

Newport™ e360 Ventilator with Accessories



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The ventilator should be operated and serviced only by trained professionals. Covidien's sole responsibility with respect to the ventilator and software, and its use, is as stated in the limited warranty provided.

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1 Introduction

1.1 Overview

It is very important to read and understand all of the information in this manual before attempting to service the Newport™ e360 ventilator. Please review all warnings and cautions in this manual before attempting to service the ventilator.

1.2 Definitions

1.2.1 Warnings, Cautions, and Notes



WARNING:

A warning describes a condition that can cause personal injury.



Caution:

A caution describes a condition that can cause damage to equipment.



Note:

A note emphasizes information that is important or convenient.

1.2.2 Other Definitions

- **Inspection:** Examination of actual condition.
- **Service:** Measures to maintain specified condition.
- **Repair:** Measures to restore to specified condition.
- **Maintenance:** Inspection, service, and repair where necessary.
- **Preventive maintenance:** Maintenance performed at regular intervals.
- **Operational verification:** A routine verification procedure to ensure proper operation.
- **Overhaul procedure:** A procedure for replacing key components at regular intervals.

1.3 General Warnings

Please review all warnings and cautions in this manual before attempting to service the ventilator.

Warnings and cautions appear throughout this manual where they are relevant. The warnings and cautions listed here apply generally any time you work on the ventilator.



WARNING:

To maintain grounding integrity, connect only to a hospital-grade receptacle. Always disconnect the power supply before servicing the ventilator.



WARNING:

There is a risk of explosion if used in the presence of flammable anesthetics.



WARNING:

Before returning to patient use, the ventilator must pass the operational verification procedure.



WARNING:

All ventilator service or repair must be performed by Covidien-trained service personnel.



WARNING:

Use extreme caution when working inside the ventilator while it is connected to a power source.



WARNING:

The design of the Newport™ e360 Ventilator, the operating and service manuals, and the labeling on the ventilator take into consideration that the purchase and use of the equipment is restricted to trained professionals, and that certain inherent characteristics of the ventilator are known to the operator. Instructions, warnings, and caution statements are therefore limited to the specifics of the Newport™ e360 Ventilator.



WARNING:

The functioning of this machine may be adversely affected by the operation of other medical equipment (such as high-frequency surgical (diathermy) equipment, defibrillators, or short-wave therapy equipment) in the vicinity.

1.4 General Cautions

-  **Caution:**
Use standard antistatic techniques when working inside the ventilator or handling any electronic parts.
-  **Caution:**
Clean all external parts of the ventilator prior to service.
-  **Caution:**
Use only dry, clean compressed air and medical-grade oxygen.
-  **Caution:**
Water in the air or oxygen supply can cause equipment malfunction and damage.
-  **Caution:**
Mains voltage must correspond to the voltage range selected on the power module of the ventilator. Always replace an open fuse with one of correct type and rating.
-  **Caution:**
Do not place containers of liquids near the ventilator. Liquids that get into the ventilator can cause equipment malfunction or damage.
-  **Caution:**
To avoid the risk of electric shock, the ventilator should not be opened by anyone other than Covidien-trained service personnel.

1.5 General Note

-  **Note:**
Use the tools specified in the manual to perform specific procedures.

1.6 Service Guidelines

1.6.1 Regular Service

Service must be provided at regular intervals by Covidien-trained service personnel who have received training specific to the maintenance and repair of the Newport™ e360 ventilator.

1.6.2 Complete Service Records

All service performed on the ventilator must be recorded in a service log in accordance with hospital procedures and local and national regulations.

1.6.3 Service Life

The expected service life of the e360 ventilator is 10 years. The expected service life is based on the premise of normal and reasonable operation and routine maintenance of the ventilator, parts and replaceable parts.

1.7 Disclaimers



WARNING:

The use of accessories or cables other than those specified with the exception of parts sold by Covidien as replacements for internal components, may result in increased emissions or decreased immunity of the ventilator system.

Covidien has no responsibility for the safe operation of the Newport™ e360 ventilator if the intended use, intended user, and intended use environment requirements specified in this document are not followed.

Covidien has no responsibility for the safe operation of the Newport™ e360 ventilator if operating instructions and maintenance specified in this document are not followed or if service maintenance or repairs are performed by persons who have not received the appropriate professional training.

Covidien disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences that might result from the combination of this ventilator with other products, whether supplied by Covidien or by other manufacturers, if such a combination is not endorsed by Covidien.

1.8 Electromagnetic Compatibility (EMC)

The ventilator is suitable for prescription use only in the specified electromagnetic environments, in accordance with the IEC 60601-1-2(EN 60601-1-2) standard. The ventilator requires special precautions during installation and operation for electromagnetic compatibility. In particular, the use of nearby mobile or portable communications equipment may influence ventilator performance. The ventilator is intended for use in the electromagnetic environment specified. Users of the ventilator should ensure it is used within such an environment. Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the e360 ventilator, including cables specified by the manufacturer, otherwise degradation of the performance of this equipment could result.

**Note:**

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Table 1-1. , *Table 1-2.* and *Table 1-3.* contain the manufacturer's declarations for the ventilator system electromagnetic emissions, electromagnetic immunity, and a list of compliant cables.

Table 1-1. Electromagnetic Emissions

The ventilator is intended for use in the electromagnetic environment specified below. The customer or the operator of the ventilator should assure that it is used in such an environment.		
Phenomenon and standard	Compliance	Electromagnetic environment—guidance
Conducted and radiated RF emissions CISPR 11	Group 1 Class A	The ventilator uses RF energy only for its internal functions. The ventilator is intended to be used only in a professional healthcare facility environment and not be connected to the public mains network.
Harmonic distortion IEC 61000-3-2	Class A	The ventilator is intended to be used only in a professional healthcare facility environment and not be connected to the public mains network.
Voltage fluctuations and flicker IEC 61000-3-3	Complies	

Table 1-2. Electromagnetic Immunity

Phenomenon	Basic EMC standard or test method	Immunity test levels for professional healthcare facility environment
Electrostatic discharge	IEC 61000-4-2	± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air
Electrical fast transients / bursts	IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines 100kHz repetition frequency
Surges	IEC 61000-4-5	± 0.5 kV, ± 1 kV line-to-line ± 0.5 kV, ± 1 kV, ± 2 kV line-to-ground
Voltage dips	IEC 61000-4-11	0% UT ¹ ; 0.5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0% UT; 1 cycle and 70% UT; 25/30 cycles ² Single phase: at 0°
Voltage interruptions	IEC 61000-4-11	0% UT; 250/300 cycles ²

Table 1-2. Electromagnetic Immunity (Continued)

Phenomenon	Basic EMC standard or test method	Immunity test levels for professional healthcare facility environment
Rated power frequency magnetic fields	IEC 61000-4-8	30 A/m 50 Hz or 60 Hz
Conducted disturbances induced by RF fields	IEC 61000-4-6	3 V rms. 0.15 MHz–80 MHz 6 V rms in ISM ³ bands between 0.15 MHz and 80 MHz
Radiated RF EM fields	IEC 61000-4-3	3 V/m 80 MHz–2.7 GHz 80% AM at 1 kHz
Proximity fields from RF wireless communications equipment	IEC 61000-4-3	27 V/m, 18 Hz PM ⁴ , 385 MHz 28 V/m, 18 Hz PM, 450 MHz 9 V/m, 217 Hz PM, 710 MHz 9 V/m, 217 Hz PM, 745 MHz 9 V/m, 217 Hz PM, 780 MHz 28 V/m, 18 Hz PM, 810 MHz 28 V/m, 18 Hz PM, 870 MHz 28 V/m, 18 Hz PM, 930 MHz 28 V/m, 217 Hz PM, 1720 MHz 28 V/m, 217 Hz PM, 1845 MHz 28 V/m, 217 Hz PM, 1970 MHz 28 V/m, 217 Hz PM, 2450 MHz 9 V/m, 217 Hz PM, 5240 MHz 9 V/m, 217 Hz PM, 5500 MHz 9 V/m, 217 Hz PM, 5785 MHz

