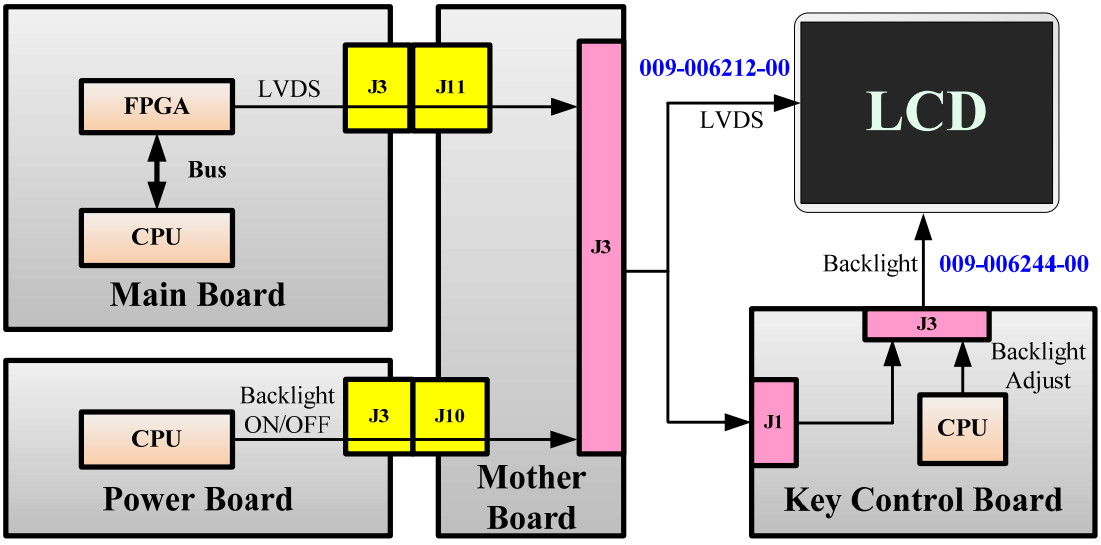
Pin No.	Signal Name	Discription
1)	3V3_Keyboard	3.3V supply
2)	GND	Ground

3)	RST_N_KEY	Touch key CPU reset signal
4)	IIC1_SCL	Key board 12C1 clock signal
5)	IIC1_SDA	Key board 12C1 data signal
6)	WAKEUP_KEY	Dormancy signal of touch key CPU

2.1.4.2 Screnn and Touchscreen

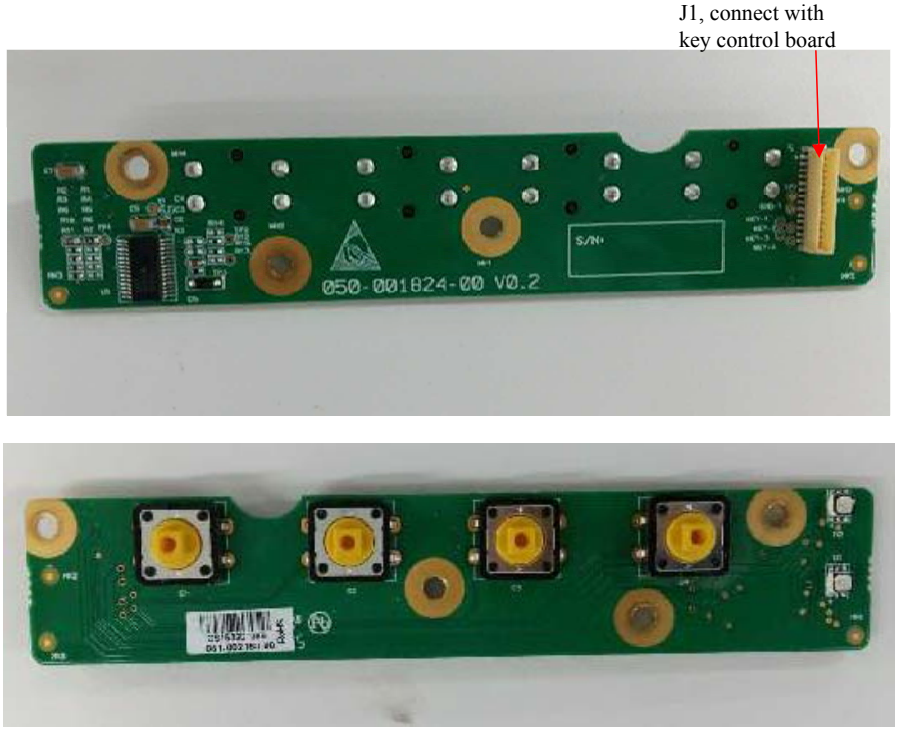
WATO EX-35(0619) anesthesia machine configures with a screen of 10.4”, 24 bits, 1024×768 resolution, LVDS port. In addition, WATO EX-35(0619) anesthesia machine configure with touchscreen of corresponding size, as the important input component of human-machine interaction.

Signal flow of screen:



2.1.4.3 Key&alarm light board

Key&alarm light board realizes 2 functions:one function is the key function,another function is realizes the alarm light with red,yellow ot blue.

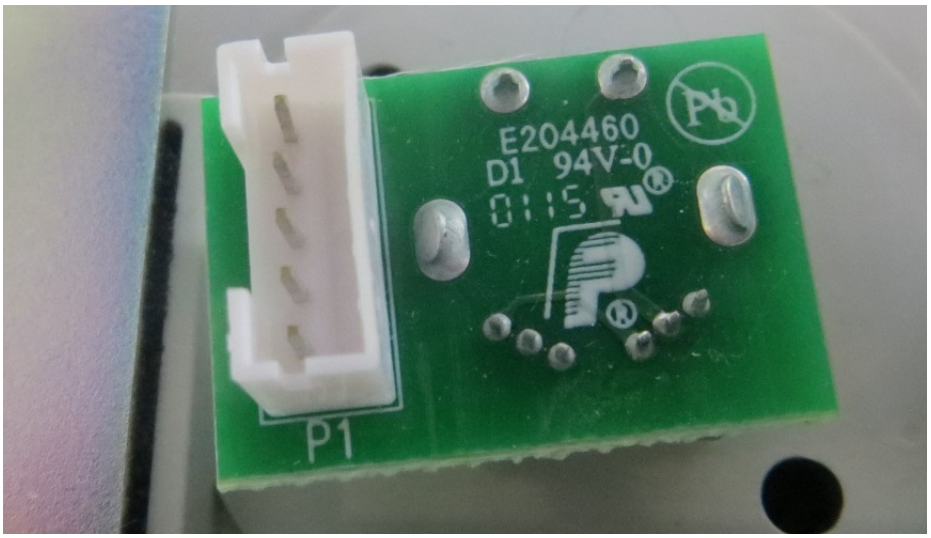


Definition of key&alarm light board

Pin No.	Signal Name	Description
1)	VDD	3.3V supply
2)	VDD	3.3V supply
3)	GND	Ground
4)	GND	Ground
5)	SCL	Main control board IIC data signal
6)	SDA	Main control board IIC data signal
7)	VPP	12V supply
8)	VPP	12V supply
9)	GND	Ground
10)	GND	Ground
11)	KEY1	Key signal
12)	KEY2	Key signal
13)	KEY3	Key signal
14)	KEY4	Key signal

2.1.4.4 Encoder Board

User can rotate it to left or right, ot press it down.



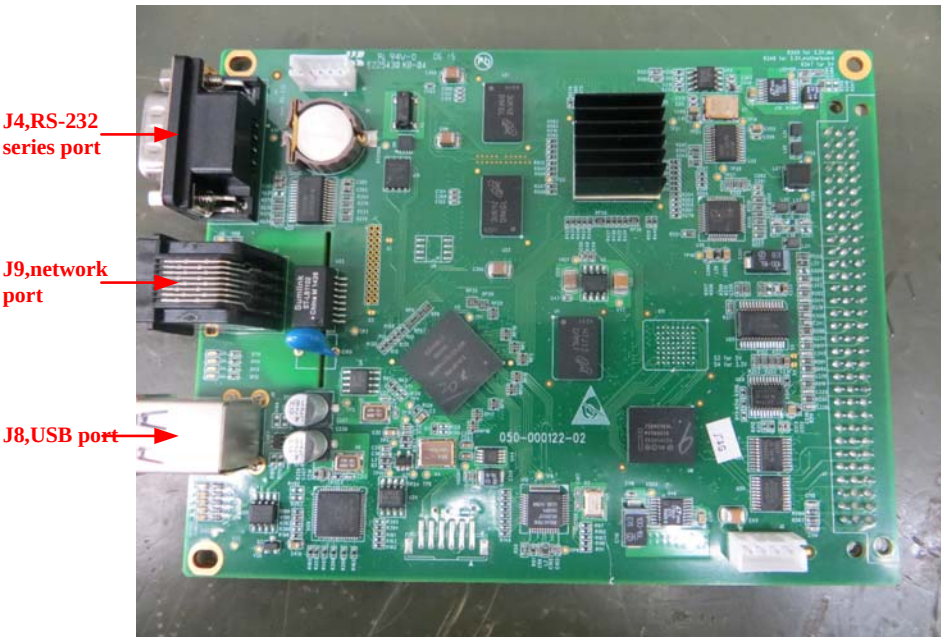
Definition of encoder board J1

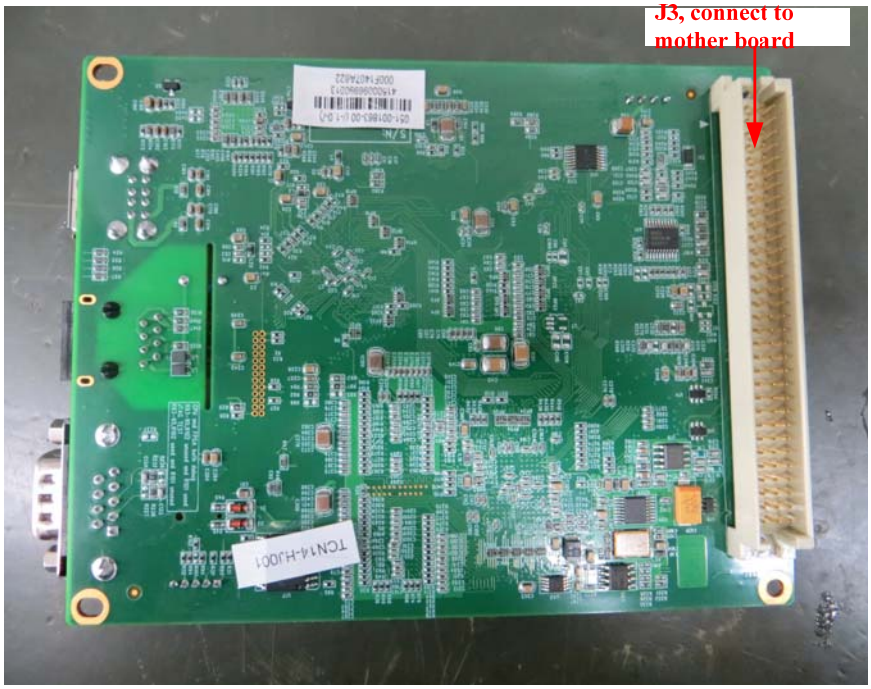
Pin No.	Signal Name	Discription	Note
1)	VCC	5V supply	0.06A
2)	A	Encoder output A	High electrical level: [2.4, 5.25]V Low electrical level: [0, 0.4]V
3)	B	Encoder output B	High electrical level: [2.4, 5.25]V Low electrical level: [0, 0.4]V
4)	S2	Encoder is pressed down	High electrical level: [2.4, 5.25]V Low electrical level: [0, 0.4]V
5)	GND	Ground	/

2.1.5 Control System

2.1.5.1 Main Control Board

Main control board is the main control component of human-machine interaction in anesthesia machine. It drives the displays and speaker, and exchanges data with monitoring module, key control board, and infrared communication board through series ports.





Definition of main control board J3

Pin No.	Signal Name	Discription
1)	GND	Ground
2)	GND	Ground
3)	VCC	Main control board 5V supply
4)	VCC	Main control board 5V supply
5)	GND	Ground
6)	GND	Ground
7)	VDD	Main control board 3.3V supply
8)	VDD	Main control board 3.3V supply
9)	GND	Ground
10)	FAN_STATE1_IN	Fan status signal 1
11)	FAN_STATE2_IN	Fan status signal 2
12)	AC_DET	Detection signal of AC in-place
13)	RSVD_IN3_IN	Backup detection signal
14)	DIMMING_OUT	Backlight brightness adjustment signal
15)	PCON	Power on/off control signal
16)	GND	Ground
17)	SDA	IIC data
18)	SCL	IIC clock
19)	GND	Ground
20)	DM3	USB3 data signal -
21)	DP3	USB3 data signal +
22)	UIVCC_USB	USB 5Vsupply

Pin No.	Signal Name	Discription
23)	GND	Ground
24)	RXD_TC	Series port sent signal (with AG module)
25)	TXD_TC	Series port received signal (with AG module)
26)	GND	Ground
27)	RXD_KB	Series port sent signal (with module rack)
28)	TXD_KB	Series port received signal (with module rack)
29)	BL_BCON	Backlight enable signal
30)	COLOR_SEL_LCD	LCD color (18/24bits) choosing
31)	GND	Ground
32)	LCDVDD	Power supply of LCD
33)	VCC_USB2	Power supply of USB2
34)	DM2	USB2 data signal -
35)	DP2	USB2 data signal +
36)	DM1	USB1 data signal +
37)	DP1	USB1 data signal -
38)	GND	Ground
39)	DP0	USB0 data signal +
40)	DM0	USB0 data signal -
41)	VCC_USB1	Power supply of USB1
42)	GND	Ground
43)	RSVD_IN2_IN	Backup detection signal
44)	OUT2	Backup output
45)	RXD2_IF	Series port received signal (with key

Pin No.	Signal Name	Discription
		board)
46)	TXD2_IF	Series port sent signal (with key board)
47)	GND	Ground
48)	RXD1_IF	Series port received signal (with flowmeter)
49)	TXD1_IF	Series port sent signal (with flowmeter)
50)	GND	Ground
51)	RXD0_IF	Series port received signal (with power board)
52)	TXD0_IF	Series port sent signal (with power board)
53)	GND	Ground
54)	VGA_VSN	VGA audio signal
55)	VGA_HSN	VGA line frequency signal
56)	VGA_B	VGA cyan signal
57)	VGA_G	VGA green signal
58)	VGA_R	VGA red signal
59)	GND	Ground
60)	SPKOUT+	Speaker drive signal -
61)	SPKOUT-	Speaker drive signal +
62)	NC	No connection inside
63)	NC	No connection inside
64)	NC	No connection inside
65)	SD_WP	Detection signal of SD crad writing protection
66)	SD_CD	Detection signal of SD card in-place
67)	RSVD_IN1_IN	Backup detection signal

Pin No.	Signal Name	Discription
68)	FAN_PWM2_OUT	Fan control signal 2
69)	FAN_PWM1_OUT	Fan control signal 1
70)	RSVD_OUT1_OUT	Safety valve control signal
71)	TPPWR_CTRLOUT	TouchPad supply control signal
72)	GND	Ground
73)	RXD3_IF	Series port received signal (reserved)
74)	TXD3_IF	Series port sent signal (reserved)
75)	GND	Ground
76)	RXD_VPM	Series port sent signal (with VPM)
77)	TXD_VPM	Series port received signal (with VPM)
78)	GND	Ground
79)	RXD_VCM	Series port received signal (with VCM)
80)	TXD_VCM	Series port sent signal (with VCM)
81)	GND	Ground
82)	LCD_LVDS_Y3P	LVDS data signal
83)	LCD_LVDS_Y3M	LVDS data signal
84)	GND	Ground
85)	LCD_LVDS_CKLP	LVDS clock signal
86)	LCD_LVDS_CKLM	LVDS clock signal
87)	GND	Ground
88)	LCD_LVDS_Y2P	LVDS data signal
89)	LCD_LVDS_Y2M	LVDS data signal
90)	GND	Ground

Pin No.	Signal Name	Discription
91)	LCD_LVDS_Y1P	LVDS data signal
92)	LCD_LVDS_Y1M	LVDS data signal
93)	GND	Ground
94)	LCD_LVDS_Y0P	LVDS data signal
95)	LCD_LVDS_Y0M	LVDS data signal
96)	GND	Ground

Definition of main control board J4

Pin No.	Signal Name	Discription
1)	NC	No connection inside
2)	RXD	RS-232 received
3)	TXD	RS-232 sent
4)	NC	No connection inside
5)	GND	Ground
6)	NC	No connection inside
7)	NC	No connection inside
8)	NC	No connection inside
9)	NC	No connection inside

Definition of main control board J8

Pin No.	Signal Name	Discription
1)	VCC0	USB power supply
2)	DM1	Positive signal of USB data
3)	DP1	Negative signal of USB data
4)	GND0	Ground

5)	VCC1	USB power supply
6)	DM2	Negative signal of USB data
7)	DP2	Positive signal of USB data
8)	GND1	Ground

Definition of main control board J9

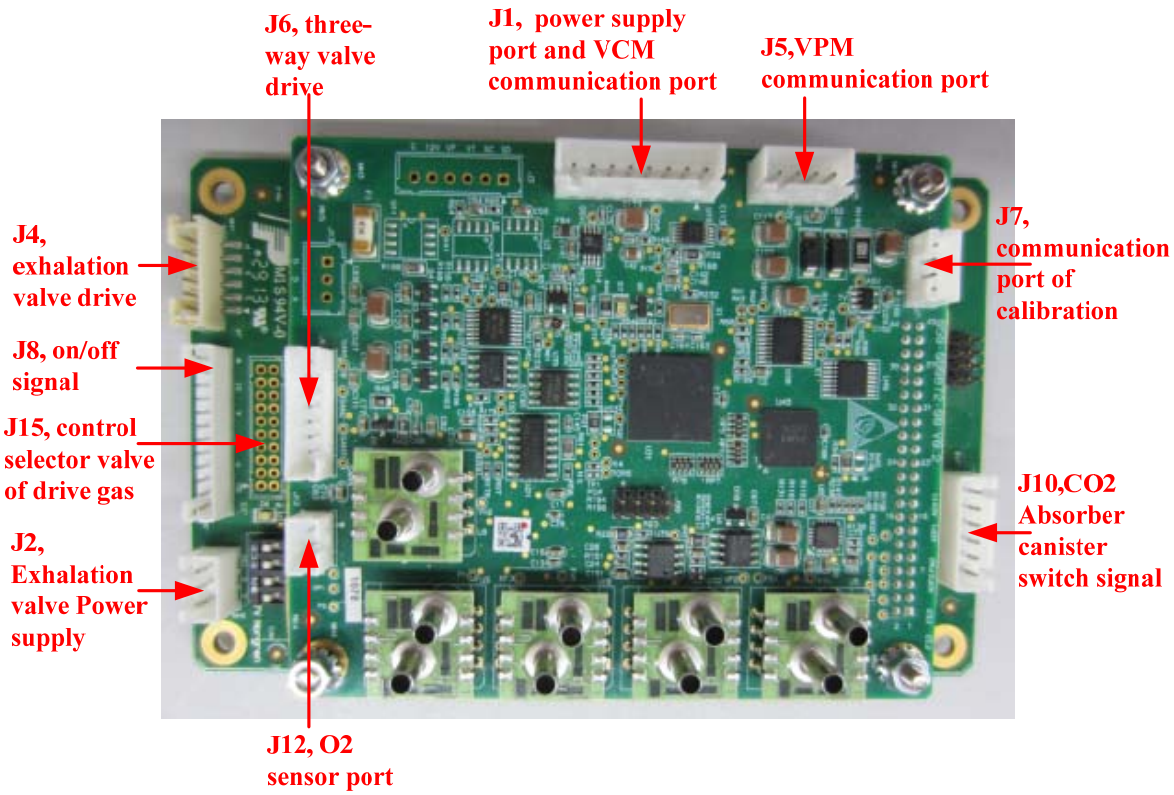
Pin No.	Signal Name	Discription
1)	TX+	Positive end of sent signal
2)	TX-	Negative end of sent signal
3)	RX+	Positive end of received signal
4)	CT1	No Definition
5)	CT1	No Definition
6)	RX-	Negative end of received signal
7)	CT2	No Definition
8)	CT2	No Definition

2.1.5.2 Monitoring Module

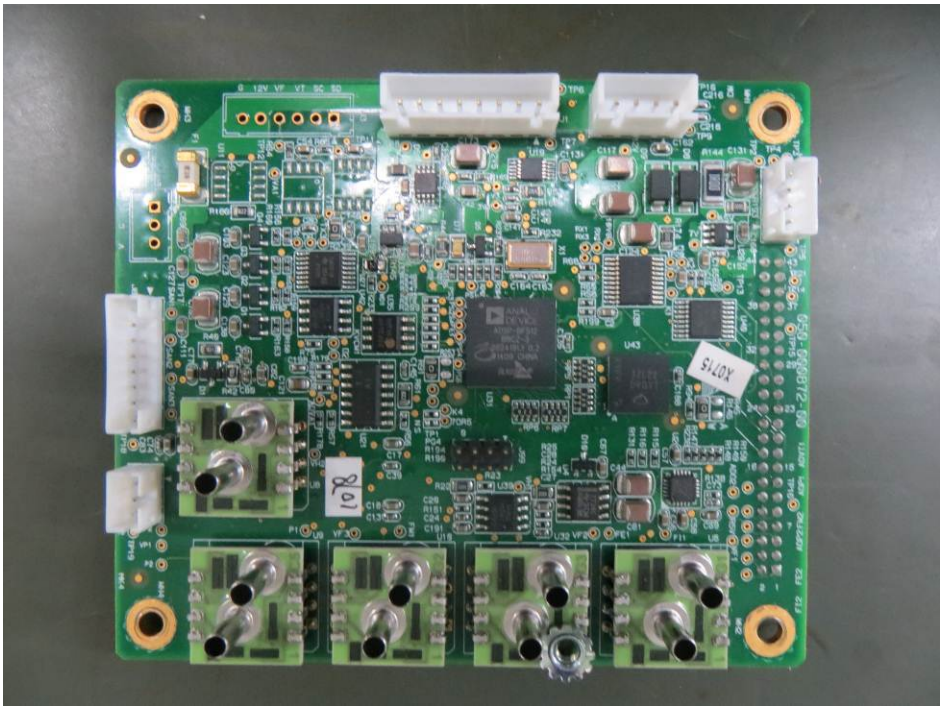
Monitoring module monitors pressure and flow of anesthesia machine and breathing system, controls valves, monitors and collects statuses, reads O2 concentration, monitors pressure and flow in circuit, and control accuracy accurately. Monitoring module contains VCM and VPM.

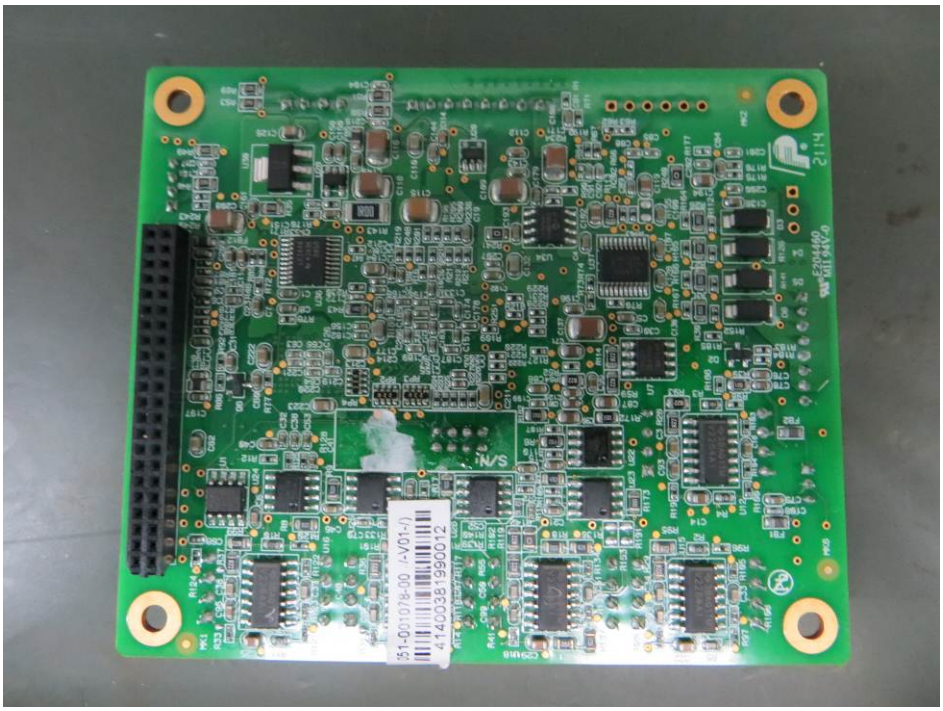
VCM monitrs the parameters including inspiratory flow, expiratory flow, interior flow of the machine, airway pressure, PEEP, O2 concentration, etc, and controls the actions of three-way valve and exhalation valve (including safety valve, PEEP valve, and inspiration valve).

VPM monitors the signal of the pressure switch of drive gas, ACGO limit switch, pressure switch at O2 inlet assembly, pressure switch at AIR inlet assembly,auto/manual switch, CO2 absorbent canister in-place switch, etc. VPM also controls the selector valve of drive gas, and controls safety valve with VCM, and send monitoring information to the main board through series port.


J6, three-way valve drive
J1, power supply port and VCM communication port
J5,VPM communication port
J4, exhalation valve drive
J7, communication port of calibration
J8, on/off signal
J15, control selector valve of drive gas
J10,CO2 Absorber canister switch signal
J2, Exhalation valve Power supply
J12, O2 sensor port

VCM





Definition of VCM J1

Pin No.	Signal Name	Discription
1)	TXD	Sent signal by series port
2)	RXD	Received signal by series port
3)	VPP	＋12V power supply
4)	GND	Ground
5)	GND	Ground
6)	VPP	＋12V power supply
7)	PRST	Safety valve control signal
8)	VCC	＋5V power supply

Definition of VCM J5

Pin No.	Signal Name	Discription
1)	TXD	sent signal by series port
2)	RXD	Received signal by series port
3)	GND	Ground
4)	VPP	＋12V power supply

Definition of VCM J6

Pin No.	Signal Name	Discription
1)	VSAN	Three-way valve power supply
2)	SANTONG1-	Three-way valve control 1 (inspiration)
3)	VSAN	Three-way valve power supply
4)	SANTONG2-	Three-way valve control 2 (pressure)
5)	VSAN	Three-way valve power supply
6)	SANTONG3-	Three-way valve control 3 (expiratioj)
7)	VSAN	Three-way valve power supply
8)	SANTONG4-	Three-way valve control 4 (ACGO)

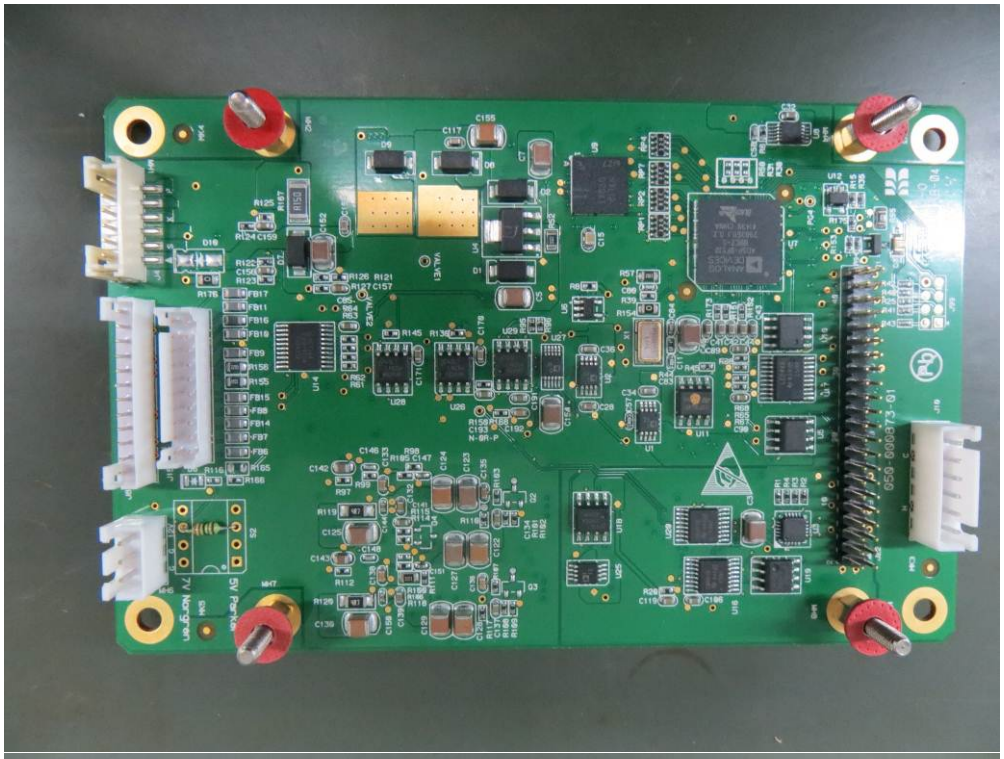
Definition of VCM J7

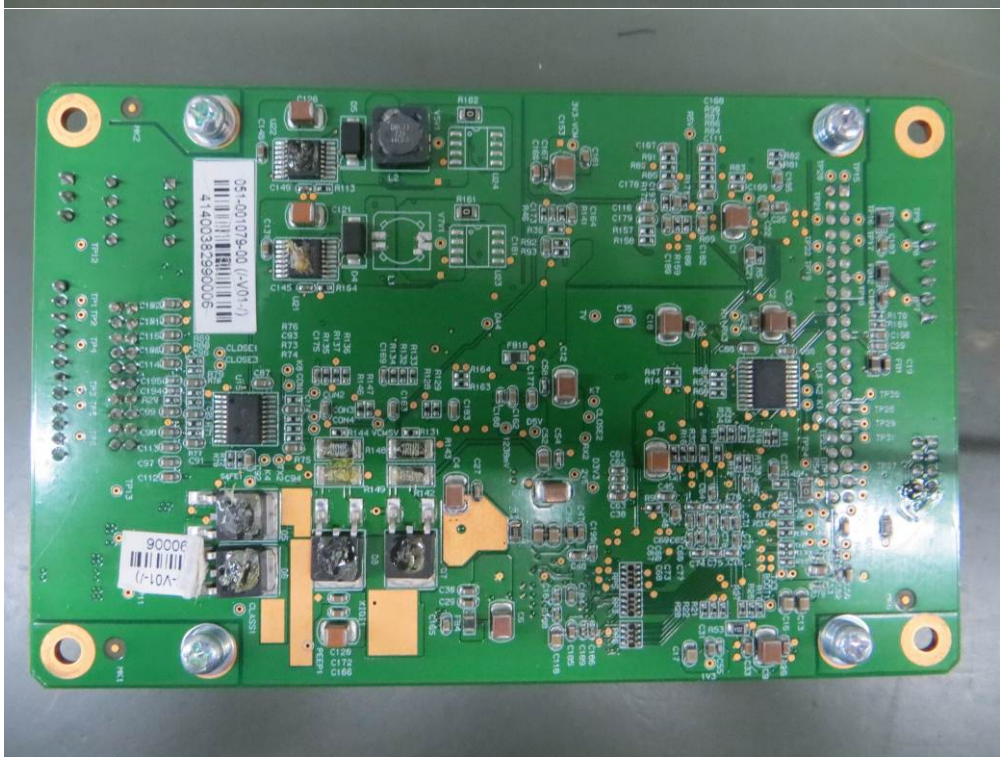
Pin No.	Signal Name	Discription
1)	TXD	sent signal by series port
2)	RXD	Received signal by series port
3)	GND	Ground
4)	VPP	＋12V

Definition of VCM J12

Pin No.	Signal Name	Discription
1)	O+	Anode of O2 sensor
2)	O-	Cathode of O2 sensor
3)	GND	Ground

VPM





Definition of VPM J2

Pin No.	Signal Name	Discription
1)	GND	Ground
2)	GND	Ground
3)	VB	12V power supply of exhalation valve

Definition of VPM J4

Pin No.	Signal Name	Discription
1)	VSAFE	7V power supply of safety valve
2)	SAFE	Safety valve control signal
3)	VXIQI_PEEP	7V power supply of inspiration valve
4)	FLOW	Inspiration valve control signal
5)	VXIQI_PEEP	7V power supply of PEEP valve
6)	PEEP	PEEP valve control signal

Definition of VPM J8

Pin No.	Signal Name	Discription
1)	GND	Ground
2)	QUDONGQITI	Pressure switch signal of circuit block
3)	GND	Ground
4)	POWER_VERSION	Reserved switch signal
5)	GND	Ground
6)	KUAI_O2	Pressure switch at AIR inlet assembly
7)	GND	Ground
8)	ACGO_Switch	ACGO switch signal

9)	GND	Ground
10)	QIYUANO2_Switch	Switch signal of O2 pressure at gas source inlet
11)	GND	Ground
12)	MANU_AUTO_Switch	Auto/manual switch signal

Definition of VPM J10

Pin No.	Signal Name	Discription
1)	GND	Ground
2)	CO2_SWITCH	CO2 absorbent canister switch signal
3)	GND	Ground
4)	GND	Ground
5)	HUILU_SWITCH	Circuit switch signal
6)	GND	Ground

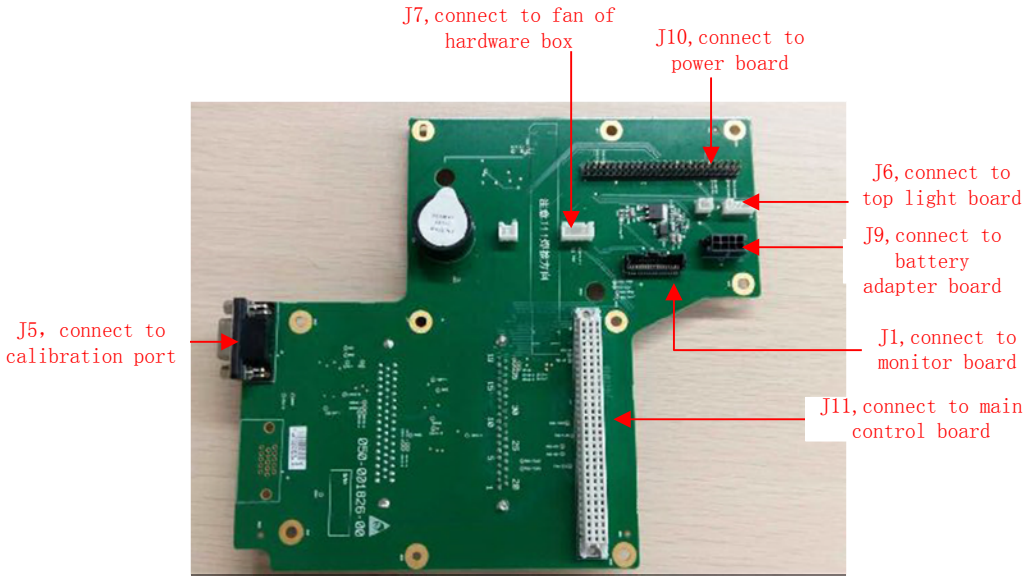
Definition of VPM J15

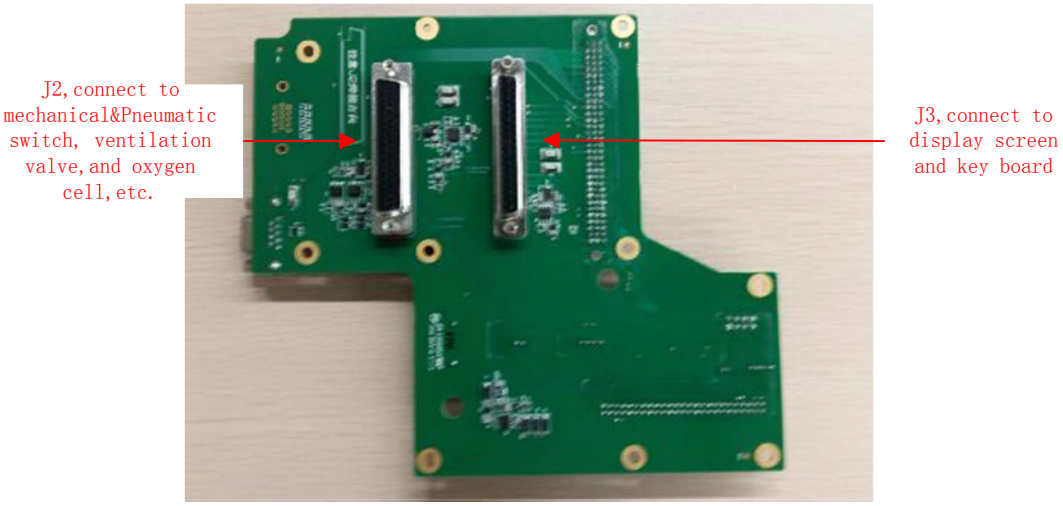
Pin No.	Signal Name	Discription
1)	GND	Ground
2)	GND	Ground
3)	IN1	Reserved switch monitor signal 1 (AD)
4)	GND	Ground
5)	GND	Ground
6)	GND	Ground
7)	IN2	Reserved switch monitor signal 2 (AD)
8)	EXTEND_OUT2	Reserved I/O control signal 2
9)	DA_C	Reserved DA control signal
10)	TXD	Sent signal of reserved VPM series port

11)	VCC	Reserved 5V power supply signal
12)	RXD	Sent signal of reserved VPM series port
13)	GND	Ground
14)	GND	Ground
15)	IN3	Reserved switch monitor signal 3 (AD)
16)	EXTEND_OUT3	Drive gas selector valve control signal
17)	GND	Ground
18)	GND	Ground
19)	IN4	Status monitoring signal of drive gas selector valve
20)	EXTEND_OUT4	Reserved I/O control signal 4

2.1.5.3 Mother Board

Mother board transfers the signal of each card and electrical component.





Definition of mother board J1 (with monitoring module port)

Pin No.	Signal Name	Discription
1)	TXD_VPM2	Sent signal of VPM series port (reserved)
2)	RXD_VPM2	Received signal of VPM series port (reserved)
3)	12VA	+12V power supply
4)	GND	Ground
5)	GND	Ground
6)	VPM_monitor_IO4	Drive gas selector valve status
7)	Driving_O2_control	Drive gas selector valve controlsignal
8)	12VA	+12V power supply
9)	GND	Ground
10)	VF_Sensirion	SENSIRION sensor output signal
11)	TXD_VPM1	Sent signal of VPM series port (with main control board)
12)	RXD_VPM1	Received signal of VPM series port (with main control board)
13)	TXD_VCM2	Sent signal of VCM series port (with calibration device)

Pin No.	Signal Name	Discription
14)	RXD_VCM2	Received signal of VCM series port (with calibration device)
15)	GND	Ground
16)	5V	+5V power supply
17)	12VA	+12V power supply
18)	GND	Ground
19)	TXD_VCM1	Sent signal of VCM series port (with main control board)
20)	RXD_VCM1	Received signal of VCM series port (with main control board)
21)	O2+	O2 sensor +
22)	O2-	O2 sensor -
23)	CO2_switch	CO2 absorbent canister in-place switch
24)	Huilu_switch	Circuit switch
25)	MANU_AUTO_switch	Auto/manual switch
26)	VPM_monitor_IO1	First reserved I/O monitoring signal of VPM
27)	O2QIYUAN_switch	Pressure switch at O2 supply inlet
28)	VPM_control_IO2	Drive gas selector valve status 2
29)	ACGO_switch	ACGO switch
30)	GND	Ground
31)	POWER_VERSION	Reserved I/O monitoring signal of VPM
32)	KUAI_O2	Pressure switch at AIR inlet assembly
33)	GND	Ground
34)	Qudongqiti_switch	Drive gas pressure switch
35)	VPEEP	PEEP valve power supply
36)	PEEP	PEEP valve control signal

Pin No.	Signal Name	Discription
37)	VXIQI	Inspiration valve power supply
38)	XIQI	Inspiration valve control signal
39)	VSAFE	Safety valve power supply
40)	SAFE	Safety valve control signal

Definition of mother board J2 (pneumatic assembly port)

Pin NO.	Signal name	Description
1)	SAFE	Safety valve control signal
2)	VSAFE	Safety valve power supply
3)	XIQI	Inspiration valve control
4)	VXIQI	Inspiration valve power supply
5)	PEEP	PEEP valve control signal
6)	VPEEP	PEEP valve power supply
7)	GND	Ground
8)	ACGO_switch	Mechanical ACGO status switch
9)	CO2_switch	CO2 absorber switch
10)	GND	Ground
11)	MANU_AUTO_switch	Manual/Vent switch
12)	Qudongqiti_switch	Pressure switch of drive gas
13)	GND	Ground
14)	O2QIYUAN_switch	Pressure switch at O2 inlet assembly
15)	Huilu_switch	Breathing circuit switch
16)	GND	Ground
17)	KUAI_O2	Pressure switch at AIR inlet assembly
18)	3V3_Gasbench	Infrared backplane board power supply
19)	GND	Ground
20)	12VA_GasbenchFAN	Power supply for the fan at module r
21)	GND	Ground

Pin NO.	Signal name	Description
22)	12VA_Gasbench	12V Power supply for Infrared backplane board
23)	GND	Ground
24)	RXD_HW_OR_JH	Received signal of three-slot infrared module rack series port
25)	TXD_HW_OR_JH	Sent signal of three-slot infrared module rack series port
26)	Fan_State2	Yellow line, status signal
27)	Fan_PWM2	Fan PWM control signal
28)	GND	Ground
29)	LED_BAT1	Battery indicator
30)	LED_AC1	AC indicator
31)	GND	Ground
32)	PCON+(3.3V)	3.3 system on/off signal
33)	PCON-	system on/off signal
34)	P15V	Heater drive voltage
35)	P15V	Heater drive voltage
36)	GND	Ground
37)	GND	Ground
38)	Temperature-R11	Thermistor 1 signal
39)	Temperature-R12	Thermistor 1 signal
40)	Temperature-R21	Thermistor 2 signal
41)	Temperature-R22	Thermistor 2 signal
42)	GND	Ground
43)	O2-	O2 concentration signal
44)	O2+	O2 concentration signal
45)	GND	Ground
46)	12VA_AUX_Flowlight	Flow meter back light signal
47)	12VA	12power supplu for drive gas select valve
48)	O2_DRIVING	Drvie gas select valve control signal

Pin NO.	Signal name	Description
49)	GND	Ground
50)	POWER_VERSION	Reserved port for VPM IO monitering

Definition of mother board J3 (display assembly port)

Pin No.	**Signal Name**	**Discription**
1)	LCDVGA4+	Display differential signal
2)	LCDVGA4-	Display differential signal
3)	LCD3V3	Display dedicated 3.3V power supply
4)	GND	Ground
5)	LCDCLK+	Display differential clock signal
6)	LCDCLK-	Display differential clock signal
7)	GND	Ground
8)	LCDVGA3+	Display differential signal
9)	LCDVGA3-	Display differential signal
10)	GND	Ground
11)	LCDVGA2+	Display differential signal
12)	LCDVGA2-	Display differential signal
13)	GND	Ground
14)	LCDVGA1+	Display differential signal
15)	LCDVGA1-	Display differential signal
16)	GND	Ground
17)	GND	Ground
18)	LCD3V3	Display dedicated 3.3V power supply
19)	LCD3V3	Display dedicated 3.3V power supply
20)	12VA_AUX_Light	+12V power sully of auxiliary light board

Pin No.	Signal Name	Discription
21)	GND	Ground
22)	TXD_Touch	Sent signal of key board series port
23)	RXD_Touch	Received signal of key board series port
24)	TXD_KEY	Sent signal of key board series port (flowmeter knob)
25)	RXD_KEY	Received signal of key board series port (flowmeter knob)
26)	SDA_CPU	Main board IIC data signal
27)	SCL_CPU	Main board IIC clock signal
28)	GND	Ground
29)	5V_Touch_screen	+5V power supply
30)	GND	Ground
31)	3V3_Keyboard	+3.3V power supply
32)	LCD_EN	Backlight enable signal
33)	LCD_BR	Backlight brightness adjustment signal
34)	GND	Ground
35)	GND	Ground
36)	12VA_UI	12V power supply signal of backlight
37)	12VA_UI	12V power supply signal of backlight

Definition of mother board J5 (calibration port)

Pin No.	Signal Name	Discription
1)	NC	No connection inside
2)	NC	No connection inside
3)	NC	No connection inside
4)	NC	No connection inside

5)	GND	Ground
6)	12VA	12V power supply output
7)	RXD_VCM2	Received signal of alibration series port
8)	TXD_VCM2	Sent signal of calibration series port
9)	GND	Ground

Definition of mother board J6 (top light board port)

Pin No.	Signal Name	Discription
1)	12VA	12V power supply signal
2)	GND	Ground
3)	Lighting	Brightness level control signal
4)	Speaker+	Anode of speaker
5)	Speaker-	Cathode of speaker

Definition of mother board J7 (fan port of hardware box)

Pin No.	Signal Name	Discription
1)	12VA	Power supply
2)	Fan_PWM1	Fan PWM control signal
3)	Fan_STATE1	Status signal
4)	GND	Ground

Definition of mother board J9 (battery adapter board port)

Pin No.	Signal Name	Discription
1)	BAT1+	Battery voltage
2)	NTC1	Thermistor inside battery
3)	BC1	Battery in-place signal

4)	GND	Ground
5)	BAT2+	Electric
6)	NTC2	Thermistor inside battery
7)	BC2	Battery in-place signal
8)	GND	Ground

Definition of mother board J10 (power board port)

Pin No.	Signal Name	Discription
1)	PLAM	Audio buzzer drive control signal
2)	RXD_POWER	Received signal of power board series port
3)	Huilu_switch	Circuit switch, indicating whether circuit is in-place
4)	TXD_POWER	Sent signal of power board series port (received by main control board)
5)	NC	No connection inside
6)	GND	Ground
7)	LED_BAT	Battery indicator control signal
8)	LCD_EN	LCD backlight enable signal
9)	LED_AC	AC status indicator drive output
10)	LCD_BR	LCD backlight brightness adjustment control voltage
11)	PCON-	Power on/off signal, LVTTL pulse signal. When it is high level, the system powers on; when it is low level, the system powers off.
12)	PCON+	3.3 V only for powering on/off
13)	BAT2+	Lithium battery 2 input, connected to the anode of battery
14)	GND	Ground

Pin No.	Signal Name	Discription
15)	BC2	Lithium battery 2 in-place signal. Low level indicates there is battery; high level indicates there is no battery
16)	NTC2	Lithium battery 2, connected with thermistor signal inside
17)	BAT1+	Lithium battery 1 input, connected to the anode of battery
18)	GND	Ground
19)	BC1	Lithium battery 1 in-place signal. Low level indicates there is battery; high level indicates there is no battery
20)	NTC1	Lithium battery 1 connected with thermistor signal inside
21)	GND	Ground
22)	GND	Ground
23)	P15V	Heating wire drive voltage output
24)	P15V	Heating wire drive voltage output
25)	Temperature-R12	Thermistor pin 1 of heating wire
26)	Temperature-R22	Thermistor pin 1 of heating wire
27)	Temperature-R11	Thermistor pin 2 of heating wire
28)	Temperature-R21	Thermistor pin 2 of heating wire
29)	GND	Ground
30)	GND	Ground
31)	3V3	3.3V power supply voltage output
32)	3V3	3.3V power supply voltage output
33)	5V	5.0 V power supply voltage output
34)	GND	Ground
35)	GND	Ground

Pin No.	Signal Name	Discription
36)	GND	Ground
37)	12VB	Second 12V power supply voltage output
38)	GND	Ground
39)	12VB	Second 12V power supply voltage output
40)	12VB	Second 12V power supply voltage output
41)	GND	Ground
42)	GND	Ground
43)	12VA	First 12V power supply voltage output
44)	GND	Ground
45)	12VA	First 12V power supply voltage output
46)	12VA	First 12V power supply voltage output
47)	NC	No connection inside
48)	15.2V	15.2V power supply voltage output
49)	NC	No connection inside
50)	15.2V	15.2V power supply voltage output

Definition of mother board J11 (main control board port)

Pin No.	Signal Name	Discription
1)	LCD3V3	LCD power supply
2)	GND	Ground
3)	NC	No connection inside
4)	NC	No connection inside
5)	RXD_HW_OR_JH	Received signal of infrared backpanel or patient monitor
6)	TXD_HW_OR_JH	Sent signal of infrared backpanel or patient monitor
7)	GND	Ground
8)	RXD_AG_232	Received signal of interior AG module
9)	TXD_AG_232	Sent signal of interior AG module
10)	GND	Ground
11)	Touchpad_5V	5V power supply of touchpad
12)	Touchpad_usb+	Touchpad USB data signal+
13)	Touchpad_usb-	Touchpad USB data signal-
14)	GND	Ground
15)	SCL_CPU	Alarm light board IIC clock signal
16)	SDA_CPU	Alarm light board IIC data signal
17)	GND	Ground
18)	MAIN_ACGO_CTRL2	ACGO control signal 2
19)	NC	No connection inside
20)	ACGO_State1	ACGO status signal 1
21)	NC	No connection inside
22)	FAN_State2	Fan status signal 2

Pin No.	Signal Name	Discription
23)	FAN_State1	Fan status signal 1
24)	GND	Ground
25)	3V3	3.3V power supply of main control board
26)	3V3	3.3V power supply of main control board
27)	GND	Ground
28)	GND	Ground
29)	5V	5V power supply of main control board
30)	5V	5V power supply of main control board
31)	GND	Ground
32)	GND	Ground
33)	NC	No connection inside
34)	NC	No connection inside
35)	NC	No connection inside
36)	SPEAK-	Speaker drive signal +
37)	SPEAK+	Speaker drive signal -
38)	GND	Ground
39)	VGA_Red	VGA red signal
40)	VGA_Green	VGA green signal
41)	VGA_Blue	VGA cyan signal
42)	VGA_HSYNC	VGA line frequency signal
43)	VGA_VSYNC	VGA audio signal
44)	GND	Ground
45)	RXD_POWER	Received signal of power board series port

Pin No.	Signal Name	Discription
46)	TXD_POWER	Sent signal of power board series port
47)	GND	Ground
48)	RXD_FLOW	Received signal of flowmeter series port
49)	TXD_FLOW	Sent signal of flowmeter series port
50)	GND	Ground
51)	RXD_Touch	Received signal of key board series port (for communication with key board CPU actually)
52)	TXD_Touch	Sent signal of key board series port (for communication with key board CPU actually)
53)	OUT2	Backup output
54)	ACGO_State2	ACGO status signal 2
55)	GND	Ground
56)	NC	No connection inside
57)	DISPLAY_USB-	USB data signal – of display adapter board
58)	DISPLAY_USB+	USB data signal + of display adapter board
59)	GND	Ground
60)	NC	No connection inside
61)	NC	No connection inside
62)	NC	No connection inside
63)	NC	No connection inside
64)	NC	No connection inside
65)	GND	Ground
66)	LCDVGA1-	LVDS data signal
67)	LCDVGA1+	LVDS data signal

Pin No.	Signal Name	Discription
68)	GND	Ground
69)	LCDVGA2-	LVDS data signal
70)	LCDVGA2+	LVDS data signal
71)	GND	Ground
72)	LCDVGA3-	LVDS data signal
73)	LCDVGA3+	LVDS data signal
74)	GND	Ground
75)	LCDCLK-	LVDS data signal
76)	LCDCLK+	LVDS data signal
77)	GND	Ground
78)	LCDVGA4-	LVDS clock signal
79)	LCDVGA4+	LVDS clock signal
80)	GND	Ground
81)	RXD_VCM1	Received signal of monitoring signal detection board series port
82)	TXD_VCM1	Sent signal of monitoring signal detection board series port
83)	GND	Ground
84)	RXD_VPM1	Received signal of auxiliary control module series port
85)	TXD_VPM1	Sent signal of auxiliary control module series port
86)	GND	Ground
87)	RXD_KEY	Reserved series port signal
88)	TXD_KEY	Reserved series port signal
89)	GND	Ground
90)	Touchpad_CON	TouchPad power supply control signal

Pin No.	Signal Name	Discription
91)	MAIN_ACGO_CTRL1	ACGO valve control signal 1
92)	FAN_PWM1	Fan control signal
93)	FAN_PWM2	Fan control signal
94)	IN1	Backup input signal
95)	NC	No connection inside
96)	NC	No connection inside

2.1.5.4 Top Light Board

Top light board supports two levels of top lighting: high light and low light. And it also transfers the signal of speaker.





Definition of top light board J1 (port connect with the mother board)

Pin No.	Signal Name	Discription
1)	VPP	12V power supply signal
2)	GND	Ground
3)	Lighting	Brightness level control signal
4)	Speaker+	Anode of speaker
5)	Speaker-	Cathode of speaker

Definition of top light board J2 (three-level switch port)

Pin No.	Signal Name	Discription
1)	LOW	Low-light level
2)	LOW	Low-light level
3)	COM	Off
4)	COM	Off
5)	High	High-light level
6)	High	High-light level

Definition of top light board J3 (speaker port)

Pin No.	Signal Name	Discription
1)	Speak+	Positive pole of speaker
2)	Speak-	Negative pole of speaker

2.1.5.5 Auxiliary Light board

Auxiliary light board, controlled by the top light board switch, is to light the worktable. When the switch of top light board is set to ligh-light level or low-light level, the auxiliary light lights; otherwise, the auxiliary light is out.



J1，port for power supply and lighting control



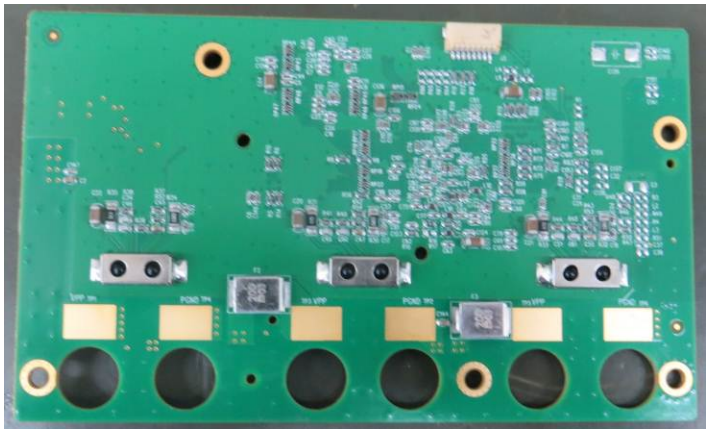
Definition of auxiliary light board J1

Pin No.	Signal Name	Discription
1)	12VA_AUX_Light	12V power supply of light board
2)	Lighting	Control signal
3)	GND	Ground

2.1.5.6 Infrared Communication Board

Infrared communication board offers power supply to module rack module, and receives parameters monitored by AG module, CO2 module and BIS module , and then send these parameters to main control board through series port.





Definition of infrared communication board J2

Pin No.	Signal Name	Discription	Note
1)	VPP	12V power supply	[10.8，13.2]V
2)	VPP	12V power supply	[10.8，13.2]V
3)	GND	Ground	/
4)	GND	Ground	/
5)	VDD	3.3V power supply	[3.14，3.46]V
6)	VCC	5V power supply(IO pull power supply)	This signal adopt 3.3V power supply
7)	GND	Ground	/
8)	GND	Ground	/

Definition of infrared communication board J4

Pin No.	Signal Name	Discription	Note
1)	INTERFACE_TX0	Sent signal of infrared	TTL or LVTTL

		communication board	
2)	INTERFACE_RX0	Received signal of infrared communication board	TTL or LVTTL
3)	GND	Ground	/

2.1.5.7 Flowmeter Backlight Board

Flowmeter backlight board, controlled by the top light board switch, is to light the mechanical. When the switch of top light board is set to ligh-light level or low-light level, the auxiliary light lights; otherwise, the auxiliary light is out.



Definition of flowmeter backlight board J1

Pin No.	Signal Name	Discription	Note
1)	VPP	12V power supply	/
2)	Lighting	Control signal	/
3)	GND	Ground	/

2.1.5.8 Indicator Board

Indicator board supports the functions of AC power indicator and battery indicator.



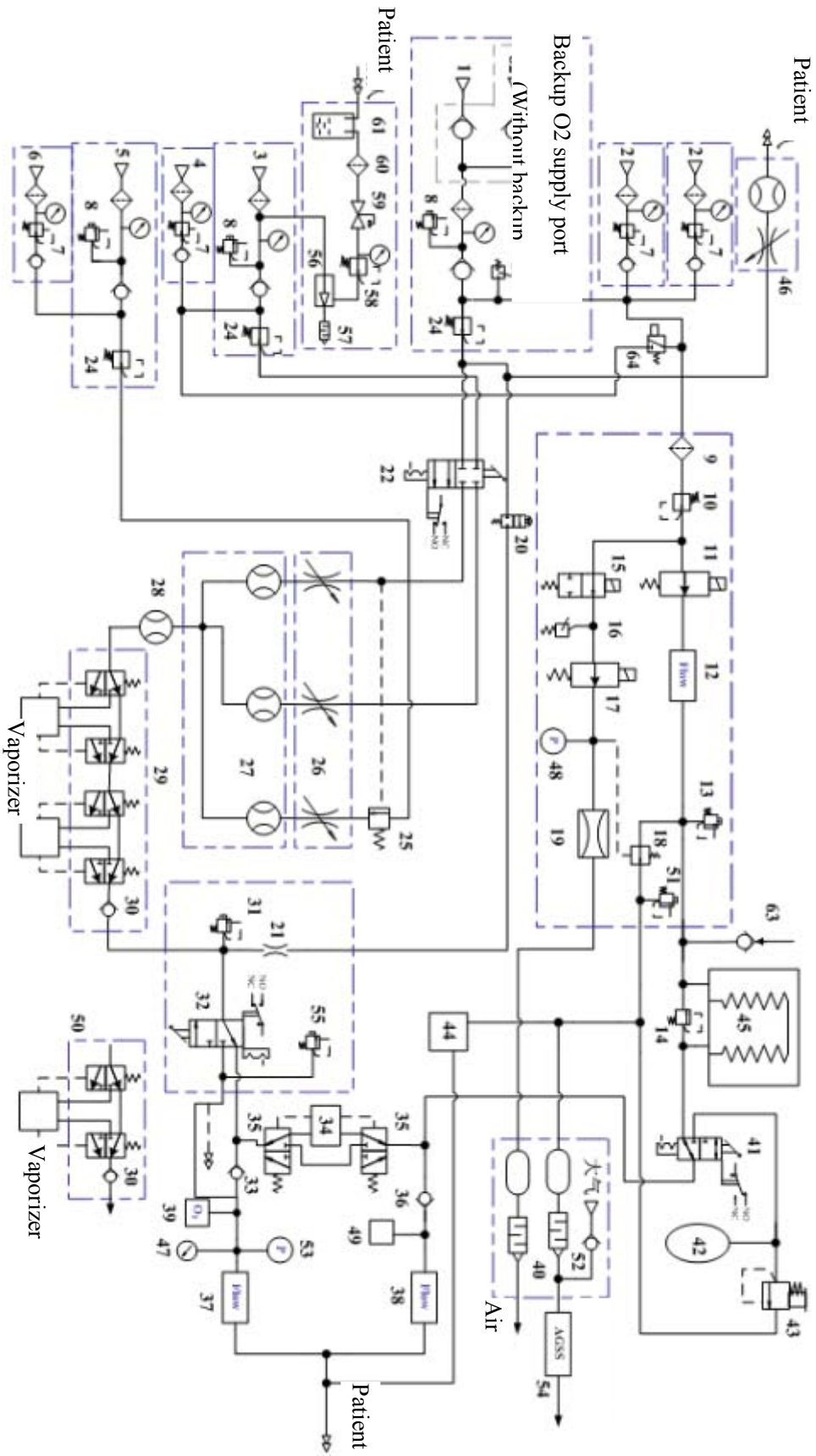
Indicator board (Top)　　Indicator board (Bottom)

Definition of indicator J1

Pin No.	Signal Name	Discription	Note
1)	LED_BAT	Battery indicator drive signal	High level: [2.5，3.5]V Low level: [0~0.4]V
2)	LED_AC	AC power indicator drive signal	High level: [2.5，3.5]V Low level: [0~0.4]V
3)	GND	Ground	/

2.2 Pneumatic Part

2.2.1 Pneumatic Circuit Diagram


Patient
Backup O2 supply port
(Without backup
Patient
Vaporizer
Vaporizer
Air
Patient

2.2.2 Pneumatic Components and Symbles

2.2.2.1 Pneumatic Components

The series numbers of components correspond with the number in the above pneumatic circuit diagram.

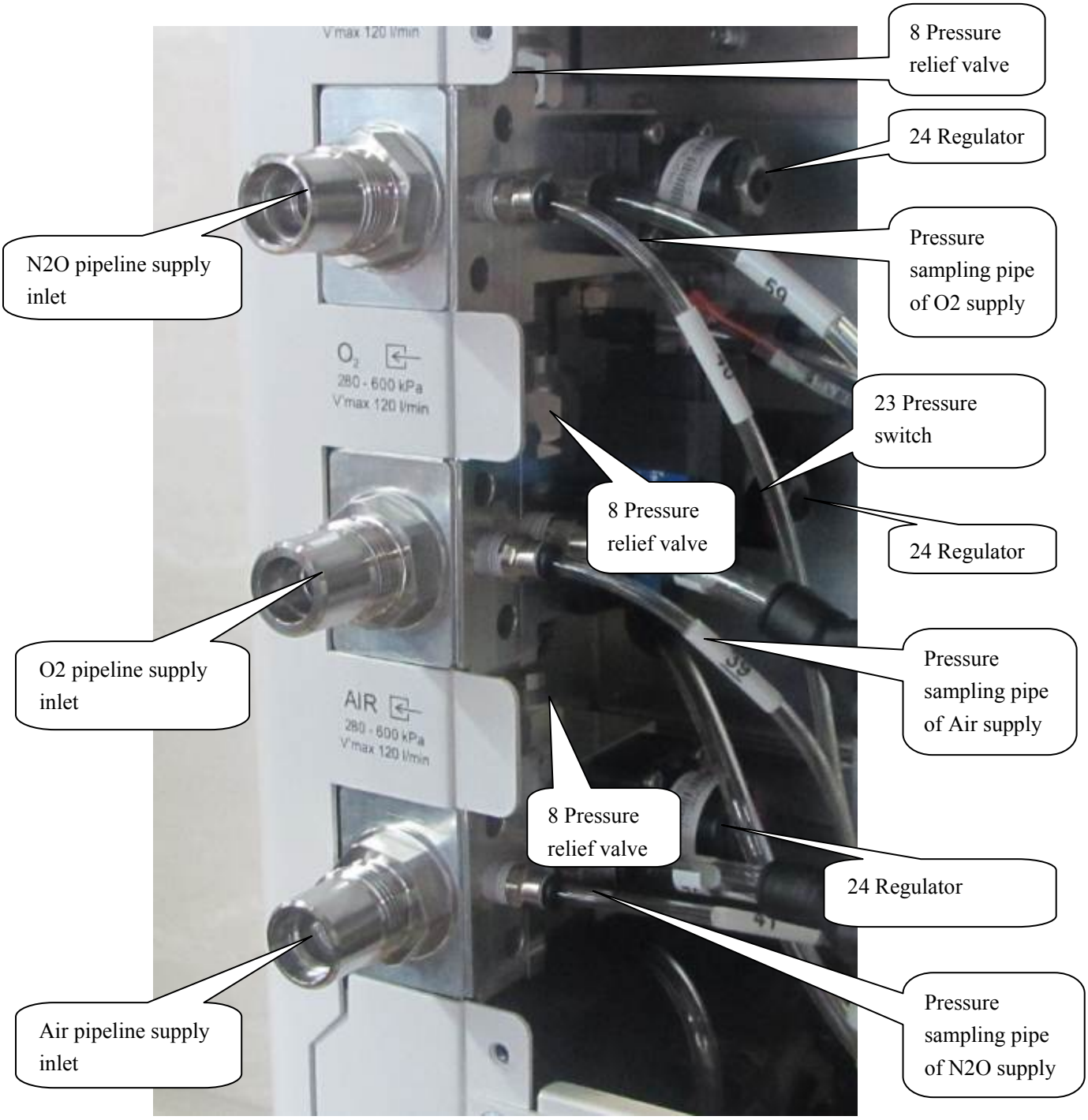
SN	Name	SN	Name
1	O2 P-Line	33	Inspiratory valve
2	O_2 cylinder	34	CO_2 absorber
3	Air P-Line	35	BYPASS cut-off valve
4	Air cylinder	36	Expiratory valve
5	N_2O P-Line	37	Inspiratory flow sensor
6	N_2O cylinder	38	Expiratory flow sensor
7	Regulator (0.4MPa)	39	O2 sensor
8	Pressure relief valve (0.758MPa)	40	Scavenging reservoir and muffler
9	Filter	41	Manual/Auto switch
10	Regulator (0.2MPa)	42	Manual bag
11	Inlet gas flow regulator	43	APL valve
12	Flow sensor (Venturi)	44	Gas module
13	Mechanical overpressure valve	45	Bellows assembly
14	Pop-Off valve	46	Auxiliary O2 supply
15	PEEP safety valve	47	Airway pressure gauge
16	Pressure switch (140KPa)	48	Pressure sensor
17	Proportional PEEP valve	49	Water collection cup
18	Expiratory valve	50	Single-vaporizer manifold
19	Pneumatic resistor	51	Pressure relief valve (10 cmH_2O)
20	O2 flush valve	52	Negative pressure valve (1 cmH_2O)
21	Flow restrictor	53	Pressure sensor
22	System switch	54	AGSS (AGSS transfer and receiving system)
23	Pressure switch (0.2 MPa)	55	Pressure relief valve (11 kPa)
24	Regulator (0.2 MPa)	56	Venturi negative pressure generator
25	O2-N2O cut-off valve (0.1 MPa)	57	Muffler
26	Flow control needle valve assembly	58	Adjustable negative pressure gauge
27	Electronic flowmeter&throttling device	59	Floating overfill protection valve
28	Rotameter	60	Negative pressure suction filter
29	Double-vaporizer manifold	61	Liquid bottle
30	Check valve	62	Backup oxygen supply connector
31	Pressure relief valve (38 kPa)	63	Free expiratory valve
32	ACGO selector switch	64	Drive Gas Switch

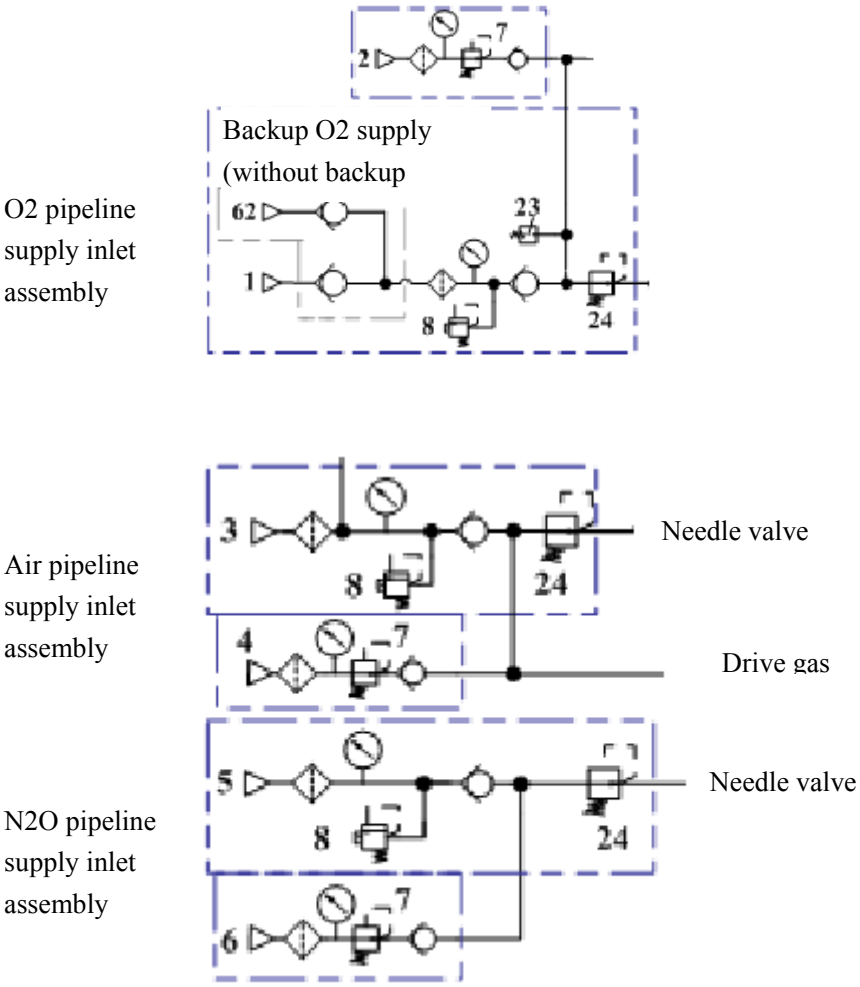
2.2.2.2 Key to Symbols

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

2.2.3 Gas Supplies

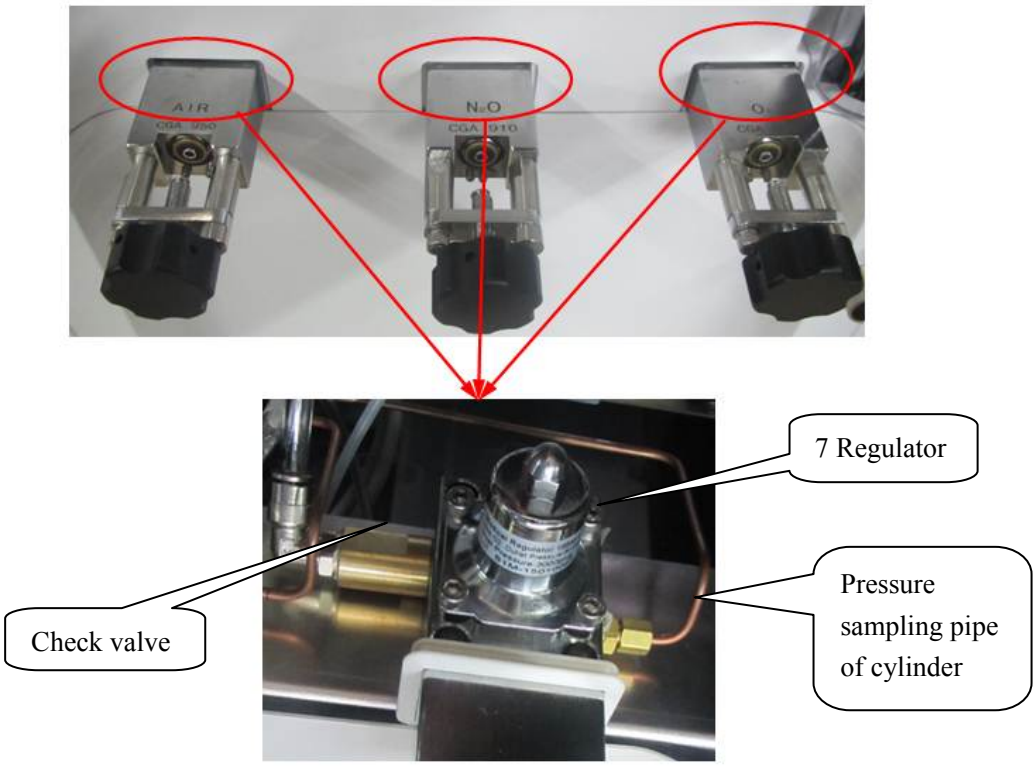
2.2.3.1 Pipeline Supply System





The above are three pipeline gas supplies, O_2, N_2O and Air, which functions to introduce the external pipeline gases into the machine. Since the pressure of external gas is very high and the external gas contains foreign substance, pressure reducing valves, filters and pressure relief valves are available in the supply gas circuit. Also, check valves are equipped in the supply gas circuit to prevent gas from flowing back into the pipeline or cylinder. The pipeline pressure ranges between 280 and 600 kPa. Pressure relief valve 8 functions to prevent the supply gas pressure from being too high. It releases excess gas when gas pressure exceeds 758 kPa. 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. Each supply gas is outputted after gas pressure is decreased below 200 kPa through regulator 24. Pressure switch 23 monitors the O2 supply pressure. When O2 supply pressure is less than approximately 200 kPa, the ventilator gives the alarm of O2 supply failure.

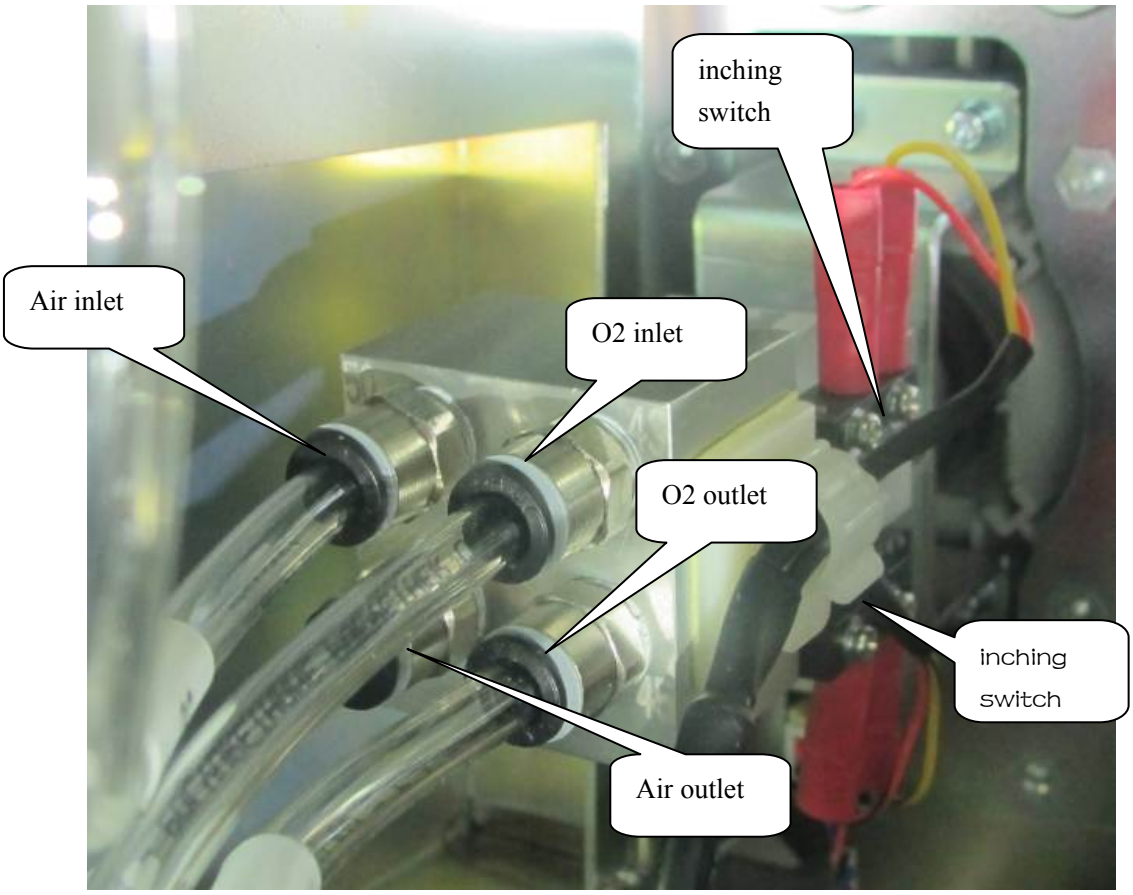
2.2.3.2 Backup Supply System



The above are three inlet assemblies of backup cylinder supplies, O_2, N_2O and Air, which functions to introduce the external cylinder gases into the machine. Cylinder gas supplies, which are O_2, Air and N_2O, go into the system through cylinder connectors 2, 4 and 6 respectively. The O2, Air and N2O cylinder pressures are 6.9 – 15 MPa, 6.9 – 15 MPa and 4.2 – 6 MPa respectively, which are decreased to approximately 400 kPa through regulator 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. Pressure relief valve 8 functions to prevent the supply gas pressure from being too high. It releases excess gas when gas pressure exceeds 758 kPa. Each supply gas is outputted after gas pressure is decreased below 200 kPa through regulator 24. Pressure switch 23 monitors the O2 supply pressure. When O2 supply pressure is less than approximately 200 kPa, the ventilator gives the alarm of O2 supply failure.

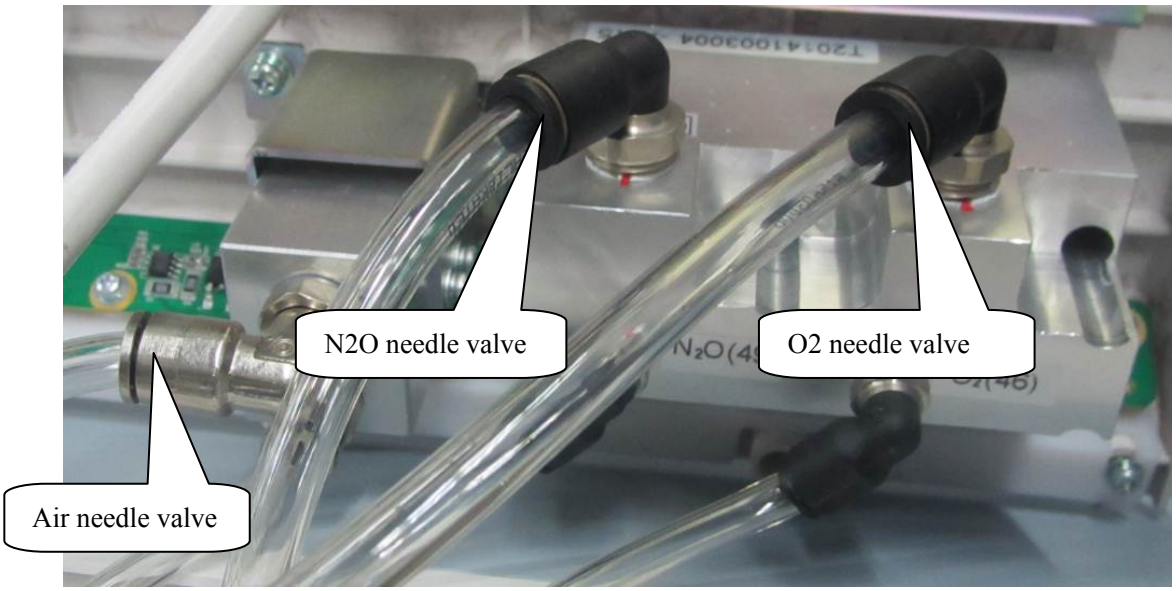
2.2.4 Anesthetic Gas Delivery System

2.2.4.1 System Switch Assembly



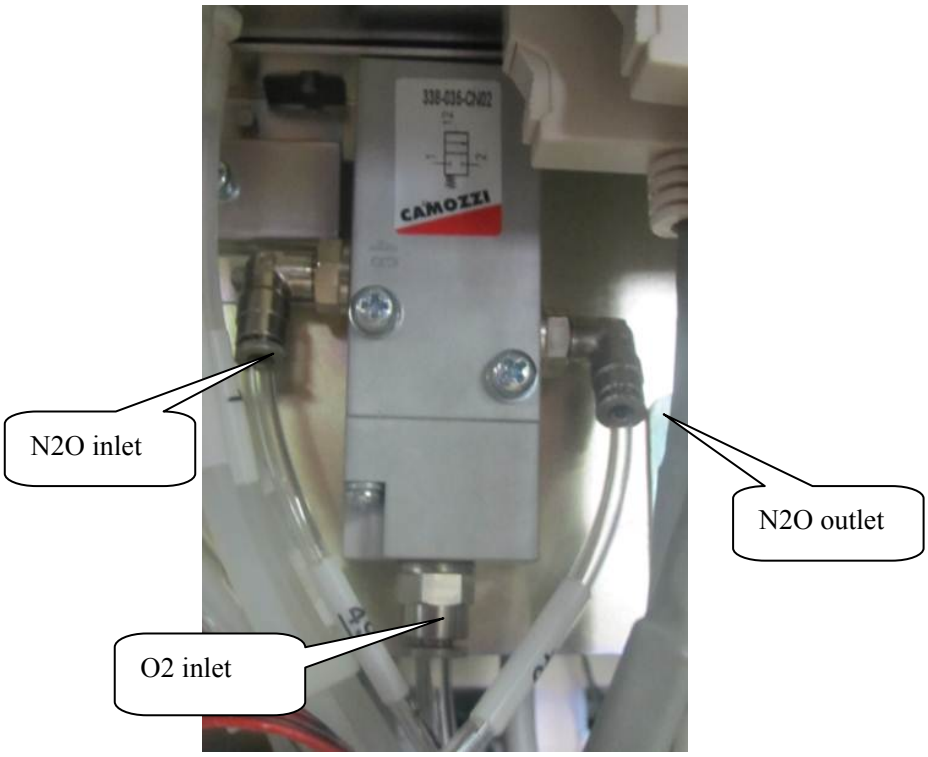
There are two kinds of systwm switch, single O2 system switch, and O2 and Air system switch. The above figure shows the O2 and Air system switch. Supply gases of Air and O2 go into system switch 22, and then needle valve. For single O2 system switch, only O2 goes into system and then needle valve. System switch has an electrical outlet which controls the power-on status of the system. When the system switch is turned on, O2 and Air enter theneedle 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 and Air cannot enter the needle valve and the system is powered off.

2.2.4.2 Flow Control Valve



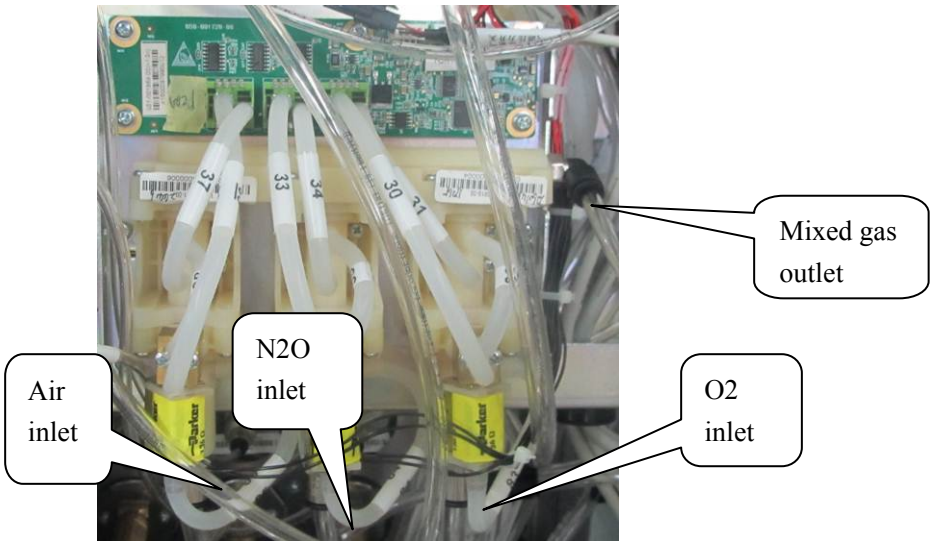
The above figure shows the flow control valves of O_2, N_2O and Air, which control the gas flows and the proportion between O2 and N2O as well to ensure that the gas flows outputted adjustable within the range of 0 – 15 L/min. O2 needle valve and N2O needle valve are are link neele valves, which realize the control of the proportion between O2 and N2O and ensure that O2 concentration is controlled not to be less than 21%. Turning flow controls counter-clockwise increases the flow and clockwise decreases the flow. For the anesthesia machine configured with O2 and Air supply, there are air needle valve on the limb of air to control the flow, and O2 needle valve on the limb of O2 to control the flow too.

2.2.4.3 O2-N2O Cut-off Valve Assembly



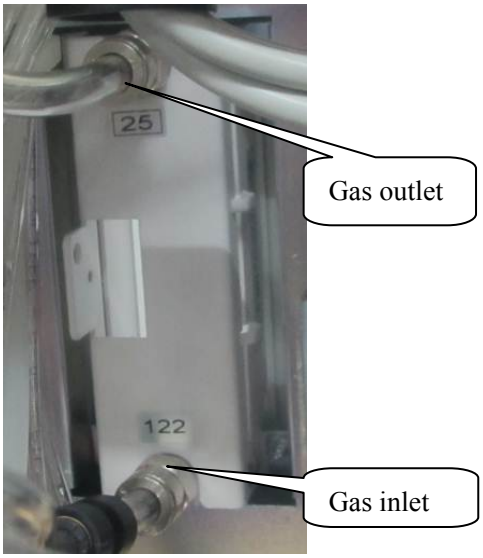
O2-N2O cut-off valve is to avoid the injury of patient caused by low O2 concentration. O2-N2O cut-off valve 25 is a pneumatically controlled three-way valve. O2 is uploaded to the control port to conduct on-off control of N2O. When the O2 supply pressure is less than 0.1 MPa, N2O supply is cut off. When the O2 supply pressure is greater than 0.1 MPa, N2O supply is switched on. O2-N2O cut-off valve 25 does not affect Air supply.

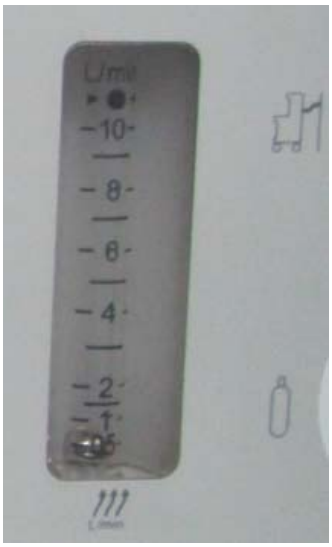
2.2.4.4 Electronic Flowmeter



Electronic flowmeter monitors the pressure differences on the two ends of differential manometer through the card sensor, and to realize the flow monitoring of each limb through AD transforming. Zeroing valves are installed on each limb to zero the electronic flowmeter. Check valves are installed on each limb of throttling device, to avoid the flow measurement of each limb to be affected by the backward flowing of the mixed gas.

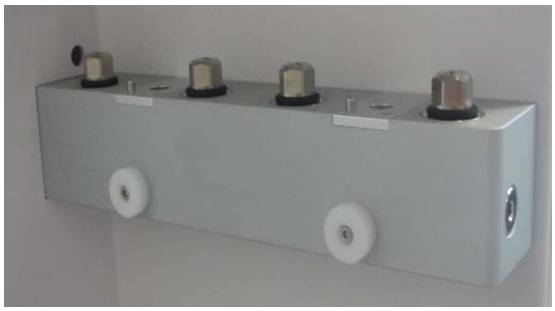
2.2.4.5 Total Flowmwter





The mixed gas of O2, N2O, and Air goes through the total flowmwter (28), and then into the vaporizer manifold.

2.2.4.6 Vaporizer Manifold



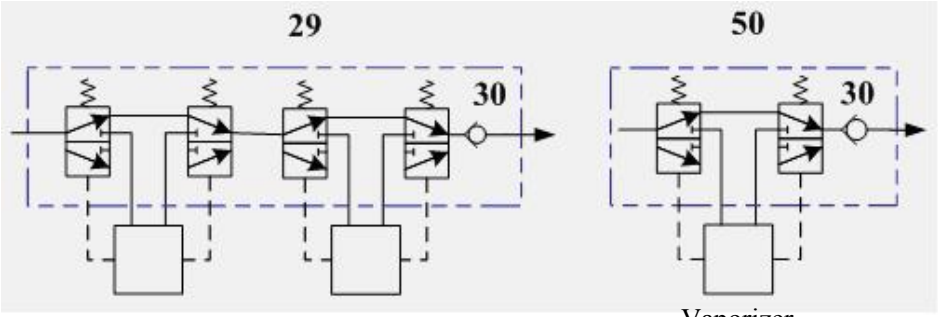
Double vaporizer manifold



Single vaporizer manifold

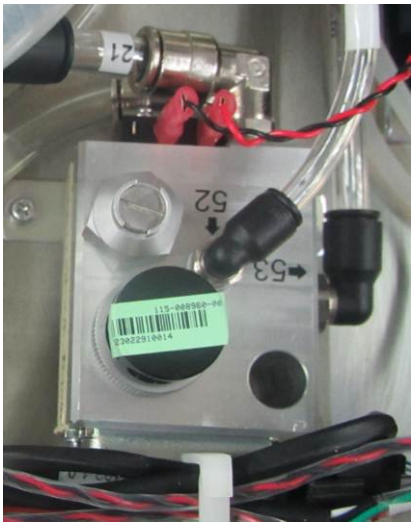
There are two kinds of vaporizer manifold, double vaporizer manifold and single vaporizer manifold. The anesthetic gas delivery device (vaporizer) is connected to the anesthetic gas delivery system. The mixed gas of N2O, O2 and Air go into the device and the fresh gas containing these three gases and anesthetic agent is finally outputted to the ACGO assembly.

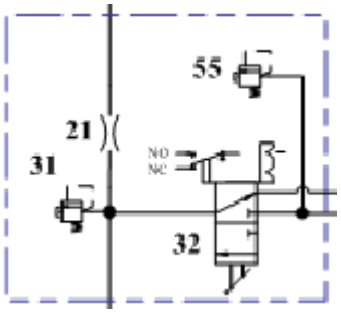
The following diagram shows the pneumatic circuit of anesthetic gas delivery device (vaporizer).



Double-vaporizer manifold 29 is integrated with check valve 30 which prevents flushing O2 and fresh gas from flowing back to the vaporizer. When a double-vaporizer manifold is used, Selectatec mounting with interlocking function can prevent the user from turning on two vaporizers simultaneously.

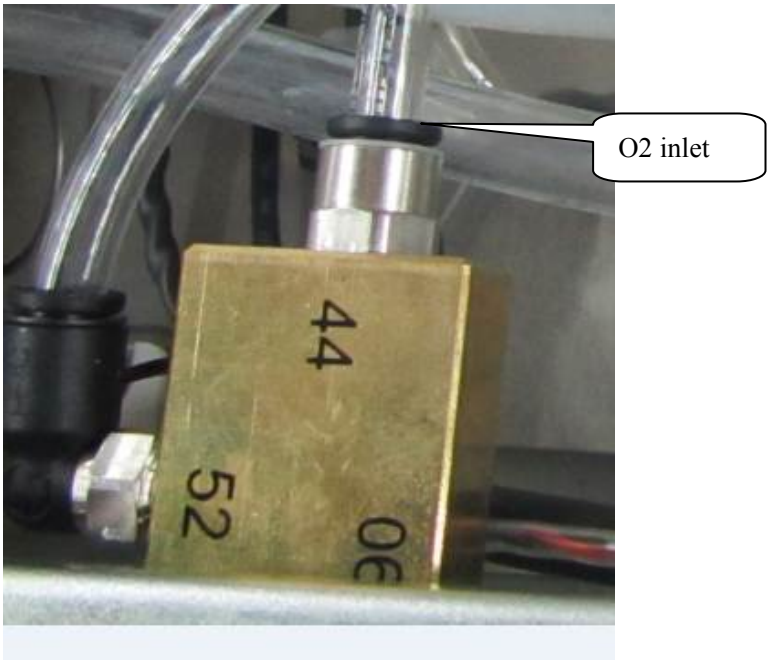
2.2.4.7 ACGO Assembly





The above picture shows the ACGO assembly. The ACGO assembly includes flow restrictor 21, pressure relief valve 31, and pressure relief valve 55. Inputted O2 and fresh gas are mixed and enter the ACGO. Pressure relief valve 31 at the front restricts the pressure of inputed O2 and also that of the fresh gas not to exceed 37.9 kPa. Pressure relief valve 55 at the back ensures that the pressure of the gas outputted to the ACGO does not exceed 12.5 kPa. Flushing O2 and fresh gas are mixed through the three-way valve and enter the ACGO. The outputs include fresh gas provided for the breathing system (when ACGO is turned off) and that provided for the patient (when ACGO is turned on). Pressure relief valve 31 at the front restricts the pressure of flushing O2 and also that of the fresh gas not to exceed 38 kPa (approximate value). Pressure relief valve 55 at the back ensures that the pressure of the gas outputted to the ACGO does not exceed 12.5 kPa.

2.2.4.8 O2 Flush Button Assembly



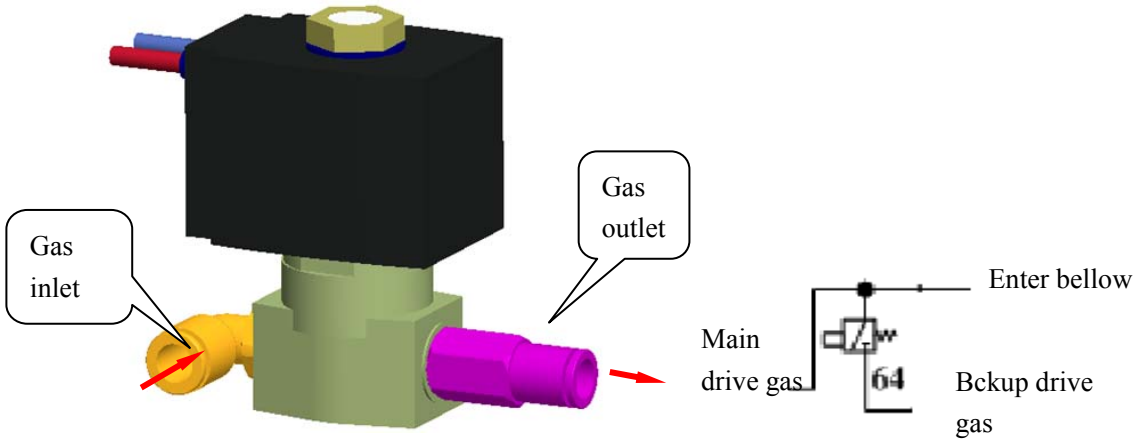
The above picture shows the O2 flush button assembly. When O2 flush valve 20 is depressed, O2 rushes into the pneumatic circuit which is cut off when this valve is released. The O2 supply gas at 0.2 MPa after regulated goes through the O2 flush valve, the ACGO assembly, and into the breathing system. 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 which ensures automatic reset each time the valve is depressed and released via the spring.

2.2.4.9 Auxiliary Supply Assembly



For auxiliary supply assembly, O2 of 200KPa goes into the patient, with flow controlled by regulator 24 and displayed by a glasstube float flowmeter. The flow range adjusted is from 0 to 15 L/min. Turning the flow control counter-clockwise increases the flow and clockwise decreases the flow.

2.2.4.10 Drive Gas Switch Assembly

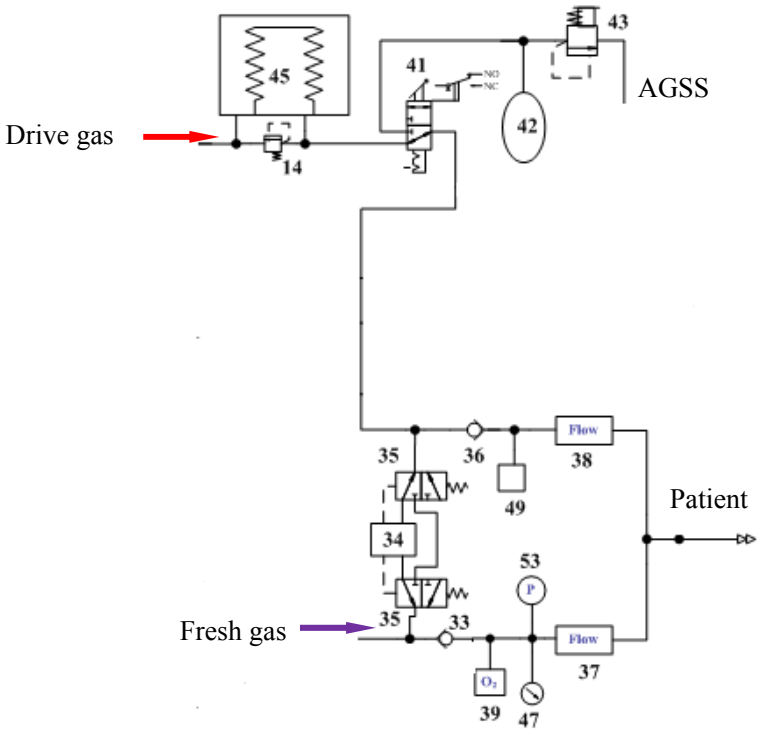


The core component of drive gas switch assembly (64) is a pneumatically controlled two-way solenoidvalve, which is installed on Air limb or O2 limb to realize a main drive gas and a backup drive gas. When the pressure of main drive gas limb is lower than 140 kPa, the alarm of pressure switch on the exhalation valve is triggered, and a dialog of drive gas switch appears on the screen to note the operater to turn on the drigve gas switch and enable backup drive gas.

2.2.5 Breathing System

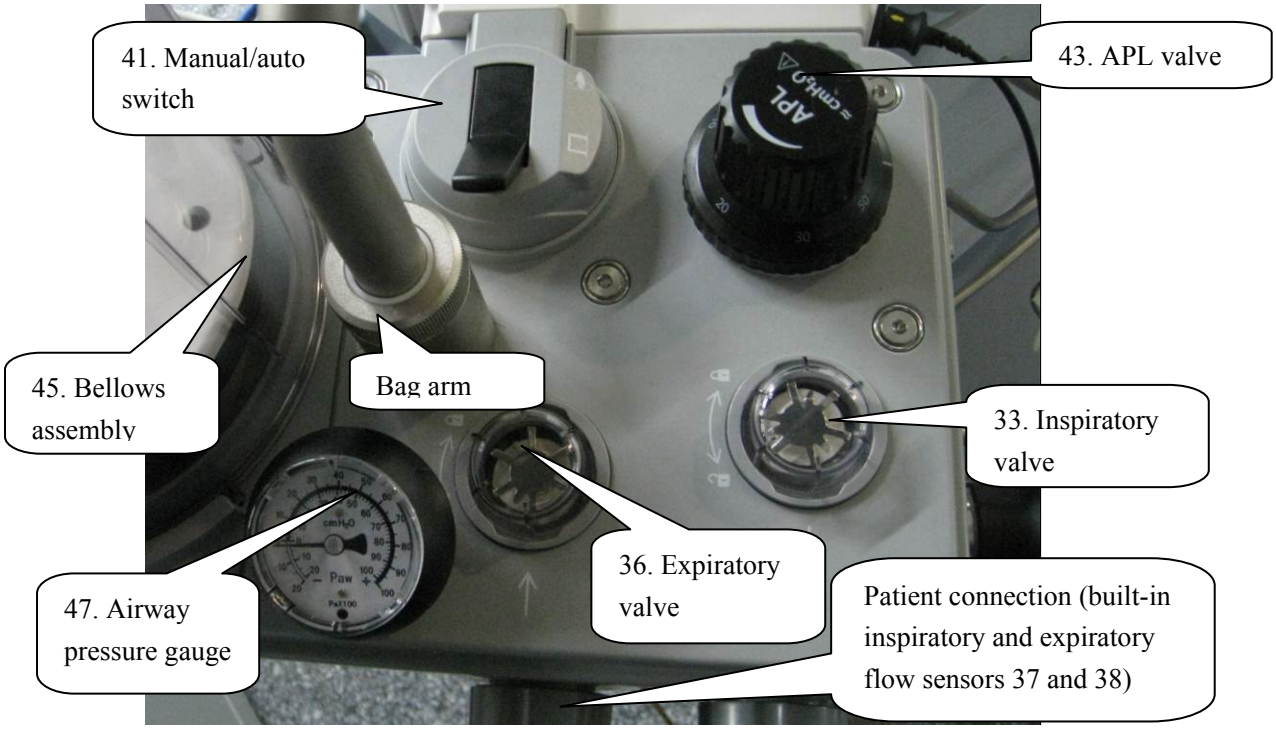
2.2.5.1 Overview

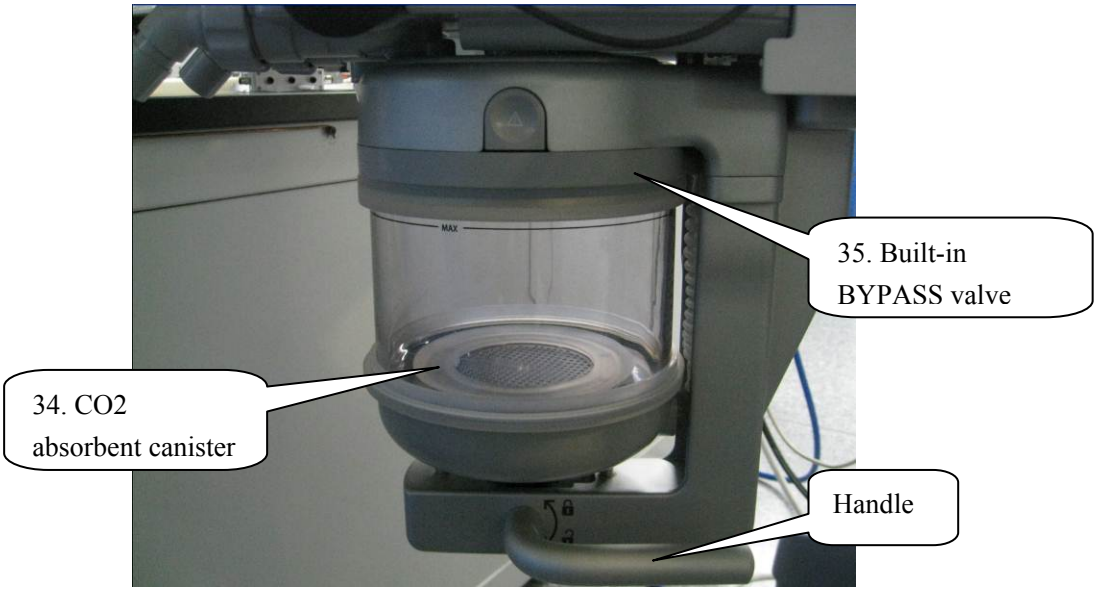
The breathing system provides a closed loop for the anesthetic gas. The CO2 in the patient's expired gas can be inspired in the inspiration phase to maintain the temperature and humidity conditions of the patient's exhaled gas. During inspiration, the drive gas depresses the bag inside the bellows or the doctor presses manual bag 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 or manual bag. Sodalime canister 34 absorbs CO2 the patient expires. The following diagram shows the pneumatic circuit of breathing system.



Manual and mechanical ventilation modes are selected through the manual/auto switch 41. When manual ventilation is selected, the doctor presses manual bag 42 to supply gas for the breathing system. APL valve 43 is used to adjust the pressure inside the pneumatic circuit in case of manual ventilation. When mechanical ventilation is selected, the ventilator starts to work. It controls the drive gas to depress the folding bag inside bellows 45 and supply gas for the breathing system as per the selected ventilation mode.

Breathing system is connected to the anesthesia machine main unit through the circuit adapter. Its tubes are all built in except the tube connected to the patient and the O2 cell cable, as shown below.





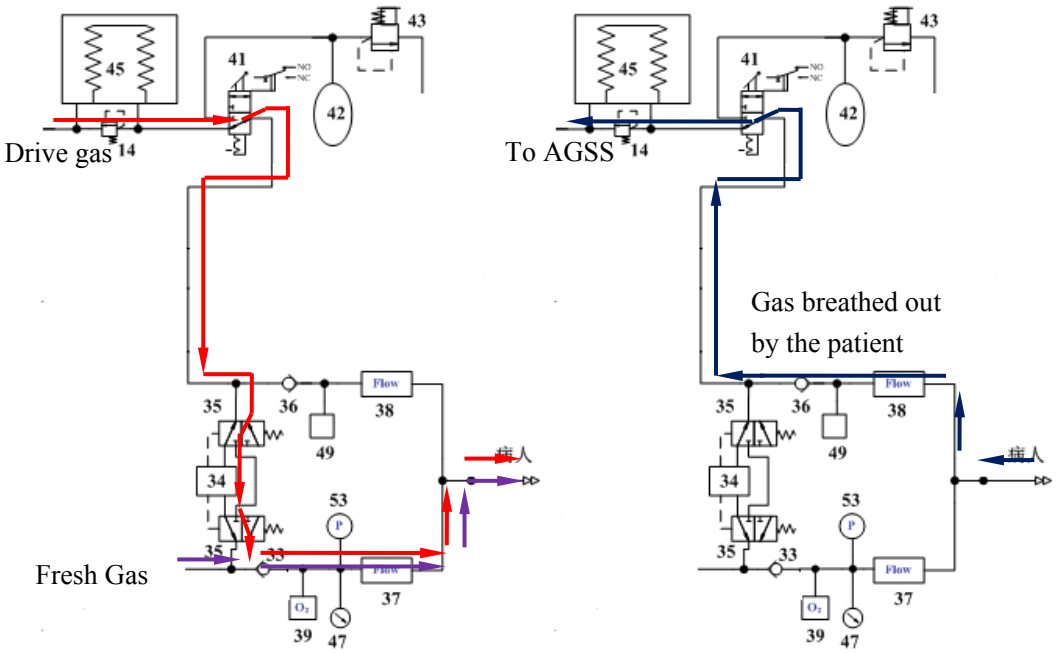
In case of mechanical ventilation, during inspiration, gas flows through manual/auto switch 41, BYPASS valve 35 or sodalime canister 34, inspiratory valve 33, O2 sensor 39, airway pressure gauge 47, and inspiratory flow sensor 37 to the patient. During expiration, gas flows through expiratory flow sensor 38, expiratory valve 36 and manual/auto switch 41 to the folding bag or manual bag. Airway pressure is monitored by pressure sensor 53.

The water generated by condensation is collected in the water collection cup on the bottom of breathing system.

The breathing system is easily disassembled and is autoclavable at 134℃.

2.2.5.2 Mechanical Ventilation

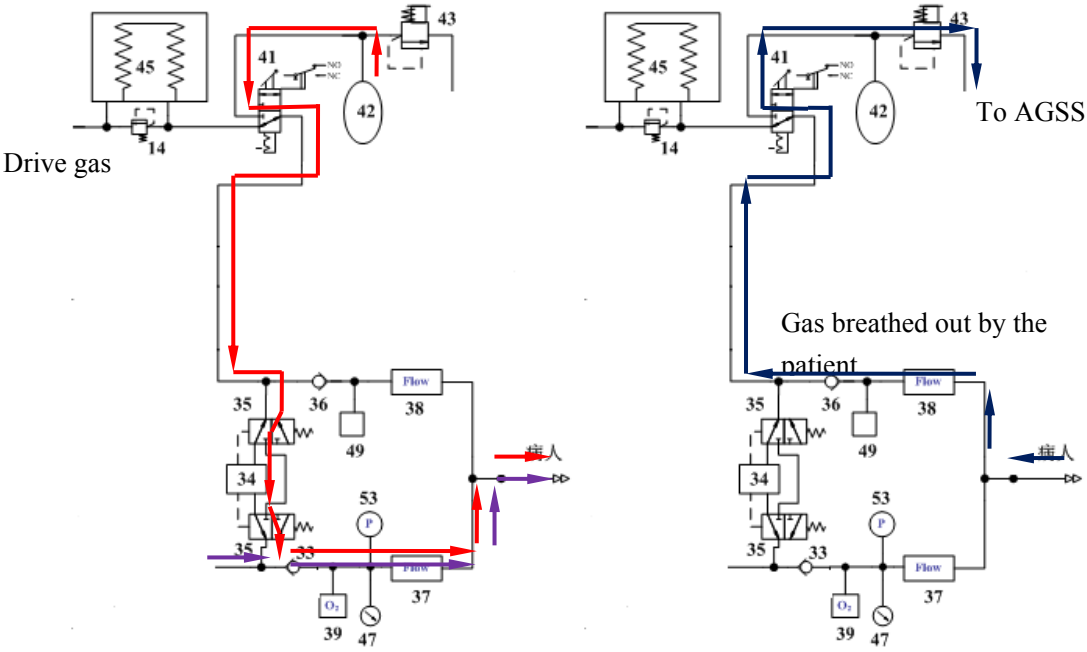
The breathing system is in mechanical ventilation by switching manual/auto switch to auto position, as shown in the following figures. During inspiration, gas in the bellow flows through manual/auto switch 41, BYPASS valve 35 or sodalime canister 34, and then is mixed with the fresh gas and continue to flow through inspiratory valve 33, O2 sensor 39, airway pressure gauge 47, and inspiratory flow sensor 37 to the patient. During expiration, gas breathed out by the patient flows through expiratory flow sensor 38, expiratory valve 36 and manual/auto switch 41 to the below, and then enter the anesthetic gas scavenging system (AGSS).



A. Mechanical inspiration mode B. Mechanical expiration mode

2.2.5.3 Manual Ventilation

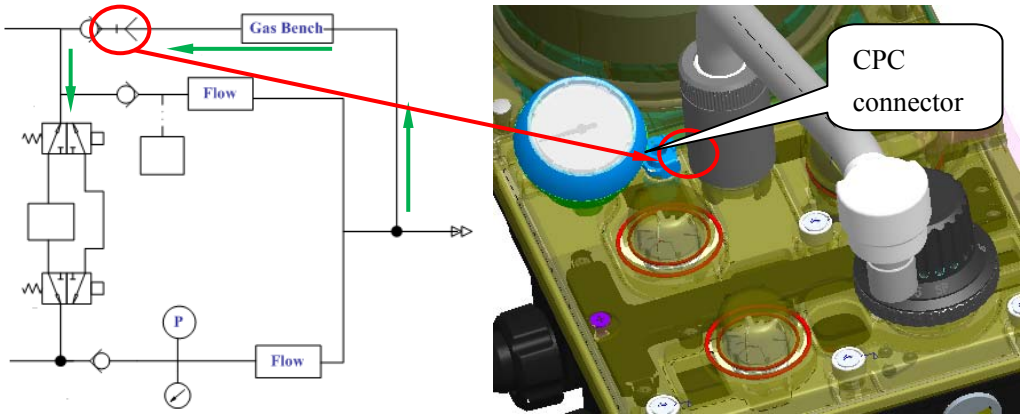
The breathing system is in manual ventilation by switching manual/auto switch to manual position, as shown in the following figures. During inspiration, drive gas flows through manual/auto switch 41, BYPASS valve 35 or sodalime canister 34, and then is mixed with the fresh gas and continue to flow through inspiratory valve 33, O2 sensor 39, airway pressure gauge 47, and inspiratory flow sensor 37 to the patient, by pressing manual bag. During expiration, gas breathed out by the patient flows through expiratory flow sensor 38, expiratory valve 36 and manual/auto switch 41 to the APL valve 43, and then enter the anesthetic gas scavenging system (AGSS).



A. Manual inspiration mode

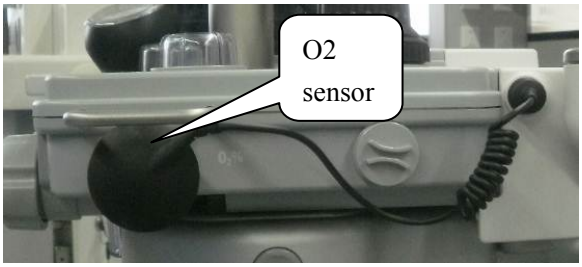
B. Manual expiration mode

2.2.5.4 Gas Bench



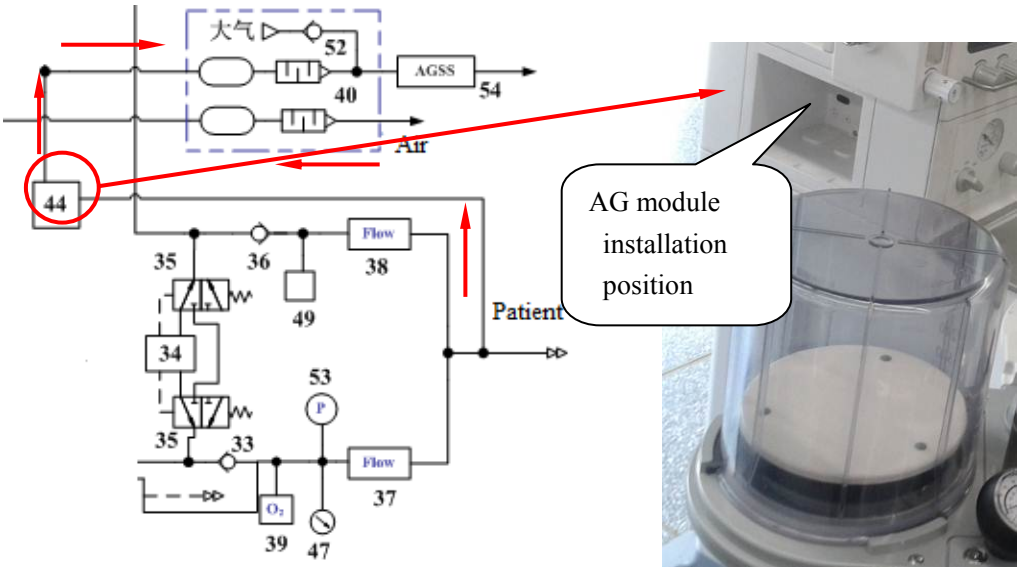
The sample gas, collected by AG module from the patient end, reenters to the breathing circuit through the CPC connector with self closing function, shown as the above figure.

2.2.5.5 O2 Sensor



O2 sensor, installed on the inspiration limb of the breathing circuit, monitors the O2 concentration of the inspiration limb, shown as the above figure. If the O2 concentration of inspiration limb is too low, an alarm will be triggered.

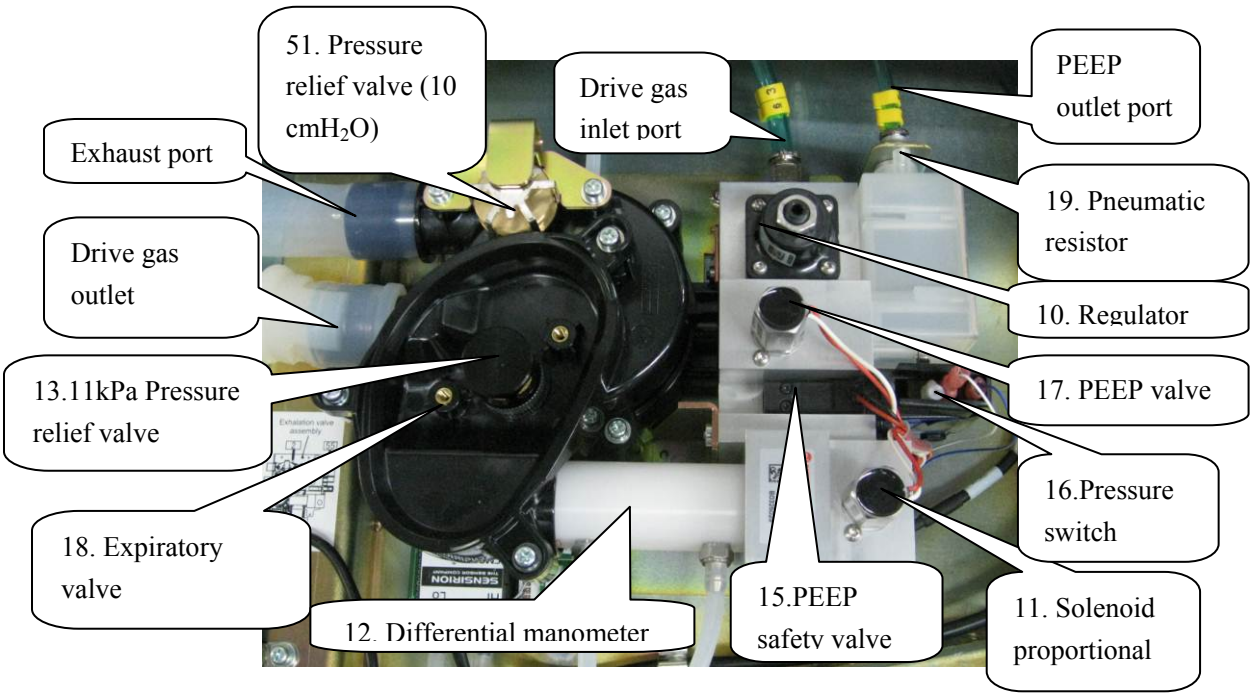
2.2.5.6 Anesthesia Calculation Module (If Available)



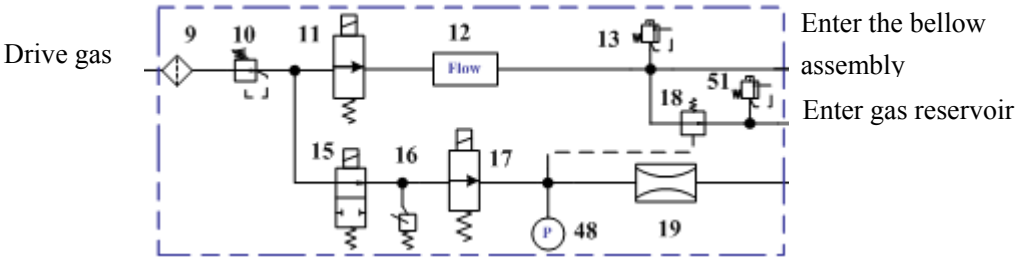
Anesthesia calculation module (44, AG module), collecting the sample gas from patient, monitors and calculates anesthesia concentration and CO2 concentration. When the anesthesia concentration or CO2 concentration of the patient end is too high, an alarm will be triggered.

2.2.6 Pneumatically-Controlled Module of Anesthetic Ventilator

The pneumatically-controlled module of the anesthetic ventilator provides drive gas for the patient to breathe. O2 (or AIR) from the gas supply inlet assembly enters the anesthetic ventilator and is output 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 implement various ventilation modes and prevent excessively high pressure inside the pneumatic circuit from injuring the patient. The following figure shows the gas flow and components.



The following figure shows the pneumatic circuit diagram of the pneumatically-controlled module of anesthetic ventilator.



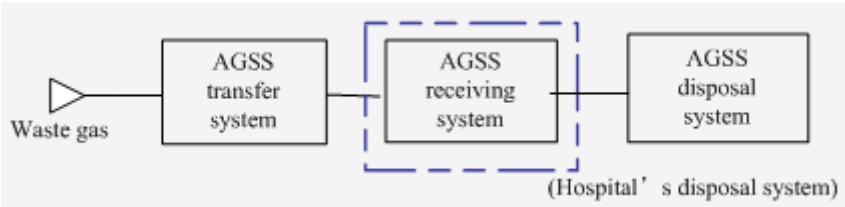
As shown in the above figure, in the drive gas limb, the filter 9 filters drive gas again. The regulator 10 regulates pressure (about 0.2 MPa) inside the pneumatic circuit. The proportional solenoid valve 11 controls thedrive gas flow. The drive gas goes through the flow sensor 12 of differential pressure type that monitors drive gas flow. The mechanical overpressure valve 13 ensures that the pressure in the drive gas circuit does not exceed the safety pressure. It releases excess gas when gas pressure exceeds 11 kPa (110 cm H2O). The drive gas enters the bellow through the exhalation valve 18. During expiration, the drive gas in the bellow goes out through theis valve.

In PPEP limb, the PEEP function is performed through the expiratory valve. When PPEP valve 17 opens, gas is bled from the pneumatic resistor 19, forming relatively stable pressure in the pneumatic circuit from PEEP valve 17 to the pneumatic resistor 19. 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 a solenoid on-off valve, is placed before the gas pathway of the expiratory valve. When the drive gas pressure is less than 140 kPa, an alarm is triggered by the pressure switch 16. The pressure sensor 48 monitors the pressure at the expiratory valve which is closed. The mechanical pressure relief valve 51 ensures that the tube pressure after the expiratory valve is less than 10 cm H2O in expiration phase.

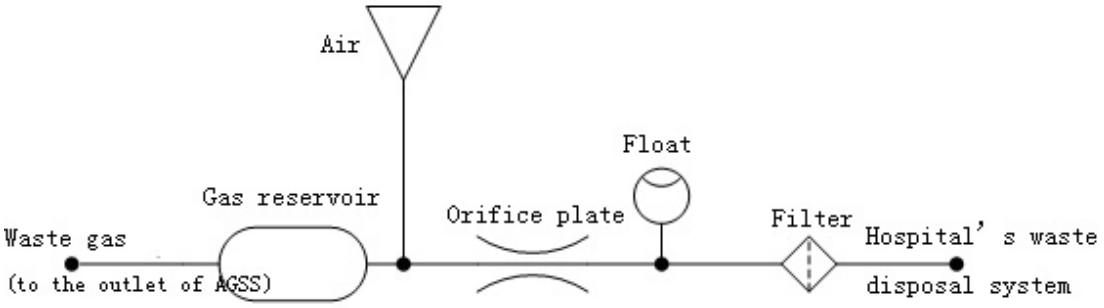
2.2.7 Anesthetic Gas Scavenging System

The 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 in the following figure.

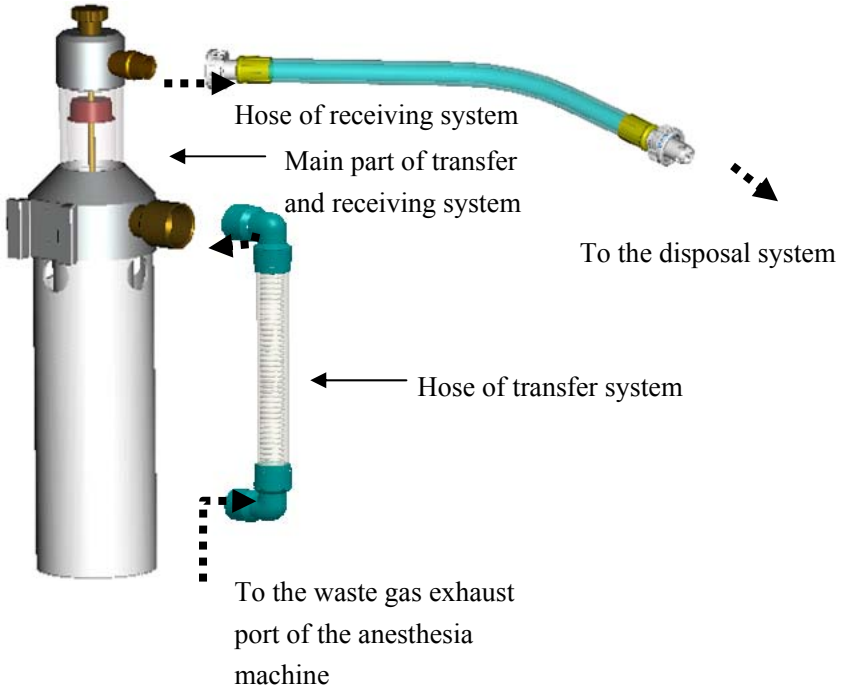


The following diagram shows the operational theory of the AGSS. The throttling holes reduce the effect of negative pressure at the AGSS outlet onto the flow at the entrance. The float helps the user to learn if the AGSS works normally. When the upper edge of the float is between the MAX and MIN marks of the sight glass, it indicates that the AGSS is in normal working status. The filter filters foreign substance 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 purple conical connectors at both ends, a female 30 mm conical connector as the inlet and a male 30 mm conical connector as the outlet. The transfer system is connected to the receiving system through the male 30 mm conical connector. The following figure shows the AGSS structure and the connections between the AGSS transfer system, receiving system, and disposal system.



2.2.8 Breathing System Heater

The breathing system heater of this anesthesia machine provides dual overheat protection for software and hardware. The heater can change its operating mode automatically according to the ambient temperature.

2.2.9 Ventilator Pneumatic - O2 Drive Gas

Oxygen or air, switching by the drive gas switch, is the drive gas for the ventilator. In addition to the flow meter block, a high pressure regulator reduces the supply pressure of the drive gas for the ventilator to 200 kPa (29 psi).

The drive pressure regulator is placed in front of the proportional valve that generates the drive gas flow during the inspiratory phase. This flow is injected into the space between the bellows and the bellows housing.

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

The drive pressure regulator stabilizes the supply pressure upon 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 of inspiratory flow of 110 L/min at the ventilator.

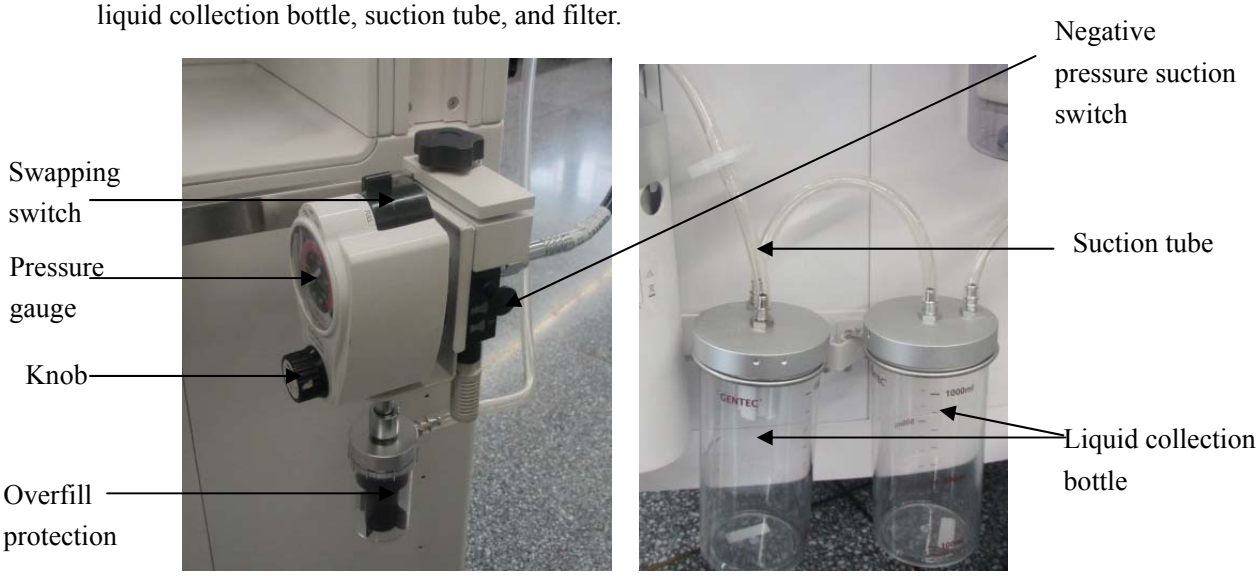
2.2.11 Drive Gas Assembly

The drive gas assembly comprises the inspiratory circuit and PEEP circuit. The gas flow of the inspiratory circuit goes through the inspiratory valve, which generates a gas flow of 0 to 110 L/min. The gas flow of the PEEP circuit goes through the PEEP valve, which also generates gas pressure of 3 to 30 cm H2O. Both the PEEP and inspiratory valves are proportional solenoid valves controlled by the valve drive board.

2.2.12 Negative Pressure Suction System

This negative pressure suction system is a Venturi negative pressure suction system. Negative pressure is produced by the Venturi pipe in the negative pressure generator drive d by Air. The negative pressure value is displayed and adjusted as needed by the negative pressure control pamel assembly. Drive gas goes through the negative pressure generator, and then is discharged from the muffler assembly to the air. Negative pressure control pamel realizes the on-off controlling and adjusting of the negative pressure source.

The negative pressure suction device is mainly composed of negative pressure regulator, liquid collection bottle, suction tube, and filter.



3 Installation Guide

3.1 Preparation of additional materials

Before installation, contact the customer and ask the customer to supply the following additional materials. Missing items may result in delays, incomplete installations, and/or additional service visits.

- Hose connector for gas supply
- Compatible emergency O2, N2O, and AIR cylinders
- Agent vaporizers and key fillers (if not purchased with the anesthesia system)
- Liquid agent medication
- 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)
- Negative pressure source, negative pressure source connection related hoses(if not purchased with the anesthesia system)

3.2 Installation Procedures

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.**

3.2.1 Unpacking and Setup

1. When the WATO EX-35(0619) is delivered, IMMEDIATELY inspect the box for any damage.

   a. If the box is intact and ALL tip indicators on the box exterior have not turned into red, then sign and date the bill of lading or airway bill to indicate safe receipt of the anesthesia machine.
   b. If there is DAMAGE or ANY of the tip indicators on the box exterior have activated (turned into red), 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.

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.



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 WATO EX-35(0619) onto the floor.



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



5. Remove the top foam piece on the WATO EX-35(0619).



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



7. Remove the affiliated boxes beside the machine and above the wooden base.



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



9. Cut the strap that fix the bottom of the machine.
10. Use a pair of scissors to cut off the two straps on the wooden base of the box. Remove the foam and front board.



11. Place the front board near the container base to use it as a ramp as shown in the figure. The flat side of the wooden board must face 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.

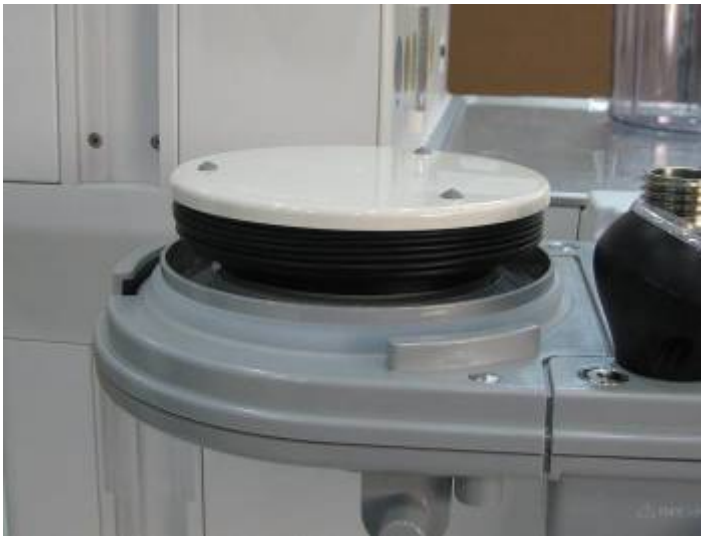


12. Rotate the casters 90° and carefully roll the unit down the ramp. Remove the bag from the unit. Save the bag in case repacking is needed.
13. Open the bottom drawer of the patient circuit assembly and remove the patient circuit assembly and the bag arm assembly.



14. Align the respiration circuit assembly carefully to the circuit connector, and then push it firmly towards the WATO EX-35(0619) until the assembly clicks into place.
15. Carefully open the small box that contains the Folding Bag Assembly (Bellows) and Bellows Dome. Remove the plastic bags from the Assembly. Place the foam pieces and plastic bags in the box.

16. Install the bellows on the patient circuit. Ensure that the bellows is stretched completely around the lip on the breathing system when installed.



17. Install the bellows dome by placing it down on the patient circuit 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).





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

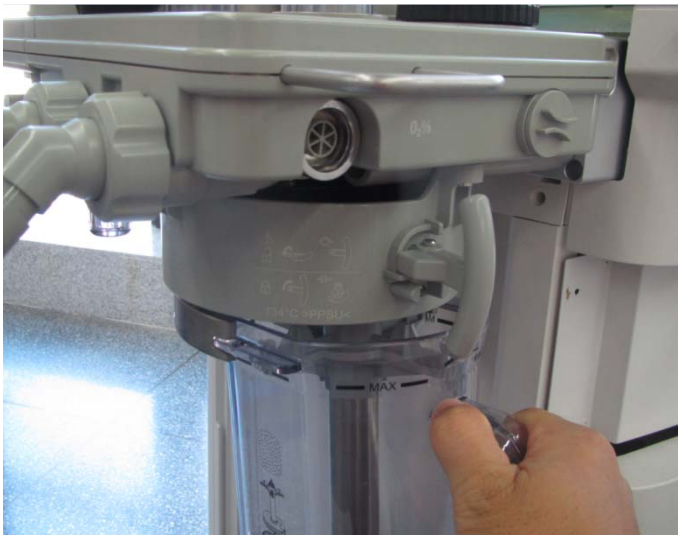


19. Then, push the Bag Arm Assembly into the patient circuit and tighten the knurled collar as shown below.



20. Open the affiliated box and carefully remove the removable absorber assembly.

21. Turn the lever of the prompting device to the vertical position and insert the removable absorber assembly into position.



22. Turn the locking lever to the horizontal position to lock the removable absorber assembly in place.



23. Slide the AGSS body into the track on the lower left side (same side of the patient circuit assembly) of the machine, fasten the wing screws on the AGSS body to fix it in position. Install one end of the AGSS transfer hose on the AGSS body and the other on the waste gas scavenger hose. See the following figure.



24. Open the top drawer and check that it contains the following contents:
    - Operation Guide
    - Inspiratory Flow Sensor & Expiratory Flow Sensor (PN: 115-001366-00)
    - Drawer Key (PN: 034-000353-00)
25. Before installing the gas cylinders (if equipped) at the rear of the WATO EX-35(0619), verify that the tank washers are installed. Remove the tape holding washers in place. Then, install the gas cylinders. Ensure that the cylinders are secured to their matching cylinder supply connections, which are labeled “O2”, “Air”, and “N2O”.
26. Check that the gas supply connectors match with the gas supply (if not, the customer must provide matching ones) and connect each gas supply by connecting the hose connectors to the gas supply connectors. Verify that the pressure of the gas supply is within the specifications of the machine.
27. Connect a manual ventilation bag (supplied by the user) to the bag arm on the patient circuit assembly.
28. Connect a patient breathing hose (supplied by the user) to the inspiratory and expiratory connections.

⚠WARNING

- **Use patient circuits and manual bags in accordance with ASTM F1208 and compatible with standard 22mm male conical fittings per ASTM specifications F1054.**

29. Connect the active blowdown hose between the AGSS body and the AGSS system connector in the operation room. Turn the knob on top of the AGSS body until the float is between the Min and Max markings. Connect the hose from the gas scavenger to the operating room's EVAC connector.
30. Install the oxygen sensor into the stainless steel housing and tighten it properly.
31. Connect the oxygen sensor cable between the oxygen sensor and the side of the WATO EX-35(0619), aligning the yellow marks with the cable and connector.
32. Plug the power cord into a grounded socket. Power up the WATO EX-35(0619) by turning the main power switch to the ON position. Check that the start-up self-test is successful. Perform leak test as instructed on the LCD display. Do not connect, disconnect or move the breathing hose or breathing bags while the self-test is in process.
33. Mount the monitor and arm as per the instructions in the monitoring kit.

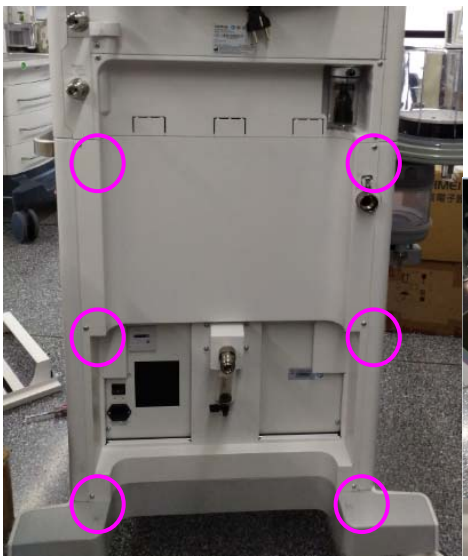
⚠WARNING

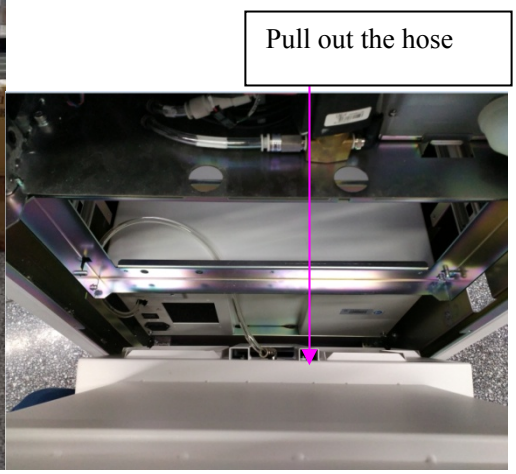
- **Use only Mindray-declared monitors and arms with the WATO EX-35(0619).**

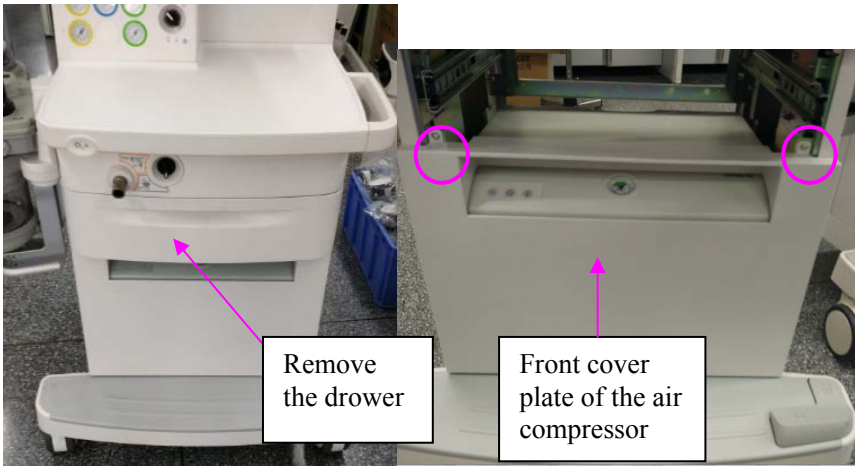
34. Place the following parts into the bottom drawer:
    - Operator's Manual (P/N: 046-008398-00)
    - Washer Seal (P/N: 0348-00-0185)
35. Hang the Operation Manual onto the handle of the unit.

For an anesthesia machine with an air compressor, you need to perform the following installation steps in addition to the above procedure:

1. Unfasten the six screws fixing the back cover plate of the rollstand, remove the connected hoses, and remove the back cover plate.
2. Remove the next drawer from the front, loosen the two screws fixing the front cover plate of the air compressor, and remove the front cover plate.



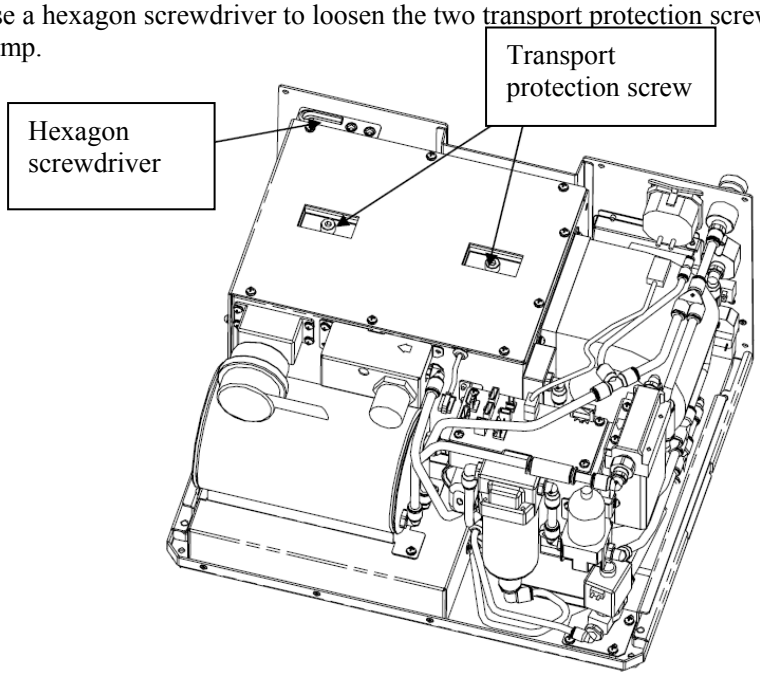




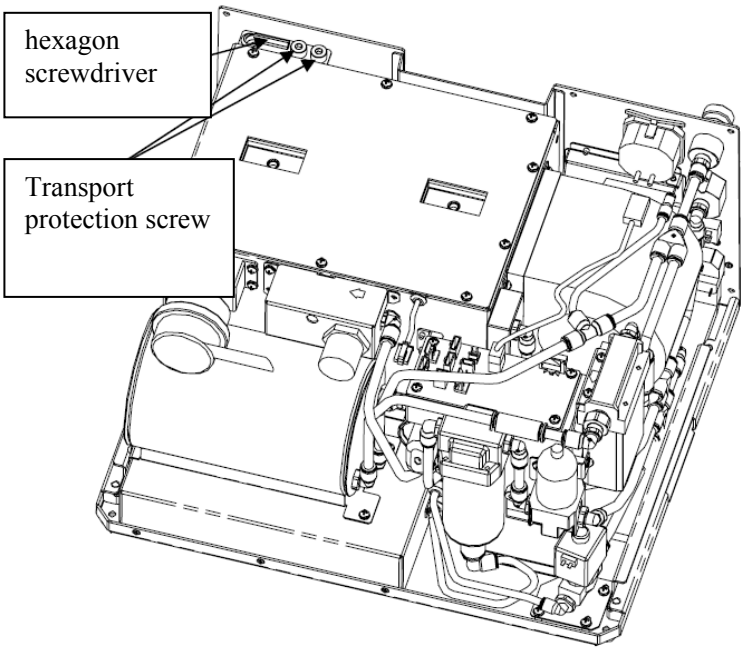
3. Loosen the five screws fixing the top cover of the air compressor on the rear side. Pull out the up cover assembly from the front side. Disconnect the cables and tubes connecting the up cover, and remove the up cover assembly.



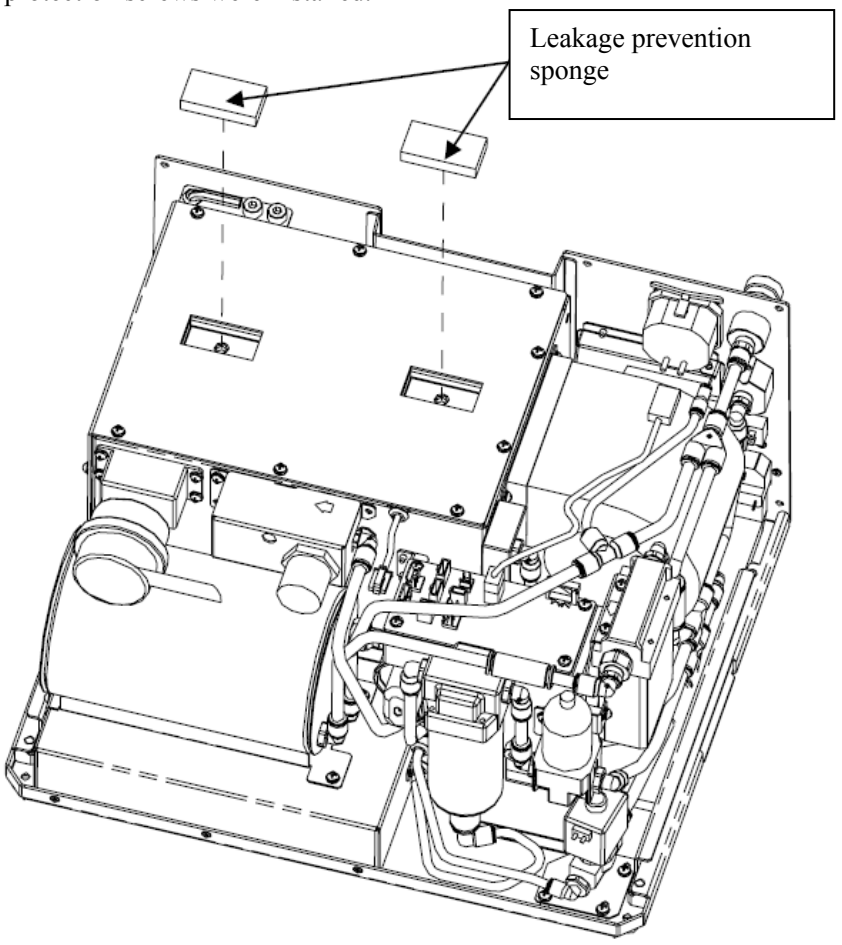
4. Use a hexagon screwdriver to loosen the two transport protection screws that fix the air pump.



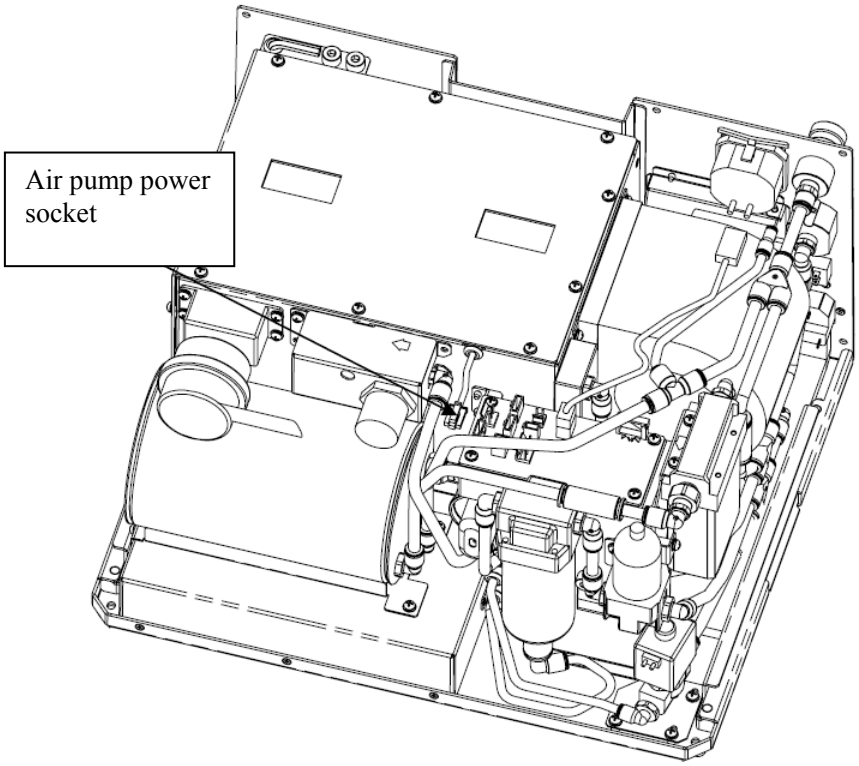
5. Fasten the two transport protection screws on the air compressor in the position shown in the following figure:



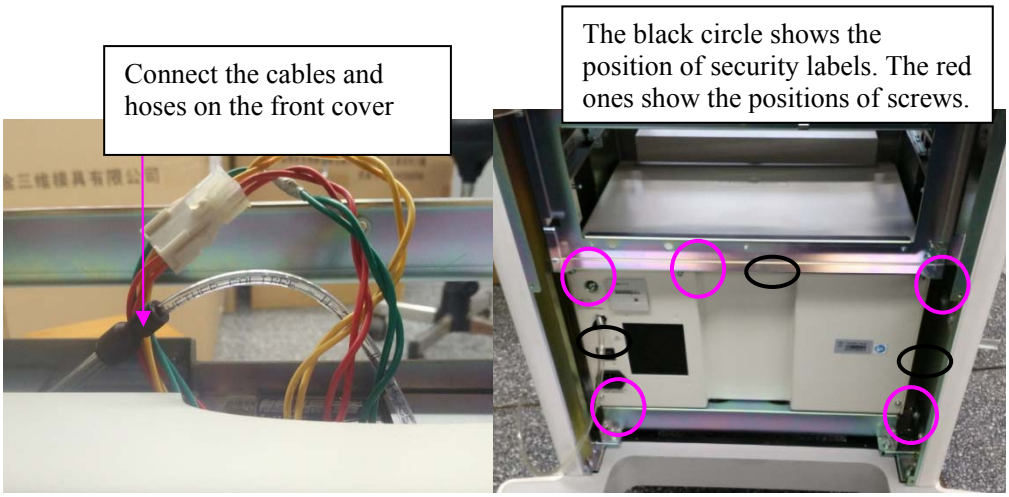
6. Install the two leakage prevention sponges in the accessory bag to the position where the transport protection screws were installed.



7. Plug the air pump power cord into the power socket

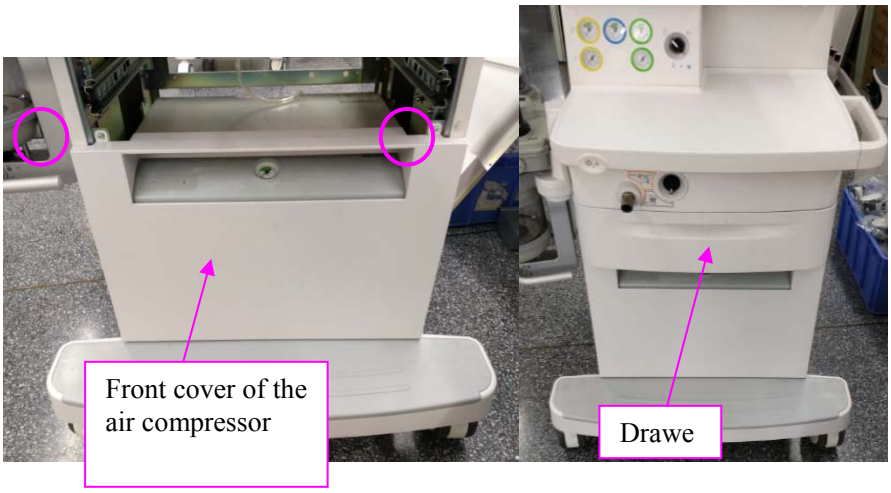


8. Close the top cover of the air compressor to the 2/3 position along the guide barrel. Connect the hose and indicator plug for the pressure gauge. Then, push the top cover in position. Fasten the five screws on the rear side and stick the three security labels to the position as shown in the black circle in the following figure:

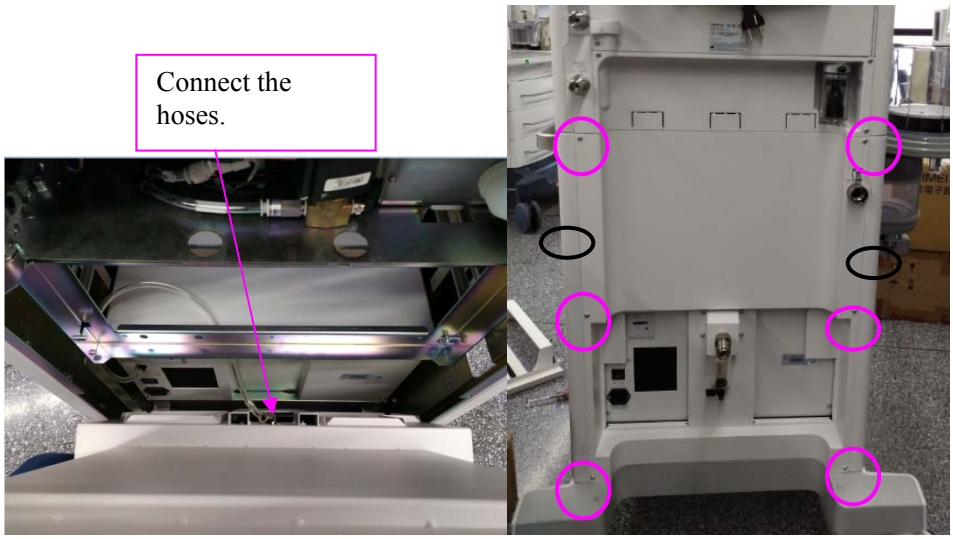


9. Fix the front cover of the air compressor to the rollstand with two screws on the front.

10. Install the drawer on the rollstand.

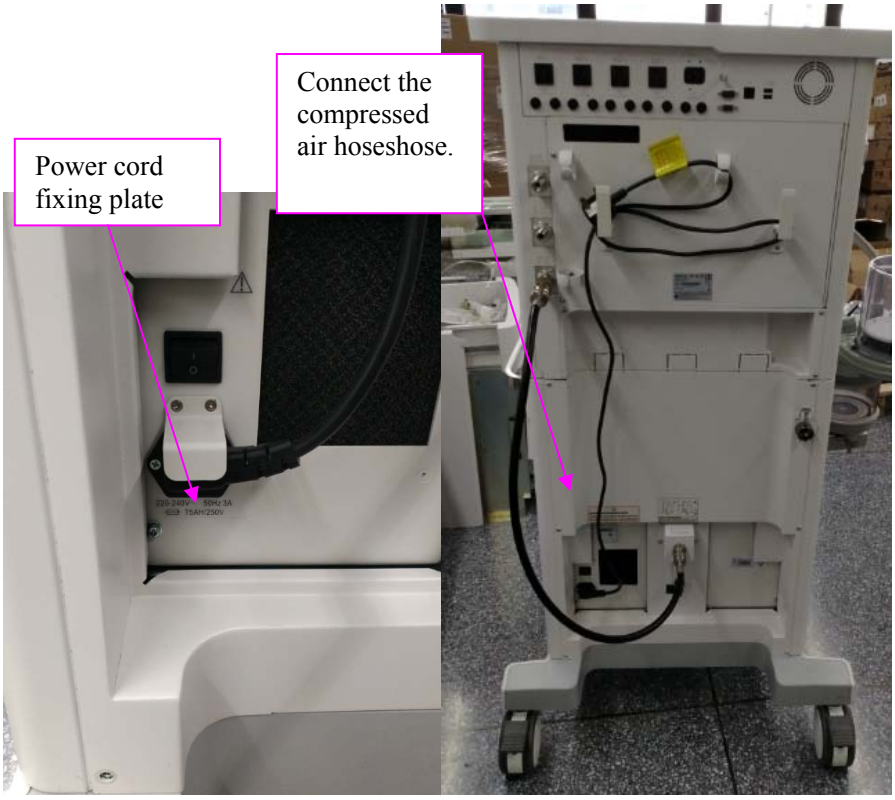


11. Place the back cover of the rollstand on the rear side of the rollstand, connect the hoses, and fix it with six screws. Stick two security labels on the position as shown in the following figure:

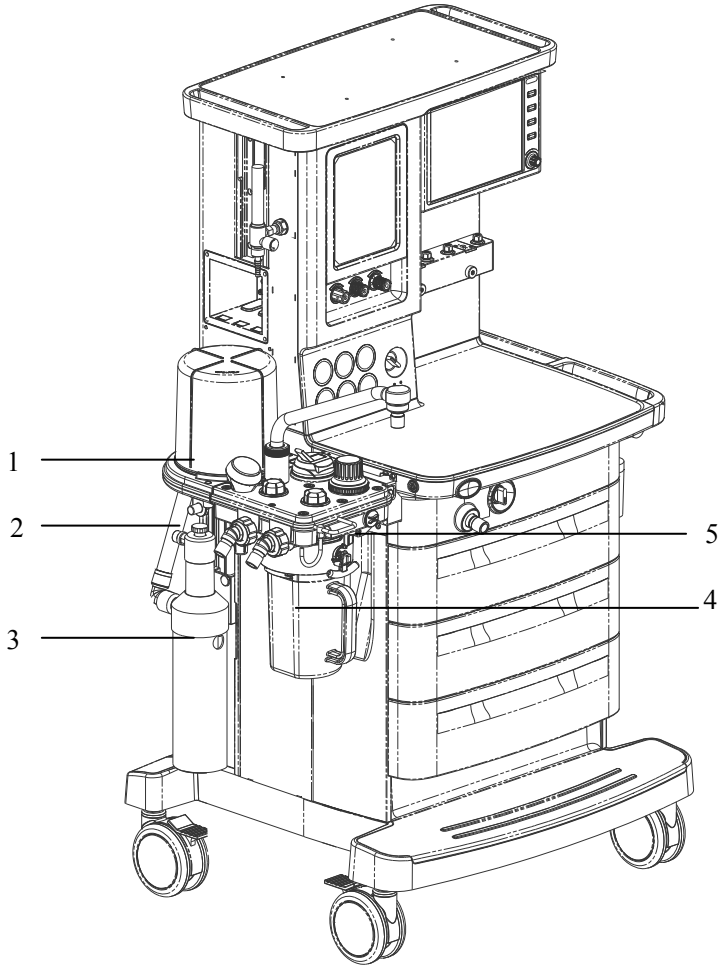


12. Take the power cord, power cord fixing plate, and M3 screws from the accessory bag and fix the power cable as shown below.

13. Insert one end of the compressed air hose to the air outlet of the filter and the other end to the air supply inlet of the anesthesia machine.


Power cord
fixing plate
Connect the
compressed
air hoseshose.

3.2.2 Breathing System



1. Patient circuit
2. AGSS Transfer hose
3. AGSS body
4. Soda lime canister
5. O2 sensor and cable

3.2.3 AGSS Connections

1. Remove the Anesthetic Gas Scavenging System (AGSS) from the foam and bag.
2. Mount the AGSS to the WATO EX-35(0619) via the GCX compatible rail system.
3. Attach the AGSS Transfer Hose between the inlet port of the AGSS and the exhaust port of the WATO EX-35(0619).

3.2.3.1 Tank Wrench and Operation

1 Mount the tank wrench on the rear of the WATO EX-35(0619) so that it can be used to open or close each cylinder without disconnecting it from the machine.

2. Hang the Operation Guide onto the handle of the machine.

3.2.4 Vaporizers

⚠WARNING

- **If the vaporizer is incompatible with the anesthesia machine, the vaporizer will not work at all. Use ISO 8835-4 compliance vaporizers with Selectatec adapters. For details about drug filling and draining the vaporizer and other information, refer to the vaporizer manufacturer's Instructions For Use.**
- **Selectatec mounting system prevents simultaneous use or turn-on of more than one vaporizer. Do not attempt to override this safety feature.**
- **Warning: The vaporizer is much heavier than expected, based on their size and shape. Therefore, observe care in lifting and manipulating vaporizers during the mounting process.**

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.**

1. Align the vaporizer over the valve cartridges of the mounting bar. Hang the vaporizer on the mounting bar as shown below. Note that the locking mechanism handle is in the unlocked position.



Locking Mechanism Handle in the Unlocked Position

2. Rotate the locking mechanism handle clockwise into the locked position as shown below.



Locking Mechanism Handle in the locked Position

3.2.4.1 Assemble the Vaporizer

1. Mount the vaporizer vertically 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 requires an additional power cord. For more detailed instructions on installation and proper use, refer to the specific manufacturer's Instructions for Use of the Desflurane vaporizer.**

3.2.4.2 Fill the Vaporizer

NOTE

- **The WATO EX-35(0619) should use ISO 8835-4 compliance vaporizers with Selectatec adapters. For details about drug filling and draining the vaporizer and other information, refer to the vaporizer manufacturer's Instructions For Use.**

⚠WARNING

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

3.2.4.3 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 WATO EX-35(0619) 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.**

3.2.5 Gas Cylinder(s)

1. Remove the cover from a new O2, N2O, and AIR cylinder.
2. Mount one cylinder at a time onto the rear of the anesthesia machine.
3. Discard the cylinder's tank washer. Always use the approved tank washer provided with the WATO EX-35(0619).
4. Open the bail of each yoke and mount the cylinder over the tank washer.
5. Ensure the O2 cylinder mates to the O2 Pin Index Safety System (PISS) connection on the O2 yoke. Close the yoke bail and use the hand-screw to tighten the cylinder to the yoke port.
6. Ensure that the N2O cylinder mates to the N2O PISS connection on the N2O yoke. Close the yoke bail and use the hand-screw to tighten the cylinder to the yoke port.
7. Ensure that the AIR cylinder mates to the AIR PISS connection on the AIR yoke. Close the yoke bail and use the hand-screw to tighten the cylinder to the yoke port.

3.2.6 Patient Circuit and Soda Lime Canister

1. Attach the patient circuit of the anesthesia machine to the inspiratory and expiratory ports as detailed in the directions for use. Attach the breathing bag and any other respiratory accessories as described.
2. Put the CO2 absorber into the absorber canister.
3. Install the absorber canister with a quarter turn of the lever at the bottom the absorber assembly, ensuring tight seal.

3.2.7 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 monitor and mounting hardware is performed by the installer.**

2. After mounting a monitor to the WATO EX-35(0619), connect it to one of the AC outlets located on the rear of the WATO EX-35(0619).
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 WATO EX-35(0619). Ethernet and power cables can be routed through the clips.

3.2.8 Module Installation and Waste Gas Recycling

1. An exhaust hole is available on the module installed in the module rack or the breathing gas monitoring product to discharge waste gas. The exhaust hole on the gas monitor must connect to the sample gas return port on the back of WATO EX-35(0619). The exhausted gas will return to patient circuit through lines in the system to be reused, to reduce the waste and pollution of anesthesia gas.
2. Make sure that a tight connecting fitting is attached to the exhaust port of gas monitor. Make sure that the other end of the same tube is connected to the back of WATO EX-35(0619).

3.2.9 Negative Pressure Suction

Install the negative pressure suction body on the right handle of the machine. Place the liquid collection bottle of negative pressure suction on the dedicated bracket on the left and connect the tubes.



FOR YOUR NOTES

4 Testing

⚠WARNING

- **After servicing the equipment or replacing its components, complete all the tests in this section.**
- **Before doing the tests in this section, completely reassemble the equipment and refer to 7 System Calibration to do necessary calibrations.**

4.1 System Inspection

NOTE

- **Make sure that the patient circuit is correctly connected and not damaged.**
- **The top shelf weight limit is 30 kg.**

⚠WARNING

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

Make sure that:

1. The equipment is not damaged.
2. All components are correctly attached.
3. The patient circuit is correctly connected and the breathing tubes are not damaged.
4. The vaporizers are locked in position.
5. The fixing nuts of the negative pressure suction system are fastened.
6. The gas supplies are connected and the pressures are correct.
7. Cylinder valves are closed on models with cylinder supplies.
8. The casters are not loose and the brake (s) is set and prevents movement.
9. Make sure the patient circuit is locked safely.
10. The power cord is correctly connected. The AC mains indicator and the battery indicator work normally.
11. The anesthesia machine is switched on or off normally.

4.2 System Self- Test

When the system is powered on, it performs a self-test to ensure its alarm system (alarm LED, speaker, and buzzer) and hardware (flowmeter board, ventilator board, assistant ventilator board, power board, and CPU board) are properly functioning.

System Self-test Sequence	Comments
1. A high-pitched beep is sounded. A click is sound if O_2.N2O drive switch is configured.	Alarm self-test
2. The startup screen is displayed.	/
3. The LED above the touchscreen illuminates in sequence: red, yellow, and blue.	Alarm self-test
4. A test low priority alarm is sounded.	Alarm self-test; no abnormal sound
5. The System Self-Test progress bar is displayed.	/
6. The System Self-Test is automatically started.	Hardware self-test
7. The results of the System Self-Test are displayed.	/

Ensure the system self-test is passed, and no abnormal alarm messages.

NOTE

- **Make sure that the patient circuit is correctly connected and not damaged.No abnormal sounds of buzzer, such as breaking sound, hoarse sound, changed sound, sound too large, or sound too small, during the system self-test.**
- **All needle valves are closed totally during the system self-test.**

4.3 Leak and Compliance Tests

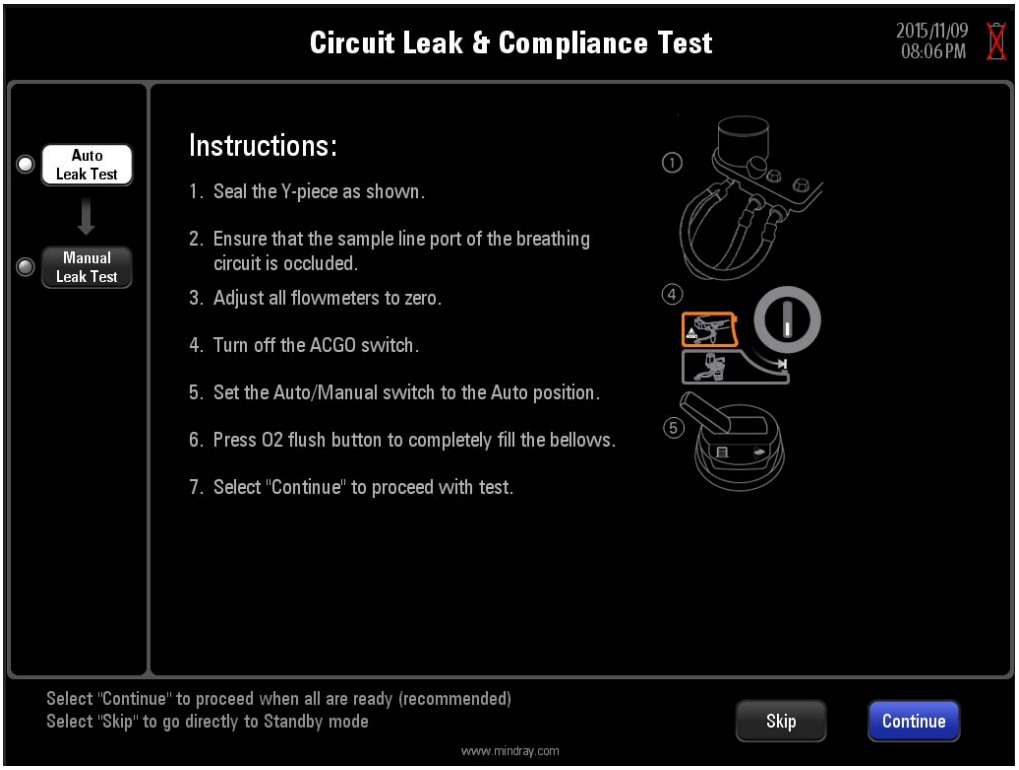
NOTE

- **Perform leak test after maintaining the anesthesia machine, replacing parts, or reconnecting tubes.**

4.3.1 Automatic Circuit Leak and Compliance Test

This test checks if the pneumatic circuit has leakage in mechanical ventilation mode. The test items include bellows, drive gas circuit, CO2 absorber canister, patient tube, flow sensor, and flow sensor connector.

The following figure shows the Automatic Circuit Leak & Compliance Test screen.



To perform an automatic circuit leak test,

NOTE

- **The system records the result of the last automatic circuit leak test in the [General] tab, including if the test result is passed or failed, or the test is skipped. To view the last test result, select > [General] on the main screen.**

1. From system power-up:

   If the system is being powered on, the system automatically initiates a self-test and enters the Automatic Circuit Leak Test screen and then the Manual Circuit Leak Test screen. If the Skip button is selected, the system bypasses the Automatic Circuit Leak Test and Manual Circuit Leak Test screens and enters the Standby screen.

   Or

   From the main screen:

   Select Setup > General > Test Leak/Compliance.
2. Follow the directions on the screen.

NOTE

- **The Continue button can be selected only when the Auto/Manual switch is set to the Auto position and no fresh gas is detected.**

3. Compare the test results with the results of the automatic circuit leak and compliance test, and proceed accordingly.

Result	Comments/Options
Automatic Circuit Leakage: **Pass** Compliance Test: **XX.X mL/cmH2O**	Leakage rate ≤ 200 mL/min Compliance test results are displayed in green. Select Continue to enter the Manual Circuit Leak Test screen.
Automatic Circuit Leakage: **XXX mL/min** Compliance Test: **Success**	200 mL/min< Leakage rate ≤ 1000 mL/min The compliance test has performed successfully. Select **Continue** to enter the **Manual Circuit Leak Test** screen and use the previous compliance values . Or Select **Retry** to repeat the automatic circuit leak and compliance tests. Treatment measures: 1. Check if all the pipes are connected well. 2.Check if the Y-piece connector is blocked. 3.Check is the water collection cup is installed well and the drain valve is closed. 4.Check is the sampling pipe is connected well.
Automatic Circuit Leakage: XXX mL/min Compliance Test: **Fail**	200 mL/min< Leakage rate ≤ 1000 mL/min Select **Continue** to enter the **Manual Circuit Leak Test** screen and use the previous compliance values (using fresh gas to compensate the leakage) Select **Retry** to repeat the automatic circuit leak and compliance tests. Treatment measures: 1. Check if all the pipes are connected well. 2.Check if the Y-piece connector is blocked. 3.Check is the water collection cup is installed well and the drain valve is closed. 4.Check is the sampling pipe is connected well.
Automatic Circuit Leakage: **Fail** Compliance Test: **Fail**	Leakage rate > 1000 mL/min Fresh gas is not detected. Follow directions on the screen for troubleshooting. Or Select **Manual Only** to enable only manual ventilation for the equipment. The low-priority alarm "Automatic Ventilation Disabled–Leak Test Failed" will be displayed on the main screen. **⚠WARNING** ● **Selecting Manual Only will disable mechanical ventilation.** Treatment measures: 1. Check if all the pipes are connected well. 2.Check if the Y-piece connector is blocked. 3.Check is the water collection cup is installed well and the drain valve is closed. 4.Check is the sampling pipe is connected well.

Result	Comments/Options
MACHINE NON-FUNCTIONAL Automatic Circuit Leakage: **Fail** Compliance Test: **XX.X mL/cmH2O** Safety Valve Control: **Fail**	The safety valve control test or pressure verification test failed. Select **Retry** to repeat the automatic circuit leak and compliance tests. Or Contact the customer service center if this error condition persists. **NOTE** ● **Service Access button: This button is available only to Mindray-authorized service personnel and a service password is required.** Treatment measures: Check if the safety valve connection cable is connected well.

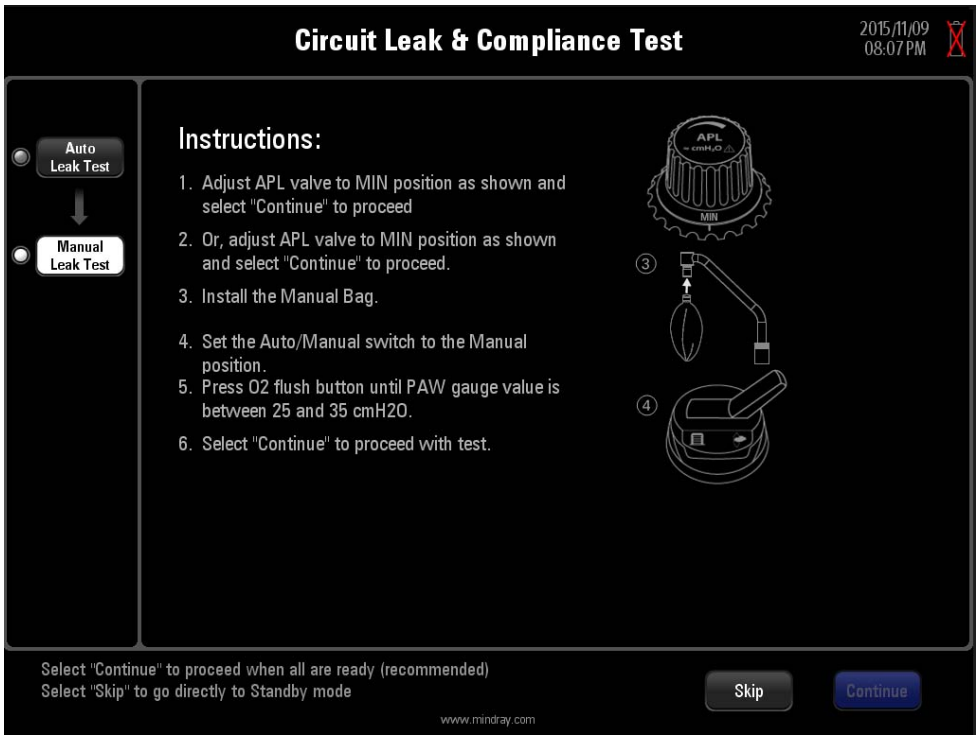
NOTE

- **The result of automatic circuit leak and compliance test is recorded in Service Log. To view the test result, select > [Service] > [Review Logs] > [Service] on the main screen.**

4.3.2 Manual Circuit Leak Test

This test checks if the pneumatic circuit has leakage in manual ventilation mode. The test items include APL valve, check valve, CO2 absorber canister, patient tube, flow sensor, and flow sensor connector.

The following figure shows the Manual Circuit Leak Test screen.



To perform a manual circuit leak test,

NOTE

- **If fresh gas is detected by the system before undergoing the manual circuit leak test, a message is displayed on the screen for zeroing all flowmeters.**

1. From system power-up:

   If the system is being powered on, the system automatically initiates a self test followed by automatic circuit leak and compliance tests and a manual circuit leak test. If the [**Skip]** button is selected, the system bypasses these tests and enters the **Standby** screen.

   Or

   From the main screen:

   Select  > [General] > [Test Leak/Compliance].
2. Follow the directions on the screen.

NOTE

- **The Continue button can be selected only when the Auto/Manual switch is set to the Manual position and no fresh gas is detected.**

Result	Comments/Options
Pass	Leakage rate <= 200ml/min. Adjust the APL valve to the SP position. Select **Continue** to enter the main screen.

Result	Comments/Options
Fail: XXX mL/min	Leakage rate >200 ml/min & <=1000 ml/min. Follow directions on the screen for troubleshooting. Or Adjust the APL valve to the SP position and select **Accept** to enter the main screen. Treatment measures: 1. Check if all the pipes are connected well. 2.Check if the Y-piece connector is blocked. 3.Check is the water collection cup is installed well and the drain valve is closed. 4.Check is the sampling pipe is connected well.
Fail	Leakage rate > 1000 mL/min. Follow directions on the screen for troubleshooting. Or Adjust the APL valve to the SP position and select **Accept** to enter the main screen. Treatment measures: 1. Check if all the pipes are connected well. 2.Check if the Y-piece connector is blocked. 3.Check is the water collection cup is installed well and the drain valve is closed. 4.Check is the sampling pipe is connected well.
Fail: Please cut off the fresh gas flow	Open the fresh air. Treatment measure: Cut off the fresh air. Choose Retry to repeat the test.
Time Out	The test failed. Choose Retry and repeat the automatic circuit leak and compliance test. OR Choose Neglect to skip the test. Treatment measures: 1. Check if all the pipes are connected well. 2.Check if the Y-piece connector is blocked. 3.Check is the water collection cup is installed well and the drain valve is closed. 4.Check is the sampling pipe is connected well.
Backup Flow Control is enabled	The BFCS is enabled. Follow directions on the screen for troubleshooting. Or Select **Accept** to enter the normal operation mode. The system uses the previous compliance values. Treatment measures: Shut down the backup flow control system.

NOTE

- **The result of manual circuit leak test is recorded in Service Log. To view the test result, select  > [Service] > [Review Logs] > [Service] on the main screen.**

4.3.3 Troubleshooting—Leak Test

The following table lists the commonly-encountered problems and recommends actions for breathing system leak test in mechanical ventilation mode.

Fault 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 switch is set to the Manual position and the message [Manual Vent.] is prompted.	Set the Auto/Manual switch to the Auto 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 280 to 600 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. 4. The sample gas return quick connector is not blocked.	1. Allow the bellows to be fully inflated before leak test. 2. Connect the Y piece on the breathing tube to the test plug. 3. Re-install the bellows housing. 4. Block the sample gas return quick connector

4.4 Gas Supply Tests

All the three needle valves must be closed before the following tests.

4.4.1 O2 Pipeline Supply Test

NOTE

- **Remove the O2 cylinder from the yoke before performing this test.**

1. Connect the machine to the O2 supply connector on the wall via O2 supply hose.
2. Check that the O2 supply pressure gauge reads 280 to 600 kPa.
3. Turn on the system switch.
4. Adjust the O2 needle valve, make the flow of O2 at the values 5L/min, 10L/min, 15L/min, 10L/min, 5L/min, and 1L/min (error of the value within ±10% is acceptable),keep each flow valve for 3s. During adjusting the O2 flow, make sure that the needle valve could be adjusted smoothly, without any noise or flow shake. And the flow of AIR and N2O should be zero.
5. Disconnect the O2 pipeline supply, and open the O2 needle valve fully
6. Make sure that the alarms of "O2 Supply Failure" and "Drive Gas Pressure Low" occur with the decrease of O2 pressure.
7. Check that the O2 supply pressure gauge decreases to zero.
8. Close the O2 needle valve, and finish the test.

4.4.2 N2O Pipeline Supply Test

NOTE

- **Remove the N2O cylinder from the yoke before performing this test.**

1. Connect the machine to the O2 and N2O supply connectors on the wall via O2 and N2O supply hoses.
2. Check that the O2 and N2O supply pressure gauges read 280 to 600 kPa.
3. Turn on the system switch.
4. Adjust the N2O needle valve, make the flow of N2O at the values 1L/min, 5L/min, 10L/min, 5L/min, and 1L/min (error of the value within ±10% is acceptable), keep each flow valve for 3s. During adjusting the O2 flow, make sure that the needle valve could be adjusted smoothly, without any noise or flow shake. And the flow of AIR should be zero.
5. Disconnect the N2O pipeline supply, and open the O2 and N2O needle valve fully.
6. Make sure that the N2O supply pressure gauge decreases to zero.
7. Close the N2O needle valve, and finish the test.

4.4.3 Air Pipeline Supply Test

NOTE

- **Remove the air cylinder from the yoke before performing this test.**

1. Connect the machine to the Air supply connector on the wall via Air supply hose.
2. Check that the Air supply pressure gauge reads 280 to 600 kPa.
3. Turn on the system switch.
4. Adjust the AIR needle valve, make the flow of AIR at the values 1L/min, 5L/min, 10L/min, 15L/min, 10L/min, 5L/min, and 1L/min (error of the value within ±10% is acceptable), keep each flow valve for 3s. During adjusting the O2 flow, make sure that the needle valve could be adjusted smoothly, without any noise or flow shake. And the flow of O2 and N2O should be zero.
5. Disconnect the Air pipeline supply, and open the AIR needle valve fully.
6. Make that the Air supply pressure gauge decreases to zero.
7. Close the AIR needle valve, and finish the test.

4.5 Cylinder Supply Tests

All the three needle valves must be closed before the following tests.

4.5.1 O2 Cylinder Supply Test

1. Remove the O2 supply hose from the gas source inlet assembly.
2. Mount the backup cylinder full of O2 on the backup cylinder yoke. If necessary, place a new clean washer between the cylinder and cylinder yoke to minimize leakage caused by yoke connections.
3. Keep the O2 cylinder open, before the cylinder pressure gauge displays the pressure of the cylinder.
4. Turn off O2 cylinder.
5. Ensure that the pressure value displayed on the front panel O2 pressure gauge does not decrease by less than 10% within one minute.

4.5.2 N2O Cylinder Supply Test

1. Remove the N2O supply hose from the gas inlet assembly.
2. Mount the backup cylinder full of N2O on the backup cylinder yoke. If necessary, place a new clean washer between the cylinder and cylinder yoke to minimize leakage caused by yoke connections.
3. Keep the N2O cylinder open, before the cylinder pressure gauge displays the pressure of the cylinder.
4. Turn off N2O cylinder.
5. Ensure that the pressure value displayed on the front panel N2O pressure gauge does not decrease by less than 10% within one minute.

4.5.3 Air Cylinder Supply Test

1. Remove the Air supply hose from the gas inlet assembly.
2. Mount the backup cylinder full of Air on the backup cylinder yoke. If necessary, place a new clean washer between the cylinder and cylinder yoke to minimize leakage caused by yoke connections.
3. Keep the Air cylinder open, before the cylinder pressure gauge displays the pressure of the cylinder.
4. Turn off Air cylinder.
5. Ensure that the pressure value displayed on the front panel Air pressure gauge does not decrease by less than 10% within one minute.

4.6 Flow Control System Tests

4.6.1 Without O2 Sensor

NOTE

- **Turn the flow controls slowly. Do not turn further when the flowmeter indicates the maximum or minimum flow to avoid damaging the control valve.**

⚠WARNING

- **If N2O is available and flows through the system during this test, use a safe and approved procedure to collect and remove it.**
- **Incorrect gas mixtures can cause patient injury. If the O2-N2O Link system does not supply O2 and N2O in the correct proportions, do not use the system.**

To do the flow control system tests:

1. Connect the pipeline supplies or slowly open the cylinder valves.
2. Turn all flow controls fully clockwise (minimum flow).
3. Set the system switch to the ⊙ position.
4. Connect the AC power source if battery capacity shortage occurs. Do not use the system if other ventilator failure alarm occurs.
5. Set the flow controls to mid range. Check that the flow tube float moves smoothly.
6. Test the Link system with N2O flow increasing:

   a. Turn the O2 and N2O flow controls fully clockwise (minimum flow).

   b. Turn the N2O flow control only.

   c. Increase the N2O flow gradually as shown in the table. Make sure that the O2 flow must be greater than the minimum limits.

   d. If the N2O flow is set crossing the limit, before continuing the test, turn the O2 flow control clockwise till the N2O flow decreases to the preset value.

Step	N2O flow (L/min)	O2 flow (L/min)
1	0.9	≥0.25
2	1.5	≥0.4
3	3.0	≥0.8
4	6	≥1.6

7. Test the Link system with O2 flow decreasing:

   a. Set the N2O flow to 9.0 L/min.

   b. Set the O2 flow to more than 3 L/min.

   c. Slowly turn the O2 flow control clockwise to set the N2O flow to the rates shown in the table. Make sure that the O2 flow must be greater than the minimum limits.

   d. If the O2 flow is set crossing the limit, before continuing the test, turn the N2O flow control counterclockwise till the N2O flow increases to the preset value.

Step	N2O flow (L/min)	O2 flow (L/min)
1	6	≥1.6
2	3.0	≥0.8
3	1.5	≥0.4
4	0.9	≥0.25

8. Cut off the N2O pipeline supply or close the N2O cylinder valve. Turn the O2 and N2O flow controls counterclockwise respectively and turn on the O2 and N2O flowmeters. Make sure that there is no residual gas in the N2O pathway and the pressure gauge in the N2O pathway goes to zero. Then turn the O2 and N2O flow controls clockwise respectively and make sure that the O2 and N2O flows are at the minimum.
9. Disconnect the O2 pipeline supply or close the O2 cylinder valve.

NOTE

- **During O2 supply disconection, with the decrease in O2 pressure, alarms of O2 Supply Failure and Drive Gas Pressure Low are triggered.**

10. Set the system switch to the position.

4.6.2 With O2 Sensor

Do as described in ***4.10.2Test the O2 Concentration Monitoring and Alarms*** before testing. To do the flow control system tests:

1. Connect the pipeline supplies or slowly open the cylinder valves.
2. Turn all flow controls fully clockwise (minimum flow).
3. Set the system switch to the position.
4. Connect the AC power source if battery capacity shortage occurs. Do not use the system if other ventilator failure alarm occurs.
5. Set the flow controls to middle range. Check that the flow tube float moves smoothly.

⚠WARNING

- **During steps 6 through 7, the O2 sensor used must be correctly calibrated and the Link system must be kept in working status.**

6. Test the Link system with N2O flow increasing:

   a. Turn the O2 and N2O flow controls fully clockwise (minimum flow).

   b. Turn the N2O flow control only.

   c. Increase the N2O flow gradually and the O2 flow should increase accordingly. The measured O2 concentration must be ≥21% through the full range.

7. Test the Link system with O2 flow decreasing:

   a. Set the N2O flow to 9.0 L/min.

   b. Set the O2 flow to more than 3 L/min.

   c. Slowly turn the O2 flow control clockwise and the N2O flow should decrease accordingly. The measured O2 concentration must be ≥21% through the full range.

8. Cut off the N2O pipeline supply or close the N2O cylinder valve. Turn the O2 and N2O flow controls counterclockwise respectively and turn on the O2 and N2O flowmeters. Make sure that there is no residual gas in the N2O pathway and the pressure gauge in the N2O pathway goes to zero. Then turn the O2 and N2O flow controls clockwise respectively and make sure that the O2 and N2O flows are at the minimum.
9. Disconnect the O2 pipeline supply or close the O2 cylinder valve.

NOTE

- **During O2 supply disconection, with the decrease in O2 pressure, alarms of O2 Supply Failure and Drive Gas Pressure Low are triggered.**

10. Set the system switch to the ⏻ position.

4.7 Vaporizer Test

4.7.1 Vaporizer Interlock Test

1. Attach two vaporizers to the vaporizer manifold and lock them in place.
2. Rotate one vaporizer dial to 3%.
3. Verify that the other vaporizer dial is disabled.
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 in good condition.
9. Reconnect both vaporizers to the vaporizer manifold.

4.7.2 Vaporizer Back Pressure Test

⚠WARNING

- **Use only the Selectatec series vaporizers. Make sure that the vaporizers are locked when doing the test.**
- **During the test, the anesthetic agent comes out of the fresh gas outlet. Use a safe and approved procedure to remove and collect the agent.**
- **To prevent damage, turn the flow controls fully clockwise (minimum flow or OFF) before using the system.**

Before the test, make sure that the vaporizers are correctly installed.

1. Connect the O2 pipeline supply or open the O2 cylinder valve.
2. Turn the O2 flow control and set the O2 flow to 6 L/min.
3. Make sure that the O2 flow stays constant.
4. Adjust the vaporizer concentration from 0 to 1%. Make sure that the O2 flow must not decrease more than 1 L/min through the full range. Otherwise, install a different vaporizer and try this step again. If the problem persists, the malfunction is in the anesthesia system. Do not use this system.
5. Test each vaporizer as per the steps above.

NOTE

- **Do not perform test on the vaporizer when the concentration control is between "OFF" and the first graduation above "0" (zero) as the amount of anesthetic drug outputted is very small within this range.**

4.7.3 Vaporizer Accuracy Test

1. Set the APL valve to 70cmH2O.
2. Put the Auto/Manual switch to the Manual position.
3. Connect one end of the breathing hose to the expiration port and the other end to the bag arm.
4. Connect the sampling tee of the gas analyzer to the inspiration port.
5. Use a breathing hose to connect the output end of the sampling tee to the scavenging system.



6. Verify that the scavenging system is connected to the wall and the float is between MIN and MAX scales.

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 equipment.
9. Test the vaporizer accuracy per the manufacturer's instructions.
10. Test each vaporizer in turn.
11. Test all the vaporizers on the vaporizer storage mount.
12. Remove the measuring equipment.
13. Disconnect the waste gas scavenging hose.

NOTE

- **The vaporizer has deviations due to change of barometric pressure (high altitude). And the Riken F-211 gas analyzer also has deviations. 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 it in high altitude area.**

4.7.4 Vaporizer Leak Test

1. Set the Auto/Manual switch to the Manual position.
2. Set the ACGO switch off (if ACGO function is configured.
3. Set the APL valve to the SP position.
4. Connect the manual bag to the manual arm port.
5. Connect the Y-piece of the patient circuit into the leak test port to close the breathing system.



6. 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.)
7. Set the fresh gas flow to 0.2 L/min.
8. Set the APL valve to 75 cmH2O.
9. Hold down the O2 Flush button and verify that the pressure on the PAW gauge increases above 30 cmH2O.
10. Release the O2 Flush button and observe the PAW gauge. Verify that the value read on the PAW gauge does not decrease.
11. Turn off the vaporizer.
12. Repeat steps 6, 7, 8, 9, 10, and 11 for the other vaporizer.

4.8 Other Functional Tests

4.8.1 Drive Gas Switching Function Test

NOTE

- **1 This test is for the device configured with drive gas switching function.**
- **2 Connect O2 supply and Air supply both before operating this test. Set the ventilation mode as VCV, patient size as Audlt, keep the other vent parameters as default value, switch the vetilation mode to auto mode.**
- **3 For the main drive gas, see the button of the upper left corner of the screen.**



The main drive gas is Air

For the device of which the main drive gas is O2:

1. Disconnect O2 supply in automatic ventilation mode. Ensure there are two alarms “O2 supply failure” and “Drive gas pressure low” ,and a dialog appears to suggest switch the drive gas, and select [Yes].
2. A sound of switch is heard, and the drive gas is switched to Air, and a message of drive gas being switching to Air appears. Make sure that the anesthesia machine could work properly.
3. Reconnect O2 supply, a dialog of O2 supply resumed appears.
4. Select [Yes], and confirm the device can switch the drive gas to O2 normally.

For the device of which the main drive gas is Air:

1. Disconnect Air supply in automatic ventilation mode. Ensure there are two alarms “AIR supply failure” and “Drive gas pressure low” ,and a dialog appears to suggest switch the drive gas, and select [Yes].
2. A sound of switch is heard, and the drive gas is switched to O2, and a message of drive gas being switching to Air appears. Make sure that the anesthesia machine could work properly.
3. Reconnect AIR supply, a dialog of AIR supply resumed appears.
4. Select [Yes], and confirm the device can switch the drive gas to AIR normally.

4.8.2 O2 Flush Test

4.8.2.1 In Mechanical Ventilation Mode

1. Connect the O2 pipeline supply or cylinder.
2. Set the bag/vent switch to the mechanical ventilation position.
3. Set the system to standby or working status.
4. Plug the patient connection using a test plug.
5. Turn off ACGO (if ACGO is configured).
6. Let the folding bag completely collapse.
7. Press and hold the O2 flush button O_2+. Measure the time required for fully inflating the folding bag.
8. Repeat the operation (opening patient connection to collapse the folding bag) at least twice.
9. Check that the folding bag is fully inflated within 1 to 3 seconds.

4.8.2.2 In Manual Ventilation Mode

1. Set the bag/vent switch to the bag position.
2. Set the system to standby or working status.
3. Plug the patient connection using a test plug.
4. Connect a 3 L or 1 L bag to the bag arm or manual bag port.
5. Turn off ACGO (if ACGO is configured).
6. Let the bag completely collapse.
7. Turn the APL valve to 75 cmH2O.
8. Press and hold the O2 flush button O_2+. Measure the time required for the reading on the pressure gauge to reach 10 cmH2O.
9. Repeat the operation (open patient connection and press the bag to completely collapse the bag) at least twice.
10. Check that
    - The 3 L bag is fully inflated within 3 to 6 seconds.
    - The 1 L bag is fully inflated within 1 to 3 seconds.
    -

4.8.3 ACGO Function Tests

4.8.3.1 ACGO Switch Alarm Test

NOTE

- **It is no need to do this test for the device which do nou configure with ACGO.**

1. Exit Standby mode.
2. Turn the ACGO switch to the position of ACGO. The icon of ACGO appears on the ventilation mode area on the screen. And ACGO prompt message appears on message area.
3. Turn the ACGO switch to the position of patient circuit. Prompt message disappears.

4.8.3.2 ACGO Pressure Detection Function Test

NOTE

- **All devices configued with ACGO have pressure detection function.**

1. Enter maintenance interface in Standby mode, and set the ACGO selection to independent ACGO with three way valve.
2. Exit Standby mode, and enter VCV mode. After three (3) to five (5) normal ventilation cycles, turn the ACGO switch to ACGO mode, and confirm VCV is replaced by ACGO on the ventilation mode area on the screen.
3. Connect O2 supply and adjust the O2 flow knob to set the flow to 4.5~5.5L/min.
4. Block the independent ACGO outlet, and there should be pressure fluctuating on PAW area of the screen.

4.8.4 AGSS Inspection

4.8.4.1 Check the Float

Install the AGSS and connect the gas supplies. Check if the float floats off and is between the MAX and MIN levels. If the float fails to be between the MAX and MIN levels by turning the flow adjustment knob at the top of AGSS, or if the float is tacky or damaged, re-install the AGSS or replace the float.

NOTE

- **Do not block the AGSS pressure compensation openings during the inspection.**

If the float fails to float off, the possible reasons are:

1. The float is tacky or stuck to the guide bar. Invert the AGSS and check if the float moves up and down freely. If not, clean where the float and guide bar meet to remove possible foreign substance. Replace the float or guide bar when necessary.
2. The filter screen inside the top cove may be occluded. Remove the filter screen as described below and check if the filter screen is occluded.

   a. Turn the top cover counterclockwise to separate it from the sight glass. Remove the filter screen.

   b. Shake dust and foreign substance from the removed filter screen until satisfactory clean effect is achieved.



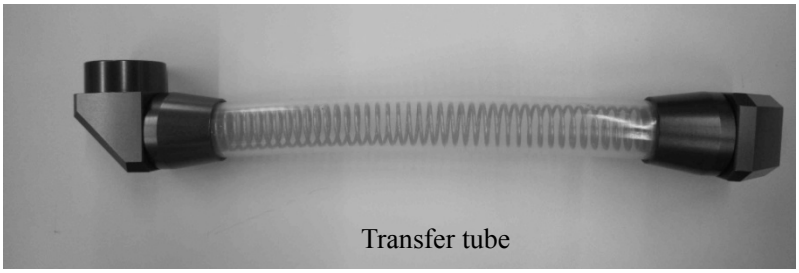
3. The waste gas disposal system is not working or the pump rate is less than the AGSS normal working flow. Check if the waste gas disposal system reaches the pump rate range which the AGSS declares, which is 25 to 50 L/min for low flow AGSS and 75 to 105 L/min for high flow AGSS.

4.8.4.2 Check the Transfer Tube and Active Scavenging Tube

1. Disconnect the tubes from other components.

   Check the transfer tube and its connectors for damage.

   Check if the transparent silicone hose for damage.

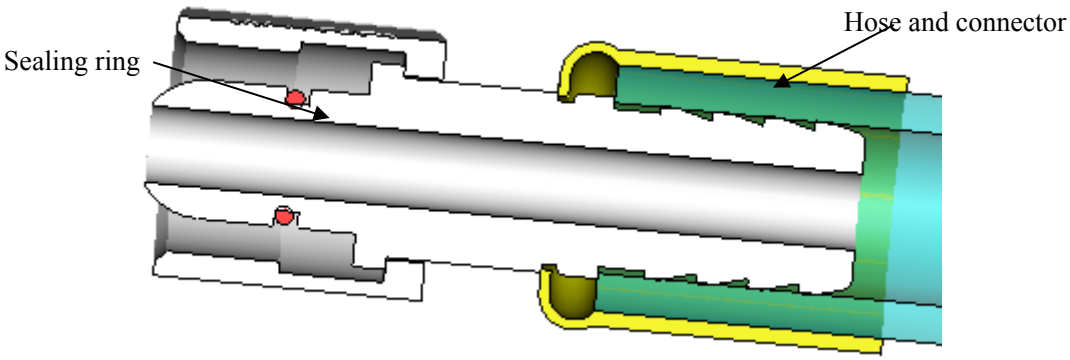


2. Check the receiving hose regarding the following three aspects:

   a. The receiving hose and its connectors for damage.

   b. If the connections between the receiving hose and its connectors are loose.

   c. The sealing ring for damage.



If any damage or loose connection is detected, replace the corresponding part.

4.8.5 Negative Pressure Suction Inspection

4.8.5.1 Check the Tube Connections of Liquid Collection Bottle

1. Check if the tubes are correctly connected following the connection diagram printed on the liquid collection bottle. If not, the overfill protection device cannot work normally.
2. Check if the tubes are inserted in place. If not, leakage may occur, resulting in failure to reach negative pressure of 50 kPa.



4.8.5.2 Check the Negative Pressure

1. Read the reading on the Air pipeline pressure gauge on the front side of the anesthesia machine and make sure that the pipeline supply gas pressure is within the normal pressure range. (Only for the anesthesia machines without Venturi negative pressure suction configuration.)
2. Set the swapping switch on the negative pressure regulator to REG position.
3. Set the switch of Venturi negative pressure generator to ON position. (Only for the anesthesia machines without Venturi negative pressure suction configuration.)
4. Occlude the patient connection outlet of suction tube with hand.
5. Check if the reading on the negative pressure regulator is greater than 50 kPa. If it is less than 50 kPa, check the following:

   a. Increase the pressure at the rear end of negative pressure regulator clockwise.

   b. Rotate counterclockwise to remove the muffler. Shake dust and foreign substance from the muffler.

   c. Occlusion can occur after the filter is used for a long time. Replace the filter and do the test again.
6. If the negative pressure suction device is without Venturi, step 1 and step 3 is no need.

4.9 Patient Circuit Tests

4.9.1 Check Valve Test

⚠WARNING

- **Objects in the patient circuit can stop gas flow to the patient. This can cause injury or death. Make sure that there are no test plugs or other objects in the patient circuit.**
- **Do not use a test plug that is small enough to fall into the patient circuit.**

1. Make sure that the patient circuit is correctly connected and not damaged.
2. Make sure that the check valves in the patient circuit work correctly:
   - ◆ The inspiratory check valve opens during inspiration and closes at the end of inspiration, and remains closed during expiration.
   - ◆ The expiratory check valve opens during expiration and closes at the end of expiration, and remains closed during inspiration.

4.9.2 Bellows Test

1. Set the system to Standby.
2. Set the Bag/vent switch to the mechanical ventilation position.
3. Set all flow controls to minimum.
4. Connect the Y piece on the breathing tube to the leak test plug to occlude the outlet of the Y piece..
5. Push the O_2 flush button to fill the bellows, which rises to the top.
6. Make sure that the pressure reading on the airway pressure gauge must not increase to more than 15 cmH_2O
7. Release the O2 flush button and the bellows should not fall. If it falls, it indicates that the bellows assembly has a leak. You need to reinstall the bellows.

4.9.3 Breathing System Leak Test in Manual Ventilation Mode

NOTE

- **Perform leak test again each time after servicing the anesthesia machine, replacing the components, or re-connecting the tubes.**
- **Before performing breathing system leak test, make sure that there is no alarm of pressure monitoring channel failure on the screen.**

The test aims to check if the pneumatic circuit has leaks in manual ventilation mode. Test items include APL valve, check valve, sodalime canister, patient tubes, flow sensors and their connectors.

There are two methods available for breathing system leak test in manual ventilation mode. One is by software auto test and the other by manual test.

4.9.3.1 Software Auto Test

There are two ways available to enter the software auto test screen.

Way 1: Push the [**Maintenance**] key to enter the maintenance menu. Select [**Factory Maintenance>>**] and enter the required password to enter the factory maintenance menu. Select [**System Setup**] and switch on leak test in the system setup menu. Then restart the machine. Select [**Continue**] on the startup selftest result screen to enter the manual leak test screen.

Way 2: Make sure that the system is Standby. If not, press the ⏻ key and select [**Ok**] from the pop-up menu to enter Standby. Push the [**Maintenance**] key to enter the maintenance menu. Select [**System Leak&Compliance Test**] to enter manual leak test screen.

To do the manual leak test:

1. Make sure that the system is Standby. If not, press the ⏻ key and select [**Ok**] from the pop-up menu to enter Standby.
2. Set ACGO to patient circuit (if ACGO is configured).
3. Insert the Y piece into the test plug.
4. Install the manual bag.
5. Turn the APL valve to 75 cmH2O.
6. Turn all flow controls to zero.
7. Set the bag/vent switch to the bag position.
8. Push the O_2 flush button to let the pressure fall between 25 and 35 cmH2O on the airway pressure gauge.
9. Select [**Continue**] to start manual leak test.
10. When the manual leak test is completed, the screen for manual leak test result is switched to automatically, prompting the manual leak test result.
    - ◆ "Pass" is displayed if the manual leak test is passed.
    - ◆ "Fail" is displayed in red if the manual leak test is failed.

4.9.3.2 Manual Test

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

1. Make sure that the system is Standby. If not, press the ⏻ key and select [**Ok**] from the pop-up menu to enter Standby.
2. Set ACGO to patient circuit (if ACGO is configured).
3. Set the bag/vent switch to the bag position.
4. Connect the manual bag to the manual bag port.
5. Turn the APL valve control to fully close the APL valve (75 cmH_2O).
6. Turn the O_2 flow control to set the O_2 flow to 0.15 to 0.2 L/min.
7. Close the breathing system at the patient connection.
8. Push the O_2 flush button to let the pressure increase to approximately 30 cmH_2O on the airway pressure gauge.
9. Release the O2 flush button. A pressure decrease on the airway pressure gauge indicates a leak. Look for and repair the breathing system leak.

4.9.3.3 Commonly-encountered Problems and Recommended Actions

The following table lists the commonly-encountered problems and recommends actions for breathing system leak test in manual ventilation mode.

Failure description	Possible cause	Recommended action
Software auto leak test is failed.	1. The reading on the drive gas 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 280 to 600 kPa.
	2. The bag/vent switch is not set to the bag position.	Set the bag/vent switch to the mechanical ventilation position.
Manual circuit is leaky.	1. The Y piece on the breathing tube is not connected to the test plug. 2. The APL valve is not turned to the maximum pressure. 3. The manual bag port is not occluded with test lung. 4. The CO2 absorbent canister is not installed in place.	Check the pneumatic connections and do the test again strictly following the operation instructions.

4.9.3.4 Definitions of Error Information during Breathing System Leak Test in Manual Ventilation Mode

During the leak test, many abnormal factors or operations may result in breathing system manual circuit leak test failure. The following table lists the definitions of various abnormal factors. If the breathing system leak test fails, the relevant error code will be recorded in the service logbook.

S/N	Cause	Description	Error code
1	The user cancels the command.	/	0000 0001
2	The bag/vent switch is in vent position.	/	0000 0002
3	ACGO is ON.	/	0000 0004
4	O2 supply pressure is low.	/	0000 0008
5	The airway pressure sensor has an error.	The zero point of airway pressure sensor is not within the range of 0~1200(AD).	0000 0010
6	The airway pressure is not sufficient.	Before the test, the airway pressure in the circuit is less than 18cmH2O	0000 0020
7	Pressure drops drastically.	Pressure drops by more than 10cmH2O.	0000 0040

NOTE

- **If there is indeed a leak, check the pneumatic circuit system for leakage and troubleshoot the problems as described in 8 Troubleshooting.**
- **After leak failure is troubleshot, do the leak test again and make sure the test is passed.**

4.9.4 Breathing System Leak Test in Mechanical Ventilation Mode

NOTE

- **Perform leak test again each time after servicing the anesthesia machine, replacing the components, or re-connecting the tubes.**

The test aims to check if the pneumatic circuit has leaks in mechanical ventilation mode. Test items include bellows, drive gas circuit, CO2 absorbent canister, patient tubes, flow sensors and their connectors.

4.9.4.1 Test Procedures

NOTE

- **Patient circuit leak test must be performed when the system is Standby.**
- **Before doing the patient circuit leak test, make sure that the patient circuit is correctly connected and the breathing tubes not damaged.**
- **Before doing the breathing system leak test, make sure that the drive gas pressure is sufficient and the screen does not have alarms of flow sensor failure or pressure monitoring channel failure. During the leak test, make sure that the test procedures are strictly followed.**
- **During the leak test, selecting [**Cancel**] will stop the ongoing leak test. To continue the test, you must select [**Continue**] to start the leak test again.**

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

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

1. Make sure that the system is Standby. If not, press the ⏻ key and select [**Ok**] from the pop-up menu to enter Standby.
2. Set ACGO to patient circuit (if ACGO is configured).
3. Connect the Y piece on the breathing tube to the leak test plug to occlude the outlet of Y piece.
4. Turn all flow controls to zero.
5. Make sure that the bag/vent switch is set to the position.
6. Push the O_2 flush button to fill the bellows, bellows rising to the top.
7. Select the [**Maintenance**] shortcut key and select [**System Leak&Compliance Test**] to enter the manual leak test screen. Select [**Skip**] to enter the auto leak test screen. Select [**Continue**] to start the breathing system leak test and compliance test in mechanical ventilation mode. Typically, the test requires 3 to 5 minutes.
8. When the leak test is completed, the screen for auto leak&compliance test result is switched to automatically, prompting the system leakage and system compliance test result.

   1) If the leakage is less than or equal to 200 ml/min, it indicates that the system has good airtightness. The actual leakage is displayed in green.

   2) If the leakage is between 200 and 1000 ml/min (including 1000 ml/min), it indicates that the system has some leakage. The actual leakage is displayed in red.

   3) If the leakage is greater than 1000 ml/min, it indicates that the system has significant leakage. “>1000 ml/min” is displayed in red.

   4) “Fail” is displayed directly when the leak test cannot be executed or the leakage is too serious.

5) If the tube compliance is displayed in green numerics, it indicates that the tube compliance measured value is within the reasonable range. If tube compliance measurement is failed because the leakage exceeds 200 ml/min or due to other reason, the failure message is displayed directly.

9. If the leak test is passed, it indicates that leakage of mechanical ventilation circuit is within 0.2 L/min and the system has good airtightness. If the leak test is failed, it indicates that the leakage of mechanical ventilation circuit exceeds 0.2 L/min and the leak test screen prompts the user to do the following checking:

   1) If the Y-shaped tube is sealed;

   2) If the bellows rises to the top of the bellows housing;

   3) If the O2 sensor is installed;

   4) If the sampling port is occluded;

   5) Select Retry to do the test again and select Override to enter Standby.

   Check following the above steps. Select Retry to do the test again. If the leak test is still failed, overhaul the machine.

NOTE

- **In case of leak test failure, check all of the possible leak sources, including bellows, breathing system tubes and CO2 absorbent canister. Check that they are correctly connected and their connectors are not damaged.**
- **If there is indeed a leak, check the pneumatic circuit system for leakage and troubleshoot the problems as described in 8.5 Airway System Failure.**
- **After leak failure is troubleshot, do the leak test again and make sure the test is passed.**

4.9.4.2 Commonly-encountered Problems and Recommended Actions

The following table lists the commonly-encountered problems and recommends actions for breathing system leak test in mechanical 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 bag/vent switch is set to the bag position and the message [Manual Vent.] is prompted.	Set the bag/vent 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 280 to 600 kPa.
	The ACGO switch is turned on and the screen displays prompt message of ACGO.	Turn off the ACGO switch.
The airway pressure does not drop during the test but test failure is prompted.	Fresh gas is not turned off.	Turn off the fresh gas.
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. 4. The CO2 absorbent canister is not installed in place.	Check the pneumatic connections and re-install the pneumatic circuit.
During leak test, the pressure indicated by the airway pressure gauge reaches 30 cmH2O but then falls rapidly.	1. The bellows housing may not be installed properly. 2. The expiratory valve assembly is leaky. 3. The circuit is not tightly connected to the circuit adapter. 4. The connection between the sampling line of the sensor and the board is leaky.	Check the pneumatic connections and re-install the pneumatic circuit.
After the leak test, the alarm of [Ventilator Hardware Error 11] occurs.	Control of safety valve by the auxiliary control board fails.	Restart the machine. Verify if the safety valve is controllable by using the safety valve control command of the monitor board. If the safety valve is damaged, replace the safety valve. If the safety valve is in good condition, it indicates that the auxiliary control board or the main control board is faulty regarding the control path of the safety valve. Check the connecting lines or replace the faulty board.
After the leak test, the alarm of [PEEP Safety Valve Failure] occurs.	Control of safety valve by the monitor board fails.	

4.9.4.3 Definitions of Error Information during Breathing System Leak Test in Mechanical Ventilation Mode

During the leak test, many abnormal factors or operations may result in breathing system manual circuit leak test failure. The following table lists the definitions of various abnormal factors. If the breathing system leak test fails, the relevant error code will be recorded in the service logbook.

S/N	Cause	Description	Error code
1	The user cancels the command.	/	0000 0001
2	The bag/vent switch is in bag position.	/	0000 0002
3	ACGO is ON.	/	0000 0004
4	The drive gas pressure is low.	/	0000 0008
5	The airway pressure sensor has an error.	The zero point of airway pressure sensor is not within the range of 0~1200(AD).	0000 0010
6	The flow sensor has an error.	/	0000 0020
7	Pressure rise time is too long.	The longest time for pressure to rise to the specified pressure threshold 30cmH2O (+5cmH2O) exceeds 30s.	0000 0040
8	Pressure drops drastically.	Pressure is less than 18cmH2O.	0000 0080
9	Leakage is too large.	Leakage exceeds 1000ml/min.	0000 0100

NOTE

- **In case of leak test failure, check the machine for leakage and roughly assess the amount of leakage by using the following methods.**
  - Method 1: In the default VCV mode, stop fresh gas supply. If the bellows rises to the top each time, it indicates that the machine is not leaky. Otherwise, the machine is leaky. Gradually increase fresh gas. The amount of fresh gas when the bag rises to the top at each expiration can be roughly calculated as the amount of leakage.
  - Method 2: During leak test, observe the airway pressure gauge. A period of time (about 30 s) belongs to pressure holding stage after the airway pressure rises. If the airway pressure gauge shows that airway pressure is gradually falling, it indicates that the machine is leaky. Slowly increase fresh gas until airway pressure stops falling. The amount of the then fresh gas can be calculated as amount of leakage.
- **If there is indeed a leak, check the pneumatic circuit system for leakage and troubleshoot the problems as described in 8.5 Airway System Failure.**
- **After leak failure is troubleshot, do the leak test again and make sure the test is passed.**

4.9.5 APL Valve Test

1. Make sure that the system is Standby. If not, press the ⏻ key and select [**Ok**] from the pop-up menu to enter Standby.
2. Set the Bag/vent switch to the bag position.
3. Connect the manual bag to the manual bag port on the patient circuit.
4. Connect the Y piece on the breathing tube to the leak test plug on the manual bag port.
5. Turn the APL valve control to let the pressure of APL valve stay at 30 cmH_2O.
6. Push the O2 flush button to inflate the manual bag.
7. Make sure that the reading on the airway pressure gauge is with the range of 25 to 35 cmH_2O.
8. Turn the APL valve control to the SP position.
9. Set the O_2 flow to 3 L/min. Turn any other gases off.
10. Make sure that the reading on the airway pressure gauge is less than 5 cmH_2O.
11. Push the O_2 flush button. Make sure that the reading on the airway pressure gauge does not exceed 10 cmH2O.
12. Turn the O_2 flow control to set the O_2 flow to minimum. Make sure that the reading on the airway pressure gauge does not decrease below 0 cmH_2O.

4.9.6 O2 Sensor Related Tests

4.9.6.1 O2 Sensor Disconnection Alarm Test

1. Select , and then [**System**], and enter password: 799789.
2. Set [**O_2 Cell Monitoring**] to [**On**], and select [**Confirm**].
3. Disconnect the plug of O2 sensor, a prompt message of O2 Sensor Disconnected should appear. Connect O2 fixture (0611-K08-XX), this message should disappear.

4.9.6.2 O2 Concentration Test

21% O2 concentration test:

1. Put the O2 sensor unit with O2 sensor in the air.
2. Observe the display value of O2 concentration on the screen; confirm it is within the range of 21% to 24%.

100% O2 concentration test:

1. Set the O2 flow to 8L/min, and press O2 Flush button, to make the circuit to fill with 100% O2 as soon as possible.
2. Observe the display value of O2 concentration on the screen; confirm it is within the range of 97% to 100%. Turn off O2 flow.

4.9.7 Bypass Function Test

1. Hold and pull up the rotary handle for 90 degrees.
2. Turn the rotary handle for 90 degrees anticlockwise.
3. Pull off the CO2 absorbent canister from the lifting device.
4. Observe the bottom of the lifting device. If it is BYPASS configuration, power on the anesthesia machine for one minute, and the anesthesia machine can work normally.

NOTE

- **For the connections between CO2 absorbent canister and lifting device of two configurations are different, see the following figure 1.**
- **For two Circuits, with BYPASS and without BYPASS, see the following figure2 and figure 3.**
- **The disposable sodalime canister circuit is configured with BYPASS. It is no need to check.**

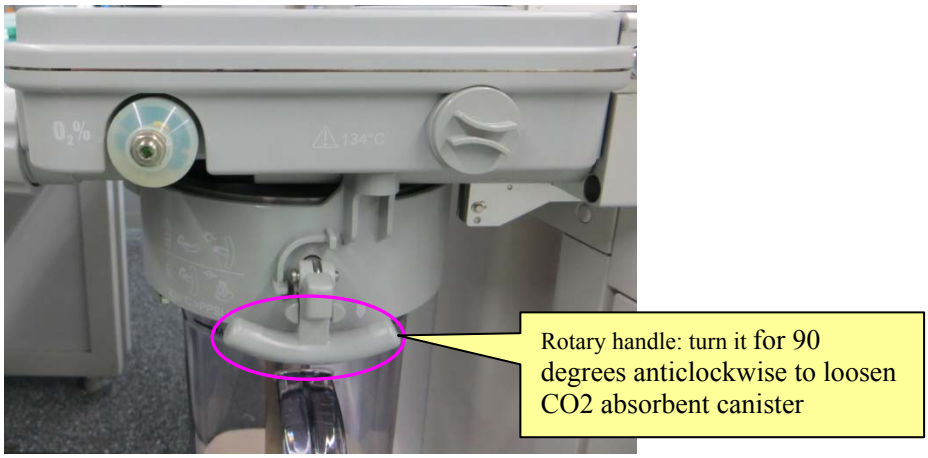


Figure 1

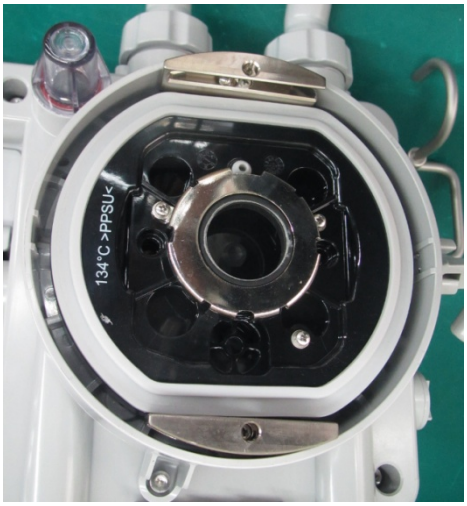


Figure2 (without BYPASS)



Figure 3 (with BYPASS)

4.10 Alarm Tests

4.10.1 Prepare for Alarm Tests

1. Connect a test lung or manual bag to the Y piece patient connection.
2. Set the Bag/vent switch to the position.
3. Set the system switch to the position.
4. Set the system to Standby.
5. Set the ventilator controls as follows:
   - Ventilation mode: select [**Vent Mode**] and then [**VCV**].
   - [**TV**]: 500 ml.
   - [**Rate**]:12 BPM.
   - [**I:E**]: 1:2.
   - [**Plimit**]: 30 cmH_2O.
   - [**PEEP**]: OFF.
   - [**TIP:TI**]: OFF.
6. Push the O_2 flush button to fill the bellows, which rises to the top.
7. Turn the O_2 flow control to set the O_2 flow to 0.5 to 1 L/min.
8 Press the key and select [**Ok**] from the pop-up menu to exit Standby.
9. Make sure that:
   - The ventilator displays the correct data.
   - The bellows inflates and deflates normally during mechanical ventilation.