1. UT is the AC mains voltage prior to application of the test level.
2. 25/30 means 25 periods at 50 Hz and 30 periods at 60 Hz
3. The ISM (industrial, scientific and medical) bands between 0,15 MHz and 80 MHz are 6,765 MHz to 6,795 MHz; 13,553 MHz to 13,567 MHz; 26,957 MHz to 27,283 MHz; and 40,66 MHz to 40,70 MHz. The amateur radio bands between 0,15 MHz and 80 MHz are 1,8 MHz to 2,0 MHz, 3,5 MHz to 4,0 MHz, 5,3 MHz to 5,4 MHz, 7 MHz to 7,3 MHz, 10,1 MHz to 10,15 MHz, 14 MHz to 14,2 MHz, 18,07 MHz to 18,17 MHz, 21,0 MHz to 21,4 MHz, 24,89 MHz to 24,99 MHz, 28,0 MHz to 29,7 MHz and 50,0 MHz to 54,0 MHz.
4. PM is the Pulse Modulation

Table 1-3. List of Compliant Cables

Part number and description	Cable length
PWR1500P-EU, E360 power cord, European style C plug	2.5 m (8 ft)
PWR2103P-BR, E360 power cord, Brazilian detachable cordset 250VAC, 10A	2.5 m (8 ft)
PWR1500P, E360 power cord, North American style plug	3.0 m (10 ft)
PWR290P-EU, FPD2126A power cord, European style C plug	2.5 m (8 ft)
FPD2126A-IN, 15 in. external touchscreen kit, medical grade, w/ Euro PS	4.6 m (15 ft) power cable 2.5 m (8 ft) VGA cable 2.0 m (7 ft) COM cable
FPD2126A, 15 in. external touch screen kit, medical grade	4.0 m (13 ft) power cable 2.5 m (8 ft) VGA cable 2.0 m (7 ft) COM cable
GR-CBL1829A, remote alarm cable for nurse call system	3.0 m (10 ft)
PST3600A, 110V medical-grade power strip assembly	4.6 m (15 ft)

1.9 Revision History

The part number, revision level, and date on the documentation indicate its version. The revision level and date change when a new edition is printed in accordance with the revision history of the documentation. Minor corrections and updates incorporated at reprint do not cause the revision number to change. The document part number may change when extensive technical changes are incorporated into the document.

1.10 Warranty Information

The information contained in this document is subject to change without notice. Covidien makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties or merchantability and fitness for a particular purpose. Covidien shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

1.11 Contact Information

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Covidien UK Unit 2, Talisman Business Park London Road, Bicester OX26 6HR United Kingdom [T] +44 0 1869 328 092 [F] +44 0 11869 327 585	Covidien USA 2824 Airwest Blvd Plainfield, IN 46168 [T] 1 800 255 6774 (option 4 & option 2) Email: venttechsupport@covidien.com
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2 Maintenance, Overhaul, and Software Upgrade

2.1 Overview

This chapter describes preventive maintenance, overhaul, and software upgrade procedures for use on the Newport™ e360 ventilator.

2.2 Maintenance and Overhaul Intervals

The level 1 preventive maintenance procedure should be performed once a year or every 5000 hours, whichever comes first.

Perform the level 2 overhaul procedure every five years or 25 000 hours, whichever comes first.

Replace the lead acid battery and the O₂ sensor at least every 2 years, or when not performing as intended.

2.3 General Warnings



WARNING:

To prevent personal injury or death, do not attempt any ventilator service or enter service mode while a patient is connected to the ventilator.



WARNING:

Hazardous voltages are present inside the ventilator. Use extreme caution if it is necessary to work inside the ventilator while it is connected to a power source. Disconnect electrical power, air, and oxygen sources before attempting any disassembly. Failure to do so could result in injury to service personnel or damage to equipment.



WARNING:

To maintain grounding integrity, the ventilator must be connected to a hospital-grade receptacle when in use.



WARNING:

There is a risk of explosion if the ventilator is used in the presence of flammable anesthetics.



WARNING:

Before returning to patient use, the ventilator must pass the operational verification procedure.



WARNING:

All service repairs of the ventilator must be performed by Covidien-trained service personnel.



WARNING:

To prevent damage from ESD and possible failure of the ventilator, use standard anti-static techniques when working inside the ventilator, handling circuit boards, or other electronic components.

2.4 General Cautions



Caution:

Clean all external parts of the ventilator prior to service. Use only dry, clean compressed air and medical-grade oxygen.



Caution:

Water in the air or oxygen supply can cause ventilator malfunction or damage.



Caution:

Mains voltage must correspond to the voltage range specified on the ventilator power entry module. Always replace fuses with those of correct type and rating.



Caution:

Keep all liquids away from the ventilator. Liquids in the ventilator can cause malfunction or damage.



Caution:

Always use standard antistatic techniques when working inside the ventilator or handling any electronic parts.

2.5 Tools Required

Use the tools specified in the manual to perform specific procedures.

- Large Phillips screwdriver
- Medium Phillips screwdriver
- Needle nose pliers

- 5/64 in. hex key
- Nonconductive tool for coin battery removal
- USB-style keyboard

2.6 Parts Required

2.6.1 Preventive Maintenance Kit

The preventive maintenance kit (PMK360A) includes the items listed in [Table 2-1](#).

Table 2-1. Preventive Maintenance Kit Parts List

Part number	Quantity	Description
JFK100P	2	JAR filter kit (oxygen and air for older models)
KIT2103P	1	Element & o-ring kit for water trap WTR2103P
ADP2105M	1	Exhalation valve adapter
DIA1800M	1	Emergency relief diaphragm
SEL1800M	1	Exhalation valve seal
ORG1200P	1	O-ring, exhalation flow sensor
DIA1810M	1	Exhalation valve diaphragm
FLT2102P	4	25 mm disk filter
RES2102P	1	Restrictor with filter
CBL2132A	1	Cable, SBC replacement battery ¹
GRD1800P	1	Finger guard and filter
VLV2100M	1	Valve, umbrella

1. For use with older-style SBC boards SBC2100P and SBC2108P.

2.6.2 Overhaul Kit

The overhaul kit (OVL360A) includes the items listed in [Table 2-2](#).

Table 2-2. Overhaul Kit Parts List

Part number	Quantity	Description
JFK100P	2	JAR filter kit (oxygen and air for older models)
KIT2103P	1	Element & o-ring kit for water trap WTR2103P
RRK1800M	2	Regulator rebuild kit
GRD1800P	1	Finger guard and filter
ADP2105M	1	Exhalation valve adapter
PPT1805A	1	Exhalation valve poppet assembly
ORG1200P	1	O-ring, exhalation flow sensor
DIA1800M	2	Emergency relief diaphragm
VLV2101M	1	Emergency intake diaphragm
VLV2100M	1	Valve, umbrella
FLT2102P	4	25 mm disk filter
RES2102P	1	Restrictor with filter
CBL2132A	1	Cable, SBC replacement battery ¹
SPPT00055561	1	Coin battery spare for SBC2105A

1. For use with older-style SBC boards SBC2100P and SBC2108P.

2.6.3 Biannual Maintenance

Biannual maintenance includes changing the items listed in [Table 2-3](#).