4.10.2 Test the O_2 Concentration Monitoring and Alarms

NOTE

- **This test is not required if O_2 sensor is not configured.**

1. Set the Bag/vent switch to the position.
2. Remove the O_2 sensor and make sure that the sensor measures approximately 21% O_2 in room air.
3. Select [**Alarm Setup**] and then [**Ventilator >>**]. Set the FiO_2 low alarm limit to 50%.
4. Make sure that a low FiO_2 alarm occurs.
5. Set the FiO_2 low alarm limit to a value less than the measured FiO_2 value and make sure that the alarm cancels.
6. Put the O_2 sensor back in the circuit.
7. Select [**Alarm Setup**] and then [**Ventilator >>**]. Set the FiO_2 high alarm limit to 50%.
8. Connect the manual bag to the manual bag port on the patient circuit. Push the O_2 flush button to fill the manual bag. After two to three minutes, make sure that the sensor measures approximately 100% O_2.
9. Make sure that a high FiO_2 alarm occurs.
10. Set the FiO_2 high alarm limit to 100% and make sure that the alarm cancels.

4.10.3 Test the Low Minute Volume (MV) Alarm

1. Make sure that MV alarm is turned on.
2. Select [**Alarm Setup**] and then [**Ventilator** >>]. Set the MV low alarm limit to 8.0 L/min.
3. Make sure that a low MV alarm occurs.
4. Select [**Alarm Setup**] and then [**Ventilator** >>]. Set the MV low alarm limit to the default.

4.10.4 Test the Apnea Alarm

1. Connect the manual bag to the manual bag port.
2. Set the Bag/vent switch to the  position.
3. Turn the APL valve control to set the APL valve to the minimum position.
4. Inflate the manual bag to make sure that a complete breathing cycle occurs.
5. Stop inflating the manual bag and wait for at least 20 seconds to make sure that the apnea alarm occurs.
6. Inflate the manual bag to make sure that the alarm cancels.

4.10.5 Test the Sustained Airway Pressure Alarm

1. Connect the manual bag to the manual bag port.
2. Turn the O_2 flow control to set the O_2 flow to minimum.
3. Turn the APL valve control to set the APL valve to 30 cmH_2O position.
4. Set the Bag/vent switch to the  position.
5. Push the O_2 flush button for approximately 15 seconds. Make sure that the sustained airway pressure alarm occurs.
6. Open the patient connection and make sure that the alarm cancels.

4.10.6 Test the High Paw Alarm

1. Set the Bag/vent switch to the  position.
2. Select [**Alarm Setup**] and then [**Ventilator** >>].
3. Set the Paw low alarm limit to 0 cmH_2O and Paw high alarm limit to 5 cmH_2O.
4. Make sure that a high Paw alarm occurs.
5. Set the Paw high alarm limit to 40 cmH_2O.
6. Make sure the high Paw alarm cancels.

4.10.7 Test the Low Paw Alarm

1. Set the Bag/vent switch to the position.
2. Select [**Alarm Setup**] and then [**Ventilator** >>].
3. Set the Paw low alarm limit to 2 cmH_2O.
4. Disconnect the manual bag from the Y piece patient connection.
5. Wait for 20 seconds. View the alarm area and make sure that a low Paw alarm occurs.
6. Connect the manual bag to the manual bag port. Push the O2 flush button to fill the bellows, bellows rising to the top.
7. Make sure the low Paw alarm cancels.

4.10.8 Patient Circuit Not Mounted Alarm Test

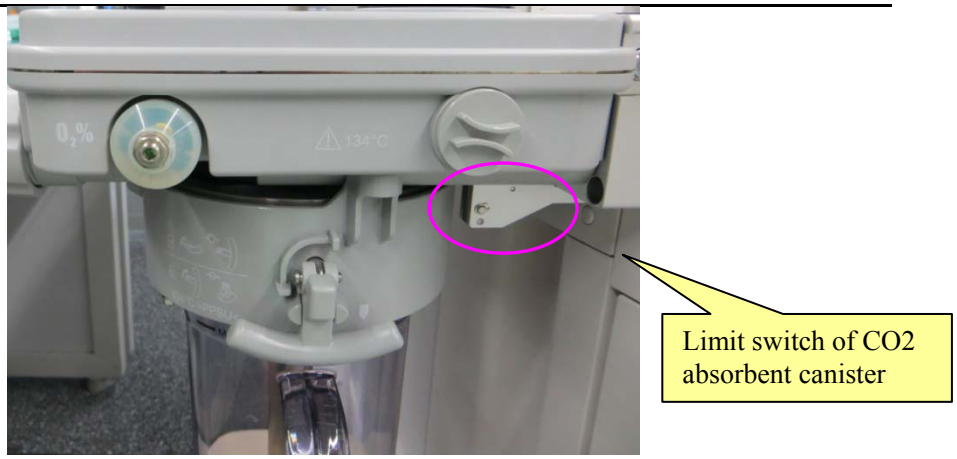
Disconnect the patient circuit, and the alarm of Respiration Circuit Not Mounted should occur.

4.10.9 CO2 Absorbent Canister Alarm Test

Remove the CO2 absorbent canister, and the alarm of CO2 absorbent canister not mounted should occur.

NOTE

- **Operate this test when there is limit switch of CO2 absorbent canister.**



4.10.10 O2 Supply Failure Alarm Test

1. Connect the O2 supply inlet with fixture O2. Adjust the O2 flow to 10L/min in Standby mode.
2. Adjust the input pressure of O2 supply to 220.6±34.2kPa. Confirm whether there is an audio alarm of O2 Supply Failure. Stop the O2 supply for one (1) minute, this alarm should not disappear.
3. Observe the alarm lamp, and it should be red. Restore O2 supply, and adjust the input pressure to 300±10kPa, and the alarm should disappear.
4. For anesthesia machine with N2O supply, turn on all gas flowmeter, and stop the O2 supply. Observe the flow value of O2, N2O flowmeter, and they should reduce to 0 gradually.

4.10.11 Drive Gas Pressure Low Alarm Test

1. Connect corresponding gas to the anesthesia machine according to the drive gas. Disconnect other gas supply.
2. Set the mode to VCV in Standby mode, and set tidal volume to 500ml, and set Rate to 25.
3. Exit Standby mode, and observe to confirm that the anesthesia machine can work normally (observe for five cycles of the ups and downs of the bellow; one up and down is one cycle.)
4. Turn off the gas supply, and the system prompt "Drive Gas Pressure Low".

4.10.12 Power Failure Test

1. Connect the anesthesia machine to the AC power source. Both AC power LED should be on. If the AC power LED is not lit, check the fuse and power board.
2. Set the system switch to the ⊙ position.
3. Unplug the power cord with the system turned on. The message [**Battery in Use**] is displayed. Meanwhile, the AC power LED is extinguished.
4. Reconnect the AC power. The prompt message disappears. The AC power LED is illuminated.

4.11 System Ventilation Performance Tests

4.11.1 Standby Mode Ventilation Test

1. Ensure the pressure of O2, N2O and Air is within the range of specifications.
2. Power on the system.
3. Operate power on test following the guidance on the screen, and ensure all test are passed.
4. Set the mechanical Auto/Manual switch to the Manual position.
5. Connect the patient circuit and test lung to the Y piece three way valve.

NOTE

- **For testing purposes always use a reusable patient circuit.**

6. Set the APL valve to 15cmH2O。
7. Set the air flow to 5 L/min using the flow control valve. Adopt O2 flow if there is no air flow.
8. Squeeze the breathing bag once every 10 seconds to expand and contract the test lung, and generate a pressure about 20cmH2O.
9. Verify the inflation and deflation of the test lung.

4.11.2 Manual Mode Ventilation Test

1. Set the mechanical Auto/Manual switch to the Manual position. Press the screen to switch the system to the manual mode.
2. Set the APL valve to 25 cmH2O. Push the O2 Flush button to fill the breathing bag.
3. Set the air flow to 1 L/min using the flow control valve.
4. Squeeze the breathing bag once every 3 seconds.
5. Verify the inflation and deflation of the test lung.
6. Verify that a PAW waveform and all numeric values appear on the screen during bag compressions.
7. Stop squeezing the breathing bag and set the APL valve to the open position (SP).

4.11.3 VCV Adult Ventilation Mode Test

1. Attach a patient circuit and breathing bag.

NOTE

- **For testing purposes always use a reusable patient circuit.**

2. Attach an adult test lung to the Y-piece of the patient circuit.
3. Attach a ventilation tester between the expiratory port and the breathing hose.
4. Set the O2 flow to 2 L/min and disable the N2O and air flow rates.
5. Set the **Auto/Manual** switch to the **Auto** position.
6. Set breathing parameters.

Parameter	Setting
Patient Size	Adult
Ventilation Mode	VCV
Vt	600
Rate	8
I:E	1:2
Tpause	10
PEEP	Off
Plimit	50

7. Press the [**Set Mode]** button to begin ventilation.
8. Verify that the pressure waveform, respiratory capacity, mean or plateau pressure, respiratory rate, and minute ventilation appear on the screen.
9. Verify that the tidal volume displayed on the ventilation tester is within 10% (±60 mL) of the set value within approximately the first 1 minute after ventilation starts.

10. Verify that the tidal volume displayed on the anesthesia machine is within 10% of the set value within approximately the first 1 minute after ventilation starts.
11. Verify that the measured O2 concentration is at least 97% after 5 minutes
12. Set the air flow to 3 L/min and disable the O2 flow rates.
13. Verify that the measured O2 concentration is 21% ±3% (volume fraction) after 5 minutes.

4.11.4 VCV Child Ventilation Mode Test

1. Attach a patient circuit and breathing bag.

NOTE

- **For testing purposes always use a reusable patient circuit.**

2. Attach an adult test lung to the Y-piece of the patient circuit.

NOTE

- **Limit the volume in the test lung to provide sufficient airway pressure to satisfy the Low Peak Pressure alarm. Or set the peak pressure alarm limit to a smaller value to prevent the alarm when an adult test lung is used.**

3. Attach a ventilation tester between the expiratory port and the breathing hose.
4. Set the O2 flow to 2 L/min and set the N2O and air flow rates to the minimum value.
5. Set breathing parameters.

Parameter	Setting
Patient Size	Child
Ventilation Mode	VCV
Vt	120
Rate	15
I:E	1:2
Tpause	10
PEEP	Off
Plimit	40

6. Press the [**Set Mode]** button to begin ventilation.
7. Verify that the pressure waveform, respiratory capacity, mean or plateau pressure, respiratory rate, and minute ventilation appear on the screen.
8. Verify that the tidal volume, measured by a ventilation tester at the expiratory port, is within 15 mL of the set value within approximately the first 1 minute after ventilation starts.

4.11.5 Air Way Disconnection Alarm Test

1. Disconnect the expiratory limb from the expiratory port of breathing system when the ventilator is working.
2. Ensure the following alarms appear:
   - A low Paw alarm appears on the screen
   - Alarm sounds

4.11.6 PCV Adult Ventilation Mode Test

1. Attach a patient circuit and breathing bag.

NOTE

- **For testing purposes always use a reusable patient circuit.**

2. Attach an adult test lung to the Y-piece of the patient circuit.
3. Attach a ventilation tester between the expiratory port and the breathing hose.
4. Set the O2 flow to 3 L/min and disable the N2O and air flow rates.
5. Set breathing parameters.

Parameter	Parameter Setting
Patient Size	Adult
Ventilation Mode	PCV
Pinsp	15
Rate	8
I:E	1:2
PEEP	Off
Tslope	0.2

6. Press the **Set Mode** button to begin ventilation.
7. Verify that the peak value read on the display is within the set Pinsp ±2 cmH2O.
8. Verify that the pressure waveform, respiratory capacity, respiratory rate, and minute ventilation appear on the screen.
9. Verify that the peak value measured by the ventilation tester reaches 15 ±2.5 cmH2O within the beginning five breaths after ventilation starts.

4.11.7 PS Ventilation Mode Test

1. Attach a patient circuit and breathing bag.

NOTE

- **For testing purposes always use a reusable patient circuit.**

2. Attach an adult test lung to the Y-piece of the patient circuit.
3. Attach a ventilation tester between the expiratory port and the breathing hose.
4. Set the O2 flow to 1 L/min and disable the N2O and air flow rates.
5. Set breathing parameters.

Parameter	Parameter Setting
Patient Size	Adult
Ventilation Mode	PS
Min Rate	4
ΔPsupp	20
F-Trig	3
PEEP	Off
Tslope	0.2

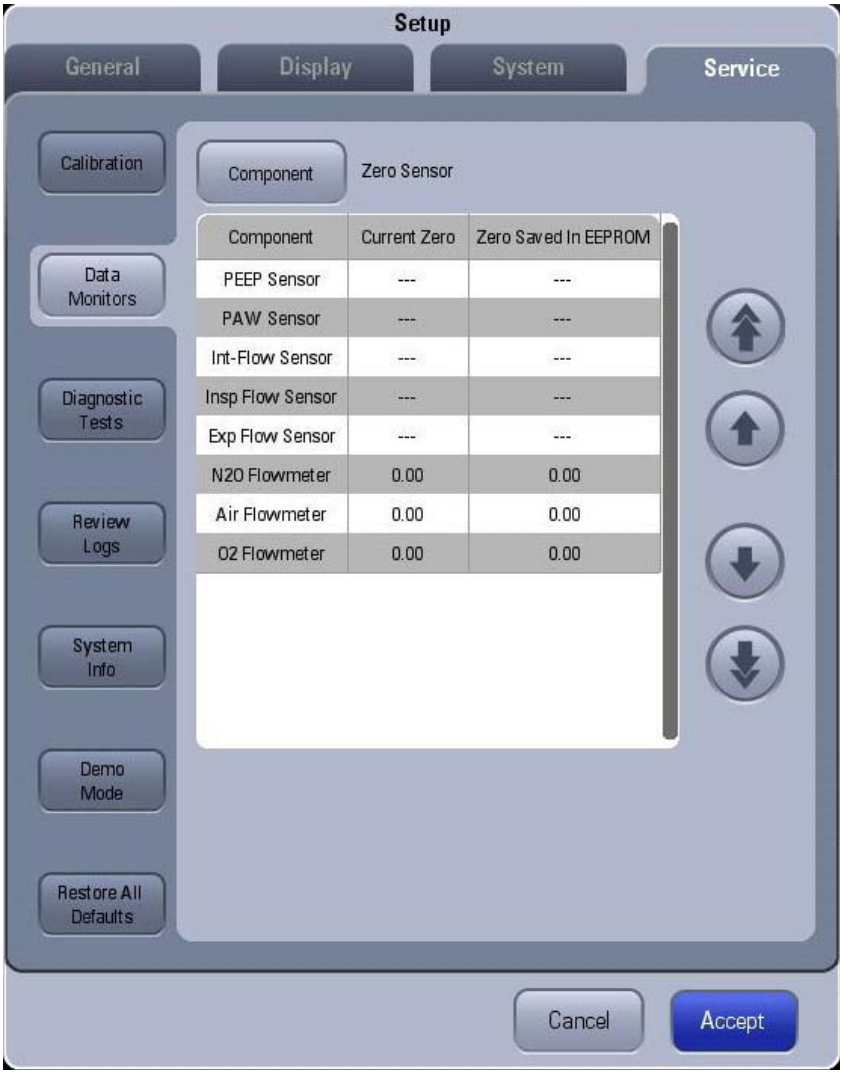
6. Press the **Set Mode** button to begin ventilation.
7. Trigger breaths by slightly squeezing the test lung and releasing. Maintain a continuous breath rate.
8. Verify that a pressure waveform and all ventilation parameters appear on the screen.
9. Verify that the peak pressure read on the display is within ΔP + PEEP ±2.
10. Stop triggering breaths.
11. Verify that the ventilator delivers a breath and displays the "Apnea Ventilation" message 15 seconds later.
12. Verify that the system is ventilating at a frequency of 4 bpm.

4.12 State Test of Sensors

4.12.1 Checking the Sensor Zero Point

To check the sensor zero point, perform the following operations:

1. Turn off all fresh gases and position the Y piece in the patient circuit to the air.
2. Make sure that the system is standby.
3. Select > [**Service**]> [**Data Monitors**]> [**Component**]> [**Zero Sensor**] to access the following menu.



4. The second column is the zero point of the current sensor and the third column is the zero point in case of factory calibration.

   The following table lists the normal range of the zero point of WATO EX-35(0619)pressure and flow sensors.

Sensor	**Normal Range of Zero Point (AD Counts)**
PAW sensor	7432-16206
PEEP pressure sensor	7432-16206
Inspiratory flow sensor	554-26457
Expiratory flow sensor	1392-19306
Internal flow sensor	1699-16768

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 zeroing is successful,but the AD count of sensors is still out of the range, replace the VCM.

NOTE

- **If the zero point of the pressure sensor is inaccurate in case of ventilation, the baseline of the PAW waveform is not at the zero point and a great deviation exists between pressure control and measurement.**
- **If the zero point of the inspiratory/expiratory sensor is inaccurate in case of ventilation, the baseline of the PAW waveform is not at the zero point and a great deviation exists between TV control and measurement.**
- **If the zero point A/D value of any sensor runs out of the normal range, it cannot be corrected. Instead, the ventilator control board must be replaced.**

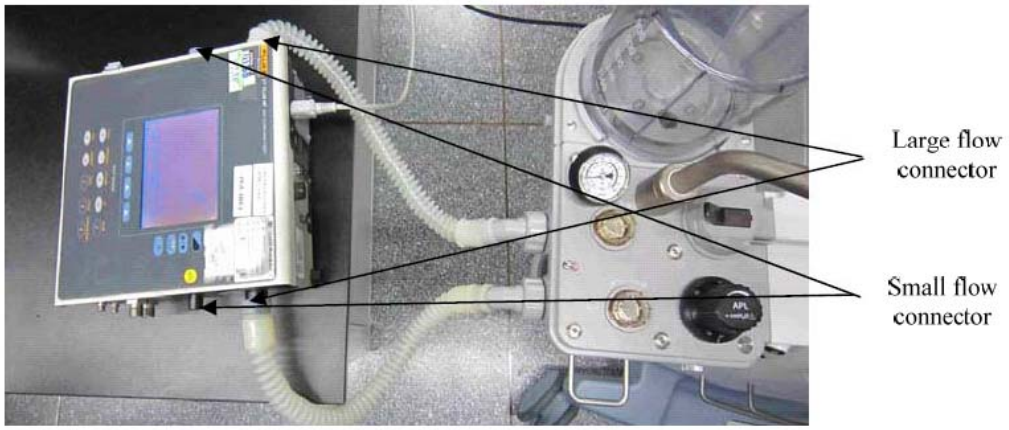
4.12.2 Constant Flow Test (Checking the Flow Sensor Accuracy)

NOTE

- **If a great deviation occurs on the measured Vt value, test the measurement accuracy of flow sensors so as to determine whether another flow calibration is necessary.**
- **You can use any flowmeter with an accuracy of at least ±2% for the accuracy measurement of the flow sensors.**

To check the measurement accuracy of flow sensors, perform the following operations:

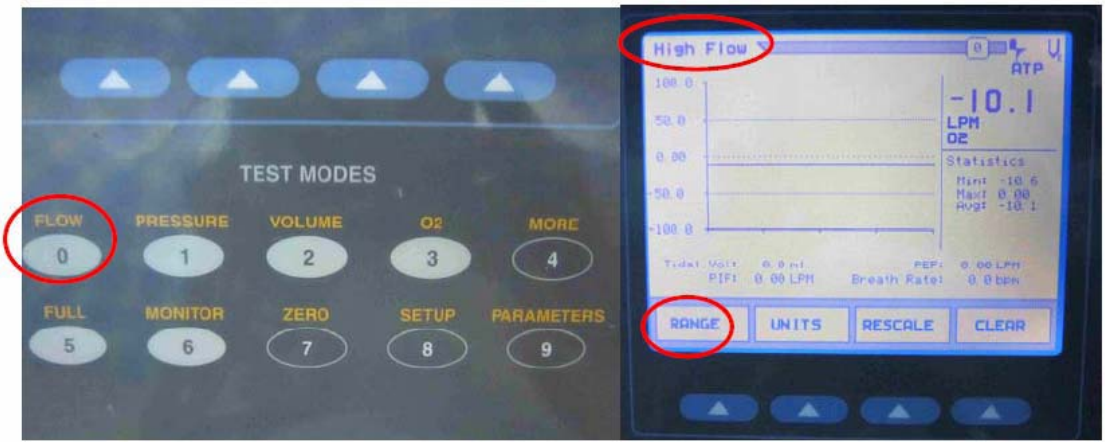
1. Remove the bellows and water collection cup.
2. The pneumatic connections between the anesthesia machine and calibration device are as shown in the following picture. You can connect the tube to a high-flow connector or low-flow connector based on the requirements.



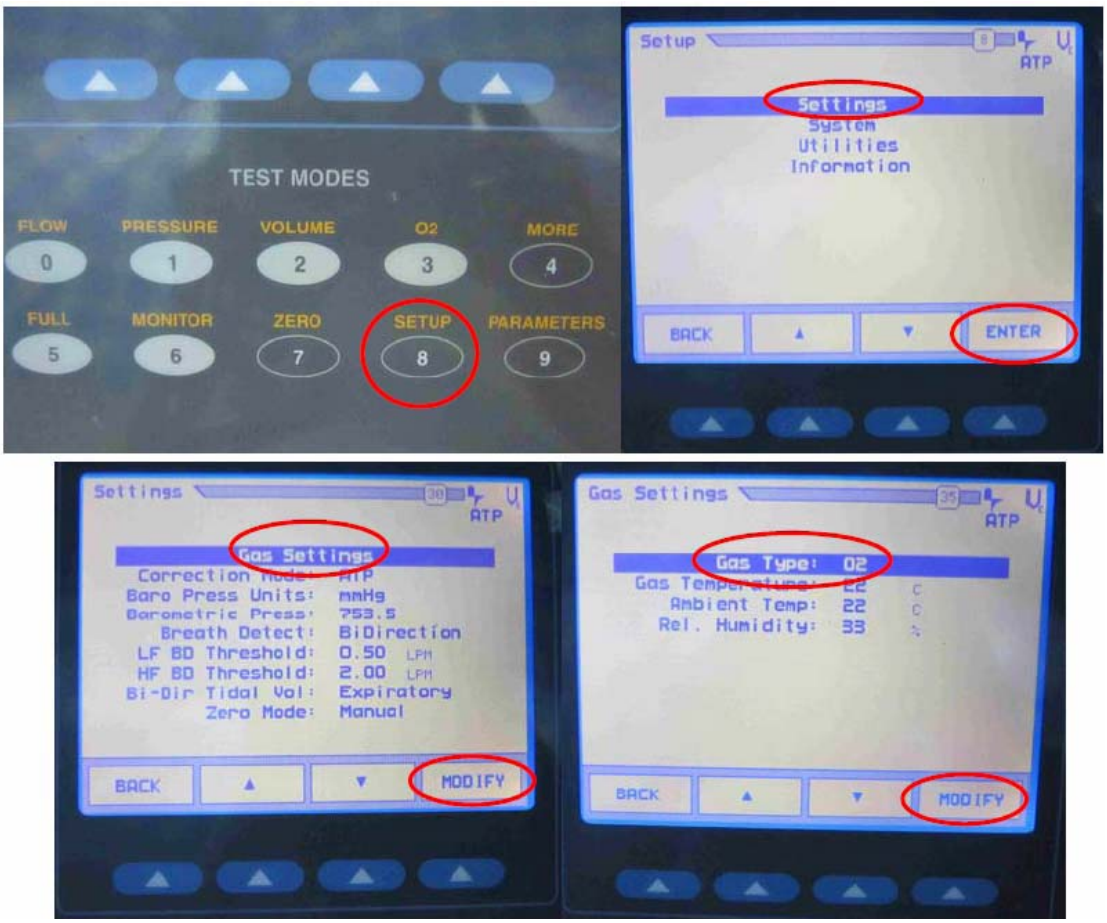
Calibration Device (VT Plus)

3. Set the calibration device as described below.

a. Flow Settings: Press the **Flow** button on the front calibration control panel. You can set **Range** to **High Flow** or **Low Flow** as required.



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



c. Select BACK->BACK-> BACK.



4. When the system is standby, select -> **Service**-> **Diagnostic Tests**->**Valves** to access the following menu.



5. Set Safety Valve to On.
6. Set **PEEP Valve Pressure** to 30 cmH2O.
7. Set **Insp Valve Flow** to the following values: (3±0.5)L/min, (10±1)L/min, (20±1)L/min, (30±2)L/min, (60±3)L/min

Make sure that the deviation between the measured data of the inspiratory flow sensor, expiratory flow sensor and ventilator flow sensor and that of the anesthesia machine calibration device must not exceed 1 L/min or 5% of the measured value of the calibration device, whichever is greater. Otherwise, perform flow calibration again.

Reinstall the bellows and the water collection cup. When testing the flow accuracy of (60±3)L/min, only compare the accuracy of the inspiratory flow sensor and expiratory flow sensor.

It is no need to compare the ventilator flow sensor.

4.12.3 Constant Pressure Test (Checking the Pressure Sensor Accuracy)

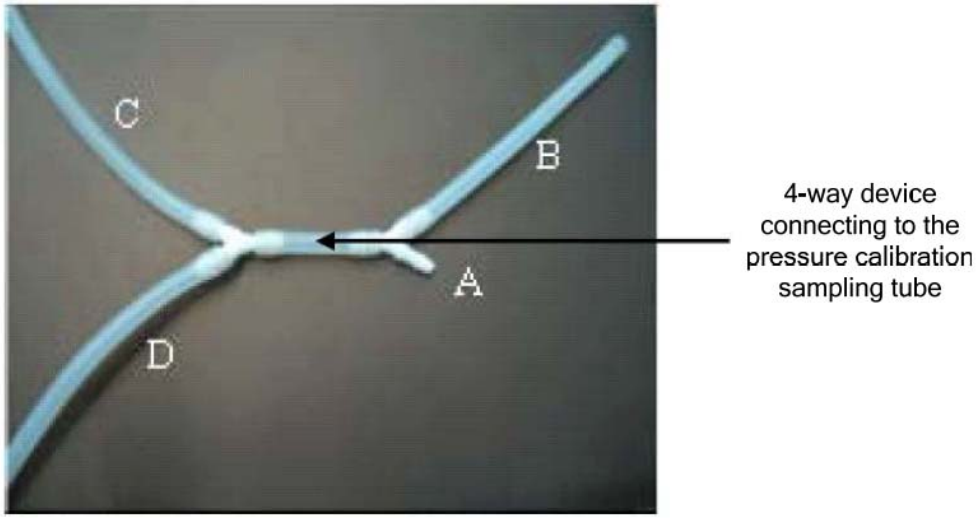
NOTE

- **Generally, measurement deviations seldom occur to pressure sensors. However, in case that the ventilator control board, three-way valve assembly, or expiratory valve assembly needs to be replaced, you must perform pressure calibration and check the pressure sensor accuracy so as to confirm the effectiveness of calibration.**
- **You can use any flowmeter with an accuracy of at least ±2% for the accuracy measurement of the pressure sensors.**

To check the measurement accuracy of pressure sensors, perform the following operations:

1. Complete pneumatic connections as follows:

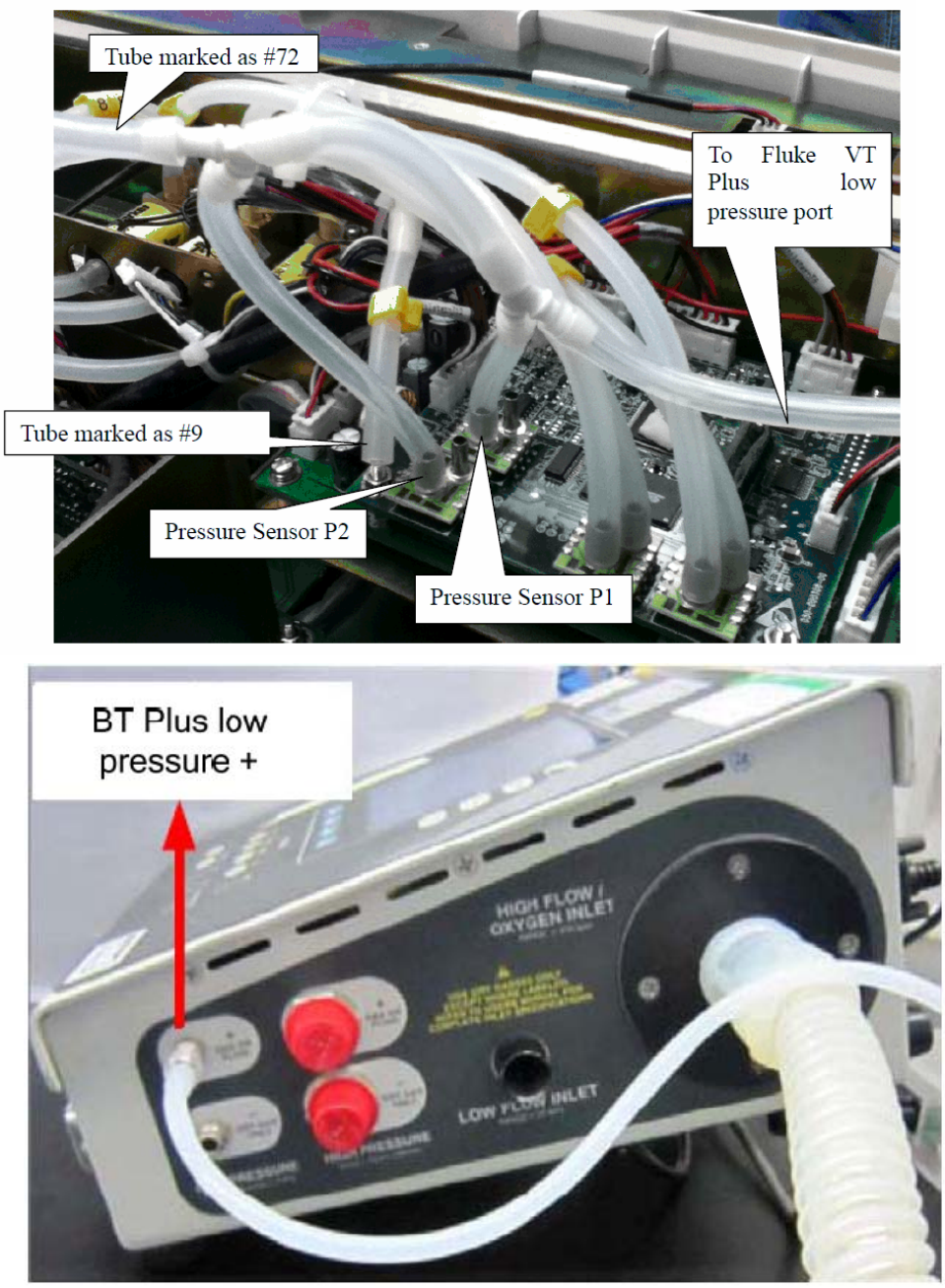
The following picture shows a four-way device.



a. Remove the top cover (3 captive screws).

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

c. Connect the four-way tube to the pressure sensor P1 of the monitor board, PEEP pressure sensor P2, 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.

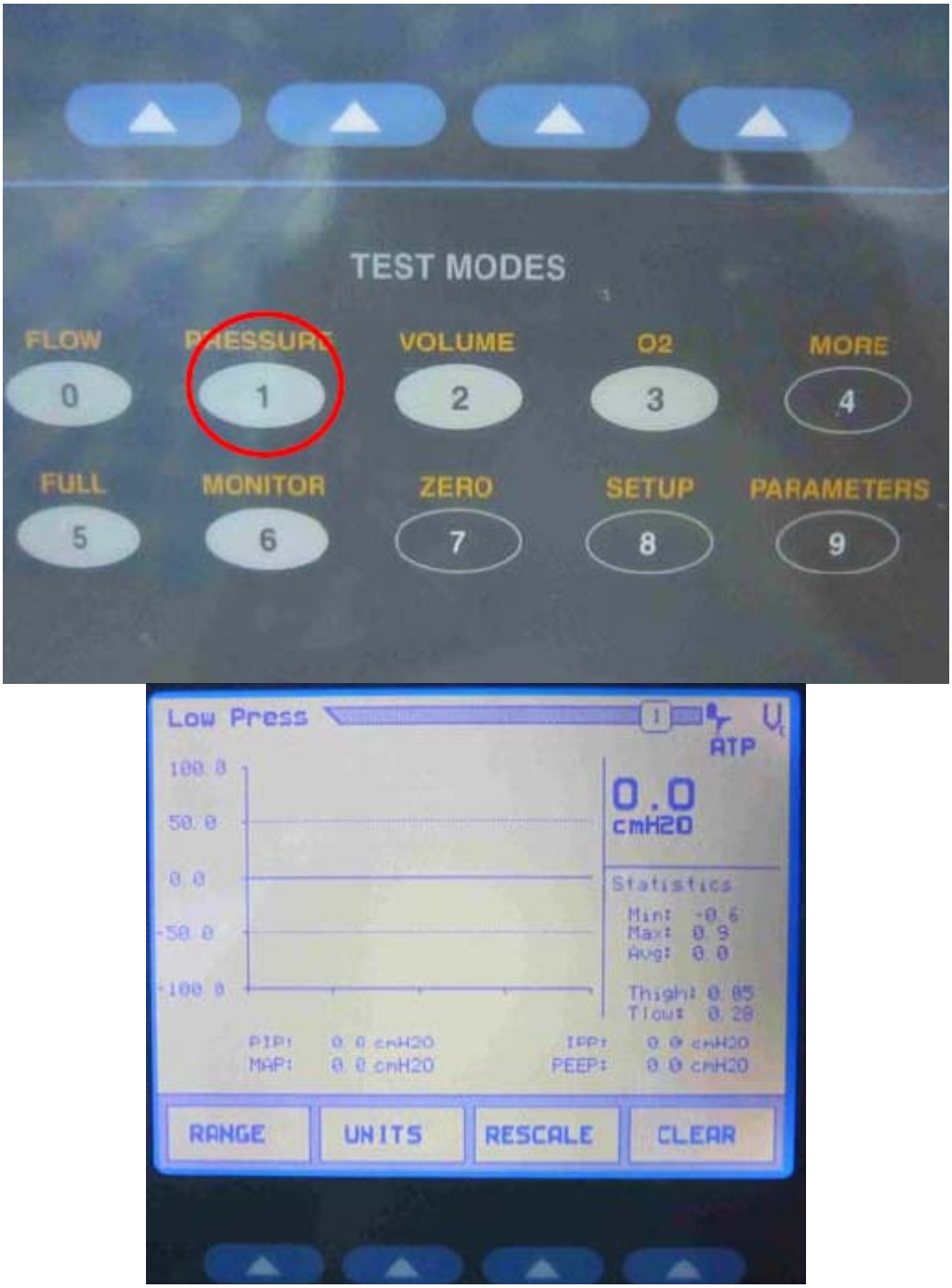


Calibration Device (VT Plus)

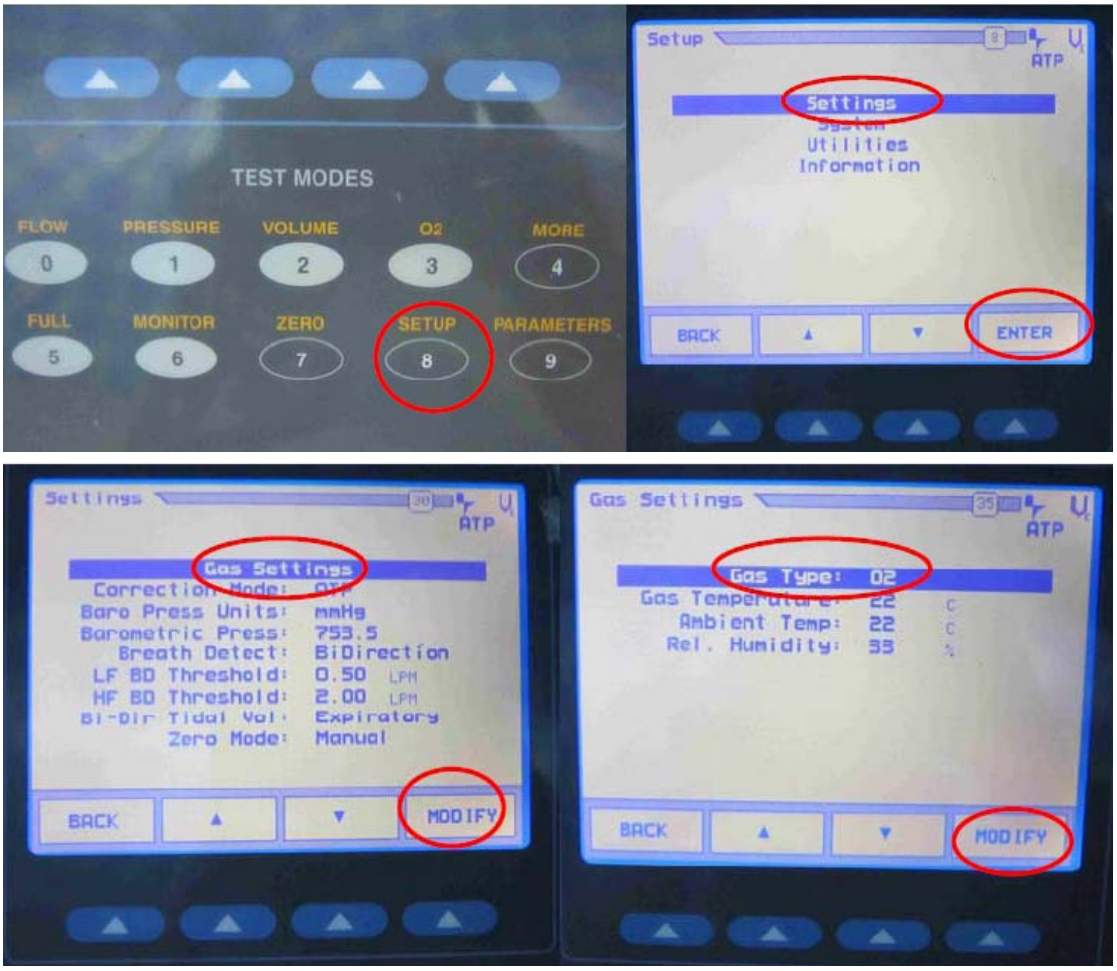
2. Set the calibration device as described below.

   To set the VT-Plus, perform the following operations:

   a. Pressure Settings: Press the **PRESSURE** button on the front calibration control panel. Select **Range** and then set it to **Low Press**.


TEST MODES
FLOW
PRESSURE
VOLUME
O2
MORE
0
1
2
3
4
FULL
MONITOR
ZERO
SETUP
PARAMETERS
5
6
7
8
9
Low Press
ATP
100.0
50.0
0.0
-50.0
-100.0
0.0
cmH2O
Statistics
Min: -0.6
Max: 0.9
Avg: 0.0
Thigh: 0.05
Tlow: 0.20
PIP: 0.0 cmH2O
MAP: 0.0 cmH2O
IPP: 0.0 cmH2O
PEEP: 0.0 cmH2O
RANGE
UNITS
RESCALE
CLEAR

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



c. Select BACK->BACK-> BACK.



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



4. Set Safety Valve to On.
5. Set PEEP Valve Pressure to the following values:
   (5±1)cmH2O, (20±1)cmH2O, (50±1)cmH2O, (70±2)cmH2O, (90±2)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, perform pressure calibration again.

4.13 Electrical Safety Inspection

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.**
- **The electrical safety inspection should be performed once a year.**

4.13.1 Auxiliary Electrical Outlet Test

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

4.13.2 Working table Light, flow meter backlight Test

1. Turn on the top-mounted lamps on the bottom side of the top plate.
2. Verify that theworking table light and flow mete backlight works at the low brightness level when the switch is set to **I**, works at the high brightness level when the switch is set to **II**, and working table light andt flow mete backlight is turned off when the switch is set to **O**.
3. Verify that the brightness of each LED of top light are the same, and the switch **II** is in the front of **I**.
2. Verify that theworking table light andt flow mete backlight can be lit on when the switch is set to **I** and **II**, and the brightness is stable and even.

4.13.3 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. Connect the compressor, if configured, to the auxiliary electrical outlet.
3. Perform the following earth leakage current tests:
   - normal polarity;
   - reverse polarity;
   - normal polarity with open neutral; and
   - reverse polarity with open neutral.
4. Verify the maximum leakage current does not exceed 500 μA (0.5 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.**

4.13.4 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		

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

5 Factory Maintenance Menu

5.1 Calibration

The calibration screen includes [**Flow Sensors**], [**Pressure sensors**], [**Zero Sensors**], and [**O2 Sensor**] calibration buttons. When the machine is configured with an AG module that has the paramagnetic oxygen module, the machine uses the paramagnetic oxygen module rather than the O2 sensor to monitor the oxygen concentration. In this case, the [**O2 Sensor**] calibration button is invisible; otherwise, the [**O2 Sensor**] calibration button is visible.

Please refer to the following screens:



The [**Flow Sensors**], [**Pressure Sensors**], and [**O2 Sensor**] buttons are available only in standby mode. The [**Zero Sensors**] button is always available.

During the calibration or zero calibration process, when you close the calibration or zero menu, the relevant calibration or zero calibration process stops.

During the calibration or zero calibration process, click the [**Accept**] button in the [**Setup**] menu. The system returns to the main screen, and the relevant calibration or zero calibration process stops.

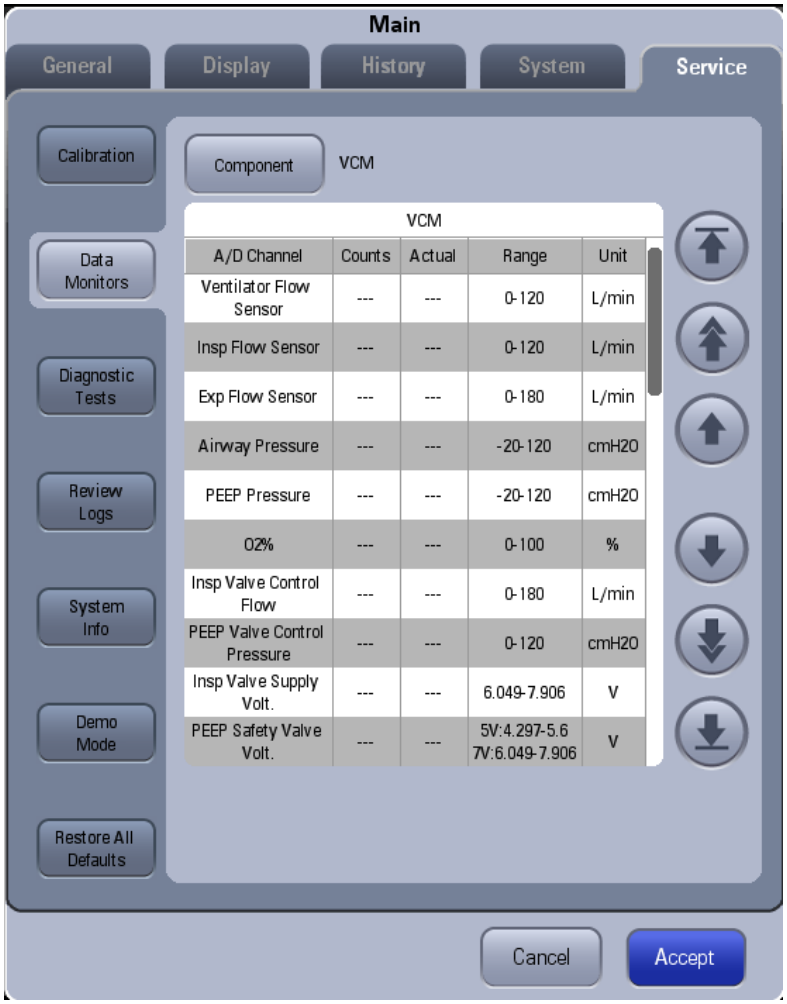
5.2 Data Monitors

Data Monitors provide A/D channel data monitors of VCM, VPM, Mainboard, Power System, data monitors of Calibration Sensor, Zero Sensor, Trends, and Status Monitor.



The VCM screen can monitor the measured values of flow sensors sand pressure sensors in real time, the power supply voltage and opening of valves, the power supply voltage of the ventilator, the status of three way valve etc.

The following figure shows the screen display of VCM A/D channel data:



When the actual value in the table is displayed in red, this value exceeds the reference range provided in the table. Further testing is required for confirmation.

The VPM screen can monitor the measured values of pressure sensors and flow sensor, the power supply voltage and opening of valves, and the power supply voltage of the ventilator in real time.

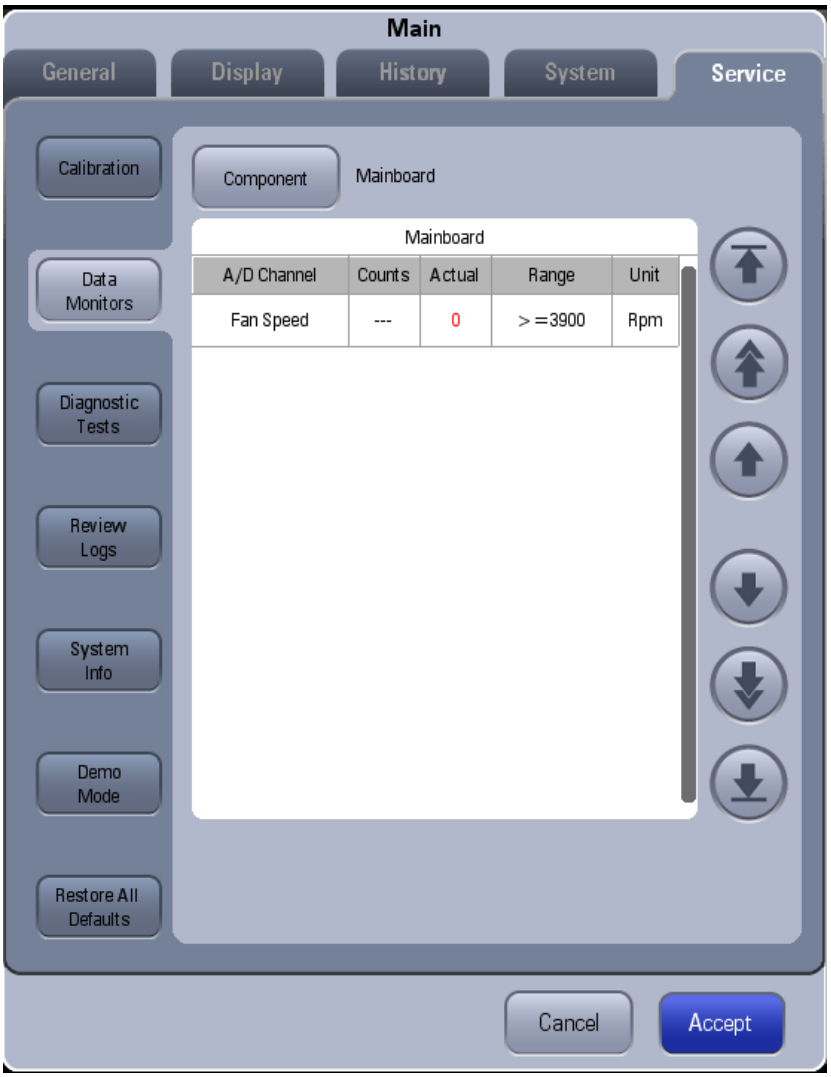
The following figure shows the screen display of VPM A/D channel data:



When the actual value in the table is displayed in red, this value exceeds the reference range provided in the table. Further testing is required for confirmation.

The Mainboard screen can monitor the fan speed of hardware box and module rack.

The following figure shows the screen display of mainboard A/D channel data:



1) [**Fan Speed**] monitors the fan speed of the hardware box.

2) [**Fan Speed 2**] monitors the fan speed of the module rack.

When the actual value in the table is displayed in red, this value exceeds the reference range provided in the table. Further testing is required for confirmation.

NOTE

- **[Fan Speed 2] is displayed only when module rack is configured and [Module Rack] configuration is opened. To check the status of [Module Rack], select → [System] → [Configuration Info] on the main screen. To change the configuration, refer to 5.8 Factory Setup.**

The Power System screen displays the battery voltage and power supply voltage collected by the power system in real time, and the voltage and temperature of the heating module.

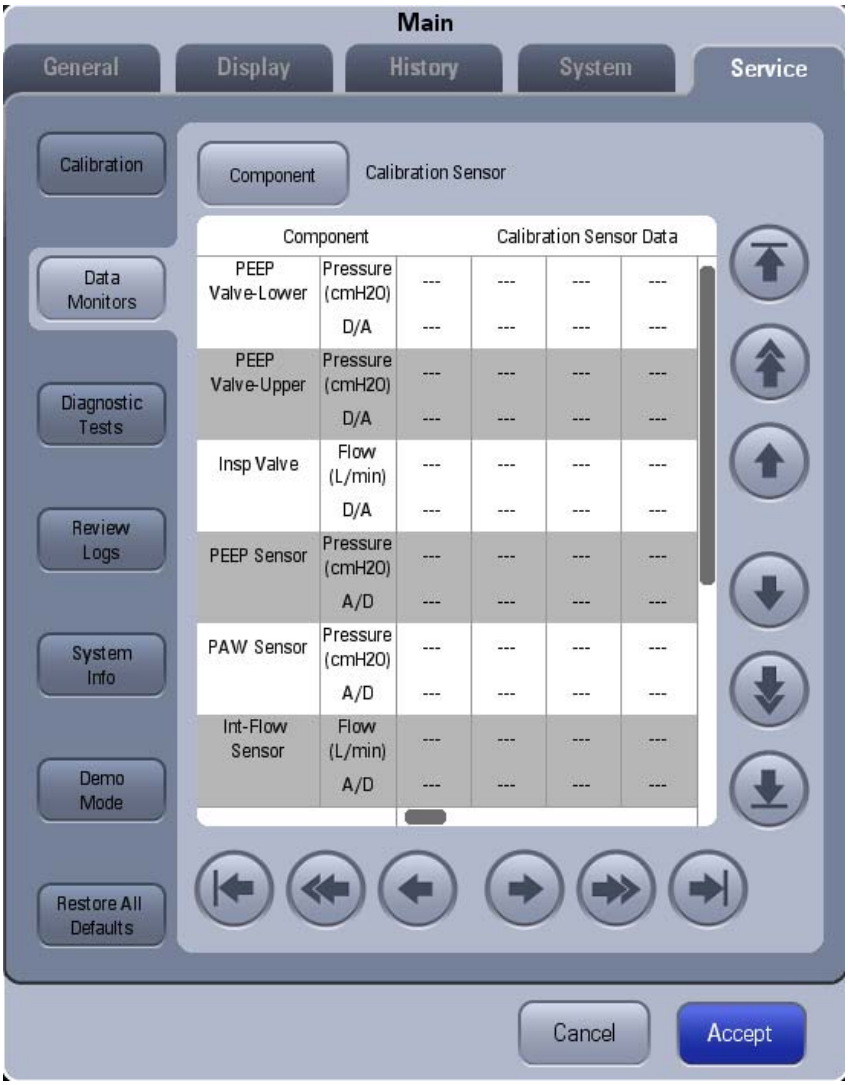
The following figure shows the screen display of power system A/D channel data:



When the actual value in the table is displayed in red, this value exceeds the reference range provided in the table. Further testing is required for confirmation.

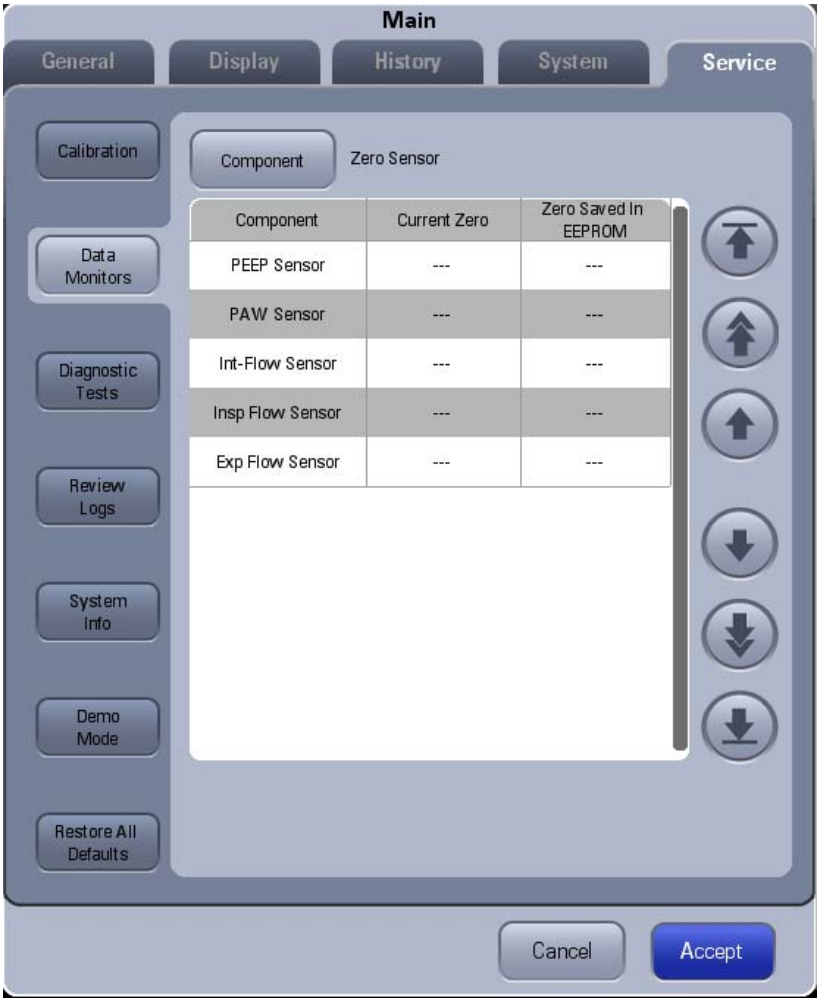
The Calibration Sensor screen can be accessed to check the calibration table data of valve, sensor, and O2 concentration. The sensors include pressure sensor and inter flow sensor.

The following figure shows the screen display of the calibration data of each sensor:



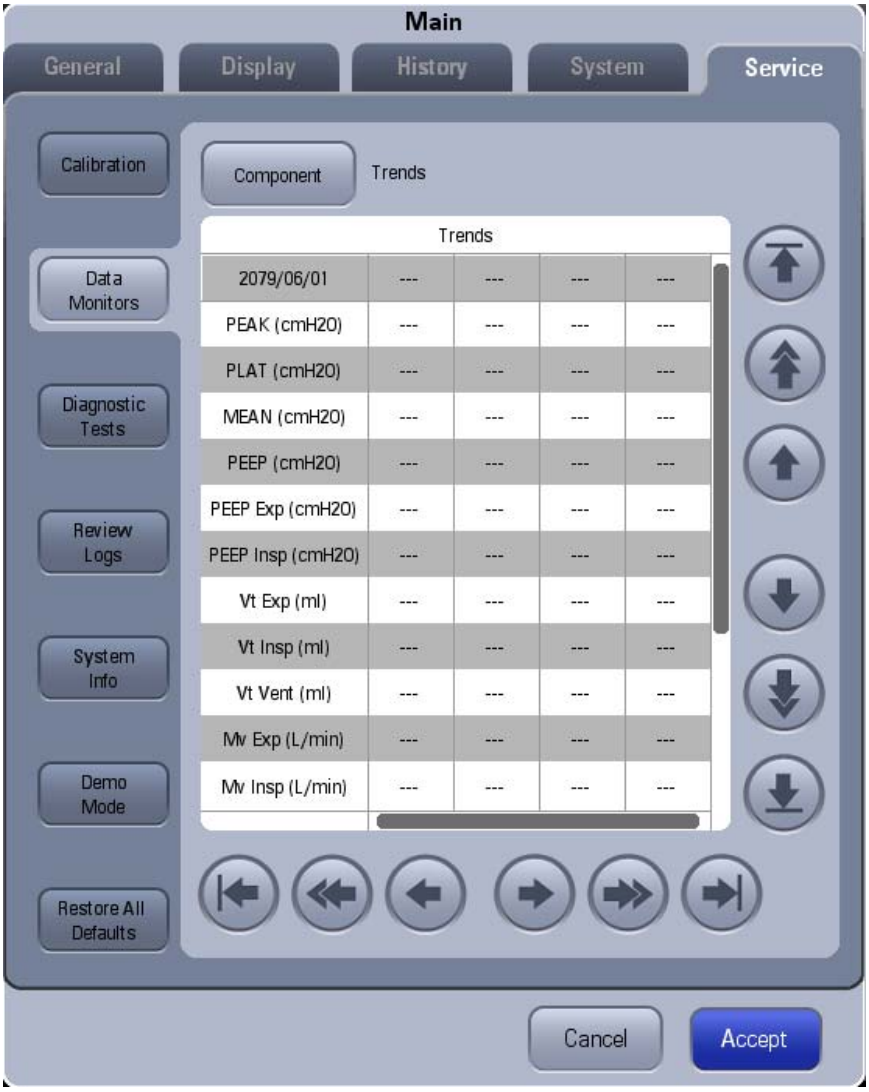
The Zero Sensor screen can be accessed to check the zero point the sensor currently uses and the zero point the zeroing table saves.

The following figure shows the screen display of the zero data of each sensor:



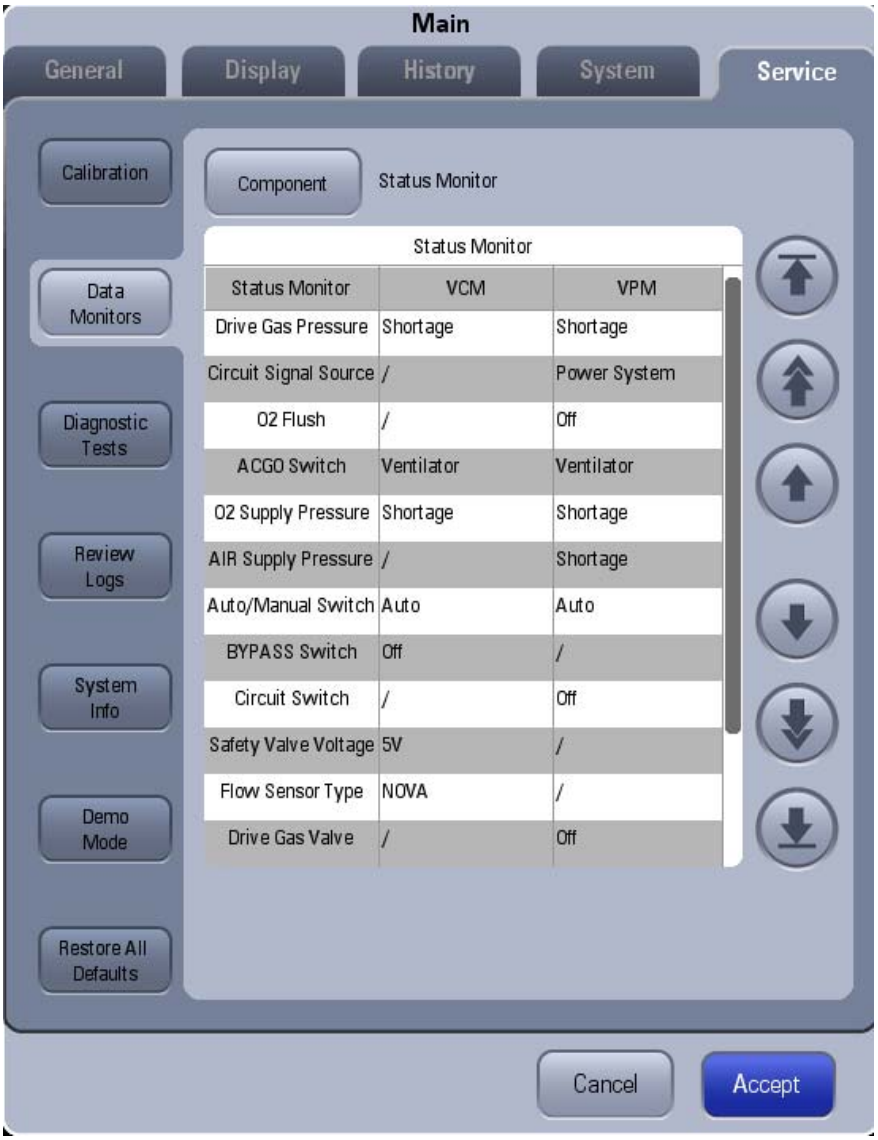
The Trends screen can be accessed to check the changing trend of such monitoring parameters as pressure, tidal volume, resistance, and compliance within a period of time.

The following figure shows the screen display of trends:



The Status Monitor screen can be accessed to check all status information, including gas supply, Auto/Manual switch, ACGO switch, type of flow sensor and drive gas switch valve etc.

The following figure shows the screen display of Boolean value:



5.3 Valves Diagnostic Test Tools

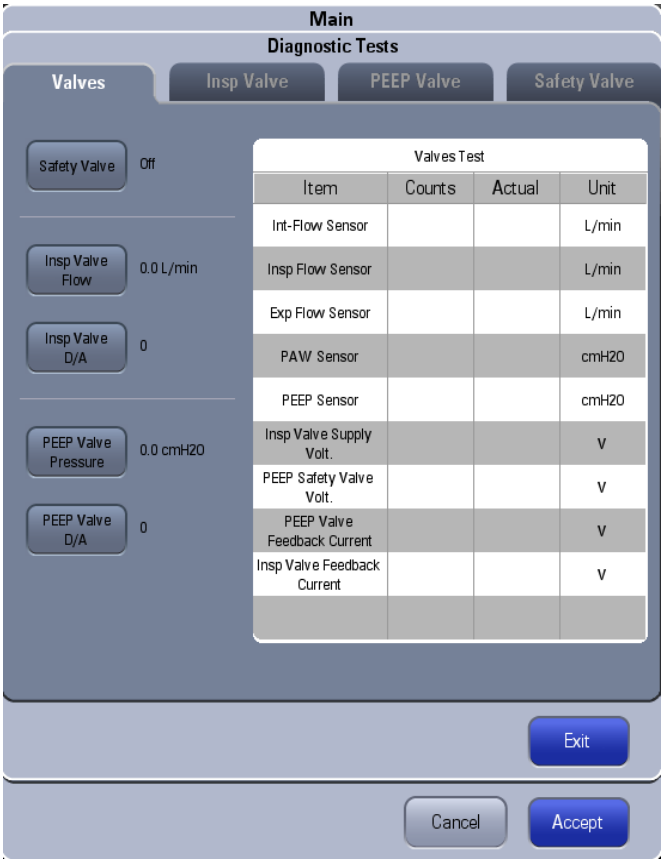
The diagnostic function is available only in standby mode.

The diagnostic function includes valves test, inspiratory valve test, PEEP valve test, and safety valve test.

During the test, when you click the [**Done**] button in the [**Diagnostic Tests**] menu, the system returns to the [**Service**] menu, and the relevant test stops.

5.3.1 Valves Test

The valve test menu includes the safety valve setting, inspiratory valve flow setting, inspiratory valve D/A setting, PEEP valve pressure setting, and PEEP valve D/A setting. For details, see the following figure:



For the anesthesia machine configured with the function of Drive Gas Auto Switch, there will be a [Drive Gas Valve] button added under the [PPEP Valve D/A] button in this menu.

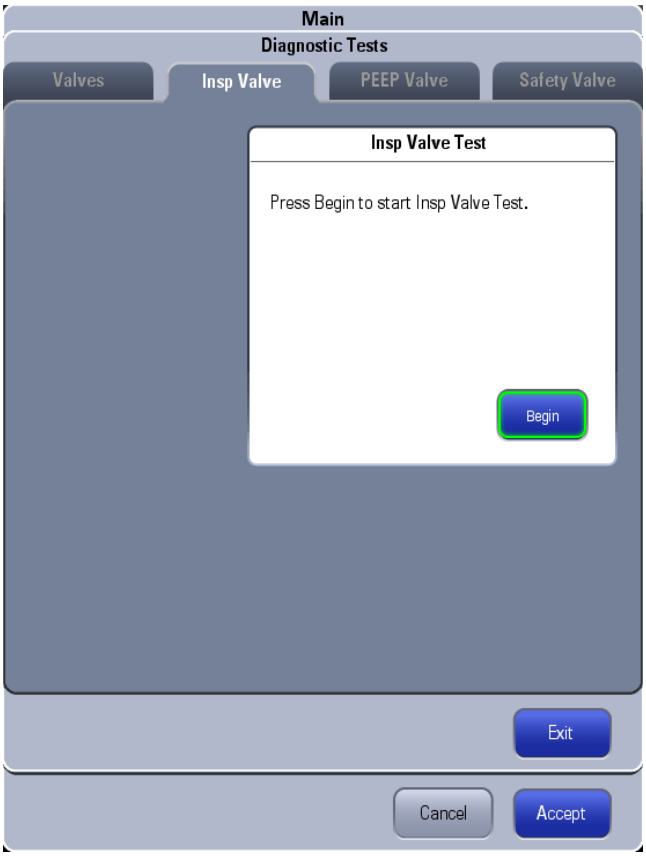
After setting relevant items, check the A/D value and actual value in the valve test table on the right to judge whether the test item is accurately controlled. The A/D value is significant for zero verification. When no air flows through the sensor (for example, obstruct the air source, stop the fresh air flow, or enter standby mode), the displayed A/D value is the present zero value. When there is no offset at zero, the actual value shall be 0.

However, if offset occurs to the sensor zero point, the actual value displayed is not always 0. In this case, zero calibration is required to adjust the measured value to 0. The ranges of zero point AD value of each sensor are as follows:

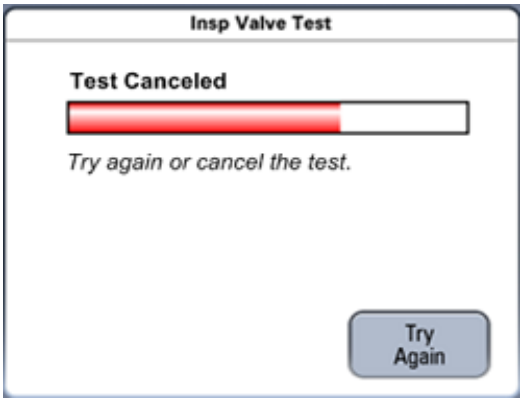
Name of sensors	**The ranges of zero point AD value**
internal flow sensor	1699-16768
inspiratory flow sensor	554-26457
expiratory flow sensor	1392-19306
airway pressure sensor	7432-16206
PEEP pressure sensor	7432-16206

5.3.2 Insp. Valve Test

An inspiratory valve test is conducted by checking whether the power supply voltage and drive and feedback voltage of the inspiratory valve are within the normal range. For details about the inspiratory valve test menu, see the following figure:



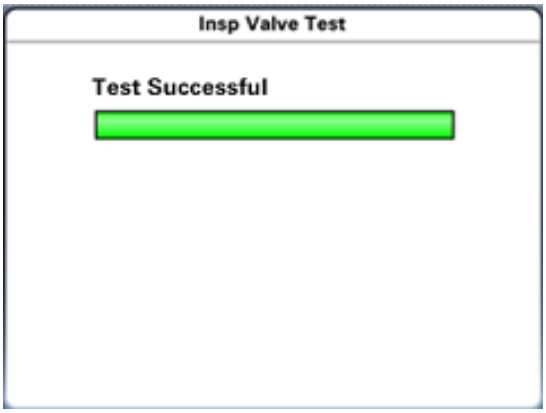
1. Click the [**Start**] button to start an inspiratory valve test. During the test, you can click [**Cancel**] to cancel the test.
2. When you click [**Cancel**], a screen as shown in the following figure is displayed. You can click [**Retry**] to test again.



3. If the inspiratory valve test fails, a screen as shown in the following figure is displayed. You can click [**Retry**] to test again.



4. When the inspiratory valve test is successful, a screen as shown in the following figure is displayed.



5.3.3 PEEP Valve Test

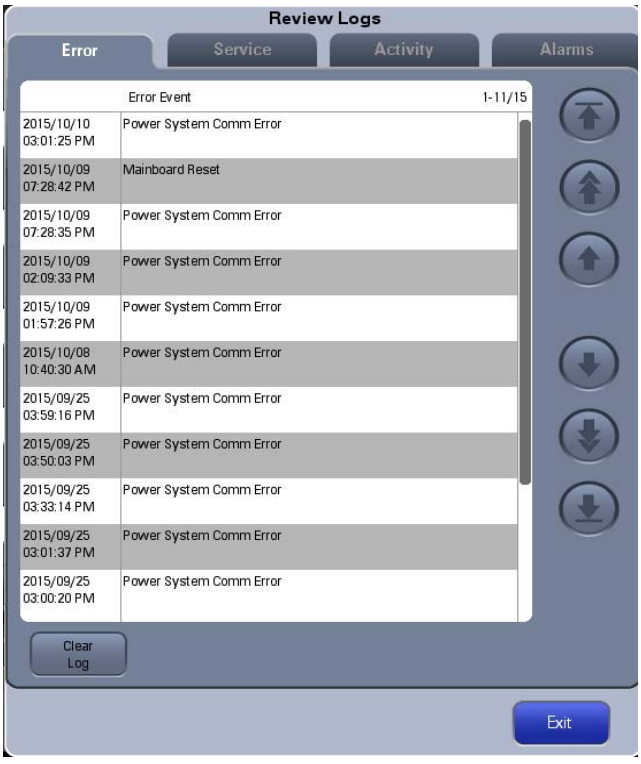
A PEEP valve test is conducted by checking whether the power supply voltage and drive and feedback voltage of the PEEP valve are within the normal range. For the PEEP valve test screen, refer to ***5.3.2 Insp. Valve Test***.

5.3.4 Safety Valve Test

The safety valve test process is as follows: In the condition where drive gas is available, after opening and then closing the safety valve, read the status of the gas drive pressure switch to determine the actual status of the safety valve. If the status of the drive gas pressure switch detects no pressure after you open the safety valve, or if the status of the drive gas pressure switch detects pressure after you close the safety valve, the safety valve test fails. For the safety valve test screen, refer to ***5.3.2 Insp. Valve Test***.

5.4 Review Logs

Review logs include fault logs, maintenance logs, operation logs, and alarm logs. Fault logs record faults of the machine that do not trigger a technical alarm. A maximum of 500 such records can be stored. Maintenance logs record maintenance operations on the machine. A maximum of 500 such records can be stored. Alarm logs record the physiological and technical alarms triggered on the machine. A maximum of 500 such records can be stored. For details, see the following figure:



The preceding logs can be exported by choosing [**Export data**] in the [**System**] menu.

If the number of logs exceeds 500, the new one will cover the older one. And the data will not be lost after powering off and on or upgrading software.

5.5 System Info

System information includes Software Version information, Running time, and Register.

Software version includes the joint version and the versions and release date of the system program, bootstrap, FPGA program, VPM software, VCM software, power board software, language and key board software, etc.

If the combination of all current software versions matches a joint version in the version file, the joint version is displayed as the correct version.

If the combination of all current software versions does not match any joint version in the version file, the joint version is displayed as Fail.

If the combination of all current software versions does not match any joint version in the version file, the software version of the system program and the software versions of other modules not matching the system program are displayed in red.

The running time includes the machine's running time and the ventilator's running time.

Register records data related to running exceptions of the machine.



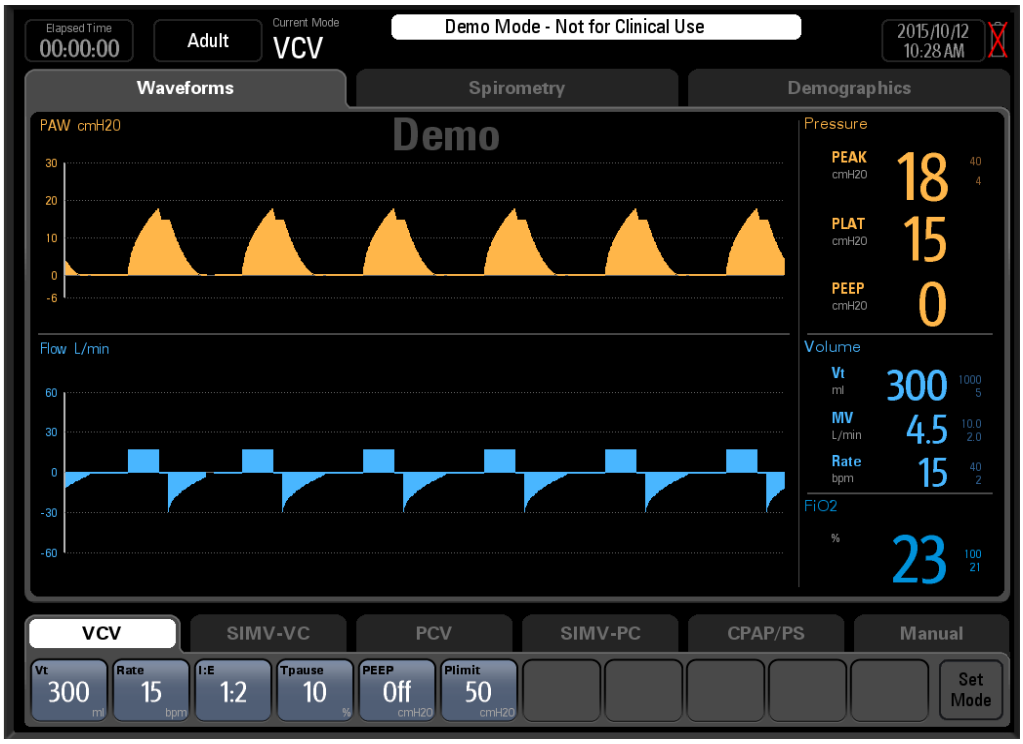
5.6 Demo Mode

You can enter demo mode only in standby mode.

Demo mode has two types: demo mode with alarm and demo mode without alarm. You can select either of the two types by clicking the [**Demo mode**] button.

In demo mode, only the [**Demo mode**] button is available in the maintenance menu.

The following figure shows the demo mode screen:



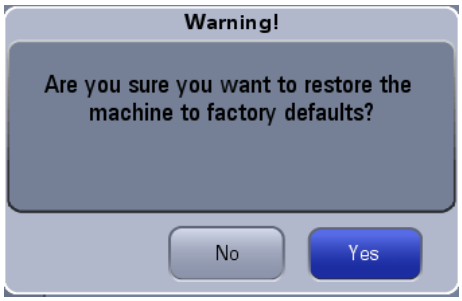
5.7 Restore All Default

The restoring all configuration function can be used to restore the current configurations of patient-related configuration items, machine-related configuration items, and user maintenance-related configuration items to factory defaults.

The event logs and loops are cleared once you restore all configurations.

The current patient category is switched to the default patient category once you use the restoring all configuration function.

When you click the [**Restore all default**] button, an operation confirmation dialog box is displayed, as shown in the following figure:

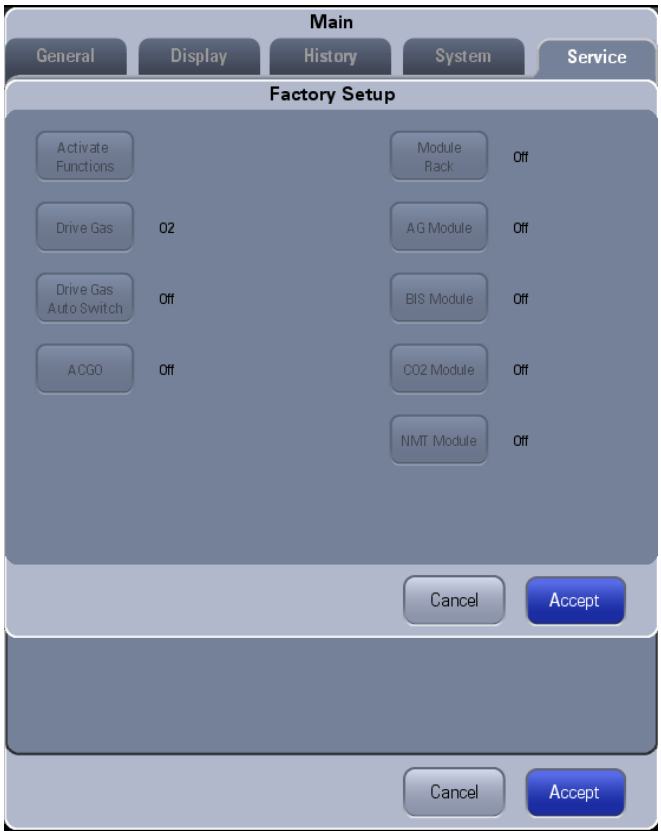


5.8 Factory Setup

The password set by the factory is 558188.

Choose  > [**Service**] and then enter the password set by the factory to access the factory setting menu.

The factory setting menu includes function activation, drive gas setting, drive gas auto switch, flowmeter standard setting, flowmeter pipeline, ACGO setting, module rack setting, AG module setting, BIS module setting and CO2 module setting. The preceding settings can be reconfigured only in standby mode. After you modify some factory configurations, you have to restart the machine for the modification to take effect. After you enter the password set by the factory, a screen as shown in the following figure is displayed.



NOTE

- **All setting items in the [Factory Setup] menu are enabled only in standby mode. After you modify some factory configurations, you have to restart the machine for the modification to take effect.**

5.8.1 Function Activation

The system supports activation code-based activation and activation code file-based activation.

The activation code file must be placed in the root directory of USB.

If both CPAP/PS and PSV ventilation modes are activated for a machine, the system only reserves theCPAP/PS ventilation mode.

The newly activated function can take effect only after you restart the machine.

5.8.2 Drive Gas

Drive gas has three options, that is, O2, AIR and air compressor. Maintenance personnel shall configure this function as required. Please note this option must match the configuration of the machine.

When the drive gas is set to air compressor, drive gas auto switch is ON by default.

5.8.3 Drive Gas Auto Switch

The setting of AG module provides two options: Open and Close. Maintenance personnel shall configure this function as required.

When Drive Gas Auto Switch is set to Open, a Drive Gas button will appear on the upper left corner of the screen to display the current drive gas type.

5.8.4 Air Pressure Switch

Air pressure switch has two options, that is, On and Off. Maintenance personnel shall configure this function as required.

5.8.5 ACGO

ACGO has two options, that is, Off, ACGO with three-way valve. Among them, Off applies to the machine that does not need to be configured with ACGO, machine that needs to be configured with a non-independent ACGO, and machine that needs to be configured with independent ACGO without three-way valve. Independent ACGO with three-way valve applies to the machine that needs to be configured with ACGO with three way valve.

5.8.6 Module Rack

The setting of module rack provides two options: Open and Close.

When module rack is set to Open, the machine can support to identify module plugging and monitor the fan speed of module rack.

When module rack is set to Close, the machine cannot support to identify module plugging or monitor the fan speed of module rack.

5.8.7 AG Module

The setting of AG module provides two options: Open and Close.

When AG module is set to Open, the machine can identify the external AG module.

When AG module is set to Close, the machine cannot identify the external AG module.

5.8.8 CO2 Module

The setting of CO2 module provides two options: Open and Close.

When CO2 module is set to Open, the machine can identify the external CO2 module.

When CO2 module is set to Close, the machine cannot identify the external CO2 module.

6 Device Maintenance

WARNING

- **When it comes to test and maintain the equipment, make sure that the patient is disconnected from the equipment.**
- **The equipment may have been used on patients carrying infectious diseases. Before testing or maintaining the equipment, wear sterile rubber gloves to reduce the risk of being infected.**
- **When the equipment to be maintained contains blood or other secretion, clean, disinfect and sterilize the equipment strictly in accordance with infectious diseases control and safety procedures.**

6.1 Maintenance Overview

Physical check, disposables replacement, and performance check shall be conducted at regular intervals according to the periods listed in the following table. The factory will bear no liability if some parts are damaged or lost because the disposables are not replaced within the suggested period.

6.2 Maintenance Period

Maintenance Operation	After Each Maintenance	Every 12 Months	Every 36 Months
Preoperative check: 1.System ventilation performance tests 2.Breathing system leak test in mechanical ventilation mode 3.Breathing system leak test in manual ventilation mode 4.Checking the sensor zero point 5.Constant flow test（checking the flow sensor accuracy） 6.Constant pressure test（checking the pressure sensor accuracy）		●	●
System check		●	●
Disposables replacement		●	●
Battery maintenance and replacement			●
Function test after maintenance		●	●
Test before operation	●	●	●

6.3 System Check

1. Ensure that the device is intact.
2. Ensure that the breathing system and absorbent canister are well connected.
3. Ensure that the vaporizer is filled with a defined amount of anesthetic agent.
4. Check that the operation guide is attached.
5. Confirm the additional standby cylinder wrench.
6. Ensure that the AGSS transfer hose is not damaged. Drain the water build-up.
7. Ensure that the AC power cable is not damaged.

6.4 Maintenance Package Parts

To ensure the long-term reliability and stability of the anesthesia machine, periodical maintenance of the equipment and replacement of its parts must be performed by authorized service personnel. For details about parts replacement, refer to ***9 Repair and Disassembly.*** Periodical parts replacement can be carried out every year or every three years. To distinguish the clients' requirements, there are three kinds of one-year service packages: one-year maintenance package, one-year expansion package, and one-year complete package. Make records of the parts that have been replaced before the periodical replacement.

NOTE

- **These schedules are the minimum frequency based on typical usage of 2000 hours per year. You should service the equipment more frequently if you use it more than the typical yearly usage.**
- **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.**

6.4.1 One-year Replaceable Parts

One-year replaceable parts vary depending on patient circuit configuration. Non-circuit part and circuit part are described separately. For non-circuit part, the lists of replaceable parts for machines of different configuration are the same. For circuit part, it differs subject to machine configuration.

The code of one-year service packages:

115-036963-00 one-year maintenance package (0619)

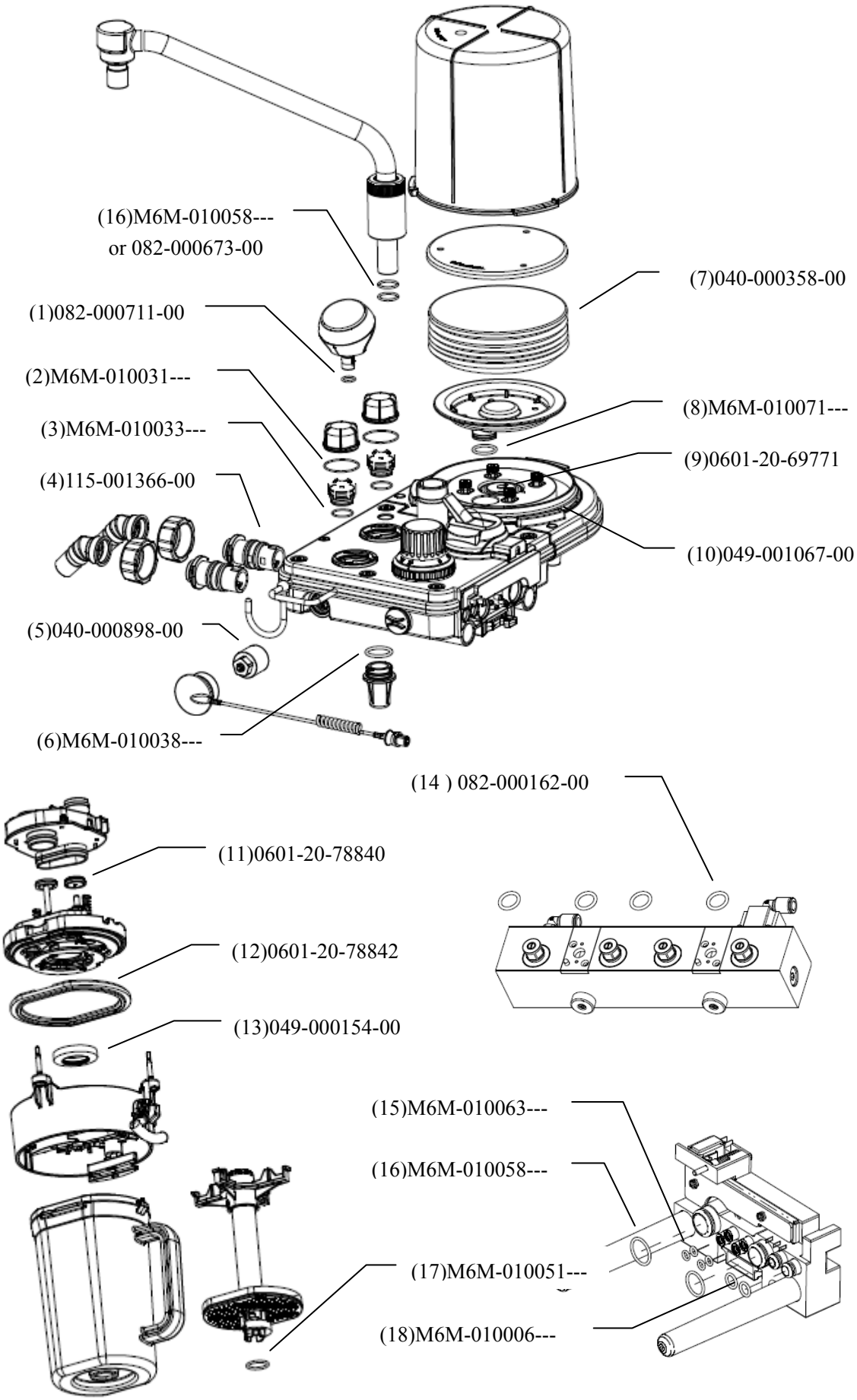
115-036964-00 one-year expansion package (0619)

115-036965-00 one-year complete package (0619)

NO	P/N	Description	Qty	Usage	Note
1	082-000711-00	O-ring 10X1.8, viton, A70	1	Airway pressure gauge	
2	M6M-010031---	O-ring 27X1.5, silicone, A50, red	2	Valve cover	
3	M6M-010033---	O-ring 20X1.5, silicone, A50, red	2	Valve body	
4	115-001366-00	Flow sensor assembly	1	Breathing circuit	one-year complete package
5	040-000898-00	Sensor Oxygen	1	Breathing circuit	one-year complete package
6	M6M-010038---	O-ring 23.47X2.95, silicone, A50, red	1	Water collection cup	
7	040-000358-00	Bellows, neoprene, 8 folds	1	Bellows dome assembly	one-year expansion package or one-year complete package
8	M6M-010071---	O-ring 20.29X2.62, silicone, A50, red	1	Top cover 2 assembly	
9	0601-20-69771	PoP-off valve rubber pad (Die MR69771)	1	PoP-off valve rubber pad	
10	049-001067-00	bellows packing washer (0615)	1	Bellows dome assembly	
11	0601-20-78840	BYPASS large sealing cushion (Die MR78840)	1	BYPASS large sealing cushion	Only for Bypass configuration
12	0601-20-78842	Sodalime canister sealing part （Die MR78842）	1	Bypass lower part assembly	Only for Bypass configuration

13	049-000154-00	Outlet sealing cushion (0601)	1	Bypass lower part assembly	Only for Bypass configuration
14	082-000162-00	O-ring 14.00X2.65, silicone, A50, black	4	Vaporizer support rack	
15	M6M-010063---	O-ring 4.7X1.8, viton, A50, black	4	Pressure sampling port	
16	M6M-010058---	O-ring 16X2, viton, A50, black	4	Drive gas connector (2) Without position limit bag arm (2)	
17	082-000673-00	O-ring 15.54X2.62 viton A70	2	Position limit bag arm (2)	
18	M6M-010051---	O-ring 18X2.5, viton, A50, brown	1	Sodalime canister support rack	
19	M6M-010006---	O-ring 8.5X2.0, viton, A75, black	2	Fresh gas/ ACGO	

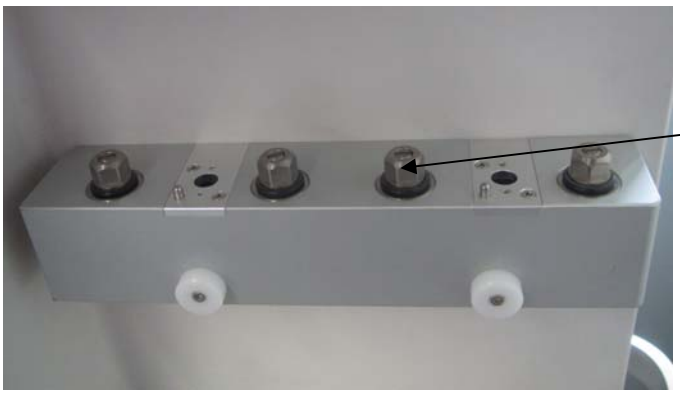
Note: The sealing rings in the above table are only suitable for 0619 Nylon circuit.


(16)M6M-010058---
or 082-000673-00
(7)040-000358-00
(1)082-000711-00
(2)M6M-010031---
(8)M6M-010071---
(3)M6M-010033---
(9)0601-20-69771
(4)115-001366-00
(10)049-001067-00
(5)040-000898-00
(6)M6M-010038---
(14) 082-000162-00
(11)0601-20-78840
(12)0601-20-78842
(13)049-000154-00
(15)M6M-010063---
(16)M6M-010058---
(17)M6M-010051---
(18)M6M-010006---

6.4.1.1 Parts Replacement

Non-circuit part

1. As required, replace the sealing ring (082-000162-00) between the vaporizer support rack connector and the vaporizer every 12 months.

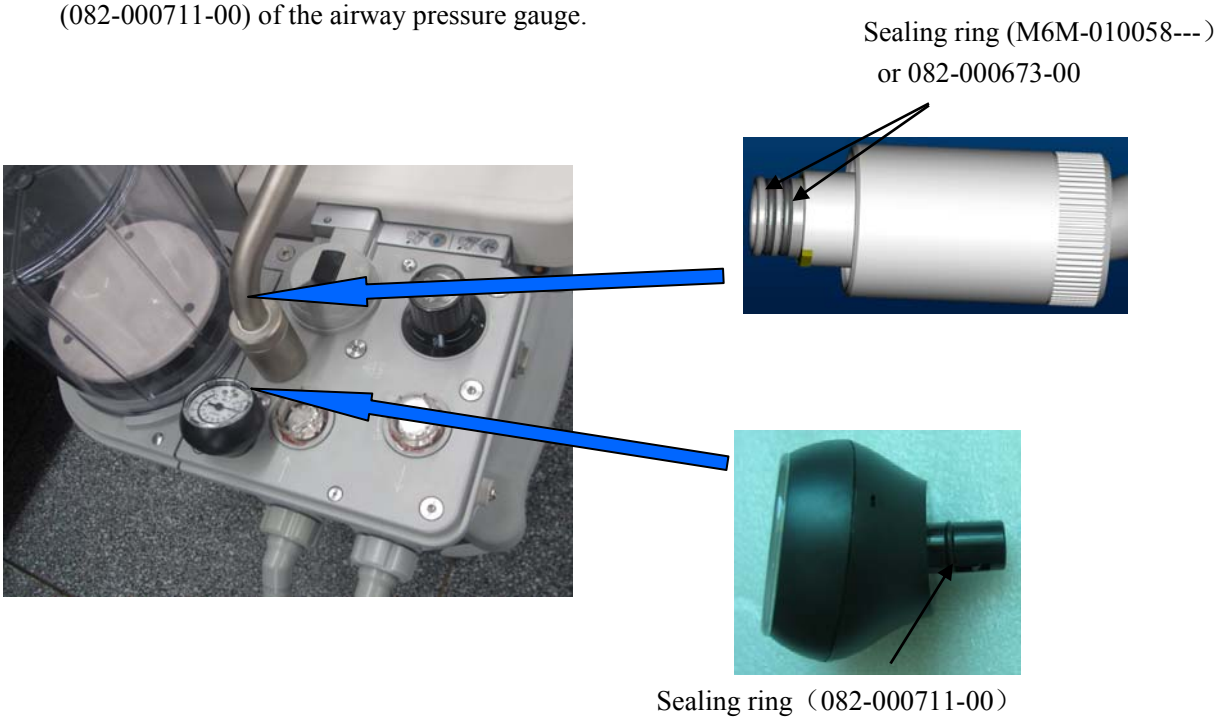


2. Exchange the sealing ring (M6M-010063---) of the pressure sampling port, sealing ring (M6M-010006---) for fresh gas and ACGO, and sealing ring (M6M-010058---) for drive gas and APL every 12 months.

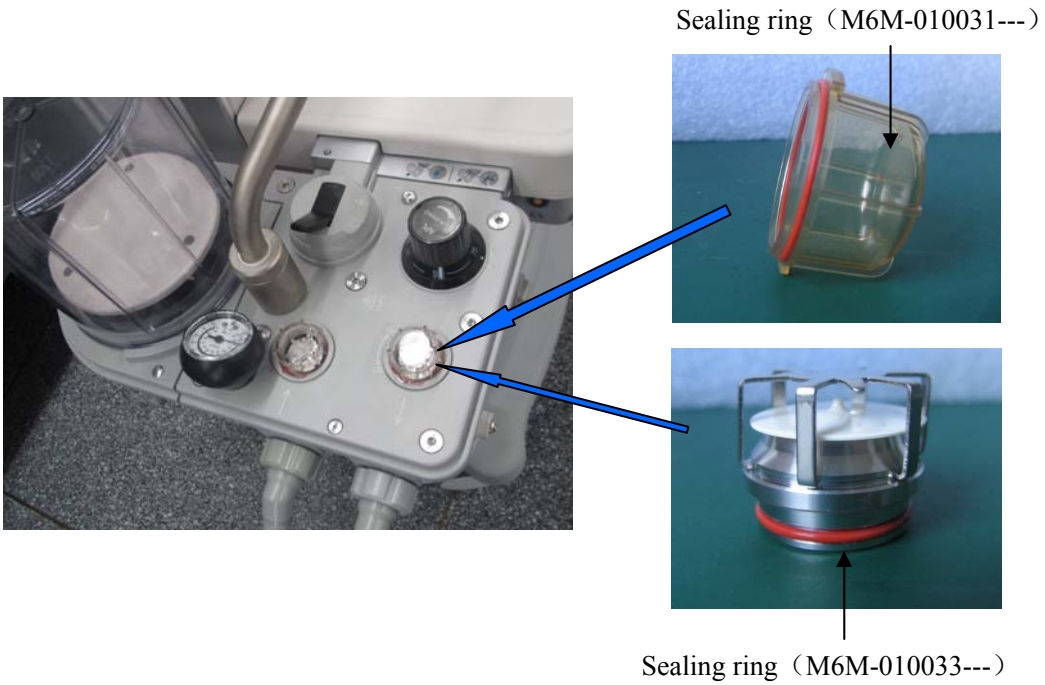


Circuit part

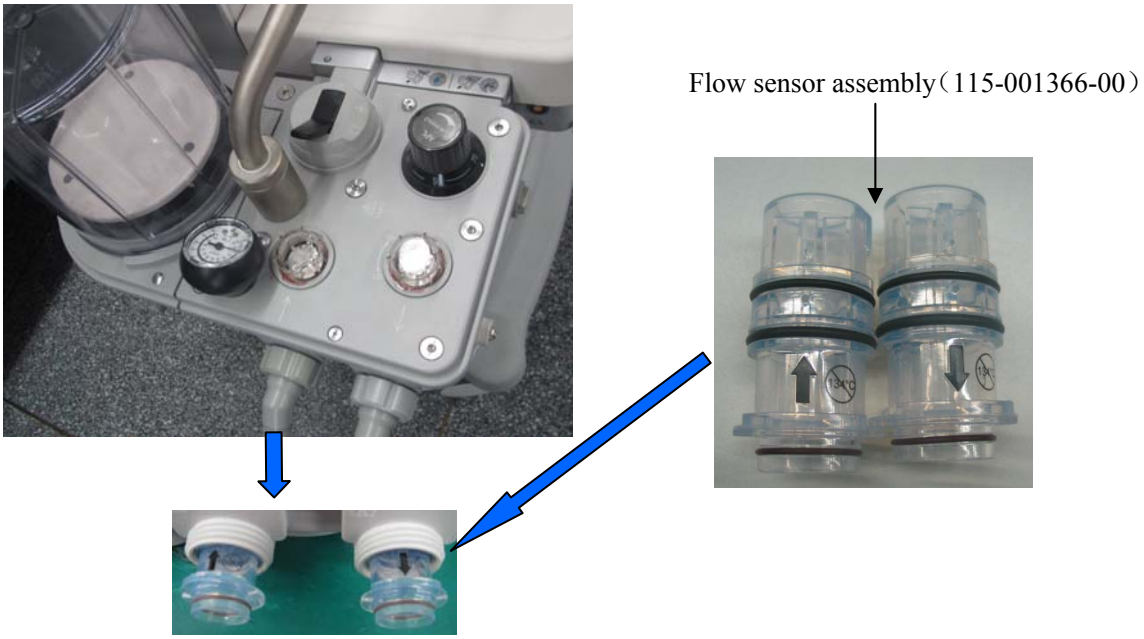
1. Remove the sealing ring (M6M-010058--- or 082-000673-00) from the bag arm. Remove the airway pressure gauge directly, to exchange the sealing ring (082-000711-00) of the airway pressure gauge.



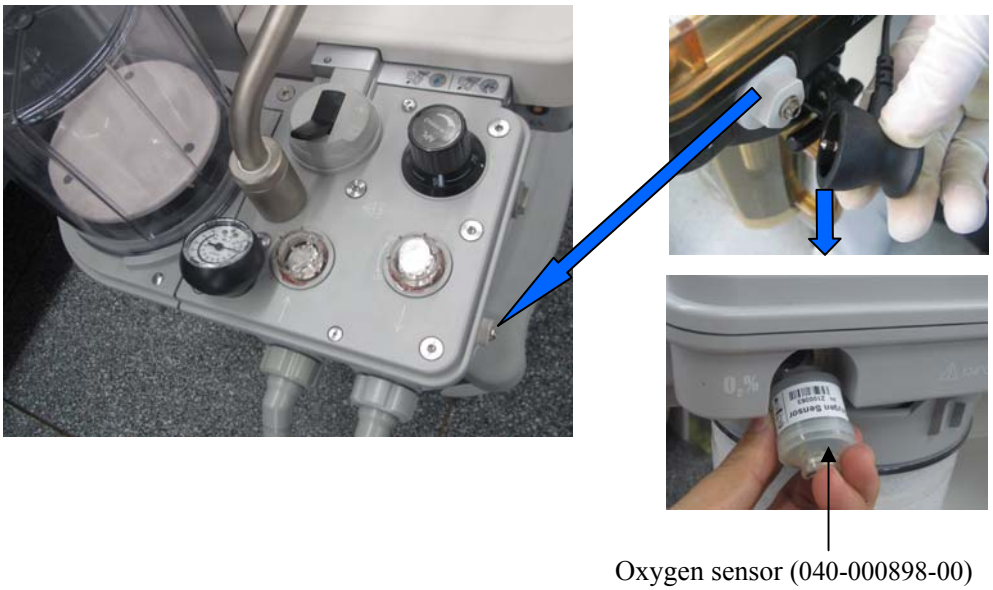
2 Exchange the sealing ring (M6M-010031---) of the valve cover and sealing ring (M6M-010033---) of the valve seal.



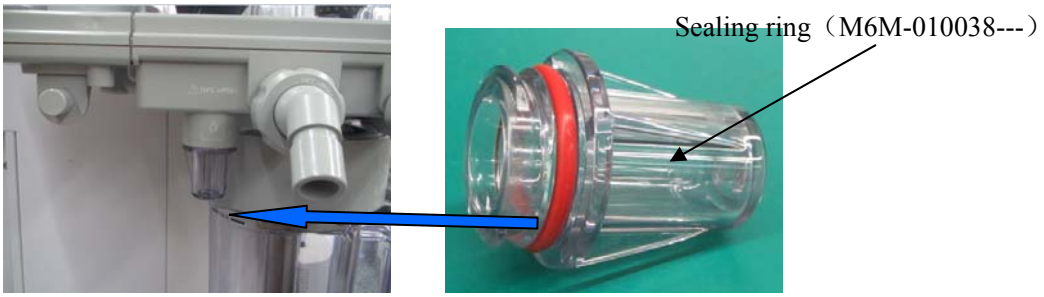
3. Remove the breathing connector, to exchange the flow sensor assembly.



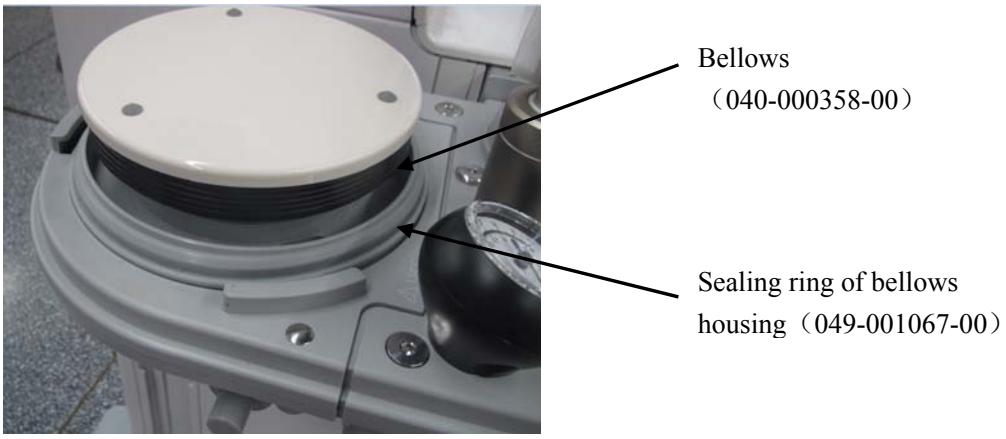
4. Unplug the cable of oxygen sensor, to exchange oxygen sensor (040-000898-00).



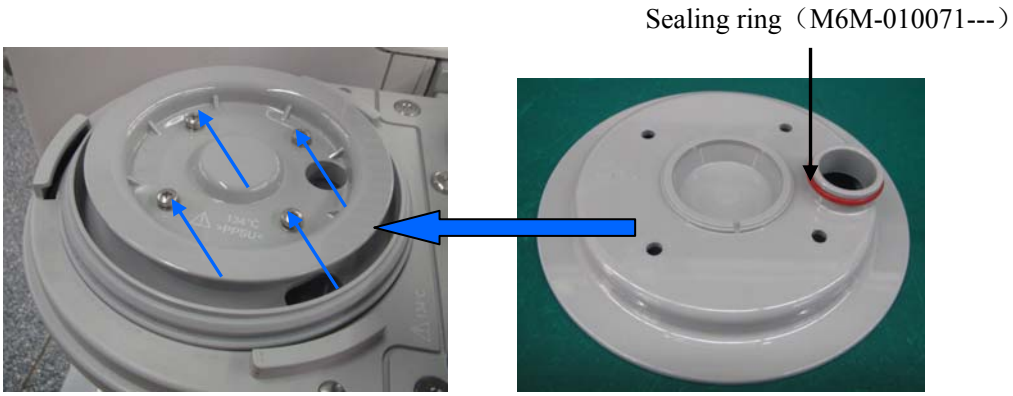
5. Exchange the sealing ring (M6M-010038---) of the water collection cup.



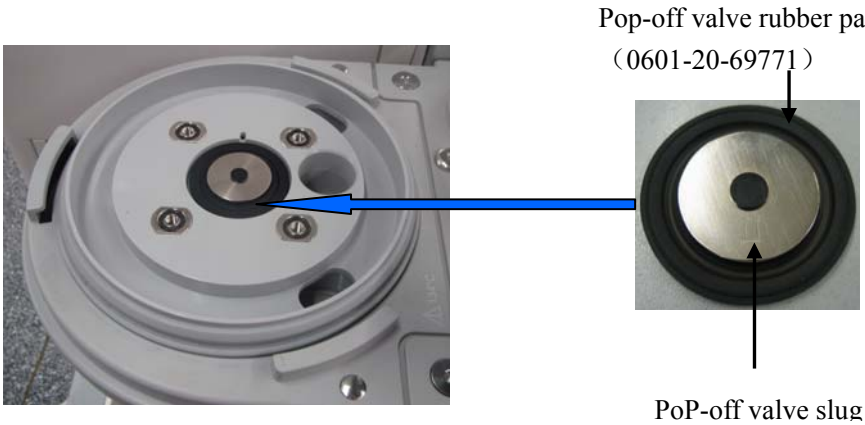
6. Exchange the sealing ring (049-001067-00) of bellows housing and bellows (040-000358-00).



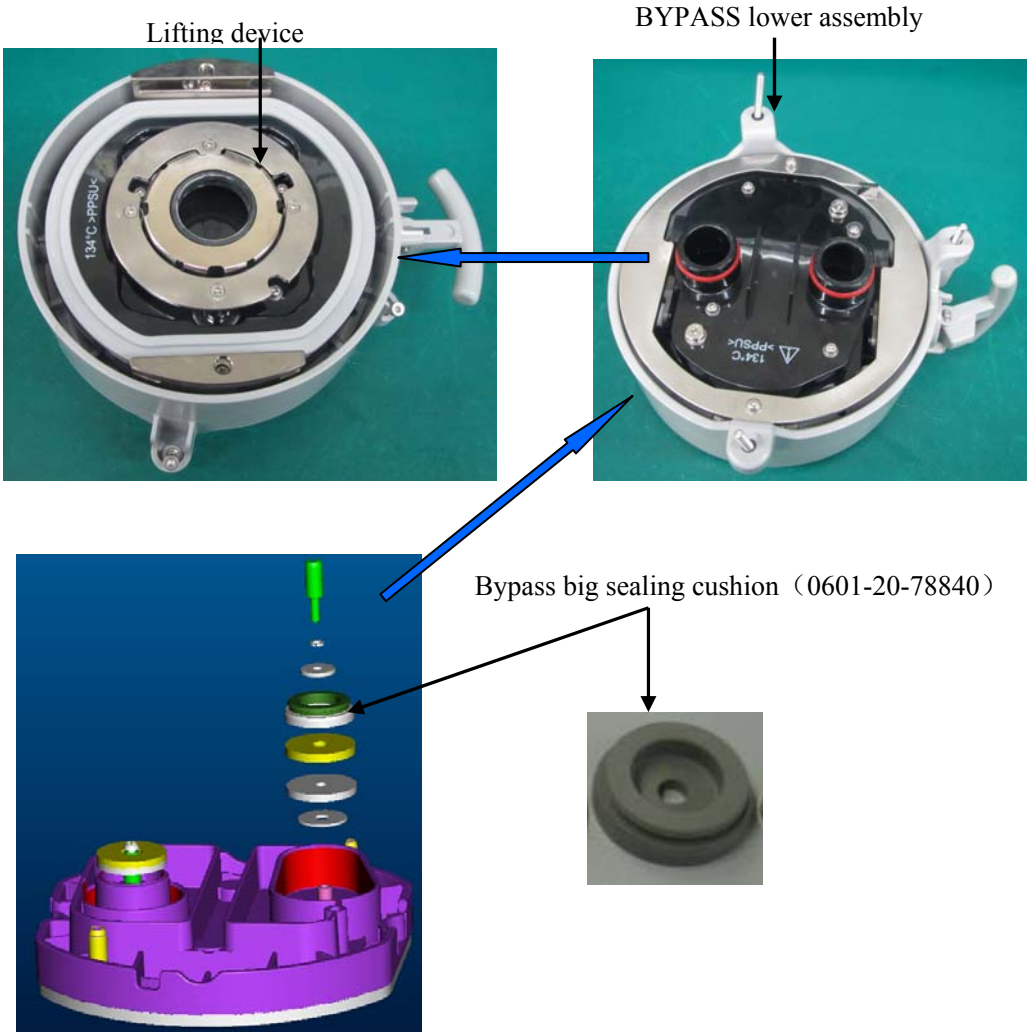
7. Remove the bellows housing and bellows, and unscrew the four screws. Open the Pop-off valve cover, to exchange the sealing ring (M6M-010071---).



8. After opening the Pop-off valve cover, exchange the Pop-off valve rubber pad (0601-20-69771) of the Pop-off valve slug.



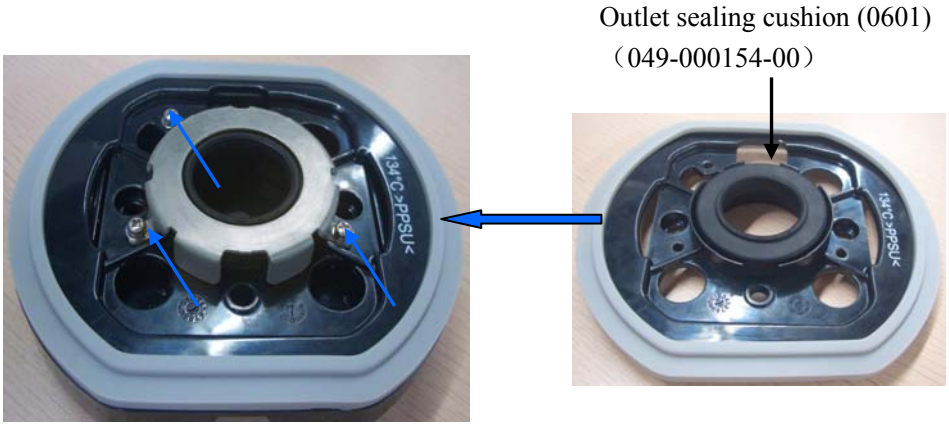
9. Remove the lifting device assembly, and remove the BYPASS lower assembly, and then exchange the Bypass big sealing cushion (0601-20-78840).（Only for Bypass configuration）



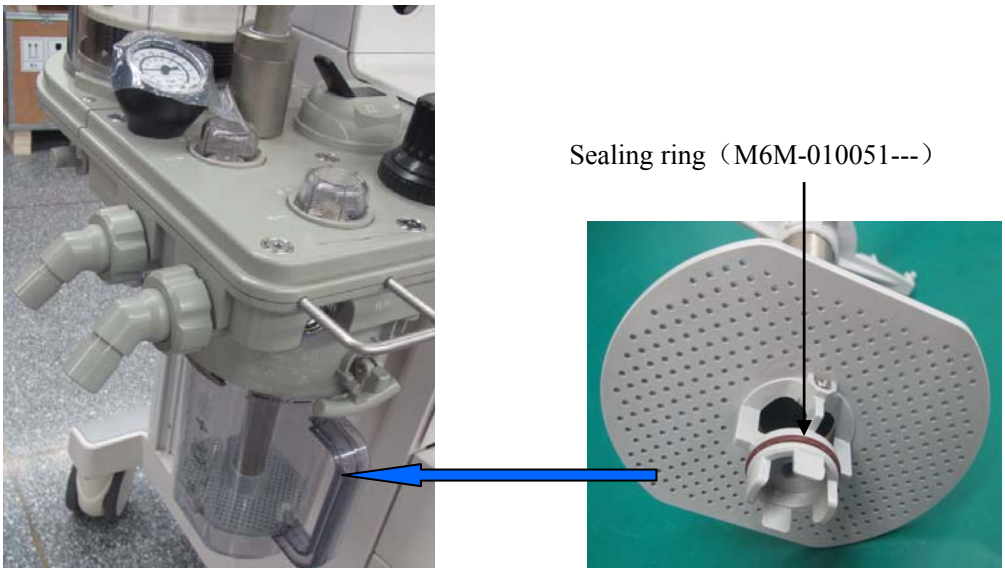
10. Remove the Bypass lower assembly, and exchange the sodalime canister sealing part (0601-20-78842).（Only for Bypass configuration）



11. Remove the Bypass lower assembly, to exchange the outlet sealing cushion (0616) (049-000154-00).（Only for Bypass configuration）



12. Exchange the sealing ring (M6M-010051---) of the sodalime canister support rack.



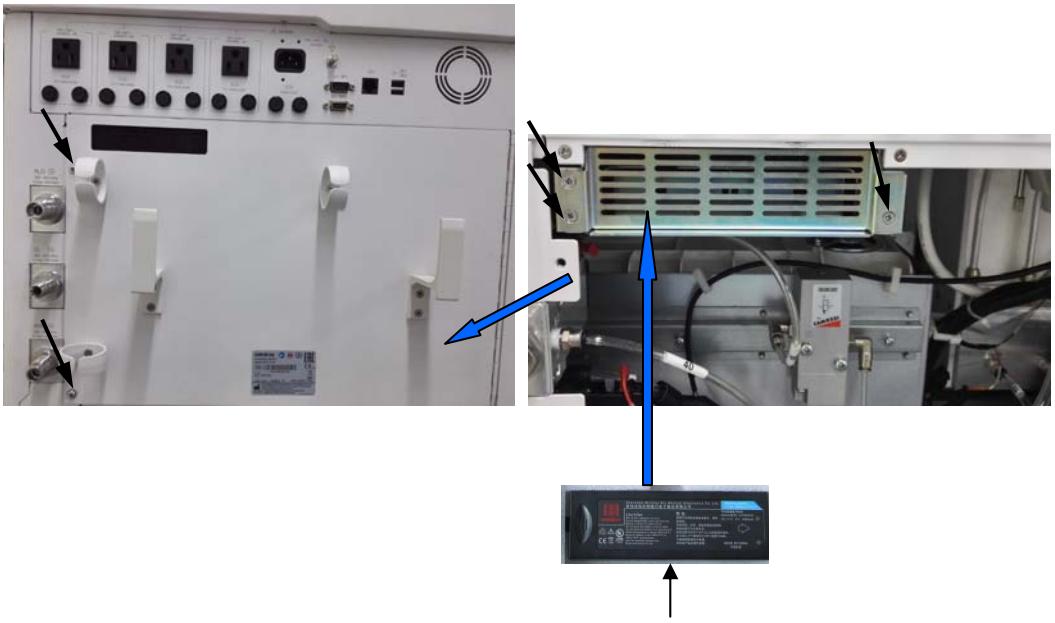
6.4.2 Three-year Replaceable Parts

S/N	P/N	Description	Qty	Usage
1	022-000008-00	Lithium battery Li-ion 11.1V4400mAh LI23S001A	1	Reserve battery
2	M05-010R03---	Cell battery Lithium 3V35mAh D12.5*2.0	1	Main control board

6.4.2.1 Parts Replacement

Circuit part

1. Open the service door, take the cover of battery box off, and then replace the battery (022-000008-00)



Li-ion battery（022-000008-00）

2. Take the top plate and monitor control board off，and replace the cell battery on the main control board (M05-010R03---）



Cell battery（M05-010R03---）

6.5 Other Materials Need to be Checked and Replaced

6.5.1 Maintenance and Replacing of Battery

It is no need to maintain the lithium battery. If the battery cannot work normally, replace it as follows:

1. Open the rear cover plate of the anesthesia machine.
2. Open the battery box.
3. Remove the old battery.
4. Install new battery.
5. Closed the battery box.
6. Closed the rear cover plate.

Please only adopt the battery (P/N: 022-000008-00) which Mindray anaesthesia machine supports.

6.6 Tests after Maintenance

After 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

6.6.1 Check the Mechanical Ventilation Mode

NOTE

- **The main function of the anesthesia machine is to provide breathing support—mechanical ventilation which complies with the doctor's settings to the patient. The tests in this section are performed aiming to ensure that the machine is able to provide normal mechanical ventilation.**
- **The tests can help to judge if the machine operates normally.**

Checking the mechanical ventilation mode is to check:

- If the pressure measured by the machine sensor is consistent with that displayed on the Paw gauge;
- If the machine setting value is consistent with the measured value;
- If the machine works normally;
- If an alarm errors;
- If the circuit has great leaks through rough evaluation of fresh gas compensation and bellows collapse so as to judge if the machine can work normally.

6.6.1.1 Check Volume Control Ventilation (VCV)

NOTE

- **VCV is the standard ventilation mode of the anesthesia machine and also the most basic mechanical ventilation mode.**

The check item helps determine whether the VCV functions properly on the machine, covering the control, feedback, and measurement of TV, the measurement of the pressure sensor and Paw gauge, the working condition of the bellows, obvious leakage on the machine, and sufficient compensation of fresh air, and ventilation alarm performance.

To check VCV:

1. Make sure that the supply pressure is normal and that the tubes in the breathing circuit are correctly connected as required for mechanical ventilation. Connect a 2 L bag, which is used as the test lung, to the Y piece in the patient circuit.
2. Set the bag/vent switch to the mechanical ventilation position.
3. Select VCV as the ventilation mode.
4. Adjust total amount of fresh gas to 0.5 L/min.

5. Set the following combinations of TV and Rate respectively: 300 ml and 15 BPM, 600 ml and 15 BPM, 900 ml and 15 BPM, 1200 ml and 15 BPM. Set others to the defaults. Record the displayed TVe and Ppeak values, and the peak pressure reading on the airway pressure gauge in each setting stabilized status.
6. Judge if the above measured data meet the following conditions:
   - ◆ TV control and measurement are normal: the displayed TVe value should be within the range of TV setting X (1±10%) ml.
   - ◆ Circuit leak is within the acceptable range: the folding bag can reach the top of the bellows housing each time and the lowest graduation on the bellows housing which the bag falls to approximately the TV setting each time.
   - ◆ Pressure measurement is normal: the Ppeak measured value is close to the peak pressure reading on the airway pressure gauge. The error should not exceed 2 cmH2O.
   - ◆ No other ventilation failure occurs: the Paw and flow waveforms are displayed normally and no technical alarms occur.

If the above test requirements are not met, perform subsequent checks and do the test again.

NOTE

- **If any errors are detected during VCV test, perform troubleshooting as per 8.5 Airway System Failure and do the test again until the system is normal.**

6.6.1.2 Check Pressure Control Ventilation (PCV)

NOTE

- **PCV is one of the basic mechanical ventilation modes of the anesthesia machine. PCV is configured depending on the user's selection and machine type. If the anesthesia machine under test is not configured with this mode, this test is not required.**

The check item helps determine whether the PCV functions properly on the machine,, covering the control, feedback, and measurement of TV, the measurement of the pressure sensor and Paw gauge, the working condition of the bellows, obvious leakage on the machine, and sufficient compensation of fresh air, and ventilation alarm performance.

Checking pressure control ventilation is to check:

- If the machine can provide pressure control ventilation normally, including pressure control, feedback and measurement;
- If the tidal volume and bellows scale measurements are normal;
- The working status of the bellows assembly;
- If the machine has obvious leaks;
- If the fresh gas compensation is normal;
- If the machine has ventilation failure alarm.

To check PCV:

1. Make sure that the supply pressure is normal and that the tubes in the breathing circuit are correctly connected as required for mechanical ventilation. Connect a 2 L bag, which is used as the test lung, to the Y piece in the patient circuit.
2. Set the bag/vent switch to the mechanical ventilation position.
3. Select PCV as the ventilation mode.
4. Adjust total amount of fresh gas to 0.5 L/min.
5. Set the following combinations of Pinsp, Rate and PEEP respectively: (10 cmH2O, 15 BPM, OFF), (15 cmH2O, 12 BPM, 5 cmH2O), (20 cmH2O, 10 BPM, 8 cmH2O). Set others to the defaults. Record the displayed Ppeak and PEEP values, and maximum and minimum readings on the airway pressure gauge in each setting stabilized status
6. Judge if the above measured data meet the following conditions:
   - Pressure control and measurement are normal: the displayed Ppeak value should be within the range of Pinsp setting ±2 cmH2O.
   - Circuit leak is within the acceptable range: the folding bag can reach the top of the bellows housing each time.
   - Pressure measurement is normal: in one breathing cycle, the Ppeak measured value should be close to the maximum reading on the airway pressure gauge (with error not exceeding 2 cmH2O) and the displayed PEEP value close to the minimum reading on the airway pressure gauge (with error not exceeding 1 cmH2O).
   - No other ventilation failure occurs: the Paw and flow waveforms are displayed normally and no technical alarms occur.

If the above test requirements are not met, perform subsequent checks and do the test again.

NOTE

- **If any errors are detected during PCV test, perform subsequent checks and do the test again until the errors are corrected.**

6.6.2 Breathing System Leak Test in Mechanical Ventilation Mode

This test is to check if the mechanical ventilation pneumatic circuit has leaks, including the bellows, drive gas circuit, sodalime canister, patient tubing, flow sensor and their connections.

For details, refer to ***4.3.1*** Automatic Circuit Leak and Compliance Test.

6.6.3 Breathing System Leak Test in Manual Ventilation Mode

This test is to check if the manual ventilation pneumatic circuit has leaks, including the APL valve, check valve, sodalime canister, patient tubing, flow sensor and their connections.

For details, refer to ***4.3.2 Manual Circuit Leak Test***.

6.6.4 Check the Sensor Zero Point

For details, refer to ***4.3.2 Manual Circuit Leak Test***.

6.6.5 Check the Flow Sensor Accuracy

NOTE

- **If a great deviation of TV measured value occurs, test the measurement accuracy of flow sensors so as to determine whether to perform flow calibration again.**

Please refer to ***4.12.2 Constant Flow Test (Checking the Flow Sensor Accuracy)***.

6.6.6 Check the Pressure Sensor Accuracy

NOTE

- **Generally, measurement deviations do not easily occur to pressure sensors. However, in case of maintaining or replacing the monitor board, three-way valve assembly, or expiratory valve assembly, you need to perform pressure calibration and check the flow sensors accuracy so as to confirm the effectiveness of calibration.**

Please refer to ***4.12.3 Constant Pressure Test (Checking the Pressure Sensor Accuracy).***

FOR YOUR NOTES

7 System Calibration

7.1 Overview

This section elaborates how to test and calibrate the WATO EX-35(0619) anesthesia machine. Calibration refers to mechanical and electrical adjustments using test devices. The anesthesia machine needs to be tested and calibrated after repairs or at regular intervals as part of routine maintenance.

NOTE

- **Functional tests must be performed after calibration to verify the calibration result.**

Ensure that all test materials including the drive gas, breathing circuits, test fixtures, tools, and documents are the latest, available, and calibrated prior to calibration.

7.2 Precautions

7.2.1 Warnings

⚠WARNING

- **Use fuses of the specified type and rating to prevent fire.**
- **The machine (protection class I) can be connected only to a correctly grounded power supply (including the socket with grounding contact) to prevent electric shocks.**
- **Remove all auxiliary devices from the shelf before moving the anesthesia machine on the rough road or any slope. The anesthesia machine with a weight on its top is likely to tip over, causing personal injuries.**
- **To avoid the possible explosion hazard, do not operate the machine near flammable anaesthetic agents or other flammable substances. Do not use flammable anesthetic agents such as ether or cyclopropane.**
- **When high-frequency electric surgery equipment is used, anti-static or electrically conductive breathing tubes may cause burns. Therefore, they are recommended at no time.**
- **The electric shock hazard may exist. The machine can be opened only by authorized service personnel.**
- **According to IATA and DOT regulations, compressed gases are dangerous. Therefore, the packages or transport packages of dangerous goods must be properly identified, packed, marked, classified, labeled, and documented in accordance with the DOT and IATA regulations. For details, see the International Air Transport Association – Dangerous Goods Regulations or Part 171-180 "Transportation" in Title 49 of the Code of Federal Regulations.**

7.2.2 Cautions

⚠CAUTION

- **Refer to the maintenance period in the Chapter 6 Device Maintenance when conducting periodic maintenance.**
- **If the pipeline gas supply is in use and the main switch of the system is set to the ON position, ensure that the standby gas cylinder valve is not opened. Otherwise, the cylinder gas supply could be depleted, resulting in an insufficient reserve in the case of a pipeline gas supply failure.**
- **Use the cleaning agent sparingly. Excess fluid could enter the machine, causing damage.**
- **The machine can be operated only by trained and skilled medical personnel.**

7.2.3 Notes

NOTE

- **Only bacterial filter with a low-flow resistance can be connected to the patient module and/or patient pipe.**
- **Wear surgical gloves when touching or disassembling valves or other internal components of the breathing system.**
- **Ensure that the gas supply of the machine always complies with technical specifications.**
- **The APL valve and the PAW gauge marker are for reference only. The anesthesia machine displays the calibrated airway pressure.**
- **If the machine malfunctions during initial calibration or testing, do not use it until the fault is rectified by a professional service technician.**
- **After servicing, functional tests, sensor tests, and system tests must be carried out prior to clinical application.**
- **The machine supports up to two vertical mounting brackets to accommodate additional monitors and other devices. Unauthorized mounting accessories are not recommended.**
- **Ensure that all devices on the top plate of the machine are secured.**

7.3 System Calibration

NOTE

- **The drive gas of the anesthesia machine and the drive gas set in the calibration device must be consistent with the actual drive gas configured for the machine.**
- **If a test item concerning measurement accuracy fails in the system test, perform relevant calibration.**
- **VT or Fluke VT Plus: The zero point (baseline) of pressure measurements may slightly drift with the temperature and time. Users can perform zeroing manually to eliminate zero offset. In general, zeroing needs to be performed if the monitor displays a non-zero reading in the case of no pressure. Perform zeroing on the calibration device before making any measurements.**
- **You can use VT or Fluke VT Plus to perform automatic calibration on pressure sensors or flow sensors, or use other calibration devices meeting the accuracy requirement to perform manual calibration.**

The anesthesia machine provides the functions of monitoring the volume, pressure, inspiratory O2 concentration, CO2 concentration, and gas concentration inside the machine. Great measurement deviations of the monitored values are very likely to be caused by the offset in measured values of relevant measurement components, and calibration needs to be performed. After the machine is serviced, for example, the VCM or expiratory valve assembly is replaced, the flow sensors or pressure sensors of the machine need to be calibrated. The following table lists the possible calibration items and calibration occasions.

No.	Calibration Item	Function Description	Calibration Occasion
1	Flow calibration (user)	Calibrates flow sensors of the breathing system.	1. The TV measured value greatly deviates from the settings (with the deviation of more than 9%) after the flow sensors in the patient circuit have been used for a long time. 2. The flow sensors in the patient circuit are replaced.
2	Flow calibration (service)	Calibrates the flow sensors and inspiration valve of the anesthesia machine.	1. The expiratory valve assembly is replaced. 2. The VCM is replaced. 3. The measured value of the built-in flow sensor deviates from that of the flow measuring device by 5% of the reading or 1 L/min, whichever is larger.
3	Pressure calibration (service)	Calibrates the pressure sensors and PEEP valve of the anesthesia machine.	1. The VCM is replaced. 2. The expiratory valve assembly is replaced. 3. The measured value of the machine's pressure sensor deviates from that of the standard pressure gauge by 5% of the reading or 2cmH2O, whichever is larger.
4	Pressure and flow zeroing (service)	Zeros the VCM and the auxiliary VCM.	The pressure or flow waveform deviates from the baseline.

No.	Calibration Item	Function Description	Calibration Occasion
5	O2 sensor calibration (user)	Calibrates the measurement accuracy of the O2 sensor in 21% O2 concentration and 100% O2 concentration.	1. The measured value of the O2 sensor deviates from that of the actual value. The deviation is greater than 3% in both air (21% O2 concentration) and pure O2 (100% O2 concentration) environment. 2. The O2 sensor is replaced. 3. The VCM is replaced.
6	CO2 sensor calibration (service)	Calibrates the module to make it work more accurately.	The deviation between measured value and the actual value exceeds the standard accuracy range.
7	AG concentration calibration (service)	Calibrates the module to make it work more accurately.	The deviation between measured value and the actual value exceeds the standard accuracy range.
8	O2 module calibration	Calibrates the module to make it work more accurately.	The deviation between measured value and the actual value exceeds the standard accuracy range. The O2 module is replaced.

7.3.1 Flow Calibration (User)

NOTE

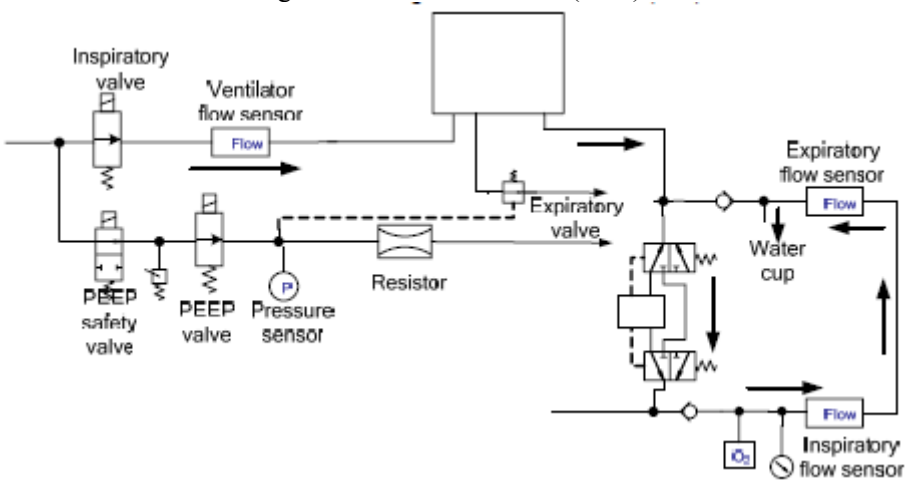
- **A new flow sensor must be calibrated.**
- **The measurement accuracy of flow sensors may be affected by the operating environment, especially when they have been used for a long time, and the tidal volume control may also experience a great deviation correspondingly. After-sales engineers can call users to help them resolve the deviation problem through calibration.**
- **Before a calibration, perform the auto circuit leak test and ensure that no leak exists.**
- **During a calibration, ensure that the drive gas pressure is within the specified range. Otherwise, the calibration may fail.**

7.3.1.1 Flow Calibration Principles

This calibration item is used to calibrate only the flow sensors and inspiration valve in the circuit. The built-in flow measurement base source of the machine is utilized to calibrate the inspiratory flow sensor and expiratory flow sensor on the breathing system. The VCM opens the inspiration valve based on inspiration valve DA values obtained from service calibration, to inflate the circuit of the breathing system, records the flow of the built-in flow sensor, and uses the measured value of the built-in flow sensor as well as AD values collected by the inspiratory flow sensor and expiratory flow sensor as the data of one calibration point for flow sensors, and uses the measured value of the built-in flow sensor as well as the DA value of the inspiration valve as the data of one calibration point for the inspiration valve. Change the DA value of the inspiration valve to obtain calibration data under a series of flows, forming a flow calibration data table. The flow should be in the range from 0 L/min to 120 L/min when the inspiration valve is opened during flow calibration.

If the inspiratory flow sensor and expiratory flow sensor have been used for months, for example, three months after calibration, the measured tidal volume greatly deviates from the settings (with the deviation of more than 9%) due to sensor aging or environmental factors; or a flow sensor is replaced. In this case, the flow sensor needs to be calibrated. The flow calibration (user) can be adopted.

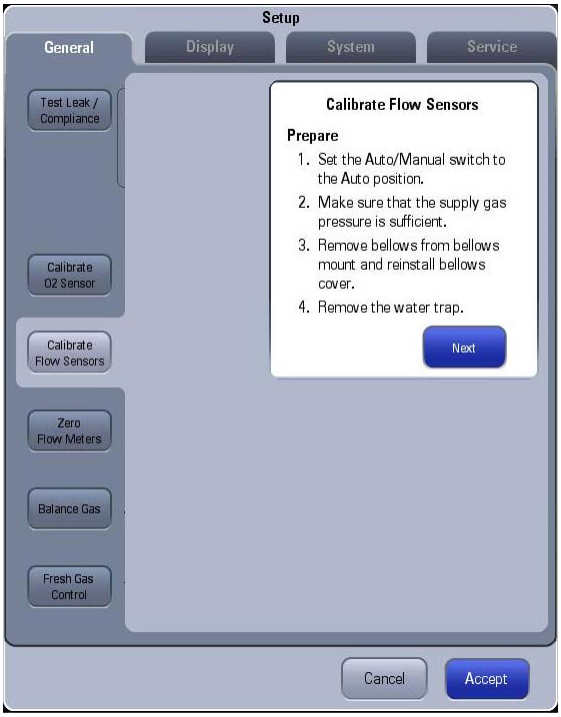
FIGURE 1 Schematic Diagram of Flow Calibration (User)



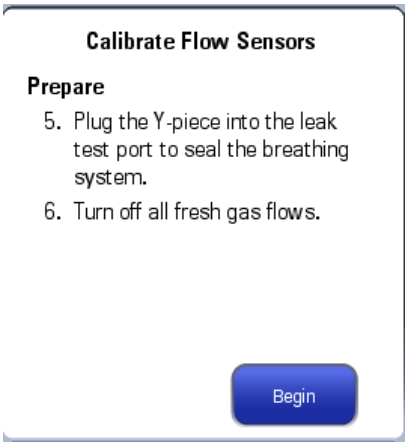
7.3.1.2 Calibration (User) Procedure

Perform the following steps to calibrate flow sensors.

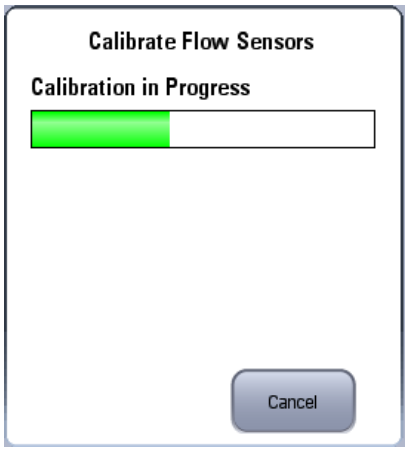
1. Enter the standby mode.
2. Select > [**General**]> [**Calibrate Flow Sensors]**, to enter the screen shown below.



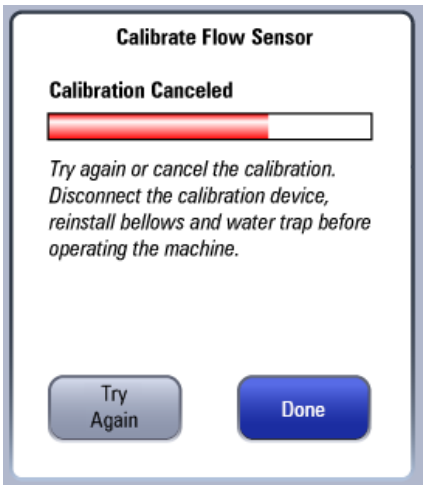
3. Follow the instructions on the screen to set the machine and select [Next] to enter the screen shown below.



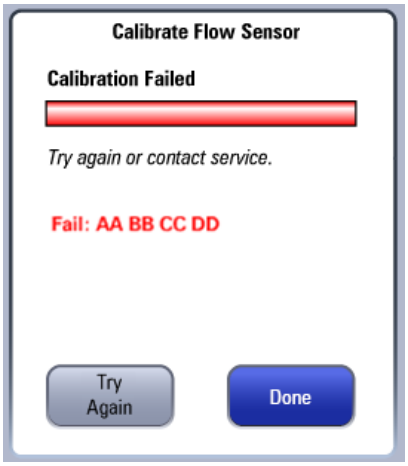
4. Select [**Begin]** to calibrate the flow sensor. During the calibration, you can select [**Cancel]** to abort.



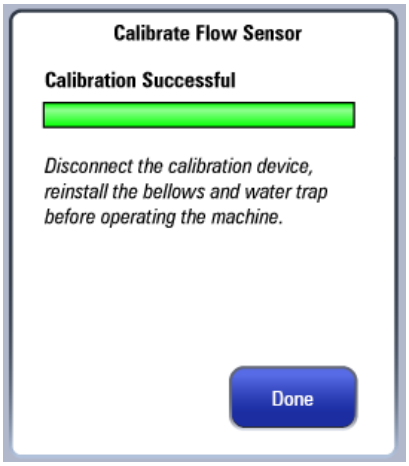
5. The screen shown below is displayed if the ongoing calibration is aborted. Select [**Try Again**] to do the calibration again or select [**Done**] to exit the calibration screen.



6. The screen shown below is displayed if the flow sensor calibration fails. Select [**Try Again**] to do the calibration again or select [**Done**] to exit the calibration screen.



7. The screen shown below is displayed upon a successful flow sensor calibration. Select [**Done**] to exit the calibration screen.



NOTE

- **If measurement deviations are not corrected after multiple flow sensor calibrations, it is recommended that a flow sensor in the circuit be replaced and then a calibration be performed for the new flow sensor. If the problem persists, send the machine to the manufacturer for maintenance. After the problem is fixed, perform the calibration and system tests.**

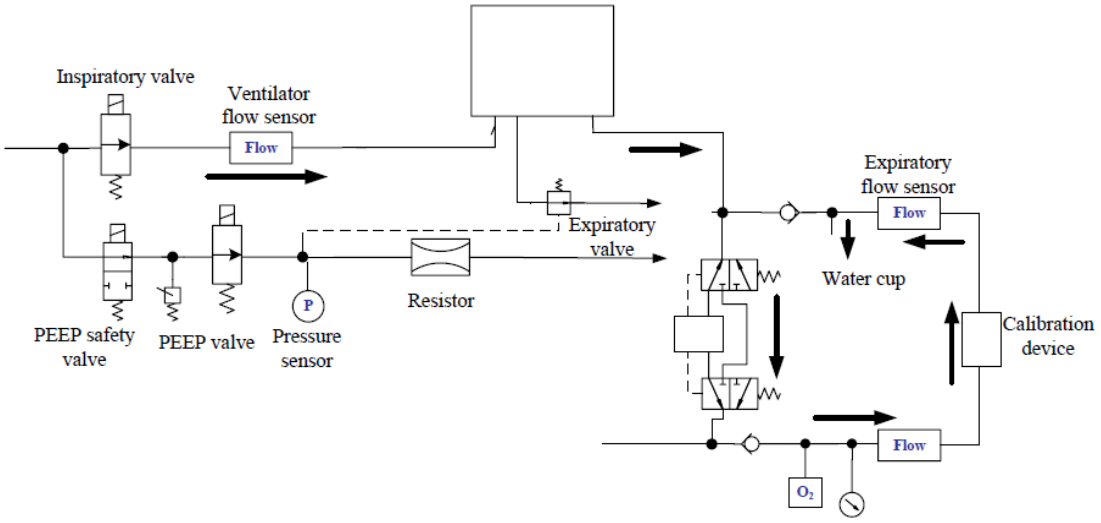
7.3.2 Flow calibration (Service)

NOTE

- **After the VCM or expiratory valve assembly is replaced, flow calibration (service) shall be implemented.**
- **If the deviation between the value measured by the embedded flow sensor and the value measured by a standard flow measurement device is great, flow calibration (service) shall be implmented.**

7.3.2.1 Flow Calibration Principles

In the automatic flow calibration, the anesthesia machine calibration device specified by the manufacturer needs to be used to calibrate the inspiration valve, ventilator flow sensor, inspiratory flow sensor, and expiratory flow sensor. The calibration principles are as follows: The anesthesia machine calibration device can communicate with the VCM. The VCM opens the inspiration valve based on a certain DA value. The ventilator flow sensor, inspiratory flow sensor, expiratory flow sensor, and anesthesia machine calibration device collect the flow value of the circuit. The calibration device sends the collected flow value to the VCM. The VCM uses the flow measured by the calibration device and the AD values collected by the flow sensors as the data of one calibration point for flow sensors, and VCM also uses the flow measured by the calibration device and DA value of the inspiration valve as the data of one calibration point for the inspiration valve. The VCM controls the inspiration valve to change the DA value to obtain calibration data under a series of flows, forming a flow calibration data table. The flow should be in the range from 0 L/min to 120 L/min when the inspiration valve is opened during flow calibration.



7.3.2.2 Precautions

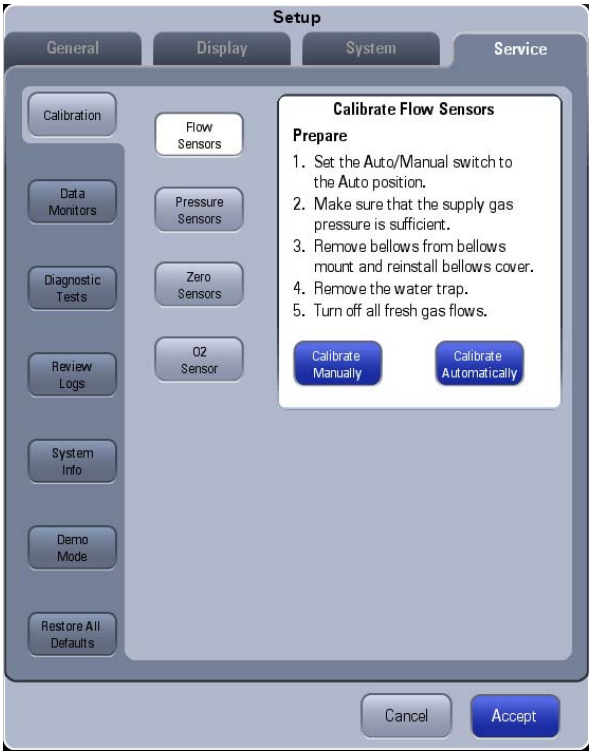
NOTE

- **Ensure that tubes do not leak when connected. That is, they have passed the leakage test.**
- **Do not move or press tubes during calibration.**
- **When connecting calibration tubes, ensure that the gas flow direction is correct. Normally, the gas flows from the inspiration connector of the breathing system, the high-flow inlet of the anesthesia machine calibration device, the anesthesia machine calibration device, the high-flow outlet of the anesthesia machine calibration device, to the expiration connector of the breathing system.**
- **Ensure that no sensor- or valve-related technical alarm is generated.**
- **Ensure that the drive gas pressure is sufficient during calibration. Otherwise, the calibration may fail.**
- **You can use VT Plus for automatic calibration, or use a flow calibration device that meets the accuracy requirement for manual calibration.**
- **For calibration devices with high and low flow channels, flow channel switchover is required during automatic or manual calibration.**

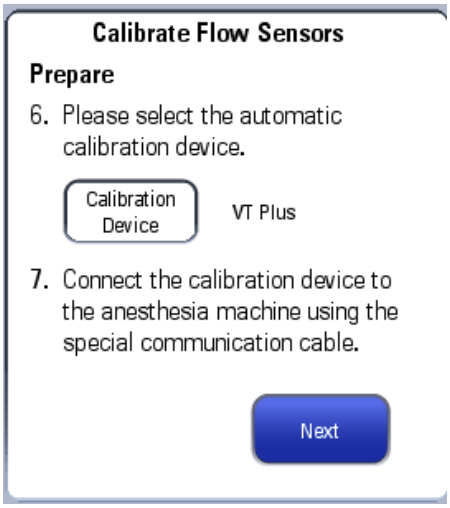
7.3.2.3 Calibration Procedure

Perform the following steps to calibrate flow sensors.

1. Enter the standby mode.
2. Select > [**Service**] > [**Calibration**] > [**Flow Sensors**] to enter the screen shown below.

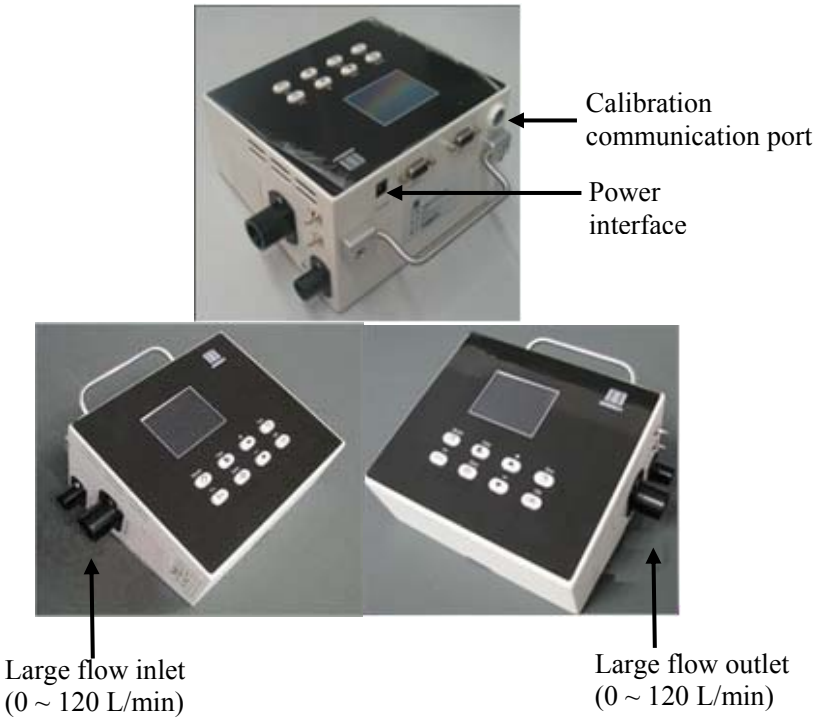


3. Select [**Calibrate Automatically]** to enter the screen shown below. Select the required calibration device.



Connect a calibration device with the anesthesia machine using a communication cable. The calibration device can be the VT or Fluke VT Plus.

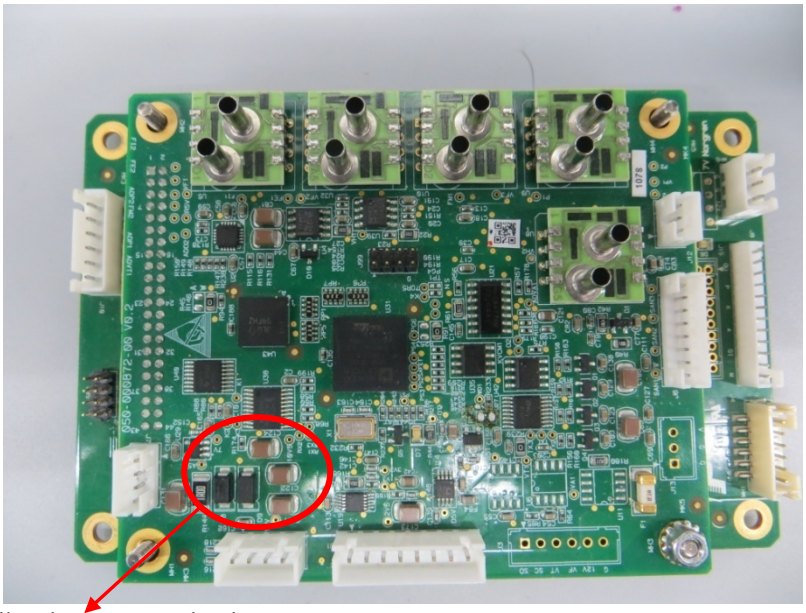
- The following figure shows the ports on the VT and the corresponding settings:



Use a dedicated communication cable to connect the communication port on the calibration device to the calibration communication port on the anesthesia machine. There are two modes of communication connection between the calibration device and the anesthesia machine.

The following figure shows the two types of communication cables A and B used on anesthesia machine calibration devices.

Mode I: Remove the cover on the top of the anesthesia machine. Connect the communication port (the white cable on the left in the figure) on the calibration device to the calibration communication port on the VCM board on the anesthesia machine using the communication cable A. See the following figure:



Calibration communication port on the VCM board

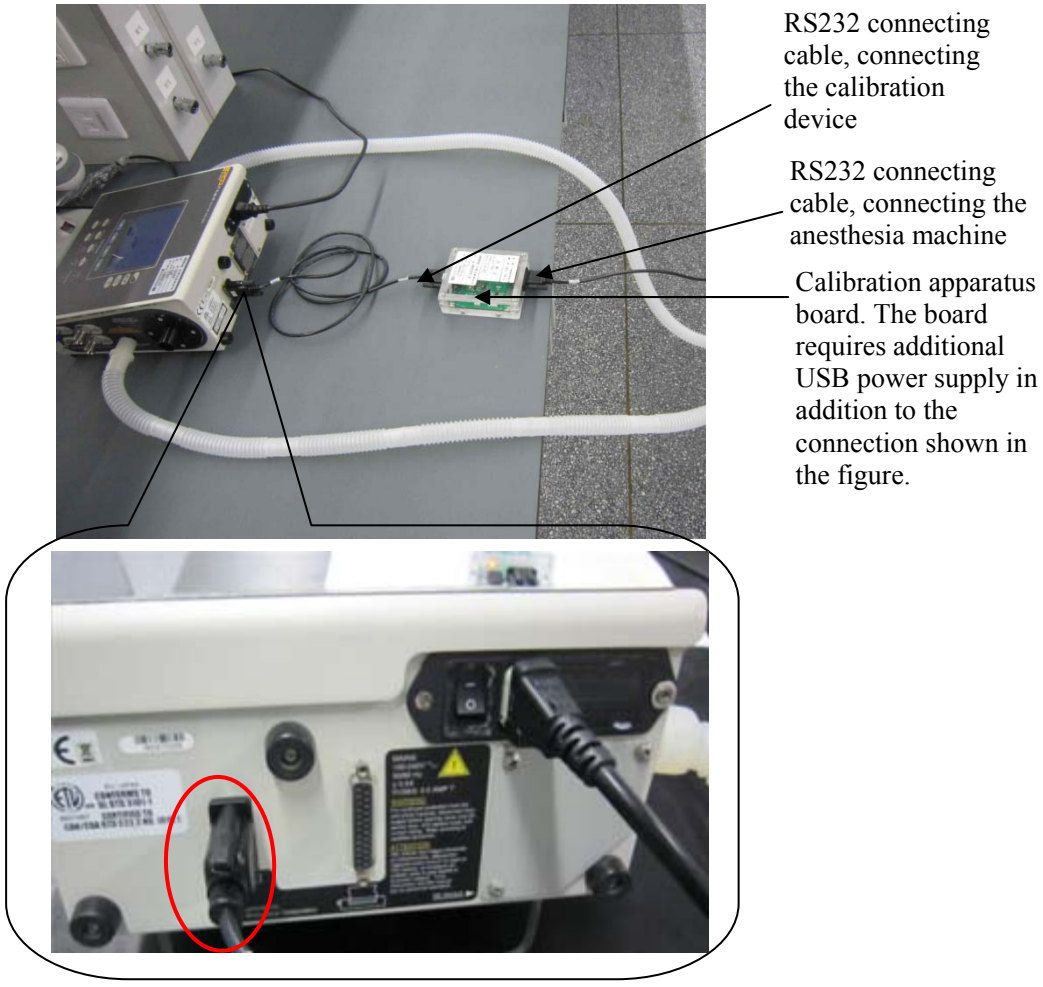
Mode II: Connect the communication port on the calibration device to the calibration port (a multiplex port providing also the function of a CIS power port) on the back of the anesthesia machine directly using the communication cable B. See the following figure:



Dedicated communication cable B for anesthesia machine calibration devices

■ The following figure shows the ports on the Fluke VT Plus and the corresponding settings:

(1). Power on the anesthesia machine calibration device Fluke VT Plus. The following figure shows the ports on the Fluke VT Plus:



(2). Connect the Fluke VT Plus to the anesthesia machine. The following figure shows the corresponding port:



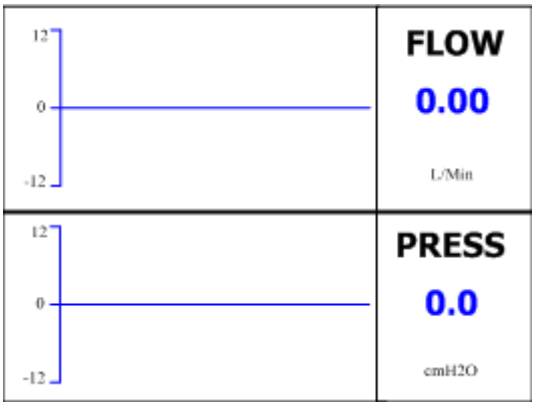
Cable connection on the back of the anesthesia machine

5. Configure the calibration device.

If the VT is used as the calibration device, configure the VT in the following way:

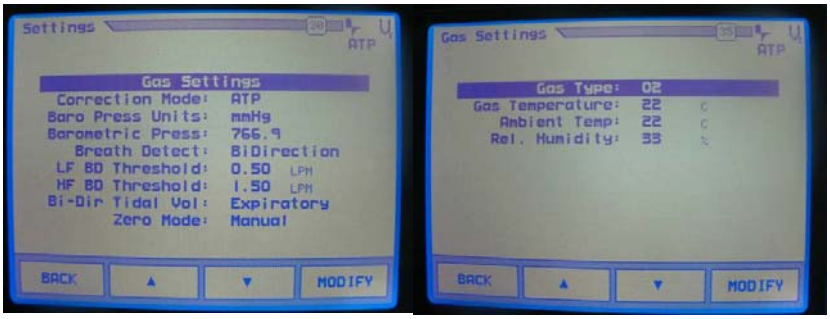
(1) Start the anesthesia machine calibration device. On the startup interface, go to the sensor heating interface (waiting for five minutes according to the prompt), and then go to the zeroing interface. Press [**ZERO**] on the panel. In the displayed interface, press [**OK**] to complete zeroing.

(2) On the panel of the calibration device VT, press [**MODE**]. Select [**Calibration Mode**] from the menu, and press [**OK**] on the panel to go to the calibration interface. See the following figure:

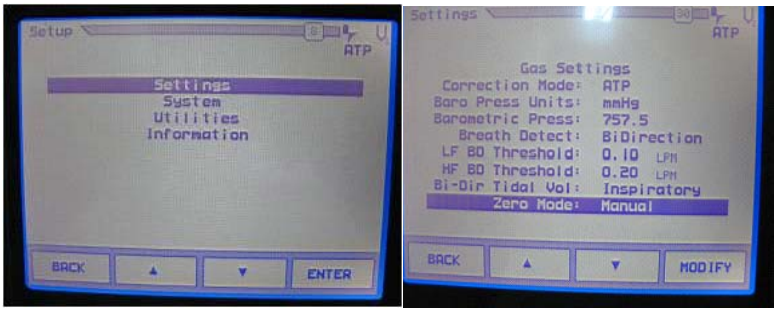


If the VT Plus is used as the calibration device, configure the Fluke VT Plus in the following way:

(1) Gas settings: Select [**Setup**], and select [**Setting**] > [**ENTER] > [GasSettings**] > [**MODIFY**] > [**Gas Type**] > [**O2**] > [**BACK**] > [**BACK**].



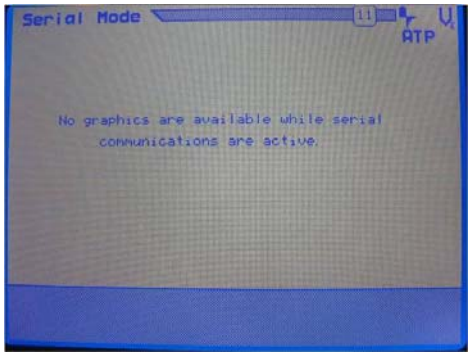
(2) Zeroing settings: Select [**Setup**], and select [**Setting**] > [**ENTER**] > [**Zero Mode**] > [**Manual**] > [**BACK**] > [**BACK**].



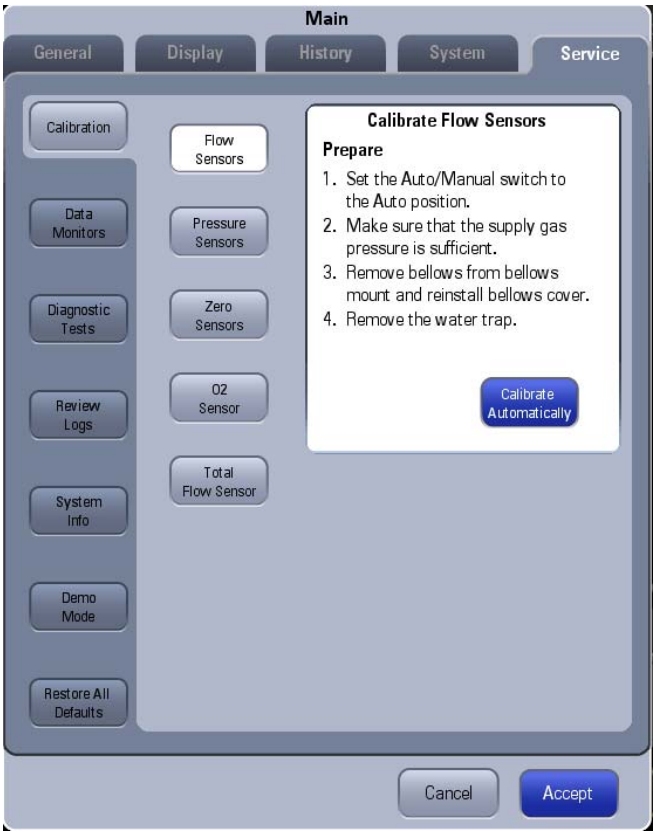
(3) Serial port mode settings: Select [**Setup**], and select [**Setting**] > [**System**] > [**Enter**] > [**Serial Mode**] > [**OTIS Ctrl**] > [**BACK**] > [**BACK**].



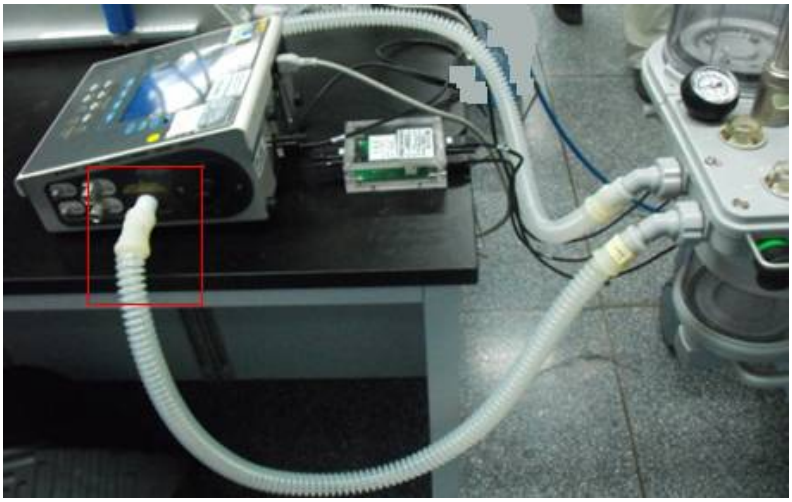
(4) The calibration goes into the serial port mode interface after the VT Plus is configured.



6. Press [**Next**]. The menu as shown in the following figure is displayed:

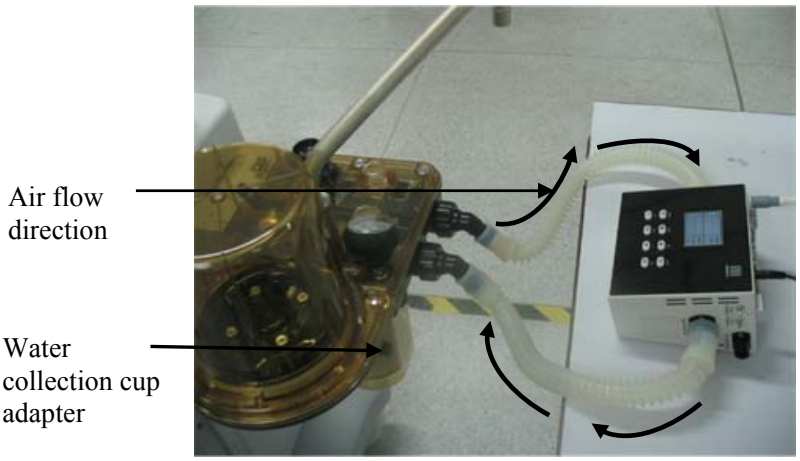


7. Select the low-speed channel first if the VT Plus is used as the calibration device. See the following figure:



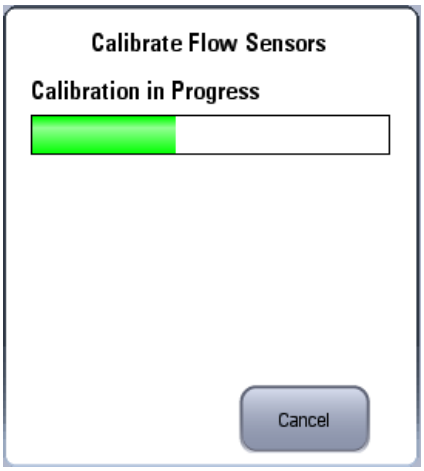
Airway connection involving the VT Plus

Select the large-volume flow inlet/outlet (0 – 120 L/min) on the calibration device if the VT is used as the calibration device. See the following figure:

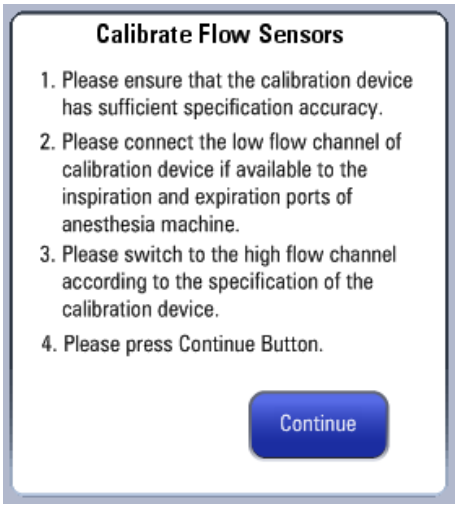


Airway connection involving the VT

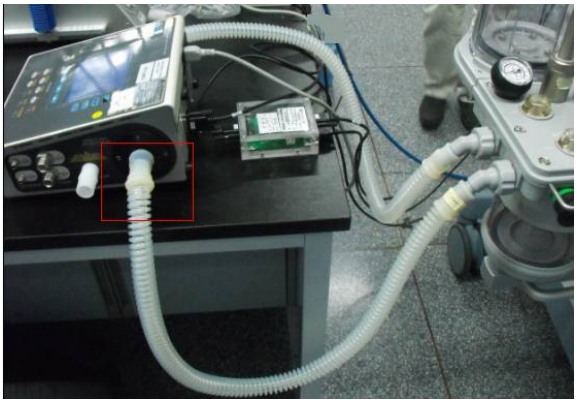
8. Select [**Start**]. The menu as shown in the following figure is displayed:



9. The menu as shown in the following figure is displayed after the low-speed channel calibration is complete:



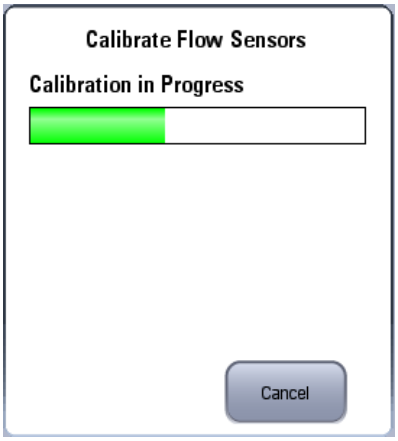
10. Connect to the high-speed flow channel of the calibration device as shown in the following figure if the VT Plus is used as calibration device:



Airway connection involving the VT Plus

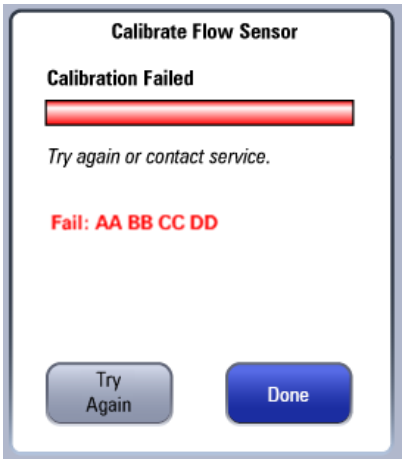
Select [**Continue**] without changing the flow speed if the VT is used as the calibration device.

11. Select [**Continue**]. The menu as shown in the following figure is displayed:

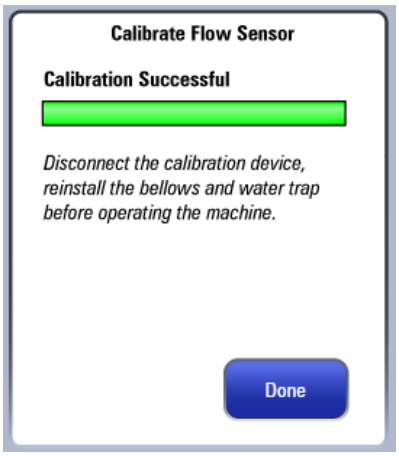


12. The interface as shown in the following figure is displayed after the calibration is complete.

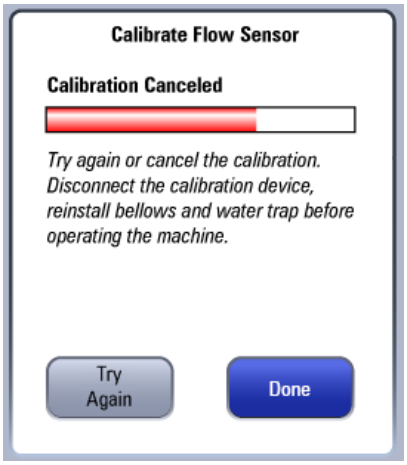
- If the flow sensor calibration fails, the interface as shown in the following figure is displayed. Read the detailed information displayed on the calibration device, troubleshoot the failure and rectify the fault. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



- If the flow sensor calibration succeeds, the interface as shown in the following figure is displayed. Select [**OK**] to quit calibration.



13. The interface as shown in the following figure is displayed if the ongoing calibration is cancelled. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



7.3.2.4 Common Failures and Recommended Actions

Failure Description	Possible Cause	Recommended Action
After Begin is selected, no ventilation sound is heard. The prompt message "Calibration Failure! Please try again." is displayed very soon.	The prompt message "Manual Vent." is displayed, indicating that the Auto/Manual switch is set to the Manual position.	Set the Auto/Manual switch to the Auto position.
	The alarm "Drive Gas Pressure Low" is generated. The pressure indicated by the drive gas (O2) pressure gauge is lower than 200 kPa	Change or connect the gas supply to ensure that the drive gas pressure is within the specified range.
	A zero point error occurs in the inspiratory/expiratory flow sensor.	Replace the VCM.

Failure Description	Possible Cause	Recommended Action
After Begin is selected, the ventilation sound is heard. The prompt message "Calibration Failure! Please try again." is displayed very soon.	The sampling line of at least one of the inspiratory flow sensor, expiratory flow sensor, and ventilator flow sensor is not connected or connected incorrectly.	Re-connect the sensor sampling line.
	The maximum flow is smaller than 90 L/min when the inspiration valve is opened.	Replace the expiratory valve assembly.
	1. An error occurs in the pneumatic circuit connection between the anesthesia machine calibration device and the VCM. 2. An error occurs in the communication connection between the anesthesia machine calibration device and the anesthesia machine. 3. The anesthesia machine calibration device is set incorrectly.	1. Check the pneumatic circuit connection between the anesthesia machine calibration device and the VCM. Reconnect the pneumatic circuit if necessary. 2. Check the communication connection between the anesthesia machine calibration device and the anesthesia machine, or reconnect them to ensure normal communication. Replace the communication cable if the problem persists. 3. Check the settings of the anesthesia machine calibration device. Set the anesthesia machine again if necessary.
The prompt message "Calibration Failure! Please try again." is displayed 15 minutes after calibration is started.	Calibration data is incorrect	Replace the inspiratory and expiratory flow sensors and conduct calibration again. If calibration still fails, replace the VCM.
	When the flow reaches 90 L/min, the collected AD value of the inspiratory flow sensor or expiratory flow sensor is larger than 3900, which is out of the normal range.	1. Replace the flow sensor in the circuit. 2. Replace the VCM.
[00000002] is displayed	Drive gas pressure is low.	1. Check the drive gas supply. 2. Check the drive gas switch if the drive gas supply is in proper condition.
[00000004] is displayed	The Auto/Manual switch is in Manual position.	1. Check whether the Auto/Manual switch is set to the Auto position. 2. Check whether the Auto/Manual switch can be set normally.
[00000008] is displayed	There is a zero point error for the inspiratory flow sensor.	1. Check whether fresh gas is turned on. 2. Check whether the inspiratory valve is switched off: After the inspiratory valve is switched off (DA=0 on the valve diagnosis tool), the AD value of the sensor on the anesthesia machine does not change (or the change is within 1%) when the gas supply is connected and disconnected. This indicates the valve is switched off. 3. Check the correctness of the zero point for the sensor. 4. Replace the VCM.

Failure Description	Possible Cause	Recommended Action
[00000010] is displayed	There is a zero point error for the expiratory flow sensor.	1. Check whether fresh gas is turned on. 2. Check whether the inspiratory valve is switched off: After the inspiratory valve is switched off (DA=0 on the valve diagnosis tool), the AD value of the sensor on the anesthesia machine does not change (or the change is within 1%) when the gas supply is connected and disconnected. This indicates the valve is switched off. 3. Check the correctness of the zero point for the sensor. 4. Replace the VCM.
[00000020] is displayed	There is a zero point error for the ventilator flow sensor.	1. Check the zero point of the sensor. 2. Check whether the inspiratory valve is switched off: After the inspiratory valve is switched off (DA=0 on the valve diagnosis tool), the AD value of the sensor on the anesthesia machine does not change (or the change is within 1%) when the gas supply is connected and disconnected. This indicates the valve is switched off. 3. Replace the VCM.
[00000040] is displayed	The measured range of the inspiratory flow sensor is abnormal.	1. Check whether the sampling line is connected correctly. 2. Diagnose the failure using the valve diagnosis tool: In the calibration airway connection environment, start the valve diagnosis tool. Seal the expiratory valve with 4000 DA. Turn on the inspiratory valve gradually, and observe the measured values on the calibration device when each valve is switched on. If the measured value on the calibration device close to (smaller than) 90 L/min corresponds to a sampling AD greater than 60000 on the inspiratory flow sensor, the measured range of the inspiratory flow sensor is abnormal. In this case, replace the inspiratory flow sensor. 3. Replace the VCM.

Failure Description	Possible Cause	Recommended Action
[00000080] is displayed	The measured range of the expiratory flow sensor is abnormal.	1. Check whether the sampling line is connected correctly. 2. Diagnose the failure using the valve diagnosis tool: In the calibration airway connection environment, start the valve diagnosis tool. Seal the expiratory valve with 4000 DA. Turn on the inspiratory valve gradually, and observe the measured values on the calibration device when each valve is switched on. If the measured value on the calibration device close to (smaller than) 90 L/min corresponds to a sampling AD greater than 3900 on the inspiratory flow sensor, the measured range of the expiratory flow sensor is abnormal. In this case, replace the expiratory flow sensor. 3. Replace the VCM.
[00000100] is displayed	The measured range of the ventilator flow sensor is abnormal.	1. Check whether the sampling line is connected correctly. 2. Diagnose the failure using the valve diagnosis tool: In the calibration airway connection environment, start the valve diagnosis tool. Seal the expiratory valve with 4000 DA. Turn on the inspiratory valve gradually, and observe the measured values on the calibration device when each valve is switched on. If the measured value on the calibration device close to (smaller than) 45 L/min corresponds to a sampling AD greater than 3900 on the inspiratory flow sensor, the measured range of the flow sensor on the machine end is abnormal. In this case, replace the flow sensor on the machine end.
[00000200] is displayed	The inspiratory flow sensor does not satisfy monotonicity.	1. Check whether the check valve on the inspiratory flow sensor end is connected correctly. 2. Check whether the sampling line is connected correctly. 3. Replace the inspiratory flow sensor. 4. Replace the VCM.
[00000400] is displayed	The expiratory flow sensor does not satisfy monotonicity.	1. Check whether the check valve is connected correctly. 2. Check whether the sampling line is connected correctly. 3. Replace the expiratory flow sensor. 4. Replace the VCM.
[00000800] is displayed	The ventilator flow sensor does not satisfy monotonicity.	1. Check whether the sampling line is connected correctly. 2. Replace the ventilator flow sensor. 3. Replace the VCM.

Failure Description	Possible Cause	Recommended Action
[00001000] is displayed	The resolution of the inspiratory flow sensor is incorrect.	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Check the configuration of the calibration device. 4. Troubleshoot the sensor and valve fault using the valve diagnosis tool. For details, see section ***8.6***. 5. Replace the corresponding flow sensor on the circuit. 6. Replace the VCM.
[00002000] is displayed	The resolution of the expiratory flow sensor is incorrect.	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Check the configuration of the calibration device. 4. Troubleshoot the sensor and valve fault using the valve diagnosis tool. For details, see section ***8.6***. 5. Replace the corresponding flow sensor on the circuit. 6. Replace the VCM.
[00004000] is displayed	The resolution of the ventilator flow sensor is incorrect.	1. Check whether the sampling line is connected correctly. 2. Replace the ventilator flow sensor. 3. Replace the VCM.
[00008000] is displayed	The valve output flow speed is insufficient.	1. Check whether the gas supply volume is sufficient for the whole calibration process. 2. Check whether the maximum output flow on the valve is greater than 90 L/min. If not, replace the inspiratory valve.
[00010000] is displayed	The valve resolution is insufficient.	1. Check whether the gas supply volume is sufficient for the whole calibration process. 2. Check whether the calibration device works properly. 3. Replace the inspiratory valve.
[00020000] is displayed	The flow change is not unidirectional.	1. Check whether the tubes are connected correctly based on the instructions. 2. Check whether the gas supply volume is sufficient for the whole calibration process. 3. Check whether the calibration device works properly.

Failure Description	Possible Cause	Recommended Action
[00040000] is displayed	The communication connection to the calibration device is interrupted.	1. Check the communication connection between the calibration device and the anesthesia machine, or reconnect the calibration device and the anesthesia machine to ensure that communication connection works properly. If the communication connection does not work properly, replace the communication cable. 2. Check the configuration of the calibration device. Re-configure the device if necessary.
[00080000] is displayed	The system fails to write to the EEPROM.	1. Perform the calibration again. 2. Replace the VCM.
[00100000] is displayed	The ACGO switch is in ON position.	1. Check whether the ACGO switch is in OFF position. 2. Check the monitoring status of the ACGO switch on the interface of the anesthesia machine.
[00200000] is displayed	The maximum value cannot be found.	1. Use the valve diagnosis tool to diagnose: (1) Turn on the inspiratory valve in 4000 DA and check that the flow speed measured by the calibration device reaches 90 L/min. (2) Turn off the inspiratory valve. Open up the inspiratory valve gradually in DA. Check the DA when the flow speed measured by the calibration device is 80 L/min. Increase the DA by 10. If the flow speed is increased no more than 5 L/min, it indicates that the maximum point may exist and the software fails to found it. In this case, a re-calibration is recommended. 2. Replace the inspiratory valve.
[00400000] is displayed	The minimum value cannot be found.	1. Use the valve diagnosis tool to diagnose: (1) Turn on the inspiratory valve in 0 to 2000 DA. If the AD value measured by the inspiratory flow sensor increases gradually, a re-calibration is recommended. 2. Replace the inspiratory valve.
[00800000] is displayed	Locating the minimum flow speed DA range timed out.	1. Check that the calibration tube is connected to the flow inlet on the calibration device correctly. 2. Replace the inspiratory valve.
[01000000] is displayed	The zero point of the calibration device exceeds the standard.	1. Zero the calibration device.
[02000000] is displayed	The small flow speed calibration is not monotonic.	1. Check that the calibration tube is connected to the flow inlet on the calibration device correctly. 2. Replace the inspiratory valve.
[04000000] is displayed	The valve is leaking.	Replace the inspiratory valve assembly.

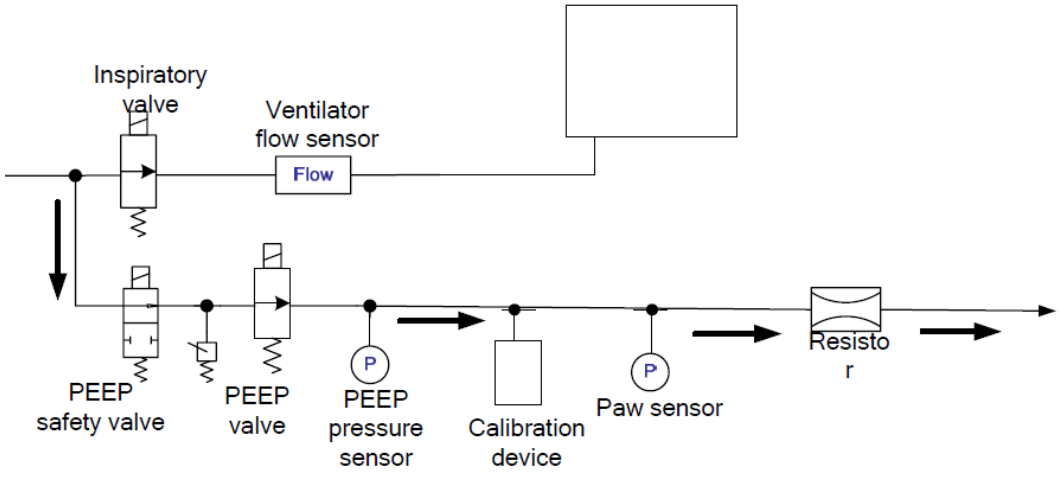
7.3.3 Pressure Calibration (Service)

NOTE

- **After the VCM or expiratory valve assembly is replaced, pressure calibration (service) shall be implemented.**
- **If the deviation between the value measured by the embedded pressure sensor and the value measured by a standard flow measurement device is great, pressure calibration (service) shall be implemented.**

7.3.3.1 Pressure Calibration Principles

In pressure calibration (service), the anesthesia machine calibration device specified by the manufacturer needs to be used to calibrate the PEEP valve, Paw sensor, and PEEP pressure sensor. The calibration principles are as follows: The anesthesia machine calibration device can communicate with the VCM, which controls the tight closing of the inspiration valve. The VCM opens the PEEP valve based on a certain DA value to make the circuit pressure reach a certain value. The Paw sensor, PEEP pressure sensor, and anesthesia machine calibration device collect the circuit pressure. The calibration device sends the collected pressure to the VCM. The VCM uses the pressure measured by the calibration device and AD values collected by the pressure sensors as the data of one calibration point for the pressure sensors, and uses the pressure measured by the calibration device and DA value of the PEEP valve as the data of one calibration point for the PEEP valve. The VCM controls the PEEP valve to change the DA value to obtain calibration data under a series of pressures, forming a pressure calibration data table. The gas pressure should be in the range from 0 cmH20 to 100 cmH20 when the VCM opens the PEEP valve.



7.3.3.2 Precautions

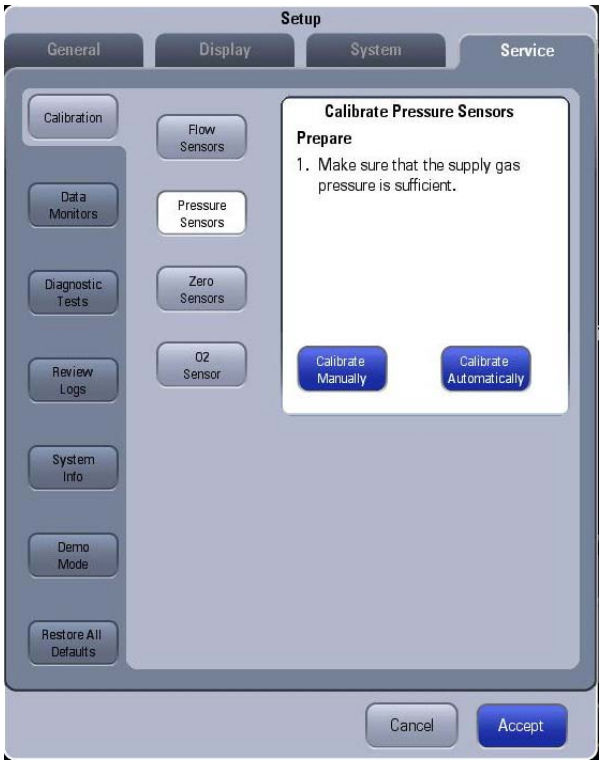
NOTE

- **Before pressure calibration, ensure tube tightness during connection. Ensure that no leakage occurs.**
- **Do not move or press the tube during the calibration process.**
- **You can use the anesthesia machine calibration device VT or Fluke VT Plus for automatic calibration. You can also use a pressure calibration device that meets the precision requirement in manual calibration.**

7.3.3.3 Calibration Procedure

Calibrate the pressure sensor and the PEEP valve as follows:

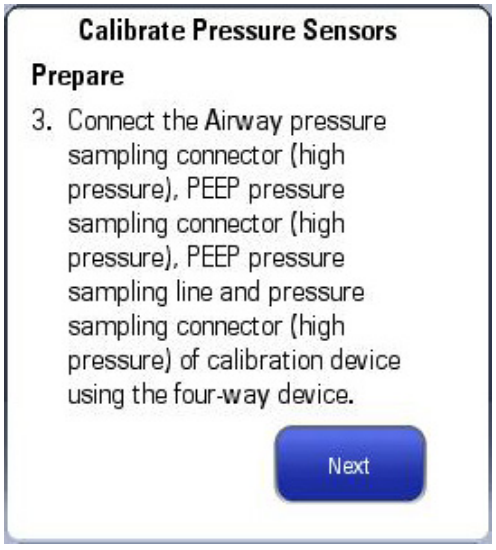
1. Ensure that the anesthesia machine is in standby mode.
2. Select > [**Maintenance**] > [**Calibrate**] > [**Calibrate Pressure Sensor**] to go the screen as shown in the following figure:



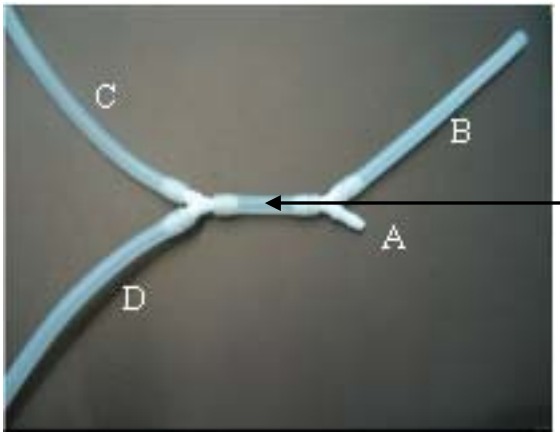
3. Select [**Auto Calibrate**]. The menu as shown in the following figure is displayed.



4. Perform automatic calibration according to Step 4 in section ***7.3.2.3*** Connect the calibration device and the anesthesia machine with a communication cable.
5. Press [**Next**]. The menu as shown in the following figure is displayed:

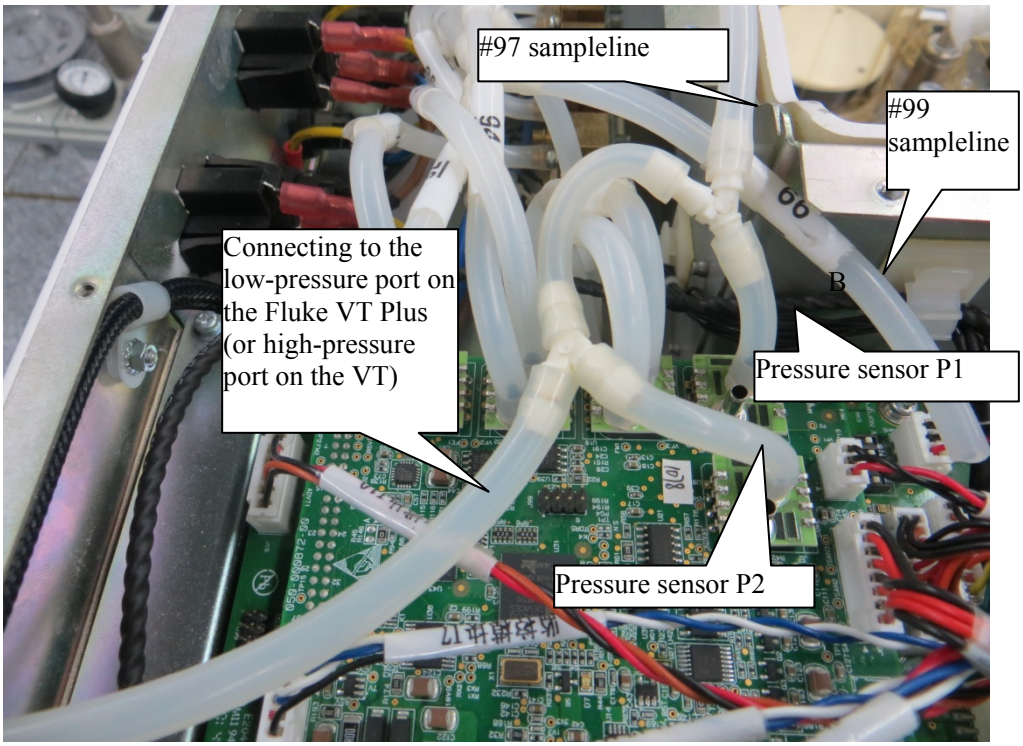


Connect the sampling lines for pressure calibration with a 4-way assembly. The following figure shows the 4-way assembly, calibration device connector, and VCM used for pressure calibration.



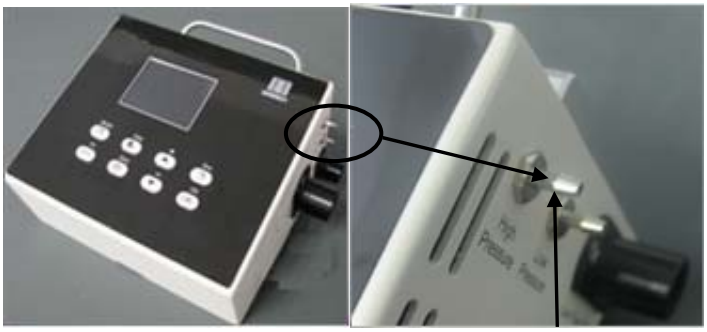
Remove the #97 and #99 sampling lines from the pressure sensor. (See the following figure.)

Connect the 4-way assembly to the pressure sensor P1, PEEP pressure sensor P2, and #97 sampling line on the VCM, and the low-pressure port on the Fluke VT Plus (or high-pressure port sampling interface on the VT). The #99 sampling line is not connected to the assembly during this calibration.





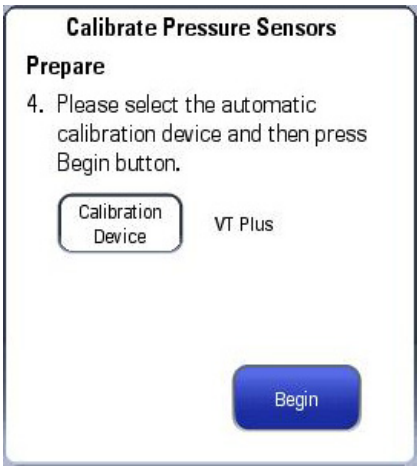
Airway connection involving the calibration device VT Plus



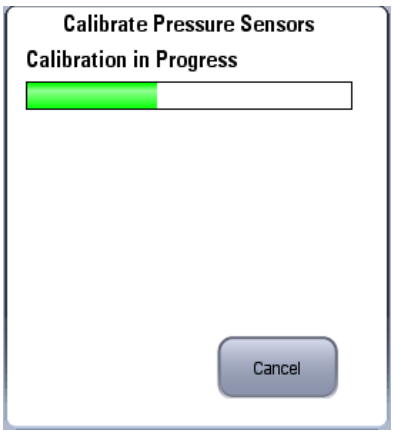
High-pressure port sampling interface on the calibration device VT

6. Connect the power supply to the calibration device and zero the calibration device manually.
7. Configure the calibration device.

   For details, see step 5 in section ***7.3.2.3***.
8. Press [**Next**]. The menu as shown in the following figure is displayed:

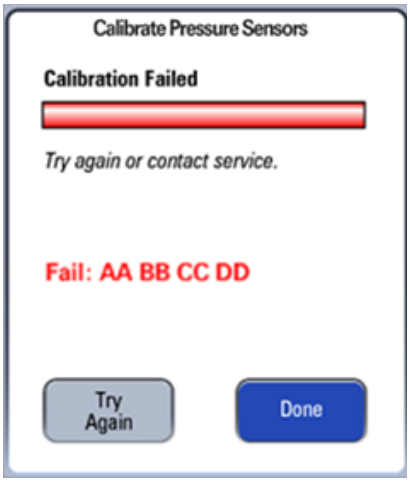


9. Select the required calibration device, select [**Start**]. The calibration interface as shown in the following figure is displayed. During the calibration process, you can select [**Cancel**] to cancel calibration.

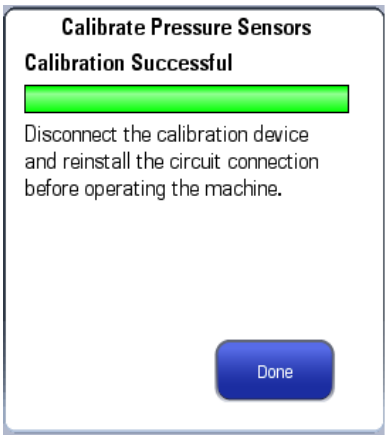


10. The interface as shown in the following figure is displayed after the calibration is complete.

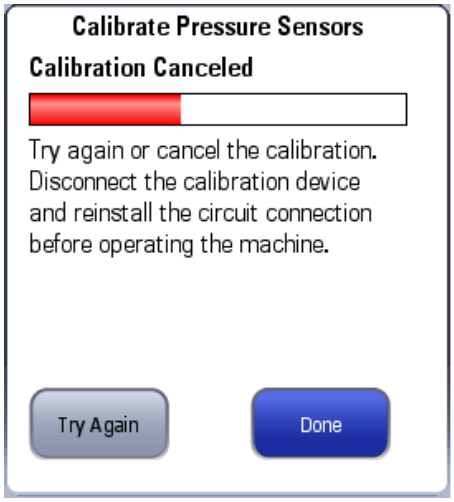
- If the pressure sensor calibration fails, the interface as shown in the following figure is displayed. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



- If the pressure sensor calibration succeeds, the interface as shown in the following figure is displayed. Select [**OK**] to quit calibration.



11. The interface as shown in the following figure is displayed if the ongoing calibration is cancelled. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



7.3.3.4 Common Failures and Recommended Actions

Failure Description	Possible Cause	Recommended Action
After [**Start**] is selected, no ventilation sound is heard. The prompt message "Calibration Failure! Please try again." is displayed very soon.	The alarm "Drive Gas Pressure Low" is generated. The pressure indicated by the drive gas (O2) pressure gauge is lower than 200 kPa.	Change or connect the gas supply to ensure that the drive gas pressure is within the specified range.
	A zero point error occurs in the inspiratory, expiratory, or ventilator pressure sensor or PEEP pressure sensor. For details, see section ***4.12.1.***	Replace the VCM.
After [**Start**] is selected, the ventilation sound is heard. The prompt message "Calibration Failure! Please try again." is displayed very soon.	The sampling line of the inspiratory, expiratory, ventilator pressure sensor, or PEEP pressure sensor is not connected or is connected incorrectly. For details, see section ***8.6.***	Re-connect the sensor sampling line.
	The maximum pressure generated by the PEEP valve is smaller than 95 cm H2O. For details, see section ***8.6***.	Replace the expiratory valve assembly.
	1. An error occurs in the pneumatic circuit connection between the anesthesia machine calibration device and the VCM. 2. An error occurs in the communication connection	1. Check the pneumatic circuit connection between the anesthesia machine calibration device and the VCM. Reconnect the pneumatic circuit if necessary. 2. Check the communication

Failure Description	Possible Cause	Recommended Action
	between the anesthesia machine calibration device and the anesthesia machine. 3. The anesthesia machine calibration device is set incorrectly.	connection between the anesthesia machine calibration device and the anesthesia machine, or reconnect them to ensure normal communication. Replace the communication cable if the problem persists. 3. Check the settings of the anesthesia machine calibration device. Set the anesthesia machine again if necessary.
The prompt message "Calibration Failure! Please try again." is displayed 15 minutes after calibration is started.	The calibration data is incorrect: The measured range of the sensor is abnormal, the calibration data does not satisfy monotonicity, or the sensor resolution is incorrect. For details, see section ***4.12.3***.	Replace the VCM.
[00000002] is displayed.	Drive gas pressure is low.	1. Change or connect the gas supply to ensure that the drive gas pressure is within the range of 350 – 450 kPa. 2. Check the drive gas switch if the drive gas source is in proper condition.
[00000004] is displayed.	The Auto/Manual switch is in Manual position.	1. Check whether the Auto/Manual switch is set to the Auto position. 2. Check whether the Auto/Manual switch can be set normally.
[00000008] is displayed.	There is a zero point error for the flow pressure sensor.	1. Check the zero point. 2. Replace the VCM.
[00000010] is displayed.	There is a zero point error for the PEEP pressure sensor.	1. Check the zero point. 2. Replace the VCM.

Failure Description	Possible Cause	Recommended Action
[00000020] is displayed.	The measured range of the flow pressure sensor is abnormal.	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Check the configuration of the calibration device. 4. Troubleshoot the sensor and valve fault using the valve diagnosis tool. For details, see section ***8.6***. 5. Replace the VCM.
[00000040] is displayed.	The measured range of the PEEP pressure sensor is abnormal.	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Check the configuration of the calibration device. 4. Troubleshoot the sensor and valve fault using the valve diagnosis tool. For details, see section ***8.6***. 5. Replace the VCM.
[00000080] is displayed.	The calibration data of the flow pressure sensor does not satisfy monotonicity.	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Troubleshoot the sensor and valve fault using the valve diagnosis tool. For details, see section ***8.6***. 4. Replace the VCM.
[00000100] is displayed.	The calibration data of the PEEP pressure sensor does not satisfy monotonicity.	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Troubleshoot the sensor and valve fault using the valve diag. 4. Replace the VCM. nosis tool. For details, see section ***8.6.***
[00000200] is displayed.	The flow pressure sensor resolution is incorrect. (The difference between the maximum AD value and the minimum AD value is smaller than or equals to 500 AD. When the step of the pressure value is greater than or equals to 1 cm H2O, the	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Check the configuration of the calibration device. 4. Troubleshoot the sensor and valve fault using the valve diagnosis tool.

Failure Description	Possible Cause	Recommended Action
	resolution is smaller than 1 cm H2O to 2 AD.)	For details, see section ***8.6***. 5. Replace the VCM.
[00000400] is displayed.	The PEEP pressure sensor resolution is incorrect. (The difference between the maximum AD value and the minimum AD value is smaller than or equals to 500 AD. When the step of the pressure value is greater than or equals to 1 cm H2O, the resolution is smaller than 1 cm H2O to 2 AD.)	1. Check the sampling line connection and tightness. 2. Check the gas supply pressure. 3. Check the configuration of the calibration device. 4. Troubleshoot the sensor and valve fault using the valve diagnosis tool. For details, see section ***8.6***. 5. Replace the VCM.
[00000800] is displayed.	The valve output pressure is insufficient.	1. Check whether the gas supply volume is sufficient for the whole calibration process. 2. Use the valve diagnosis tool to check that the maximum output pressure of the PEEP valve is greater than 90 cm H2O. If not, replace the flow module.
[00001000] is displayed.	The pressure change is not unidirectional.	1. Check whether the sampling line is connected correctly. 2. Replace the VCM.
[00002000] is displayed.	The communication between the calibration device and the anesthesia machine is interrupted.	1. Check the communication cable connection between the calibration device and the anesthesia machine. 2. Replace the calibration device and perform the calibration again.
[00004000] is displayed.	The system fails to write to the EEPROM.	1. Perform the calibration again. 2. Replace the VCM.
[00008000] is displayed.	The ACGO switch is in ON position.	1. Check whether the ACGO switch is in OFF position. 2. Check the monitoring status of the ACGO switch on the interface of the anesthesia machine.
[00010000] is displayed.	The valve resolution is insufficient.	1. Check whether the gas supply volume is sufficient for the whole calibration process. 2. Check whether the calibration device works properly.

Failure Description	Possible Cause	Recommended Action
		3. Replace the PEEP valve.
[00020000] is displayed.	The maximum value cannot be found.	1. Use the valve diagnosis tool to diagnose: (1) Turn on the PEEP valve in 4000 DA and check that the pressure measured by the VT reaches 90 cm H2O or higher. (2) Turn off the PEEP valve. Open up the PEEP valve gradually in DA. The AD value measured by the flow pressure sensor increases gradually. If the above two conditions are met, a re-calibration is recommended. 2. Replace the PEEP valve.
[00040000] is displayed.	The minimum value cannot be found.	1. Use the valve diagnosis tool to diagnose: (1) Open up the PEEP valve from 0 to 2000 DA. If the AD value measured by the inspiratory pressure sensor increases gradually, a re-calibration is recommended. 2. Replace the PEEP valve.
[00080000] is displayed.	The zero point of the calibration device exceeds the standard.	1. Zero the calibration device.
[00100000] is displayed.	The small pressure calibration is not monotonic.	1. Check the connection between the calibration device and the sampling line. 2. Replace the PEEP valve assembly.

7.3.4 Pressure and Flow Zeroing (Service)

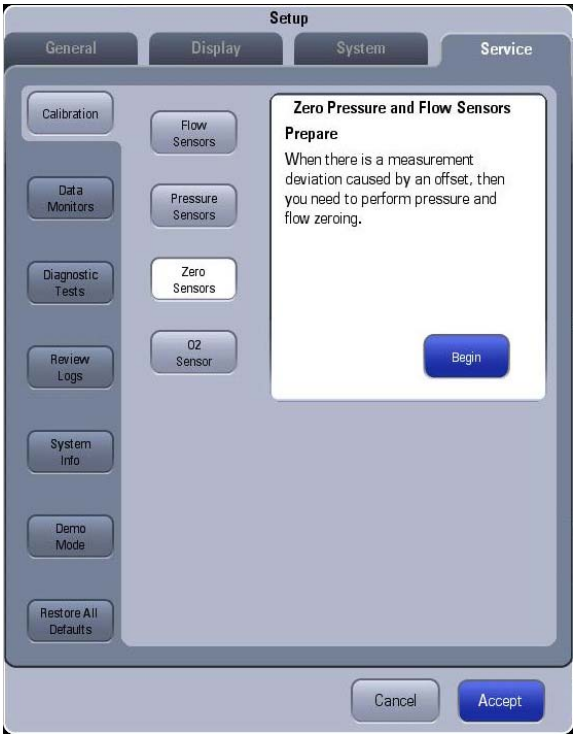
7.3.4.1 Zeroing Mechanisms

The anesthesia machine automatically performs pressure and flow zeroing at regular intervals during operation. You can also perform pressure and flow zeroing manually in the factory maintenance menu. Manual zeroing can immediately eliminate measurement deviations caused by zero offset of sensors. The anesthesia machine supports automatic and periodic pressure and flow zeroing. The first four zeroing operations are done automatically 1, 5, 15, 30, and 60 minutes after ventilation starts. Then automatic zeroing takes place every 60 minutes. The three-way valve is opened and closed for valve flushing during mechanical ventilation and before automatic zeroing.

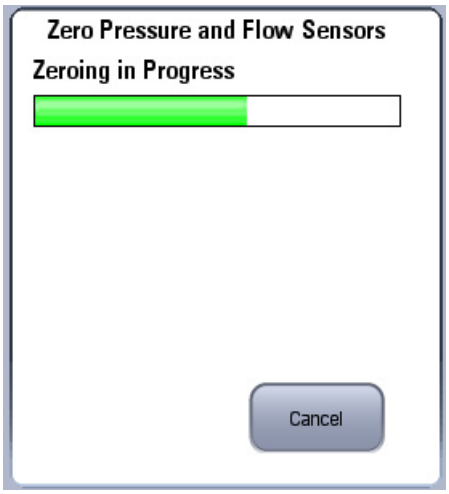
7.3.4.2 Zeroing Procedure

Zero the pressure and flow sensors as follows:

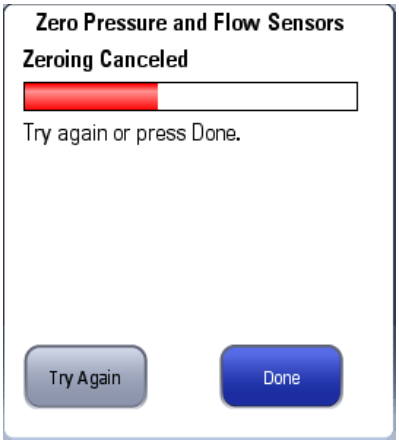
1. Select > [**Maintenance**] > [**Calibrate**] > [**Zero Sensor**] to go the screen as shown in the following figure:



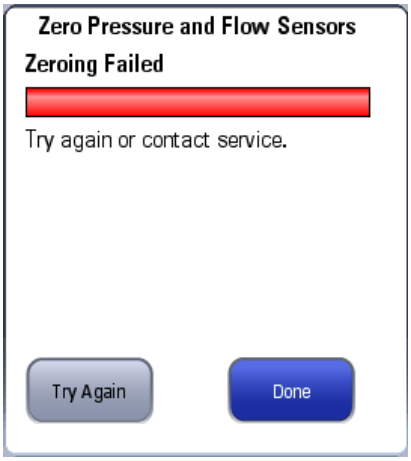
2. Select [**Start**]. The zeroing interface as shown in the following figure is displayed. During the zeroing process, you can select [**Cancel**] to cancel zeroing.



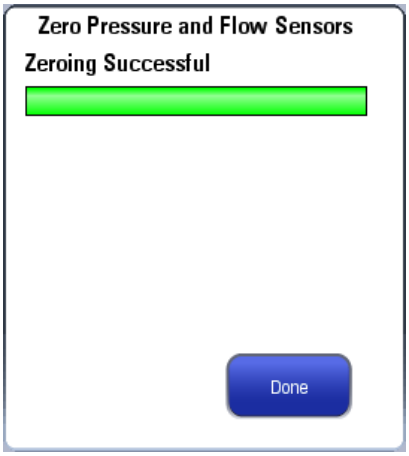
3. The interface as shown in the following figure is displayed if the ongoing zeroing process is cancelled. Select [**Retry**] to re-zero. Select [**OK**] to quit zeroing.



4. The interface as shown in the following figure is displayed if zeroing fails. Select [**Retry**] to re-zero. Select [**OK**] to quit zeroing.



5. The interface as shown in the following figure is displayed after the zeroing is complete. Select [**OK**] to quit zeroing.



NOTE

- **If zeroing fails, other faults may occur on the machine. In this case , you need to troubleshoot the machine.**

7.3.4.3 Common Failures and Recommended Actions

If zeroing fails, troubleshoot the failure as follows:

1. Set the anesthesia machine to manual or standby mode. Shut down the fresh gas. Remove the ventilator pipes to expose the inspiratory and expiratory openings to the atmosphere. Discharge the remaining gas in the bellow. Ensure that no flow or pressure is input into the flow or pressure sensor.
2. Check whether the zero point of the sensor is normal. For details, see section ***4.12.1***.
3. If the zero point of the sensor is incorrect, remove the sensor sampling line. Ensure that the sampling line or the 3-way valve is not clogged. If the zero point remains incorrect, the VCM may be faulty. In this case, replace the VCM.
4. If the zero point of the sensor is correct and zeroing failure persists, the 3-way valve assembly may be faulty. In this case, replace the 3-way valve assembly.

7.3.5 O2 Sensor Calibration

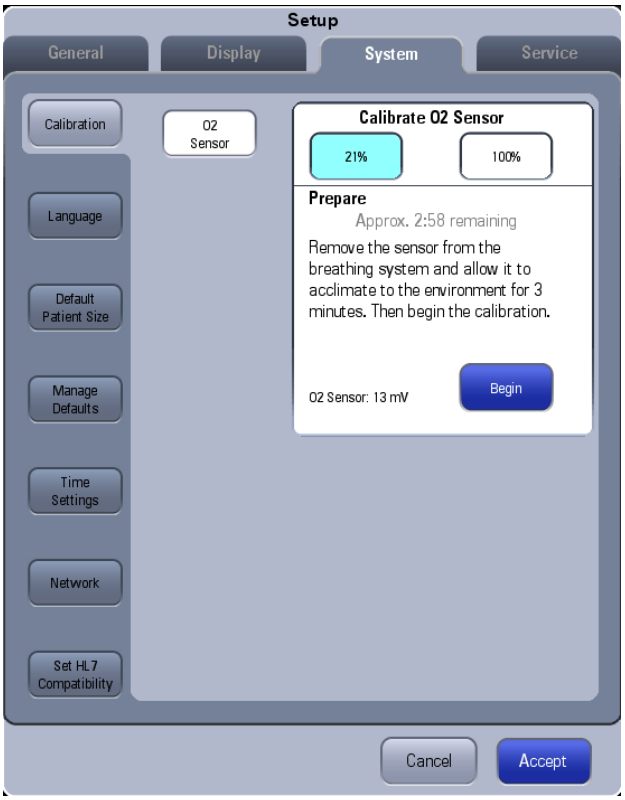
NOTE

- **The O2 sensor needs to be calibrated when a great deviation occurs in the O2 monitored value or the O2 sensor or VCM is replaced.**
- **Observe whether the O2 sensor displays values on the measure screen before calibration. If not, check whether the O2 measure switch is turned on, check the connection cables of the O2 sensor, or replace the O2 sensor until values are displayed.**
- **The O2 sensor needs to be calibrated at 21% O2 and 100% O2 and corresponding standard O2 concentration gases are required.**

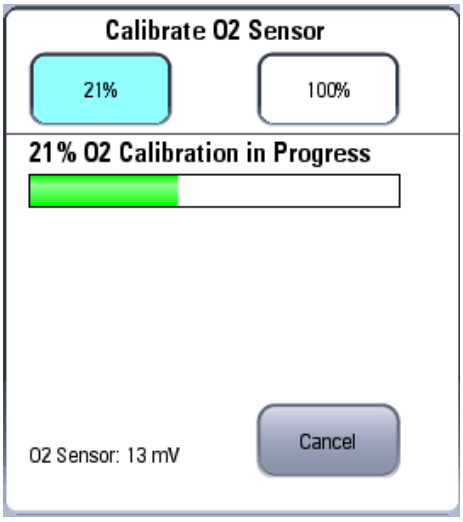
7.3.5.1 21% O2 Calibration

Perform 21% O2 sensor calibration as follows:

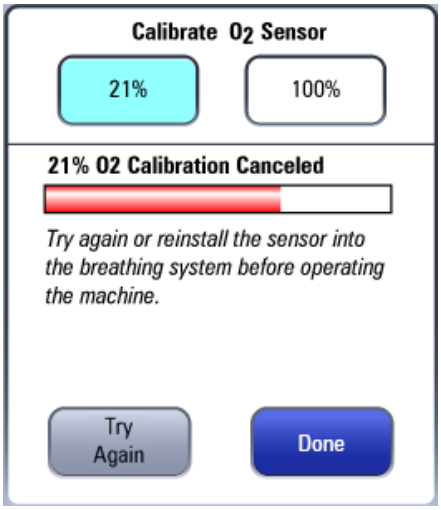
1. Select > [**General**] > [**Calibrate O2 Sensor**], or select > [**System**] > [**Calibrate**] > [**O2 Sensor**] or [**Setting**] > [**Maintenance**] > [**Calibrate**] > [**O2 Sensor**] to go to the screen as shown in the following figure. The [**General**] tab page displays only the 21% O2 sensor calibration option. The [**System**] and [**Maintenance**] tab pages require the password for 21% and 100% O2 sensor calibration. You can set the machine based on the instructions displayed on the screen. Select [**Start**] to start calibration.



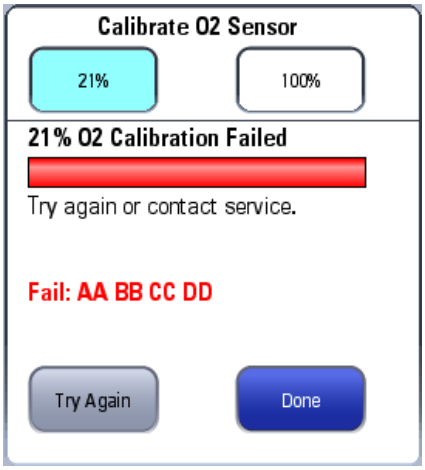
2. The calibration interface as shown in the following figure is displayed after you select [**Start**]. During the calibration process, you can select [**Cancel**] to cancel calibration.



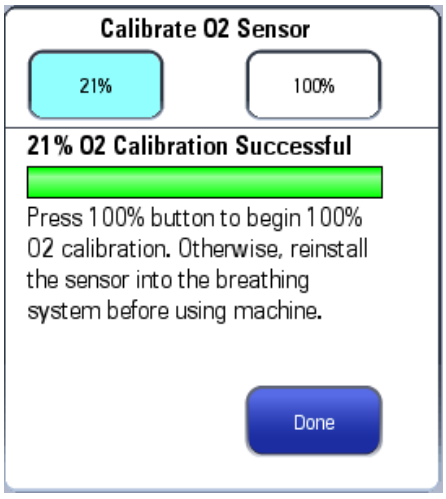
3. The interface as shown in the following figure is displayed if the ongoing calibration is cancelled. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



4. The interface as shown in the following figure is displayed if the calibration fails. The message displayed in red indicates the error code. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



5. The interface as shown in the following figure is displayed after the calibration is complete. Select [**OK**] to quit calibration.



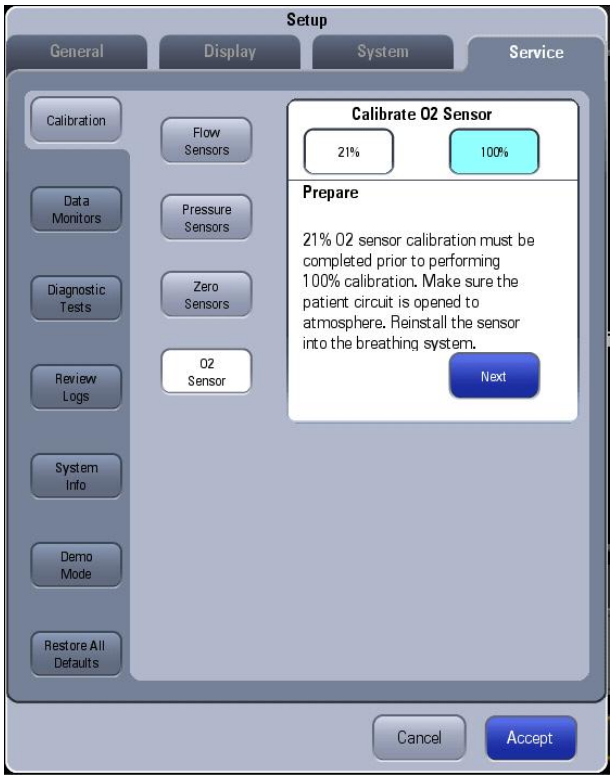
7.3.5.2 100% O2 Calibration

NOTE

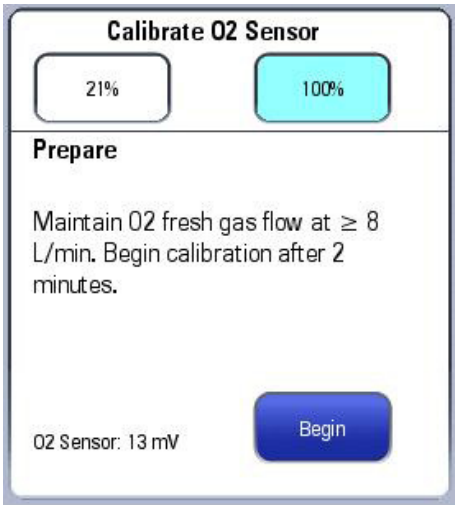
- **100% O2 calibration must be performed in standby mode.**
- **100% O2 calibration can be performed only after 21% O2 calibration is completed successfully.**

Perform 100% O2 sensor calibration as follows:

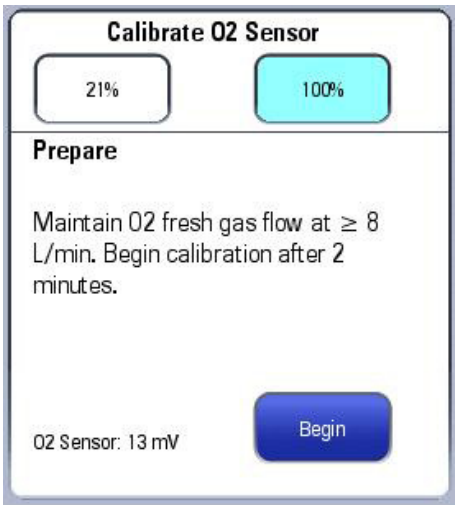
1. Enter the standby mode.
2. Select > [**System**] > [**Calibrate**] > [**O2 Sensor**] or [**Setting**] > [**Maintenance**] > [**Calibrate**] > [**O2 Sensor**]. The [**System**] and [**Maintenance**] tab pages require the password for 21% and 100% O2 sensor calibration. Select [**100%**]. The calibration interface as shown in the following figure is displayed.Set the machine according to the instructions displayed on the screen, and select [**Next**]. Set the Auto/Manual switch to the Auto position.



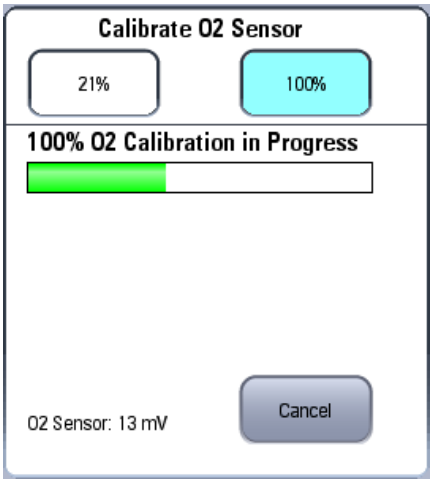
3. Select [**Next**].The calibration interface as shown in the following figure is displayed. You can set the machine based on the instructions displayed on the screen.