Table 2-3. Parts Changed During Biannual Maintenance

Part number	Quantity	Description
BAT2100A ¹	1	Battery
SEN2103P	1	FiO ₂ sensor

1. To order a replacement battery, request BAT2100S.

2.7 Maintenance Procedures

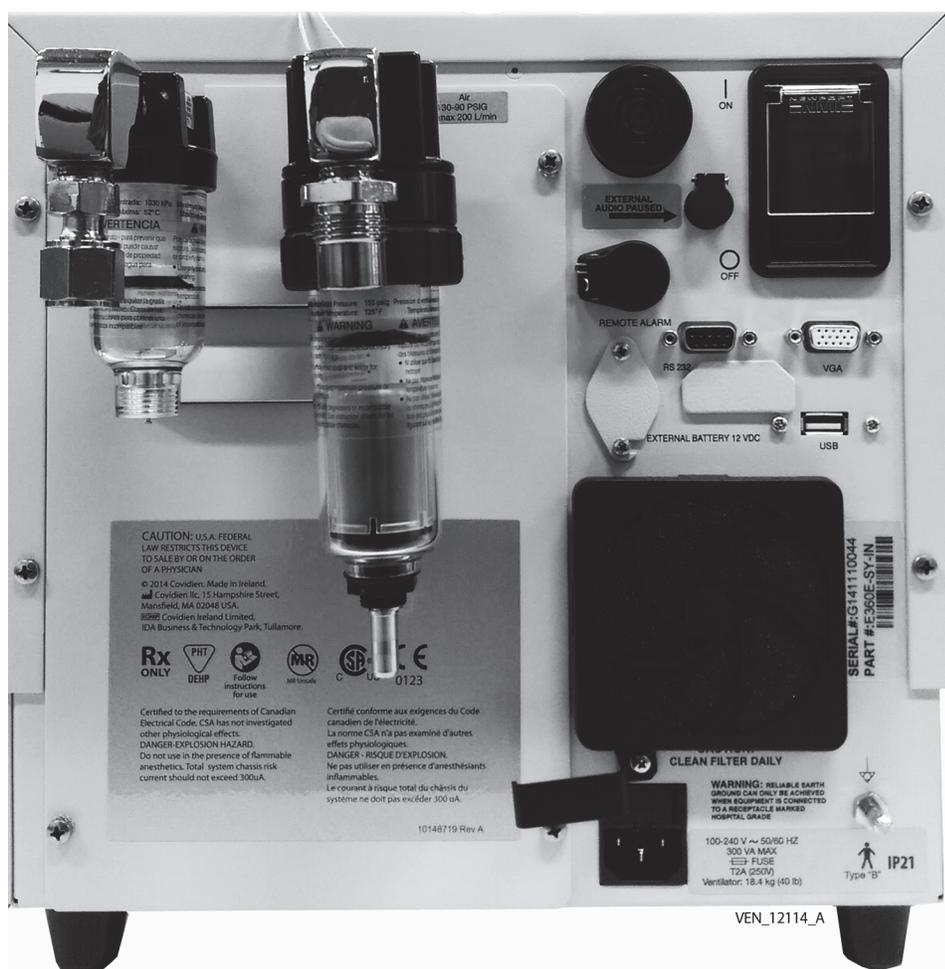


WARNING:

Disconnect electrical power, air, and oxygen sources before attempting any disassembly.

2.7.1 Inlet Water Trap Filters and O-Ring Assembly

Figure 2-1. Inlet Water Trap Filter Replacement



Oxygen Filter

To replace the oxygen filter, perform the following steps:

1. Unscrew the collection bowl from the inlet water trap.
2. Unscrew the filter holder.
3. Remove and replace the inlet filter and o-ring (JFK100P).



Note:

Ensure the o-ring is properly seated.

4. Reinstall the filter holder.
5. Reassemble the water trap assembly.

Air Filter



Note:

If your air-side filter is the same as the oxygen filter, follow the steps in *Oxygen Filter* on page 2-5 to change the air filter. If your air-side filter is larger than the oxygen filter, follow the steps in this section.

To replace the air filter, perform the following steps:

1. Unscrew the retaining ring securing the water trap bowl to the filter.
2. Unscrew the filter holder.
3. Remove and replace the inlet filter and o-ring (KIT2103P).



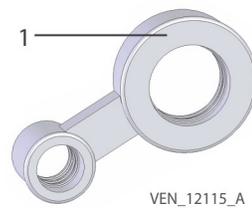
Note:

Ensure the o-ring is properly seated.

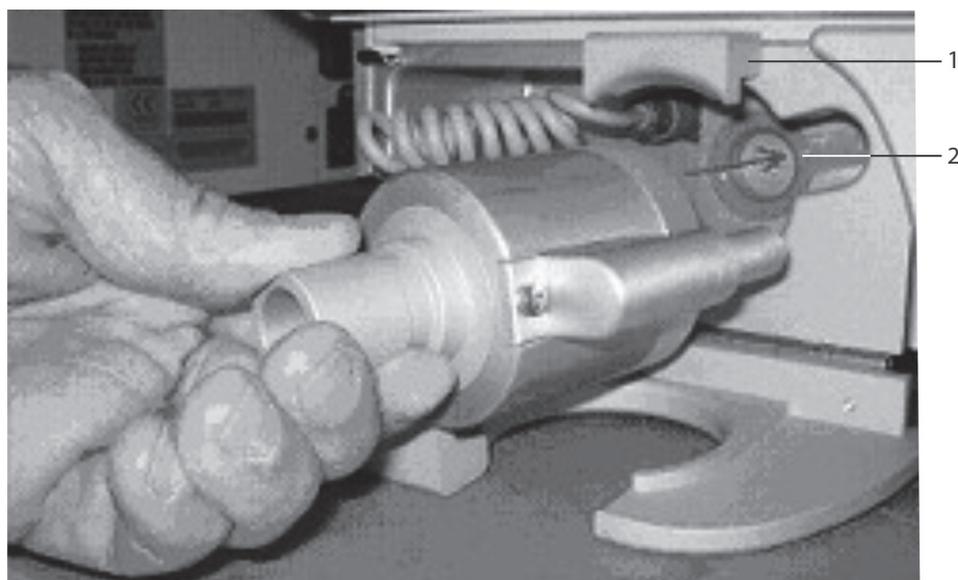
4. Reinstall the filter holder.
5. Reassemble the water trap assembly.

2.7.2 Exhalation Valve Adapter

Figure 2-2. Exhalation Valve Adapter



- 1 Adapter lip

Figure 2-3. Exhalation Valve Adapter Replacement

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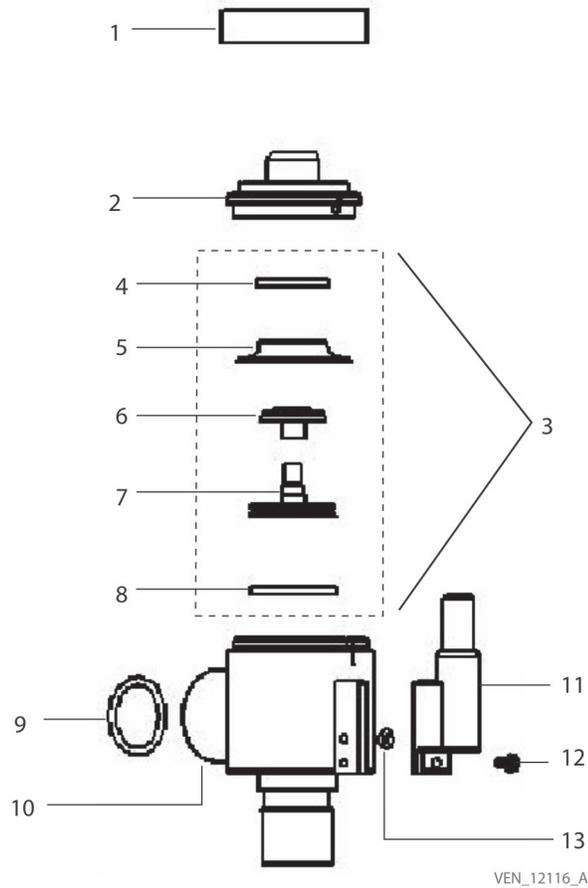
1 Retaining latch 2 Valve adapter

To replace the exhalation valve adapter, refer to [Figure 2-3](#), and perform the following steps:

1. Access the exhalation valve adapter by lifting the retaining latch and removing the exhalation valve and exhalation flow sensor (see [Figure 2-2](#), and [Figure 2-3](#)).
2. To remove the silicone exhalation valve adapter, use your finger to grasp the adapter and pull it straight out.
3. To replace the exhalation valve adapter, orient the adapter lip toward the inside of the exhalation valve housing and press into place.
4. Confirm that the adapter is properly seated.
5. Reinstall the exhalation valve and exhalation flow sensor.