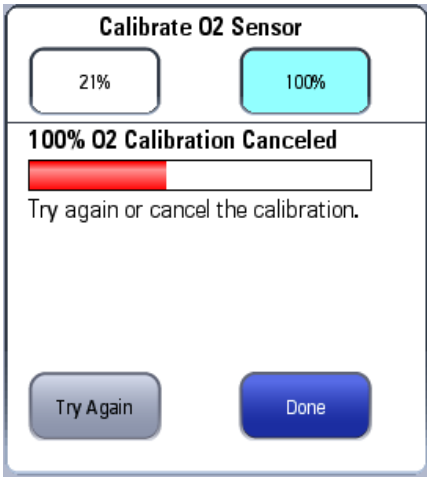
4. Select [Next].The calibration interface as shown in the following figure is displayed. You can set the machine based on the instructions displayed on the screen. Wait for two minutes to ensure that the O2 battery voltage is stabilized at the maximum value for at least 30 seconds. Select [**Start**].



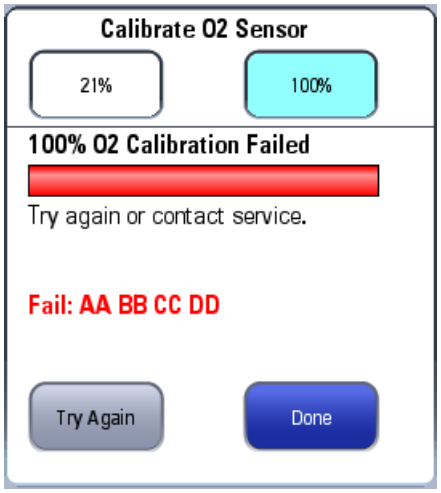
5. The calibration interface as shown in the following figure is displayed after you select [**Start**]. During the calibration process, you can select [**Cancel**] to cancel calibration.



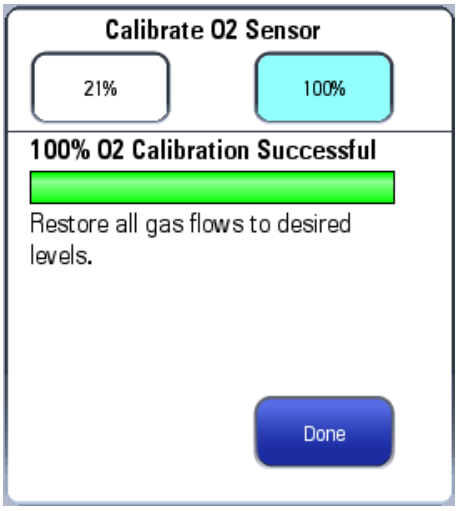
6. The interface as shown in the following figure is displayed if the ongoing calibration is cancelled. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



7. The interface as shown in the following figure is displayed if the calibration fails. The message displayed in red indicates the error code. Select [**Retry**] to re-calibrate. Select [**OK**] to quit calibration.



8. The interface as shown in the following figure is displayed after the calibration is complete. Select [**OK**] to quit calibration.



7.3.5.3 Common Failures and Recommended Actions

Failure Description	Possible Cause	Recommended Action
After [**Start**] is selected, the prompt message indicating calibration failure is displayed very soon.	An "O2 Sensor Disconnected" alarm is displayed, indicating that the O2 sensor is not connected.	Connect the O2 sensor.
	The O2 supply pressure is insufficient (smaller than 200 kPa).	Change or connect the gas supply to ensure that the O2 supply pressure is sufficient.
	21% O2 calibration is not complete before 100% O2 calibration is performed.	Perform 100% O2 calibration after completing the 21% O2 calibration.
The prompt message indicating calibration failure is displayed three minutes after calibration is started.	The O2 sampling value is not within the normal range. That is, the 21% O2 sampling value exceeds the range of 3586 to 9140, and the 100% O2 sampling value exceeds the range of 9602 to 35727. You can select  > [**Maintenance**] > [**Diagnosis Data**] > [**VCM**] to check the O2 sampling value.	Replace the O2 sensor.

Error Code	Description	Recommended Action
00000002	The O2 supply pressure is insufficient. During 100% O2 calibration, the O2 pressure supply is insufficient.	Check whether the cable connection of the O2 sensor is proper. Check the O2 pressure. Check whether the output voltage of the O2 sensor in the calibration menu is stable. Replace the O2 sensor.
00000004	The O2 sensor is disconnected.	Check whether an "O2 Sensor Disconnected" alarm is displayed on the interface. If the alarm is displayed, check whether the cable connection of the O2 sensor is in proper condition. Check whether the output voltage of the O2 sensor in the calibration menu is stable. Replace the O2 sensor.

Error Code	Description	Recommended Action
00000008	The 21% O2 calibration value is not in the normal range of 3586 to 9140 (AD value).	Check whether the cable connection of the O2 sensor is proper. Check whether the O2 sensor is in the 21% O2 environment. Check whether the output voltage of the O2 sensor in the calibration menu is stable. Replace the O2 sensor.
00000010	The 100% O2 calibration value is not in the normal range of 9602 to 35727 (AD value).	Check whether the cable connection of the O2 sensor is proper. Check whether the O2 sensor is in the 100% O2 environment. Check whether the output voltage of the O2 sensor in the calibration menu is stable. Replace the O2 sensor.
00000020	An EEPROM writing error occurs.	Perform the calibration again. Replace the VCM.

7.3.6 CO2 Calibration (factory)

7.3.6.1 Preparations

Prepare the following before doing the calibration:

- Gas cylinder: one or more cylinders filled with 3% , 4%, 5%, 6% , or 7% CO_2
- T-shape connector
- Samping line

7.3.6.2 Calibration Procedures

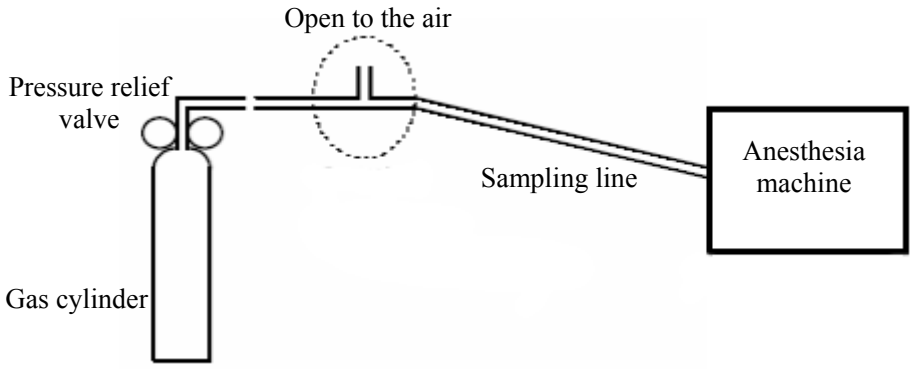
NOTE

- **During the calibration, selecting [**Calibrate**] again does not take effect or exit the calibration menu. Other operations than menu options are disabled until the end of calibration.**

Calibrate as follows:

1. Make sure that the CO2 module is already warmed up.
2. Select the [**Maintenance**] shortcut key → [**Factory Maintenance** >>] → enter the required password → [**Module Cal.** >>] → [**Gas Module Cal.** >>] → [**CO2 Module Cal.**].

3. Check the airway and make sure that there are no occlusions or leaks.
   - Vent the sampling line to the air and check that the current rate is approximately 150 mL/min.If the deviation is great, it means that the airway is occluded. Check the airway for occlusions.
   - Block the gas inlet of the sampling line. The current rate should drop rapidly and the message of airway occlusion should be prompted. Otherwise, it means that the airway leaks. Check the airway for leakage.
4. Wait for the sensor temperature to reach and stay at 35ºC.
5. Select [**Zero**] to start zeroing.
6. Connect the gas cylinder to the sampling line using a T-shape connector, as shown below.



7. Vent the sampling line to CO2 opening the cylinder pressure relief valve.
8. In the [**CO2 Module Cal.**] menu, enter the vented CO2 concentration in the [**CO2**] field.
9. In the [**CO2 Module Cal.**] menu, the measured CO2 concentration, barometric pressure, sensor temperature and current pump rate are displayed. After the measured CO2 concentration becomes stable, select [**CO2 % Cal**.] to calibrate the CO2 module.
10. After a successful calibration, the screen shows [**Calibration Completed!**]. Otherwise, the message [**Calibration Failure! Please try again.**] is displayed. In this case, you need to do the calibration again.

7.3.6.3 Commonly-encountered Problems and Recommended Actions

Failure description	Possible cause	Recommended action
Calibration is not completed.	1. The module is damaged. 2. The difference between the set AG calibration concentration and the selected standard AG concentration is too great.	1. Return the module to factory for repair. 2. The difference between the standard gas concentration and the set calibration concentration can not exceed 40% of the standard gas concentration.

7.3.7 AG Calibration (factory)

7.3.7.1 Preparations

Prepare the following before doing the calibration:

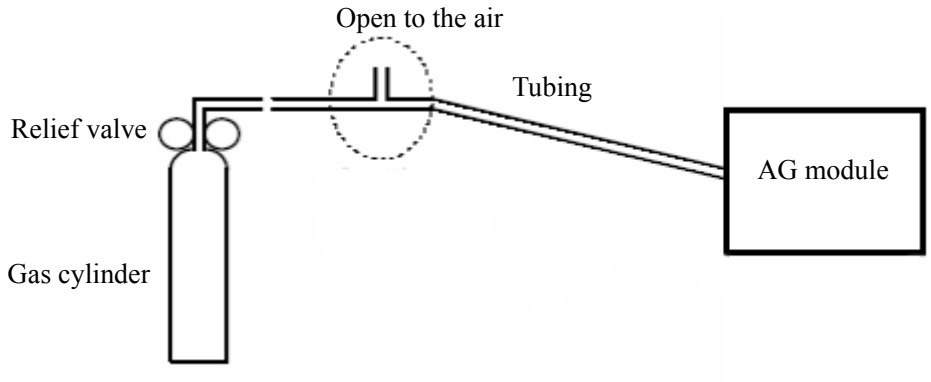
- Gas cylinder, with a certain standard gas or mixture gas. Gas concentration should meet the following requirements: AA≥1.5%, CO2≥1.5%, N2O≥40%, O2≥40%, of which AA represents an anesthetic agent. a/c≤0.01 (a is the gas absolute concentration accuracy; c is the gas concentration).
- T-shape connector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

7.3.7.2 Calibration Procedures

Follow this procedure to perform a calibration:

1. Make sure that the system is not Standby and the AG module is in [**Measure**] state.
2. Wait for the AG module to be fully warmed up.
3. Select the [**Maintenance**] shortcut key → [**Factory Maintenance >>**] → enter the required password → [**Module Cal. >>**] → [**Gas Module Cal. >>**] → [**AG Module Cal.**].
4. Check the airway and make sure that there are no occlusions or leaks.
   - ◆ Vent the sampling tubing to the air and check whether the current rate and set rate are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.
   - ◆ Block the gas inlet of the sampling tubing. The current rate should drop rapidly and the message of airway occlusion is prompted. Otherwise, it means that the airway leaks. Check the airway for leakage.

Connect the test system as follows.



6. Open the relief valve and vent a certain standard gas or gas mixture and make sure that there is an excess gas flow through the T-shape connector to air.

7. In the [**AG Module Cal.**] menu, the measured gas concentration and flow are displayed.
   - ◆ If the difference between the measured gas concentration and the actual one is tolerable, a calibration is not needed.
   - ◆ If the difference is great, a calibration should be performed.
8. Enter the vented gas concentration. If you use only one gas for calibration, set other gases' concentration to 0.
9. Select [**Calibrate**] to start a calibration.
10. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. Otherwise, the message [**Calibration Failure! Please try again.**] is displayed. In this case, you need to do the calibration again.

NOTE

- **If the calibration fails, you can select [**Defaults**] to restore the factory default calibration values. If the deviation is great, select [Calibrate] again to do a calibration.**
- **If the calibration still fails, replace the AG module.**

7.3.7.3 Commonly-encountered Problems and Recommended Actions

Failure description	Possible cause	Recommended action
Calibration menu is inaccessible.	The AG module is not fully warmed up or not in measure mode.	Wait for the AG module to be fully warmed up and then access the calibration menu.
Calibration is not completed.	1. The module is damaged. 2. The difference between the set AG calibration concentration and the selected standard AG concentration is too great.	1. Return the module to factory for repair. 2. The difference between the standard gas concentration and the set calibration concentration can not exceed 25% of the standard gas concentration.

7.3.8 O2 Module Calibration (factory)

7.3.8.1 Preparations

Calibrate the O2 module once a year or when the measured value has a great deviation. Prepare the following before doing the calibration:

- Gas cylinder with 100% O2 and the O2 concentration not less than 99%.
- T-shape connector
- Tubing

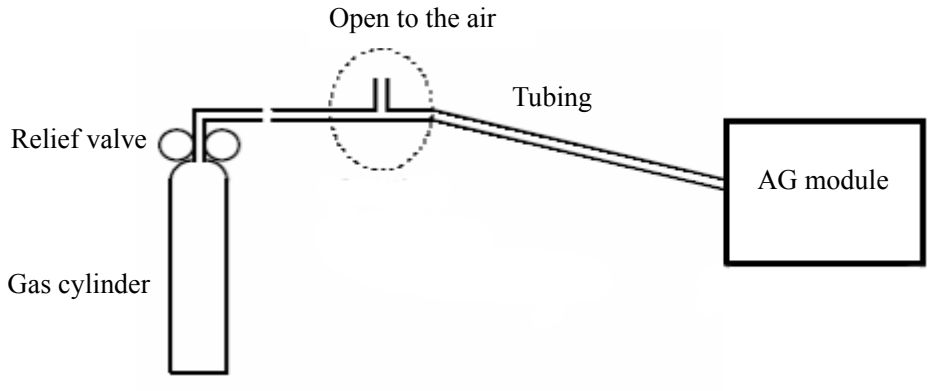
7.3.8.2 Calibration Procedures

NOTE

- **Do not calibrate the O2 module when there are significant leaks in the airway.**
- **In case of calibration failure, select [**Calibrate**] again to do a calibration.**
- **If the calibration still fails, replace the O2 module.**
- **Calibrate the O2 module, if it has been transported for long distance or if you suspect it does not work properly.**

Follow this procedure to perform a calibration:

1. Make sure that the system is not Standby and the AG module is in [**Measure**] state.
2. Wait for the AG module to be fully warmed up.
3. Select the [**Maintenance**] shortcut key → [**Factory Maintenance** >>] → enter the required password → [**Factory Cal.** >>] → [**Gas Module Cal.** >>] → [O2 **Module Cal.**].
4. Check the airway and make sure that there are no occlusions or leaks.
   - ◆ Vent the sampling tubing to the air and check whether the current rate and set rate are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.
   - ◆ Block the gas inlet of the sampling line. The current rate should drop rapidly and the message of airway occlusion is prompted. Otherwise, it means that the airway leaks. Check the airway for leakage.
5. Connect the test system as follows.



6. Open the relief valve and vent a certain standard gas or gas mixture and make sure that there is an excess gas flow through the T-shape connector to air.

7. In the [O**2 Module Cal.**] menu, the measured gas concentration and flow are displayed.
   - If the difference between the measured gas concentration and the actual one is tolerable, a calibration is not needed.
   - If the difference is great, a calibration should be performed.
8. Select [**Calibrate**] to start a calibration.
9. Enter the vented gas concentration and set other gases' concentration to 0.
10. After a successful calibration, the screen shows [**Calibration Completed!**]. Otherwise, the message [**Calibration Failure! Please try again.**] is displayed. In this case, you need to do the calibration again.

7.3.8.3 Commonly-encountered Problems and Recommended Actions

Failure description	Possible cause	Recommended action
Calibration menu is inaccessible.	The AG module is not fully warmed up or not in measure mode.	Wait for the AG module to be fully warmed up and then access the calibration menu.
Calibration is not completed.	1. The module is damaged. 2. The difference between the set O2 calibration concentration and the selected standard O2 concentration is too great.	1. Return the module to factory for repair. 2. The difference between the standard gas concentration and the set calibration concentration can not exceed 25% of the standard gas concentration.

FOR YOUR NOTES

8 Troubleshooting

8.1 Troubleshooting Guide

8.1.1 Fault Determination

Problems that are hard to detect may exist in some fault symptoms due to existence of multiple potential faults. If related faults exist, the following troubleshooting can help you identify faults (if any).

8.1.2 Avoiding Short Circuit of Component Leads

During the repairing process, a serial of quick measurement must be conducted. Ensure that you shut down the power supply before connecting or disconnecting the testing leads or probes. Short circuit of leads may cause damage to components. In addition to the security risks, short circuit of leads may also cause secondary faults.

8.1.3 Using Appropriate Tools

The following tools may be required for repairing:

- Metric hex wrench set (2.5, 3, 4, 5, and 8 mm)
- Philips screwdriver (#1 and #2)
- Diagonal pliers
- Screwdriver
- Metric M3 and M4 socket screwdriver
- Adjustable wrench
- Tweezers
- Krytox lubricant (P/N: 0510-00-0020)

Use the specified tools to ensure that all the test procedures and results are correct.

8.1.4 Cleanup of the Maintenance Area

Clean up the maintenance area after each maintenance.

8.2 Technical Alarms

A technical alarm, as apposed to a parameter alarm, is an alarm condition that exists no matter whether a patient is connected to the machine. Technical alarms include:

- Startup alarm messages
- CPU board runtime alarms
- Power board runtime alarms
- VCM runtime alarms
- AG module runtime alarms

Before troubleshooting the anesthesia machine, check for technical alarm messages. 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, see the Operator's Manual.

8.2.1 Startup Alarm Messages

Message	Alarm Priority	Cause	Solution
Bundle Version Error Bundle Version: Time out	High	1. The software versions are not compatible with each other. 2. "Time out" is displayed when the communication between the corresponding software and the system software fails.	1. Re-upgrade the compatible software version.

Message	Alarm Priority	Cause	Solution
Aux Control Module Self Test Error Aux Control Module Self Test: Time out	High	1. CPU, Flash or WTD error. 2. After the machine is restarted, the CPU board cannot communicate with the Aux Control board.	1. Restart the anaesthesia machine. 2. Reconnect or replace the communication line between the CPU board and the Aux Control board. 3. If the problem persists, replace the ventilation protection board. 4. If the problem persists, replace the CPU board.
Ventilator Self Test Error Ventilator Self Test: Time out	High	1. CPU, TIMER, RAM, WTD, EEPROM or AD error 2. After the machine is restarted, the CPU board cannot communicate with the VCM board.	1. Restart the anaesthesia machine. 2. Reconnect or replace the communication line between the CPU board and the VCM board. 3. If the problem persists, replace the VCM board. 4. If the problem persists, replace the CPU board.
Ventilator Voltage Error	High	5 V or 12 V voltage error	1. Restart the anaesthesia machine. 2. Measure the supply voltage of the VCM board and check whether the voltage meets the requirement. 3. If not, replace the power board or cable. 4. If the problem persists, replace the VCM board.
PEEP Valve Failure	Medium	1. PEEP valve voltage error 2. PEEP valve pressure error	1. Check whether the accuracy of the PEEP sensor is within the valid range. On the [Maintenance] menu, calibrate the sensor or replace VCM. 2. Test the voltage at the corresponding testing point. 3. Check the installation of and connection between the power cable and expiratory valve assembly. 4. When necessary, replace the VCM board. 5. When necessary, replace the expiratory valve assembly.. 6. When necessary, replace the power board.

Message	Alarm Priority	Cause	Solution
Insp Valve Failure	Medium	1. Inspiratory valve voltage error2. Inspiratory valve flow error	1. Check whether the accuracy of the inspiratory flow sensor is within the valid range. On the [Maintenance] menu, calibrate the flow sensor. Or, when a flow error occurs, replace the flow sensor. 2. Test the voltage at the corresponding testing point. 3. Check the installation of and connection between the power cable and expiratory valve assembly. 4. When necessary, replace the VCM board. 5. When necessary, replace the expiratory valve assembly.. 6. When necessary, replace the power board.
Safety Valve Failure	Medium	PEEP safety valve voltage error	1. Test the voltage at the corresponding testing point. 2. Check the installation of and connection between the power cable and expiratory valve assembly. 3. When necessary, replace the VCM board. 4. When necessary, replace the expiratory valve assembly. 5. When necessary, replace the power board.
Flow Sensor Failure	Low	The ventilator flow is out of range.	1. Check whether the zero point of the flow sensor is within the valid range. 2. Check whether the monitored value of the flow sensor is within the valid range. 3. Replace the flow sensor and perform calibration. 4. Replace the VCM board and perform calibration.

Message	Alarm Priority	Cause	Solution
Calibrate Flow Sensor and Insp Valve	Low	1. The calibration table is not found in the EEPROM. 2. The checksum of Calibration table does not match.	Perform maintenance calibration. Refer to chapters related to the flow sensor calibration.
Calibrate Pressure Sensor and PEEP Valve	Low	1. The calibration table is not found in the EEPROM. 2. The checksum of Calibration table does not match..	Perform maintenance calibration. Refer to chapters related to the pressure sensor calibration.
Calibrate O2 Sensor	Low	1. The calibration table is not found in the EEPROM. 2. The checksum of Calibration table does not match. 3. The AD difference between the 100% and 21% O2 concentrations in the O2 sensor table is smaller than 79AD.	1. Calibrate the O2 sensor. 2. If the problem persists, replace the O2 sensor.
Ventilator Initialization Error Ventilator Initialization: Time out	High	After the machine is powered on, the CPU board cannot send the control parameter settings to the VCM board.	1. Restart the anaesthesia machine. 2. Reconnect or replace the communication line between the CPU board and the VCM board. 3. If the problem persists, replace the VCM board. 4. If the problem persists, replace the CPU board.
Drive Gas Pressure Low	High	The drive gas pressure is low.	1. Check whether the gas supply is normal. 2. Short circuit the pressure switch. The alarm should disappear. If the alarm does not disappear, the pressure switch fails. Replace the pressure switch. If the pressure switch does not fail, check the connection between the pressure switch and the VCM board. 3. If both of the preceding items are normal, replace the VCM board.

Message	Alarm Priority	Cause	Solution
Drive Gas Valve Self Test Error	Low	The control status of the drive gas valve is different from the detected status.	Restart the machine for a self test again.
O2 Supply Failure	High	The O2 supply pressure is low.	Use the same method for solving the problem of low drive gas pressure to check the O2 pressure switch.
Power Supply Voltage Error	High	3.3 V, 5 V, or 12 V voltage error	1. Test the voltage at the corresponding testing point. 2. If the problem persists, replace the power board.
RT Clock Needs Battery	High	No button battery is available in the system, or the button battery is exhausted..	1. Replace the button battery on the CPU board with a new one. 2. If the problem persists, replace the CPU board.
RT Clock Failure	High	The clock chip is faulty.	1. Restart the anaesthesia machine. 2. If the problem persists, replace the button battery of main control board.
Keyboard Self Test Error Keyboard Self Test: Time out	High	The keyboard is faulty.	1. Check the cable connection between the keyboard and CPU board. 2. Restart the machine for a self test again. 3. If the problem persists, replace the keyboard.
External AG Self Test Error External AG: Time out	Low	An error occurs during the external AG self test.	1. Reconnect the external AG module, and restart the machine for a self test again. 2. Check the cable connection between the module rack and CPU board. 3. Check whether the module rack runs normally. 4. Replace the external AG module.
Internal AG Error 02 Internal AG: Time out	Low	An error occurs during the internal AG self test.	1. Restart the machine for a self test again. 2. Reconnect the cable between the internal AG module and CPU board. 3. Replace the internal AG module.

Message	Alarm Priority	Cause	Solution
BIS Self Test Error BIS Self Test: Time out	Low	An error occurs during the BIS module self test.	1. Reconnect the BIS module, and restart the machine for a self test again. 2. Check the cable connection between the module rack and CPU board. 3. Check whether the module rack runs normally. 4. Replace the BIS module.
CO2 Self Test Error CO2 Self Test: Time out	Low	An error occurs during the CO2 module self test.	1. Reconnect the CO2 module, and restart the machine for a self test again. 2. Check the cable connection between the module rack and CPU board. 3. Check whether the module rack runs normally. 4. Replace the CO2 module.

8.2.2 CPU Board Runtime Alarms

Message	Alarm Priority	Cause	Solution
IP Address Conflict	Medium	The IP address of the machine is the same as the IP address of another device in the local network.	1. Re-configure the IP address. 2. If the problem persists, upgrade the system software or replace the CPU board.
Fan Failure	Medium	The speed of the fan is lower than the rated speed by 20%.	1. Check whether the fan stops running, or the speed is low (the normal speed is about 4000 RPM). 2. Reconnect the fan cable. 3. If the problem persists, check whether the supply voltage of the 12 V fan is within the valid range. If not, check the power board. 4. If the problem persists, replace the fan. 5. If the problem persists, replace the CPU board.

Message	Alarm Priority	Cause	Solution
Fan Failure 02	Medium	The speed of the fan in the module rack is lower than 3640 RPM.	1. Check whether the fan stops running, or the speed is low (the normal speed is about 4000 RPM). 2. Reconnect the fan cable. 3. If the problem persists, check whether the supply voltage of the 12 V fan is within the valid range. If not, check the power board. 4. If the problem persists, replace the fan. 5. If the problem persists, replace the CPU board.

8.2.3 Power Board Runtime Alarms

Message	Alarm Priority	Cause	Solution
Power System Comm Stop	High	The CPU board loses communication with the power board for 10s consecutively.	1. Restart the anaesthesia machine. 2. Reconnect the communication cable. 3. Remove the internal battery. Shut down the power supply of the power board for 5 minutes, and then restart the power board. 4. Replace the communication cable. 5. Check whether the software of the power board is normal. If necessary, upgrade the software of the power board. 6. If the problem persists, replace the power board. 7. If the problem persists, replace the CPU board.
Power Supply Voltage Error	High	3.3 V, 5 V, or 12 V voltage error	1. Test the voltage at the corresponding testing point. 2. Remove the internal battery. Shut down the power supply of the power board for 5 minutes, and then restart the power board. Repeat step 1. 3. If the problem persists, replace the power board. 4. If the problem persists, contact the technical support.

Message	Alarm Priority	Cause	Solution
Low Battery Voltage	High	The battery voltage is lower than 10.6 V for 5s consecutively.	1. Check the AC power connection, and reconnect the AC power supply. 2. Check whether the battery voltage is within the valid range. 3. Check whether the charging circuit runs normally. If not, replace the power board.
System going DOWN, Battery depleted!	High	The battery voltage is lower than 10.2V.	1. Restart the anaesthesia machine. 2. If the problem persists, check the battery voltage on the [Maintenance] menu. If the voltage is lower than 10.2V, replace the battery. 3. If the problem persists, connect the machine to the AC power supply, ensure that the AC indicator is on, and charge the battery for 20 minutes. 4. If the problem persists, replace the battery. 5. If the problem persists, replace the power board.
Battery Undetected	Medium	The battery is not detected.	1. Check whether the battery voltage is within the valid range. 2. Check whether the cable is correctly connected. 3. Replace the battery. 4. If the problem persists, replace the power board. .
Battery in Use	Low	AC power failure	1. Check whether the AC power supply is connected. 2. If the AC power supply is correctly connected and the AC voltage is within the valid range, check the connection between the AC power supply and the power board. 3. If the problem persists, replace the power board.
Power Board High Temp	High	The temperature of the power board is higher than 95°C.	1. Check whether the fan on the power board runs normally. 2. Stop the machine for a period of time, and then restart the machine. If the problem persists, replace the power board.

Message	Alarm Priority	Cause	Solution
Heating Module Failure	Low	1. The temperatures of both resistances are higher than 70°C or lower than 20°C for 20s consecutively. 2. The temperature of any of the two resistances is higher than 75°C for 15s consecutively.	1. Restart the anaesthesia machine. 2. If the problem persists, check whether the temperature or voltage of the heating module is within the valid range. If not, replace the power board. 3. If the problem persists, replace the CPU board and upgrade the system software.
Breathing Circuit Not Mounted	High	The breathing circuit is not mounted.	1. Check whether the breathing circuit is mounted. 2. Check the connection between the cable and connector. 3. Replace the power board.

8.2.4 VCM Board Runtime Alarms

Message	Alarm Priority	Cause	Solution
Aux Control Module Comm Stop	High	The CPU board cannot communicate normally with the Aux Control module for 10s consecutively.	1. Restart the anaesthesia machine. 2. Reconnect the communication cable. 3. If the problem persists, replace the ventilator control board. 4. If the problem persists, replace the CPU board.
Ventilator Voltage Error	High	5 V or 12 V voltage error	1. Restart the anaesthesia machine. 2. Measure the supply voltage of the VCM board to ensure that the supply voltage is within the valid range. Check whether the cable fails. 3. If the supply voltage is out of range, replace the power board or cable. 4. If the problem persists, replace the VCM board.

Message	Alarm Priority	Cause	Solution
PEEP Valve Failure	Medium	1. PEEP valve voltage error 2. PEEP valve pressure error	1. Check whether the accuracy of the PEEP sensor is within the valid range. On the [Maintenance] menu, calibrate the sensor or update the PEEP sensor. 2. Test the voltage at the corresponding testing point. 3. Check the installation of and connection between the power cable and expiratory valve assembly. 4. When necessary, replace the VCM board. 5. When necessary, replace the expiratory valve assembly. 6. When necessary, replace the power board.
Insp Valve Failure	Medium	1. Inspiratory valve voltage error 2. Inspiratory valve flow error	1. Check whether the accuracy of the inspiratory flow sensor is within the valid range. On the [Maintenance] menu, calibrate the flow sensor. Or, when a flow error occurs, replace the flow sensor. 2. Test the voltage at the corresponding testing point. 3. Check the installation of and connection between the power cable and expiratory valve assembly. 4. When necessary, replace the VCM board. 5. When necessary, replace the expiratory valve assembly. 6. When necessary, replace the power board.
Safety Valve Failure	Medium	PEEP safety valve voltage error	1. Test the voltage at the corresponding testing point. 2. Check the installation of and connection between the power cable and expiratory valve assembly. 3. When necessary, replace the VCM board. 4. When necessary, replace the expiratory valve assembly. 5. When necessary, replace the power board.

Message	Alarm Priority	Cause	Solution
Flow Sensor Failure	Low	1. The inspiratory flow is out of range. 2. The expiratory flow is out of range. 3. The internal flow sensor is not connected.	1. Check whether the zero point of the flow sensor is within the valid range. 2. Check whether the monitored value of the flow sensor is within the valid range. 3. Replace the flow sensor and perform calibration. 4. Check the cable connection of the internal flow sensor. Reconnect the cable. When necessary, replace the flow sensor. 5. Replace the VCM board and perform calibration.
Check Flow Sensors	High	1. Inspiratory reverse flow 2. Expiratory reverse flow	1. Check whether the one-way valve is properly mounted. 2. Check whether the sampling line of the flow sensor is correctly connected. 3. Use the diagnosis tool to test the status of the flow sensor.
Pinsp Not Achieved	Low	The Pinsp does not reach the Pinsp setting in pressure mode.	1. Check whether a leak occurs on the circuit. 2. Check the accuracy of the pressure sensor. 3. If the accuracy does not meet the requirement, perform calibration. 4. Replace the VCM board and perform calibration.
Vt Not Achieved	Low	The Vt does not reach the Vt setting in VCV mode.	1. Check whether a leak occurs on the circuit. 2. Perform simulated ventilation on the machine and check whether the Vte and Vti of the machine are normal. 3. Check the accuracy of the flow sensor. 4. If the accuracy does not meet the requirement, perform calibration.
Patient Circuit Leak	Medium	1. The Vte is smaller than Vti by 200 ml or by 50% for 30s consecutively. 2. The Vti is smaller than Vt delivery in volume mode. 3. The patient is not connected.	1. Check whether the circuit and flow sensor are correctly connected. 2. Check whether the sensor and Vt meet the accuracy requirement. 3. Check whether a leak occurs on the circuit.

Message	Alarm Priority	Cause	Solution
CO2 Absorber Canister Not Locked	High	The CO2 absorber canister is not mounted.	1. Mount the CO2 absorber canister. 2. Check the cable connection between the CO2 absorber canister and VCM board. When necessary, replace the cable. 3. If the problem persists, replace the switch on the CO2 absorber canister. 4. If the problem persists, replace the VCM board.
O2 Sensor Disconnected	Low	The O2 sensor is disconnected.	1. Ensure that the cable of the O2 sensor is properly connected. 2. On the [Calibrate] menu, check the output voltage of the O2 sensor. 3. Replace the O2 sensor.
Replace O2 sensor	Medium	The O2 concentration is less than 5%.	1. On the [Calibrate] menu, check the output voltage of the O2 sensor. 2. Re-calibrate the O2 sensor. 3. Replace the O2 sensor.
Calibrate O2 Sensor	Low	The O2 concentration is greater than 110% or ranges between 5% and 15% for 3s consecutively.	1. Re-calibrate the O2 sensor. 2. Replace the O2 sensor.
Ventilator Comm Stop	High	The CPU board cannot communicate normally with the VCM board for 10s consecutively.	1. Restart the anaesthesia machine. 2. Reconnect the communication cable. 3. If the problem persists, replace the VCM board. 4. If the problem persists, replace the CPU board.
Drive Gas Pressure Low	High	The drive gas pressure is low.	1. Check whether the gas supply is normal. 2. Short circuit the pressure switch. The alarm should disappear. If the alarm does not disappear, the pressure switch fails. In this case, replace the pressure switch. If the pressure switch does not fail, check the connection between the pressure switch and the VCM board. 3. If both of the preceding items are normal, replace the VCM board.
O2 Supply Failure	High	The O2 supply pressure is low.	Use the same method for solving the problem of low drive gas pressure to check the O2 pressure switch.

Message	Alarm Priority	Cause	Solution
Drive Gas Switch Valve Failure	High	The control status of the drive gas valve is different from the detected status.	1. On the [Diagnosis] menu, switch the drive gas valve to check whether the normal status is restored. 2. Restart the machine for a self test again.
Fresh Gas Flow Too High	Low	The set fresh gas flow is greater than 2 L/min, and exceeds the gas delivery flow 0.2 L/min.	Reduce the fresh gas flow.
ACGO 3-way Valve Failure	Medium	The ACGO 3-way valve status is in error.	1. Check the connection of the 3-way valve. 2. Replace the 3-way valve assembly. 3. Replace the VCM board.
Automatic Ventilation Disabled	Low	The power-on self test fails, and the result is "Manual Only".	1. Restart the anaesthesia machine. 2. If the problem persists, check the corresponding module based on the result of the power-on self test. 3. If the problem persists, replace the corresponding module based on the result of the power-on self test.
Auto Ventilation Disabled-Leak Test Failed	Low	The automatic circuit leak test fails.	1. Check whether the circuit and pipeline are correctly mounted. (Check whether the sampling port and the drain valve are blocked.) 2. Conduct the leak test again.
Auto Ventilation is Non-Functional	High	The machine can only be manually ventilated, but the Auto/Manual switch is in Auto position.	1. Set the Auto/Manual switch to the Manual position. 2. Restart the machine for a self test again.
Pressure Monitoring Channel Failure		For VPM: The monitored value of PEEP sensor or Paw sensor is out of range.	1. Check whether the AD of the zero point of each sensor is within the valid range. If the AS is out of range, replace the ventilation control board or VCM board assembly. 2. If the AD of the zero point of each sensor is within the valid range, check whether the software of the VCM board is compatible with the system software version. If incompatible, upgrade the software of the VCM board to the compatible version. If compatible, perform the factory pressure calibration. If the problem persists after the

Message	Alarm Priority	Cause	Solution
			calibration, replace the ventilator control board or VCM board assembly.
Aux Control Module Voltage		The VPM 1.3 V supply voltage is not within the range of 1.121 V to 1.516 V.	1. Replace the ventilator control board or VCM board assembly.
Pressure Monitoring Channel Failure		For VCM: 1. The monitored value of PEEP sensor or Paw sensor is out of range. 2. The zero point of the PEEP sensor or Paw sensor is abnormal. 3. The PEEP sensor is reversely connected.	1. Check whether the pressure sampling line is connected correctly. 2. Zero the pressure and flow of each sensor. 3. Check whether the AD of the zero point of each sensor is within the valid range. If the AS is out of range, replace the ventilator control board or VCM board assembly. 4. If the AD of the zero point of each sensor is within the valid range, check whether the software of the VCM board is compatible with the system software version. If incompatible, upgrade the software of the VCM board to the compatible version. If compatible, perform the factory pressure calibration. If the problem persists after the calibration, replace the ventilator control board or VCM board assembly.

8.2.5 Keyboard Runtime Alarms

Message	Alarm Priority	Cause	Solution
Key Error	Medium	A hard key is pressed for more than 35s.	Check whether any hard key is continuously pressed.
Keyboard Comm Stop	Medium	1. The CPU board cannot communicate normally with the keyboard for 10s consecutively.	1. Restart the anaesthesia machine. 2. Check the cable connection between the keyboard and CPU board. 3. When necessary, replace the keyboard. 4. When necessary, replace the CPU board.

8.2.6 External AG Module Runtime Alarms

Message	Alarm Priority	Cause	Solution
AG Hardware Error	Medium	The AG hardware is faulty.	Replace the AG module.
O2 Sensor Error	Medium	The O2 sensor is faulty.	Replace the AG module.
External AG Self Test Error	Low	AG self test error	1. Reconnect the AG module. 2. If the problem persists or the alarm is repeatedly generated, replace the AG module.
AG Hardware Malfunction	High	The AG module is not properly installed or is faulty.	Replace the AG module.
AG Init Error	High	An error occurs during AG initialization.	1. Reconnect the AG module. 2. If the problem persists or the alarm is repeatedly generated, replace the AG module.
AG No Watertrap	Low	The watertrap falls off from the AG module.	1. Check the watertrap of the AG module. 2. Replace the watertrap of the AG module. 3. Replace the AG module.
AG Watertrap Type Wrong	Low	The patient type is neonate or infant, but the watertrap type is adult.	Replace the watertrap with the neonate-type watertrap.
AG Change Watertrap	Medium	The AG watertrap needs to be changed.	1. Check the watertrap of the AG module. 2. Replace the watertrap of the AG module. 3. Replace the AG module.
AG Comm Stop	High	The AG module is faulty or encounters a communication failure.	1. Replace the communication cable of the AG module. 2. Replace the AG module.
AG Airway Occluded	High	The actual pump rate of the AG module is lower than 20 ml/min for more than 1s.	1. Check the sampling of the AG module. 2. Replace the watertrap of the AG module. 3. Replace the AG module.
AG Zero Failed	Low	Zeroing of the AG module fails.	1. Zero the AG module again. 2. Replace the AG module.

Message	Alarm Priority	Cause	Solution
Mixed Agent	Low	The AG module supports measurement and calculation of two types of halogenated anesthetic agent, and the measured MAC is smaller than 3.	Use only one type of halogenated anesthetic agent.
Mixed Agent	Medium	The AG module supports measurement and calculation of two types of halogenated anesthetic agent, and the measured MAC is invalid.	Use only one type of halogenated anesthetic agent.
Mixed Agent and MAC ≥ 3	Medium	The AG module supports measurement and calculation of two types of halogenated anesthetic agent, and the measured MAC is equal to or greater than 3.	Use only one type of halogenated anesthetic agent.
CO2 Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.
O2 Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.
N2O Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.
HAL Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.
ENF Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.

Message	Alarm Priority	Cause	Solution
ISO Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.
SEV Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.
DES Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the concentration of the monitored gas to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.
Rate Over Range	Low	The monitored value exceeds the measurable range of the module.	1. Reduce the respiration rate to the normal range. 2. Calibrate the AG module again. 3. Replace the AG module.

8.2.7 Internal AG Module Runtime Alarms

Message	Alarm Priority	Cause	Solution
Internal AG Error 01	Low	The AG hardware is faulty.	Replace the AG module.
Internal AG Error 02	Low	AG self test error	Replace the AG module.
Internal AG Error 03	Low	The AG module is not properly installed or is faulty.	Replace the AG module.
Internal AG Error 04	Low	An error occurs during AG initialization.	Replace the AG module.
Internal AG Error 05	Low	The AG module is faulty or encounters a communication failure.	1. Replace the communication cable of the AG module. 2. Replace the AG module.
Internal AG Error 07	Low	Zeroing of the AG module fails.	1. Zero the AG module again. 2. Replace the AG module.

Message	Alarm Priority	Cause	Solution
Internal AG Error 09	Low	The device that is used as a substitution of the watertrap on the internal AG module gets loose.	1. Check the device that is used as a substitution of the watertrap on the internal AG module. 2. Replace the device that is used as a substitution of the watertrap on the internal AG module. 3. Replace the AG module.
Internal AG Error 10	Low	The actual pump rate of the AG module is lower than 20 ml/min for more than 1s.	1. Check the sampling of the AG module. 2. Replace the device that is used as a substitution of the watertrap on the internal AG module. 3. Replace the AG module.
Internal AG Error 11	Low	The device that is used as a substitution of the watertrap needs to be changed.	1. Check the device that is used as a substitution of the watertrap on the internal AG module. 2. Replace the device that is used as a substitution of the watertrap on the internal AG module. 3. Replace the AG module.

8.2.8 CO2 Module Runtime Alarms

Message	Alarm Priority	Cause	Solution
CO2 Comm Stop	High	The CO2 module is faulty or encounters a communication failure.	1. Replace the communication cable of the CO2 module. 2. Replace the CO2 module.
CO2 Sensor High Temp	Low	The temperature of the CO2 sensor is higher than 63°C.	Replace the CO2 module.
CO2 Sensor Low Temp	Low	The temperature of the CO2 sensor is lower than 5°C.	Replace the CO2 module.
CO2 Airway High Press.	Low	The airway pressure is higher than 790 mmHg.	1. Check the airway pressure. 2. Reconnect the sampling line. 3. Replace the CO2 module.
CO2 Airway Low Press.	Low	The airway pressure is lower than 428 mmHg.	1. Check the airway pressure. 2. Reconnect the sampling line. 3. Replace the CO2 module.

Message	Alarm Priority	Cause	Solution
CO2 High Barometric	Low	The barometric pressure is higher than 790 mmHg.	Replace the CO2 module.
CO2 Low Barometric	Low	The barometric pressure is lower than 790 mmHg.	Replace the CO2 module.
CO2 Hardware Error	High	1. External AD 2.5 V error 2. 12 V voltage error 3. Internal AD 2.5 V error 4. Air pump error 5. 3-way valve error	Replace the CO2 module.
CO2 Sampleline Occluded	Low	The sample line is occluded.	1. Check the sample line. 2. Replace the CO2 module.
CO2 System Error	Low	Multi-system error	Replace the CO2 module.
CO2 No Watertrap	Low	The CO2 watertrap is detached or is not connected.	1. Check the CO2 watertrap. 2. Re-install the CO2 watertrap. 3. If the problem persists, replace the CO2 watertrap. 4. If the problem persists, replace the CO2 module.
EtCO2 Overrange	Low	The monitored value is out of the measurable range.	1. Re-calibrate the CO2 module. 2. Replace the CO2 module.
FiCO2 Overrange	Low	The monitored value is out of the measurable range.	1. Re-calibrate the CO2 module. 2. Replace the CO2 module.
CO2 Zero Failed	Low	The CO2 module is faulty.	1. Re-zero the CO2 module. 2. Replace the CO2 module.
CO2 Init Error	High	CO2 initialization error	Replace the CO2 module.
Incompatible CO2 Software Version	High	The CO2 module is not compatible with the software version.	Replace the CO2 module (the M02A module is not supported).

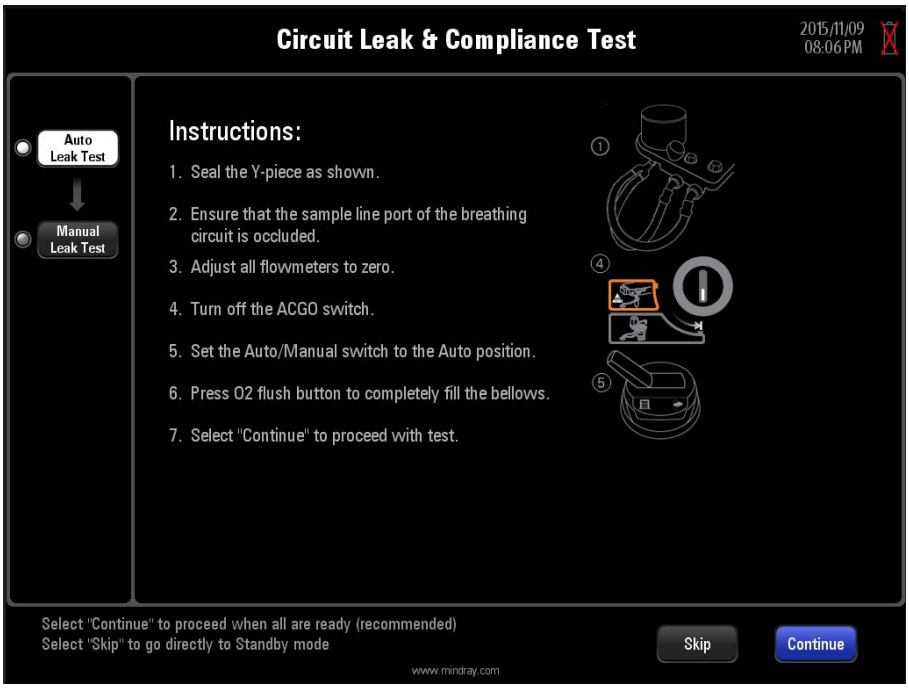
8.3 Circuit Leak Test

8.3.1 Circuit Leak Test in Mechanical Ventilation Mode

NOTE: Perform pneumatic leak tests when maintaining the anesthesia machine, or after replace components or re-connect lines.

This test checks if the pneumatic circuit has leakage in mechanical ventilation mode. The test items include bellows, drive gas circuit, CO2 absorber canister, patient tube, flow sensor, and flow sensor connector.

The following figure shows the Automatic Circuit Leak & Compliance Test screen.



To perform an automatic circuit leak test,

NOTE: The system records the result of the last automatic circuit leak test in the General tab, including if the test result is passed or failed, or the test is skipped. To view the last test result, select  > [**General**] on the main screen.

NOTE: If fresh gas is detected by the system before undergoing the automatic circuit leak and compliance test, a message is displayed on the screen for zeroing all flowmeters.

1. From system power-up:

If the system is being powered on, the system automatically initiates a system self test and then enters the Automatic Circuit Leak Test screen.

Or

From the main screen:

Select > **General** > **Test Leak/Compliance**.

2. Follow the directions on the screen.

NOTE: The **Continue** button can be selected only when the Auto/Manual switch is set to the Auto position and no fresh gas is detected.

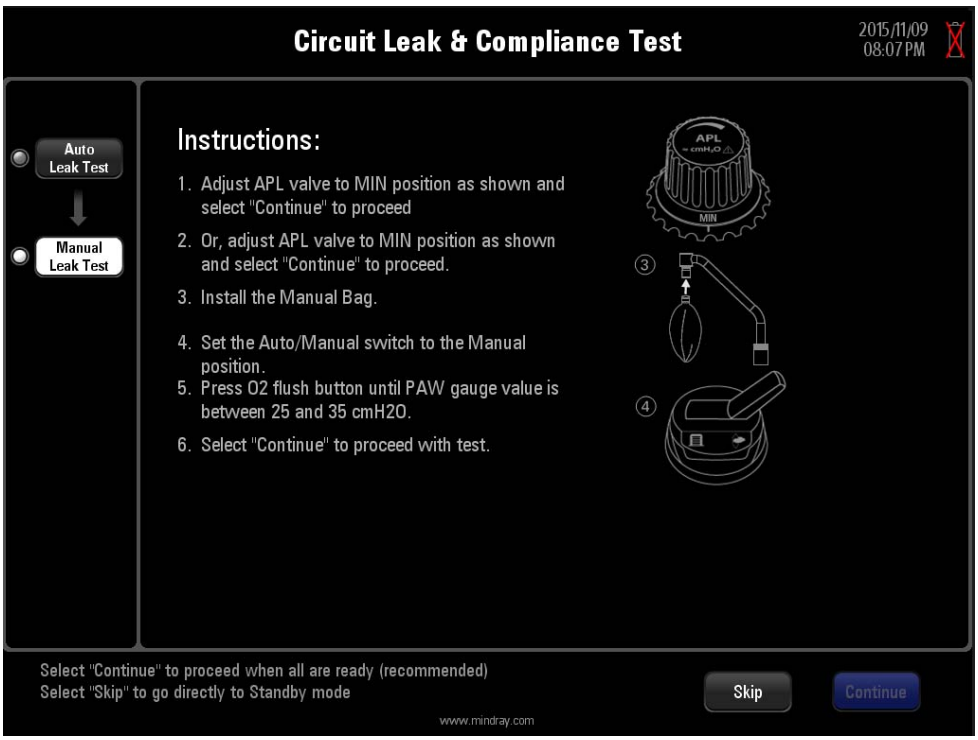
NOTE: The result of automatic circuit leak and compliance test is recorded in Service Log.

To view the test result, select > [**Service**] > [**Review Logs**] > [**Service**] on the main screen.

8.3.2 Circuit Leak Test in Manual Ventilation Mode

This test checks if the pneumatic circuit has leakage in manual ventilation mode. The test items include APL valve, check valve, CO2 absorber canister, patient tube, flow sensor, and flow sensor connector.

The following figure shows the Manual Circuit Leak Test screen.



To perform a manual circuit leak test,

NOTE: The Continue button can be selected only when the Auto/Manual switch is set to the Manual position and no fresh gas is detected.

1. From system power-up:

   If the system is being powered on, the system automatically initiates a system self test followed by automatic circuit leak and compliance tests.

   Or

   From the main screen:

Select  > [**General**] > [**Test Leak/Compliance**].

2. Follow the directions on the screen.

NOTE: The Continue button can be selected only when the Auto/Manual switch is set to the Manual position and no fresh gas is detected.

NOTE: The result of manual circuit leak test is recorded in Service Log. To view the test result, select  > [**Service**] > [**Review Logs**] > [**Service**] on the main screen.

8.3.3 Troubleshooting the Circuit Leak

Failure description	Possible cause	Recommended action
Leak test failure is prompted immediately after [Begin] is selected (typically, the leak test requires at least 3 minutes).	The Auto/Manual switch is set to the Manual position and the message [Manual Vent.] is prompted.	Set the Auto/Manual switch to the Auto position
	The reading on the drive gas (O2) pressure gauge indicates drive gas pressure low (lower than 200kPa) 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 280 to 600kPa.
During leak test, the pressure indicated by the airway pressure gauge fails to reach 30cmH2O.	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 pneumatic circuit connections and re-install the pneumatic circuit.

8.4 Constant Flow Ventilation

8.4.1 Constant Flow Test (Flow Sensor Accuracy Test)

Please refer to ***4.12.2 Constant Flow Test (Checking the Flow Sensor Accuracy)***.

8.4.2 Constant Pressure Test (Pressure Sensor Accuracy Test)

Please refer to ***4.12.3 Constant Pressure Test (Checking the Pressure Sensor Accuracy)***.

8.5 Airway System Failure

The airway system mainly consists of AG transmission system, anesthetics transmission device (vaporizer), anesthesia system, and ventilation and AG cleaning system. This section describes the faults that may occur in the airway system and the troubleshooting methods.

8.5.1 Onsite Maintenance Tools

The following table lists the tools required for troubleshooting.

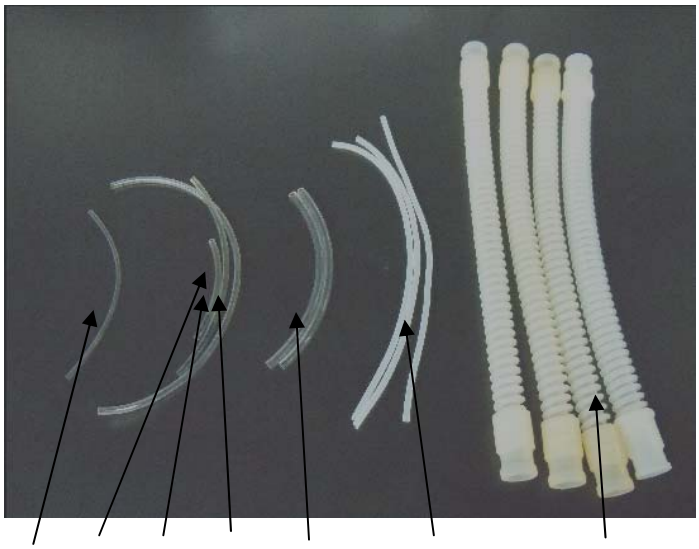
Name	**Quantity**	**P/N**
Negative pressure ball	1	040-000814-00*
Syringe (100 ml)	1	040-000040-00*
Test fixture of the circuit transit adapter	1	115-002452-00*
Test fixture of the pressure sampling tube of the flow sensor	1	115-002456-00*
Test fixture of the vaporizer support	1	115-002453-00*
1 MPa (10 bar) test pressure gauge	1	0611-30-67602*
T-shape hexagon screw wrench (4x100)	1	M90-100111---*
3106-04-06 adapter connector	1	M6Q-030068---*
3106-06-08 adapter connector	1	M6Q-030051---*
3106-10-00 adapter connector	2	082-000021-00*
3106-06-00 adapter connector	1	M6Q-030059---*
Air tube adapter connector	1	115-002454-00*
3126-04-00 tube plug	2	082-000023-00*

Name	Quantity	P/N
3126-06-00 tube plug	3	M6Q-120001---*
3126-08-00 tube plug	4	M6Q-120002---*
3126-10-00 tube plug	3	082-000022-00*
Y-shape tube	2	M90-100030---*
Y-shape air tube	1	M6Q-030028---*
3140-08-00 Y-shape tube	1	M6Q-030025---*
PU tube (4X200)	1	M6G-020046---*
PU tube (6X100)	1	M6G-020026---*
PU tube (6X200)	1	
PU tube (6X300)	1	
PU tube (8X200)	2	M6G-020014---*
Air tube	4	M6G-020017---*
Φ6 silicone tube	3	A21-000007---*
A5 maintenance manual	/	046-001140-00
Adult test lung	/	0138-00-0012
Wrench	/	0367-00-0080
15 mm Y-shape connection accessory	/	0103-00-0508
15 mm silicon air tube (0.6 meters)	2	0004-00-0076
2.3 L silicon breathing bag	/	0992-00-0139
Adjuster calibration hose	/	0453-00-1216
A5 fault locating kit	/	115-009450-00
Vaporizer guide	/	/
Dempsey430 safety analyzer or similar device	/	/
31/2 digital voltmeter	/	/
Anesthetics (N2O) analyzer with the range of ±0.3V/V%+5%	/	/
BCBiomedicalDPM-2301751NMC digital pressure gauge or similar device	/	/
DISS connector with the supply press of O2, N2O, and air being	/	/

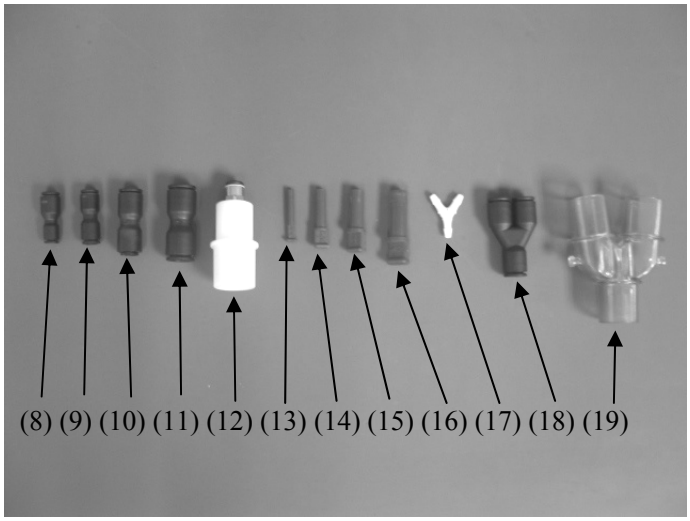
Name	Quantity	P/N
at least 35 psi		
Yoke connector of the FullPISS cylinder of the O2, N2O, and air	/	/
Metric hexagon screw wrench kits (manual operation tools)	/	/
Air flow analyzer with precision of 2%	/	/
Communication box (required for the FlukeVT Plus gas flow analyzer)	/	/
Lucer adapter connector	/	/
Network jumper cable	/	0012-00-1392-06
USB flash drive	/	0992-00-0297-01

* indicates that the item is a part of the 115-009450-00A5 fault locating kits

The following figures show the required tools.



(1) (2) (3) (4) (5) (6) (7)



(1) PU tube (4X200) (2) PU tube (6X100) (3) PU tube (6X200)

(4) PU tube (6X300) (5) PU tube (8X200) (6) Φ6 silicone tube

(7) Air 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) Air tube adapter connector (13) 3126-04-00 tube plug

(14) 3126-06-00 tube plug (15) 3126-08-00 tube plug

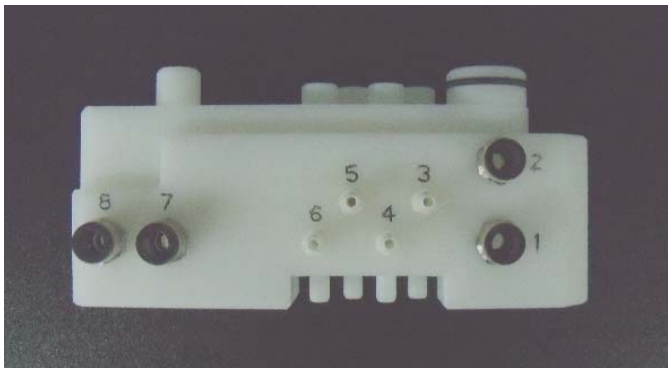
(16) 3126-10-00 tube plug (17) Y-shape tube

(18) 3140-08-00 Y-shape tube (19) Y-shape air tube

Negative pressure ball



Test fixture of the circuit transit adapter



Test fixture of the pressure sampling line of the flow sensor



Test fixture of the vaporizer support



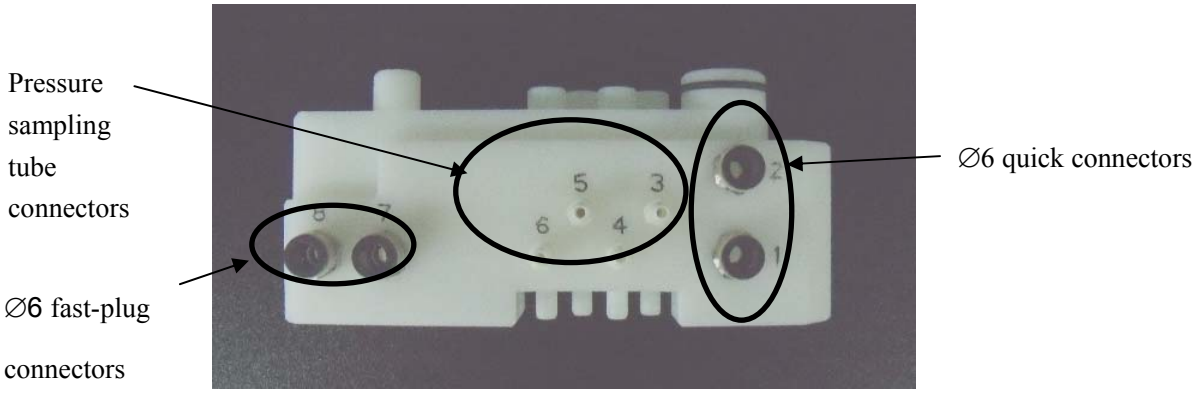
Anesthesia machine calibration device



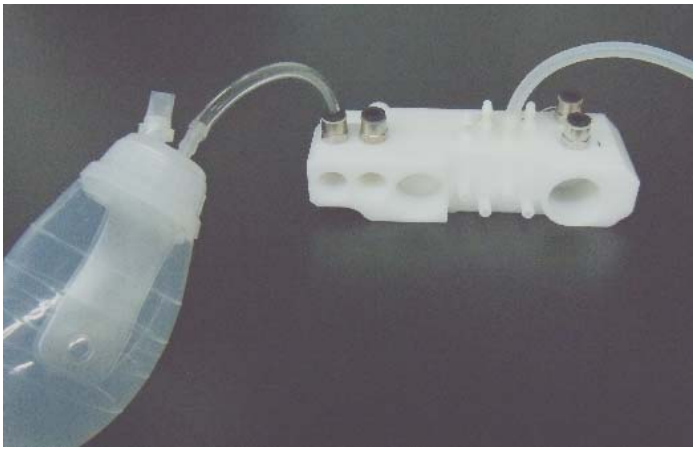
1 MPa (10 bar) test pressure gauge



The test fixture of the circuit transit adapter has four pressure sampling tube connectors and four ∅6 quick connectors, which are marked with the corresponding numerical symbols, as shown in the following figure.



The pressure sampling tube connector can be connected to the Silicon hose (6x300), and the Ø6 quick connector can be connected to the PU tube (6X100), PU tube (6X200), and PU tube (6X300), as shown in the following figure.



The test fixture of the circuit transit adapter can be installed on the circuit transit block of the anaesthesia machine or the removed patient circuit, as shown in the following figure.

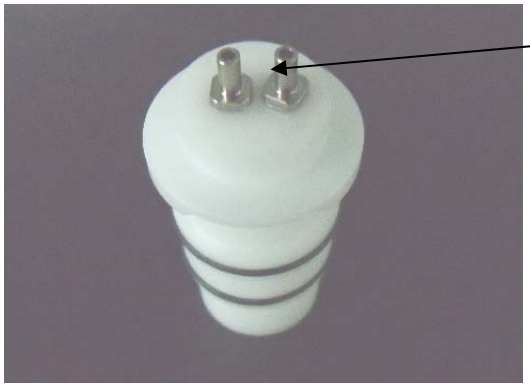


If the plugging is difficult during installation, apply some lube oil (lubricating grease or Krytox high-performance Fusso lubricating grease) on the seal ring of the corresponding circuit transit block, as shown in the following figure.



8.5.1.1 Precautions for Use of Test Fixture of Pressure Sampling Tube of Flow Sensor

The test fixture of the flow sensor tributary has two pressure sampling tube connectors, as shown in the following figure.



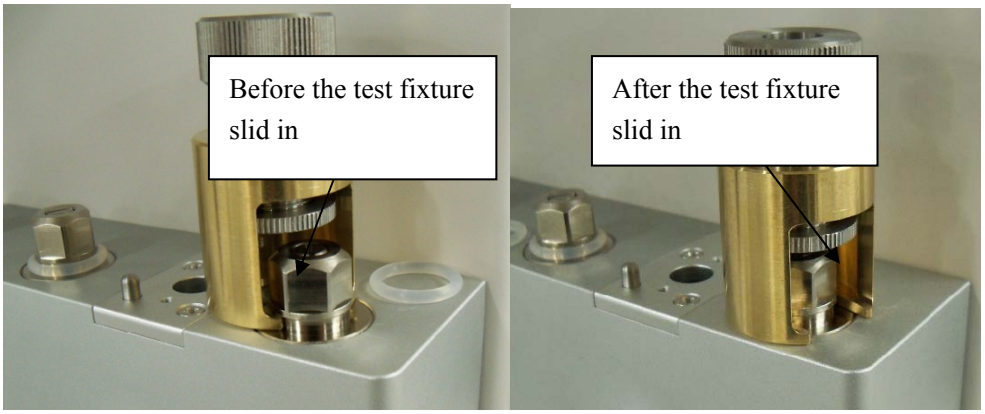
The pressure sampling tube connector can be connected to the Silicon hose (6x300). When using the test fixture of the flow sensor tributary, take out the expiration or inspiration flow sensor from the patient circuit. Install the test fixture of the flow sensor tributary in the original position of the expiration or inspiration flow sensor, and screw the cap of the breathing interface, as shown in the following figure. Perform the tests after connecting the Silicon hose (6x300) to the pressure sampling tube connector of the corresponding test tributary.





8.5.1.2 Precautions for Use of Test Fixture of Vaporizer Support

Before use, take out the seal ring on the connector of the vaporizer support for cooperating with the vaporizer. Slide the fixture into the connector, as shown in the following figures.

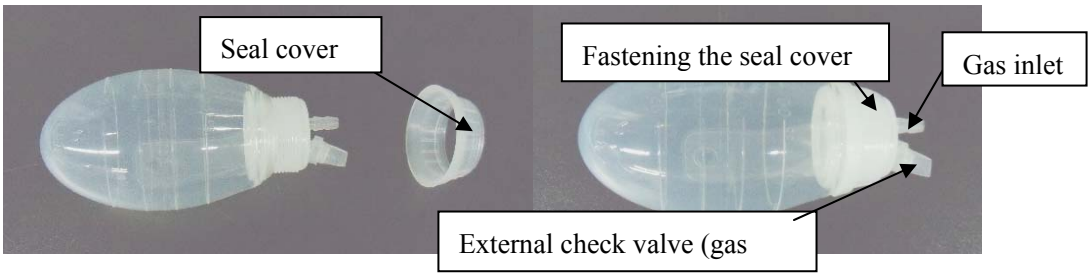


Rotate the pressure head of the test fixture of the vaporizer support clockwise to the end until the lower surface of the test fixture of the vaporizer support is in contact with the upper surface of the vaporizer support connector, as shown in the following figure.



8.5.1.3 Precautions for Use of Negative Pressure Ball

Besides the seal cover, the front end of the negative pressure ball also has two check valves, as shown in the following figure. The embedded check valve is connected to the inlet port of the negative pressure ball and is used only for gas suction. The external check valve is used only for scavenging. If the pre-seal cover is removed or loose, the sealing performance of the negative pressure ball is degraded. In this case, fasten the seal cover.



If the negative pressure ball is connected to a tested component, the negative pressure ball is used only for gas inlet. However, if the negative pressure ball is squeezed, the air is exhausted.



Ensure no leakage occurs before using the negative pressure ball. Check whether the pre-seal cover is fastened. Then, squeeze the negative pressure ball to exhaust all gas inside. Properly install the exhaust port plug. Block the pre-inlet port using your fingers and then release the negative pressure ball. Ensure that the negative pressure ball is obviously expanded within 30s. If not, replace the negative pressure ball.

8.5.2 Gas Source and Drive Gas

The following table lists the faults related to gas source and drive gas.

Failure Description	Possible Cause	Recommended Action
Leakage	The supply pipeline is damaged or the seal ring of the connector is damaged.	Replace the supply pipeline or seal ring of the connector.
	The quick connector is leaked.	Replace the quick connector or PU tube. (If the PU tube is not damaged and has enough length, cut a certain segment of the PU tube that is in contact with the quick connector and insert the segment into the PU tube.)
	The pipeline inlet assembly is leaked.	Check whether the check valve of the pipeline gas source assembly has a leakage issue in the reverse direction. If necessary, replace the check valve. Check whether the seal ring on the pipeline inlet assembly is damaged. If yes, replace the seal ring. If the issue persists, replace the pipeline inlet assembly.
	The drive gas pipeline is leaked.	Check and repair the exhalation valve according to section ***8.5.4.2 Leakage Test on the Low-pressure Airway System***.
The pipeline pressure gauge displays inaccurate reading or no reading.	The pipeline pressure gauge is damaged.	Replace the pipeline pressure gauge.
The reading of the pipeline pressure gauge is sharply fluctuated.	The filter of the pipeline supply assembly or PU tube of the pipeline pressure gauge is blocked, or the pressure gauge is damaged.	If the pipeline pressure is stable, check the PU tube of the pipeline pressure gauge or the filter of the pipeline supply assembly. If the PU tube or filter is blocked, replace it. 2. If the issue persists, replace the pipeline pressure gauge.

Failure Description	Possible Cause	Recommended Action
When the O2 supply pressure is too low, the "O2 Supply Failure" alarm is not generated; or when the O2 supply pressure is within the specified range, the "O2 Supply Failure" alarm is generated.	The pressure switch of the O2 inlet assembly is faulty.	Adjust the pressure switch of the O2 inlet assembly to keep the O2 supply pressure between 0.15 MPa and 0.25 MPa, as close to 0.2 MPa as possible when this alarm is generated. If the adjustment fails, replace the pressure switch (refer to section ***8.5.2.3 Adjusting the Pressure Switch***).
When the drive gas supply pressure is too low, the "Drive Gas Pressure Low" alarm is not generated; or when the drive gas supply pressure is within the specified range, the "Drive Gas Pressure Low" alarm is generated.	The pressure switch of the integrated airway of the exhalation valve or PEEP safety valve is faulty. Alternatively, the filter of the integrated airway of the exhalation valve assembly is blocked.	Adjust the pressure switch of the integrated airway of the exhalation valve assembly to keep the drive gas pressure between 0.05 MPa and 0.2 MPa, as close to 0.14 MPa as possible when this alarm is generated. If the adjustment fails, replace the pressure switch. If the issue persists after the pressure switch is replaced, replace the integrated airway of the exhalation valve assembly (refer to section ***8.5.2.3 Adjusting the Pressure Switch***).

8.5.2.1 Testing the Pipeline Pressure Gauge and Calibrating the Regulator

Use the following tools to test the pipeline pressure gauge and regulator of the pipeline inlet assembly:

- One 1 MPa (10 bar) test pressure gauge (before test, ensure that the test pressure gauge is in good conditions)
- One 3106-04-06 adapter connector
- One PU tube (4X200)
- One PU tube (6X200)

Test procedures:

I. O2 inlet assembly:

1. Switch off the gas source switch and switch on the O2 flush switch to release the remaining pressure.
2. Disconnect pipeline 57. Pull out this pipeline from the end connecting to the Y-shape tube instead of the end connecting to the auxiliary O2 source.
3. Connect the 1 MPa test pressure gauge to the Y-shape tube using the 3106-04-06 adapter connector.



4. Switch on the pipeline O2 source and record the reading on the pressure gauge of the O2 pipeline. Observe the test pressure gauge. If the reading is not within the range from 0.15 MPa to 0.25 MPa (from 1.5 bar to 2.5 bar), adjust the regulator of the O2 inlet assembly to enable the reading to reach 0.2 MPa (2 bar). For details about the regulator operations, refer to section ***8.5.2.4 Adjusting the Regulator of the Pipeline Gas Inlet Assembly.***
5. Switch off the gas source switch and switch on the O2 flush switch to release the remaining pressure.
6. Reconnect pipeline 57.
7. Disconnect pipeline 39 that connects to the O2 inlet assembly and O2 pipeline pressure gauge. Remove the end of the pipeline that connects to the O2 inlet assembly.
8. Connect the 1 MPa test pressure gauge to the outlet connecting to the O2 inlet assembly using the 3106-04-06 adapter connector.

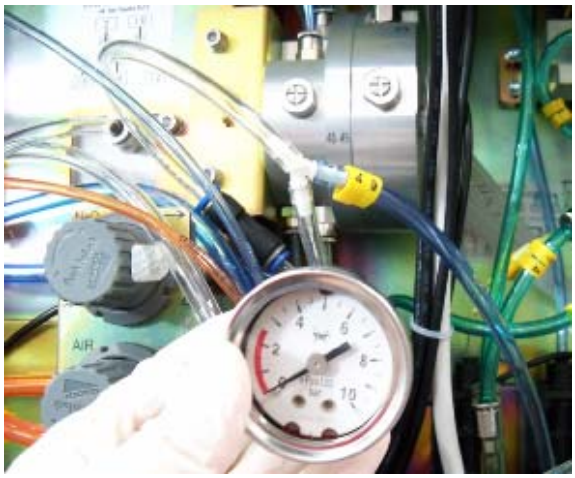


9. Switch on the pipeline source and record the reading on the pressure gauge. If the deviation between this reading and the reading on the O2 pipeline pressure gauge exceeds 0.1 MPa (1 bar), the O2 pipeline pressure gauge is damaged. Handle this issue according to the fault locating table.
10. Reconnect pipeline 39.

II. N2O inlet assembly

1. Stop the gas supply. Switch on the needle valve to release the remaining pressure. Then, switch off the needle valve. Disconnect pipeline 48. Remove only the end connecting to the ORC.

2. Connect the N2O inlet assembly to the 1 MPa test pressure gauge, removed end of pipeline 48, and ORC N2O outlet using the 3106-04-06 adapter connector.



3. Switch on the N2O and O2 sources. Adjust the regulator of the N2O inlet assembly to the measurement value/preset value of the O2 inlet assembly (refer to step 4 in O2 inlet assembly description). Record the reading on the N2O pipeline pressure gauge.

4. Switch off the N2O source and switch on the N2O flow regulator to release the remaining pressure.
5. Reconnect pipeline 48.

6. Disconnect PU tube 40 that connects to the N2O inlet assembly and N2O pipeline pressure gauge. Remove the end of the pipeline that connects to the N2O inlet assembly.
7. Connect the 1 MPa test pressure gauge to the outlet connecting to the N2O inlet assembly using the 3106-04-06 adapter connector.



8. Switch on the pipeline N2O source and record the reading on the pressure gauge. If the deviation between this reading and the reading on the N2O pipeline pressure gauge exceeds 0.1 MPa (1 bar), the N2O pipeline pressure gauge is damaged. Handle this issue according to the fault locating table.
9. Connect the pipeline to the pressure gauge. Reconnect pipeline 40.

III. Air inlet assembly:

1. Stop the gas supply. Disconnect pipeline 67. Pull out this pipeline from the end connecting to the Y-shape tube instead of the end connecting to the auxiliary gas source.
2. Connect the 1 MPa test pressure gauge to the Y-shape tube using the 3106-04-06 adapter connector.



3. Switch on the pipeline air source. If the reading is not within the range of 0.2±0.05MPa (2.0±0.5bar), adjust the regulator of the air inlet assembly to enable the reading to reach 0.2 MPa (2.0 bar). Record the reading on the air pipeline pressure gauge.
4. Switch off the air source and switch on the air flow regulator to release the remaining pressure.
5. Reconnect pipeline 67.
6. Disconnect PU tube 41 that connects to the air inlet assembly and air pipeline pressure gauge. Remove the end of the pipeline that connects to the air inlet assembly.
7. Connect the 1 MPa test pressure gauge to the outlet connecting to the air inlet assembly using the 3106-04-06 adapter connector.



8. Switch on the pipeline air source and record the reading on the pressure gauge. If the deviation between this reading and the reading on the air pipeline pressure gauge exceeds 0.1 MPa (1.0 bar), the air pipeline pressure gauge is damaged. Handle this issue according to the fault locating table.
9. Reconnect PU tube 41 to the pressure gauge.

8.5.2.2 Testing the Pressure Switch

Use the following tools to check whether the pressure switches of the O2 inlet assembly and exhalation valve assembly are qualified:

- One 1 MPa (1.0 bar) test pressure gauge
- One 3106-04-06 adapter connector
- One 3106-06-08 adapter connector
- One 3140-08-00 Y-shape tube
- Two PU tubes (8X200)
- One PU tube (6X200)
- One PU tube (4X200)

Test procedures:

1. Switch off the gas source switch and switch on the O2 flush switch to release the remaining pressure.

2. Disconnect pipeline 47. Remove only the end of the pipeline connecting to the pressure regulator assembly.

3. Connect a PU tube (8X200) to the O2 inlet of the pressure regulator assembly. Connect another end of the PU tube and the removed end of pipeline 47 to two connectors of the 3140-08-00 Y-shape tube.

4. Connect the test pressure gauge to the third connector of the 3140-08-00 Y-shape tube using the 3106-06-08 adapter connector and 3106-04-06 adapter connector.

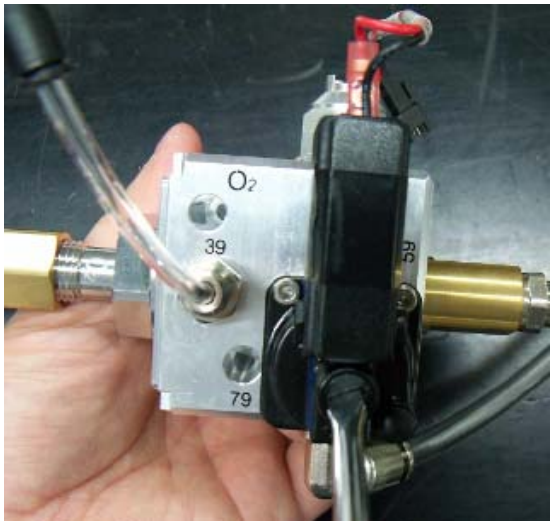


5. Switch on the pipeline O2 source.
6. Enable the system to enter standby mode.
7. Switch off all flow regulators.
8. Switch off the pipeline gas source (if the reading on the test pressure gauge is sharply decreased and continues to decrease after the gas source is switch off, one or more components among the O2 inlet assembly, exhalation valve assembly, O2 flush switch assembly, system switch assembly and O2 flow regulator have encountered leakage). Fix the leakage issue and continue the subsequent operations. Locate the fault according to fault locating methods for O2 inlet assembly in section ***8.5.3 AG Transmission System*** and section ***8.5.4 Breathing System***.
9. Manually adjust the O2 flow regulator until the O2 flow reaches 1 L/min, to gradually decrease the reading on the test pressure gauge to 0.25 MPa (2.5 bar).
10. Switch off the O2 supply and keep the reading on the test pressure gauge remain non-decreased. If the "O2 Supply Failure" alarm is generated in 10s, the pressure switch of the O2 inlet assembly is damaged. Handle this issue according to the fault locating table.
11. Adjust the O2 flow regulator until the O2 flow reaches 0.5 L/min, to gradually decrease the reading on the test pressure gauge to 0.2 MPa (2 bar).
12. Switch off the O2 supply and keep the reading on the test pressure gauge remain non-decreased. If the "O2 Supply Failure" alarm is generated in 10s, the pressure switch of the integrated airway of the exhalation valve assembly is damaged. Handle this issue according to the fault locating table.
13. Adjust the O2 flow regulator until the O2 flow reaches 0.3 L/min, to gradually decrease the reading on the test pressure gauge to 0.15 MPa (1.5 bar).
14. Switch off the O2 supply and keep the reading on the test pressure gauge remain non-decreased. If the "O2 Supply Failure" alarm is not generated in 10s, the pressure switch of the O2 inlet assembly is damaged. Handle this issue according to the fault locating table.
15. Adjust the O2 flow regulator until the O2 flow reaches 0.3 L/min, to gradually decrease the reading on the test pressure gauge to 0.05 MPa (0.5 bar).
16. Switch off the O2 supply and keep the reading on the test pressure gauge remain non-decreased. If the "O2 Supply Failure" alarm is not generated in 10s, the pressure switch of the integrated airway of the exhalation valve assembly is damaged. Handle this issue according to the fault locating table.

8.5.2.3 Adjusting the Pressure Switch

Adjust the O2 pressure switch and drive gas pressure switch.

Adjust the O2 pressure switch using a slot-head screwdriver. Screw a little bit each time, for example, 30 degree. Note that the alarm limit is decreased when you rotate the pressure switch clockwise and the alarm limit is increased when you rotate the pressure switch anticlockwise. Test the component each time you adjust the pressure. Repeat the operations until the pressure switch is correctly adjusted and the pressure is remained within the specified range (nominal value 220 kPa +/- 10 kPa).



8.5.2.4 Adjusting the Regulator of the Pipeline Gas Inlet Assembly

Remove the knob of the regulator. Rotate the knob clockwise to increase the pressure or anticlockwise to decrease the pressure. Release the pressure in the pipeline gas inlet assembly using the regulator calibration hose (PN0453-00-1216) each time you adjust the pressure. Then, switch on the pipeline gas source again. Adjust the pressure to 200 kPa.



8.5.3 AG Transmission System

The following table lists the faults related to the AG transmission system.

Failure Description	Possible Cause	Recommended Action
Leakage	The O2 flush button assembly is leaked.	Replace the seal ring on the O2 flush button assembly or replace the O2 flush button assembly.
	The system switch assembly is leaked.	Replace the seal ring on the system switch assembly or replace the system switch assembly.
	The vaporizer installation is incorrect, resulting in leakage.	Install the vaporizer again.
	The sealing part between the vaporizer support element and the vaporizer is damaged.	Clean or replace the seal ring. Replace the sealing part at least once a year according to the requirements.
	The sealing part between the internal of the vaporizer support and the connector or the rubber flat washer between the internal of the vaporizer support and the spring is damaged or polluted.	Clean the sealing part or replaced the damaged sealing part and rubber flat washer.
	The vaporizer support assembly is damaged.	Replace the vaporizer support assembly.
	The general flowmeter is leaked.	Replace the general flowmeter.
	The ORC assembly is leaked.	Replace the ORC assembly.
	The flow regulator is leaked.	Replace the flow regulator.
	The throttling apparatus is leaked.	Replace the restrictor and perform calibration again (for details about the calibration, refer to the FPM-65 Flow and Pressure Detection Device Guide.
	The pressure relief valve at the breathing connection part is leaked.	Check and replace the damaged pressure relief valve.
	The ACGO assembly is leaked.	Replace the ACGO assembly.
	The fresh air connector of the	Check the seal ring and pipeline

Failure Description	Possible Cause	Recommended Action
	circuit transit block assembly is leaked.	of the fresh air connector. Replace the damaged part.
After the system is shut down, the gas source cannot be switched off.	The internal sealing part of the system switch assembly is damaged.	Replace the system switch.
After the system is started, the system cannot be supplied with power.	The contact switch is faulty.	Replace the contact switch of the system switch assembly.
The value indicated by the flowmeter floater is inaccurate or the floater is not floated.	The floater of the general flowmeter is damaged.	Replace the floater of the general flowmeter.
The knob of the flow regulator is loose.	The flow regulator is damaged..	Replace the flow regulator.
The N2O source cannot be cut down when the O2 supply pressure is insufficient.	The ORC assembly is damaged.	Replace the ORC assembly.

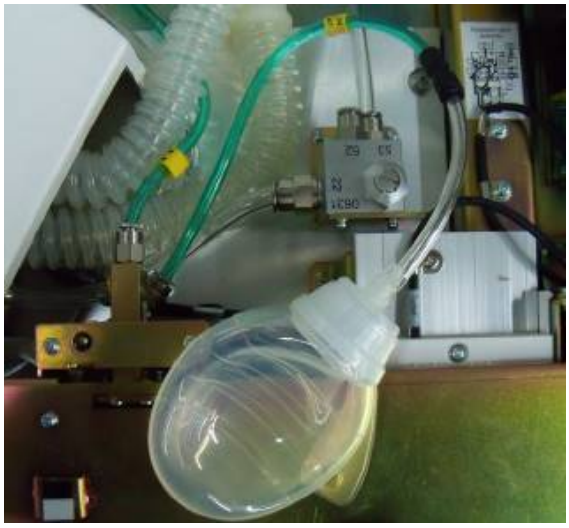
8.5.3.1 Leakage Test on the O2 Flush Button Assembly

Use the following tools to perform the leakage test on the O2 flush button assembly:

- One negative pressure ball
- One 3106-06-00 adapter connector
- One PU tube (6X100)

Test procedures:

1. Switch off the gas source switch and switch on the O2 flush switch to release the remaining pressure.
2. Remove the panel of the workbench. Remove the PU tube 52 connecting to the O2 flush switch assembly and ACGO assembly. Disconnect the ACGO end.
3. Connect the negative pressure ball inlet to the PU tube 52 using the 3106-06-00 adapter connector. Squeeze the negative pressure ball to exhaust the internal gas.
4. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the O2 flush switch assembly is damaged.



8.5.3.2 Leakage Test on Flowmeter-related Assemblies

Use the following tools to perform the leakage test on the flowmeter-related assemblies (between the flow regulator and the general flowmeter):

- One negative pressure ball
- One 3106-06-00 adapter connector
- One 3106-06-08 adapter connector
- Three 3126-06-00 tube plugs
- One 3126-08-00 tube plug
- One PU tube (6X100)

Test procedures:

1. Switch off the pipeline gas source and enable the system switch. Switch on the flow regulator to release the remaining pressure.

2. Disable the system switch.Switch on the flow regulator and rotate the regulator more than half cycle anticlockwise.

3. Remove the PU tube 25 connecting the general flowmeter and the vaporizer support assembly. Disconnect the vaporizer support end.

4. Remove the PU tubes 45, 49, and 51 connecting to the flow regulator. Disconnect the flow regulator end.

5. Block the end removed from the flow regulator using three 3126-06-00 tube plugs.



6. Connect the other end of the negative pressure ball to the removed end of PU tube 25 using the 3106-06-08 adapter connector. Squeeze the negative pressure ball to exhaust the internal gas.



7. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the general flowmeter assembly is damaged. In this case, remove the tube plug from the needle valve inlet and perform the following steps:

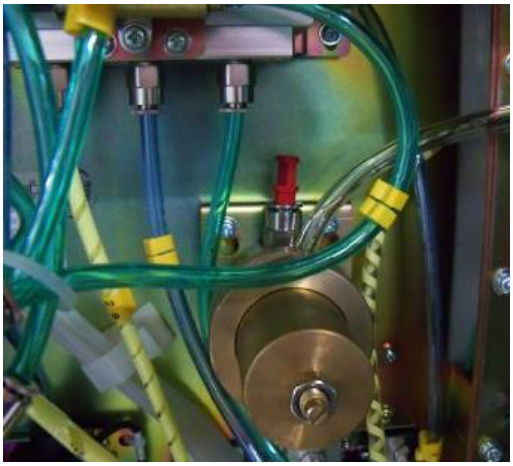
8. Remove the PU tube 26 connecting the back pressure regulator and the general flowmeter. Disconnect the general flowmeter end.
9. Block the end of the general flowmeter with pipeline removed using the 3126-08-00 tube plug.



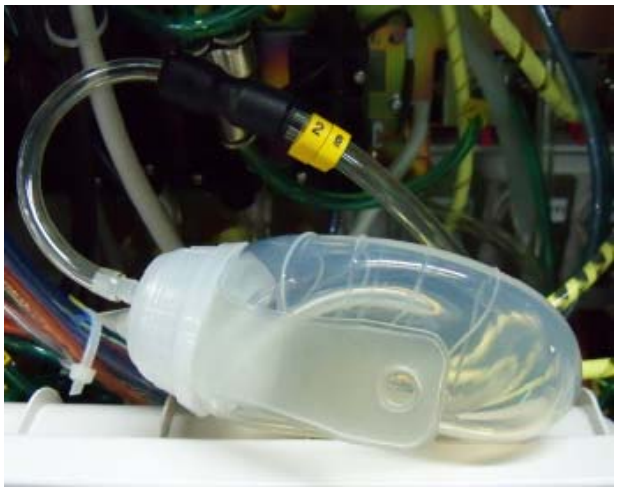
10. Squeeze the negative pressure ball connecting to pipeline 25 to exhaust the internal air.



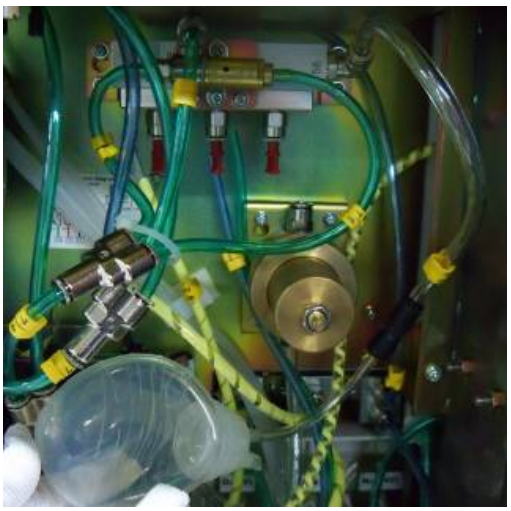
11. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the general flowmeter assembly is leaked.
12. Reconnect pipeline 25. Disconnect pipeline 58 and remove the end connecting to the back pressure valve. Disconnect pipeline 26 and remove the end connecting to the general flowmeter.
13. Block the end of the back pressure regulator with the pipeline removed using the 3126-08-00 tube plug, and connect the negative pressure ball to the removed end of PU tube 26 using the 3106-06-08 adapter connector.



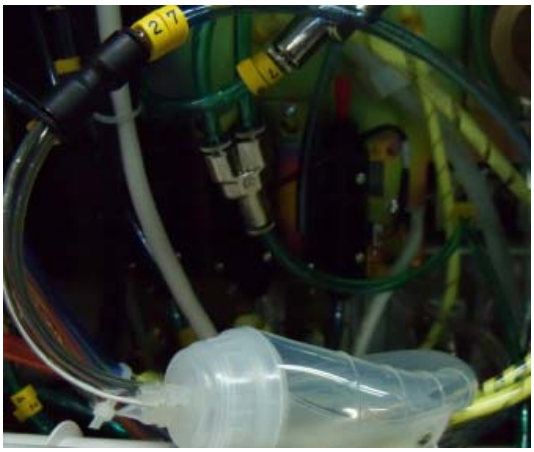
14. Squeeze the negative pressure ball to exhaust the internal air.

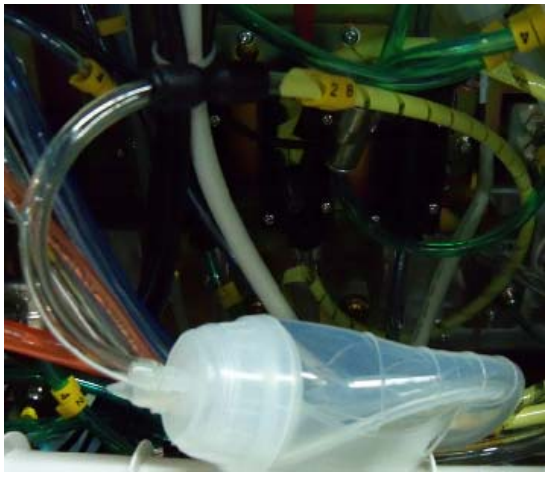


15. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the back pressure regulator is leaked.
16. Remove the pipelines 27, 28, and 29 connecting the flow sensor and the gas mixing device. Disconnect the gas mixing device end.
17. Block the end of the gas mixing device with the pipeline removed using three 3126-06-00 tube plugs.
18. Disconnect pipeline 58 and remove the end connecting to the back pressure valve. Connect the negative pressure ball to the removed end of pipeline 58 using the 3106-06-08 adapter connector.
19. Then, squeeze the negative pressure ball to exhaust all gas inside.



20. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the gas mixing device is leaked.
21. Disconnect pipeline 32 connecting to the N2O tributary and remove the end connecting to the sensor (disconnect pipeline 31 connecting to the air tributary and pipeline 78 connecting to the O2 tributary).
22. Block the end of the flow sensor with pipeline removed using the 3126-06-00 tube plug.
23. Disconnect pipeline 27 connecting to the N2O tributary. Remove the end connecting to the gas mixing device. Connect the end with the gas mixing device removed to the negative pressure ball inlet using the 3106-06-00 adapter connector (disconnect pipeline 28 connecting to the air tributary and pipeline 29 connecting to the O2 tributary). Then, squeeze the negative pressure ball to exhaust all gas inside.







24. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the flow sensor is leaked.
25. Disconnect pipeline 49 connecting to the N2O tributary and remove the end connecting to the needle valve (disconnect pipeline 51 connecting to the air tributary and pipeline 45 connecting to the O2 tributary).
26. Block the end of the needle valve with pipeline removed using the 3126-06-00 tube plug.
27. Disconnect pipeline 91 connecting to the N2O tributary. Remove the end connecting to the needle valve. Connect the negative pressure ball inlet to the needle valve outlet using the 3106-06-00 adapter connector and the PU tube (6X200) (disconnect pipeline 90 connecting to the air tributary and pipeline 73 connecting to the O2 tributary). Then, squeeze the negative pressure ball to exhaust all gas inside.







28. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the needle valve is leaked.

8.5.3.3 Leakage Test on the System Switch Assembly

Use the following tools to perform the leakage test on the system switch assembly:

- One negative pressure ball
- One 3106-06-00 adapter connector
- One 3106-06-08 adapter connector
- One 3126-08-00 tube plug
- One PU tube (6X100)

Test procedures:

1. Switch off the pipeline gas source and enable the system switch. Switch on the flow regulator to release the remaining pressure.
2. Remove pipeline 45 connecting the system switch assembly and the flow regulator. Disconnect the end connecting to the flow regulator. Connect the end with the pipeline removed to the negative pressure ball using the 3106-06-00 adapter connector.
3. Remove pipeline 43 connecting the system switch assembly and the Y-shape tube. Disconnect the end connecting to the Y-shape tube. Block the end with the pipeline removed using a 3106-06-08 adapter connector and a 3126-08-00 tube plug.
4. Then, squeeze the negative pressure ball to exhaust all gas inside.



5. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the pipeline connecting to the system switch assembly is damaged.
6. Disable the system switch.
7. Remove the 3126-08-00 tube plug used to block pipeline 43.
8. Then, squeeze the negative pressure ball to exhaust all gas inside.



9. Release the negative pressure ball. If the negative pressure ball is completely expanded within 30s in any test, the system switch assembly is damaged.

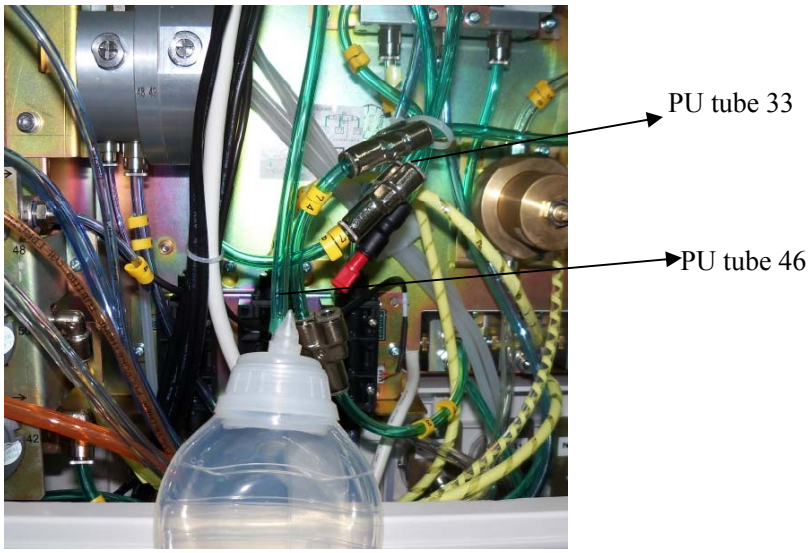
8.5.3.4 Leakage Test on the ORC

Use the following tools to perform the leakage test on the ORC assembly:

- One negative pressure ball
- One 3106-06-00 adapter connector
- Two 3126-06-00 tube plugs
- One 3126-04-00 tube plug
- One PU tube (6X100)

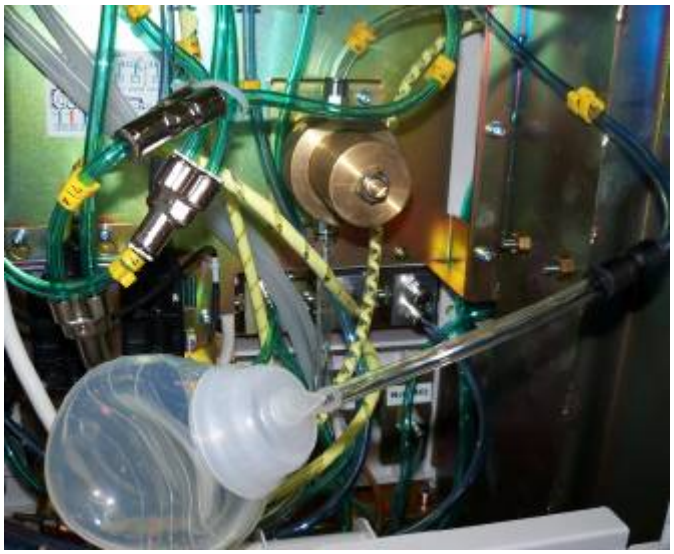
Test procedures:

1. Disconnect pipeline 3 and remove the end connecting to the Y-shape tube. Block the end with the pipeline removed using the 3106-06-00 adapter connector and the 3126-06-00 tube plug.
2. Disconnect pipeline 46 and remove the end connecting to the Y-shape tube. Directly connect the removed end to the negative pressure ball.
3. Then, squeeze the negative pressure ball to exhaust all gas inside.



4. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the ORC is damaged. Handle this issue according to the fault locating table. If not, continue the following test:
5. Reconnect the pipeline.
6. Disconnect pipelines 48, 49, and 32. Remove the end connecting to the ORC. Block the removed end using two 3126-06-00 tube plugs and one 3126-04-00 tube plug. Disconnect pipeline 30. Remove the end not connecting to the ORC and connect this end to the negative pressure ball using the 3106-06-00 adapter connector.





7. Then, squeeze the negative pressure ball to exhaust all gas inside.
8. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the ORC is damaged. Handle this issue according to the fault locating table.

8.5.3.5 Leakage Test on Vaporizer Support Assembly

Use the following tools to perform the leakage test on the vaporizer support assembly:

- One negative pressure ball
- One 3106-06-08 adapter connector
- One 3126-06-00 tube plug
- One PU tube (6X100)
- One PU tube (8X200)
- One test fixture of the vaporizer support

Test procedures:

1. Disable the system switch.
2. Remove the vaporizer.



3. Remove the PU tube 25 connecting the general flowmeter and the vaporizer support assembly. Disconnecting the end connecting to the vaporizer support and block this end using the 3126-08-00 tube plug.
4. Remove PU tube 55 connecting the vaporizer support assembly and the ACGO assembly. Remove the end connecting to the vaporizer support assembly and connect this end to the negative pressure ball using a 3106-06-08 adapter connector.
5. Then, squeeze the negative pressure ball to exhaust all gas inside.



6. Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the rubber flat washer or the upper surface in contact with the mechanical face is damaged. Handle this issue according to the fault locating table. If not, continue the following test:
7. Remove the seal ring. Fix the test fixture of the vaporizer support to the connector of the vaporizer support assembly (when fixing the test fixture, remove the seal ring between the connector and the vaporizer).



8. Repeat step 5 and step 6 each time you move the test fixture of the vaporizer support. If the negative pressure ball is completed expanded within 30s, the rubber flat washer or the lower surface in contact with the mechanical face is damaged. Handle this issue according to the fault locating table. If all test items are passed, continue the following test:
9. Place back the seal ring. Fix the vaporizer and enable it.



10. Repeat step 5 and step 6 each time you move the test fixture of the vaporizer support. If the negative pressure ball is completed expanded within 30s, the seal ring is damaged. If these two test items are passed, the vaporizer support assembly and four sealing parts are in good conditions.

8.5.4 Breathing System

The following table lists the faults related to the breathing system.

Failure Description	Possible Cause	Recommended Action
Leakage	The CO2 canister in not properly installed.	Re-install the CO2 canister. Clean the soda lime at the sealing joint. Ensure that the soda lime canister is properly installed.
	The sealing part of the canister assembly is damaged, including the sealing gaskets (049-000142-00 and 049-000145-00) that are directly in contact with the canister and two seal rings (082-000629-00) on the seal-capping of the bypass that are in contact with the bottom chassis of the circuit.	Replace the sealing part of the CO2 canister assembly. The sealing part should be replaced at least once a year.
	The sealing part of the breathing bag arm is damaged.	Replace the sealing part of the breathing bag arm. The sealing part should be replaced at least once a year.
	The water collection cup is loose.	Check and fasten the water collection cup.
	The sealing part of the water collection cup assembly is damaged.	Replace the sealing part of the water collection cup. The sealing part should be replaced at least once a year.
	The sealing part of the circuit transit block assembly is damaged.	Replace the sealing part once every year.
	The bellow enclosure or bellow is not properly installed.	Re-install the bellow enclosure or bellow. Ensure that the installation is correct.
	The sealing gasket of the bellow is dropped off or damaged.	Replace the sealing gasket of the bellow once every year.
	The valve cap of the breathing valve assembly is not properly installed.	Re-install the valve cap properly.
	The sealing part of the valve cap of the breathing valve assembly is damaged.	Replace the sealing part.
	The O2 sensor is not properly installed.	Re-install the O2 sensor properly.
	The sealing part of the O2 sensor or the O2 sensor plug is damaged.	Replace the sealing part.

Failure Description	Possible Cause	Recommended Action
	The breathing tube connecting to the patient end is damaged.	Replace the breathing tube.
	The bellow is damaged.	Replace the bellow once every year.
	The sealing connector of other parts of the breathing system is damaged.	Repair or replace the sealing connector according to section ***8.5.2.4Adjusting the Regulator of the Pipeline Gas Inlet Assembly***.
	The condensation valve of the canister assembly is not properly installed or the internal sealing part is damaged.	Re-install the condensation valve or replace the damaged internal sealing part.
The O2 concentration measurement fails or has a large deviation.	The measurement face of the O2 sensor has a build up of water.	Clean a build up of water and dry the O2 sensor in the air.
	The O2 sensor is not calibrated.	Calibrate the O2 sensor according to section ***7.3.5 O2 Sensor Calibration***.
	The O2 sensor is damaged.	Replace the O2 sensor.
The reading of the airway pressure gauge is inaccurate or the pointer of the airway pressure gauge cannot move.	The airway pressure gauge is damaged.	Replace the airway pressure gauge.
Irregular flow waveforms are displayed.	The flow sensor assembly is not properly installed.	Re-install the flow meter assembly.
	The flow sensor assembly has a build up of water.	Remove the flow sensor assembly and clean the build up of water.
	The film of the flow sensor assembly is deformed or dirty, or the internal resistance is changed. The pressure sensor of the fresh air flow sensor board encounters zero drift.	In maintenance mode, calibrate the flow sensor according to section ***7.3.2 Flow calibration (Service)***.
	The flow sensor is damaged.	Replace the flow sensor assembly.
	The pressure sensor on the fresh air flow sensor board is damaged.	Replace the fresh air flow sensor board.

Failure Description	Possible Cause	Recommended Action
	The pressure sampling line of the flow sensor is leaked.	After checking, repair the pressure sampling line of the flow sensor according to section ***8.5.4.1 Leakage Test on the Pressure Sampling Line of the Flow Sensor***.

8.5.4.1 Leakage Test on the Pressure Sampling Line of the Flow Sensor

If an irregular flow waveform is displayed, the pressure sampling line of the flow sensor may be leaked. Use the following tools to perform the leakage test:

- One anesthesia machine calibration device
- One test fixture of the pressure sampling line of the flow sensor
- One test fixture of the circuit transit adapter
- One syringe
- Three Φ6 silicon tubes
- One Y-shape tube

Test procedures:

I. Leakage test on the pressure sampling line of the flow sensor (covering four sampling lines of the expiration flow sensor and inspiration flow sensor)

1. Disable the system switch.
2. Install the breathing circuit properly.
3. Remove the flow sensor assembly.
4. Install the test fixture of the flow sensor tributary on the installation position of the flow sensor assembly on the patient circuit. Rotate the breathing interface knob securely.
5. Connect the pressure sensor interface (positive pressure end) of the anaesthesia machine calibration apparatus, syringe (pull out the pushrod to a certain position before installation), and the test fixture of the flow sensor tributary to the Silicon hose (6x300) using the Y-shape tube.



6. Push the pushrod of the syringe to make the reading of the anaesthesia machine calibration apparatus rise to 70-90 cmH2O. Stop pushing the pushrod and remain the relative position between the pushrod and the syringe body unchanged. If the pressure reading of the anaesthesia machine calibration apparatus decreases no more than 5 cmH2O within 15s, the test item is passed.

II. Leakage test on the pressure sampling line of the flow sensor inside the system (If test item I is not passed, conduct this test)

1. Fix the test fixture of the circuit transit adapter to the circuit transit block assembly.
2. Connect the pressure sensor interface (positive pressure end) of the anaesthesia machine calibration apparatus, syringe (pull out the pushrod to a certain position before installation), and the test fixture of the circuit transit adapter to the corresponding connectors of the Silicon hose (6x300) (the connector except for connects 1 to 6 on the test fixture) using the Y-shape tube.



3. Push the pushrod of the syringe to make the pressure reading on the anaesthesia machine calibration apparatus rise to 70-90 cmH2O. Then, stop pushing. Remain the relative position between the pushrod and the syringe body unchanged. If the pressure reading of

the anaesthesia machine calibration apparatus decreases no more than 5 cmH2O within 15s, the test item is passed.

If test item I is not passed but test item II is passed, the pressure sampling line of the flow sensor in the breathing system is damaged. In this case, replace the breathing system. If both test item I and test item II are not passed, check the internal sampling line and connector of the system and the sealing part and solenoid valve of the circuit transit block assembly, until test item II is passed. Then, conduct test item I. If test item I is still not passed, the pressure sampling line of the flow sensor in the breathing system is damaged. In this case, replace the breathing circuit.

8.5.4.2 Leakage Test on the Low-pressure Airway System

After you confirm that the pressure sampling line of the flow sensor is not leaked, perform the leakage test on the low-pressure airway system, as shown in Figure Ato Figure D.

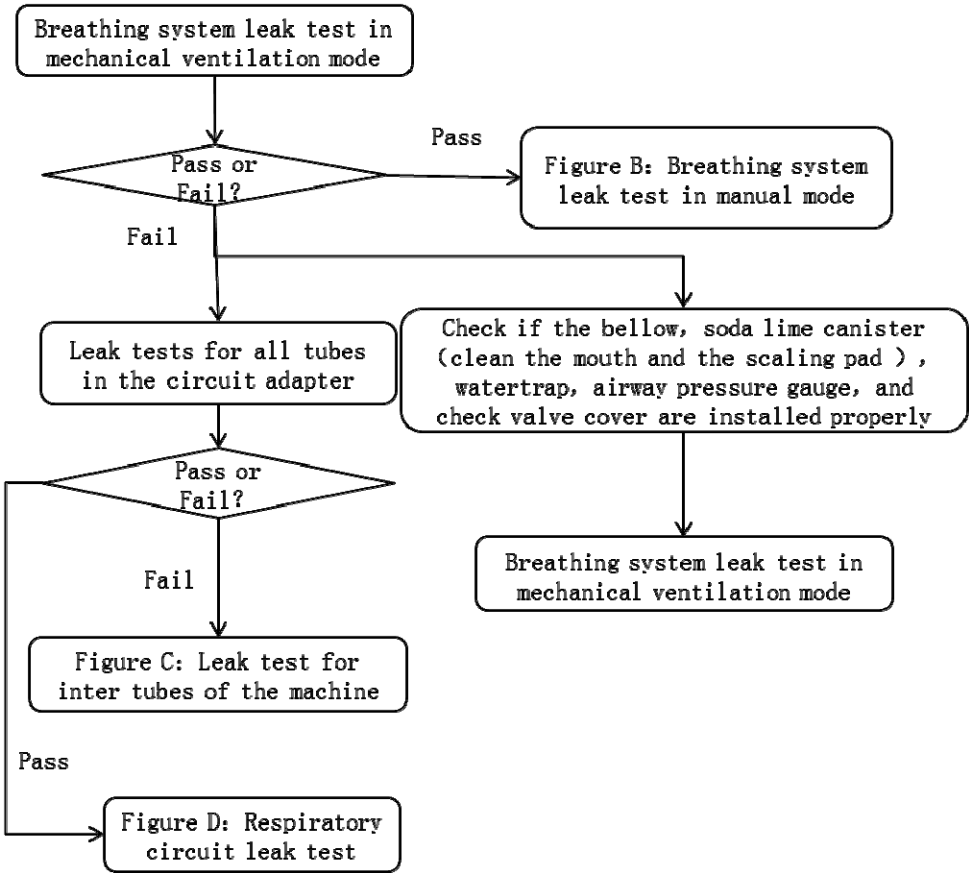


Figure A System leakage test

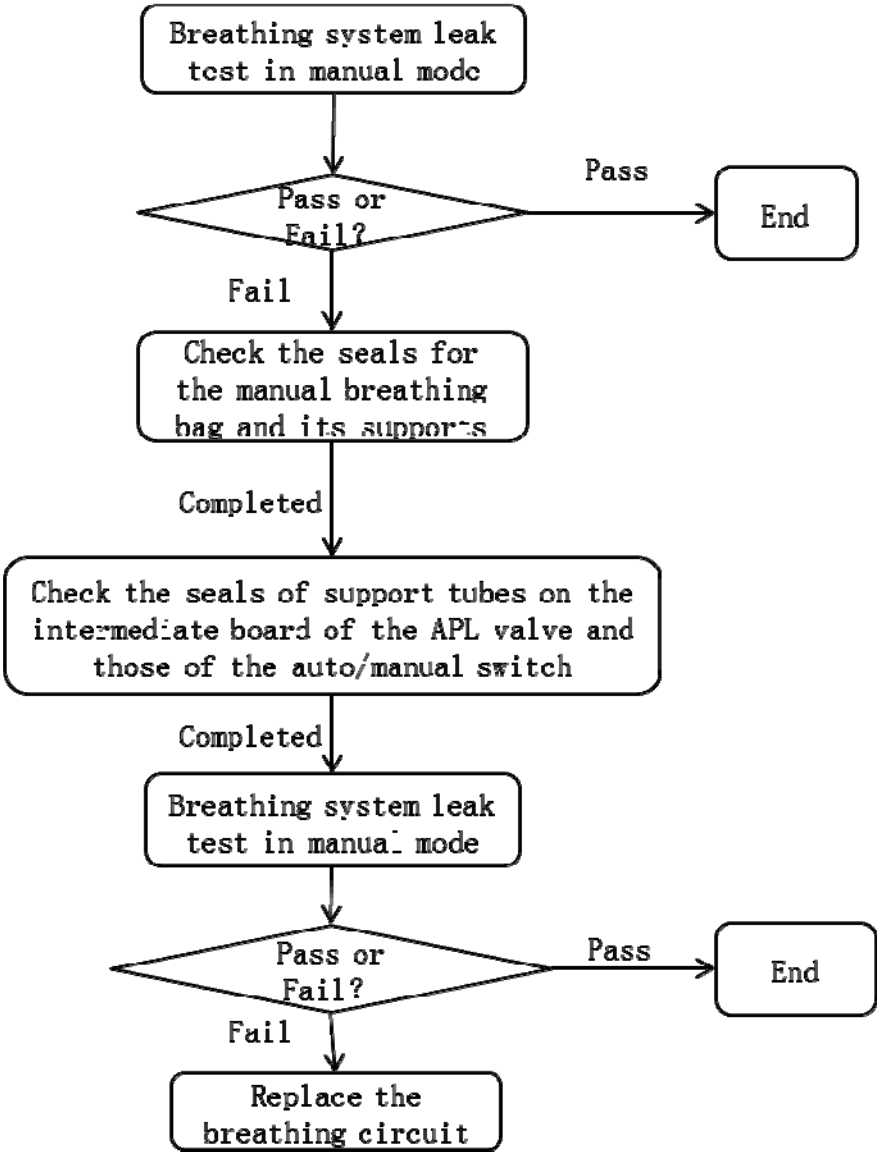


Figure B Leakage test on manual ventilation

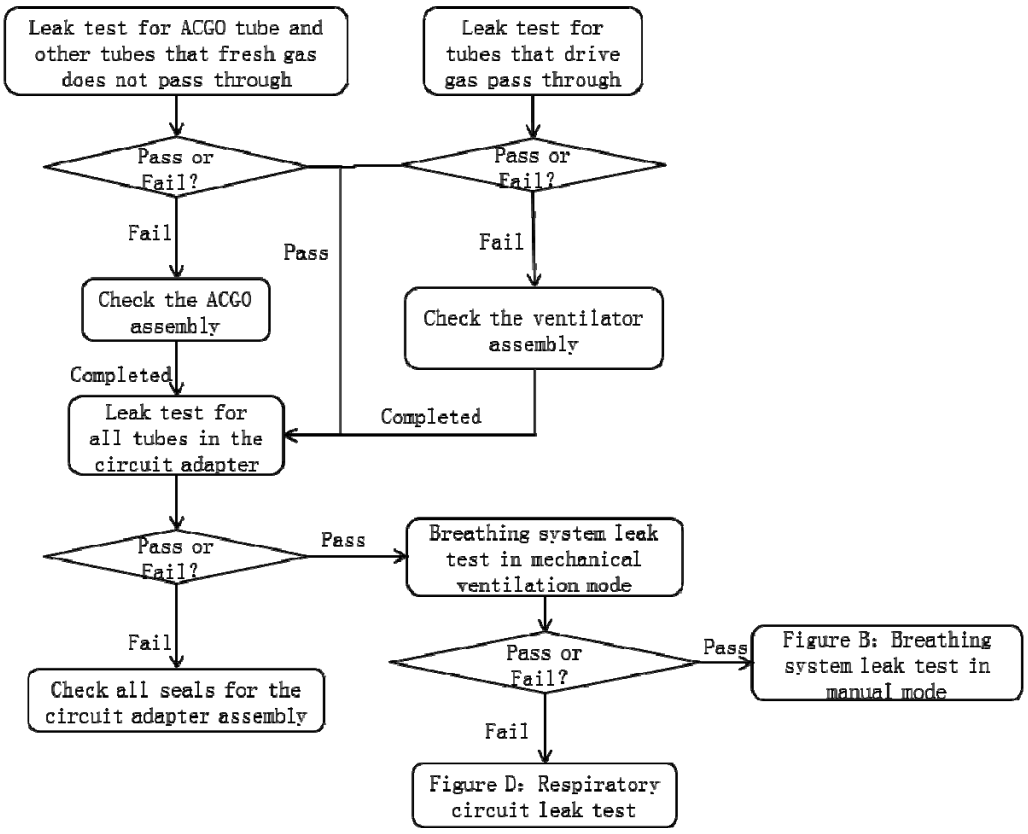


Figure C Leakage test on internal pipelines

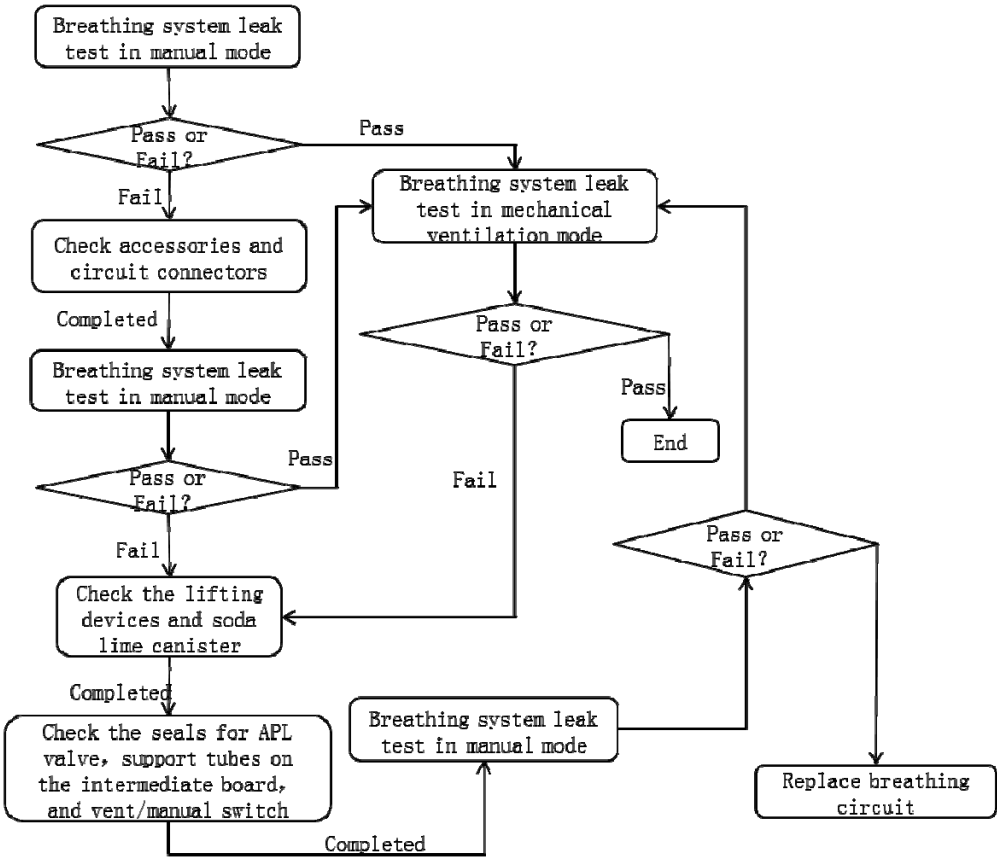


Figure D Leakage test on breathing circuit

1. Leakage test on mechanical ventilation

   Perform the leakage test in mechanical ventilation mode according to section ***4.3 Leak and Compliance Tests***.

2. Leakage test on the breathing system in manual ventilation mode

Required tools:

- Three breathing tubes
- One Y-shape breathing tube

Test procedures:

(1) Enter the standby mode.

(2) Install the breathing circuit properly.

(3) Set Automatic/Manual switch to Manual.

(4) Set the pressure of the APL valve to the maximum.

(5) Block the interfaces on the patient end and the manual airbag arm using three corrugated pipes and one corrugated pipe T-junction connector, as shown in the following figure.



(6) Enable the O2 flow regulator and set the O2 flow to 0.2 L/min.

(7) Enable the O2 flush and make the reading of the Paw pressure gauge rise to 30 cmH2O.

(8) Stop O2 inflation. If the reading of the Paw pressure gauge decreases below 30 cmH2O, this test fails.

(9) If the reading of the Paw pressure gauge rapidly increases, disable the O2 flow regulator in a timely manner to prevent the pressure from exceeding the measurement range of the Paw pressure gauge. Otherwise, the damaged APL valve may damage the Paw pressure gauge (in this test, if the O2 flow regulator is disabled due to this reason, the test is considered as passed).

3. Check the bellow housing and the ensure the Automatic/Manual switch is set to Manual.

Required tools:

- One anesthesia machine calibration device
- One test fixture of the circuit transit adapter
- One syringe
- Two Φ6 silicon tubes
- One PU tube (6X300)
- One Y-shape tube

Test procedures:

(1) Remove the bellow.

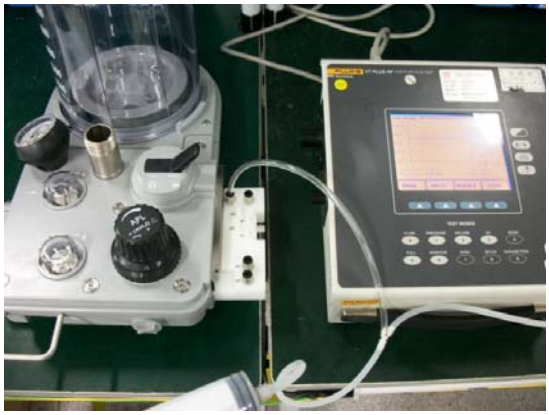
(2) Properly install the bellow housing.

(3) Set Automatic/Manual switch to Manual.

(4) Remove the breathing circuit.

(5) Install the test fixture of the circuit transit adapter on the breathing circuit.

(6) Connect the syringe connector and the pressure sensor interface (positive pressure end) of the anesthesia machine calibration device to interface 2 corresponding to the drive gas of the test fixture of the circuit transit adapter through a Y-shape T junction connector using the Silicon hose (6x300).



(7) Push the pushrod of the syringe to make the pressure reading on the anaesthesia machine calibration apparatus rise to 30-35 cmH2O. Then, stop pushing. Remain the relative position between the pushrod and the syringe body unchanged. If the pressure reading of the anaesthesia machine calibration apparatus decreases more than 10 cmH2O within 30s, the test fails. The bellow housing or the manual position of the Automatic/Manual switch is leaked. (The test is not affected if you remove the breathing bag arm because the drive gas cannot pass through the breathing bag arm.)

4. Leakage test on each tributary of the circuit transit adapter

Required tools:

- One negative pressure ball
- One test fixture of the circuit transit adapter
- One PU tube (6X100)

Test procedures:

(1) Disable the system switch.

(2) Disable the flow regulator.

(3) Remove the breathing system.

(4) Fix the test fixture of the circuit transit adapter to the circuit adapter.

(5) Squeeze the negative pressure ball to exhaust the gas inside. Seal the outlet end of the negative pressure ball and connect another end to interface 7 (the number is marked on the test fixture of the circuit transit adapter) corresponding to the fresh air tributary of the test fixture of the circuit transit adapter.



(6) Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the fresh air pipeline test is not passed. Locate the leakage point inside the system according to section ***8.5.3 AG Transmission System***.

(7) Start the system and enter the standby mode.

(8) Choose > **Service** > **DiagnosticTests** > **Valves**. Set the AD value of the PEEP valve to be larger than 50 cmH2O. Set the A/D value of the inspiration valve to 0 to generate the flow at 0 L/min. Set the PEEP safety valve to ON, as shown in the following figure.



(9) Then, squeeze the negative pressure ball to exhaust all gas inside. Re-install the plug and seal the negative pressure ball. Connect another end of the negative pressure ball to connector 1 of the drive gas pipeline of the test fixture of the corresponding circuit transit adapter, as shown in the following figure.



(10) Release the negative pressure ball. If the negative pressure ball is completed expanded within 30s, the drive gas pipeline test is not passed. Check the exhalation valve assembly and the drive gas pipeline inside the system.

5. Check the canister assembly.

Required tools:

- One VT PLUS
- One Lucer adapter connector
- One syringe
- Two Φ6 silicon tubes
- One PU tube (6X300)
- Three breathing tubes
- One Y-shape tube
- One Y-shape breathing tube
- One breathing tube adapter connector
- One T-shape hexagon screw wrench

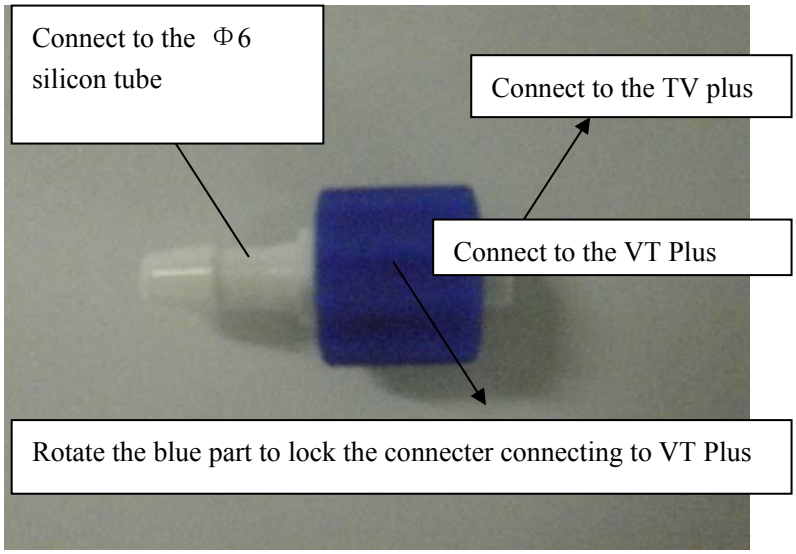
Test procedures:

(1) Disable the system switch.

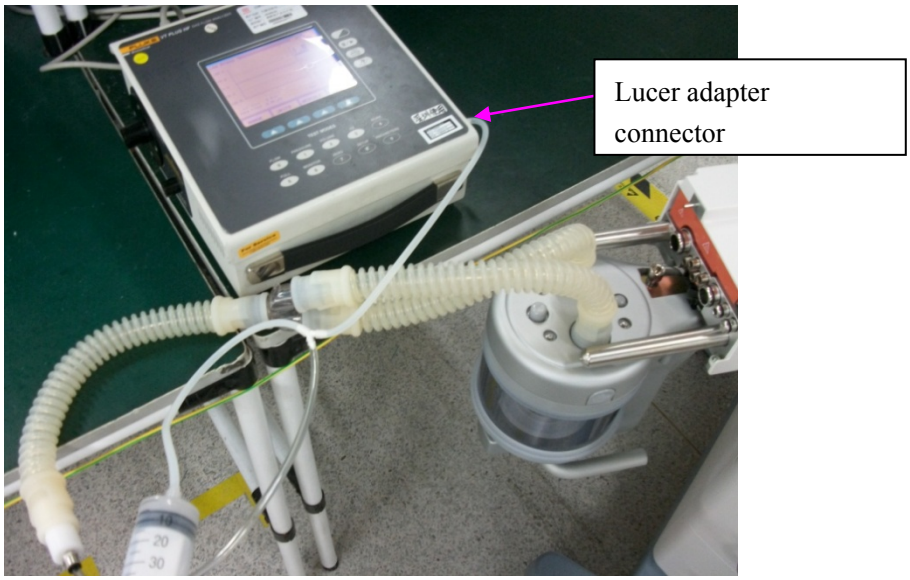
(2) Remove the the breathing circuit.

(3) Remove the sealing parts on two connectors of the canister assembly. Connect two corrugated pipes and one Y-shape connector to two connectors of the lifting device. Connect the other end of the Y-shape connector to the breathing tube adapter connector using another corrugated pipe. Connect the syringe connector, pressure sensor connector (positive pressure end) of the anaesthesia machine calibration device, and the breathing tube adapter connector to the Y-shape tube, as shown in the following figure.

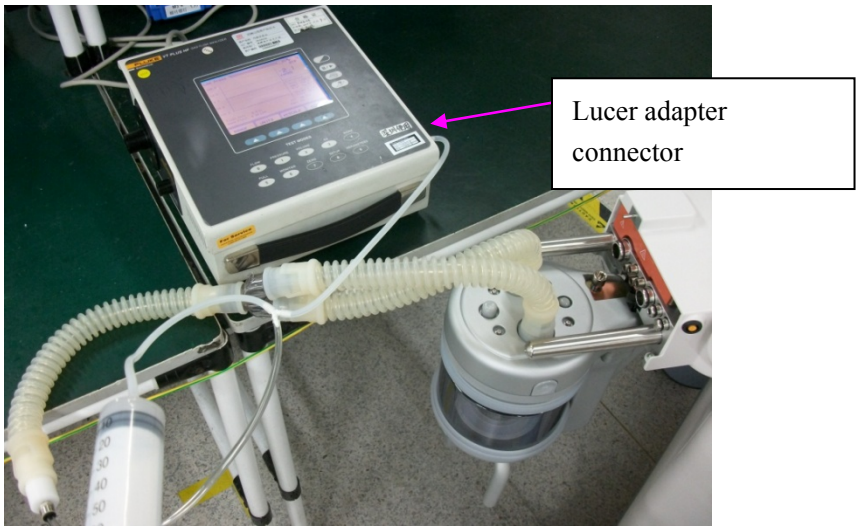
(4) Push the pushrod of the syringe to make the pressure reading on the anaesthesia machine calibration apparatus rise to 30-35 cmH2O. Then, stop pushing. Remain the relative position between the pushrod and the syringe body unchanged. If the pressure reading of the anaesthesia machine calibration apparatus decreases more than 10 cmH2O within 30s, the canister assembly encounters a leakage issue. The test is not passed. This step is required when the bypass of the canister assembly is enabled or disabled.



Lucer adapter connector



Bypass disabled



Bypass enabled

(5) Check the sealing parts on two connectors of the lifting device. If damaged, replace the sealing parts. Then, re-install the lifting device on the breathing system.

6. Check the circuit inspiration and expiration parts.

Test procedures:

(1) Disable the system switch.

(2) Check the manual breathing bag. If damaged, replace it.

(3) Check the breathing tube. If damaged, replace it.

(4) Remove the Paw pressure gauge. Check the sealing part. If damaged, replace it.

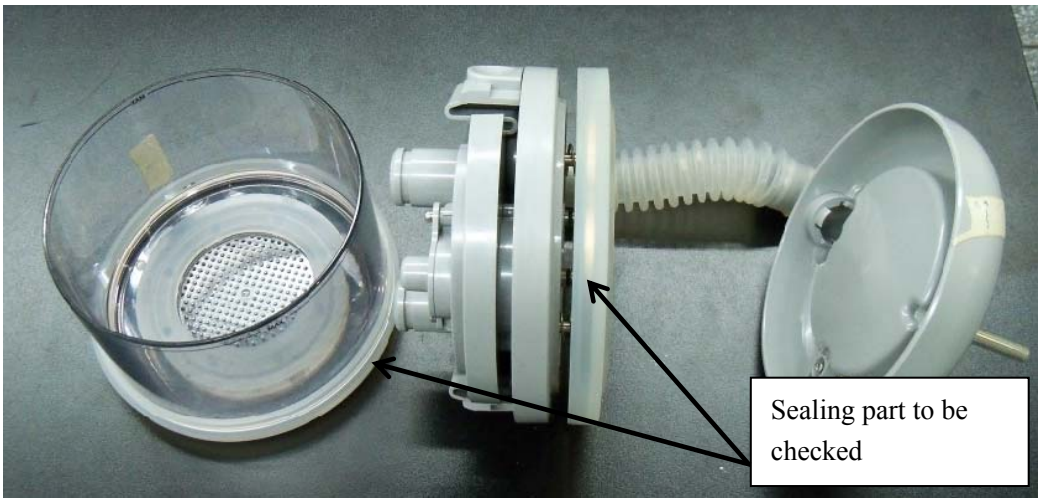
(5) Remove the water collection cup. Check the sealing part. If damaged, replace it.

(6) Remove the O2 sensor (if no O2 sensor is available, remove the plug where the O2 sensor needs to be installed). Check the sealing part. If damaged, replace it.

(7) Remove the dome cover of the check valve. Check the sealing part. If damaged, replace it.

(8) Remove the breathing bag support. Check the sealing part. If damaged, replace it.

(9) Remove the pre-pak assembly. Check the sealing part. If damaged, replace it.



7. Check the sealing parts of the APL valve, supporting tube of the intermediate plate, and the Automatic/Manual switch.

The T-shape hexagon screw wrench is required in this test.

Test procedures:

(1) Disable the system switch.

(2) Remove the APL valve. Check all the sealing parts. If any one is damaged, replace it.

(3) Remove the supporting tube from the intermediate plate. Check all the sealing parts. If any one is damaged, replace it.

(4) Remove the Automatic/Manual switch. Check all the sealing parts. If any one is damaged, replace it.

8. Check the ACGO assembly.

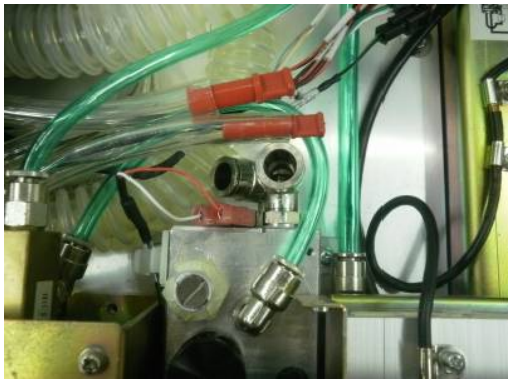
Required tools:

- One negative pressure ball
- One test fixture of the circuit transit adapter
- One PU tube (6X100)
- Two 3106-08-10 adapter connectors
- One 3126-06-00 tube plug
- One 3126-08-00 tube plug
- Two 3126-10-00 tube plugs

Test procedures:

(1) Disable the system switch.

(2) Remove PU tube 21 and PU tube 22 connecting to the ACGO assembly and circuit adapter. Remove only the end connecting to the ACGO assembly.

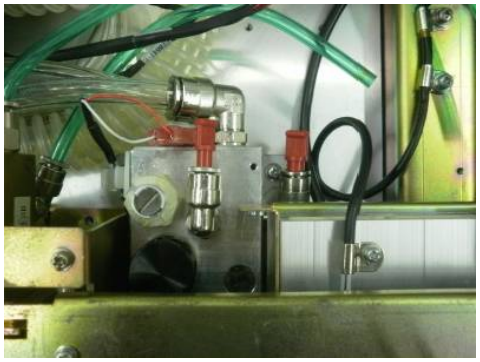


(3) Block the end with the pipeline removed using two 3126-10-00 tube plugs.

(4) Perform steps 3 to 7 in 4 Leakage Test on All Pipelines in the Circuit Adapter. If the test is not passed, the circuit adapter connector or sealing part is damaged. If leakage exists, insert the removed pipeline to the ACGO assembly. Note that the position of the black line on PU tubes 21 and 22 should be the same as that before the pipeline is removed.

(5) Remove the hose 52 and hose 53 used to connect the O2 flush assembly and the vaporizer support assembly to the ACGO assembly. Remove only the end of the hoses connecting to the ACGO assembly.

(6) Block the end of the ACGO assembly with the hoses removed using the 3126-06-00 tube plug and 3126-08-00 tube plug.



(7) Repeat step 3 to step 7 in 4 Leakage Test on Each Tributary of the Circuit Transit Adapter. If the test is not passed, the ACGO assembly is damaged, replace the seal ring of the ACGO assembly or replace the ACGO assembly.

8.5.5 Tidal Volume

The following table lists the faults that may cause inaccurate tidal volumes.

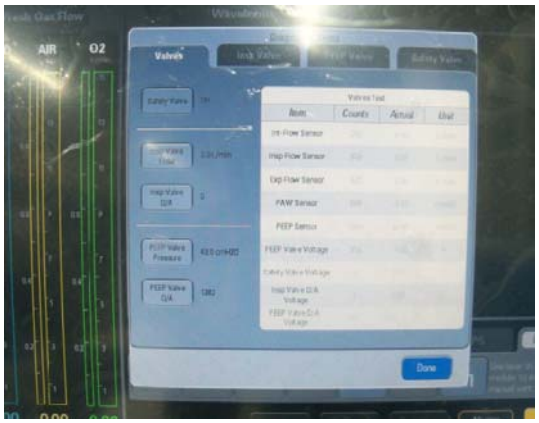
Failure Description	Possible Cause	Recommended Action
Inaccurate tidal volumes	The flow sensor is installed incorrectly.	Reinstall the flow sensor.
	The fresh gas flow is set incorrectly.	Reset the fresh gas flow.
	There is a leak in the breathing system and the fresh gas flow is too light.	Perform check according to the steps described in sections ***8.5.3 a***nd ***8.5.4*** and repair the leak points.
	*There is water build-up in the flow sensor.	Remove the flow sensor and eliminate the water build-up.
	*The film of the flow sensor is deformed or contaminated, or the internal resistance of the flow sensor is changed. Zero drift occurs on the pressure sensor on the control board of the ventilator.	Enter the service mode and calibrate the flow sensor according to section ***7.3.2 Flow calibration (Service)***.
	*There is a leak on the pressure sampling line of the flow sensor.	Perform check according to the steps described in the leak test for the pressure sampling line of the flow sensor and repair the leak points.
	*The flow sensor is damaged.	Replace the flow sensor.
	*The pressure sensor on the control board of the ventilator is damaged.	Replace the control board of the ventilator.
	The inlet flow sensor on the integrated airway of the expiratory valve is damaged.	Replace the expiratory valve or its integrated airway.
	Expiration begins in advance because the specified Plimit value is too small.	Set the Plimit to a larger value so that the Paw value does not exceed the limit.
	The displayed TVe and TVi values are different.	In the valve test tool, compare the measurement errors of the three sensors and determine whether to calibrate the sensors according to section ***7.3.2 Flow calibration (Service)***.

In the preceding table, the items marked with an asterisk (*) are possible causes of inaccurate measurement values of the flow sensor. Perform the following steps to check whether the fault of inaccurate breathing capacity is induced by the causes marked with an asterisk (*):

1. Turn off the flow regulator.
2. Ensure that the patient is disconnected from the system and the auto/manual ventilation switch is turned to the mechanical ventilation position.
3. Remove the bellows and then install the bellow housing correctly.
4. Remove the water collection cup.
5. Connect the inspiratory connector and the expiratory connector by using a corrugated tube. See the figure below.



6. Turn on the gas source and enter standby mode.
7. Choose > **Service** > **Diagnostic Tests** > **Valves** and set the A/D value of the PEEP valve properly so that the PEEP exceeds 40 cmH2O. Set the PEEP safety valve to the ON state. See the figure below.



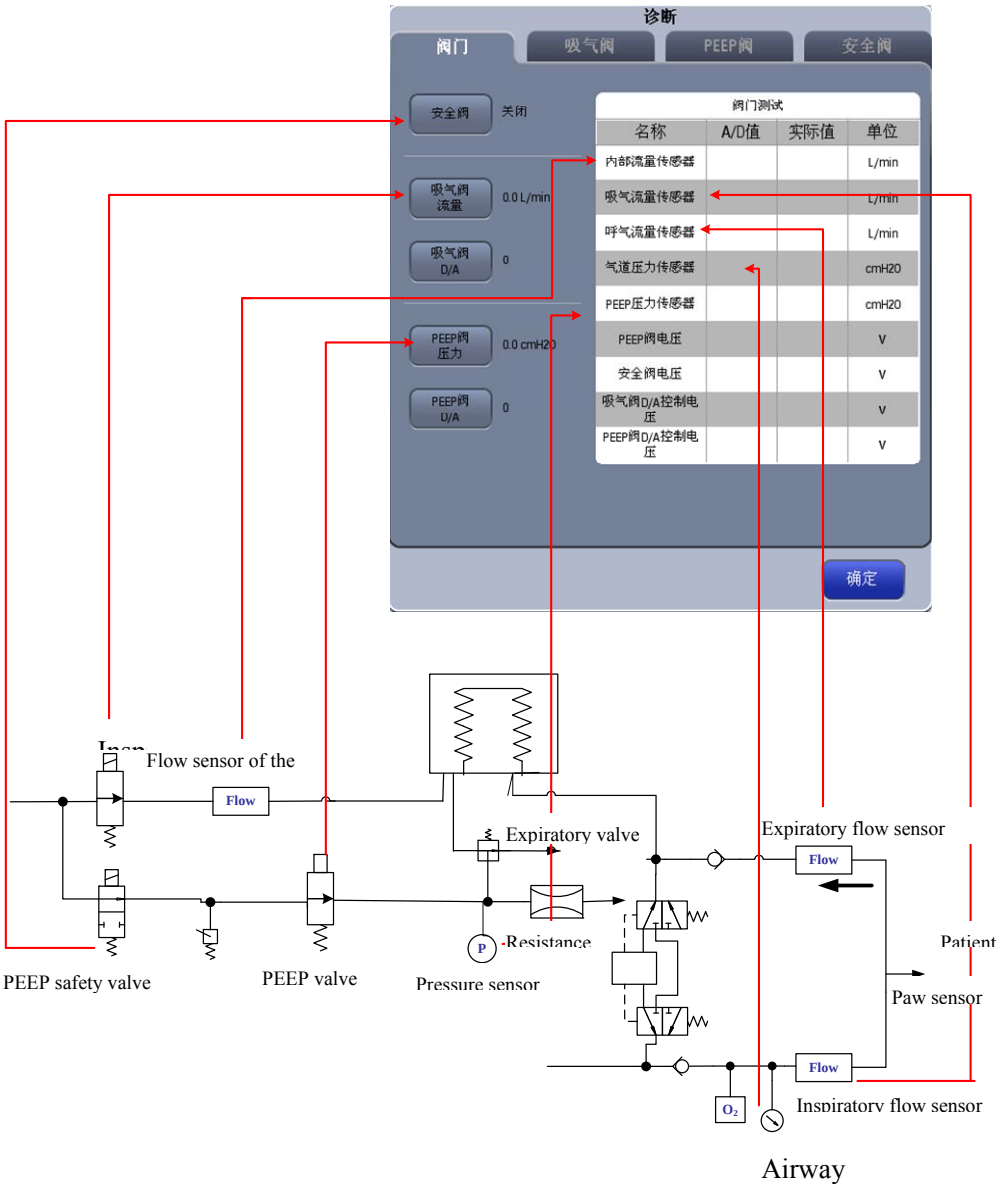
Set the A/D value of the inspiratory valve properly so that the flow at the inspiratory valve reaches a certain value. Under these circumstances, the flow volumes measured by the ventilator flow sensor, inspiratory flow sensor and expiratory flow sensor should be the same. Set the A/D value of the inspiratory valve to test multiple points. The flow volumes measured by the three sensors at each point should be the same. If the measured values are different, the measured values are inaccurate. Check the possible causes marked with an asterisk (*) in the table above.

8.6 Sensor and Valve Faults

To identify sensor or valve faults by using the valve diagnosis tool, you must be familiar with the mapping between the menu items on the tool interface and the actual airways and hardware parts.

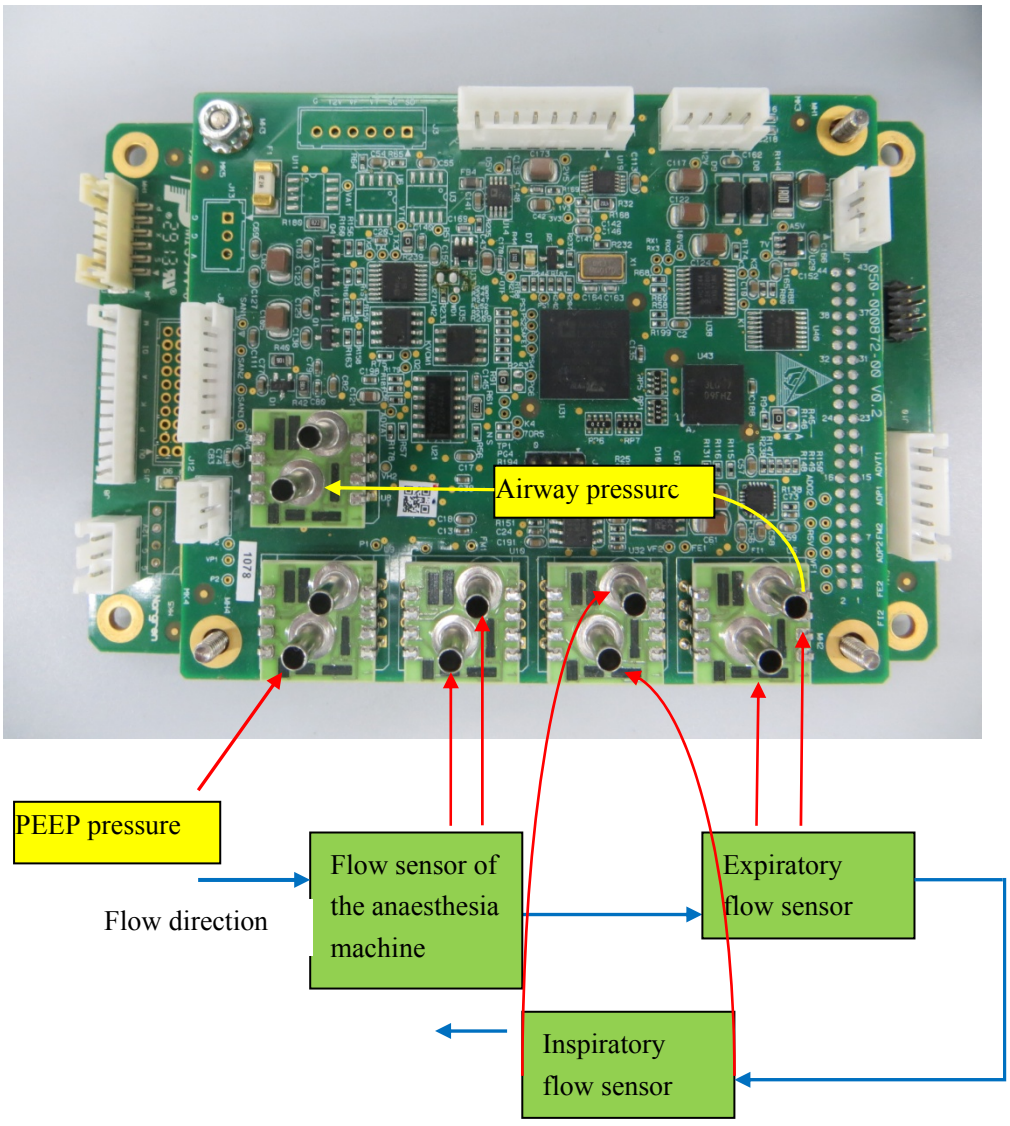
8.6.1 Mapping Between Menu Items on the Valve Diagnosis Tool Interface and Airways

The following figure shows the mapping between the sensors or valves on the tool interface and the components in the airway schematic diagram.


诊断
阀门
吸气阀
PEEP阀
安全阀
安全阀
关闭
吸气阀流量
0.0 L/min
吸气阀D/A
0
PEEP阀压力
0.0 cmH2O
PEEP阀D/A
0
阀门测试
名称
A/D值
实际值
单位
内部流量传感器
L/min
吸气流量传感器
L/min
呼气流量传感器
L/min
气道压力传感器
cmH2O
PEEP压力传感器
cmH2O
PEEP阀电压
V
安全阀电压
V
吸气阀D/A控制电压
V
PEEP阀D/A控制电压
V
确定
Flow sensor of the
Flow
Expiratory valve
Expiratory flow sensor
Flow
P
-Resistance
Patient
Paw sensor
PEEP safety valve
PEEP valve
Pressure sensor
Flow
O2
Inspiratory flow sensor
Airway

8.6.2 Mapping Between Menu Items on the Valve Diagnosis Tool Interface and Hardware Components

The following figure shows the actual connection of the sensor sampling lines on the VCM.



8.6.3 Preparations Before Using the Valve Diagnosis Tool

Before identifying valve or sensor faults by using the valve diagnosis tool, make preparations as follows:

1 Connect the airway according to the type sensor or valve to be checked.

Before using the diagnosis test menu, connect the tubes of the anaesthesia machine with constant flow to check the flow sensor and inspiratory valve. For details, see section ***7.3.2 Flow calibration (Service)***.

2. Ensure that the gas supply pressure complies with the regulations.

3. When the system is in standby mode, choose  > **Service** > **Diagnostic Tests** to access the diagnostic test menu.

8.6.4 Diagnosing Zero Point Exceptions of Sensors

You can easily determine whether the zero points of all pressure sensors and flow sensors comply with the regulations.

To diagnose the zero points of the sensors, perform the following operations:

1. Disconnect all gas sources and ensure that the actual values of the sensors are 0.
2. Query the A/D sampling value of each sensor in the menu of the valve diagnosis tool. This value is the zero point of the sensor.
3. If the zero point of any sensor exceeds the specified range, the VCM is faulty. You need to replace the VCM.

You can also check the zero points of sensors according to section ***4.12.1 Checking the Sensor Zero Point***.

Note

- **For details about the normal range of zero points of sensors, see section 3.7.3.**

8.6.5 Diagnosing Flow Data Exceptions of Sensors

The flow sensor has two sampling tubes. Connection exceptions include:

- The two sampling lines are connected reversely.
- One sampling line is not connected.
- Neither sampling line is connected.

You can check whether the sampling lines are connected correctly by using the valve diagnosis tool.

- Perform the following operations to check the connection of the sampling lines of the flow sensor:

1. Connect the tubes of the anaesthesia machine with constant flow. For details, see section ***8.6.3 Preparations Before Using the Valve Diagnosis Tool***.
2. Ensure that the gas source supplies gas normally.On the **Diagnostic Tests** interface, set the PEEP safety valve to the ON state and the D/A value of the PEEP valve to be larger than 1500 so that the pressure of the PEEP valve is higher than 30 cmH2O.
3. Increase the D/A value of the inspiratory valve gradually. The sampling A/D value measured by the flow sensor increases accordingly. As the gas supply pressure increases gradually:
   - ◆ If the sampling A/D value measured by a flow sensor decreases gradually, the two sampling lines of the flow sensor may be connected reversely.
   - ◆ If the sampling A/D value measured by a flow sensor remains unchanged, the two sampling lines of the flow sensor may be fractured or not connected.
   - ◆ If the sampling A/D value measured by a flow sensor reaches the saturation value (over 6000) quickly, the sampling line of the low pressure end (exhaust end) may not be connected.
4. For any sampling line connection errors, reconnect all sampling lines and ensure that they are connected correctly.

- Perform the following operations to diagnose the measurement error of the flow sensor:

  After confirming that the zero point of the sensor is correct and that the sampling lines are connected correctly, check the accuracy of the flow sensor:

  - ◆ As the actual flow volume increases, the measurement value of the flow sensor increases accordingly.Otherwise, the calibration data is incorrect. In this case, you need to recalibrate the flow sensor.

- The measurement value of the flow sensor is accurate compared with that of standard flow measurement equipment (calibration equipment of the anaesthesia machine). Otherwise, the calibration data is incorrect. In this case, you need to recalibrate the flow sensor.

For details about how to check the accuracy of the flow sensor, see section ***4.12.2 Constant Flow Test (Checking the Flow Sensor Accuracy)***.

8.6.6 Diagnosing Pressure Data Exceptions of Sensors

- The pressure sensor has one sampling line. Connection exceptions include:
- The sampling line is not connected.
- The sampling line is connected incorrectly.

You can check whether the sampling lines are connected correctly by using the valve diagnosis tool.

- Perform the following operations to check the connection of the sampling line of the pressure sensor:
  - During normal ventilation, sampling line connection errors will be easily noticed through the Paw waveform and technical alarms. If the waveform value decreases as the actual pressure increases and the alarm Paw Too Low or Patient Circuit Leak is generated, the sampling line of the airway pressure sensor may be connected incorrectly.
  - Access the **Diagnostic Tests** menu and set the PEEP safety valve to the ON state. Increase the D/A value of the PEEP valve gradually and observe whether the sampling A/D value measured by the PEEP pressure sensor increases accordingly. If no, it further proves that the PEEP pressure sensor may be connected incorrectly.
- To diagnose whether the sampling line of the pressure sensor is connected normally in case of pressure calibration failure, perform the following steps:

1. Connect the tubes of the anaesthesia machine according to section ***8.6.3 Preparations Before Using the Valve Diagnosis Tool.***
2. Ensure that the water collection cup is reinstalled.
3. Ensure that the gas source complies with the regulations. Access the **Diagnostic Tests** menu and set the PEEP safety valve to the ON state. Set the flow volume of the inspiratory valve to 5 L/min.

4. Increase the D/A value of the PEEP valve gradually. The sampling A/D value measured by the pressure sensor increases accordingly.
   - ◆ If the sampling A/D value measured by a pressure sensor decreases gradually, the sampling line of the pressure sensor may be connected incorrectly.
   - ◆ If the sampling A/D value measured by a pressure sensor remains unchanged, the sampling line of the pressure sensor may not be connected.
   - ◆ The pressure value on the airway pressure gauge increases. Otherwise, the airway pressure gauge is damaged.
5. For any sampling line connection errors, reconnect the sampling line and ensure that it is connected correctly.

■ Perform the following operations to diagnose the measurement error of the pressure sensor:

- ◆ As the actual pressure increases, the measurement value of the pressure sensor increases accordingly. Otherwise, the calibration data is incorrect. In this case, you need to recalibrate the pressure sensor.
- ◆ The measurement value of the pressure sensor is accurate compared with that of standard pressure measurement equipment (calibration equipment of the anaesthesia machine). Otherwise, the calibration data is incorrect. In this case, you need to recalibrate the pressure sensor.

For details, see section ***4.12.3 Constant Pressure Test (Checking the Pressure Sensor Accuracy)***.

8.6.7 Diagnosing Inspiratory valve Exceptions

You can check whether the status of the inspiratory valve is correct by using the valve diagnosis tool.

1. The tubes of the anaesthesia machine are connected according to the settings for checking whether the sampling line of the pressure sensor is connected normally. For details, see section ***8.6.3 Preparations Before Using the Valve Diagnosis Tool***.
2. In the **Diagnostic Tests** menu, increase the D/A value of the inspiratory valve gradually. If the measurement values of the embedded flow sensor, inspiratory flow sensor and expiratory flow sensor change slightly and the air flow at the interface of the water collection cup in the breathing system is light, the inspiratory valve or VCM has D/A problems.
3. In normal cases, if the D/A value is set to 2500 for the inspiratory valve, the flow volume measured by the standard flow measurement equipment can reach 90 L/min.

4. If the D/A value is set to be over 4000 for the inspiratory valve, the flow volume measured by the standard flow measurement equipment cannot reach 90 L/min and the flow calibration fails. In this case, you need to replace the expiratory valve or VCM.
5. To check whether the VCM has DA output problems, measure the DA output corresponding to the inspiratory valve on the VCM by using a multimeter. If the voltage increases as the DA increases and approaches 6 V when the DA is over 4000, the DA corresponding to the inspiratory valve of the VCM may be normal.
6. After replacing the expiratory valve or VCM, check whether the problem is solved by using similar methods.

8.6.8 Diagnosing PEEP Safety Valve Exceptions

If the PEEP safety valve is in the normally closed state and the gas source complies with the regulations, the alarm Drive Gas Pressure Low will be triggered.

You can check whether the status of the PEEP safety valve and PEEP valve is correct in the **Diagnostic Tests** menu.

- Perform the following operations to diagnose the status of the PEEP safety valve:

1. Ensure that the gas source complies with the regulations.
2. In the **Diagnostic Tests** menu, if the PEEP safety valve is in the ON state, a gentle buckling sound will be heard.
3. Change the D/A value of the PEEP valve so that the pressure measured by the PEEP pressure sensor is larger than 0 cmH2O.
4. Turn off the PEEP safety valve. The pressure measured by the PEEP pressure sensor should decrease to 0 cmH2O immediately. Turn on the PEEP safety valve. The measurement value of the PEEP pressure sensor quickly resumes to a value close to that before the PEEP safety valve is turned off.

During this process, there is flow at the exhaust port at the PEEP end when the PEEP safety valve is turned on or off, and the flow changes. This can help determine whether the PEEP safety valve is turned on or off correctly.

5. For any errors, the drive voltage on the PEEP safety valve or VCM is faulty. You can measure the drive signal (at the corresponding socket) corresponding to the PEEP safety valve on the VCM by using a multimeter. If the PEEP safety valve is in the ON state, the drive voltage should be close to 6 V.

   If the PEEP safety valve is in the OFF state, the drive voltage should be close to 0 V.

   If the preceding conditions are met, the VCM operates properly.
6. If the PEEP safety valve is faulty, replace the inspiratory valve. After replacement, you can check whether the problem is solved by using similar methods.

8.6.9 Diagnosing PEEP Proportional Valve Exceptions

If the PEEP valve is faulty, a pressure related alarm will be generated in mechanical ventilation mode.

You can check whether the status of the PEEP valve is correct in the **Diagnostic Tests** menu.

■ Perform the following operations to diagnose the status of the PEEP valve:

1. Ensure that the gas source complies with the regulations. Access the **Diagnostic Tests** menu and set the PEEP safety valve to the ON state.
2. As the D/A value of the PEEP valve increases, the value measured by the PEEP pressure sensor (or calibration equipment of the anaesthesia machine) should also increase. Note that when the D/A value is small, the PEEP valve has a non-responsive area. If the D/A value is smaller than the range, the PEEP valve cannot be turned on and the output volume is always 0. If the D/A value is larger than the range, the output pressure increases as the D/A value increases. The inspiratory valve has the same situation.
3. For details about subsequent diagnosis rules, see section ***8.6.7 Diagnosing Inspiratory valve Exceptions***.

8.7 Hardware and Electrical Faults

Failure Description	Possible Cause	Judgment Method	Recommended Action
The anaesthesia machine cannot be powered on.	The system switch is in poor condition.	According to the startup signal flow, remove the interconnection connector between the system switch cable and the airway cable, and short-circuit the pins of the airway cable. If the anaesthesia machine can be started, the system switch is in poor condition. If the anaesthesia machine cannot be started, proceed with the analysis.	Replace the system switch.
	The cable is in poor condition.	Short-circuit the J12 pins of the mother board by using a metal tool. If the anaesthesia machine can be started, the airway cable or system switch cable is in poor condition.	Replace the cable.
	The power board is faulty.	If the anaesthesia machine still cannot be started after the preceding two tests are finished, the power board is faulty.	Replace the power board.
The alarm Heating Module Failure is generated at startup and the circuit does not heat.	The heater is in poor condition.	Measure the resistances of pins 1 and 2 and pins 3 and 4 of the connector that connects to the thermistor under the workbench by using a multimeter. If the difference between the measured resistances exceeds 300 ohms, the heater is faulty.	Replace the heater.
	The power board is in poor condition.	If the difference between the measured resistances is small, the power board is faulty.	Replace the power board.

Failure Description	Possible Cause	Judgment Method	Recommended Action
During the switching of the bag/mechanical ventilation switch, the ventilation mode displayed in the upper left of the screen does not change.	The material of the bag/mechanical ventilation switch is in poor condition.	Power off the anaesthesia machine, open the cover plate of the workbench, test pins 1 and 2 of the interconnection terminal of the bag/mechanical ventilation switch by using the conduction position of the multimeter, and turn the bag/mechanical ventilation switch. If the conduction of pins 1 and 2 does not change, the material of the bag/mechanical ventilation switch is in poor condition. If the conduction changes, proceed with the analysis.	Replace the bag/mechanical ventilation switch.
	The cable is not connected properly.	Power on the anaesthesia machine, test the voltage of pins J8-12 of the VCM by using the multimeter. The voltage should be 0-0.4 V in bag ventilation mode and be 3.0-3.6 V in mechanical ventilation mode. If the measurement value is beyond the normal range, the cable is not connected properly. If the measurement value is within the normal range, proceed with the analysis.	Replace the cable of the VCM.
	The VCM is in poor condition.	If the fault cannot be identified by using the preceding two methods, the VCM is abnormal.	Replace the VCM.
The anaesthesia machine displays a black screen and the alarm indicator is off.	The cable is not connected properly.	Check whether the two connectors of the display data cable are connected properly. If so, proceed with the analysis.	Connect the cable properly.
	The CPU board is abnormal.	Power on the anaesthesia machine. If the sound of the valves can be heard and the top lamp works properly, the CPU board is abnormal. Otherwise, proceed with the analysis.	Replace the CPU board.
	The power board is abnormal.	If there is no response when you try to power on the anaesthesia machine, see the fault analysis at the beginning of this table.	Replace the cable or power board.

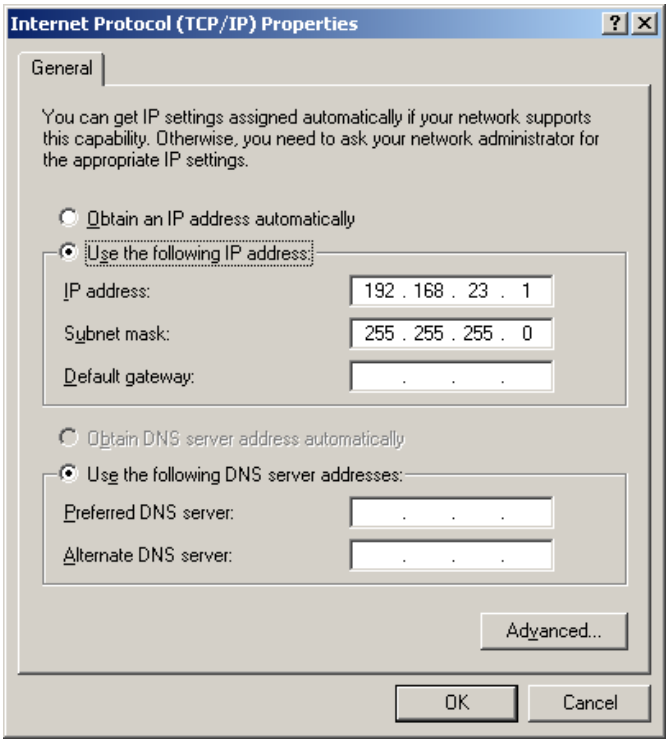
Failure Description	Possible Cause	Judgment Method	Recommended Action
The anaesthesia machine displays a blank screen or black screen.	The cable is not connected properly.	Check whether the LVDS and backlight interface are normal. If so, proceed with the analysis.	Connect the cable properly.
	The mother board is in poor condition.	Open the cover plate, power on the anaesthesia machine, and test pin 19 of mother board J3. If the voltage of this pin is beyond the range 3.0-3.6 V, the mother board is poor condition. Otherwise, proceed with the analysis.	Replace the mother board.
	The CPU board is in poor condition.	If the fault cannot be identified by using the preceding two methods, the CPU board is faulty.	Replace the CPU board.

8.8 Software Upgrade and Software Configuration Activation

Note

- **After replacing the CPU board, ventilation protection board, ventilation control board, power board, expiratory valve assembly, upgrade the software.**
- **Before upgrading WATO EX-35(0619), read the documents attached with the upgrade package and perform the upgrade according to the documents.**

1. Connect the network ports of the PC and anaesthesia machine by using a crossover network cable.
2. Before running the Mindray anaesthesia machine software upgrade tool, check that the IP address is set to 192.168.23.1 and the subnet mask is set to 255.255.255.0 for the PC. Check and set the IP address of the PC. See the figure below.



3. Ensure that the Mindray anaesthesia machine software upgrade tool is installed on the PC. If the upgrade tool is not installed, perform the following steps:

   (1) Run SystemUpdateTool.exe.

   (2) If a dialog box is displayed prompting you to set the language, select English and click **OK**.

   (3) In the welcome dialog box that is displayed, click **Next**.

   (4) If the customer information dialog box is displayed, enter the following information:

   (5) User name: Mindray

   (6) Company name: Mindray

   (7) Serial number: 26582640

   (8) Select **Next**.

   (9) If the dialog box for selecting a destination location is displayed, retain the default destination folder and select **Next**.

   (10) If the dialog box for selecting a program folder is displayed, retain the default program folder and select **Next**.

   (11) If the **Install Shield Wizard** dialog box is displayed, select **Finish**.

4. Software upgrade:

   (1) On the desktop, run the Mindray anaesthesia machine software upgrade tool. If the dialog box for selecting a product series is displayed, select **Wato Pro** and click **OK**. After the system update tool is started, perform the following operations to upgrade the software:

   (2) Click **Select Upgrade Package** on the toolbar.

(3) In the **Select Upgrade Package (non-FDA)** dialog box that is displayed, select **>>>.**

(4) In the Open dialog box that is displayed, click ▼. To view details, select **Bundle V04.00.00.mpkg**.

Document Name	Creation Time	Module	Checksum	Version	Remarks
01_Bundle V04.00.00.mpkg		BIOS		1.13.0.0	\
		System program		03.07.01	EX 35(0619)
		Language file	\	3.8	\
		Startup screen file	\	\	\
		Icon file	\	\	\
		FPGA display drive		\	\
		FPGA sound drive		\	\
		Module software		\	Flow
		Module software		\	VCM_DSP
		Module software		\	VPM_DSP
02_Power V1.7.pkg	2011-01-20 22:04:00	Module software		\	Power

Note

- **This is an example of the software version/checksum table. View the technical bulletin to obtain the table that maps the software version being installed.**

(5) Select **Open**.

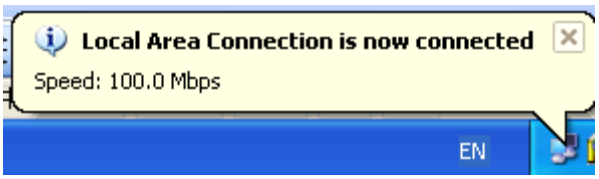
(6) In the displayed dialog box, check that the creation time, upgrade items, checksum, version and remarks of each file are correct. Then click **OK**.

(7) Start the anaesthesia machine and wait for 10 seconds before proceeding with the next step.

(8) Click **Start (standalone)** on the Mindray anaesthesia machine software upgrade tool.

(9) Shut down the anaesthesia machine and then start it again within less than 1 second.

(10) The Windows XP network icon shows a connection success.



Note

- **If this prompt is not displayed on the PC after the anaesthesia machine is started normally and performs self-test, check the IP address settings and network cable.**

(11) The software update progress is displayed on the screen of the anaesthesia machine.

(12) After the upgrade is completed, **Succeed** is displayed on the Mindray anaesthesia machine. A message indicating system update success is displayed on the Mindray anaesthesia machine software upgrade tool.

(13). Repeat steps 3-12 to upgrade the 02_Powre V1.7.pkg software.

Note

- **The software upgrade of the power board will usually fail at the first time and will succeed at the second time.**

(14) After the 02_Power V1.7.pkg software is upgraded, shut down the anaesthesia machine and then start it again.

Note

- **If the anaesthesia machine cannot be started normally after the upgrade, find the guide document attached with the upgrade package and take measures according to the document.**

(15) Choose  > **Service** to view the software version of the anaesthesia machine.

Input the service password **789789** and press **Enter** to access system information and view the software version. Check that the software version of the anaesthesia machine complies with the table below.

Module	Software Version	Date*
Host software	03.07.01	
BIOS	01.13.00.00	
FPGA display drive	1.4	\
FPGA sound drive	1.4	\
Auxiliary VCM	V01.01.00	
VCM	V01.01.00	
Power supply system	V1.7	

* The date format may vary according to the equipment settings.

Note

- **This is an example of the software version table. View the technical bulletin to obtain the table that maps the software version being installed.**

8.8.1 Common Software Upgrade Problems and Solutions

Common Problem	Cause	Solution
During the upgrade, the buzzer on the CPU board beeps and the upgrade cannot be finished.	A power failure or upgrade exception occurs, which damages the BIOS program of the CPU board.	Send the CPU board back to the factory for repair.
The upgrade screen is displayed but the upgrade cannot be finished successfully.	The BIOS version and system software version are incompatible, or the network connection is unstable.	1. Check the software version compatibility and choose a proper version for upgrade. Refer to the table listing the compatibility information between the system software,

Common Problem	Cause	Solution
		BIOS and upgrade tool. 2. Check the network connection between the PC and the hub and between the PC and the anaesthesia machine. Ensure that the network cables do not loosen.
The system cannot switch to the upgrade boot screen.	The network connection is not normal.	1. Check the network connection between the laptop, hub and anaesthesia machine. Ensure that the network cables are connected reliably. 2. Ensure that power is turned on for the hub.
After the system software or XX module software is upgraded, the system reports the XX Comm Stop alarm.	The system software version and XX module software version are incompatible, or the module is damaged.	Check the XX module software version and module code. If the information is correct, send the module back to the factory for repair.

8.8.2 Software Function Activation

The manufacturer provides activation codes for activating the functions listed in the table below. If the customer needs to add any of the following functions, the after-sales service engineer can apply to the manufacturer for the activation code.

Configuration Item	Function Description
SIMV-VC	Synchronized intermittent mandatory ventilation-volume control
SIMV-PC	Synchronized intermittent mandatory ventilation-pressure control
PS	Pressure support ventilation mode
Spirometry	Loop

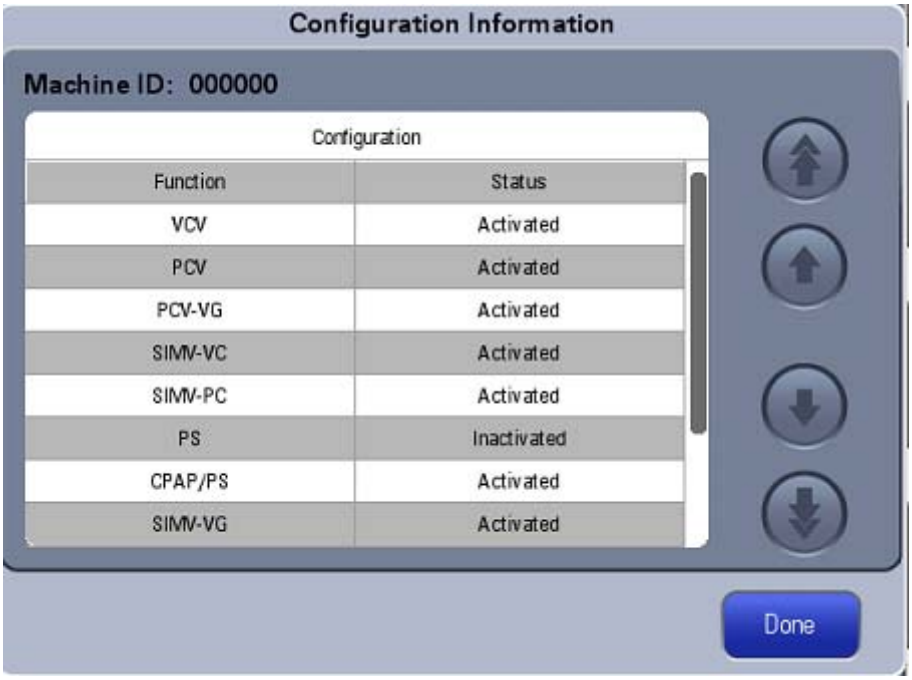
8.8.2.1 Applying for Activation Codes

Note

- **To apply for activation codes, provide relevant information about the anaesthesia machine for which functions are to be activated, including the machine ID, existing configuration, and configuration to be activated.**

When a customer needs to add pad configurations, the after-sales service engineer must apply to the after-sales service department of Mindray for the corresponding activation codes. The procedure is as follows:

1. Record the serial number (see the label on the left of the machine) of the anaesthesia machine for which configurations are to be activated.
2. Record the machine ID and existing configurations. Choose  > **System** > **Configuration Information** to access the **Configuration Information** menu.



3. Record the configurations to be activated.
4. Send the recorded information to the after-sales service department of Mindray for activation code application.

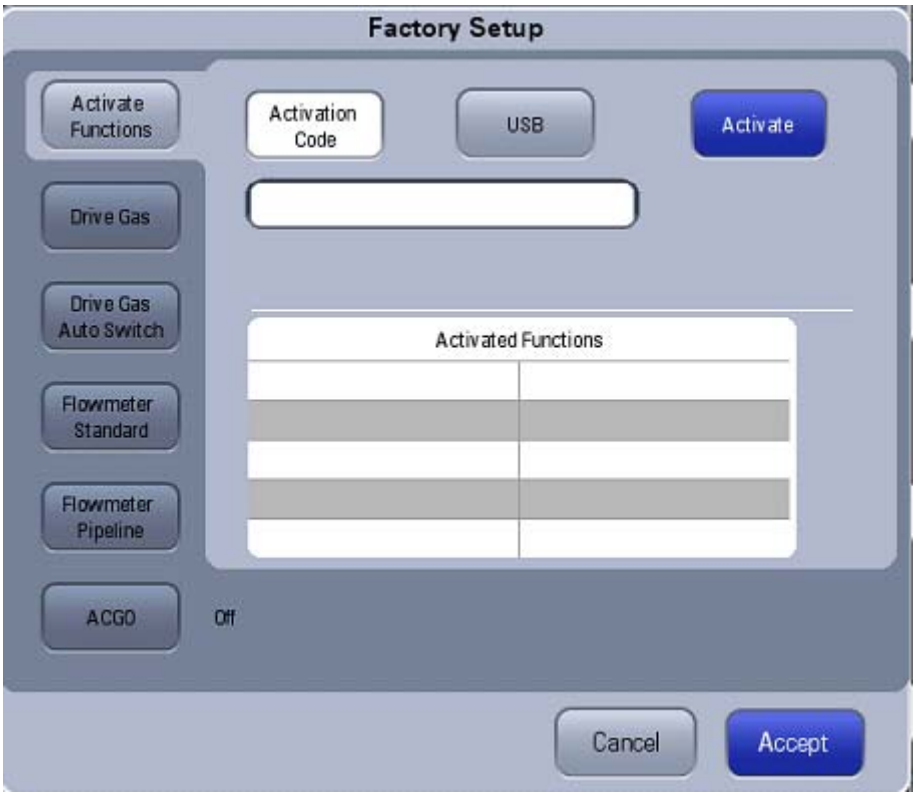
8.8.2.2 Software Function Activation Procedure

Note

- **Before activation, check and record the existing paid configurations and those that need to be added.**
- **Ensure that the entered activation code is the same as that provided by the manufacturer.**

The software function activation procedure is as follows:

1 Access the **Function Activation** menu, choose > **Service**, enter the service password, and choose **Factory Settings** > **Function Activation**. See the figure below.



2. Enter the activation code.



3. Click **Activate**. If the entered activation code is correct, the system will display the message "Activation completed. Please restart the machine for the configuration to take effect!"
4. Click **OK** and restart the anaesthesia machine for the newly activated configuration item to take effect.

Note

- **Before the anaesthesia machine displays the message indicating activation success, ensure that the power supplied to the anaesthesia machine is not interrupted. Otherwise, the BIOS program of the CPU board of the anaesthesia machine will be damaged.**
- **After the anaesthesia machine displays the activation success message, restart the anaesthesia machine to ensure that the existing paid configurations and new paid configurations are all activated after the upgrade. The newly activated functions will not take effect without restart.**

8.8.2.3 Common Software Function Activation Problems and Solutions

Common Problem	Cause	Solution
When the customer attempts to restart the anaesthesia machine after activation, the CPU board beeps and the restart fails.	Before the anaesthesia machine displays the activation success message, the power supplied to the anaesthesia machine is interrupted or the anaesthesia machine is shut down, which causes the BIOS program of the CPU board to be damaged.	Send the CPU board back to the factory for repair.
The system displays a message indicating that the activation code is invalid, and the activation fails.	The activation code is entered incorrectly or the activation code is wrong.	1. Check that the activation code is the same as that provided by the manufacturer. 2. If the activation code is entered correctly but the error message is still displayed, send the machine ID, existing configurations, and new configurations of the anaesthesia machine to the manufacturer for confirmation. 3. A wrong activation code generator version is used. Provide the system software version of the anaesthesia machine to the manufacturer and request the manufacturer to regenerate an activation code.
After activation, the activated function is inconsistent as the user configuration.	The manufacturer generates a wrong activation code, or the existing configurations and new configurations of the anaesthesia machine provided to the manufacturer are incomplete.	Reconfirm the existing configurations and new configurations of the anaesthesia machine and provide the information to the manufacturer for regenerating an activation code.

9 Repair and Disassembly

⚠WARNING

- **To prevent fire, use only lubricants approved for anesthesia or O2 equipment..**
- **Do not use lubricants containing oil or grease. Lubricants containing oil or grease may cause fire or explosion when O2 concentration reaches a certain degree.**
- **Observe the disinfecting control and security procedures as the equipment may contain blood or body fluid.**
- **Moving parts and detachable parts may pinch fingers or crush hands. Therefore, be very careful when moving or replacing these system parts.**
- **Pay attention to the edges and corners of the mechanical parts to avoid skin scratching.**
- **Pay attention to the screws during disassembling to prevent the screws from falling into the machine, causing a short circuit.**
- **Ensure that the air pressure is released before disassembling the gas devices to avoid injuries caused by high air pressure.**

NOTE

- **During re-installation, check that the components are not damaged, and replace damaged components if there is any. Use screws and parts correctly.**
- **After the maintenance or replacing is complete, check and test the system according to 4 Testing.**

9.1 Preparations for Dismounting

9.1.1 Tools

When dismounting or replacing components, you may need to use the following tools:

- Hexagon wrenches (2.5#, 3#, 4#, 5#, and 8#)
- Philips-head screwdriver
- Diagonal plier
- Slot-head screwdriver
- Sleeve screwdriver (M3 and M4)
- Flowmeter calibration device
- Adjustable wrench
- Tweezers
- M16 screw install fixture (0621-J26-1)

9.1.2 Preparations

Before dismounting the anesthesia machine, make the following preparations:

- Ensure that the anesthesia machine is shut down and the AC power supply is disconnected.
- Release the internal air pressure of the anesthesia machine properly.
- Disconnect the tube pipeline gas source and the standby air cylinder.
- Get the dismounting tools ready.
- Move the anesthesia machine to an environment suitable for dismounting and brake the casters to fix the anesthesia machine securely.

⚠CAUTION

- **The internal parts may be infected and contaminated during application. Therefore, wear professional inspection gloves during dismounting and checking.**

9.1.3 Releasing Air Pressure

Before dismounting the gas device, release the internal air pressure of the anesthesia machine to avoid body injuries or device damage during dismounting. Release the air pressure as follows:

1. Shut down the cylinder valve and disconnect the pipeline gas source. Retain the O2 source. If there is no O2 source, connect to the O2 cylinder and turn on the valve.
2. Switch on the system.
3. Turn on all the flow control switches (except for O2).
4. Ensure that the N20 source pressure and AIR source pressure are zero.
5. Disconnect the O2 source (or turn off the O2 cylinder valve). Press the O2 flash button to release the O2 inside the system.
6. Switch off the system.

9.2 Dismounting Parts

9.2.1 Dismounting Top Covers and Plates

1. Unscrew the three screws and remove the top cover (by pushing forward).
2. Unscrew the six combination screw and six hexagon socket screws and remove the top plate.



9.2.2 Dismounting the Maintenance Gate and the Back Cover Plate

1. Remove the dust screen.
2. Unscrew the six screws, remove the maintenance gate and the back cover plate.



9.2.3 Dismounting the Back Cover Plate Assembly of the Rollstand

Unscrew the eight screws and remove the back cover plate assembly of the rollstand.



9.2.4 Dismounting the SMR

1. Dismount the maintenance gate assembly.
2. Disconnect the cables of the SMR, unscrew the four screws, and remove the SMR.





9.2.5 Dismounting the SMR Fan

1. Remove the maintenance gate.

2. Dismount the SMR assembly.

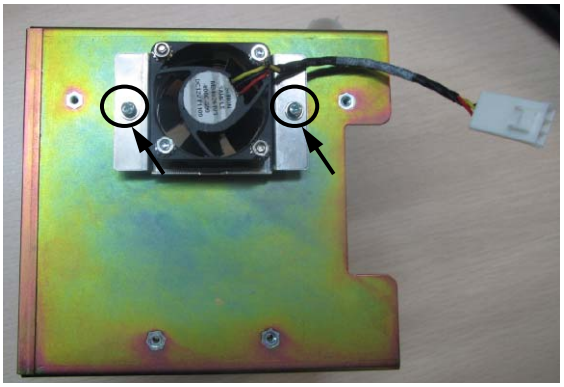
3. Remove the fan cable plug of the SMR.

4. Unscrew the four screws and remove the SMR frame assembly.

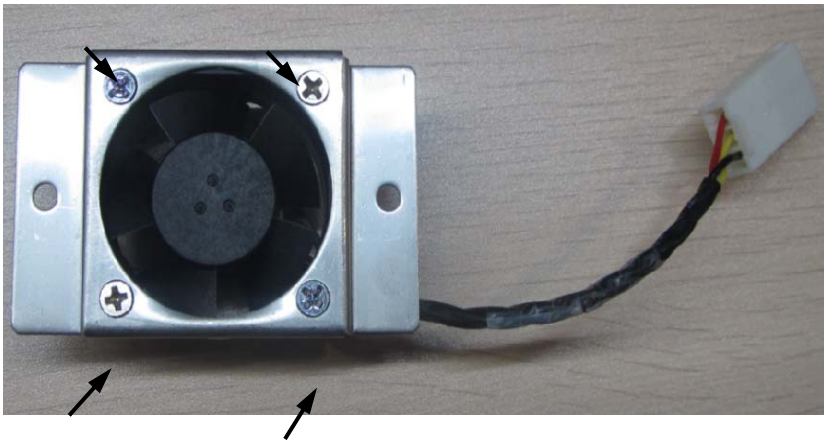




4. Unscrew the two screws and remove the fan and frame.

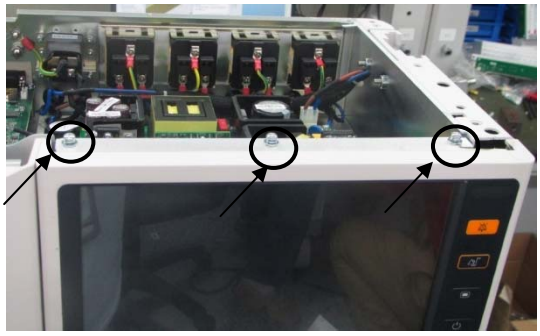


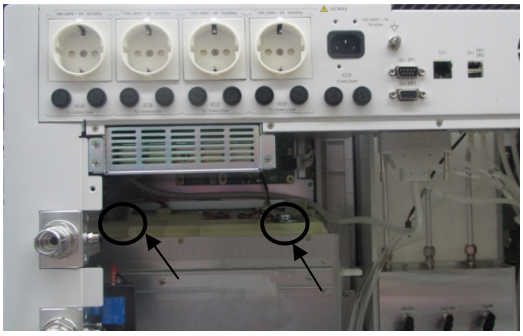
5. Unscrew the four screws and remove the SMR fan.



9.2.6 Dismounting the Display Assembly

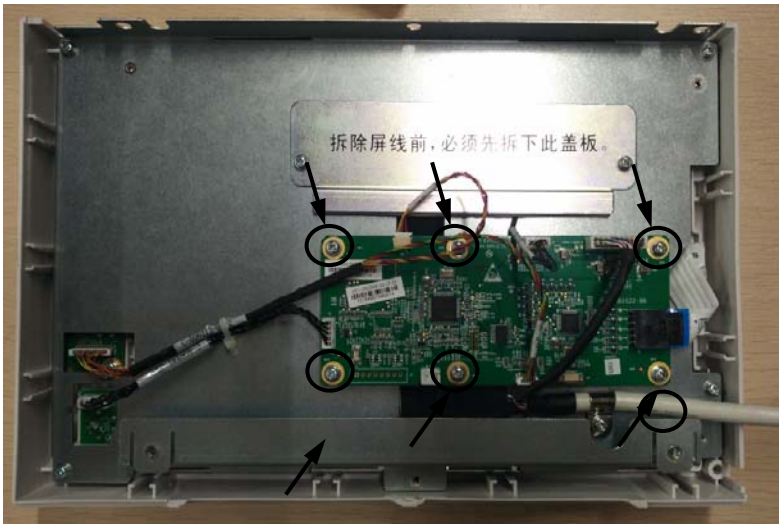
1. Dismount the top cover and plate.
2. Dismount the maintenance gate assembly.
3. Unscrew the three screws on the top of the display assembly and the two screws on the back of the machine.
4. Unscrew the connector that fixes the display on the mother board and pull out the display assembly.





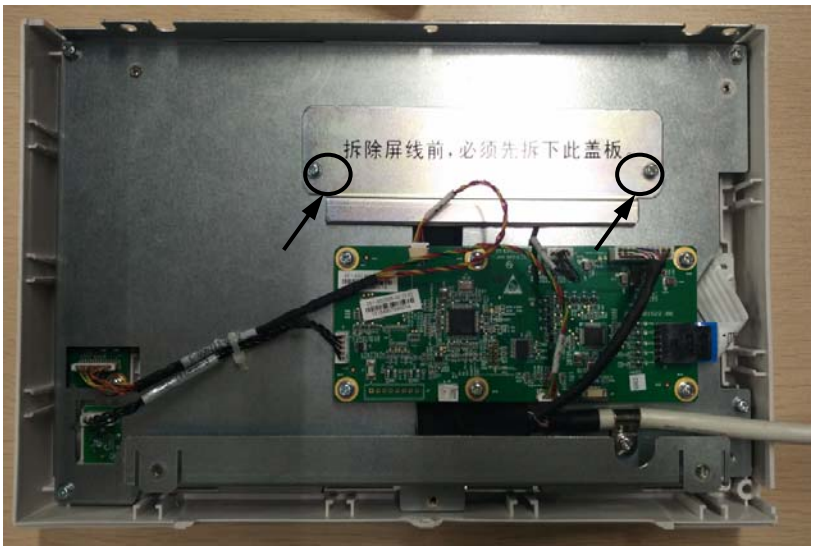
9.2.7 Dismounting the Button Control Panel PCBA (0619)

1. Dismount the display assembly.
2. Pull out the connecting cable on the button control panel PCBA (0619).
3. Unscrew the six screws that fixes the PCBA and remove the button control panel PCBA (0619).

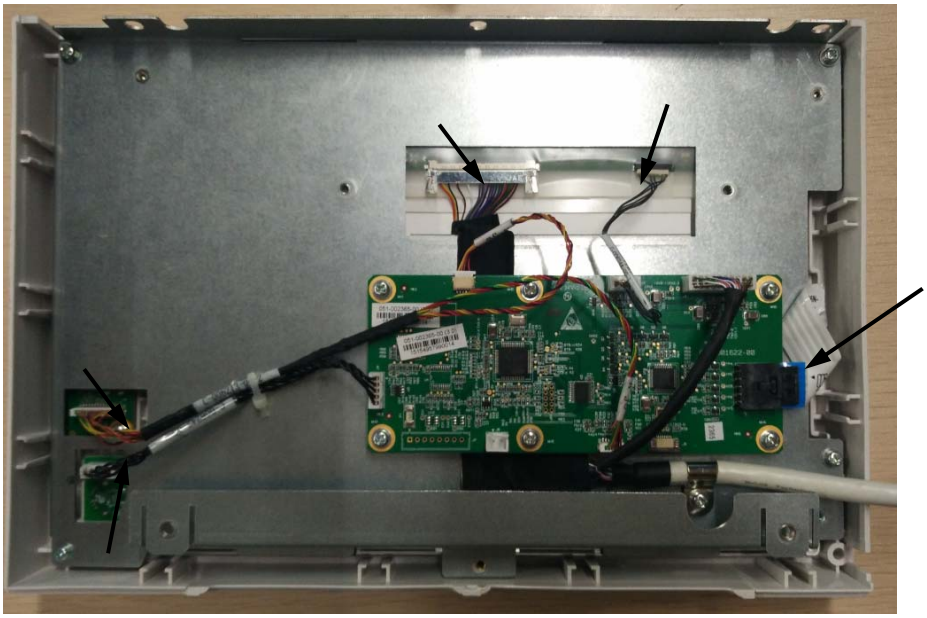


9.2.8 Dismounting the Display and Alarm Indicator Board (0619)

1. Dismount the display assembly.
2. Unfasten the six screws on the back cover plate of the display and the display fixing frame



3. Remove all cables that connect the boards and the touchscreen of the display.



4. Remove the display and the display fixing frame. Unscrew the four screws fixing the display and take out the display.



5. Unscrew the four screws that fix the alarm indicator board (0619) and remove the alarm indicator board (0619).



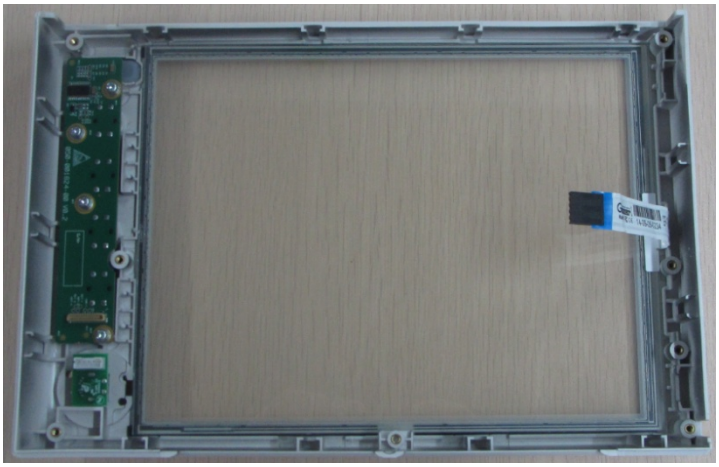
9.2.9 Dismounting Alarm Indicator Board

1. Dismount the display assembly.
2. Pull out the display.
3. Remove the touchscreen.



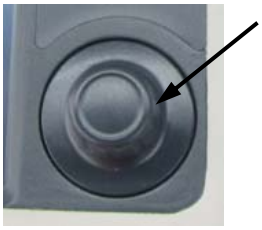
9.2.10 Dismounting the Encoder

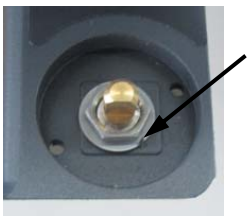
1. Dismount the display assembly.
2. Remove the cables connecting the encoder.



3. Push out the EV20 knobs with a hexagon wrench from the two round holes. Unscrew the screw and flat washer that fix the encoder and remove the encoder.

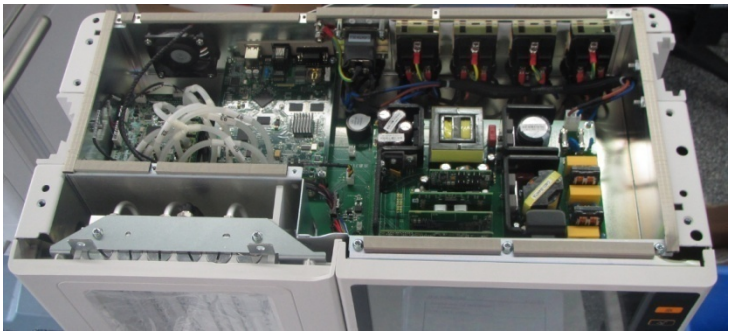




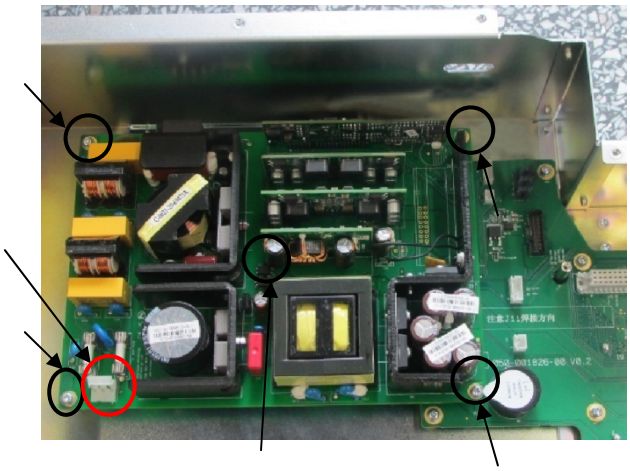


9.2.11 Dismounting the Hardware Box Component

1. Dismount the top cover and plate.



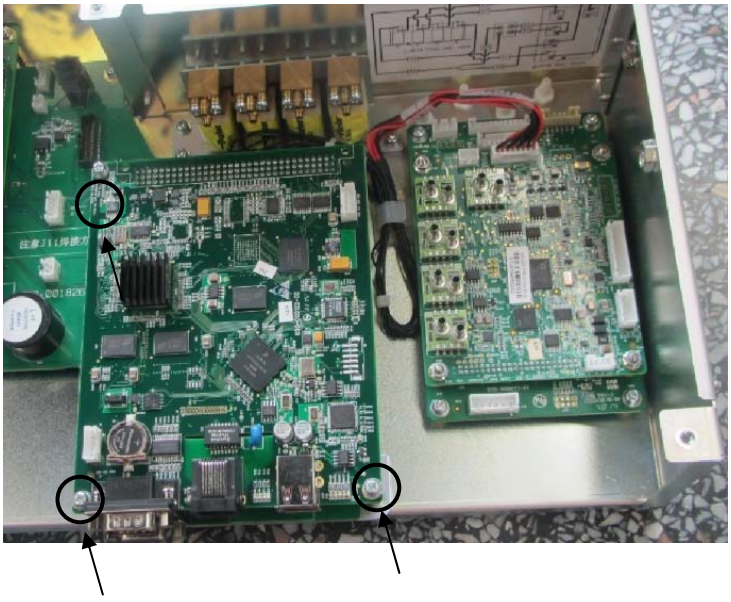
2. Remove the cables connecting the power supply board. Unscrew the four combination screws and one M3 toothed nut that fixes the power supply board and remove the power supply board.



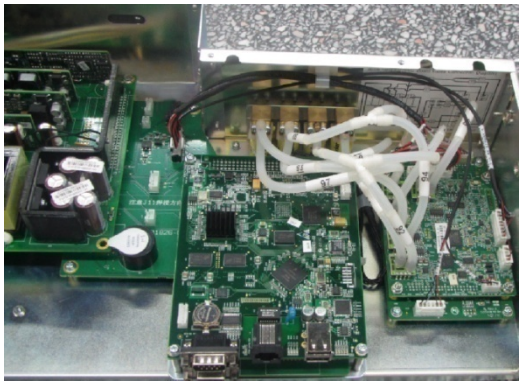
3. Remove the cables and pipelines on the monitoring board assembly, unscrew the four combination screws that fix the monitoring board assembly, and remove the monitoring board assembly.

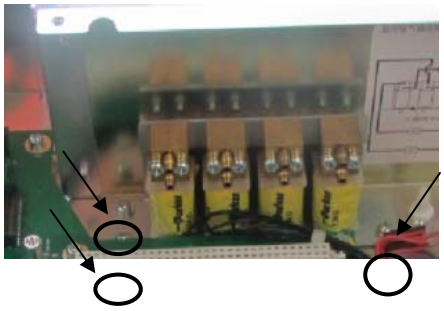


4. Unscrew the three combination screws that fix the main control board and remove the main control board.

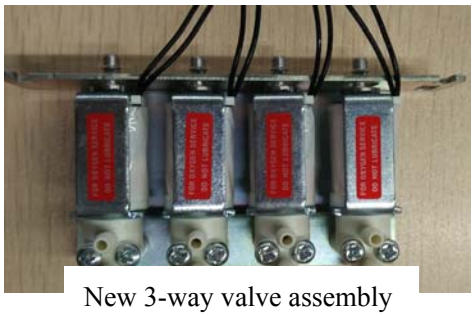


5. Remove the pipelines on the 3-way valve assembly and the cables connecting the monitoring board. Unscrew the three combination screws that fix the 3-way valve assembly and remove the 3-way valve assembly. There are two versions of the three-way valve assembly, as shown in the following pictures. The two versions can be replaced with each other.



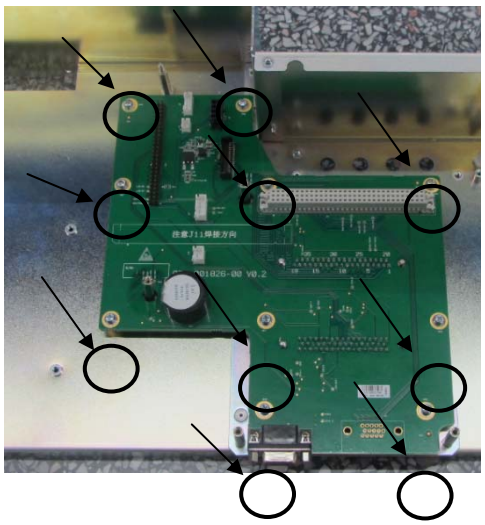


Old 3-way valve assembly

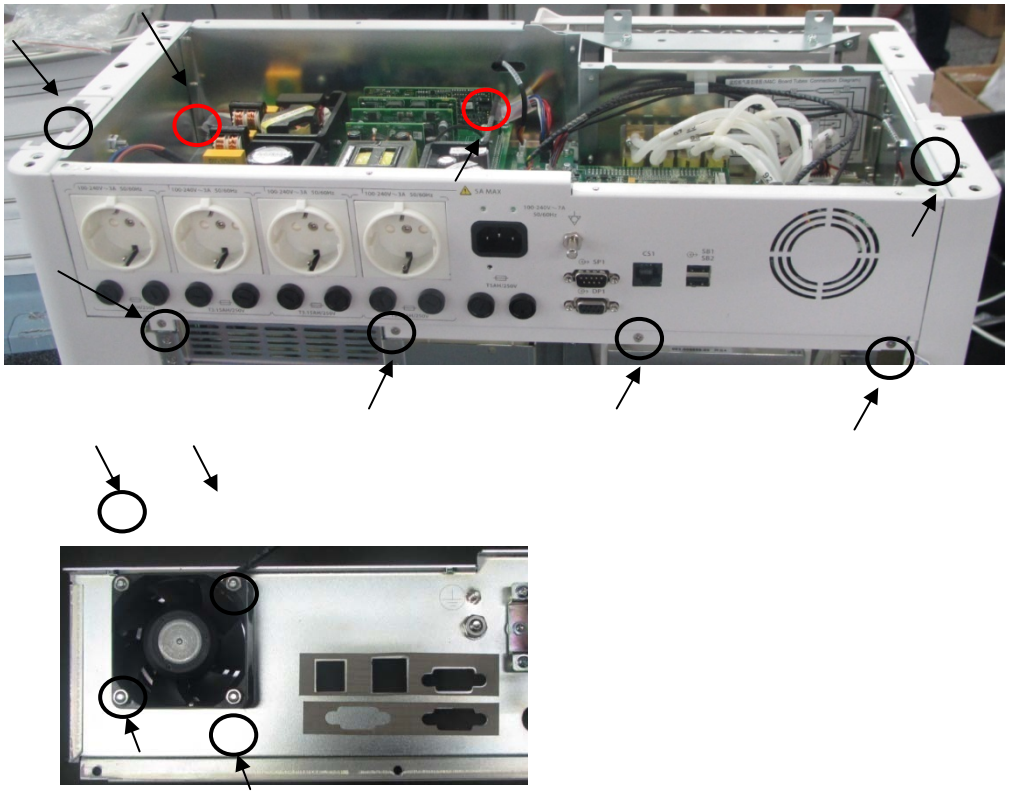


New 3-way valve assembly

6. Remove the power supply board and main control board. Remove the cables connecting the mother board. Unscrew the 10 screws fixing the mother board and remove the mother board.



7. Disconnect the cables connecting the fan and the filter to the mother board. Unscrew the five screws that fix the back cover plate of the hardware box and remove the back cover plate of the hardware box. Unscrew the four screws that fix the fan and replace the fan.



⚠WARNING

- **Ensure that the system is switched off and the power supply is disconnected before replacing the boards to prevent electric shock.**
- **Before the replacement of the main control board, please record the settings of the service menu. After the replacement of the main control board, please restore the settings of the service menu.**

9.2.12 Removing the Fuse

1. Use a slot-head screwdriver to unscrew the fuse cover in the direction shown on the fuse base.



2. Insert a new fuse and fasten the cover with a slot-head screwdriver.

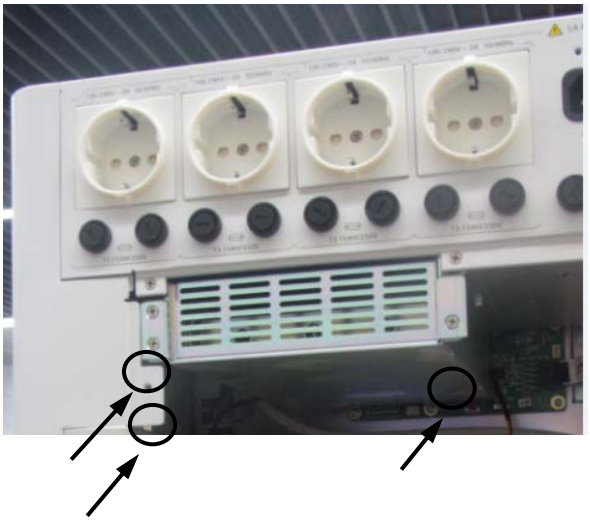
⚠WARNING

- **Ensure that the system is switched off and the power supply is disconnected before replacing a fuse to prevent electric shock.**
- **Ensure that the new fuse complies with the requirement specified in the instructions for use.**

9.2.13 Replacing the Embedded Battery

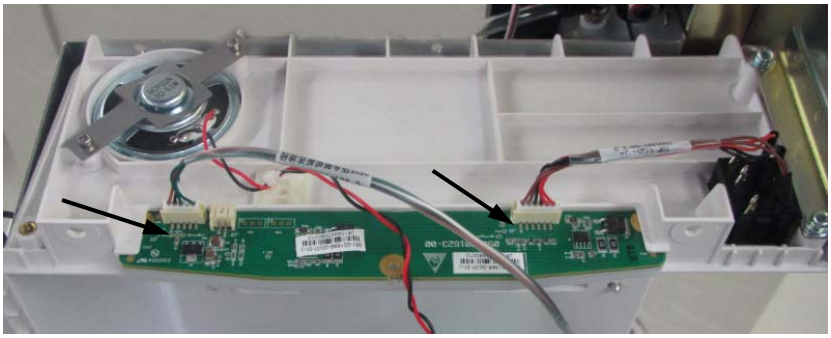
1. Dismount the maintenance gate assembly.

2. Unscrew the three screws fixing the cover of the batter box and remove the lithium battery.



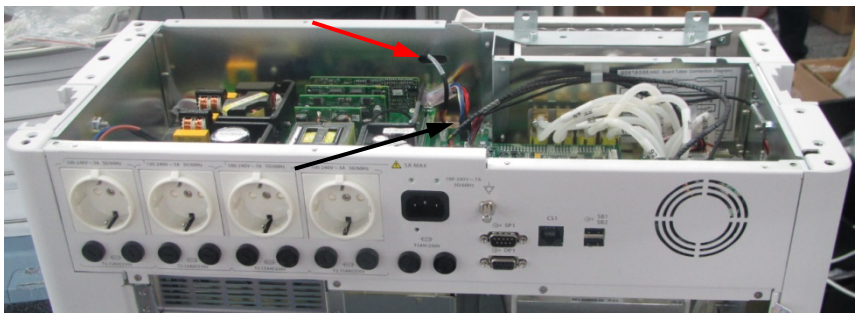
9.2.14 Removing the Top Lighting Panel

1. Dismount the display assembly.
2. Disconnect the cables connecting the top lighting panel and remove the top lighting panel.

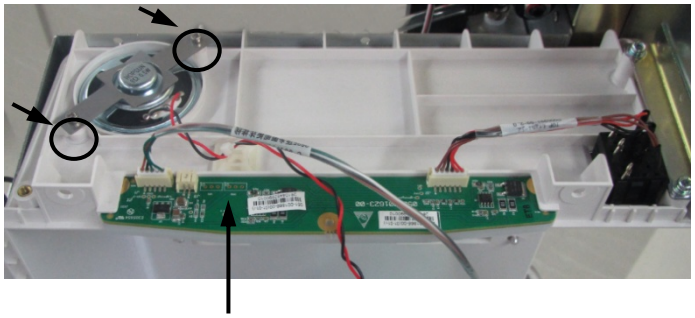


9.2.15 Removing the Speaker

1. Dismount the top cover plate, top cover, and screen assembly.
2. Disconnect the speaker cables from the power supply board in the hardware box. Remove the cables from the bubble holes on the power supply board.



3. Unscrew the two fixing screws and cut off the cable tie that fixes the cable. Remove the speaker from the front.



9.2.16 Removing the Vaporizer Bracket

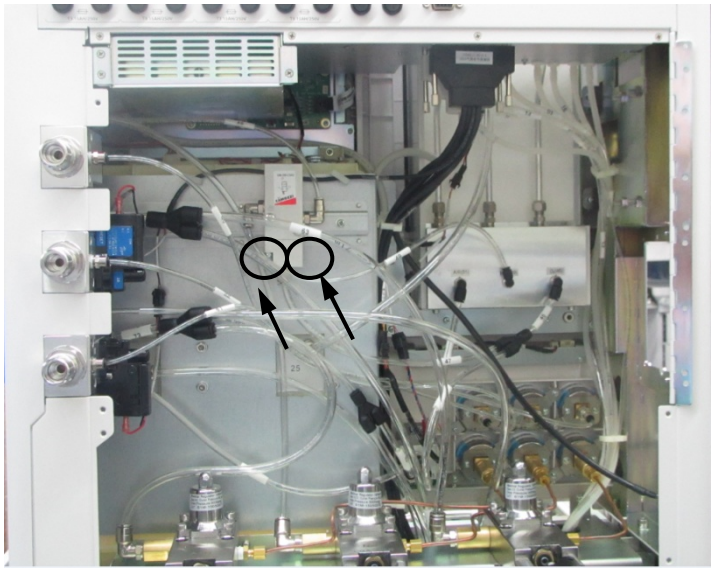
1. Dismount the maintenance gate assembly.
2. Disconnect the pipelines connecting to the vaporizer bracket.
3. Unscrew the four fixing screws and remove the vaporizer bracket from the front.





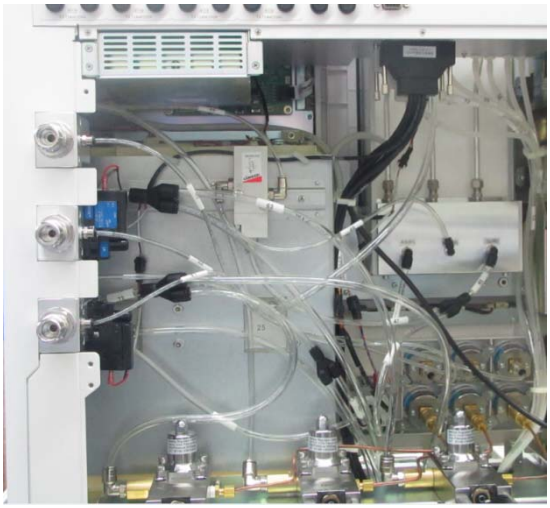
9.2.17 Removing Two 2-Way Valves

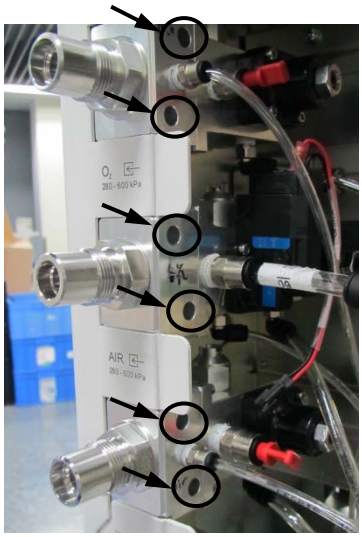
1. Dismount the maintenance gate assembly.
2. Disconnect the pipelines connecting to the two 2-way valves.
3. Unscrew the two fixing screws and remove the two 2-way valve.



9.2.18 Dismounting Gas Supply Inlet Assembly

1. Remove the maintenance gate and the back cover plate.
2. Disconnect the cables, pipelines, and stoppers from the gas supply inlet assembly.
3. Unscrew a pair of screws that fix each gas supply inlet assembly and remove the gas supply inlet assembly.



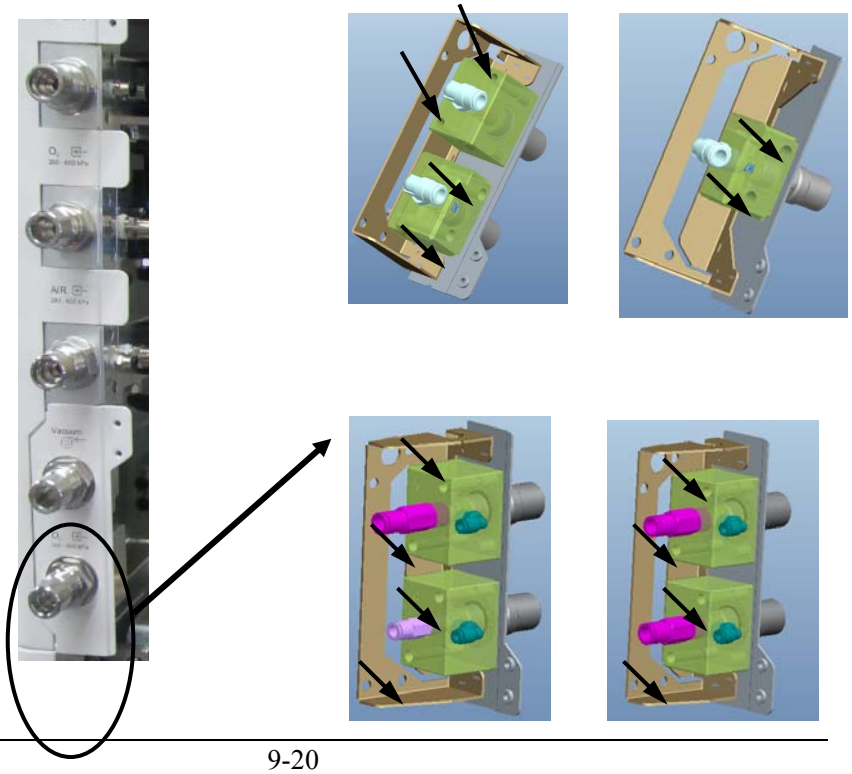


There are multiple types of gas supply inlet assemblies. These assemblies can be categorized according to gas supply type (O2 \ N2O \ AIR) and connector (NIST\DISS). Refer to the following table:

P/N	Description	Application
115-033836-00	O2 gas supply inlet assembly (0615）	NIST
115-034148-00	O2 gas supply inlet assembly (DISS/0615)	DISS
115-033838-00	N2O gas supply inlet assembly (0615）	NIST
115-034149-00	N2O gas supply inlet assembly (DISS/0615)	DISS
115-033837-00	Air supply inlet assembly (0615）	NIST/driving with oxygen
115-034150-00	Air supply inlet assembly (DISS/0615)	DISS/driving with oxygen
115-035359-00	Air supply inlet assembly (with pressure switch/DISS/0619)	DISS/driving with air/driving gas switching function
115-035360-00	Air supply inlet assembly (with pressure switch /NIST/0619)	NIST/ driving with air/driving gas switching function

9.2.19 Dismounting Standby Gas Supply Inlet Assembly

1. Remove the maintenance gate and the back cover plate.
2. Disconnect the pipelines from the standby gas supply inlet assembly.
3. Unscrew the four screws that fix the metal plate of the standby gas supply inlet assembly and remove the standby gas supply inlet assembly.
4. Unscrew a pair of screws that fix each gas supply inlet assembly and remove the standby gas supply inlet assembly.

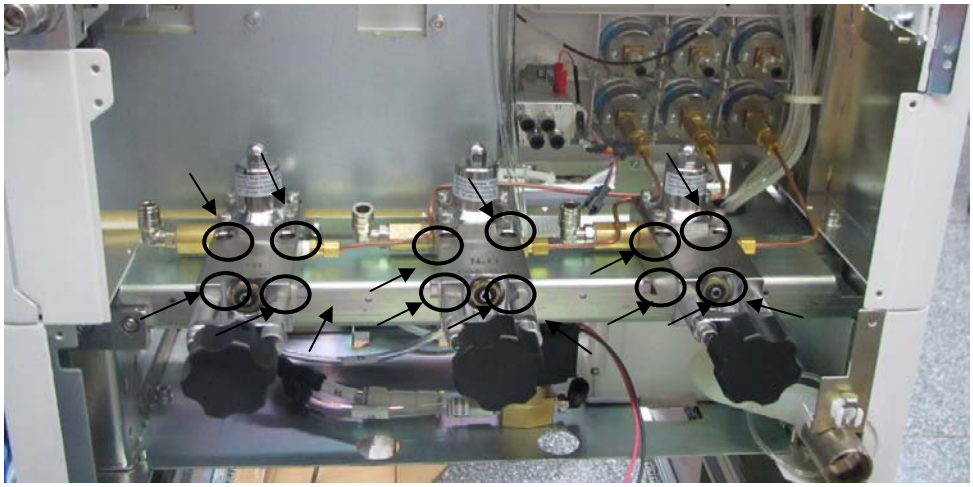


Refer to the following table for backup oxygen, pipe negative pressure inlet assemblies and large cylinder inlet assemblies:

P/N	Description	Application
115-034706-01	Backup oxygen inlet assembly (0615/umbrella valve）	NIST/backup oxygen
115-004519-01	O2 gas supply inlet assembly (with large cylinder)	NIST/with 4YOKE
115-004520-01	N2O gas supply inlet assembly (with large cylinder)	NIST/with 4YOKE
115-004558-01	O2 gas supply inlet assembly (DISS/with large cylinder)	DISS/with 4YOKE
115-004559-01	N2O gas supply inlet assembly (DISS/with large cylinder)	DISS/with 4YOKE

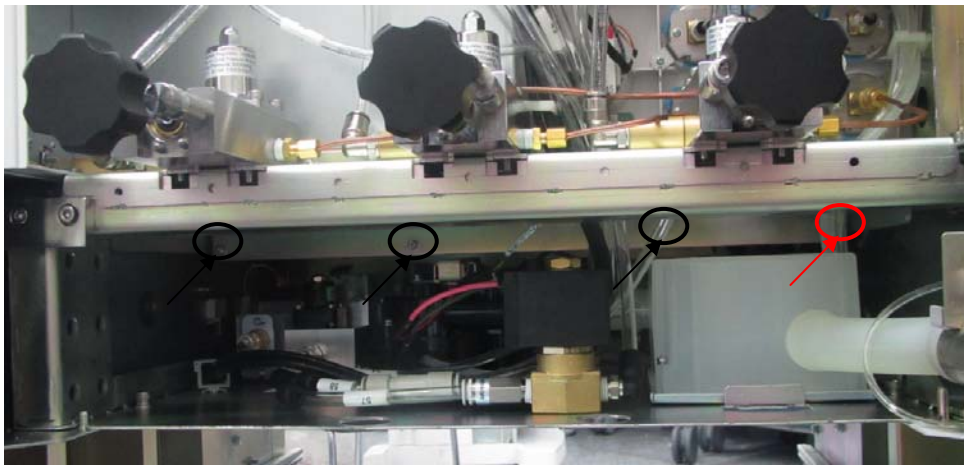
9.2.20 Dismounting Standby Air Cylinder Bracket

1. Remove the maintenance gate and the back cover plate.
2. Disconnect the pipelines and copper pipes from the standby air cylinder bracket.
3. Unscrew the four screws fixing each cylinder bracket and remove the standby air cylinder bracket.



9.2.21 Removing the Workbench Cover

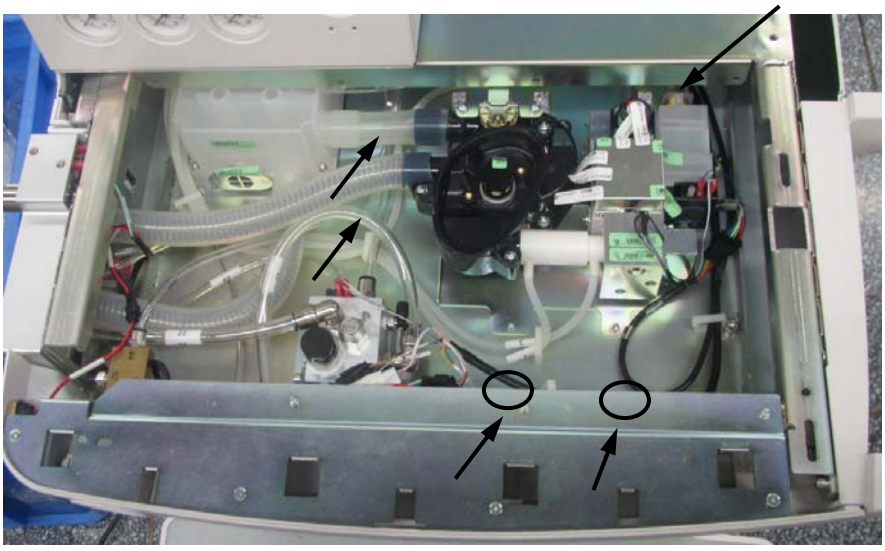
1. Remove the maintenance gate and the back cover plate.
2. Unscrew the three screws fixing the workbench cover and unfasten, do not remove, the rightmost screw.