2.7.3 Exhalation Valve Diaphragm, Seal, and O-Ring

Figure 2-4. Diaphragm, Seal, and O-Ring Replacement



1	Exhalation valve nut collar (NUT1802M)	8	Exhalation valve seal poppet (SEL1800M)
2	Exhalation valve cap (CAP2112M)	9	Silicone o-ring (ORG1200P)
3	Diaphragm poppet assembly (PPT1805A)	10	Exhalation valve body (BDY2103M)
4	Exhalation valve cap poppet (CAP1803M)	11	Exhalation valve slide (SLD2110M)
5	Exhalation valve diaphragm (DIA1810M)	12	Screw (SCR1830P)
6	Exhalation valve top poppet (PPT1800M)	13	Silicone o-ring (ORG2127P)
7	Exhalation valve lower poppet (PPT1801M)		

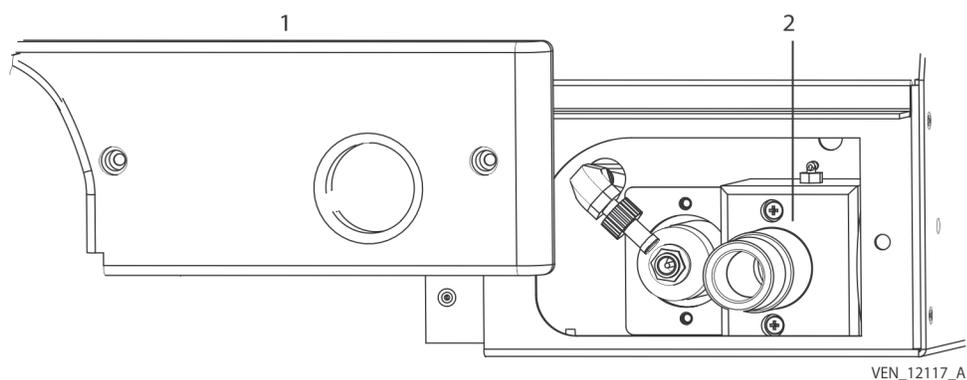
To replace the exhalation valve diaphragm, seal, and o-ring, refer to [Figure 2-4.](#) and perform the following steps:

1. Unscrew the exhalation valve nut collar and lift it off.
2. Lift off the exhalation valve cap and diaphragm/poppet assembly.

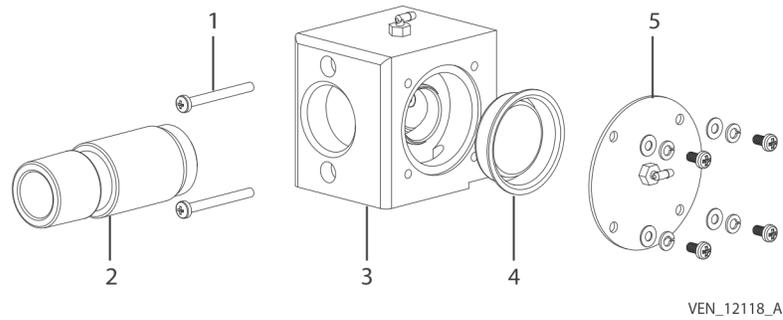
3. Disassemble the diaphragm/poppet assembly by unscrewing it.
4. To install the new DIA1810M and SEL1800M, reverse step 3.
5. To reassemble the diaphragm/poppet assembly, exhalation valve cap, and exhalation valve nut collar, reverse steps 1 and 2.
6. Locate and replace the o-ring (ORG1200P) inside the exhalation valve body (see [Figure 2-4](#)).

2.7.4 Emergency Relief Diaphragm

Figure 2-5. Inhalation Outlet Assembly



- 1 Front panel section 2 Inhalation outlet assembly

Figure 2-6. Emergency Relief Diaphragm Replacement

1	Outlet retaining screws	4	Emergency relief diaphragm (DIA1800M)
2	Inhalation adapter	5	Emergency valve cap
3	Inhalation outlet block		

To replace the emergency relief diaphragm, refer to [Figure 2-5.](#) and [Figure 2-6.](#) , and perform the following steps:

1. Access the inhalation outlet assembly by removing the lower right front panel (see [Figure 2-5.](#)).
2. Remove the inhalation outlet assembly by removing the two retaining screws (see [Figure 2-6.](#)).
3. Remove the four screws from the emergency valve cap to expose the emergency relief valve.
4. With your finger, pull the emergency relief diaphragm (DIA1800M) out of the inhalation outlet block.
5. Replace the emergency relief diaphragm.
6. Reinstall the components and assembly by reversing steps 1-4.

2.7.5 In-Line Disk Filters and Restrictor with Filter

To replace the in-line disk filters and restrictor with filter:

1. Remove the six screws securing the ventilator's cover.
2. Remove the cover.
3. Using the pneumatic diagram in Appendix C, locate and replace the four disk filters (FLT2102P).



Note:

The FLT2102P filters have luer lock connections and can be replaced by twisting the adapters while holding the filter in your hand.

4. Using the pneumatic diagram in Appendix C, locate and replace the restrictor with filter (RES2102P). When replacing it, the arrow on the restrictor should face the direction of flow.

**Note:**

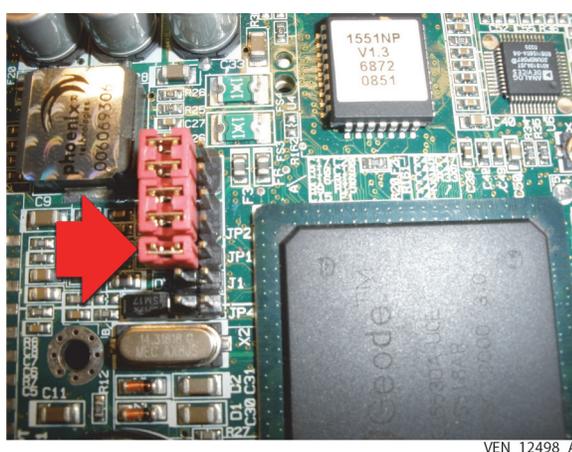
If your ventilator does not have the in-line disk filters already installed, contact the Technical Service Department to obtain the necessary filter adapters.

2.7.6 Coin Battery (SBC2100P and SBC2108P)

To replace the coin battery, perform the following steps:

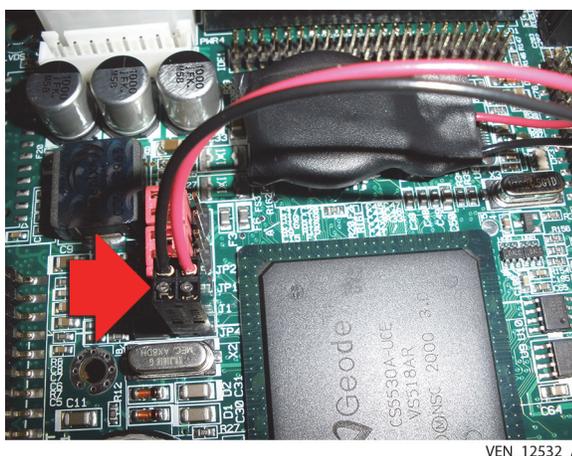
1. For first-time installation only: Locate JP1 on the SBC board and move the jumper from pins 2 and 3 to pins 1 and 2 (*Figure 2-7.*).

Figure 2-7. JP1 at Pins 1 and 2



2. Remove the cable clamp securing the SBC battery (CBL2132A).
3. Remove the SBC battery from J1 on the SBC board.
4. Reinstall the battery by reversing steps 2 and 3. When reconnecting the SBC battery to J1, confirm the cable is connected as shown in *Figure 2-8.*

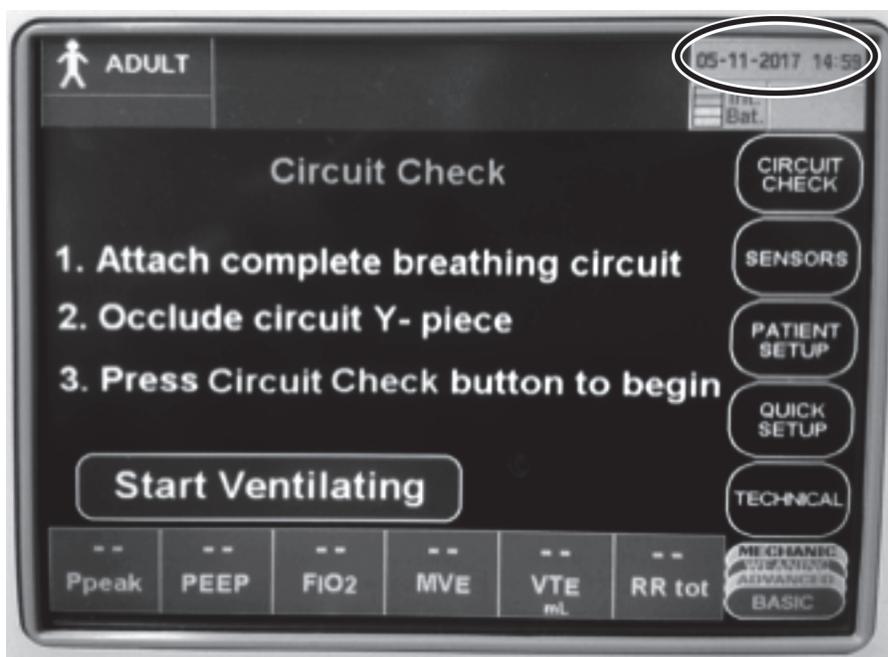
Figure 2-8. J1 with CBL2132A Connected



5. Reset the date and time on the ventilator:

- a. Turn on the ventilator, and wait for the CMOS error.
 - b. Connect a USB keyboard, and then press F1.
 - c. After the ventilator completes the power on, enter the correct date and time using the *Technical Setup* screen.
6. Verify the time and date:
- a. Turn the ventilator off, allowing it to fully shut down.
 - b. After 30 seconds has elapsed, turn the ventilator back on.
 - c. Confirm the time and date shown on the screen are correct.