3. Push the workbench cover forward and remove the workbench cover.

9.2.22 Dismounting the Inhalation Valve Assembly

1. Dismount the workbench cover assembly.
2. Disconnect the pipelines and cables from the inhalation valve.
3. Unscrew the two screws fixing the inhalation valve assembly and remove the inhalation valve assembly.

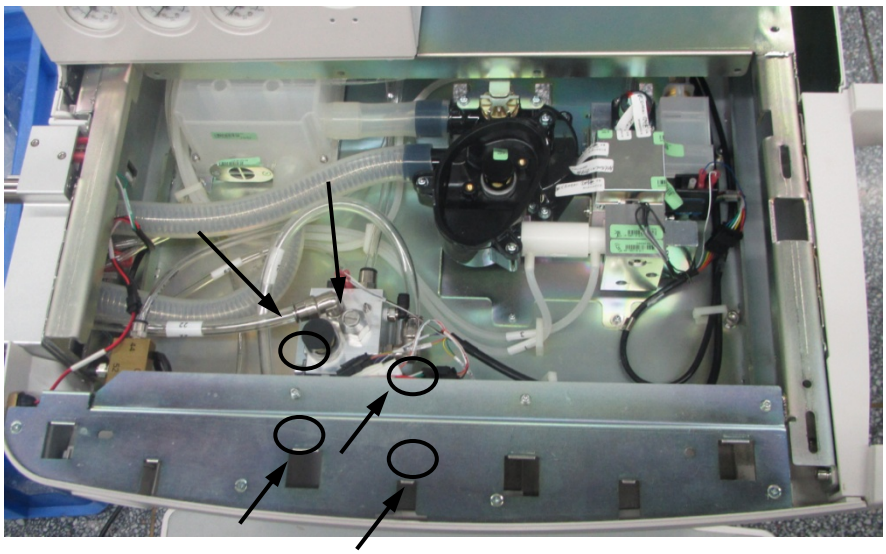


9.2.23 Dismounting the ACGO Assembly

1. Dismount the workbench cover assembly.
2. Disconnect the pipelines and cables from the ACGO assembly.
3. Unscrew the four screws fixing the ACGO assembly and remove the ACGO assembly.

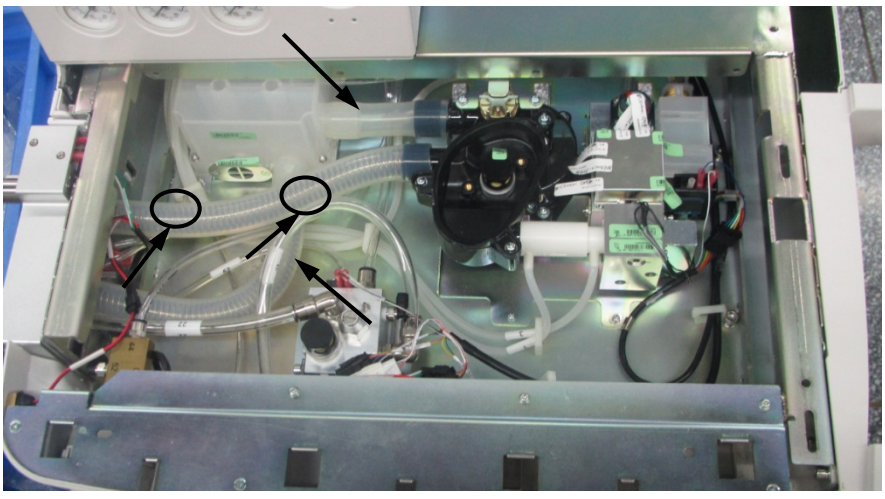
NOTE

- **The new version of ACGO assembly does not have the pressure relief valve. The old and new versions of ACGO assemblies can be replaced with each other.**



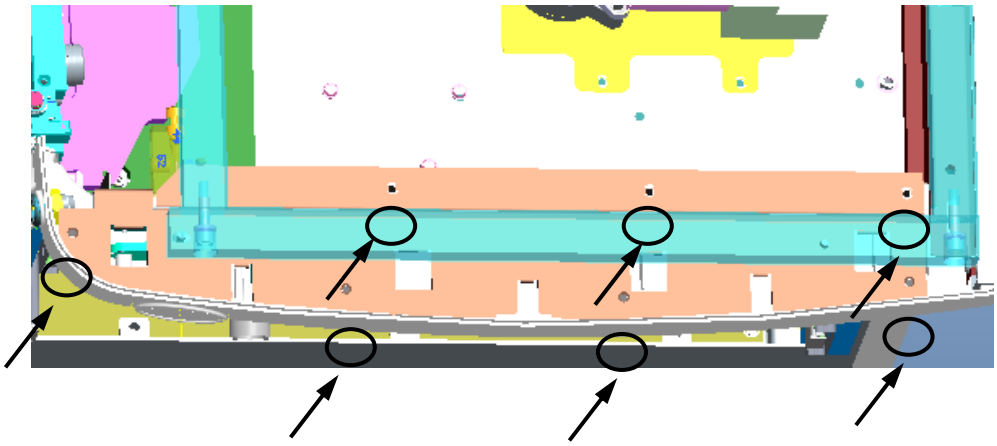
9.2.24 Dismounting the Gas Volume Assembly

1. Dismount the workbench cover assembly.
2. Disconnect the pipelines from the gas volume assembly.
3. Unscrew the two screws fixing the gas volume assembly and remove the gas volume assembly.

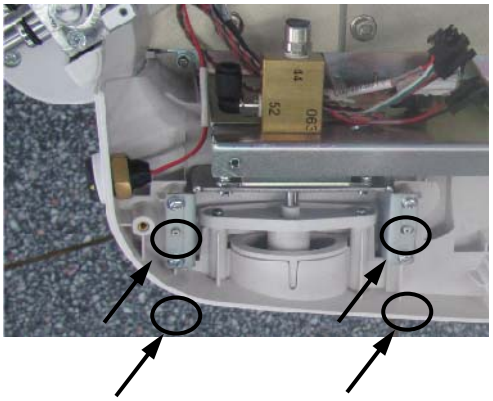


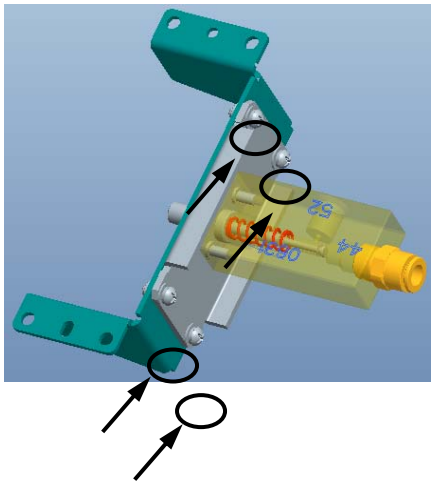
9.2.25 Dismounting the O2 Flush Assembly

1. Dismount the workbench cover assembly.
2. Unscrew the three M3X8 combination screws and four M3X8 countersunk head screws that fix the front plate bracket, and remove the front panel bracket.



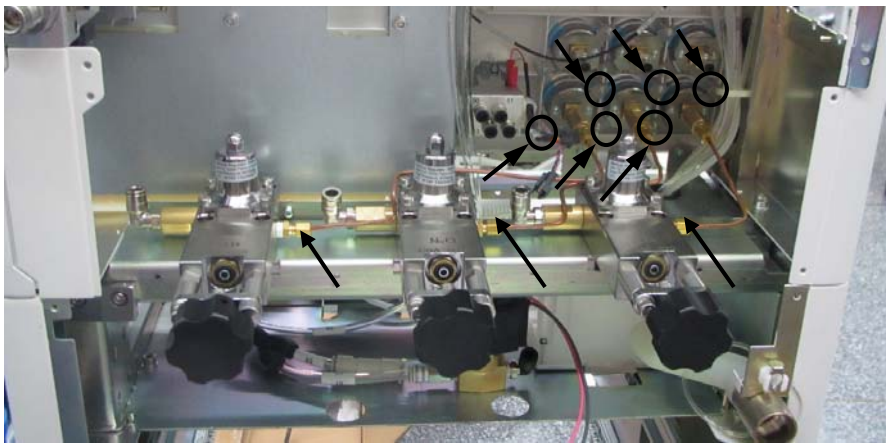
3. Unscrew the four M3X8 combination screws that fix the O2 flush bracket, unscrew the four screws that mount the O2 flush assembly onto the bracket, and remove the assembly.



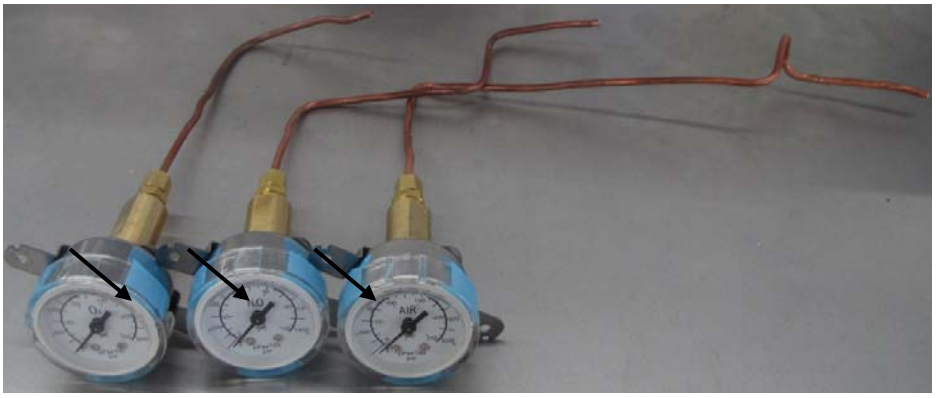


9.2.26 Dismounting the High Pressure Gauge Assembly

1. Dismount the workbench cover assembly.
2. Disconnect the copper pipe from the air cylinder bracket.
3. Unscrew the two screws that fix the high pressure gauge assembly and remove the assembly.

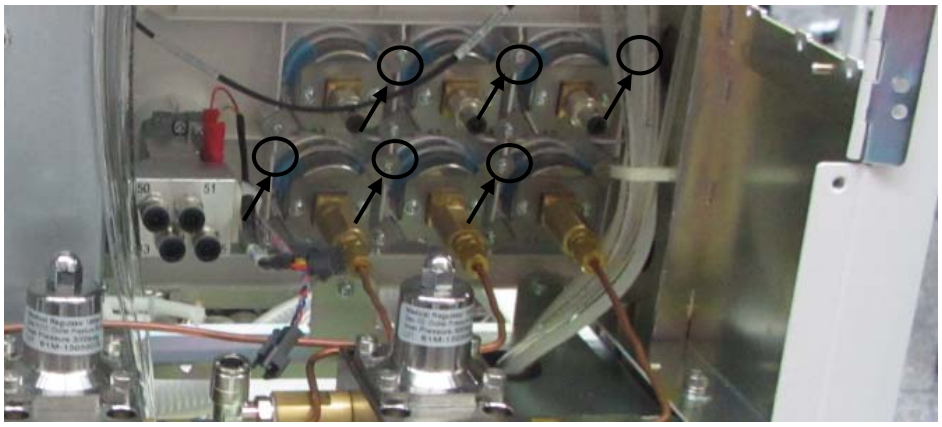


4. Disconnect the copper pipes from the high pressure gauges.



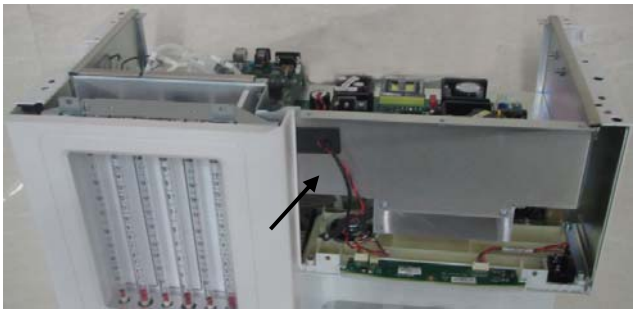
9.2.27 Dismounting the Gas Supply Pressure Gauge Assembly

1. Dismount the workbench cover assembly.
2. Disconnect the pipelines from the gas supply pressure gauge assembly.
3. Unscrew the two screws that fix each gas supply pressure gauge onto the front panel and remove the gas supply pressure gauges.



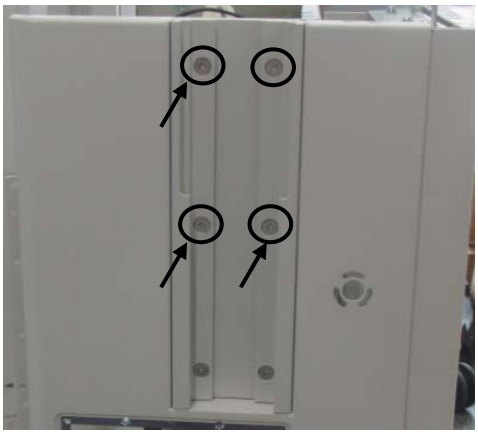
9.2.28 Dismounting the Flowmeter Assembly

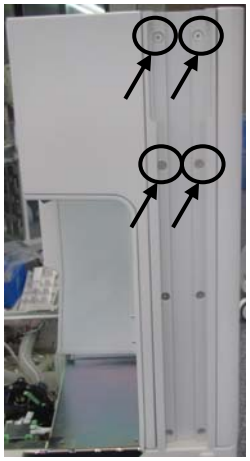
1. Dismount the top cover plate, top cover, and screen assembly.
2. Disconnect the external cables and pipelines and cables from the hardware box assembly.





3. Unscrew the four screws from the left and right sliding rails and remove the hardware box assembly.

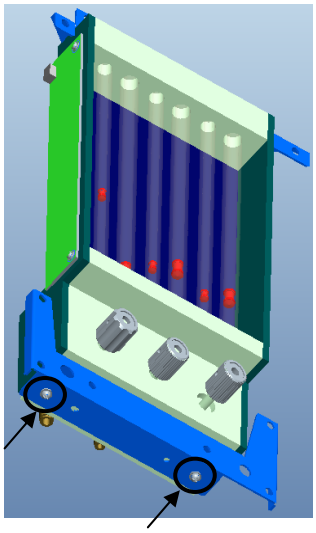


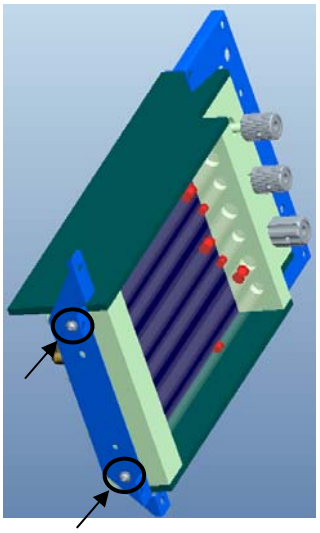


4. Disconnect the pipelines and cables from the flowmeter, unscrew the eight screws that fix the flowmeter, and remove the flowmeter assembly.



5. Unscrew the four screws from the upper and lower brackets of the flowmeter and remove the flowmeter assembly.

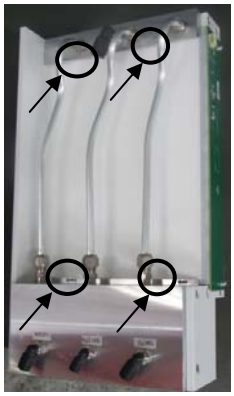




6. Unscrew the two screws of the flowmeter backlight board (0616), and remove the backlight board insulating strip (0619) and the PCB of the flowmeter backlight board (0616).



7. Unscrew the four screws that fix the flowmeter backlight board and remove the flowmeter backlight board.





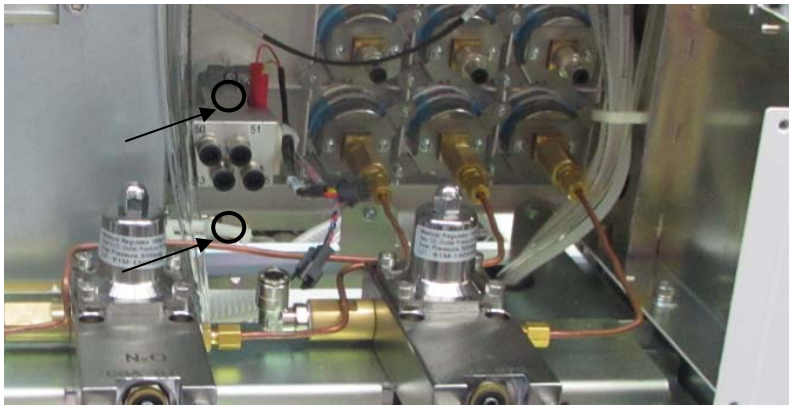
9.2.29 Dismounting the Auxiliary Lighting Panel PCBA (0619)

1. Remove the maintenance gate.
2. Disconnect the cables from the auxiliary lighting panel PCBA (0616)
3. Unscrew the three screws of the light mounting plate bracket (0619), and remove the light mounting plate bracket (0619) and auxiliary lighting panel PCBA (0619).



9.2.30 Dismounting the System Switch Assembly

1. Remove the maintenance gate and the back cover plate.
2. Disconnect the pipelines and cables from the system switch assembly.
3. Unscrew the two screws that fix the assembly and remove the assembly.



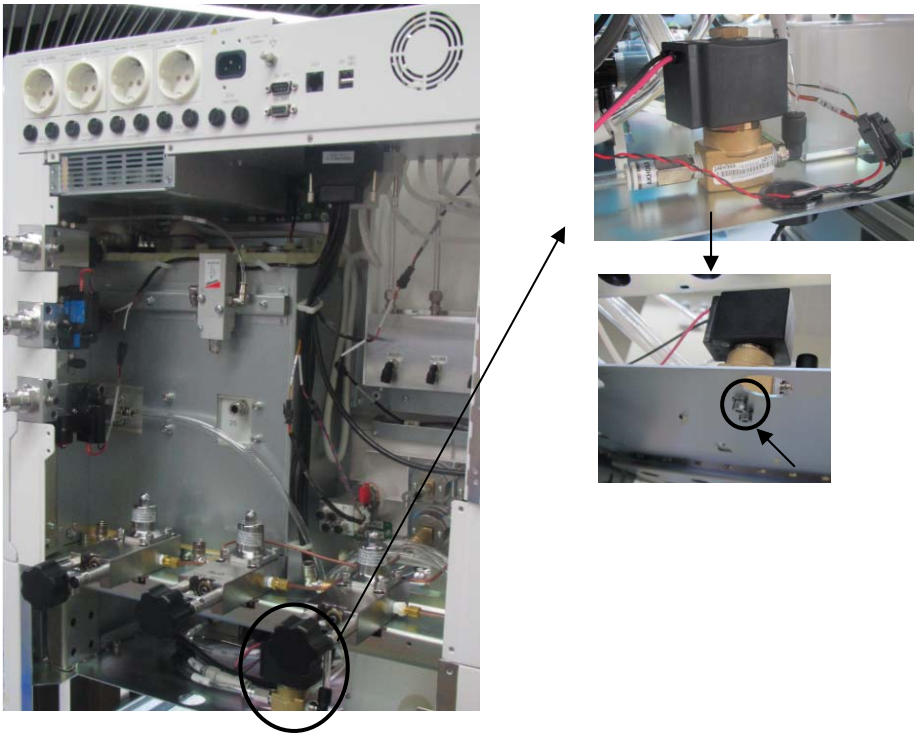
9.2.31 Dismounting the Indicator Light Board

1. Remove the maintenance gate and the back cover plate.
2. Disconnect the cables from the indicator light board.
3. Unscrew the two screws that fix the board and remove the board.



9.2.32 Dismounting the Drive Gas Switch Valve

1. Remove the back cover and rollstand back cover plate.
2. Disconnect the pipelines and cables from the drive gas switch valve.
3. Unscrew the two screws that fix the drive gas switch valve.



9.2.33 Disconnecting the Power Cable

Unscrew the three screws that fix the security-mousing-hook of the power plug and disconnect the power cable.



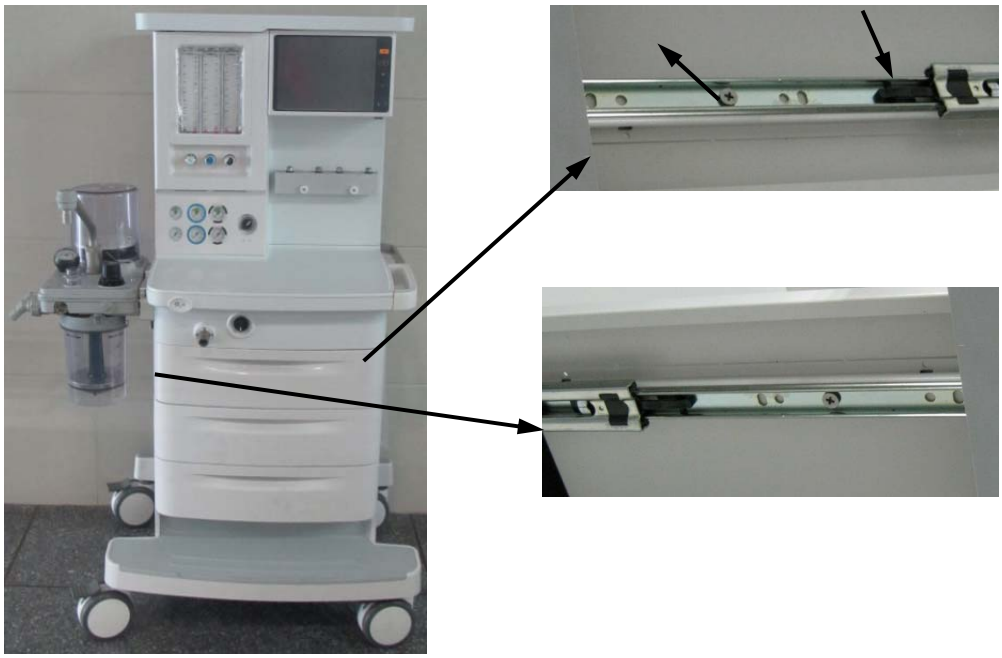


⚠WARNING

- **Before replacing the power cable, disconnect the power cable from the receptacle to prevent electric shock.**

9.2.34 Dismounting the Drawer

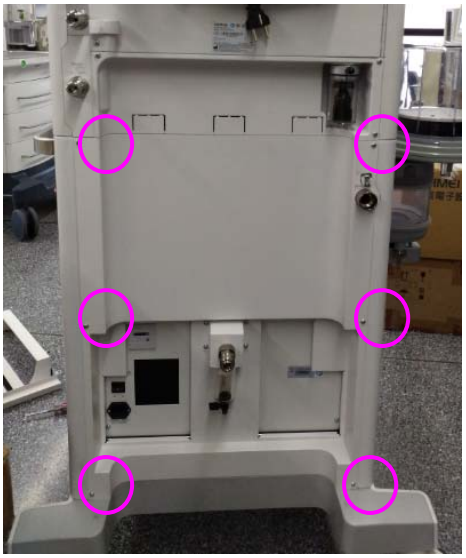
Pull out the drawer, press down the black buttons on the left and right sliding rails, and remove the drawer.

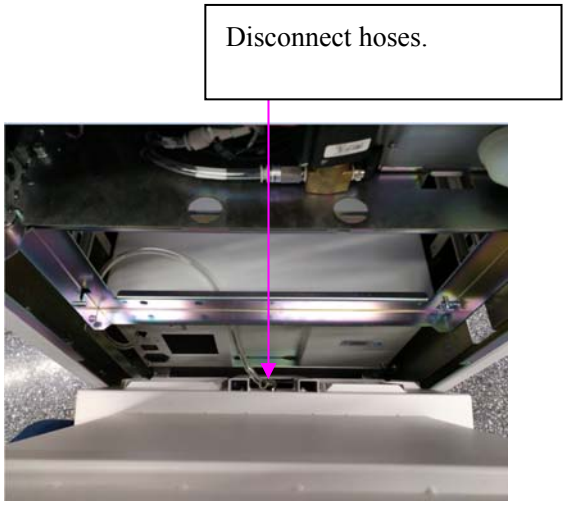


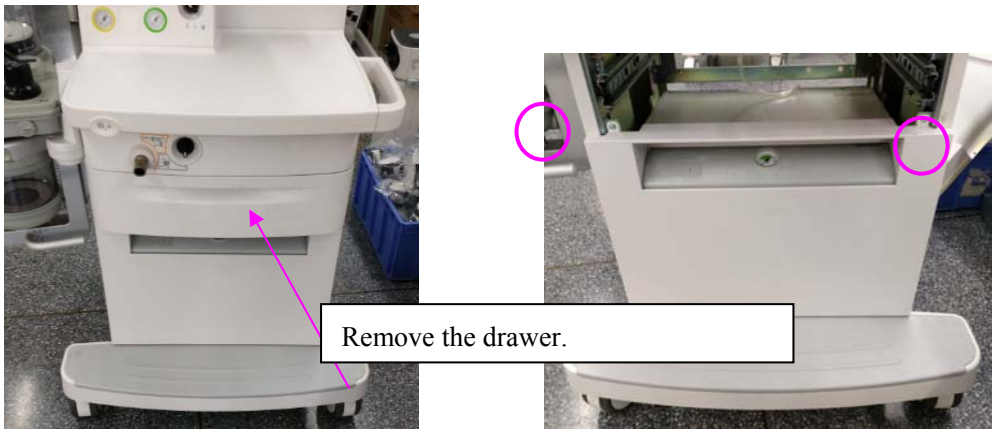
9.2.35 Dismounting the Air Compressor

14. Unscrew the six screws fixing the back cover plate of the rollstand, disconnect the hoses and remove the back cover plate of the rollstand.

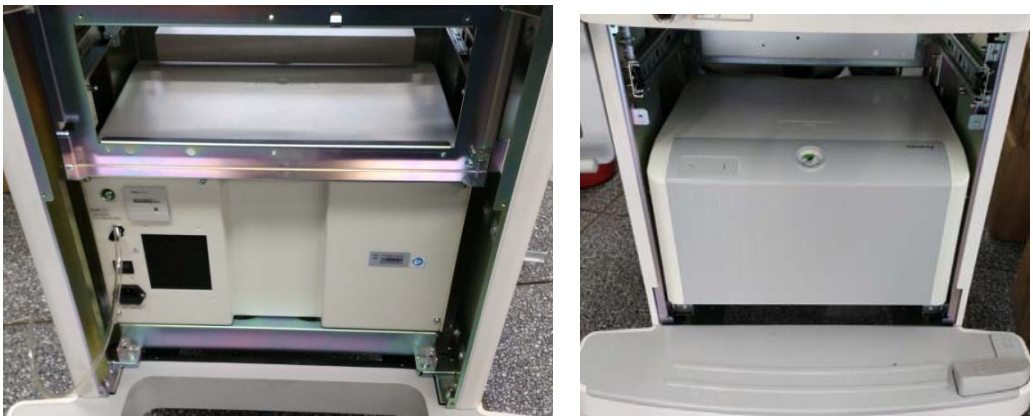
15. Take out the drawer below from the front side, loosen the two screws that fix the front cover plate of the air compressor, and remove the front cover plate of the air compressor.





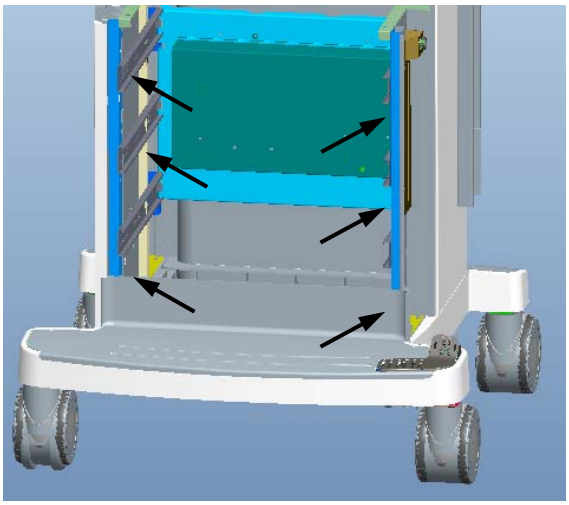


16. Unfasten the six hexagon screws that fix the air compressor on the front and rear sides. Pull the air compressor out of the rollstand as a whole. For details about the internal dismounting and maintenance of the air compressor, please see the *Air Compressor Maintenance Guide.*



9.2.36 Dismounting the Sliding Rails

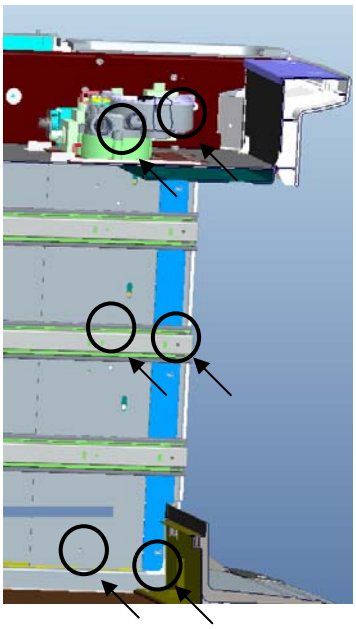
1. Dismount the drawer of the rollstand.
2. Unscrew the three screws that fix each sliding rail.



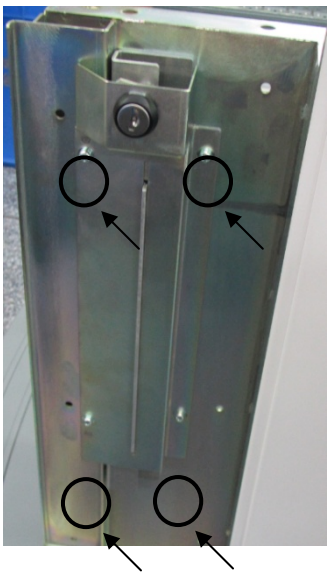


9.2.37 Dismounting the Drawer Lock

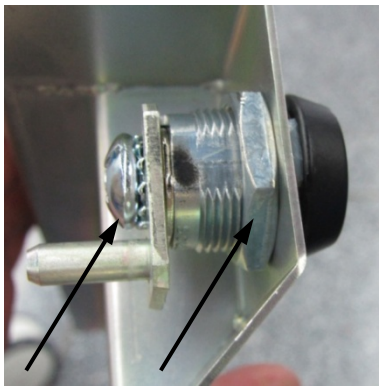
1. Dismount the drawer of the rollstand.
2. Unscrew the six M4X12 combination screws that fix the right decorative plate of the rollstand, and remove the right decorative plate.



3. Unscrew the four M4X12 combination screws that fix the cover plate of the drawer lock, and remove the cover plate.



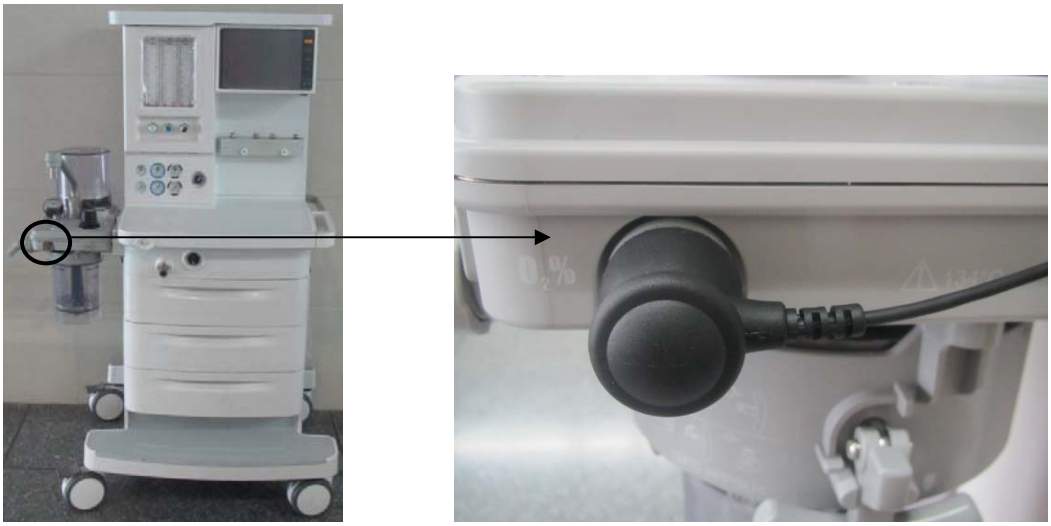
4. Unscrew the screw that fixes the locking plate, remove the nut that fixes the lock, and remove the lock.



9.3 Dismounting the Patient Circuit (not compatible with Pre-Pak)

9.3.1 Dismounting the O2 Sensor

1. Disconnect one end of the O2 sensor power cable from the $O_2\%$ port of the anesthesia machine and the other end from the O2 sensor.



2. Unscrew the O_2 sensor from the O_2 sensor port on the breathing system..



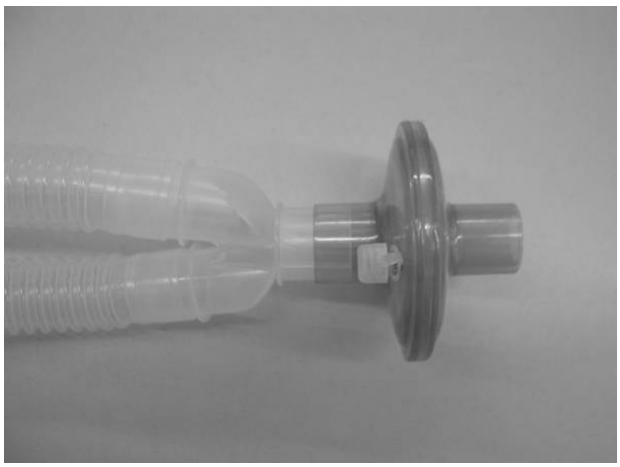


9.3.2 Disconnecting the Respiration Hose

NOTE

- **When disconnecting the respiration hose, grasp the connectors at both ends of the hose to prevent damaging the hose.**

1. Remove the filter from the Y-shaped connector.



2. Remove the expiration hose from the expiration connector and the inspiration hose from the inspiration connector of the patient circuit.



9.3.3 Dismounting the Flow Sensor

1. Rotate the respiration connector nuts counter-clockwise.



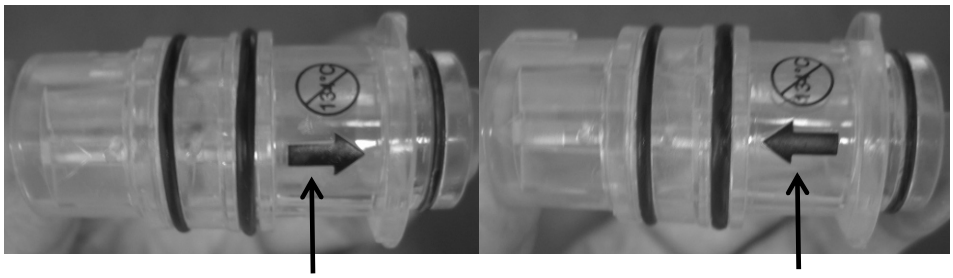
2. Pull out the respiration connectors and nuts together.



3. Pull out the flow sensor in the horizontal direction.



Assembly appearances

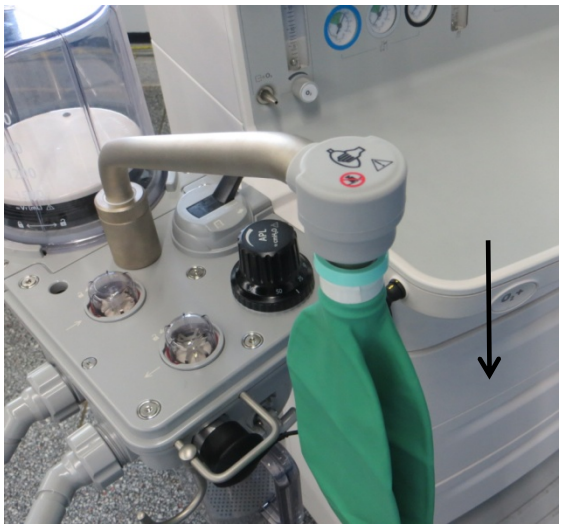


Inspiratory flow sensor assembly

Expiratory flow sensor assembly

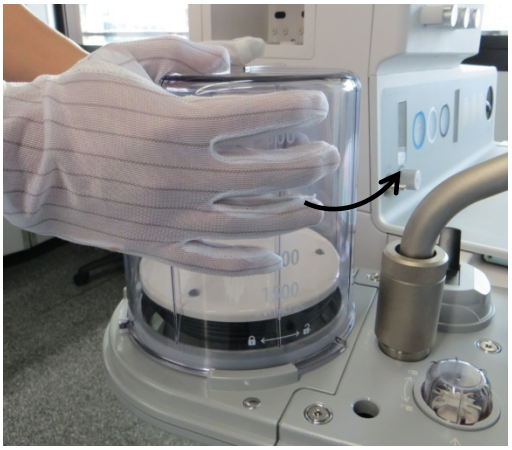
9.3.4 Dismounting the Airbag

Remove the airbag from the related connector of the patient circuit.



9.3.5 Dismounting the Bellows Housing Assembly

1. Rotate the bellows housing counter-clockwise.



2. Lift up the bellows housing.



3. Disconnect the bellows from the base.



9.3.6 Dismounting the Pop-Off Valve Assembly

1. Unscrew the bolts.



2. Pinch the pop-off valve cover and remove it upward.

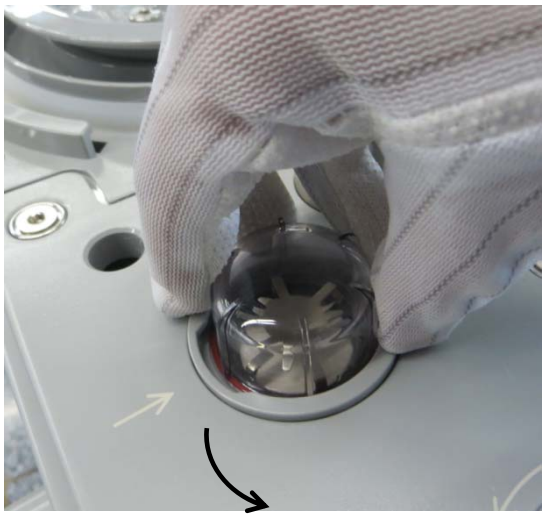


3. Remove the pop-off valve rubber washer and metal part.



9.3.7 Dismounting the Expiratory Check Valve Assembly

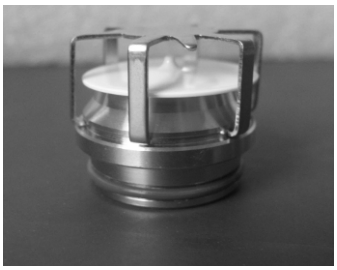
1. Pinch the valve cover, rotate it counter-clockwise, and remove it.



2. Pull out the valve from the patient circuit.



Assembly appearance



9.3.8 Dismounting the Inspiratory Check Valve Assembly

For the procedure, see Section 9.3.7"Dismounting the Expiratory Check Valve Assembly."

9.3.9 Dismounting the CO2 Absorber

1. Grasp the handle and rotate it by 90 degrees upward.



2. Rotate the handle by 90 degrees counter-clockwise.





3. Pull out the CO2 absorber from the lifting device.



⚠WARNING

- **Soda lime is a highly corrosive substance, which is irritating to eyes, skin, and the patient circuit. In case of contact with soda lime, rinse with water. If you still feel irritation, consult a physician immediately.**

9.3.10 Dismounting the Water Collection Cup

1. Pinch the water collection cup and rotate it clockwise.



2. Remove it from the patient circuit.

Assembly appearance



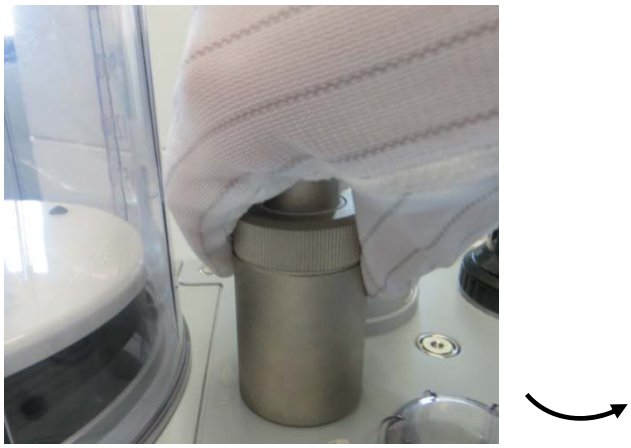
9.3.11 Dismounting the Airway Pressure Gauge

Pull the airway pressure gauge upward.

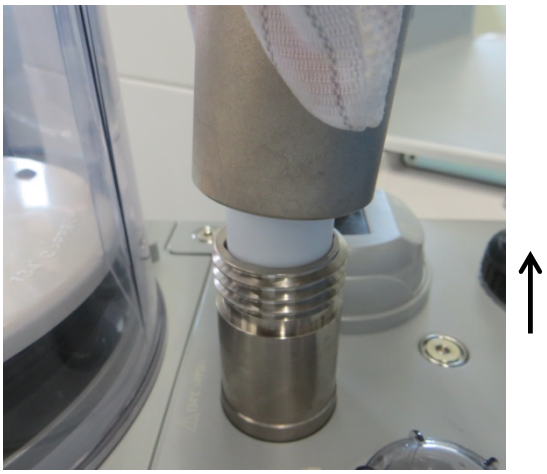


9.3.12 Dismounting the Bag Arm

1. Rotate the nut counter-clockwise.



2. Remove the bag arm from the patient circuit.



9.3.13 Dismounting the Patient Circuit

1. After the previous dismounting steps, rotate the circuit bracket counter-clockwise to reveal the buckle. Hold the patient circuit with one hand and press down the buckle with the other.



2. Use some force to remove the patient circuit from the circuit switching block.



NOTE

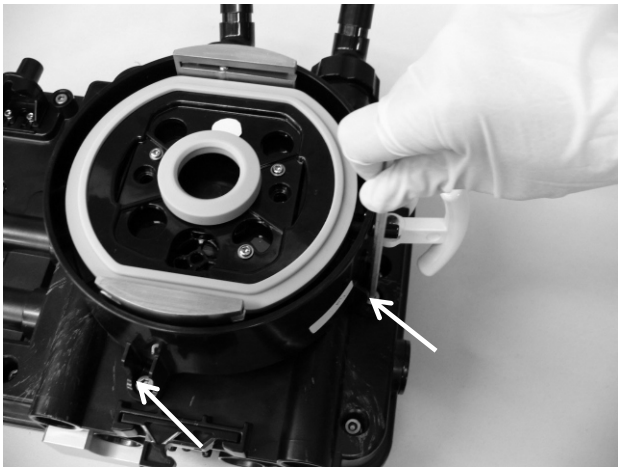
- **If it is difficult to move the patient circuit, apply lubricant onto the sealing ring of the gas connector of the patient circuit circuit switching block to reduce friction.**

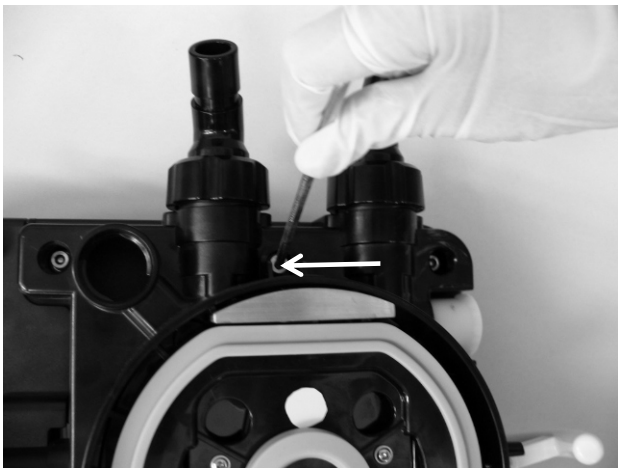
9.3.14 Dismounting the CO2 Absorber Connector Assembly

1. Turn the patient circuit upside down.

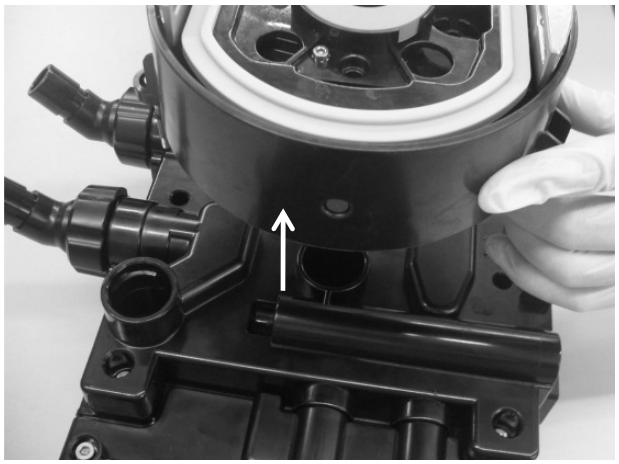


2. Use a hex socket wrench to loosen the three screws shown in the following figure.

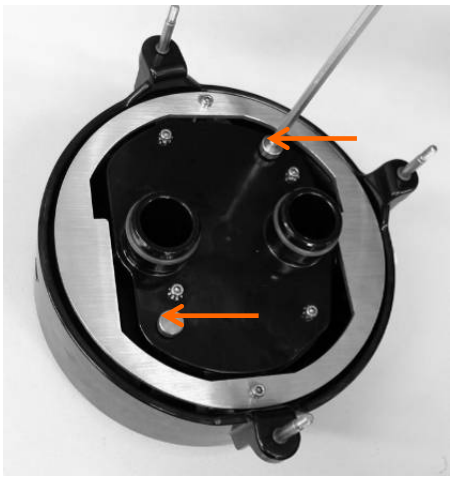




3. Remove the lifting device from the patient circuit.



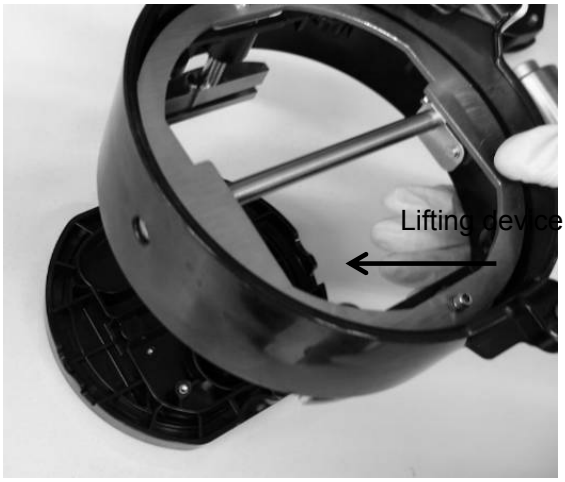
4. Turn the lifting device upside down and use a hex socket wrench to loosen the two screws shown in the following figure.



5. Use some force to lift the CO2 absorber connector assembly upward to dismantle it.

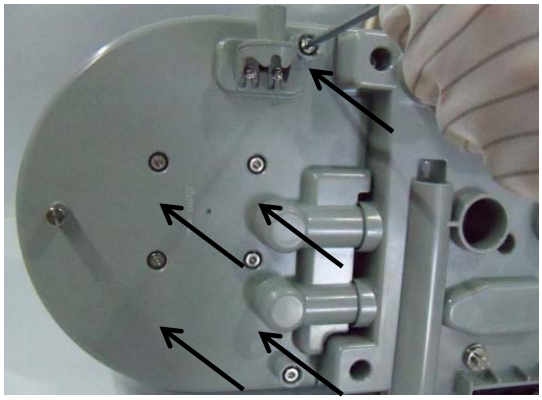


6. Pull the lifting device upward to remove it.



9.3.15 Dismounting the Upper Cover 2 and Lower Cover 2 Assemblies

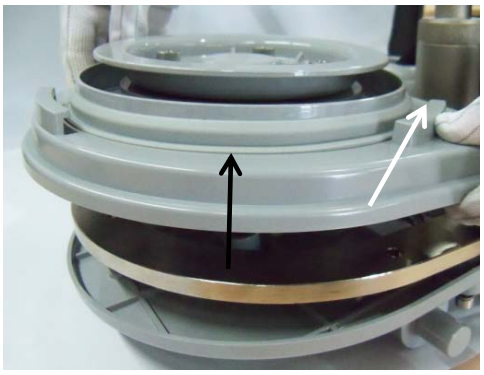
1. Use a hex socket wrench to loosen the six screws shown in the following figure.



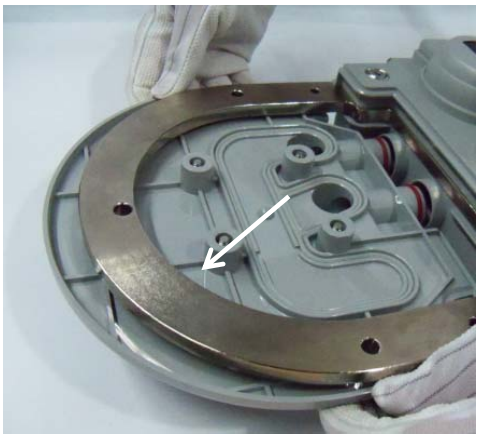
2. Loose the screw shown in the following figure.



3. Turn the patient circuit upside down and pull the upper cover 2 assembly upward to remove it.

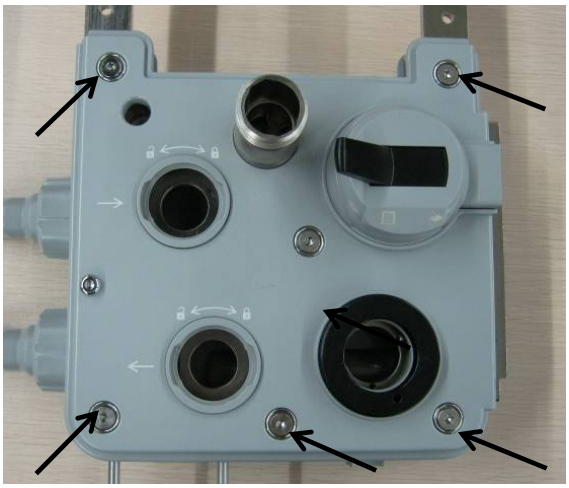


4. Pull the lower cover 2 assembly leftward to remove it.

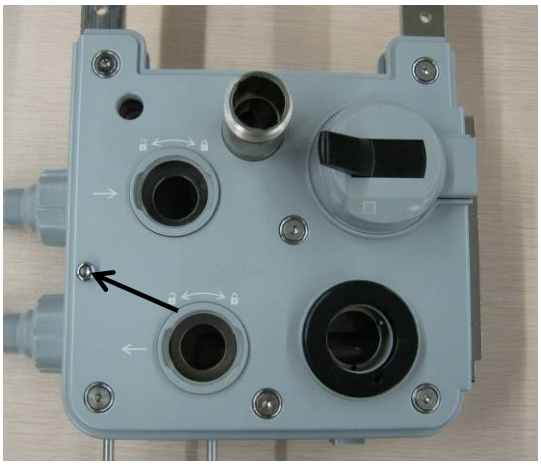


9.3.16 Dismounting the Upper Cover Assembly

1. Loose the six screws shown in the following figure.



2. Loose the screws of the upper cover assembly.

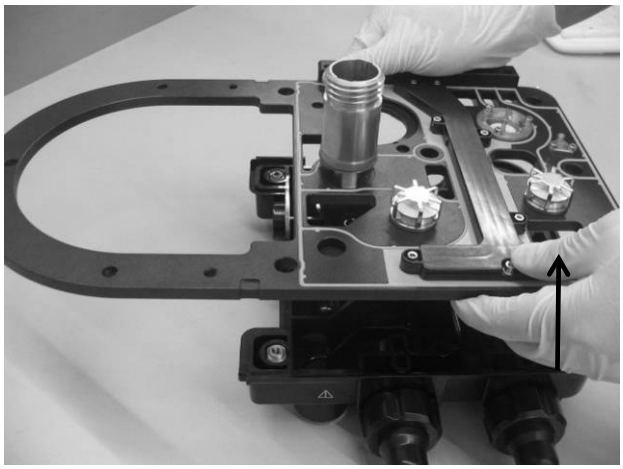


3. Use some force to remove the upper cover assembly upward.



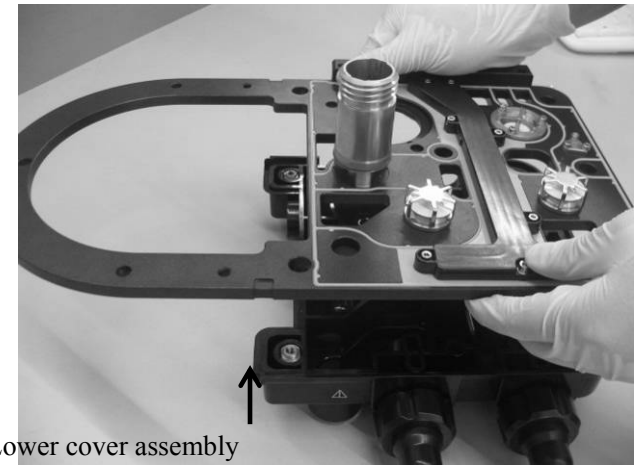
9.3.17 Dismounting the Middle Plate Assembly

Pull the middle plate upward to remove it.



9.3.18 Dismounting the Lower Cover Assembly

The following figure shows the lower cover assembly.

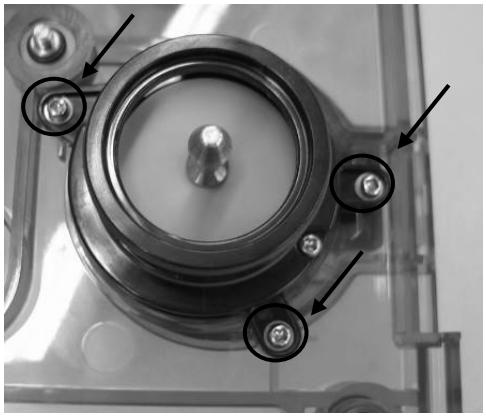


Lower cover assembly

9.3.19 Dismounting the Bag/Mechanical Ventilation Assembly

1. Follow the procedure specified in Section 9.3.16"Dismounting the Upper Cover Assembly" to dismount the upper cover assembly.
2. Turn the upper cover assembly upside down and unscrew the three screws of the bag/mechanical ventilation assembly.

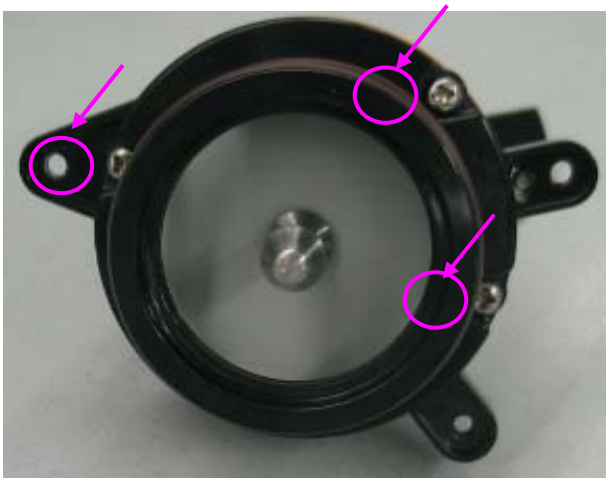




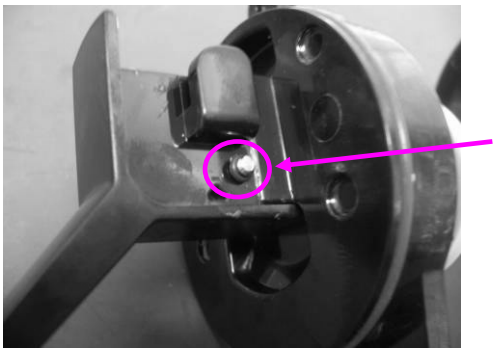
Assembly appearance



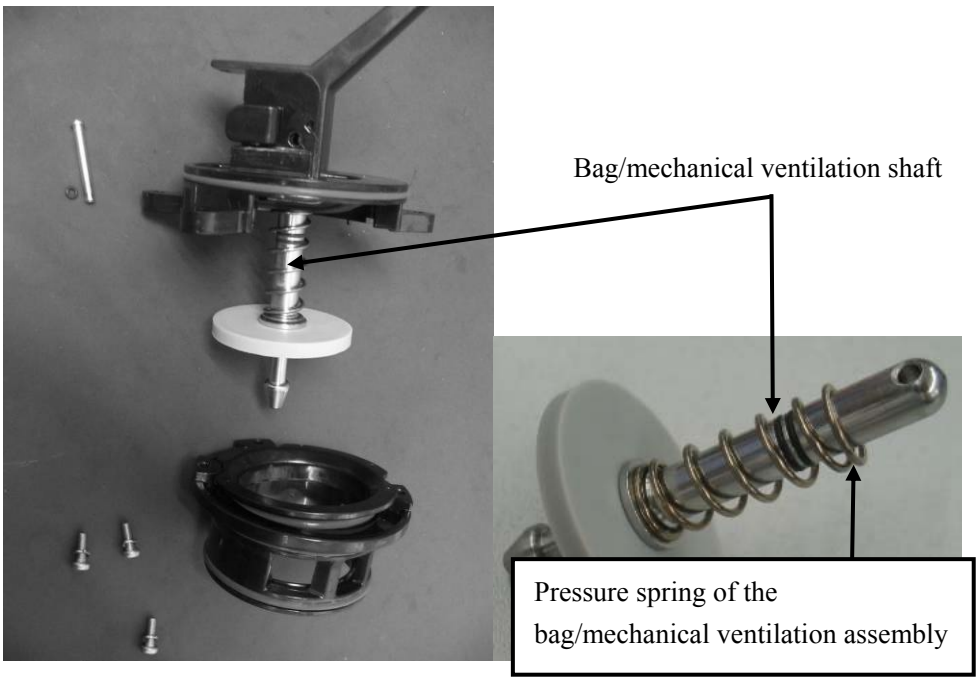
3. Unscrew the three screws.



4 Remove the sealing ring, pull out the shaft pin, and remove the bag/mechanical ventilation shaft.



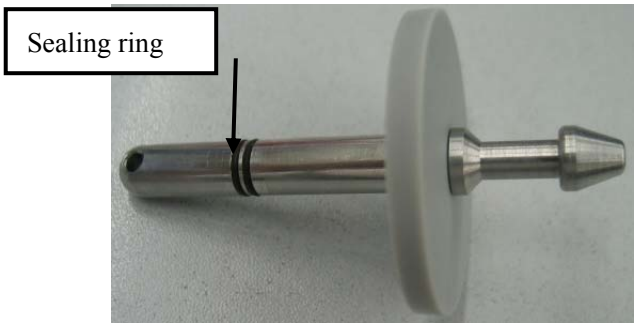
Remove the sealing ring and pull out the shaft pin



Bag/mechanical ventilation shaft

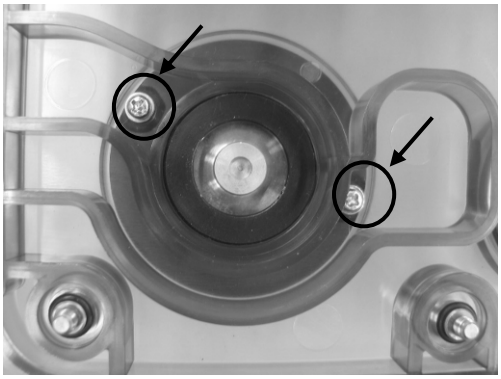
Pressure spring of the bag/mechanical ventilation assembly

5. Remove the pressure spring of the bag/mechanical ventilation assembly and replace the two sealing rings (0030-10-13077).



9.3.20 Dismounting the APL Valve Assembly

1. Follow the procedure specified in Section 9.3.18"Dismounting the Lower Cover Assembly" to dismount the lower cover assembly.
2. Unscrew the two screws and remove the assembly downward.



Assembly appearance



9.4 Disassemble the Breathing System (Compatible with Pre-Pak)

9.4.1 Remove O2 Sensor

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.



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.



9.4.2 Remove Breathing Tubes

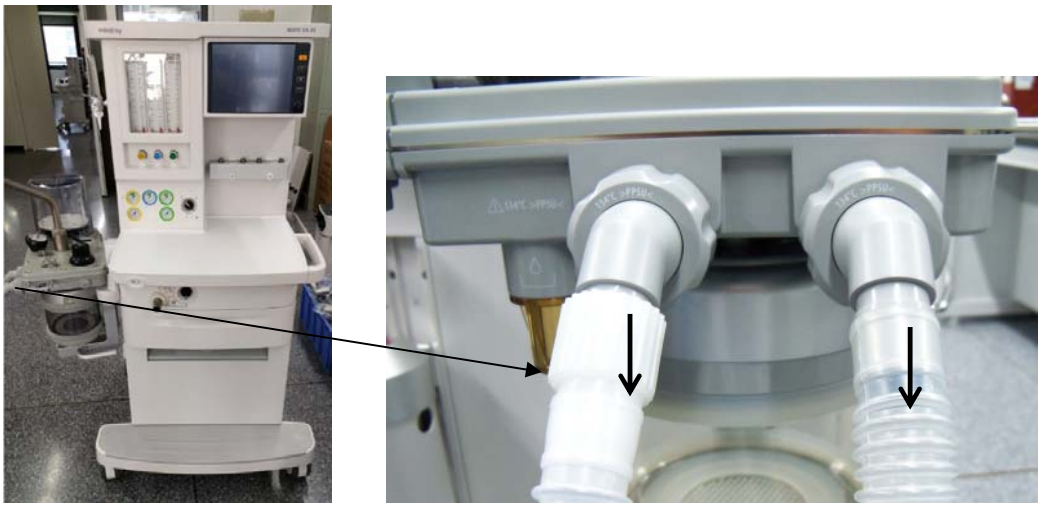
NOTE

- **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.

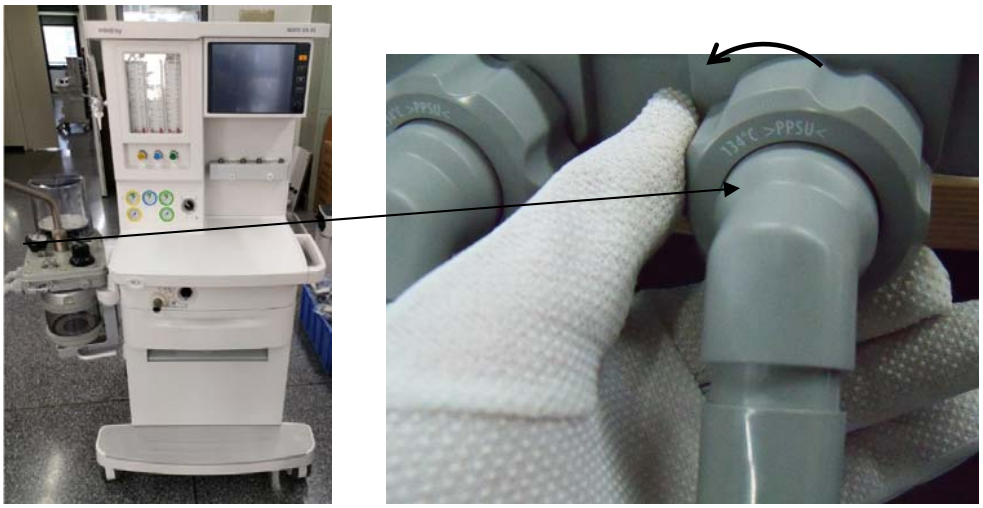


2. Disconnect the breathing tubes from the inspiration/expiration connectors on the circuit.



9.4.3 Remove Flow Sensor

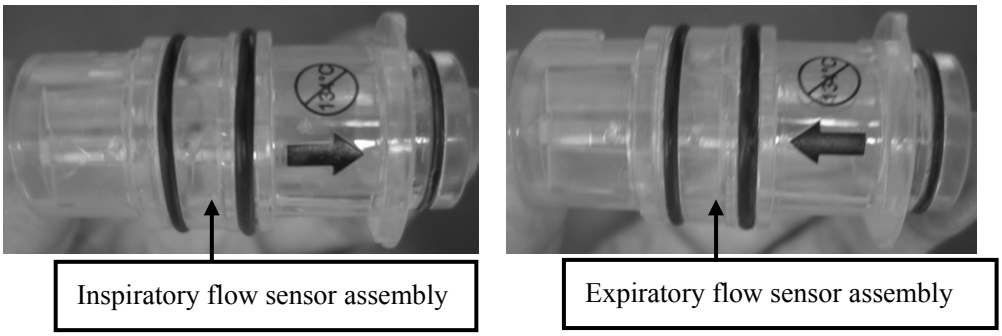
1. Turn the locking nuts counterclockwise.



2. Pull out the inspiration and expiration connectors together with their locking nuts. And then pull out the flow sensors horizontally.



The following pictures show the appearance of inspiratory and expiratory flow sensor assemblies.



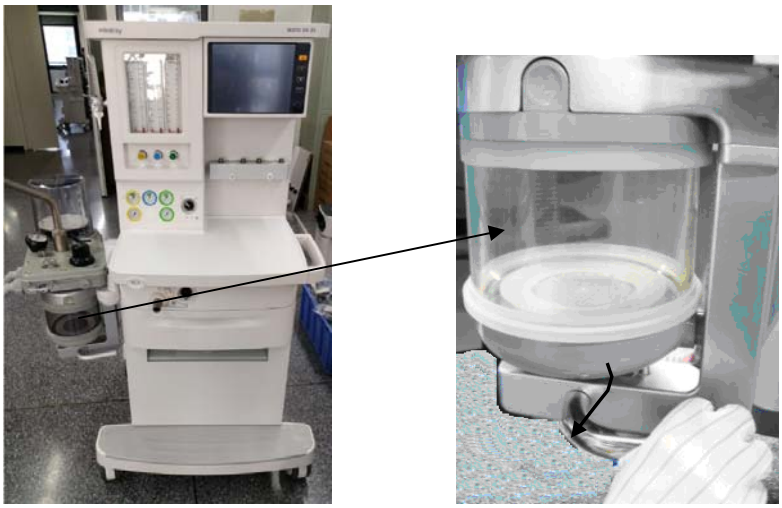
9.4.4 Remove Manual Bag

Remove the manual bag from the connector on the breathing system as shown below.



9.4.5 Remove the Absorbent Canister

1. Hold and turn the rotary handle clockwise for 45 degrees.



2. Pull out the absorbent canister horizontally.



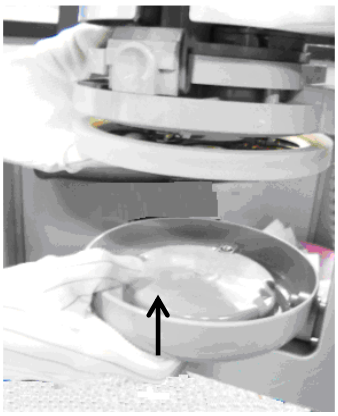
⚠WARNING

- **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.**

9.4.6 Remove CO2 Bypass Assembly

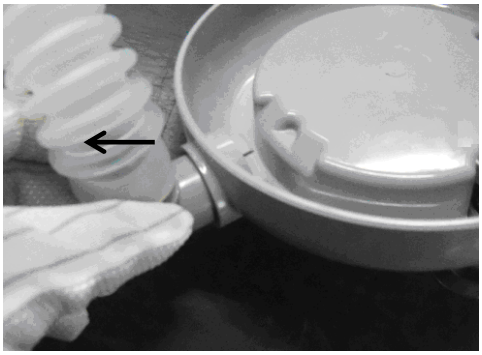
1. Remove the absorbent canister as per section 9.4.5**.**
2. Press inward the fasteners on both sides and the CO2 bypass assembly will drop down for removal.

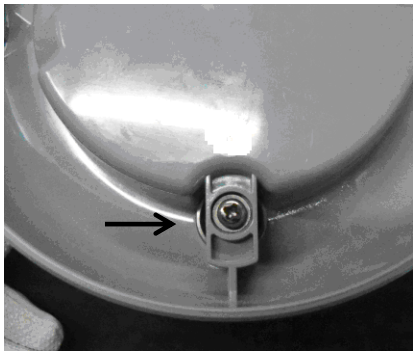




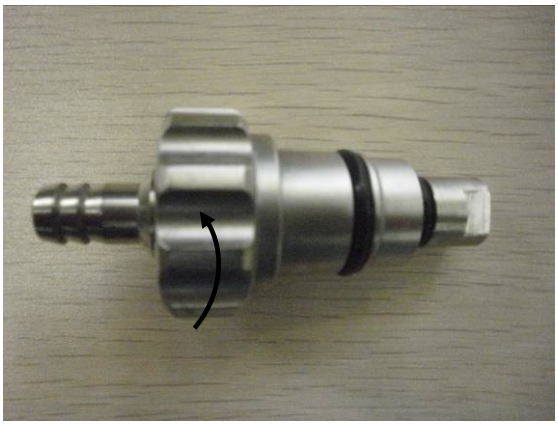
9.4.7 Remove Drain Valve

1. Remove the CO2 bypass assembly as per the section ***9.4.6***
2. Lift up and remove the CO2 Absorber Base. Unscrew the screws as shown in the picture to take out the drain valve. Remove the CO2 Absorber Hose by squeezing the retaining clips inside the absorber base.



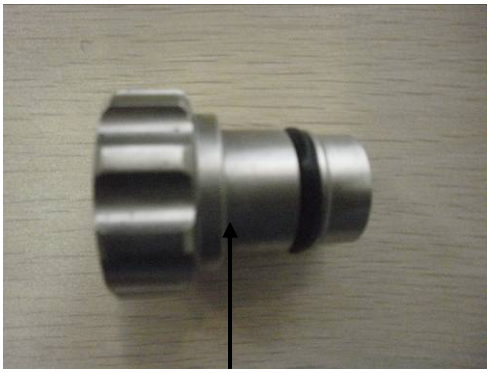


3. Turn the knurled nut counterclockwise to disassemble the drain valve.





Drain Valve Stem



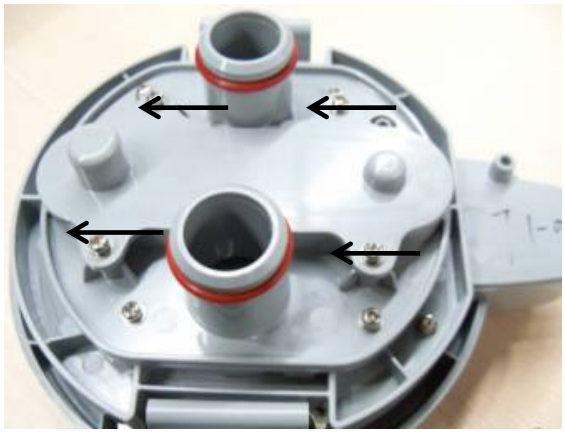
Drain Valve Body

9.4.8 Remove Bypass Valve and the Trigger Board

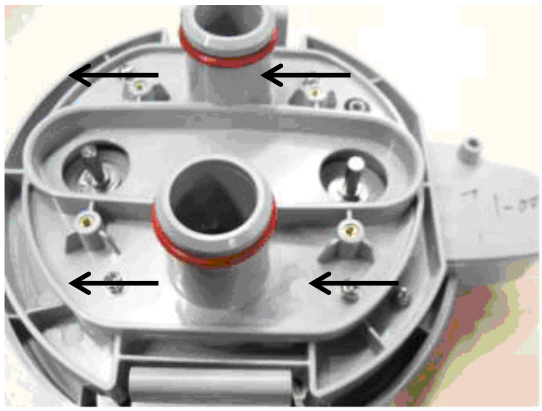
1. Remove the CO2 Bypass assembly as per section ***9.4.6***
2. Remove the transfer tube.



3. Unscrew the four screws as shown in the picture and remove the cover plate.

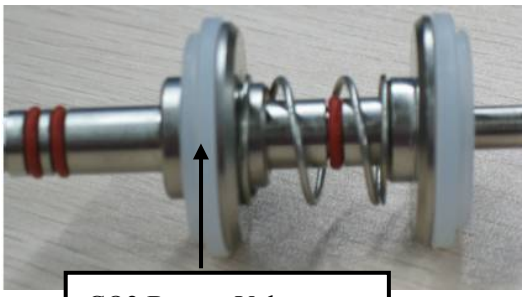


4. Unscrew the four screws as shown in the picture and remove the upper bypass cover.



5. Unscrew the two screws as shown in the picture and remove the trigger board.



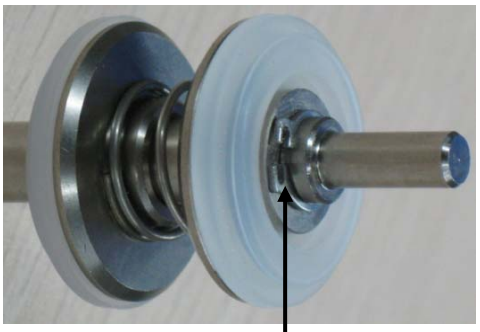


CO2 Bypass Valve

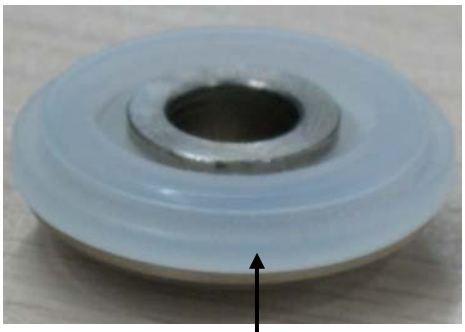


Trigger board

6. Remove the cramp ring to take out the valve needle.



Snap ring



Valve Seal

9.4.9 Remove Patient Circle Assembly

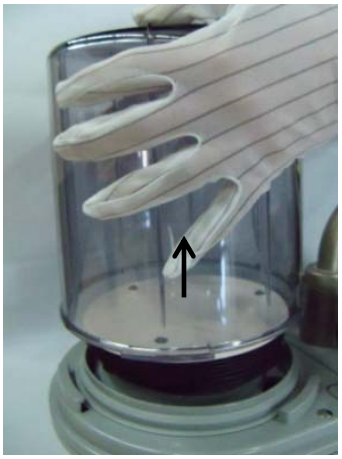
1. Remove the CO2 Bypass assembly as per section 9.4.6
2. Pull the patient circle assembly away from the rotating block assembly.



9.4.10 Remove Bellows Assembly

1. Turn the bellows dome counterclockwise and lift off to remove.



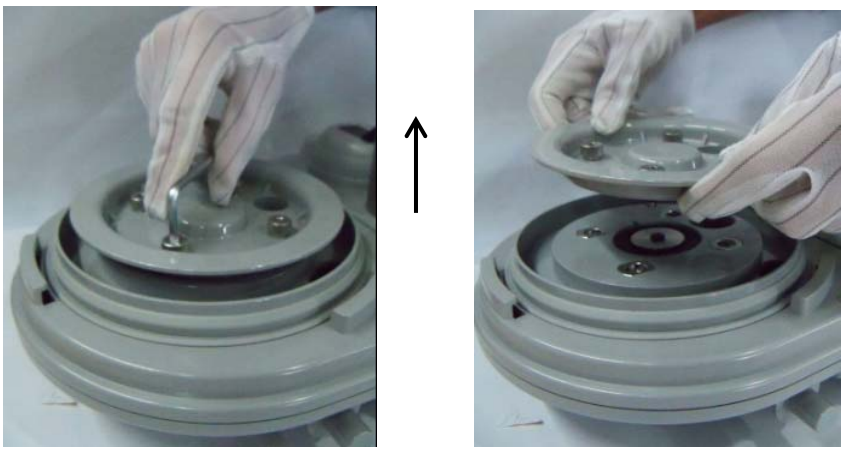


2 Remove the bellows from the bellows base.



9.4.11 Remove Pop-off Valve Assembly

1. Remove the bellows assembly as per section 9.4.10.
2. Unscrew the four locking screws as shown in the picture . Hold and pull up the Pop-Off valve cover to remove it.



3. Take out the rubber and metal Pop-Off valve.

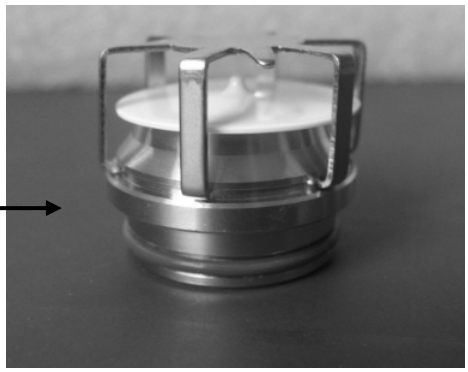


9.4.12 Remove Expiratory/Inspiratory Check Valve Assemblies

1. Turn the check valve cover counterclockwise to remove it.

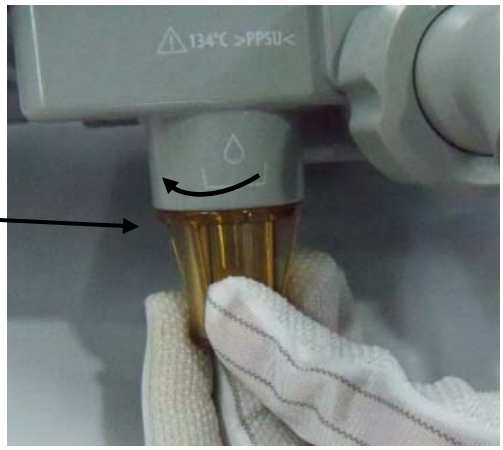



2. Pull out the check valve as shown in the following picture.

9.4.13 Remove Water Collection Cup

1. Hold the water collection cup and turn it counterclockwise to remove it.

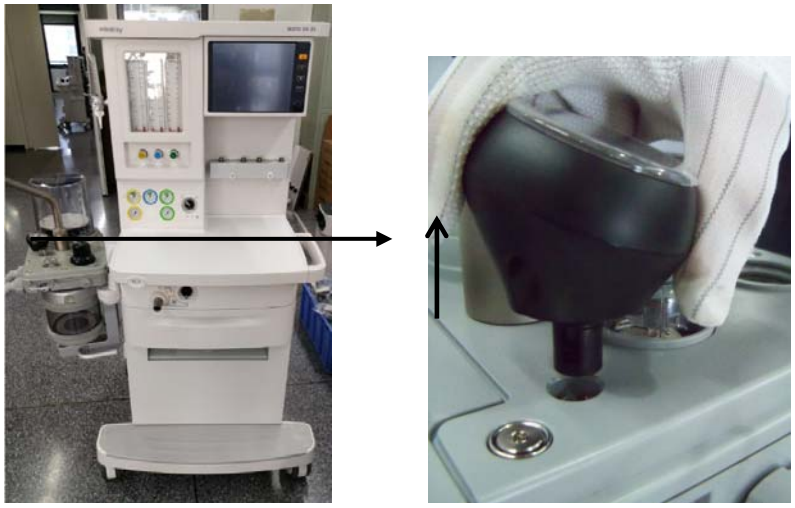



2. Remove the water collection cup.



9.4.14 Remove Airway Pressure Gauge

Lift the airway pressure gauge straight up to remove it.



9.4.15 Remove Bag Arm

1. Unscrew the locking nut counterclockwise and lift straight up to remove bag arm.

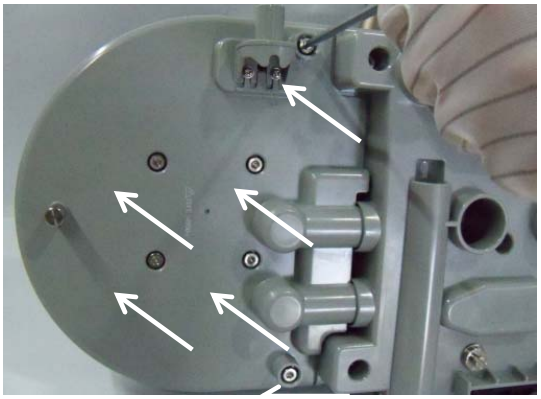


2. Remove the bag arm from the bag arm mount.

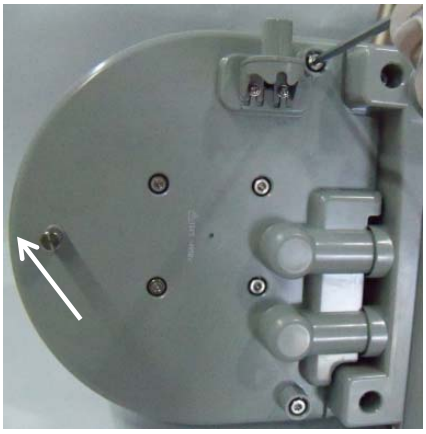


9.4.16 Remove the Back Upper Cover and Back Lower Cover Assemblies

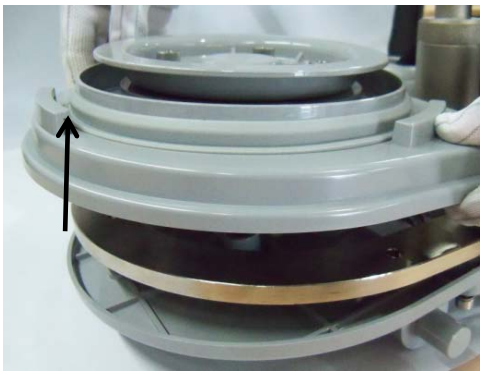
1. Unscrew the six (6) screws as shown in the following picture.



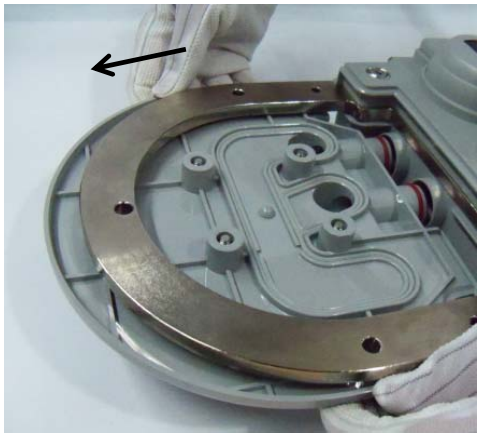
2. Unscrew the knurled thumbnut as shown in the following picture.



3. Turn over the circle. Pull up to separate the back upper cover assembly.

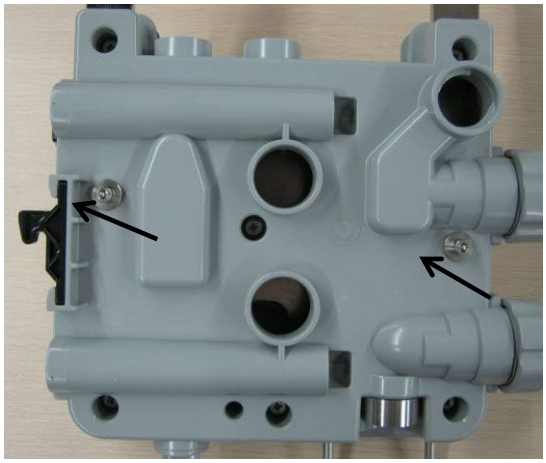


4. Pull leftwards to take out the back lower cover assemblies.

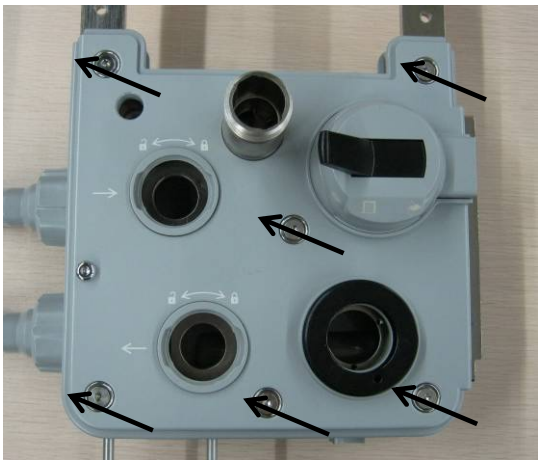


9.4.17 Remove the Front Upper Cover, Median Plate and Front Lower Cover Assemblies

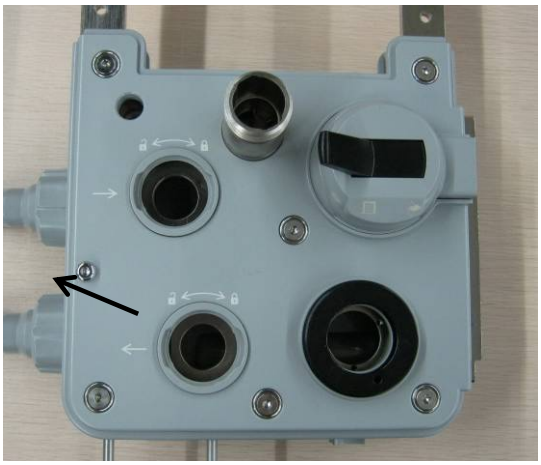
1. Remove the Back Upper Cover and Back Lower Cover Assemblies as per section 9.4.16.
2. Remove the two screws on the lower cover.



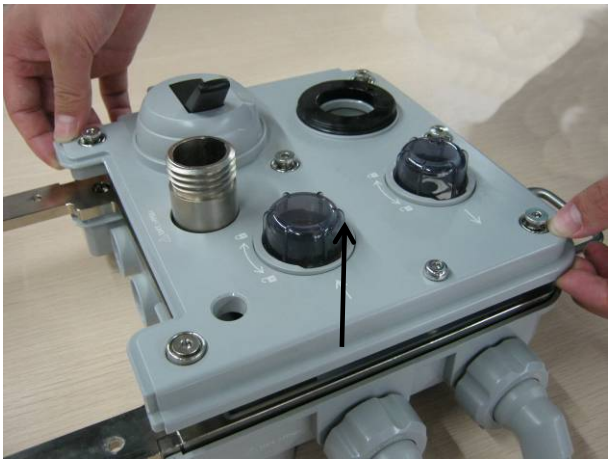
3. Loosen the six screws on the upper cover.



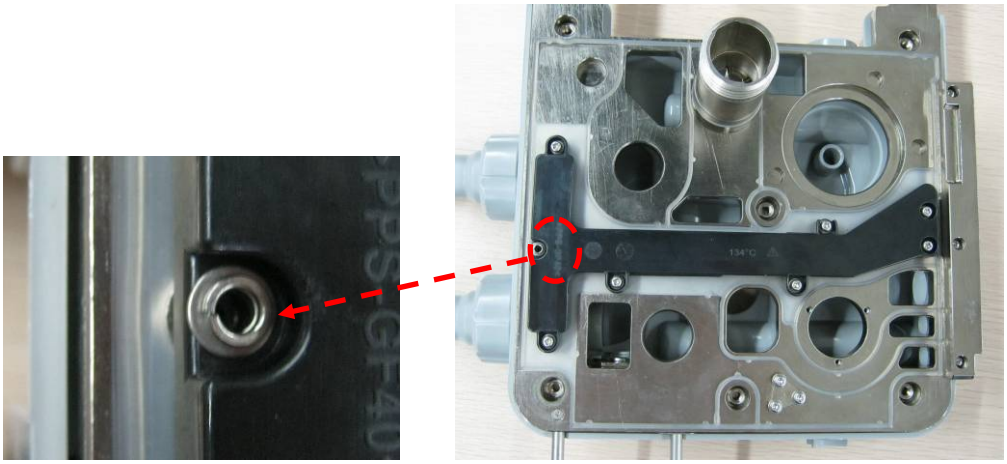
4. Loosen the captive screws on the upper cover.



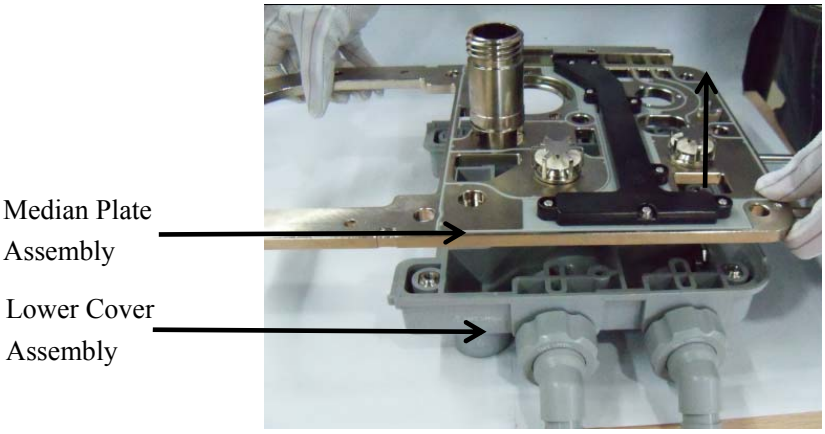
5. Hold the upper cover assembly tightly and pull it up to remove it.



6. Remove the spring washer and plain washer (note: pay special attention to the spring washer and plain washer when removing them because they easily get loose).

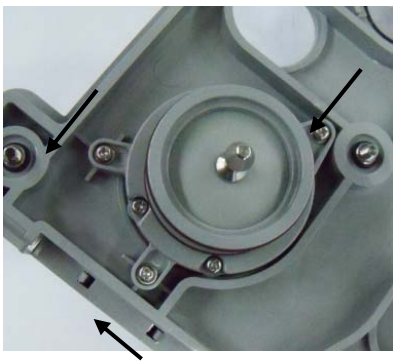


7. Pull up the median plate assembly to remove it.

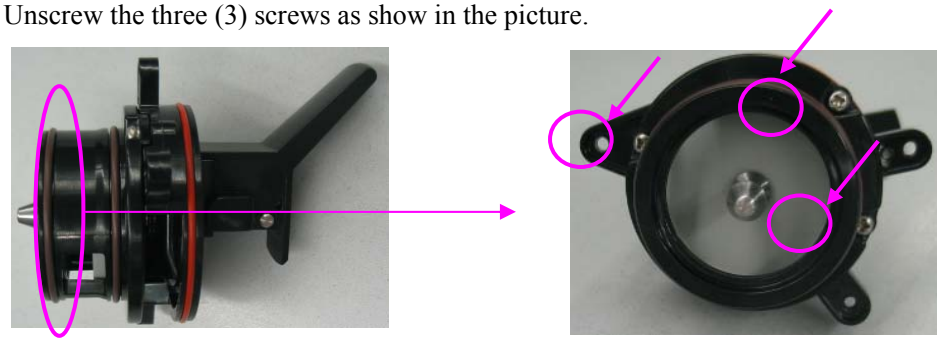


9.4.18 Remove Automatic/Manual Ventilation Switch Assembly

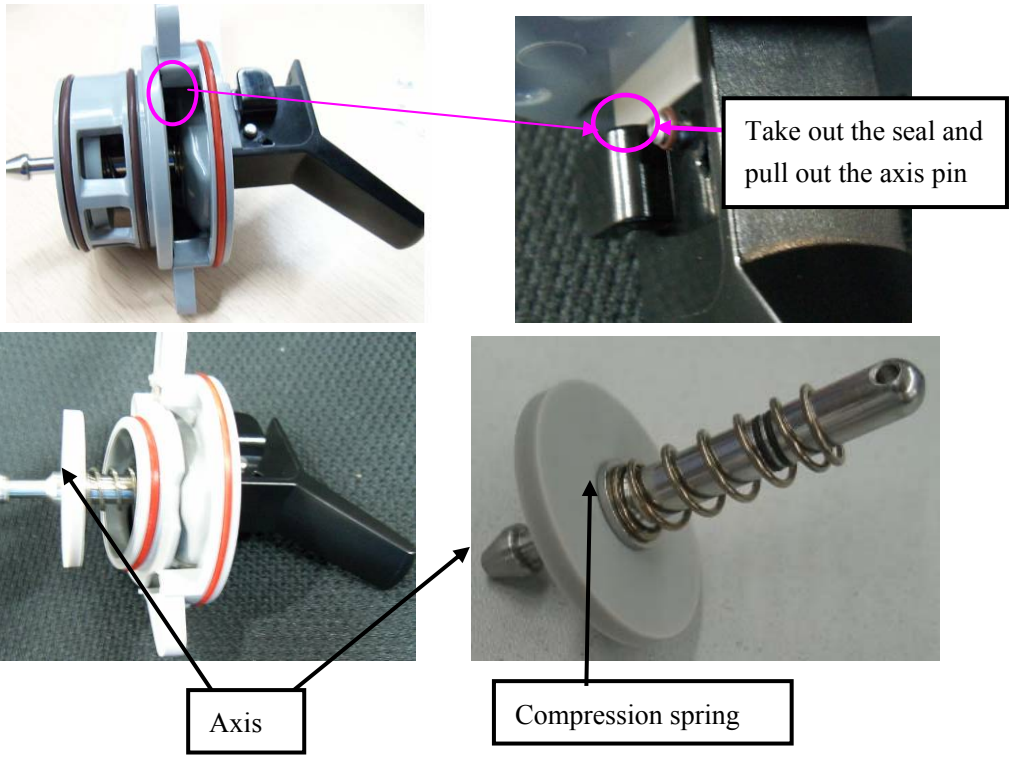
1. Remove the upper cover as per section 9.4.16.
2. Turn over the upper cover assembly to access the three screws as shown in the following picture.



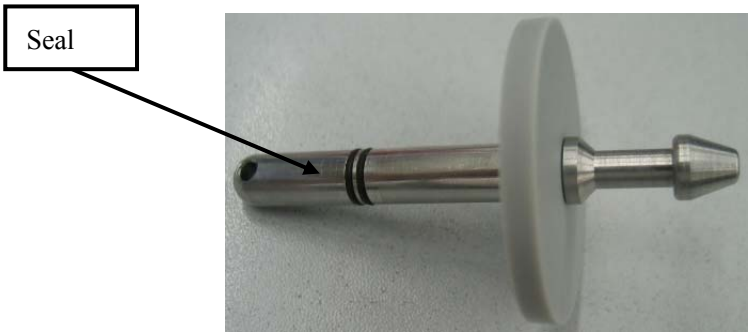
3. Unscrew the three (3) screws as show in the picture.



4. Remove the O-Ring and pull out the axis pin.



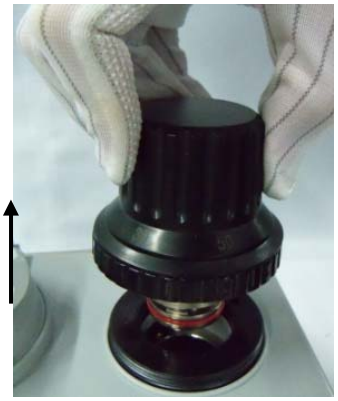
5. Remove the compression spring and replace the two seals (0030-10-13077).



9.4.19 Remove APL Valve Assembly

Turn the locking ring anticlockwise and pull the APL valve assembly straight up to remove it.



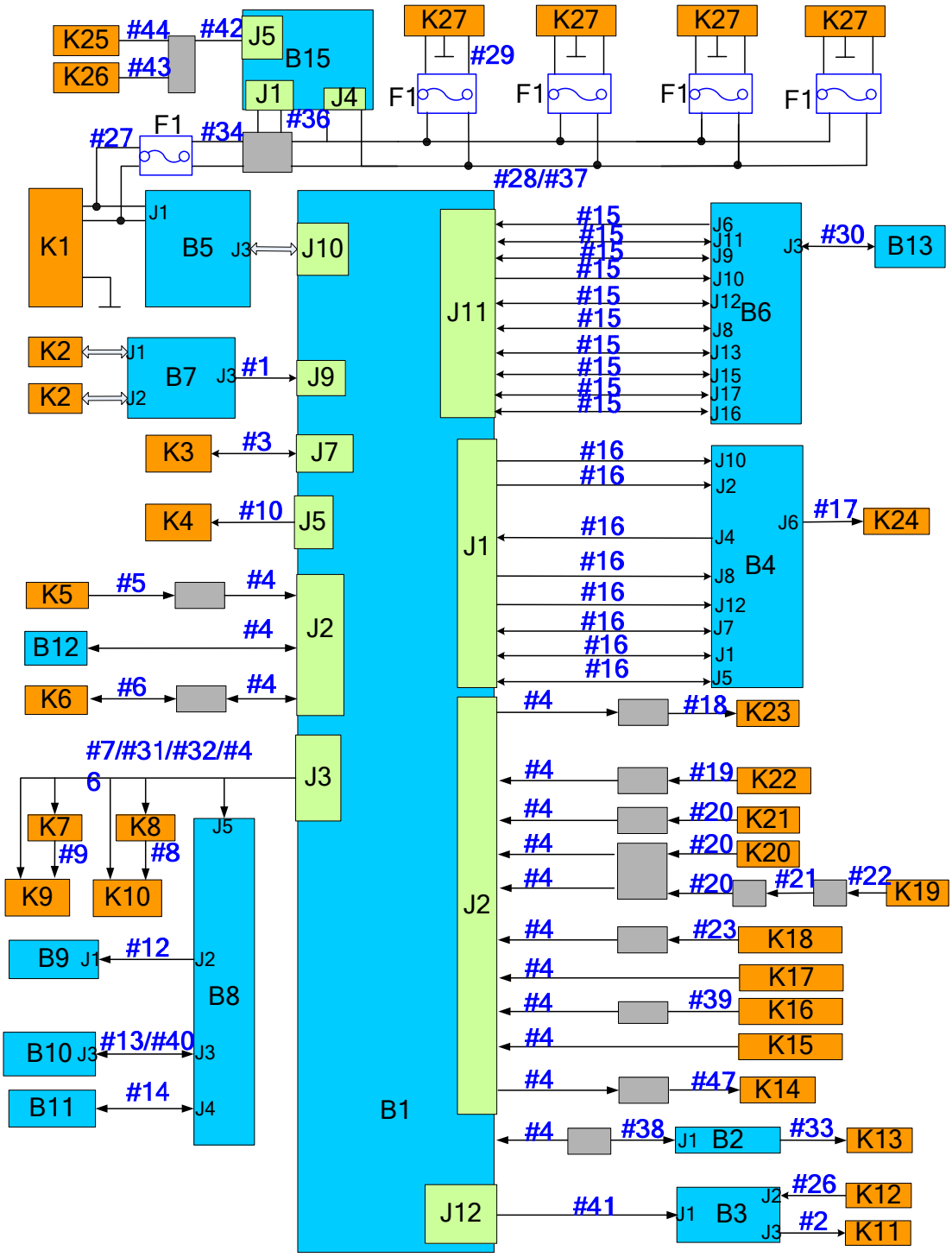


9.5 Electrical and Pneumatic Connections

After dismounting and replacing parts, refer to the following content to perform installation and connection.