Figure 2-9. Verifying the Time and Date



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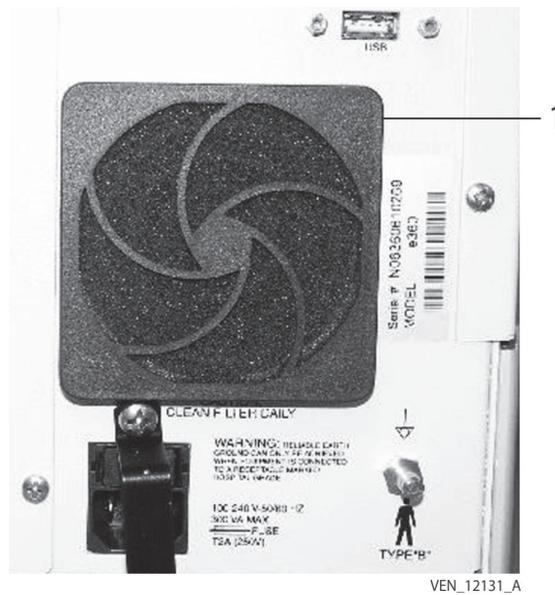


Note:

If the ventilator is fitted with a SBC2105A board, verify the ventilator maintains the correct date and time following a ventilator power down as part of the maintenance procedure. If the correct date and time are not maintained, then replace the coin battery on the SBC2105A board as described in section 2.8.11, “Coin Battery (SBC2105A).”

2.7.7 Cooling Fan Filter and Guard

Figure 2-10. Filter and Guard Assembly Replacement



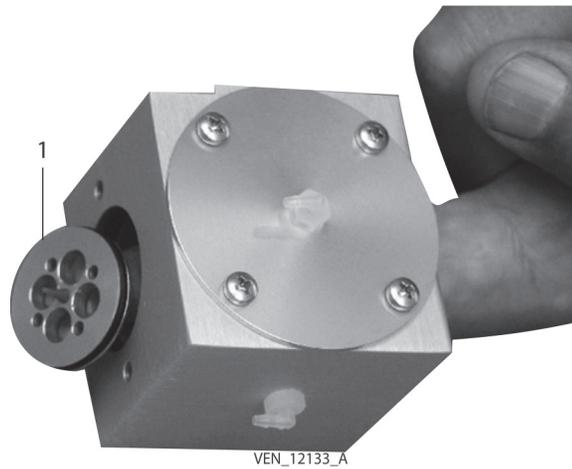
1 Cooling fan filter and guard

To replace the cooling fan filter and guard, refer to [Figure 2-10](#). and perform the following steps:

1. Pull off the filter guard.
2. Remove the old filter and insert a new one.
3. Replace the filter guard.

2.7.8 Inhalation Outlet Check Valve

Figure 2-11. Inhalation Outlet Check Valve



1 Inhalation outlet check valve

To replace the inhalation outlet check valve, refer to [Figure 2-11](#). and perform the following steps:

1. Remove the mixing block by removing the two retaining screws (see [Figure 2-13](#)).
2. Remove the inhalation adapter from the inhalation outlet assembly (see [Figure 2-5](#)).
3. Using your finger, push out the inhalation outlet check valve (see [Figure 2-11](#)).
4. Replace the inhalation outlet check valve diaphragm (VLV2100M).
5. Reinstall the components and assembly by reversing steps 1-3.

2.8 Overhaul Procedures



WARNING:

Disconnect electrical power, air and oxygen sources before attempting any disassembly.

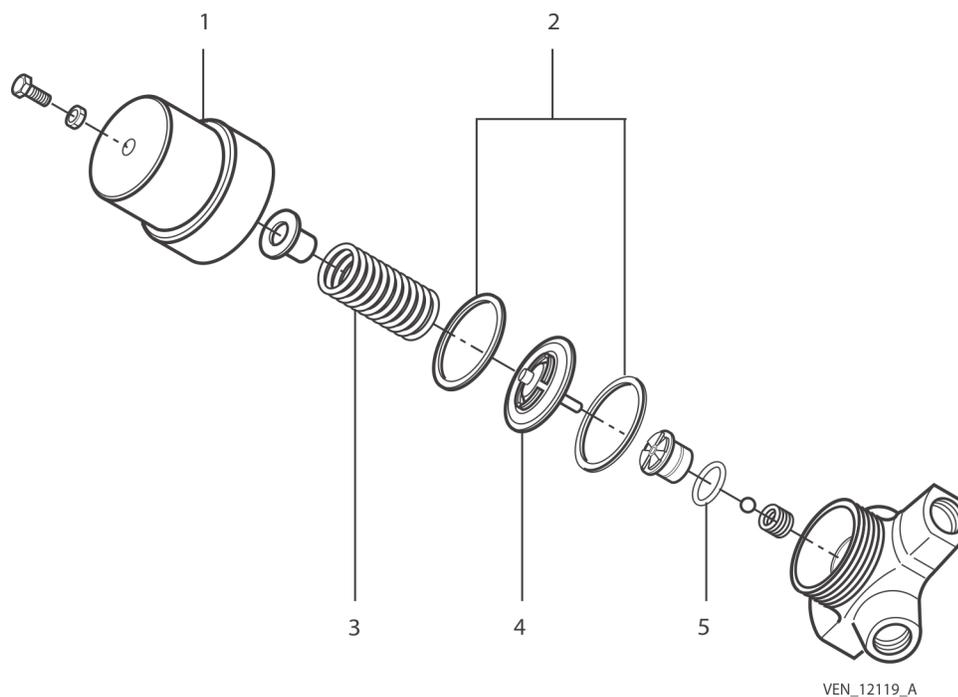
2.8.1 Inlet Water Trap Filter and O-Ring Assembly

To replace the inlet filter and o-ring assemblies, follow the procedure in section [2.7.1](#), "[Inlet Water Trap Filters and O-Ring Assembly](#)."

2.8.2 Air and Oxygen Inlet Regulator Rebuild

To remove and install the air and oxygen inlet regulator, follow the procedure in section 4.16.3, "Regulators, Inlet Blocks, and Flow Sensor Block."

Figure 2-12. Inlet Regulator Rebuild



- | | | | |
|---|-----------|---|-----------|
| 1 | Cover | 4 | Diaphragm |
| 2 | Slip ring | 5 | O-ring |
| 3 | Spring | | |



Note:

Inlet regulators must be outside of the ventilator for disassembly and reassembly.

To install the air and oxygen inlet regulators rebuild kits, refer to [Figure 2-12](#). and perform the following steps:

1. Unscrew the brass cover from the regulator (no tool should be needed).
2. Remove the spring, diaphragm, diaphragm washer, seat with o-ring, small spring, and ball.
3. Using the parts from the regulator rebuild kit (RRK1800M), replace the used parts by reversing the disassembly.



Note:

The regulator must be in a vertical position to reassemble the kit components.

4. Ensuring all components are aligned, install the regulator brass cover and hand tighten.



Note:

This procedure is the same for both the air and the oxygen regulators.

2.8.3 Cooling Fan Filter and Guard

To replace the cooling fan filter and guard, follow the procedure in section [2.7.7, "Cooling Fan Filter and Guard."](#)

2.8.4 Exhalation Valve Adapter

To replace the exhalation valve adapter, follow the procedure in section [2.7.2, "Exhalation Valve Adapter."](#)

2.8.5 Exhalation Valve Diaphragm/Poppet Assembly

To replace the exhalation valve diaphragm/poppet assembly, refer to [Figure 2-4](#). and perform the following steps:

1. Unscrew the exhalation valve nut collar, and lift it off.
2. Lift off the exhalation valve cap and diaphragm/poppet assembly.
3. Replace the diaphragm/poppet assembly (PPT1805A).
4. To reassemble the diaphragm/poppet assembly, exhalation valve cap, and exhalation valve nut collar, reverse steps 1 and 2.
5. Replace the o-ring (ORG1200P) inside the exhalation valve body.

2.8.6 Emergency Relief Diaphragm

To replace the emergency relief diaphragm, follow the procedure in section [2.7.4, "Emergency Relief Diaphragm."](#)

2.8.7 Emergency Intake Diaphragm

Figure 2-13. Emergency Intake Diaphragm and Valve Replacement



1	Mixing block	3	Mixing block retaining screws (2)
2	Emergency intake valve assembly	4	Emergency intake valve retaining screws (2)

To replace the emergency intake diaphragm, refer to [Figure 2-13](#). and perform the following steps:

1. Remove the top cover by following the procedure in section 4.6, "[Top Cover \(CVR2101M\)](#)."
2. Remove the pneumatics panel by following the procedure in section 4.16, "[Pneumatics Panel Assembly and Components](#)."
3. Remove the inspiratory flow sensors by following the procedure in section 4.16.2, "[Air and Oxygen Inspiratory Flow Sensors \(GR-FTD2100P and GR-FTD2101P\)](#)."
4. Disconnect the green tube from the emergency intake valve nipple.
5. Remove the two emergency intake valve retaining screws (see [Figure 2-13](#).).
6. Remove the cap to the emergency intake valve assembly.
7. Remove the diaphragm.
8. Install the new diaphragm (DIA1800M).
9. Using needle nose pliers, remove the emergency intake valve.
10. Replace the emergency intake diaphragm (VLV2101M).
11. Reinstall the assembly by reversing the disassembly procedure.



Note:

If your unit has the old-style intake valve, order FSK2109A for the e360T and e360T+ and FSK2103A for other models to update the unit.

2.8.8 Inhalation Outlet Check Valve

To replace the inhalation outlet check valve, follow the procedure in section 2.7.8, "[Inhalation Outlet Check Valve](#)."

2.8.9 In-Line Disk Filters and Restrictor with Filter

To replace the in-line disk filters and restrictor with filter, follow the procedure in section 2.7.5, "[In-Line Disk Filters and Restrictor with Filter](#)."



Note:

If your ventilator does not have the in-line disk filters already installed, contact the Technical Service Department to obtain the necessary filter adapters.

2.8.10 Coin Battery (SBC2100P and SBC2108P)

To replace the coin battery on older-style SBC boards SBC2100P and SBC2108P, see section 2.7.6, "[Coin Battery \(SBC2100P and SBC2108P\)](#)."

2.8.11 Coin Battery (SBC2105A)

Replace the coin battery on SBC2105A when performing the level 2 overhaul procedure (every 5 years or less) or when the ventilator time and date resets following a ventilator power on.



Note:

If your ventilator uses an older-style SBC board (SBC2100P or SBC2108P), see section 2.7.6, "[Coin Battery \(SBC2100P and SBC2108P\)](#)."

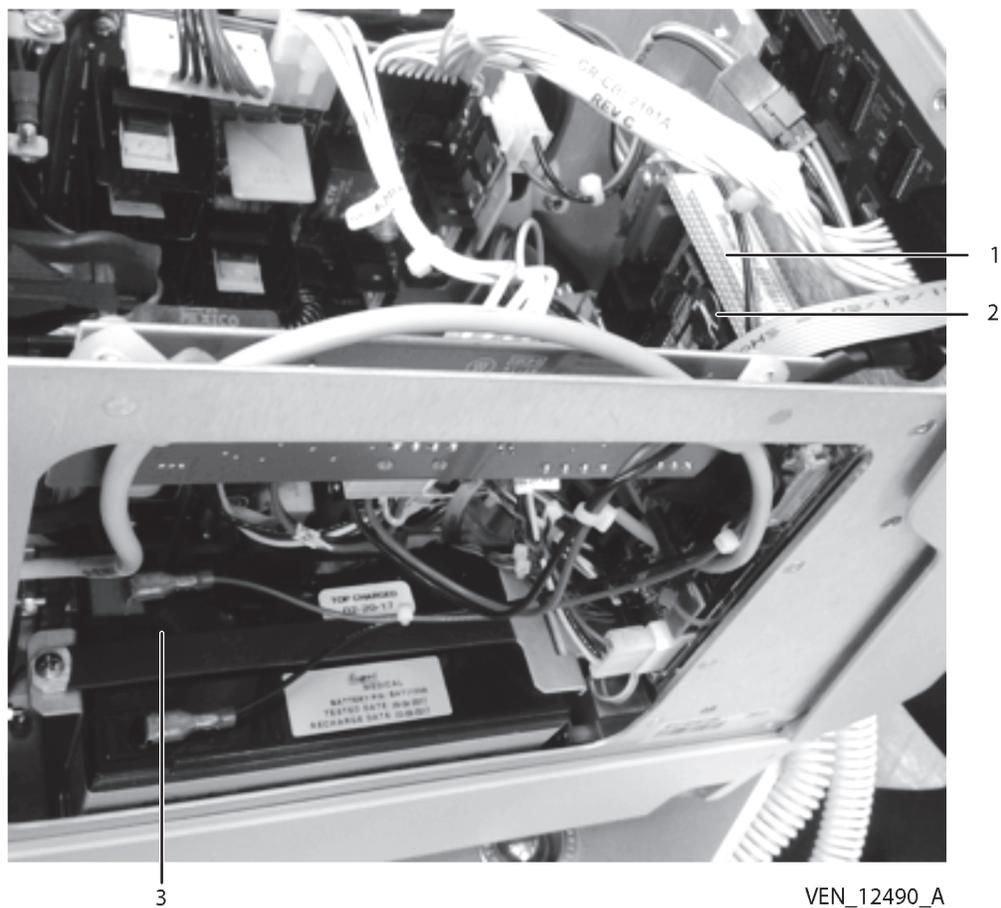


Note:

When handling the new coin battery, it is recommended to use finger cots to prevent battery surface contamination.

To replace the coin battery, perform the following steps:

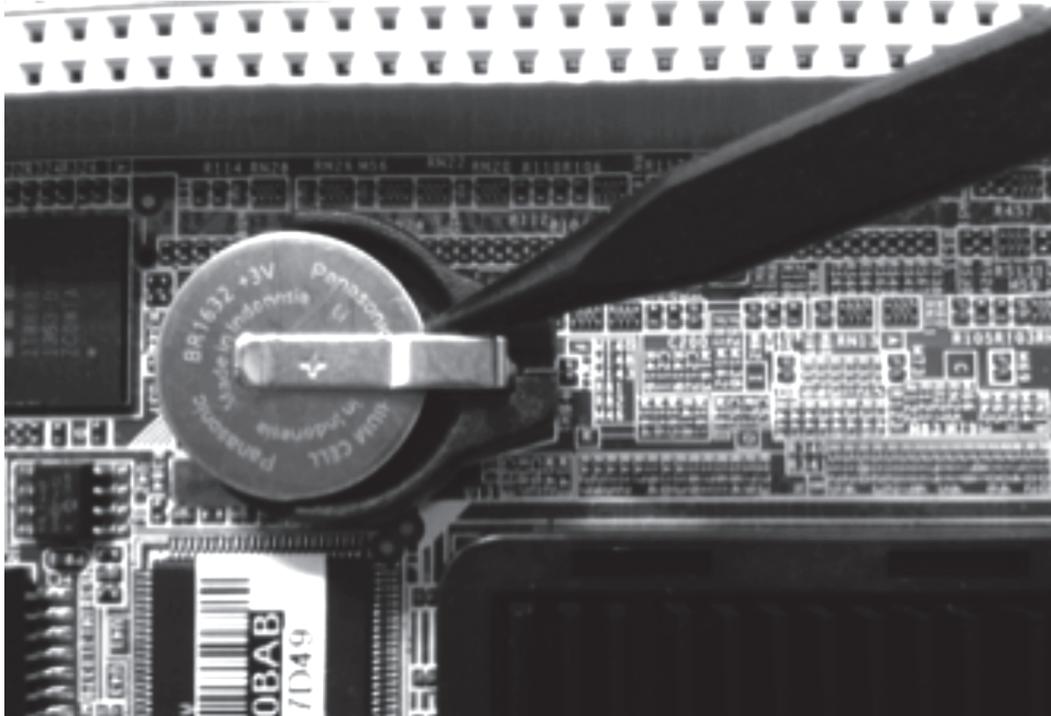
1. Disconnect the positive (+) and negative (-) terminals on the internal battery.