9.5.1 Electrical Connections

9.5.1.1 Electrical Connections



9.5.1.2 Boards and Components

SN	Description	P/N
B1	Mother board PCBA (0623)	051-000765-02
B2	Electronic flowmeter plate PCBA (0621)	0621-30-69351 (three pipes) 0621-30-78639 (two pipes) 0621-30-78638 (one pipe)
B3	Top lighting panel PCBA (0623)	051-000764-00
B4	Monitoring signal detection board (0621)	0621-30-78632
B5	0621 Power board (0621)	0621-30-78595
B6	Main control board (0621)	9210-30-30150
B7	Battery adapter plate PCBA (0623)	051-000768-00
B8	Button control adapter plate PCBA (0623)	051-000766-00
B9	Alarm indicator board PCBA (0623)	051-000767-00
B10	Touchscreen control board	6800-30-50082
B11	Copper-shaft encoder board	0010-30-43089
B12	Infrared backplane board (0621)	051-000259-00
B13	Network interface board	9210-30-30152
B14	Valve drive board (0621)	0621-30-78634
B15	Isolation transformer drive board (0616)	051-000036-00
K1	AC socket	/
K2	Lithium battery	/
K3	Hardware box radiating fan	/
K4	System switch	/
K5	Module rack fan	/
K6	CIS system	/
K7	Inverter with a 10.4-inch screen	/
K8	Inverter with a 12.1-inch screen	/
K9	10.4-inch screen	/
K10	12.1-inch screen	/
K11	Loudspeaker	/
K12	3-position switch	/
K13	3-way valve	/
K14	Heater	/
K15	O2 flush switch	/
K16	Airway block pressure switch	/
K17	ACGO position switch	/
K18	O2 pressure switch of the gas supply inlet	/
K19	O2 cell	/
K20	Bag/mechanical ventilation switch	/
K21	Circuit in-position switch	/
K22	CO2 canister position switch	/

SN	Description	P/N
K23	Airway block assembly	/
K24	3-way valve	/
K25	Isolation transformer temperature control switch	/
K26	Isolation transformer radiating fan	/
K27	Auxiliary socket	/
F1	Fuse	/

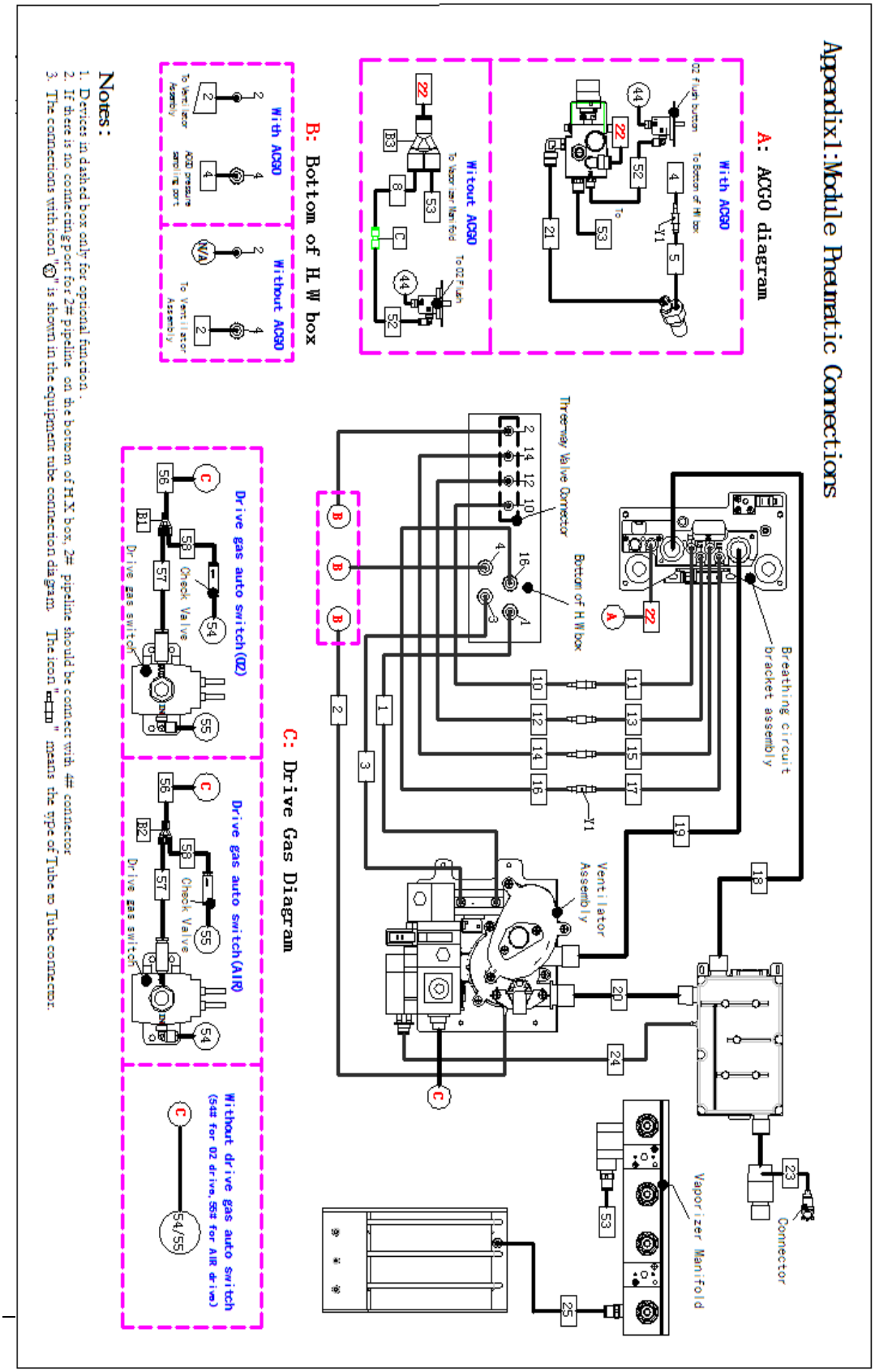
9.5.1.3 Circuit Cables

SN	Material Name	P/N
1	Battery cable (0623)	009-001455-00
2	2.25-inch loadspeaker and cable	9200-21-10633
3	Hardware box fan	024-000579-00
4	Airway assembly cable (0623)	009-001456-00
5	System switch cable (0621)	0621-20-69494
6	Module rack fan	024-000346-00
7	10.4-inch AU screen cable (0623)	009-001457-00
8	TFT screen backplane board connection cable	8000-21-10239
9	Inverter high-voltage cable B	/
10	CIS external cable (0623)	009-001459-00
11	CIS switch cable (0623)	009-001460-00
12	Alarm indicator board connection cable (0623)	009-001461-00
13	10.4-inch touchscreen connection cable (0623)	009-001462-00
14	Encoder board connection cable (0623)	009-001463-00
15	Main control board connection cable (0623)	009-001464-00
16	Monitoring board connection cable (0623)	009-001465-00
17	3-way valve connection cable (0616)	009-000061-00
18	Norgren airway block connection cable (0631)	009-000066-00
19	CO2 canister connection cable (0623)	009-001491-00
20	Internal circuit switch and O2 cell connection cable (0623)	009-001492-00
21	Internal O2 cell connection cable of the circuit	0601-21-78956
22	External O2 cell connection cable of the circuit	0601-20-78941
23	O2 pressure switch cable of the gas supply inlet	0621-20-69588
24	CO2 new circuit connection cable (0623)	009-001493-00
25	CO2 new circuit connection cable (0623)	009-001493-00
26	Top lighting panel switch cable (0631)	009-000981-00
27	AC power input cable (0623)	009-001467-00
28	Auxiliary socket power input cable (0623)	009-001468-00
29	Socket connection cable (Chinese standard)	0621-20-69608
30	Network cable (0623)	009-001469-00

SN	Material Name	P/N
31	12.1-inch AU screen data cable (0623)	009-001470-00
32	12.1-inch LG screen data cable (0623)	009-001471-00
33	3-way valve assembly connection cable of the flowmeter	0621-20-78648
34	General fuse connection cable of the auxiliary socket (0623)	009-001472-00
35	Internal heater connection cable of the circuit	0621-21-78641
36	Isolation transformer AC power input cable (0623)	009-001476-00
37	Output cable of the isolation transformer auxiliary socket (0623)	009-001477-00
38	Electronic flowmeter plate connection cable (0623)	009-001494-00
39	Airway block pressure switch connection cable (0623)	009-001495-00
40	12.1-inch touchscreen cable (0623)	009-001496-00
41	Top lighting panel connection cable (0623)	009-001497-00
42	Isolation transformer temperature control connection cable (0623)	009-000062-00
43	Transformer radiating fan and cable	0611-20-58667
44	Isolation transformer temperature control switch cable	0621-20-78594
45	Calibration power supply interface board and small VT cable	009-000056-00
46	10.4-inch LG screen data cable (0623)	009-001498-00
47	Internal heater connection cable of the circuit	0621-21-78641

9.5.2 Pneumatic Connections

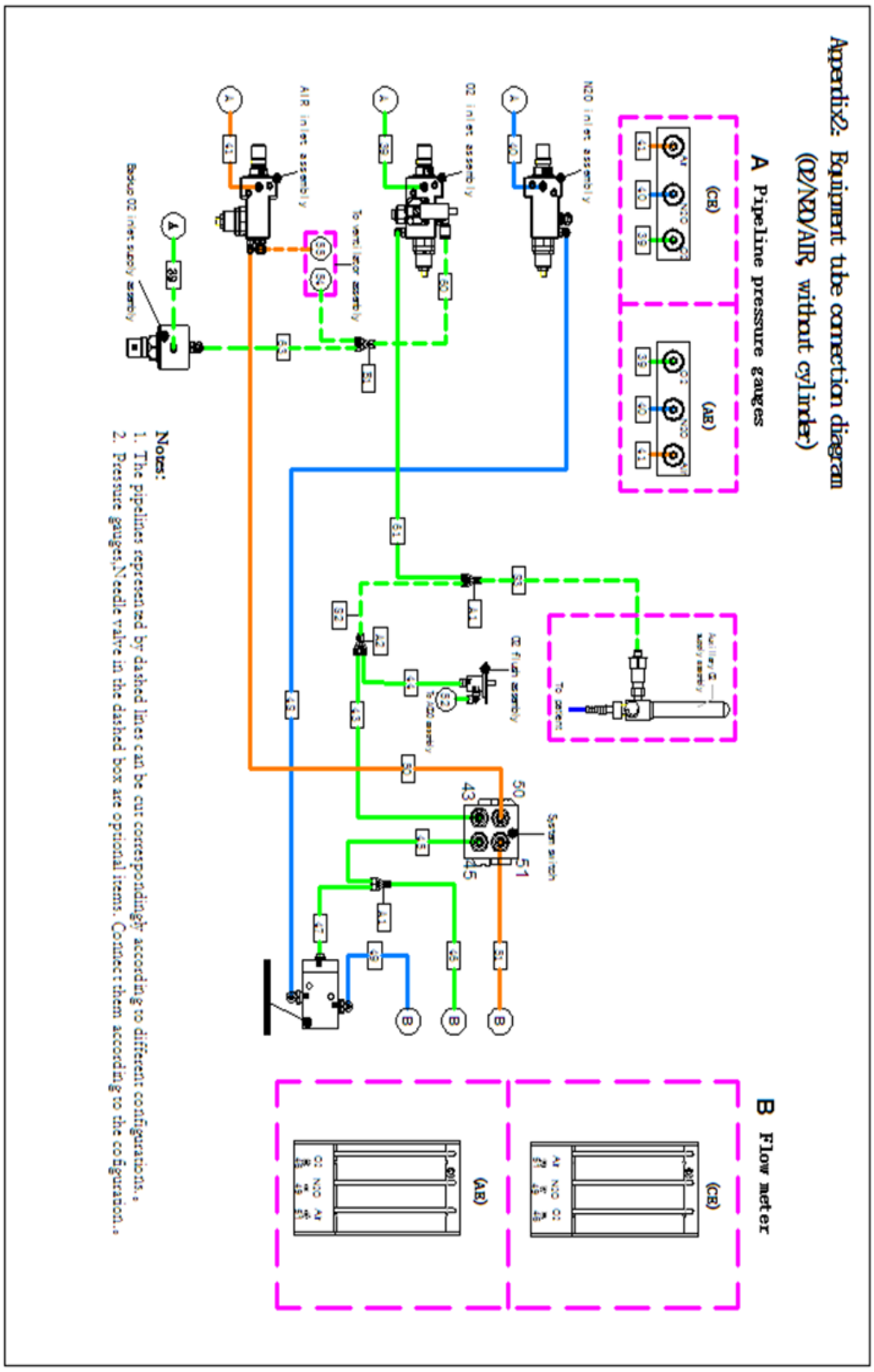
9.5.2.1 Pneumatic Connection A: Module Airway Connection



Module Airway Tubes				
SN	Length (mm)	Diameter Φ (mm)	P/N	Remarks
1	1020	Rubber tube: 5.6 x 2.4	A21-000007---	/
2	1180	Rubber tube: 5.6 x 2.4	A21-000007---	/
3	1020	Rubber tube: 5.6 x 2.4	A21-000007---	/
10	110	Rubber tube: 5.6 x 2.4	A21-000007---	/
12	120	Rubber tube: 5.6 x 2.4	A21-000007---	/
14	130	Rubber tube: 5.6 x 2.4	A21-000007---	/
16	85	Rubber tube: 5.6 x 2.4	A21-000007---	/
11	730	PU tube: 4 x 2.5	M6G-020046---	/
13	730	PU tube: 4 x 2.5	M6G-020046---	/
15	730	PU tube: 4 x 2.5	M6G-020046---	/
17	730	PU tube: 4 x 2.5	M6G-020046---	/
23	140	Rubber tube: 3.5 x 2	M6G-020005---	/
24	340	PU tube: 6 x 4	M6G-020026---	/
44	610	PU tube: 6 x 4	M6G-020026---	/
52	300	PU tube: 6 x 4	M6G-020026---	/
53	660	PU tube: 8 x 5.5	M6G-020045---	/
ACGO tube connection (choose 1/2)				
With the ACGO assembly				
4	80	Rubber tube: 5.6 x 2.4	A21-000007---	/
5	750	PU tube: 4 x 2.5	M6G-020046---	/
21	310	PU tube: 10 x 7	082-000519-00	/
22	195	PU tube: 10 x 7	082-000519-00	/
Without the ACGO assembly				
8	190	PU tube: 8 x 5.5	M6G-020045---	/

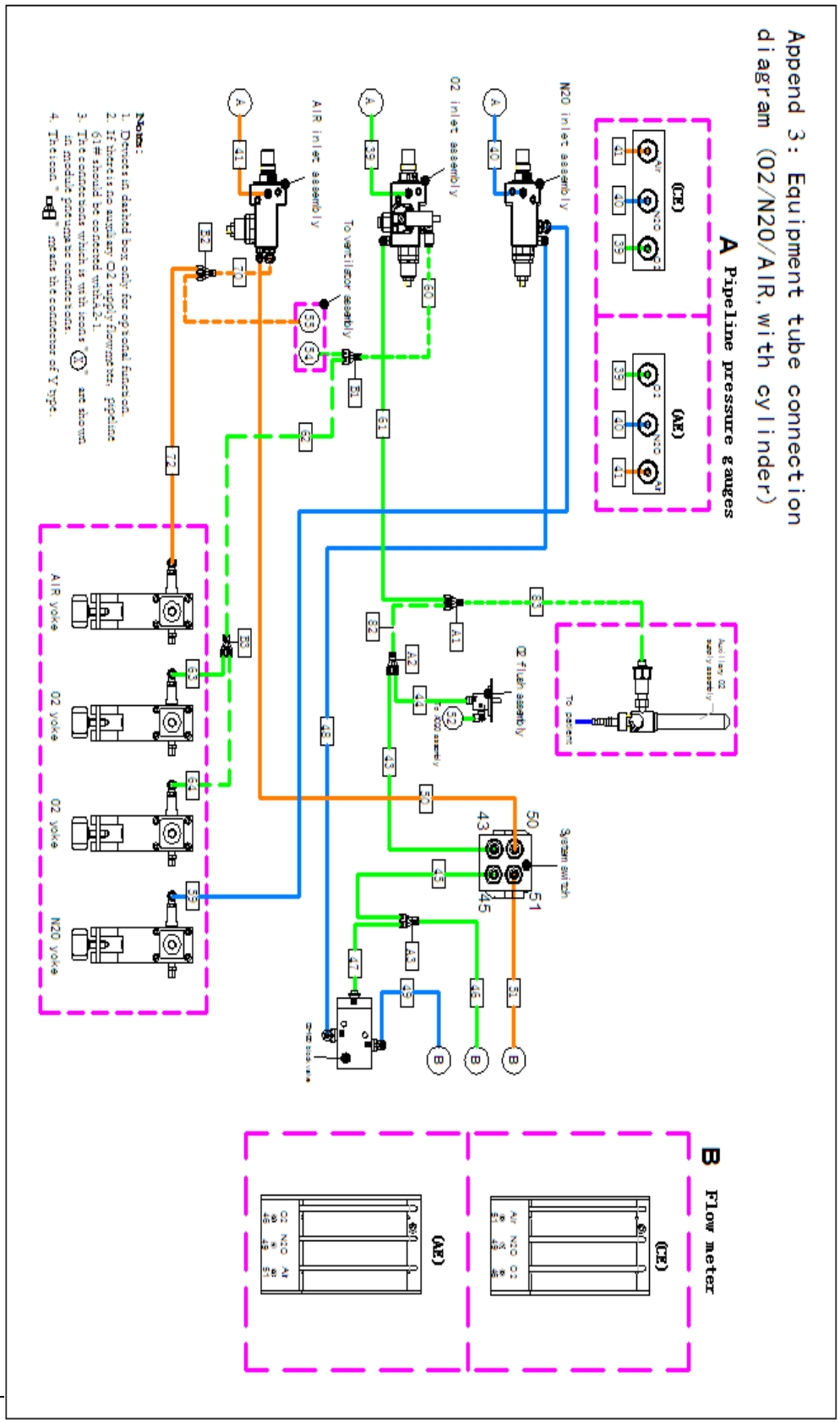
22	195	PU tube: 10 x 7	082-000519-00	/
25	470	PU tube: 8 x 5.5	M6G-020045---	/
Drive gas tube connection (choose 1/4)				
Oxygen-powered, with a switch				
54	500	PU tube: 8 x 5.5	M6G-020045---	/
55	480	PU tube: 8 x 5.5	M6G-020045---	/
56	100	PU tube: 8 x 5.5	M6G-020045---	/
57	140	PU tube: 8 x 5.5	M6G-020045---	/
58	70	PU tube: 8 x 5.5	M6G-020045---	/
Air-powered, with a switch				
54	500	PU tube: 8 x 5.5	M6G-020045---	/
55	480	PU tube: 8 x 5.5	M6G-020045---	/
56	100	PU tube: 8 x 5.5	M6G-020045---	/
57	140	PU tube: 8 x 5.5	M6G-020045---	/
58	70	PU tube: 8 x 5.5	M6G-020045---	/
Oxygen-powered, without a switch				
54	670	PU tube: 8 x 5.5	M6G-020045---	/
Air-powered, without a switch				
55	480	PU tube: 8 x 5.5	M6G-020045---	/
Note: 1. The cutting tolerance of a gas tube equal to or longer than 300 mm must be within the ±10 mm range. The cutting tolerance of a gas tube shorter than 300 mm must be within the ±5 mm range. 2. Y indicates the following connector: tube to Tube, Elbow, 200 Barb, 3/32" & 1/16" ID, P/N: M90-100027---				

9.5.2.2 Pneumatic Connection B: Overall Pneumatic Connection (With the O2, N2O, and Air Supplies and Without Gas Cylinders)



Overall Airway Tubes (With the O2, N2O, and Air Supplies and Without Gas Cylinders)				
SN	Length (mm)	Diameter Φ (mm)	P/N	Remarks
39	540	PU tube: 4 x 2.5	M6G-020046---	/
40	550	PU tube: 4 x 2.5	M6G-020046---	/
41	520	PU tube: 4 x 2.5	M6G-020046---	/
43	115	PU tube: 6 x 4	M6G-020026---	/
45	280	PU tube: 6 x 4	M6G-020026---	/
46	70	PU tube: 6 x 4	M6G-020026---	/
47	270	PU tube: 6 x 4	M6G-020026---	/
48	250	PU tube: 4 x 2.5	M6G-020046---	/
49	340	PU tube: 4 x 2.5	M6G-020046---	/
50	340	PU tube: 6 x 4	M6G-020026---	/
51	220	PU tube: 6 x 4	M6G-020026---	/
61	250	PU tube: 6 x 4	M6G-020026---	/
63	300	PU tube: 8 x 5.5	M6G-020045---	/
82	210	PU tube: 6 x 4	M6G-020026---	Available only when the auxiliary O2 supply assembly is provided
83	300	PU tube: 6 x 4	M6G-020026---	
x 60	75	PU tube: 8 x 5.5	M6G-020045---	Available only for oxygen-powered devices/devices with a drive switch (oxygen- or air-powered)
Note: 1. The cutting tolerance of a gas tube equal to or longer than 300 mm must be within the ±10 mm range. The cutting tolerance of a gas tube shorter than 300 mm must be within the ±5 mm range. 2. A indicates the following connector: tube to tube, Y-shaped 3140-06-00, P/N: M6Q-030024---. On the drawing, the labels A1, A2, and the like are used. 3. A indicates the following connector: tube to tube, Y-shaped 3140-08-00, P/N: M6Q-030025---. On the drawing, the labels B1, B2, and the like are used.				

9.5.2.3 Pneumatic Connection C: Overall Pneumatic Connection (With the O2, N2O, and Air Supplies and With Gas Cylinders)

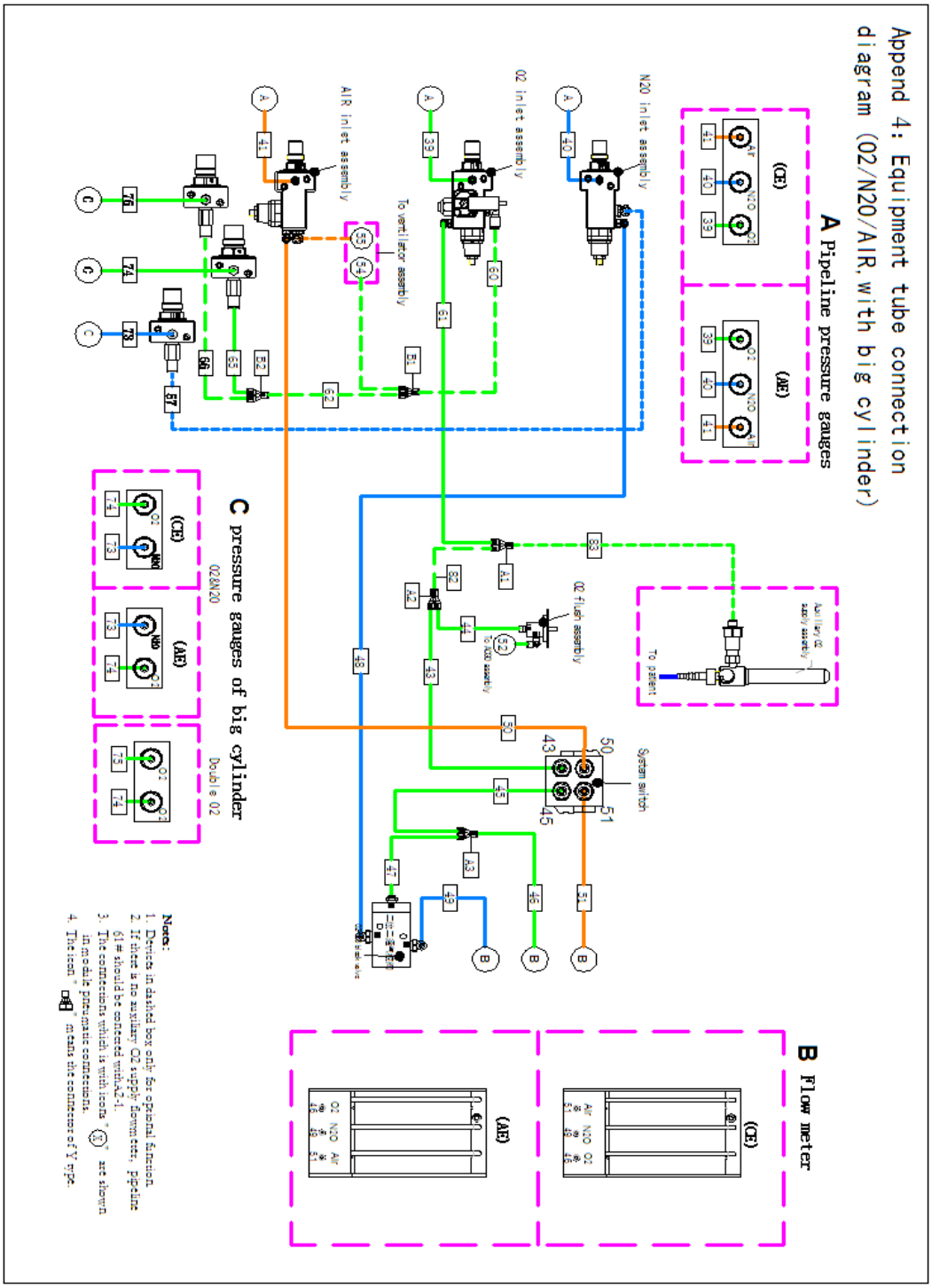


Overall Pneumatic Tubes (With the O2, N2O, and Air Supplies and with Gas Cylinders)				
SN	Length (mm)	Diameter Φ (mm)	P/N	Remarks
39	540	PU tube: 4 x 2.5	M6G-020046---	/
40	550	PU tube: 4 x 2.5	M6G-020046---	/
41	520	PU tube: 4 x 2.5	M6G-020046---	/
43	115	PU tube: 6 x 4	M6G-020026---	/
45	280	PU tube: 6 x 4	M6G-020026---	/
46	70	PU tube: 6 x 4	M6G-020026---	/
47	270	PU tube: 6 x 4	M6G-020026---	/
48	250	PU tube: 4 x 2.5	M6G-020046---	/
49	340	PU tube: 4 x 2.5	M6G-020046---	/
50	340	PU tube: 6 x 4	M6G-020026---	/
51	220	PU tube: 6 x 4	M6G-020026---	/
61	250	PU tube: 6 x 4	M6G-020026---	/
82	210	PU tube: 6 x 4	M6G-020026---	Available only when the auxiliary O2 supply assembly is provided
83	300	PU tube: 6 x 4	M6G-020026---	
x 60	75	PU tube: 8 x 5.5	M6G-020045---	Available only for oxygen-powered devices/devices with a drive switch (oxygen- or air-powered)
x 70	75	PU tube: 8 x 5.5	M6G-020045---	Available only for oxygen-powered devices/devices with a drive switch (oxygen- or air-powered)
O2, N2O, and air supplies, with two gas cylinders				
59	450	PU tube: 6 x 4	M6G-020026---	/
63	410	PU tube: 8 x 5.5	M6G-020045---	/
72	390	PU tube: 8 x 5.5	M6G-020045---	/
O2 and air cylinders				
63	410	PU tube: 8 x 5.5	M6G-020045---	/
72	390	PU tube: 8 x 5.5	M6G-020045---	/
O2 and N2O cylinders				
59	450	PU tube: 6 x 4	M6G-020026---	/

63	410	PU tube: 8 x 5.5	M6G-020045---	/
O2 cylinder				
63	410	PU tube: 8 x 5.5	M6G-020045---	/
Two O2 cylinders				
62	75	PU tube: 8 x 5.5	M6G-020045---	/
63	320	PU tube: 8 x 5.5	M6G-020045---	
64	280	PU tube: 8 x 5.5	M6G-020045---	

Note:
The cutting tolerance of a gas tube equal to or longer than 300 mm must be within the ±10 mm range. The cutting tolerance of a gas tube shorter than 300 mm must be within the ±5 mm range.
2. A indicates the following connector: tube to tube, Y-shaped 3140-06-00, P/N: M6Q-030024---. On the drawing, the labels A1, A2, and the like are used.
3. A indicates the following connector: tube to tube, Y-shaped 3140-08-00, P/N: M6Q-030025---. On the drawing, the labels B1, B2, and the like are used.

9.5.2.4 Pneumatic Connection D: Overall Pneumatic Connection (With the O2, N2O, and Air Supplies and With Large Cylinders)



Overall Pneumatic Tubes (With the O2, N2O, and Air Supplies and with Large Cylinders)				
SN	Length (mm)	Diameter Φ (mm)	P/N	Remarks
39	540	PU tube: 4 x 2.5	M6G-020046---	/
40	550	PU tube: 4 x 2.5	M6G-020046---	/
41	520	PU tube: 4 x 2.5	M6G-020046---	/
43	115	PU tube: 6 x 4	M6G-020026---	/
45	280	PU tube: 6 x 4	M6G-020026---	/
46	70	PU tube: 6 x 4	M6G-020026---	/
47	270	PU tube: 6 x 4	M6G-020026---	/
48	250	PU tube: 4 x 2.5	M6G-020046---	/
49	340	PU tube: 4 x 2.5	M6G-020046---	/
50	340	PU tube: 6 x 4	M6G-020026---	/
51	220	PU tube: 6 x 4	M6G-020026---	/
61	250	PU tube: 6 x 4	M6G-020026---	/
82	210	PU tube: 6 x 4	M6G-020026---	Available only when the auxiliary O2 supply assembly is provided
83	300	PU tube: 6 x 4	M6G-020026---	
x 60	75	PU tube: 8 x 5.5	M6G-020045---	Available only for oxygen-powered devices/devices with a drive switch (oxygen- or air-powered)
Large N2O cylinders				
57	390	PU tube: 6 x 4	M6G-020026---	/
65	280	PU tube: 8 x 5.5	M6G-020045---	/
73	510	PU tube: 4 x 2.5	M6G-020046---	/
74	510	PU tube: 4 x 2.5	M6G-020046---	/
Two large O2 cylinders				
62	75	PU tube: 8 x 5.5	M6G-020045---	/
65	230	PU tube: 8 x 5.5	M6G-020045---	/
66	280	PU tube: 8 x 5.5	M6G-020045---	/
74	510	PU tube: 4 x 2.5	M6G-020046---	/
75	510	PU tube: 4 x 2.5	M6G-020046---	/
Note:				

The cutting tolerance of a gas tube equal to or longer than 300 mm must be within the ±10 mm range. The cutting tolerance of a gas tube shorter than 300 mm must be within the ±5 mm range.
2. A indicates the following connector: tube to tube, Y-shaped 3140-06-00, P/N: M6Q-030024---. On the drawing, the labels A1, A2, and the like are used.
3. A indicates the following connector: tube to tube, Y-shaped 3140-08-00, P/N: M6Q-030025---. On the drawing, the labels B1, B2, and the like are used.

10 Replacement Parts

10.1 Introduction

This anaesthesia system can be divided into 16parts according to its structure and functions. Each part contains several replaceable parts. Table 8-1 through Table 8-16provide the information about the replaceable parts and Diagram 8-1 through Diagram 8-14 give the positions of replaceable parts. When selecting replaceable parts, consideration should be given 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 electrical 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.

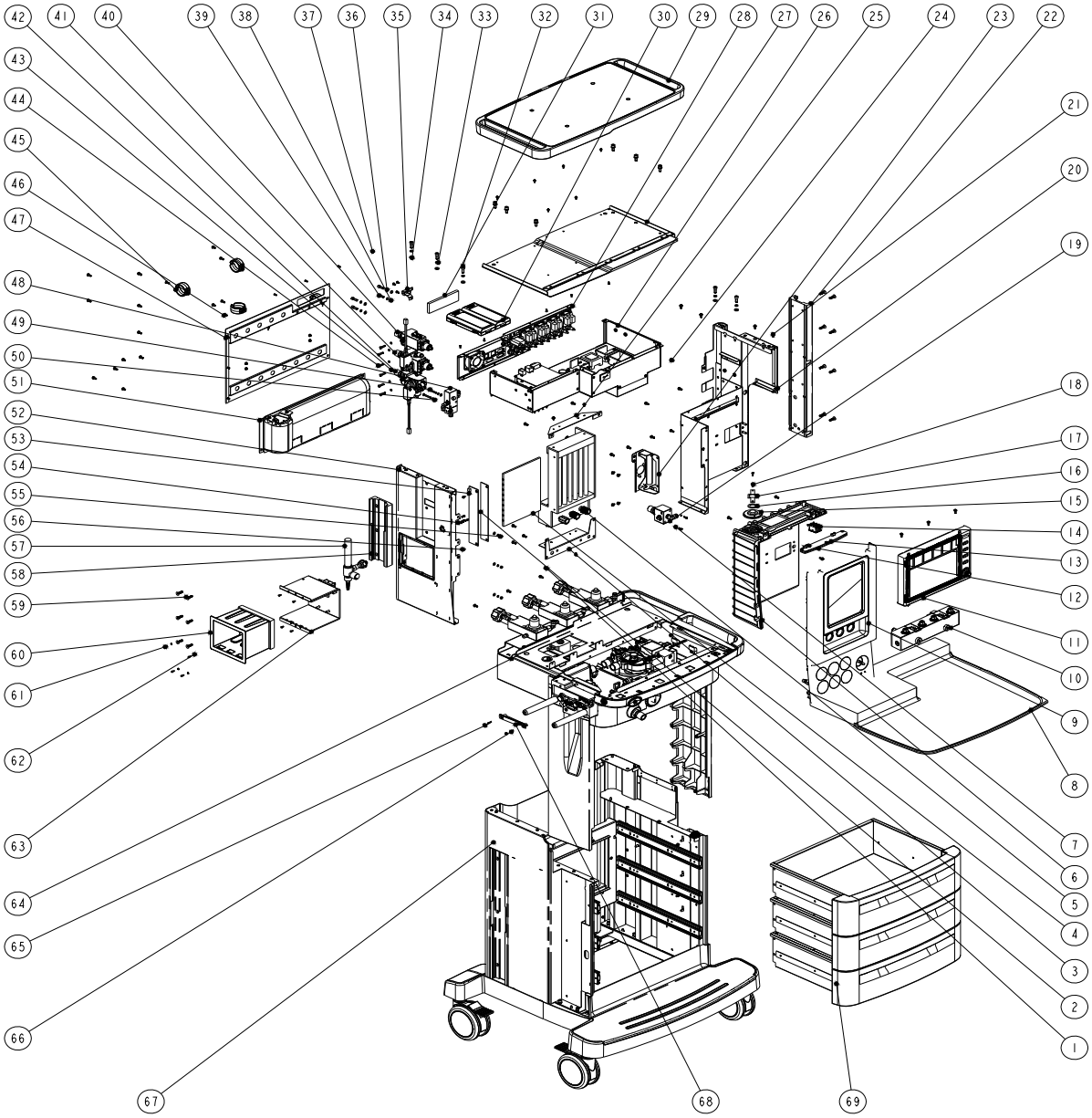
10.2 Ordering Replaceable Parts

Provide the following information to order replaceable parts:

- FRU code of the parts
- Number of the parts in the document table
- Description of the characteristics of the parts

For example: P/N: 801-0631-00001-00 Auxiliary gas supply, No.1

10.3 Diagrams and Tables



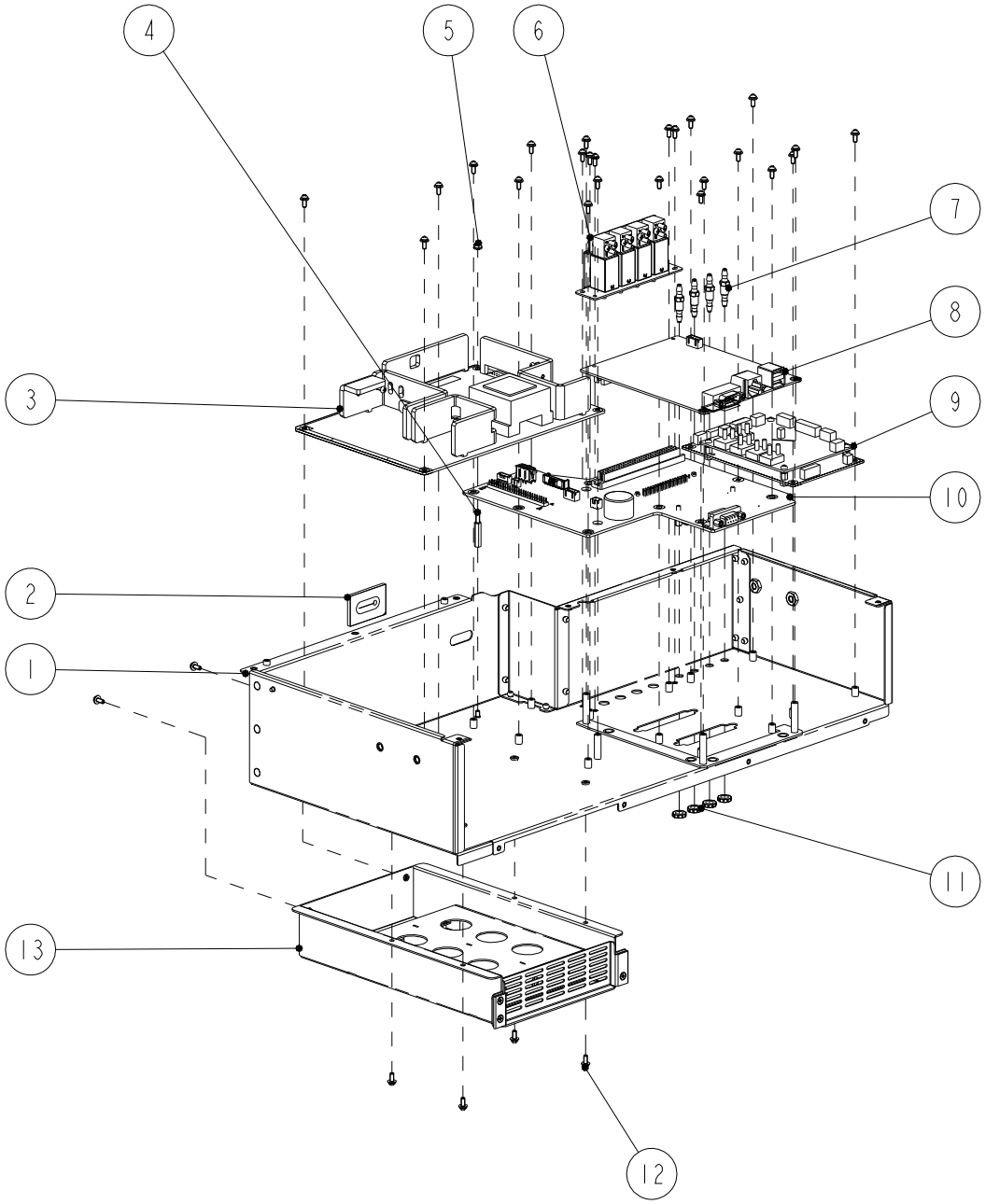
NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	M04-051141---	M4X8 COMBINED SCREW	8	No	/
2	047-016131-00	backlight board insulator	1	No	/
3	042-016473-00	flowmeter support(0619)	1	No	/
4	047-016129-00	back-light of flowmeter	1	No	/
5	0611-10-67552	6-tube flowmeter (0.1-10)L/min 2.5% LY-10T-6	1	No	/
5A	115-016499-00	O2 & AIR flowmeter assembly(GB Standard)	1	Yes	/
5B	801-0613-00015-00	flowmeter(O2/N2O)	1	Yes	/

5C	801-0613-00016-00	flowmeter(O2/N2O/AIR)	1	Yes	/
5E	082-001239-00	4-tube flowmeter.EN Standard	1	Yes	/
5F	082-000104-00	4-tube flowmeter EU	1	Yes	/
5G	082-000099-00	6-tube flowmeter EU	1	Yes	/
5H	082-001238-00	4-tube flowmeter.US Standard	1	Yes	/
5I	082-000102-00	4-tube flowmeter US	1	Yes	/
5J	082-000103-00	6-tube flowmeter US	1	Yes	/
5K	082-000951-00	4-tube flowmeter.EN color,US order	1	Yes	/
5L	082-000950-00	6-tube flowmeter.EN color,US order	1	Yes	/
6	043-006194-00	front cover of main unit(0619)	1	No	/
7	M04-000104---	spring washer GB93 3	5	No	/
8	043-006805-00	Worktable Cover Assembly(0619)	1	Yes	/
9	115-035249-00	Flowmeter Cover Assm(6-tube)	1	No	/
10	115-032993-00	double vaporizer assembly(0625)	1	Yes	/
10A	115-030766-00	Single vaporizer assembly	1	Yes	/
10B	115-027692-00	D-vaporizer assembly(plug-in)(0635)	1	Yes	/
11	115-035274-00	Display Unit(0619)	1	Yes	/
12	043-005380-00	lampshade of upper light	1	No	/
13	051-001866-00	0625 toplight board PCBA	1	Yes	/
14	009-005644-00	0625 top lighting switch cable	1	Yes	/
15	9200-21-10633	2.25 speaker with wire	1	No	/
15A	801-0631-00038-00	Speaker and Connecting Cable	1	Yes	In S9 list
16	047-004321-00	speaker cushion	1	No	/
17	9200-20-10620	Speaker bracket	1	No	/
18	M04-051096---	Hexagon socket button head screws M3X8	7	No	/
19	115-034706-00	Backup O2 assembly(0615)	1	Yes	/
20	042-014582-00	main unit support(0619)	1	No	/
21	M04-051139---	Cross recessed small pan head combination screw, M4×12mm, galvanized	34	No	/
22	041-019883-00	main unit GCX rail(right/0619)	1	No	/
23	042-016799-00	BACKUP GAS SOURCE FIX PLATE	1	No	/
24	M04-051053---	Cross recessed countersunk head screw, M4×12mm, stainless steel	5	No	/
25	042-014603-00	flowmeter support	1	No	/
26	115-035254-00	H.W.Body Assm(With Pressure Monitor)	1	No	/
27	042-014605-00	top cover support(0619)	1	No	/
28	115-035257-00	back cover asm of HD box(0619/EU)	1	No	/
29	115-030689-00	top cover assembly(0619)	1	No	/
30	022-000008-00	Li-ion battery	2	No	/
31	045-001620-00	dustproof(0625)	1	No	/

32	M04-051116---	Hexagon socket set screw M6X16	11	No	/
33	M04-004504---	Spring washer Φ6	11	No	/
34	M04-021003---	Washer Φ6	11	No	/
35	0621-20-78748	AC socket protector	1	No	/
36	M04-021069---	SUS316 standard spring washer GB/polishing T93-1987-5	4	No	/
37	M04-000405---	Screw, Flat Head Phillips M3X8	13	No	/
38	M04-021011---	M5 plain washer	4	No	/
39	M04-051062---	Hexagon socket set screw M5X16	4	No	/
40	115-033838-00	N2O supply inlet assembly(0615)	1	Yes	/
40A	115-034149-00	N2O supply inlet assembly	1	Yes	/
41	115-033836-00	O2 supply inlet assembly(0615)	1	Yes	/
41A	115-034148-00	O2 supply inlet assembly	1	Yes	/
42	115-035360-00	Air supply inlet assembly(NIST/0619)	1	No	/
42A	115-034150-00	AIR supply inlet assembly	1	Yes	/
42B	115-033837-00	Air supply inlet assembly(0615)	1	Yes	/
43	M04-021005---	Spring washer 4	11	No	/
44	M04-051065---	Hexagon socket set screw M4X16	6	No	/
45	043-001860-00	cable management clip for 0631	3	No	/
46	M04-006412---	SCREW M4X8	5	No	/
47	115-030690-00	backcover assembly(0619)	1	No	/
48	082-001231-00	valve.2-way，air-piloted valves	1	Yes	O2-N2O block valve
49	M04-051083---	Pan head screws with cross recess GB/T 818-2000 M4x30 color zinc plated	2	No	/
50	M04-004702---	WASHER 4	5	No	/
51	115-025552-00	Rear Cover Assembly	1	Yes	/
52	042-014588-00	main unit left plate(0619)	1	No	/
53	051-000040-00	0616 Flow meter back light board	1	Yes	/
54	M04-000802---	Flat washer	3	No	/
55	M04-000401---	Hexagon nut M4	3	No	/
56	M04-051140---	The M3X8 combination Bolt	11	No	/
57	115-002533-00	Auxiliary O2 supply assembly	1	No	/
57A	115-035676-00	Auxiliary O2 Package（0619）	1	Yes	/
58	041-019884-00	main unit GCX rail(left/0619)	1	No	/
59	030-000144-00	Hexagon socket countersunk head screws	14	No	/
60	115-016480-00	gas bench receptacle assembly	1	Yes	/
61	M04-000605---	Screw, Pan Head Phillips M3X8	4	No	/
62	M04-000603---	Washer GB/T862.1-1 987 3	4	No	/
63	115-012713-00	Gas Bench Bracket Assembly	1	No	/
64	115-030692-00	worktable assembly(0619)	1	No	/
65	049-000917-00	loop screw rubber(0625)	2	No	/

66	M04-051014---	Cross pan head screw M3X12	2	No	/
67	115-030693-00	trolly assembly(0619)	1	No	/
68	043-005731-00	loop gap cover	1	Yes	/
69	115-025663-00	drawer assembly(0625)	3	Yes	/

10.3.1 Hardware Box (With pressure monitoring/0619)



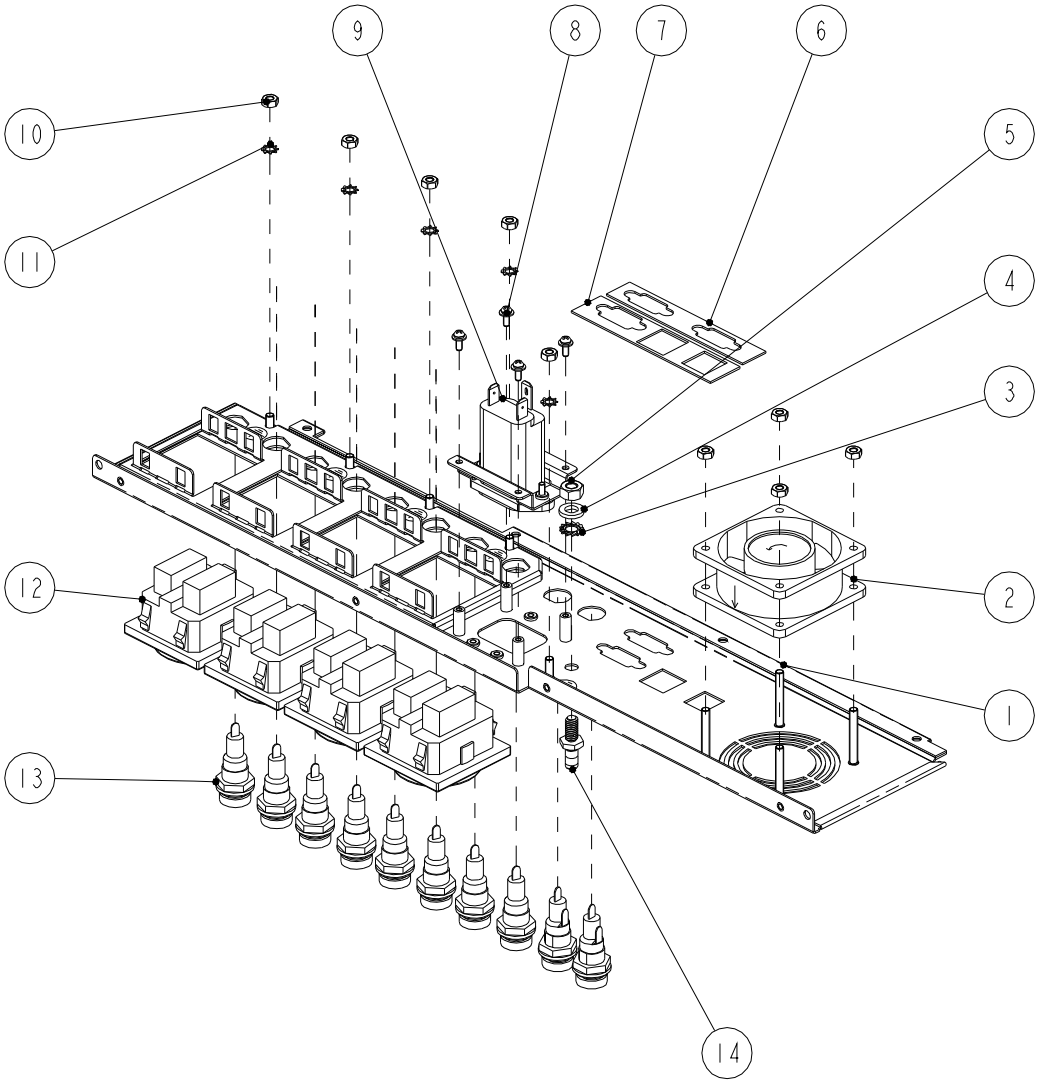
NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	042-016469-00	hardware box plate(0619/silk)	1	No	/

2	047-003914-00	Seal completely to stick	1	No	/
3	051-000685-00	0631 Power Board PCBA	1	Yes	/
4	M04-000018---	Stud bolt M3X20 8 + 8 - rust nickel plating	1	No	/
5	M04-011002---	M3 nut with washer	1	No	/
6	115-042876-00	Three-way valve assembly (ASCO/0625/3)	1	Yes	/
6A	115-042877-00	Three-way valve assembly (ASCO/0625/4)	1	Yes	/
7	082-000111-00	PMT,1/4-28UNF	4	Yes	/
8	051-000409-03	0631 Main control board PCBA	1	Yes	Machine ID and Configuration is needed for different AM
8A	115-036951-00	0619 main control board FRU(VCV+PCV)	1	Yes	With VCV+PCV mode
9	115-035472-00	0619 Monitor board assembly (DSP)	1	Yes	/
9A	051-001078-00	V01A Ventilater&Control(WATO) PCBA	1	Yes	/
9B	051-002364-00	0619 Ventilater&Protect PCBA(Parker)	1	Yes	/
10	051-002165-00	0619 Mother Board PCBA	1	Yes	/
11	M90-100012---	Lock Nut,Panel Mount,1/4-28UNF,White Nylon	4	No	/
12	M04-051140---	Phillips head screw assembly chunk GB/T9074.8 M3X8	30	No	/
13	115-035275-00	Battery box Assembly(0619)	1	No	/

Proceed as follows when you replace the main control board:

1. Before the replacing of the main control board, record the settings in the Factory Setup menu (choose  > [**Service**] and then enter the password to access the factory setting menu.).
2. After the replacing of the main control board, confirm whether the settings in the Factory Setup menu are same with the record.
3. If not, change the settings in the Factory Setup menu and make sure the settings are same with the record. Then start the machine and confirm the consistency again.

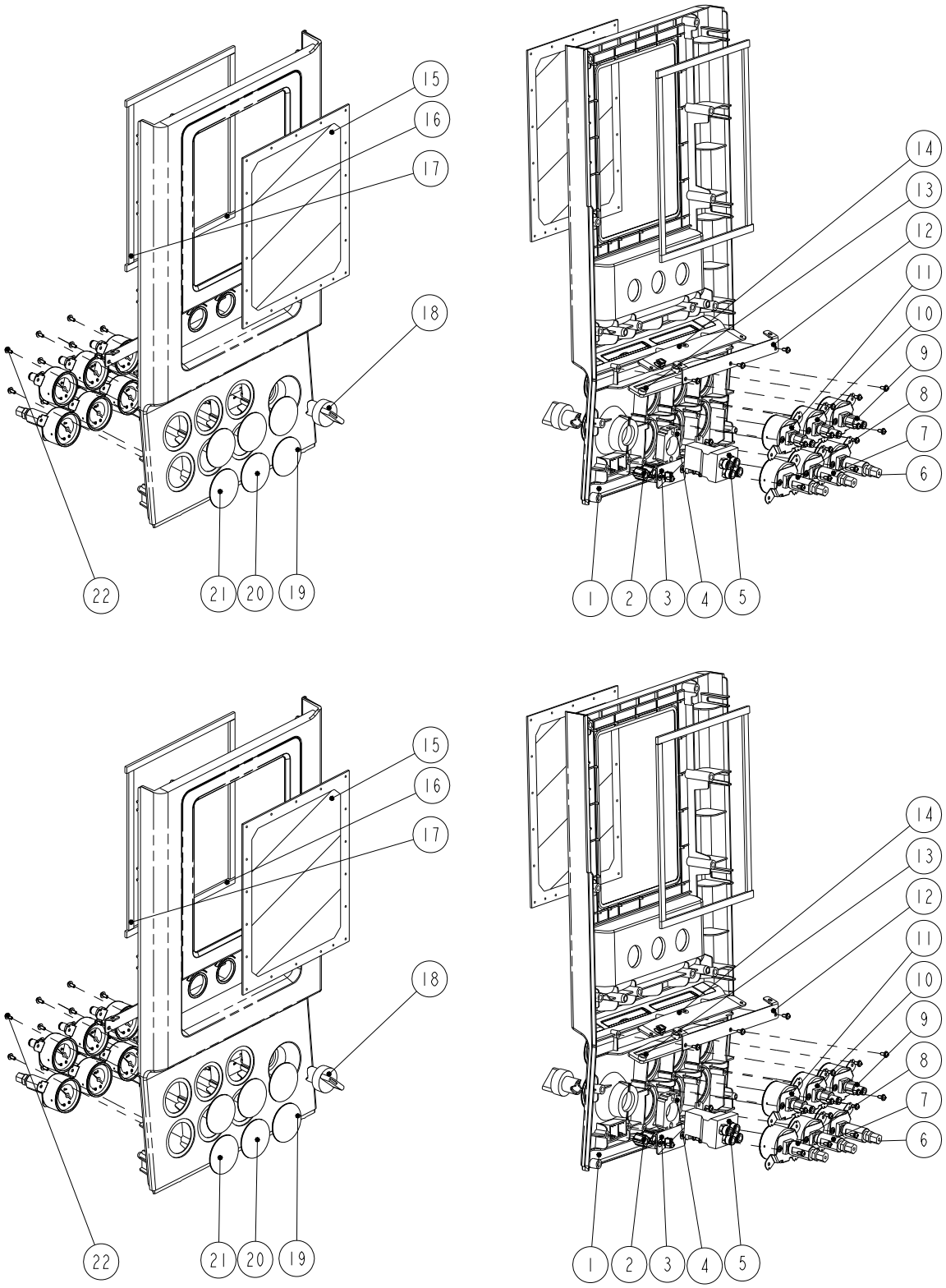
10.3.2 Back cover assembly of hardware box (EU/0619/100~240V)



NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	042-016470-00	back plate of hardware box(0619EU)	1	No	/
2	024-000125-00	FAN 12V 60*60*25mm 22.9CFM 36.5dB 380mm	1	No	/
2A	801-0631-00028-00	Fan	1	Yes	/
3	M04-021048---	Serrated lock washers external teeth 6	1	No	/
4	M04-021003---	Washer ϕ6	1	No	/
5	M04-004401---	stainless steel nut GB6170 M6	1	No	/
6	024-000598-00	electrical-through soft pad2(0625)	1	No	/
7	024-000597-00	electrical-through soft pad1(0625)	1	No	/
8	M04-051140---	The M3X8 combination Bolt	4	No	/

9	009-006245-00	0619 AC power filter cable(auxiliary)	1	No	/
10	030-000201-00	Hexagon nuts M4	9	No	/
11	030-000200-00	Washer GB/T862.1-1987 4	5	No	/
11A	801-0631-00132-00	Header power socket 3C (black)(FRU)	4	No	/
11B	801-0631-00135-00	Power Socket VDE (white)(FRU)	4	Yes	/
11C	801-0631-00134-00	3Pins UK Power Socket 13A 250V(FRU)	4	Yes	/
11D	008-000487-00	Power Socket SAS 16A/250V Switch white	4	Yes	/
11E	801-0631-00136-00	Power Socket Brzl 10A/250Vac(FRU)	4	Yes	/
11F	801-0631-00131-00	Pins India Power Socket 13A 250V(FRU)	4	Yes	/
12	M39-000208---	Header power power socket VDE certification (white)	4	No	/
13	509B-10-06194	Fuse Base	10	Yes	In S9 list
14	0509-20-00098	Grounding terminal	1	No	/
15	010-000081-00	FUSE Time-lag 250V 5A D5X20	2	Yes	In S9 list
16	M07-00131F---	FUSE Time-lag 250V 3.15AD5X20	8	Yes	In S9 list
17	009-005324-00	0625 Europe socket cable	4	No	/
18	009-006243-00	0619 auxiliary output cable	1	No	/

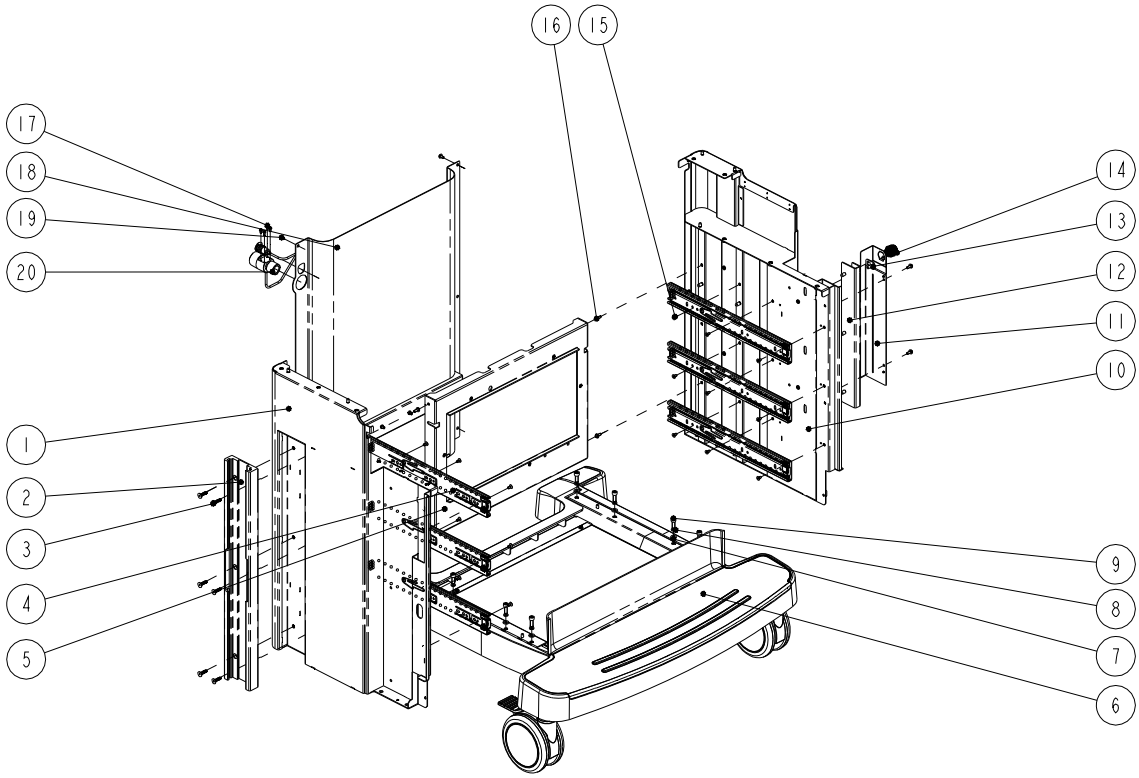
10.3.3 Flow meter and pressure gauge panel assembly



NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	043-006807-00	flowmeter and pressure gauge cover(0619)	1	No	/

2	043-000785-00	cover of indicate light	2	No	/
3	051-001934-00	0625 Indicator Board PCBA	1	No	/
4	M6Q-120015---	System Switch Base	1	No	/
5	0611-30-58781	O2&Air system switch	1	No	/
5A	801-0613-00021-00	System switch(O2)	1	Yes	/
5B	801-0611-00044-00	O2&Air system switch	1	Yes	/
6	115-035356-00	High pressure gauge assembly(O2/0619)	1	Yes	/
7	115-035358-00	High pressure gauge assembly(N2O/0619)	1	Yes	/
8	115-035357-00	High pressure gauge assembly(Air/0619)	1	Yes	/
9	115-035353-00	Pressure gauge assembly(O2/0619)	1	Yes	/
10	115-035355-00	Pressure gauge assembly(N2O/0619)	1	Yes	/
11	115-035354-00	Pressure gauge assembly(Air/0619)	1	Yes	/
12	042-014599-00	supporting frame for light	1	No	/
13	043-005380-00	lampshade of upper light	1	No	/
14	051-002386-00	0619 auxiliary lighting board PCBA	1	Yes	/
15	047-000232-00	Flowmeter lens	1	No	/
16	0611-20-45569	Flowmeter dustproof article 1	2	No	/
17	0611-20-45570	Flowmeter dustproof article 2	2	No	/
18	M07-00111S---	System Switch Knob	1	No	/
19	047-005165-00	circular pressure gauge overlay(EU AIR)	2	No	/
20	047-005164-00	circular pressure gauge overlay(EU N2O)	2	No	/
21	047-005163-00	circular pressure gauge overlay(EU O2)	2	No	/
22	M04-051140---	The M3X8 combination Bolt	19	No	/

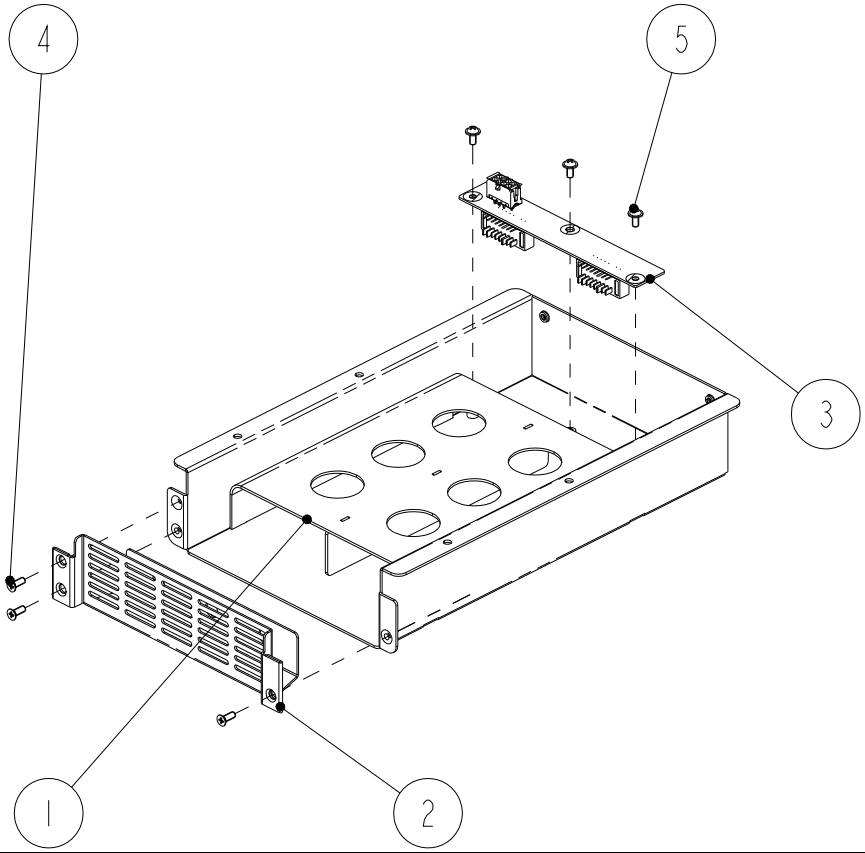
10.3.4 Cart Assembly



NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	042-012600-00	trolly left plate(0625)	1	Yes	/
2	041-017805-00	trolly left trail(0625)	1	No	/
3	030-000144-00	Hexagon socket countersunk head screws	6	No	/
4	031-000041-00	ball guided.3flod 350mm blue zinc-plated	6	Yes	/
5	042-012629-00	trolly strengthening plate(0625)	1	No	/
6	115-031121-00	Base Assmbly	1	No	/
7	M04-021003---	Washer Φ6	8	No	/
8	M04-004504---	Spring washer Φ6	8	No	/
9	M04-051116---	Hexagon socket set screw M6X16	8	No	/
10	042-014616-00	trolly right plate(0619)	1	Yes	/
11	042-012619-00	presser of drawer lock plate(0625)	1	No	/
12	042-012620-00	drawer lock plate(0625)	1	No	/
13	042-011155-00	cam of drawer lock(0631)	1	No	/
14	034-000353-00	Drawer lock	1	Yes	/

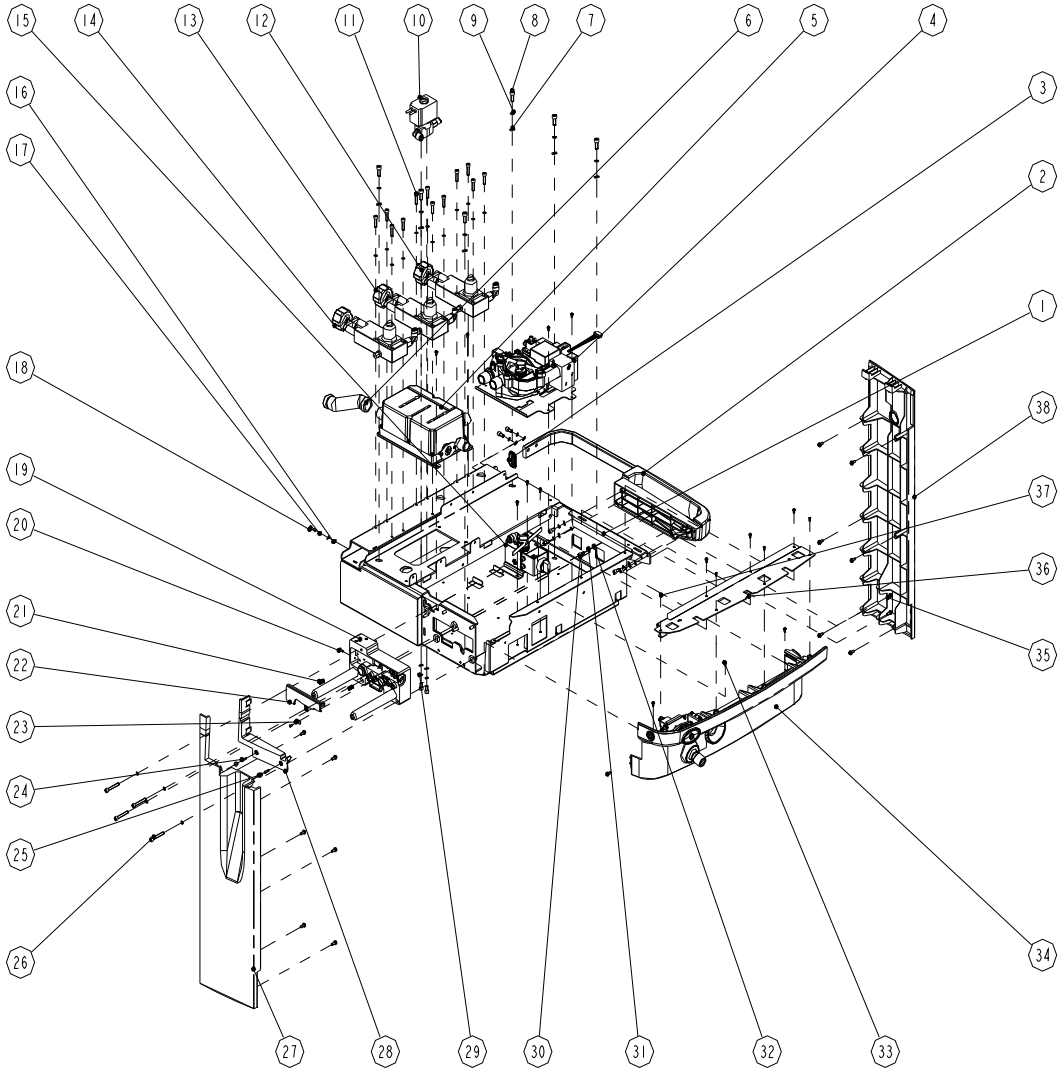
15	M04-000205---	Countersunk flat head screws	18	No	/
16	M04-051139---	Cross recessed small pan head combination screw, M4×12mm, galvanized	8	No	/
17	M04-051140---	The M3X8 combination Bolt	4	No	/
18	115-031137-00	Trolly Back Cover	1	No	/
19	M04-006412---	SCREW M4X8	6	No	/
20	115-006529-00	waste pipe connector assembly	1	No	/

10.3.5 Battery box assembly (0619)



NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	042-014416-00	battery box plate(0619)	1	No	/
2	042-012477-00	battery box front plate(0625)	1	No	/
3	051-000768-00	0623 battery board PCBA	1	Yes	/
4	M04-000405---	Screw, Flat Head Phillips M3X8	3	No	/
5	M04-004012---	Screw, Pan Head W/Washer Phillips M3X6	3	No	/
6	009-006241-00	0619 battery cable	1	No	/

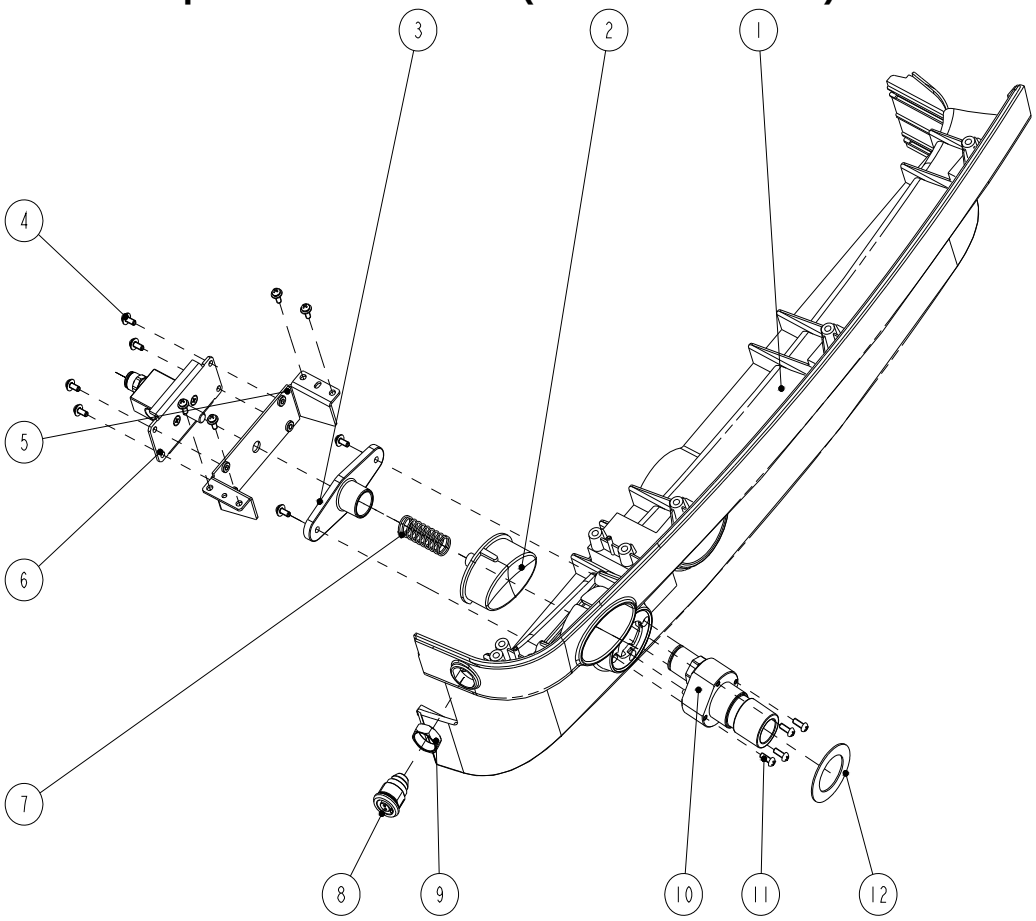
10.3.6 Work table assembly(0619)



NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	042-014612-00	worktable support(0619)	1	No	/
2	115-025655-00	handle assembly	1	No	/
3	049-000848-00	back handle rubber cap	1	No	/
4	115-011265-01	Ventilation valve assembly（0616）	1	Yes	/
4A	115-036952-00	0619 Ventilation kit FRU(O2 Drive)	1	Yes	/
4B	115-036953-00	0619 Ventilation kit FRU(AIR Drive)	1	Yes	/
5	115-032992-00	Gas reservoir assembly（0625）	1	Yes	/
6	049-000810-00	exhaust tube	1	No	/
7	030-000159-00	Washer 6 (Glass A GB/T97.1-2002)	6	No	/
8	M04-051116---	Hexagon socket set screw M6X16	6	No	/
9	M04-004504---	Spring washer φ6	6	No	/
10	115-031022-00	assembly of drive gas valve（0625）	1	Yes	/
11	M04-051115---	Hexagon socket set screw M5X20	12	No	/
12	115-002250-01	Cylinder Bracket for O2	1	Yes	/

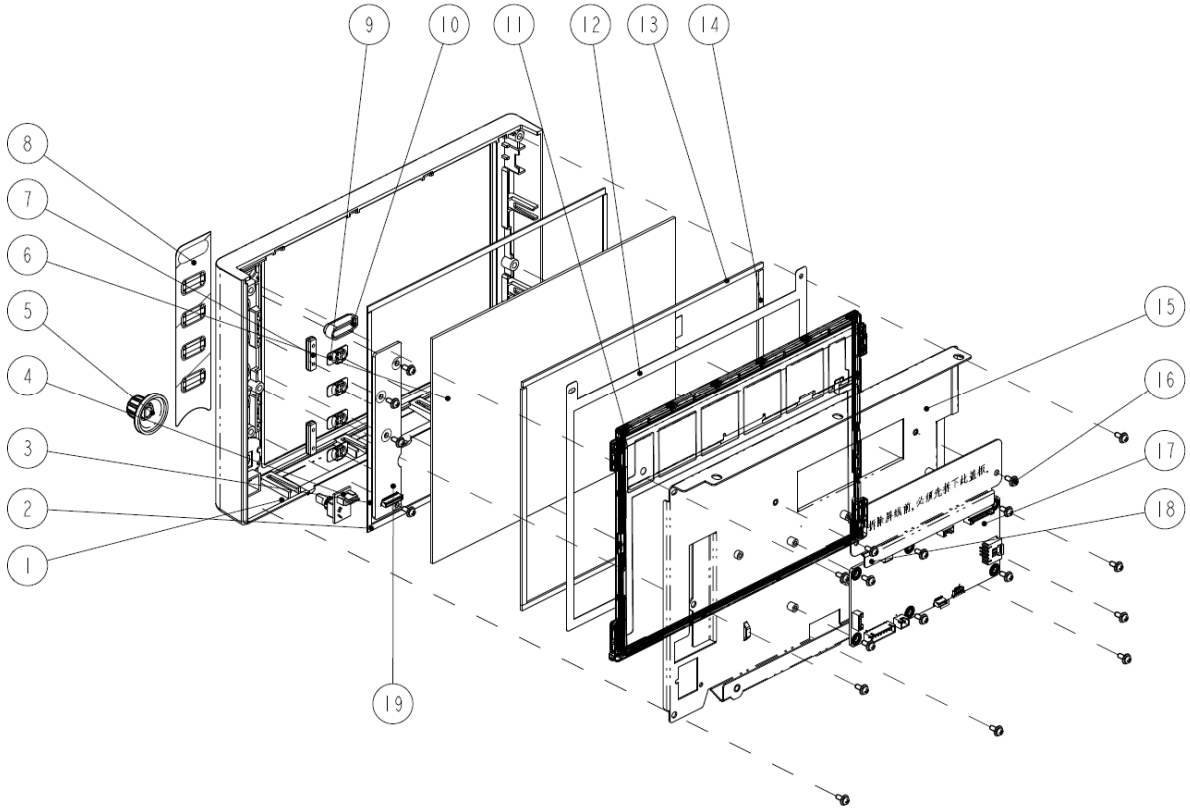
13	115-002251-02	Cylinder Bracket for N2O(Φ6)	1	Yes	/
14	115-002728-01	Cylinder Bracket for AIR	1	Yes	/
15	115-032991-00	ACGO assembly（0625）	1	Yes	/
16	M04-004702---	WASHER 4	2	No	/
17	M04-021005---	Spring washer 4	1	No	/
18	041-003066-00	screw	1	No	/
19	115-001445-00	Circuit adapter assembly	1	No	/
19 A	115-006653-00	assembly of block(No ACGO/No bypass)	1	Yes	/
19 B	115-006652-00	assembly of block(No ACGO/bypass)	1	Yes	/
20	M04-004013---	Cross panhead screw with washer M3X10	1	No	/
21	0601-20-78922	The heating plate spring	2	No	/
22	024-000185-00	BC heater for 0616	1	No	/
23	042-005565-00	heater fixer	1	No	/
24	M04-051014---	Cross pan head screw M3X12	2	No	/
25	049-000917-00	loop screw rubber(0625)	2	No	/
26	M04-051067---	Hexagon socket set screw M5X35	4	No	/
27	043-005409-00	trolly left decorative part(0625)	1	No	/
28	043-006198-00	circuit around cover(0619)	1	No	/
29	M04-021069---	SUS316 standard spring washer GB/polishing T93-1987-5	2	No	/
30	M04-051061---	Hexagon socket set screw M5X10	9	No	/
31	M04-021007---	M5 spring washer	23	No	/
32	M04-021011---	M5 plain washer	9	No	/
33	M04-051140---	The M3X8 combination Bolt	13	No	/
34	115-035273-00	WS Front Cover Assembly(With ACGO)	1	No	/
35	M04-051139---	Cross recessed small pan head combination screw, M4×12mm, galvanized	15	No	/
36	042-012597-00	front cover frame	1	No	/
37	M04-000405---	Screw, Flat Head Phillips M3X8	5	No	/
38	043-006142-00	trolly right part(0625/silk)	1	No	/

10.3.7 Front panel of work table(with ACGO/0619)



NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	043-006744-00	working table front cover	1	No	/
2	043-006141-01	O2 BUTTON(0625/SILK)	1	Yes	/
3	043-005421-00	O2 button frame	1	No	/
4	M04-051140---	The M3X8 combination Bolt	10	No	/
5	042-012596-00	O2 assembly frame	1	No	/
6	0611-30-58711	O2 flush button assembly	1	No	/
6A	801-0613-00026-00	O2 flush button assembly	1	Yes	/
7	033-000015-00	spring of locker	1	No	/
8	0601-21-78956	O2 Sensor Pedestal	1	No	/
9	041-002490-00	Socket fixed nut (0631).	1	No	/
10	115-034175-00	along ACGO assembly	1	No	/
11	M04-000605---	Screw, Pan Head Phillips M3X8	4	No	/
12	047-014226-00	ACGO cover(hole)	1	No	/

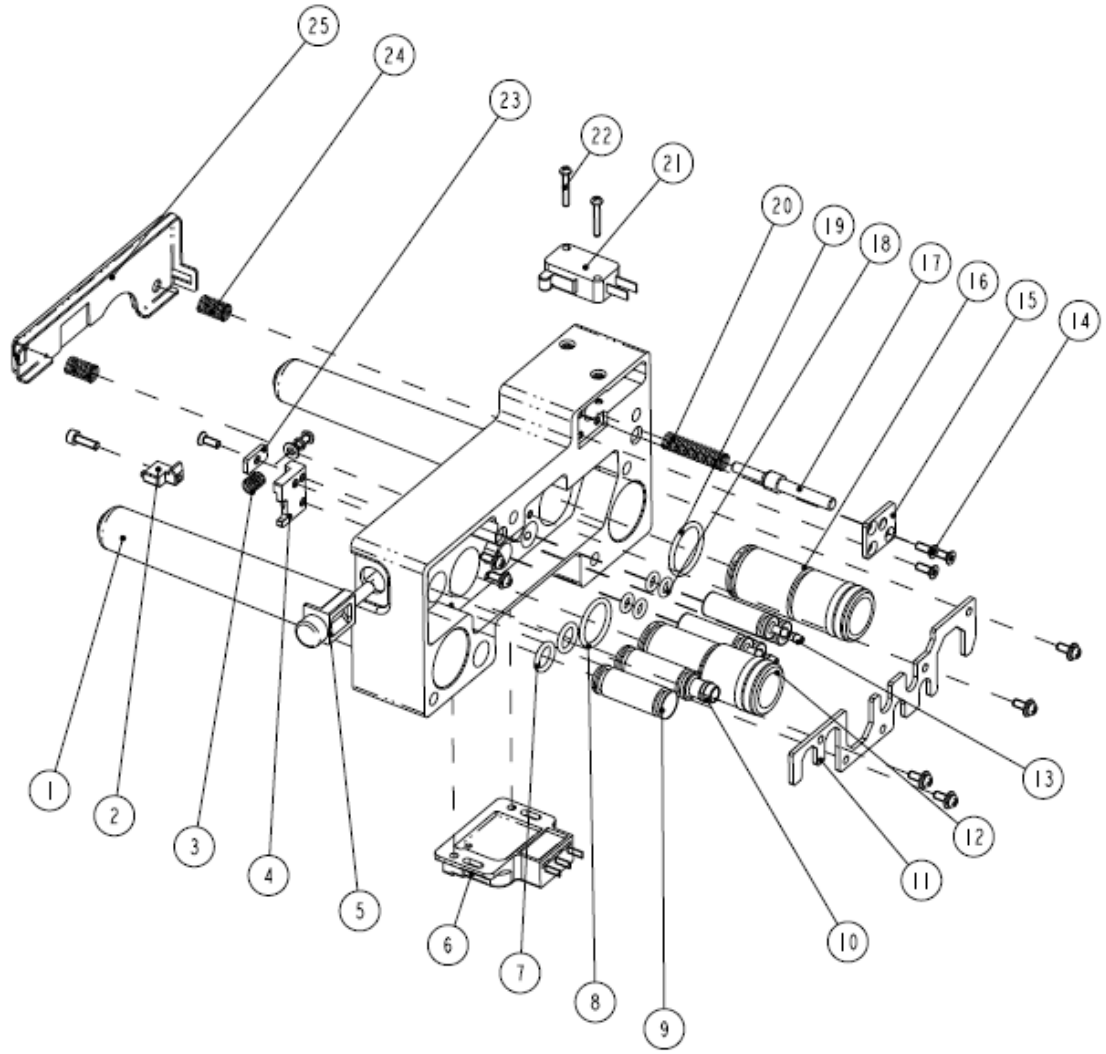
10.3.8 Display assembly



NO.	P/N	Spare Parts Description	Quantity	FRU or Not?	Remark
1	043-006806-00	Display Cover(0619)	1	No	/
2	047-014913-00	Water Proof Rubber T/B(0619)	2	No	/
3	047-014914-00	Water Proof Rubber R/L(0619)	2	No	/
4	0010-30-43089	Encoder board	1	No	/
4A	801-0613-00035-00	Encoder(FRU)	1	Yes	/
5	043-004516-00	EV20 Knob	1	Yes	/
6	021-000221-00	Touch Panel Five wire 10.4" Narrow Frame	1	Yes	/
7	049-000927-00	LCD Press（0625）	2	No	/
8	047-016128-00	keypad overlay	1	No	/
9	043-006150-00	movement with the key （0619）	4	No	/
10	043-006151-00	Waring light guider （0619）	1	No	/
11	021-000171-00	LCD TFT 10.4" 1024*768 3.3V LED-BL	1	Yes	/
12	047-013742-00	10.4” LCD Mylar(0625)	1	No	/
13	048-005295-00	LCD dust layer T/B (0619)	2	No	/
14	048-005296-00	LCD dust layer R/L (0619)	2	No	/
15	042-014424-00	LCD Back Bracket(0619)	1	No	/

16	M04-051140---	The M3X8 combination Bolt	20	No	/
17	051-002365-00	0619 Keypad Control Board PCBA	1	Yes	/
18	042-015638-00	display cable cover（0626）	1	No	/
19	051-002163-00	0619 Key and Alarm Light Board PCBA	1	Yes	/

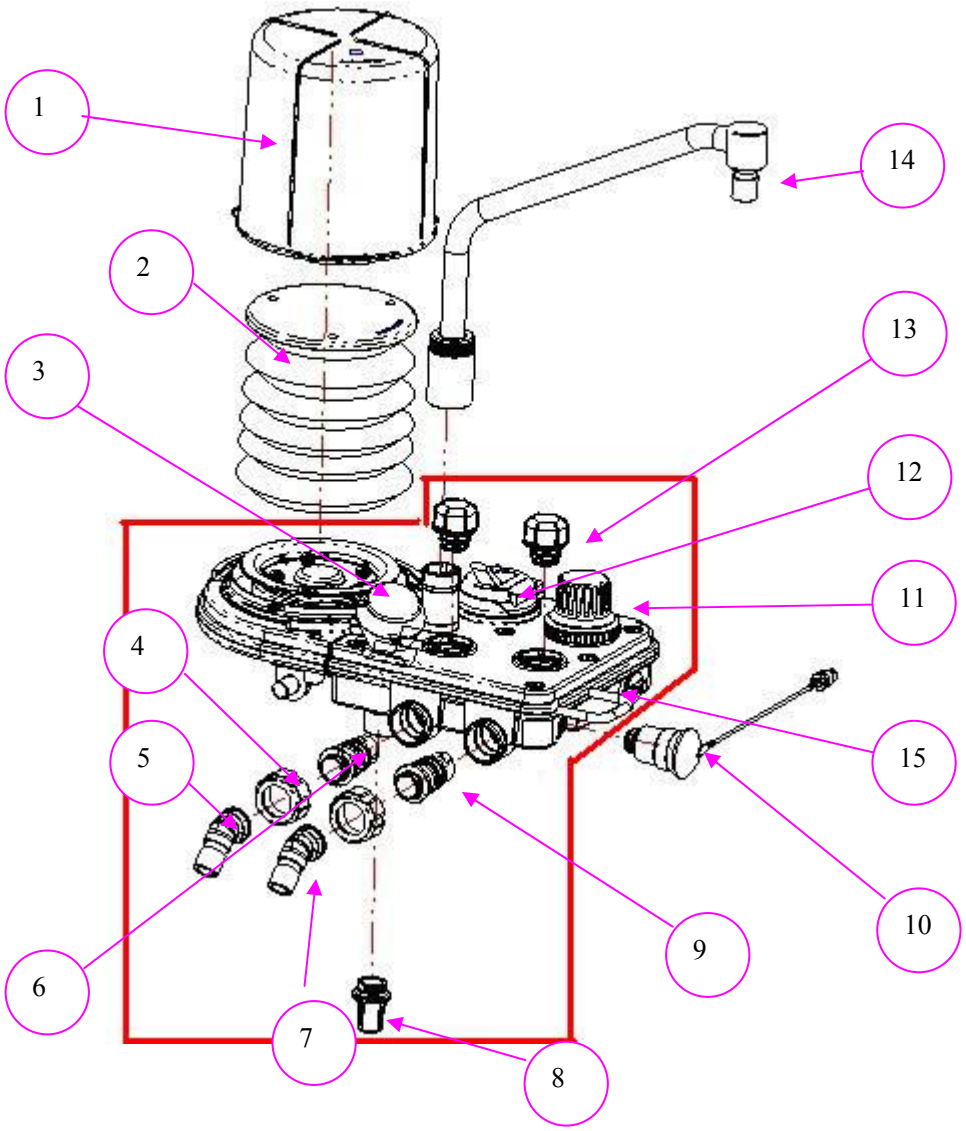
10.3.9 Breathing Circuit Adapter Block Assembly



NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	041-000153-00	Circuit adaptation block	No	/
1A	115-006653-00	assembly of block(No ACGO/No bypass)	Yes	/
1B	115-006652-00	assembly of block(No ACGO/bypass)	Yes	/
2	041-000137-00	locking bail	No	/
3	8000-20-10298	SPRING,BATTERY LEVER,TRIO	No	/
4	041-000139-00	guide pad	No	/
5	041-000136-00	Locking button	No	/
6	M90-000162---	Lock with micro switch	No	/
7	M6M-010006---	Seal,O-ring8.5X2.0fluororubber A75 black	No	/

8	M6M-010058---	Seal,O-ring 16X2 fluororubber,A50 black	No	/
9	041-002961-00	tie-in plug of ACGO	No	/
10	0601-20-69866	Fresh gas connector	No	/
11	0601-20-78908-51	Joint card board	No	/
12	0601-20-78907	APL release connector	No	/
13	0601-20-69867	Sampling connector	No	/
14	M04-000405---	Screw,Flat Head Phillips M3X8	No	/
15	0601-20-78906	The drive shaft block slice	No	/
16	0601-20-69868	Drive shaft connector	No	/
17	0601-20-78905	Drive shaft	No	/
18	M6M-010063---	Seal for pressure sampling	No	/
19	M6M-010058---	Seal,O-ring 16X2 fluororubber,A50 black	No	/
20	0601-20-78921	The drive shaft of the spring	No	/
21	M07-00010S-00	SWITCH	No	/
21A	801-0613-00055-00	Snap action switch (rolling type 200gf)	Yes	/
22	M04-004805---	SCREW,PAN-HD,CROSS,M2.5X16,NI-P	No	/
23	042-005565-00	heater fixer	No	/
24	0601-20-78922	The heating plate spring	No	/
25	024-000185-00	BC heater for 0616	Yes	/

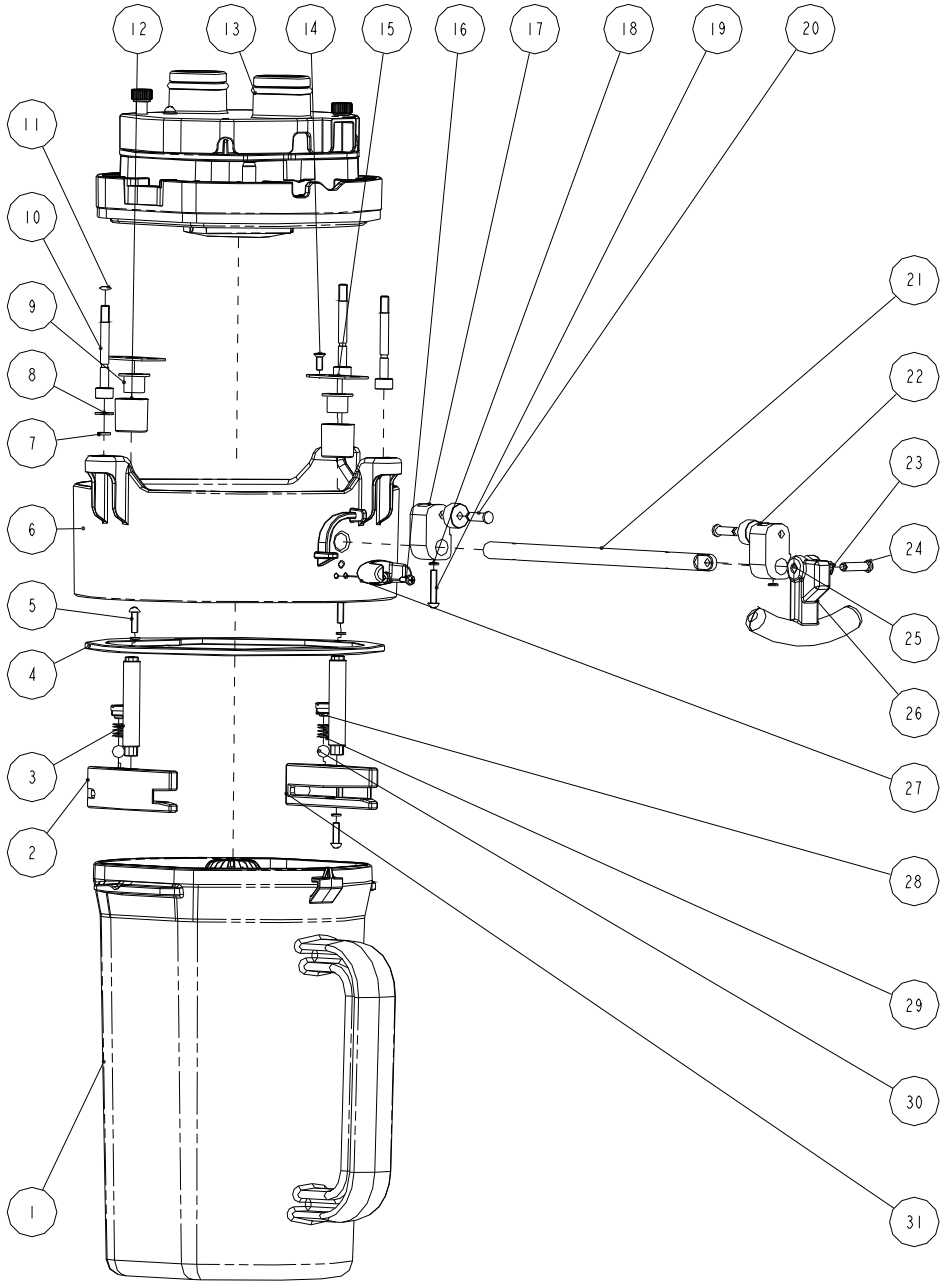
10.3.10 Main Body of the Patient Circuit



NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	043-001134-00	bellows cover (0631)	No	/
1A	801-0631-00054-00	Bellows Dome, A series	Yes	/
2	0601-30-78968	bellows assembly	No	/
2A	040-000358-00	bellow bag	Yes	/
2B	801-0631-00055-00	Bellows Assembly, A series	Yes	/
3	115-034210-00	APL valve assembly(0615)	Yes	/
4	043-006708-00	Breath rotary cap(PA/silk-screen)	Yes	/
5	043-001287-00	the connector for breath	No	/
5A	801-0631-00057-00	Insp/Exp Connector, A series	Yes	/
6	0601-30-78894	Expiratory flow sensor assembly	Yes	/

6A	115-001366-00	Flow sensor assembly	Yes	/
7	043-001287-00	the connector for breath	No	/
7A	801-0631-00057-00	Insp/Exp Connector, A series	Yes	/
8	043-001281-00	cup for collecting water	No	/
9	0601-30-69700	Inspiratory flow sensor assembly	Yes	/
9A	115-001366-00	Flow sensor assembly	Yes	/
10	0601-20-78941	O2 sensor cable	No	/
11	115-006549-00	APL valve (0631)	No	/
11A	115-046754-00	(New) APL valve assembly (FRU)	Yes	/
12	0601-30-78872	Bag/mechanical vent switch assembly	No	/
12A	801-0601-00017-00	Bag/mechanical ventilation switch	Yes	/
13	801-0631-00104-00	One-Way Valve	Yes	/
13A	801-0631-00061-00	Check valve dome, A series	Yes	/
14	0601-30-78862	Manual bag arm assembly	No	/
14A	801-0601-00005-00	Bag arm assembly	Yes	/
14	115-047846-00	Manual bag arm assembly (new silk print)	No	/
14A	115-048600-00	Manual bag arm assembly FRU (silver, with fixed pins)	Yes	/
15	115-037183-00	Circuit main unit (heat/bag arm/0619)	Yes	/
15A	043-006706-00	Manual and auto shell (PA/silk print)	Yes	/
15B	115-034979-00	Upper cover assembly FRU	Yes	Seals and screws are contented
15C	115-034980-00	Lower cover assembly (bag arm)FRU	Yes	Seals and screws are contented
15D	115-034189-00	Upper cover 2 assembly (0615)	Yes	Seals and screws are contented
15E	115-034190-00	Lower cover 2 assembly (0615)	Yes	Seals and screws are contented
15F	115-048642-00 801-0621-00169-00	Mid-plate assembly (heat/bag arm) (0619) FRU (New) APL valve seal plate assembly (FRU)	Yes	Seals are contented
15G	801-0601-00002-00	Pop-off valve assembly (FRU)	Yes	/

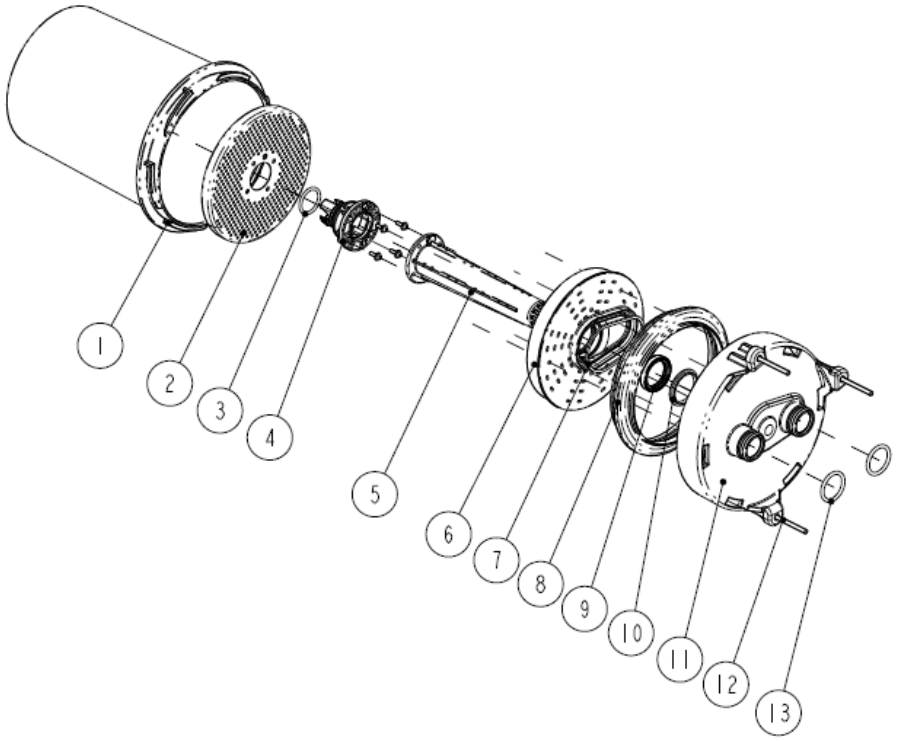
10.3.11 Lifting device



NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	115-030838-00	Canister assembly(0625)	Yes	/
1A	115-034689-00	Absorb canister shore(0625)	Yes	Contented in canister assembly
1B	043-006237-00	Absorbent canister(0625/silk)	Yes	Contented in canister assembly
1C	0601-20-78976	Foam filter (20 pcs/pack, disposable)	Yes	In S9 list
2	0601-20-78838	Left hook	No	/
3	0601-20-78836	Link connecting rod	No	/

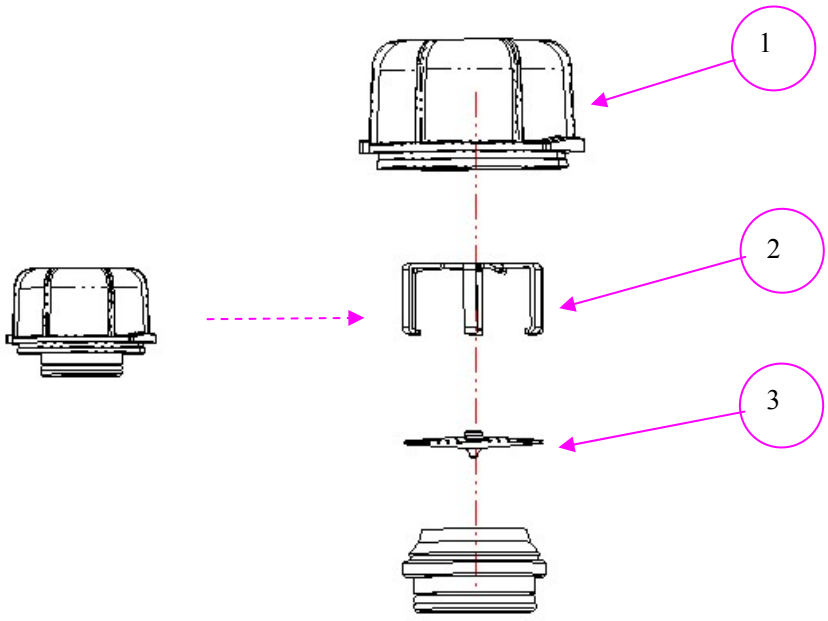
4	0601-20-78827	Improve the tray	No	/
5	M04-051118---	SUS316 cross trough pan head screw M3X10 GB/T818-2000	No	/
6	043-006236-00	lifting device base(0625/silk)	No	/
6A	115-034208-00	Lifting device(with bypass/0615)	Yes	The whole lifting device
7	M04-021068---	Spring washer, SUS316, passivated	No	/
8	M04-021073---	SUS316 flat washer - A level 4 GB/T97.1-2002	No	/
9	M6A-010005---	Flange high wear-resisting bearings bearings. XFM - 0810-09	No	/
10	0601-20-78857	Improve fastening screw	No	/
11	M6M-010068---	Nitrile rubber sealing ring. O 3 x1. 5 A50 black	No	/
12	0601-20-78962	shaft block	No	/
13	0601-30-78828	BYPASS assembly	No	/
14	M04-051107---	Tapping screws FT3x8	No	/
15	0601-20-78812	Linear bearing stator	No	/
16	M04-051108---	SUS316 cross pan head without sharp cut end self tapping screw PT2.6 X6	No	/
17	0601-20-78825	After turning block	No	/
18	M04-021067---	SUS316 standard spring washer 3 GB/T93-1987	No	/
19	M04-051123---	SUS316 cross trough pan head screw M3X16 GB/T818-2000	No	/
20	0601-20-78826	pivot pin	No	/
21	0601-20-78824	live shaft	No	/
22	0601-20-78815	gyro wheel	No	/
23	M04-021029---	Axis with elastic ring 35	No	/
24	0601-20-78835	Fixing Pin	No	/
25	0601-20-78920	Before turning block	No	/
26	043-006241-00	Rotation handle(0625)	No	/
27	043-006240-00	Handle fixing(0625)	No	/
28	0601-20-78917	Marbles screw	No	/
29	0601-20-78919	Spring	No	/
30	M6B-010001---	Steel ball. Φ six polished stainless steel	No	/
31	0601-20-78837	Right hook	No	/

10.3.12 Sodalime canister assembly



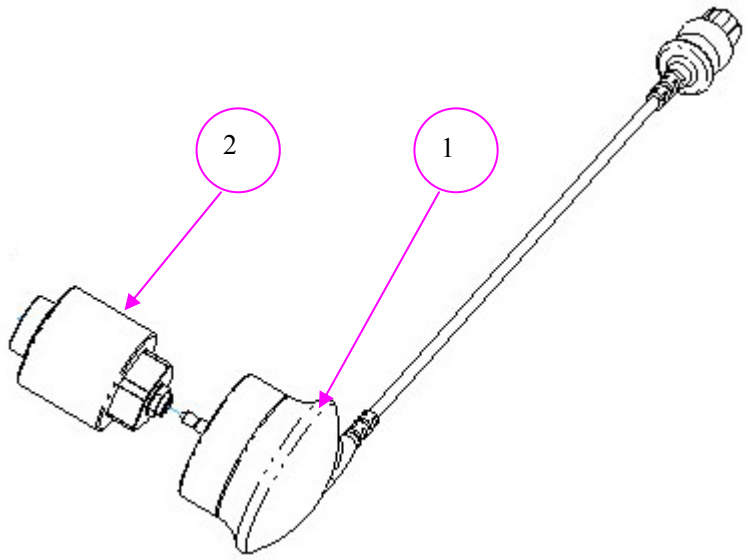
NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	043-006707-00	Canister(20B/silk-screen)	Yes	/
1A	115-034194-00	Sodalime canister assembly(20B)	Yes	/
2	042-007133-01	Sodalime support plate(0615)	No	/
3	M6M-010051---	Seal	No	/
4	043-002380-01	Canister lower snap (0615)	No	/
5	043-006399-00	absorber shore	No	/
5A	115-036950-00	Absorber caniste support module FRU(20B)	Yes	/
6	043-002378-00	Canister transfer plate(20L)	No	/
7	049-000422-00	Transfer plate seal(20L)	No	/
8	049-000416-00	Canister sealing(20L)	No	/
9	049-000415-00	sealed tray of exit(20L)	No	/
10	041-006209-00	sealing stop plate(20L)	No	/
11	043-006690-00	Canister upper cover(2B)	No	/
11A	115-034193-00	Canister upper cover assembly(20B)	No	/
12	030-000735-00	SUS304 screw.GB/T70.1-2000 M4X41.5	No	/
13	M6M-010038---	Seal for water collection cup	No	/

10.3.13 Expiratory& Inspiratory Check Valve



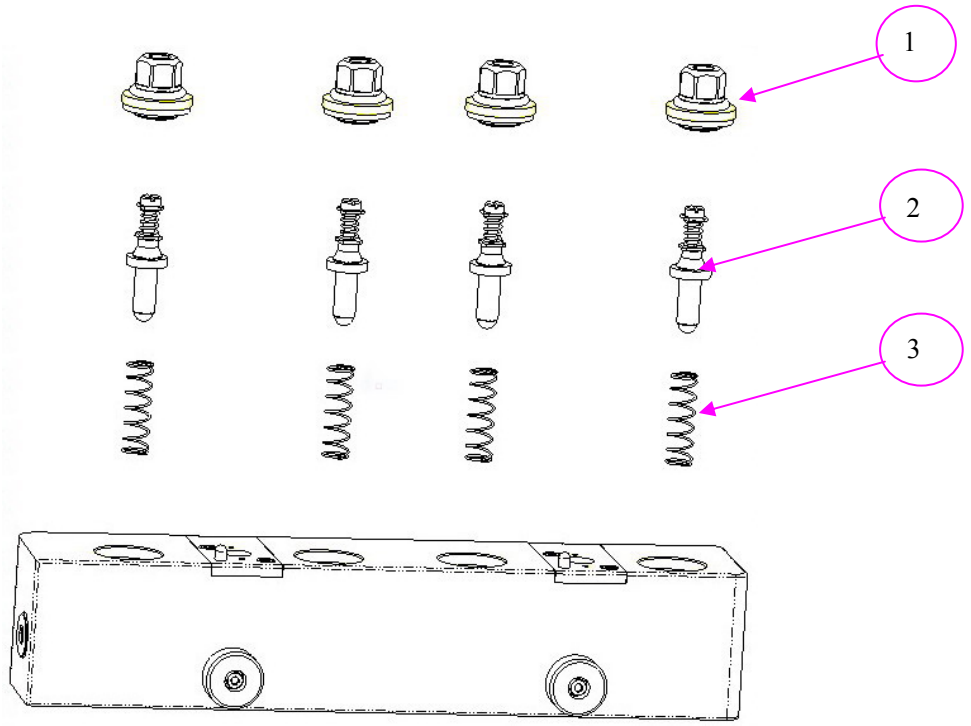
NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	801-0631-00061-00	Check valve dome, A series	Yes	/
2	801-0631-00110-00	valve cover	No	/
3	801-0631-00111-00	Disc	No	/

10.3.14 O2 sensor assembly



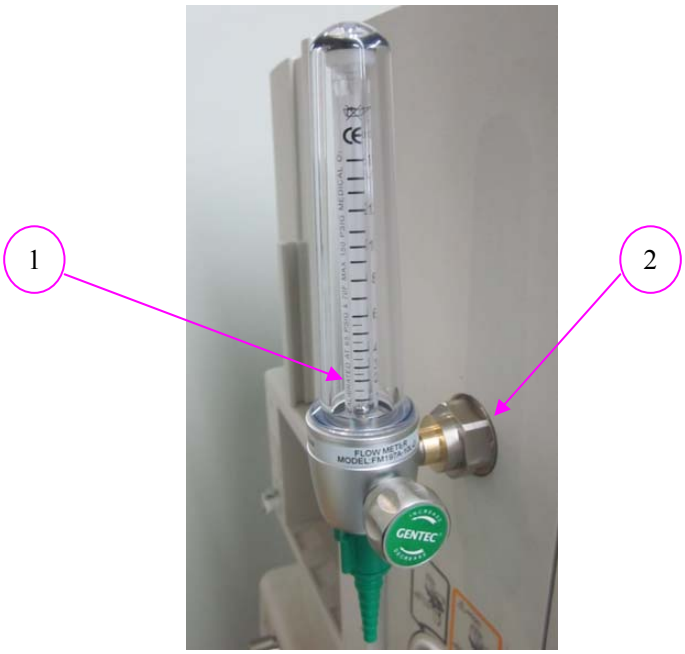
NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	0601-20-78941	O2 sensor cable	Yes	/
2	040-000898-00	sensor oxygen	Yes	/

10.3.15 Vaporizer Mounting Manifold Assembly



NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	801-0631-00117-00	Connector (vaporizer Mount)	No	/
1A	115-030766-00	Single vaporizer assembly(0625)	Yes	/
1B	115-032993-00	double vaporizer assembly(0625)	Yes	/
1C	115-027692-00	D-vaporizer assembly(plug-in)(0635)	Yes	/
1D	115-017631-00	vaporizer bracket package	Yes	/
2	801-0631-00106-00	Valve of Vaporizer Mounting Manifold	No	/
3	801-0631-00107-00	spring of Vaporizer Mounting Manifold	No	/

10.3.16 Auxiliary O2 assembly



NO.	P/N	Spare Parts Description	FRU or Not	Remark
1	082-000140-00	Auxiliary O2 flowmeter	No	/
1A	115-035676-00	Auxiliary O2 Package（0619）	Yes	Upgrade kit for auxiliary O2 supply
2	044-000299-00	AUX O2 connecter(precision casting)	No	/

10.3.17 O-ring

NO.	P/N	Description	Remark
1	049-000415-00	sealed tray of exit(20L)	/
2	049-000416-00	Canister sealing(20L)	/
3	049-000422-00	Transfer plate seal(20L)	/
4	M6M-010051---	Seal (O-ring) 18X2.5 fluoroelastomer A50 (brown)	For Sodalime canister (20L)
5	M6M-010069---	Seal (O-ring) 3x1.5 FKM A50 (black)	For the fixer of lifting device
6	0601-20-78842	Sealing component for sodalime canister	For lifting device
7	0601-20-78843	Sealing cushion for sodalime canister outlet	For lifting device
8	0601-20-69771	PoP-off valve rubber mat	/
9	049-001067-00	bellows packing washer (0615)	/
10	082-000506-00	AGSS filter	/
11	082-000934-00	O-ring 14X2.65	For the connectors of vaporizer manifold

12	082-002281-00	O ring.29.5X2 VITON A75	For the support provide of BC middle plate
13	M6M-010043---	Seal (O-ring) 29.82X2.62 EPT A50 (black)	For APL valve
14	M6M-010031---	Seal for valve cover	For check valve cover
15	M6M-010067---	O sealing ring 52X2	For check valve support
16	049-000813-00	quad-ring	For lower cover 2
17	M6M-010033---	Valve seal	For check valve
18	M6M-010038---	Seal (O-ring) 23.47X2.95 silicone A50 (red)	For watertrap and upper cover of sodalime canister
19	M6M-010042---	O sealing ring 52X2	For manual/vent switch
20	M6M-010073---	O sealing ring 40X2.2O	For manual/vent switch
21	M6M-010071---	O sealing ring 20.29 X 2.62	For pop-off valve
22	M6M-010022---	sealing ring 18X1.5	For the plug of O2 sensor port
23	0601-20-78887	Sealing cushion (mold No.MR78839)	For folwsensor
24	M6M-010006---	Seal for fresh gas and ACGO	For BC support and upper cover 2
25	M6M-010058---	Seal for drive gas and APL discharge	For BC support and bag arm
26	M6M-010063---	Seal for pressure sampling connector	For BC support and upper cover
27	0030-10-13077	Seal for axis of bag/mechanical ventilation switch	For manual/vent switch
28	M6M-010026---	O sealing ring 18X1.5	For upper cover 2
29	082-000711-00	O-RING 10X1.8 FKM A70	For paw gauge
30	082-000186-00	Seal (O-ring) 8.80x1.90 EPDM A70 (black)	For upper cover
31	082-001497-00	O-Ring 4.00X1.50 SIL A50 Crystal	For upper cover

FOR YOUR NOTES

A Test Items

A.1 Post-Installation Test Items

Hospital: Instrument SN:

Post-Installation Test Item	Section No. in Maintenance Guide	Complete
System self-check	4.2	□
Automatic circuit leak test	4.9.4	□
Manual circuit leak test	4.9.3	□
Gas supply test	4.4	□
Cylinder supply test	4.5	□
Vaporizer interlock test	4.7.1	□
Vaporizer leak test	4.7.4	□
Auxiliary O2 test		
Drive gas switching function test	4.8.1	□
O2 flush test	4.8.2	□
ACGO function test	4.8.3	□
O2 sensor related test	4.9.6	□
APL valve test	4.9.5	□
Power failure alarm test	4.10.12	□
Breathing circuit not mounted alarm test	4.10.8	□
CO2 absorbent canister alarm test	4.10.9	□
System ventilation performance test	4.11	□
Top light and auxiliary O2 backlight test	4.13.2	□

A.2 Post-Maintenance Test Item

Hospital: Instrument SN:

Post-Maintenance Test Item	Section No. in Maintenance Guide	Complete
Automatic circuit leak test	4.9.4	□
Manual circuit leak test	4.9.3	□
Vaporizer leak test	4.7.4	□
Auxiliary O2 test		
O2 flush test	4.8.2	□
ACGO function test	4.8.3	□
O2 sensor related test	4.9.6	□
APL valve test	4.9.5	□
Power failure alarm test	4.10.12	□
Breathing circuit not mounted alarm test	4.10.8	□
CO2 absorbent canister alarm test	4.10.9	□
System ventilation performance test	4.11	□
Sensor zero point check	4.12.1	□
Constant flow check	4.12.2	□
Constant pressure check	4.12.3	□

A.3 Post-Repair Test Item

Hospital: Instrument SN:

Post-Repair Test Item	Section No. in Maintenance Guide	Complete
System self-check	4.2	□
Automatic circuit leak test	4.9.4	□
Manual circuit leak test	4.9.3	□
Gas supply test	4.4	□
Cylinder supply test	4.5	□
Vaporizer interlock test	4.7.1	□
Vaporizer back pressure test	4.7.2	□
Vaporizer accuracy test	4.7.3	□
Vaporizer leak test	4.7.4	□
Auxiliary O2 test		□
Drive gas switching function test	4.8.1	□
O2 flush test	4.8.2	□
ACGO function test	4.8.3	□
O2 sensor related test	4.9.6	□
APL valve test	4.9.5	□
AGSS inspection	4.8.4	□
Power failure alarm test	4.10.12	□
Breathing circuit not mounted alarm test	4.10.8	□
CO2 absorbent canister alarm test	4.10.9	□
O2 supply failure alarm and drive gas pressure low alarms test	4.10.10；4.10.11	□
System ventilation performance test	4.11	□
Sensor zero point check	4.12.1	□
Constant flow check	4.12.2	□
Constant pressure check	4.12.3	□
Auxiliary electrical outlet test	4.13.1	□
Working table light and auxiliary O2 backlight test	4.13.2	□
Electrical safety inspection	4.13.3	□

FOR YOUR NOTES