Figure 2-14. Location of the SBC PCBA, Coin Battery, and Internal Battery

- | | | | |
|---|---------------|---|--|
| 1 | SBC2105A PCBA | 3 | Internal battery positive and negative terminals |
| 2 | Coin battery | | |

2. To avoid causing an electrical short circuit while removing the coin battery, use a nonconductive tool to push the battery out of its retainer on the SBC2105A. Capture the battery immediately as it comes out of the retainer and remove it from the ventilator.

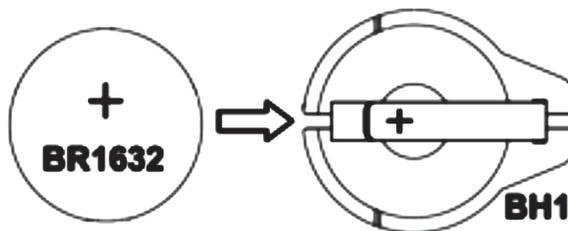
Figure 2-15. Removing the Coin Battery



VEN_12491_A

3. Slide the new coin battery (PT00055561) into the retainer (BH1), ensuring that the positive side of the battery is facing outward, away from the SBC board, as shown in [Figure 2-16](#).

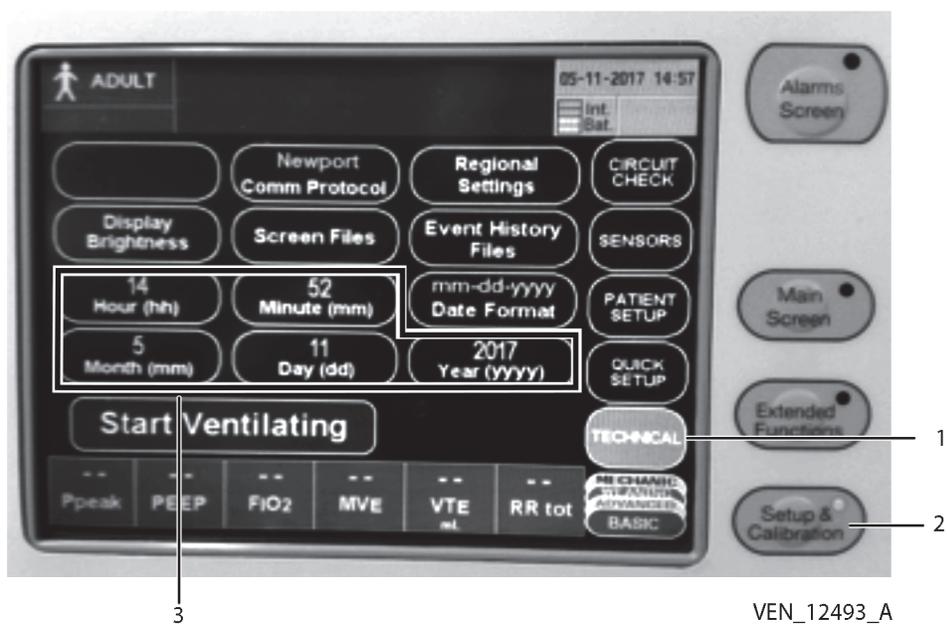
Figure 2-16. Inserting a New Coin Battery



VEN_12492_A

4. Reconnect the internal battery positive (+) and negative (-) terminals.
5. Reset the ventilator time and date:
 - a. Turn on the ventilator.
 - b. Press the Setup & Calibration key.
 - c. Touch the Technical button.
 - d. Enter the current date and time using the Hour, Minute, Month, Day, and Year buttons.

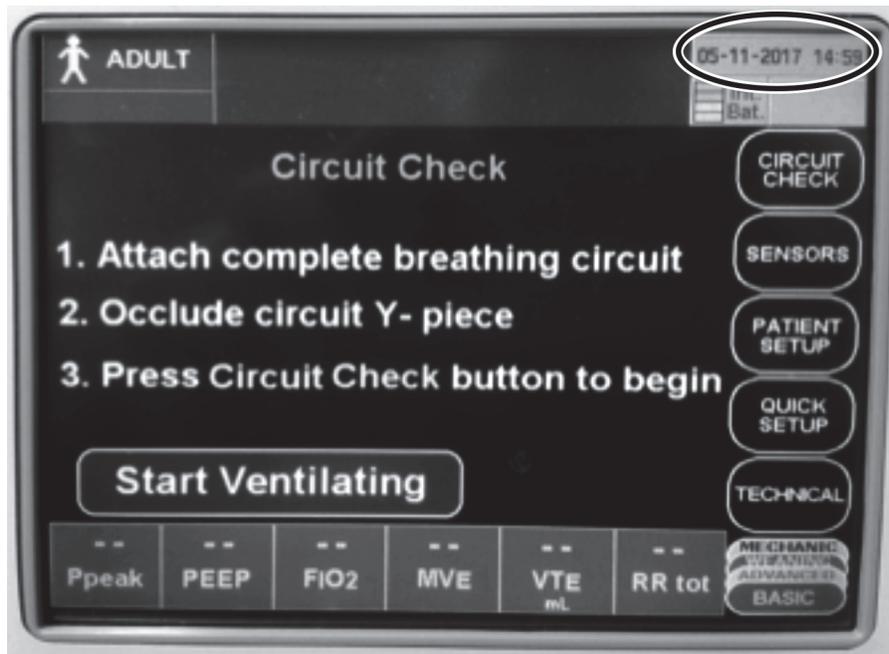
Figure 2-17. Resetting the Time and Date



- | | | | |
|---|-------------------------|---|--|
| 1 | Technical button | 3 | Hour (hh), Minute (mm), Month (mm), Day (dd) & Year (yyyy) buttons |
| 2 | Setup & Calibration key | | |

6. Verify the time and date:
 - a. Turn the ventilator off, allowing it to fully shut down.
 - b. After 30 seconds has elapsed, turn the ventilator back on.
 - c. Confirm the time and date shown on the screen are correct.

Figure 2-18. Verifying the Time and Date



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2.9 Biannual Maintenance

2.9.1 Internal Battery

Replace the internal battery at least every 2 years, or as needed to meet performance requirements.

To remove and install the internal battery, follow the procedure in section 4.24, "Battery (BAT2100A)."



WARNING:

Observe correct polarity when reconnecting the battery connectors.



Caution:

To avoid discharging the battery voltage, do not allow any metal object (including tools) to touch the battery connectors.

2.9.2 Oxygen Sensor

Replace the oxygen sensor at least every 2 years, or as needed to meet performance requirements.

To remove and install the oxygen sensor, follow the procedure in section 4.18, “Oxygen Sensor (SEN2103P).”

2.9.3 Tubing

The tubing inside the ventilator does not need to be replaced at any predetermined time interval. However, Covidien is aware that tubing may occasionally need replacing. During the overhaul procedure, carefully inspect all tubing for degradation, cracks, or brittleness. If the tubing indicates any of those symptoms, contact Customer Service to order the Newport™ e360 ventilator tube replacement kit.

To ensure each tube is cut to the proper length and to replace the worn tubing in the ventilator, refer to the system pneumatic diagram located in Appendix C.

2.9.4 Upon Completion

After an overhaul is completed, perform a complete electronic and pneumatic calibration as described in Chapter 5 and Chapter 6.

2.10 Software Upgrade Procedure

2.10.1 General Information

The following items are required for a software upgrade:

- Latest software on USB flash drive
- Software upgrade instructions
- Reusable patient circuit (PBC340A) or equivalent
- Cap to plug end of patient circuit (CAP100P) or equivalent



Note:

Perform the upgrade procedure to reload software after replacing a main board, display board, or the single-board computer.

2.10.2 Upgrade Procedure

To upgrade the software, perform the following steps:

1. After confirming the ventilator is off, connect the AC power cord to the AC wall outlet (see [Figure 2-21](#). for power entry module location).
2. Press and hold the *Accept* button, and then turn on the power.

3. When the *Logo* screen is displayed, release the *Accept* button.
4. Wait for a few minutes until the *Software Download/Diagnostics Mode* screen is displayed (see [Figure 2-19](#)).

Figure 2-19. Software Download / Diagnostics Mode Screen



5. Connect the USB flash drive (with latest software) to the USB port on the back panel of the ventilator (see [Figure 2-21](#) for USB port location).
6. Touch *Start Download* on the *Software Download/Diagnostics Mode* screen ([Figure 2-19](#)). The ventilator will sound a short beep and the message “Touch Selection to Begin” changes to a flashing message stating “downloading...” Depending on the software version your ventilator is currently running, the download may take anywhere from 2 minutes to 45 minutes.
7. When the software download is complete, the ventilator will sound a short beep. The message “Download Complete” is displayed.
8. Turn the ventilator off.
9. Wait at least 10 seconds, and then turn the power back on.
10. When the message “Ventilation Standby” appears, touch *Start Ventilating* to begin ventilating.



Note:

Because air/O₂ gas supplies are not connected, the Air/O₂ Loss alarm will sound. Disregard the alarm while verifying the software is installed correctly.

11. Confirm the message “Incompatible Software ...” does not appear on the screen. If this message appears on the screen, the software download was NOT completed successfully. Repeat steps 1–6 again. If the download is unsuccessful again, contact the Technical Service Department for further assistance.
12. Press the *Extended Functions* button on the front control panel.
13. Touch the *Event History* button on the screen.

- Confirm the software upgraded by checking the software version number (see [Figure 2-20](#), upper left corner).

Figure 2-20. Event History Log Screen

ID	TIME	DATE	EVENT
(0 - 1000)	(12 hr)	(mm/dd/yy)	
1000	01:50 P	03/14/14	LOW PAW = 0
999	01:50 P	03/14/14	HIGH PAW = 40
998	01:50 P	03/14/14	LOW MV = 1.00
997	01:50 P	03/14/14	HIGH MV = 12.0
996	01:50 P	03/14/14	VT = 500
995	01:50 P	03/14/14	PEEP = 0
994	01:50 P	03/14/14	Pressure Limit = 16
993	01:50 P	03/14/14	Pressure Support = 5
992	01:50 P	03/14/14	Flow Trigger = 0.6
991	01:50 P	03/14/14	RATE = 15
990	01:50 P	03/14/14	Flow = 100
989	01:50 P	03/14/14	FI02 = 0.21

VENTILATOR SETTINGS			
	DATE:	03/14/14	TIME: 01:50 P
MODE:	VC A/LMV	PEEP:	0
		VI:	500
TRIG:	15	Pressure Support:	5
Flow:	100	HIGH MV:	12.0
LOW PAW:	0	HIGH PAW:	40
		LOW MV:	1.00
		TRIG:	0.6 (flow)
		FI02:	0.21

- Remove the USB flash drive from the USB port on the back panel of the ventilator.

2.10.3 Circuit Check Test and Diagnostic



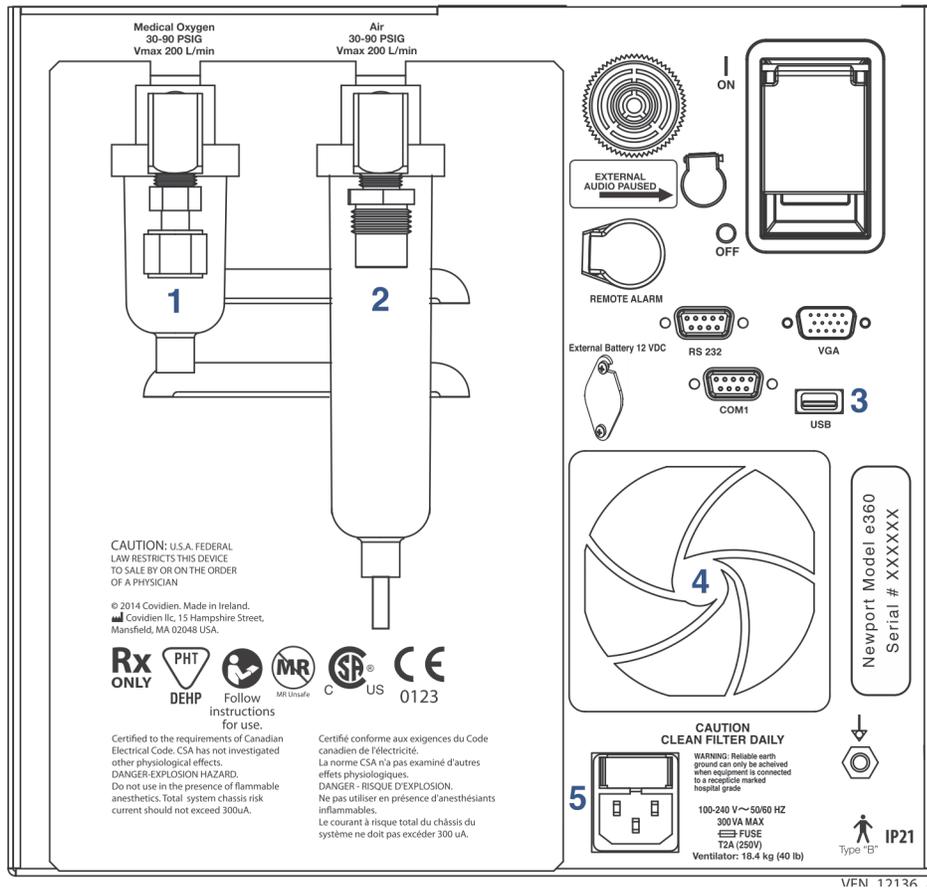
WARNING:

Before returning the ventilator back for patient use after the software upgrade, you must perform this procedure.

To do the circuit check and diagnostics, perform the following steps:

- Turn the ventilator off.
- Connect a medical-grade air source to the air inlet on the back panel of the ventilator (see [Figure 2-21](#) for air inlet location).

Figure 2-21. Back Panel of Ventilator



- | | | | |
|---|----------------------|---|--------------------|
| 1 | O ₂ inlet | 4 | Cooling fan filter |
| 2 | Air inlet | 5 | Power entry module |
| 3 | USB connection | | |

- Verify the medical-grade air source provides at least 30 psi, but does not exceed 90 psi.
- Connect the appropriate patient circuit to the ventilator, as shown in [Figure 2-22](#).

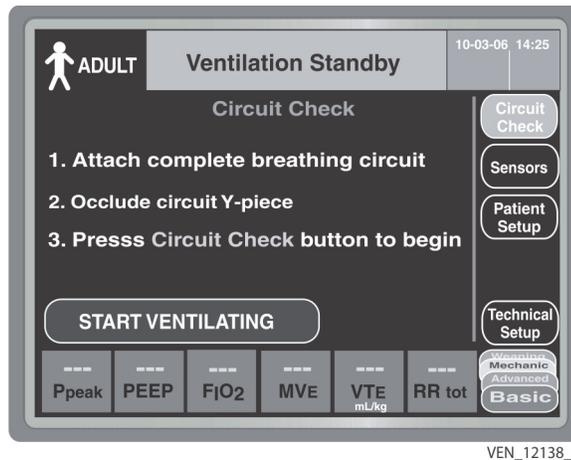
Figure 2-22. Patient Circuit Setup

1 Y-piece

2 Breathing circuit

5. Occlude the patient circuit using a cap (a filter and test lung are not required).
6. Turn the ventilator back on.
7. Wait until the *Ventilation Standby* screen appears.
8. Follow the instructions that appear on screen, as shown in [Figure 2-23](#).

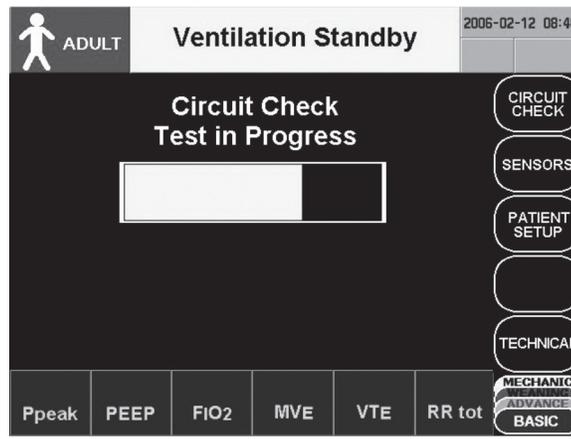
Figure 2-23. Ventilation Standby Screen



VEN_12138_A

9. Touch the *Circuit Check* button to initiate the first step. The message “Circuit Check Test in Progress” is displayed, as shown in [Figure 2-24](#).

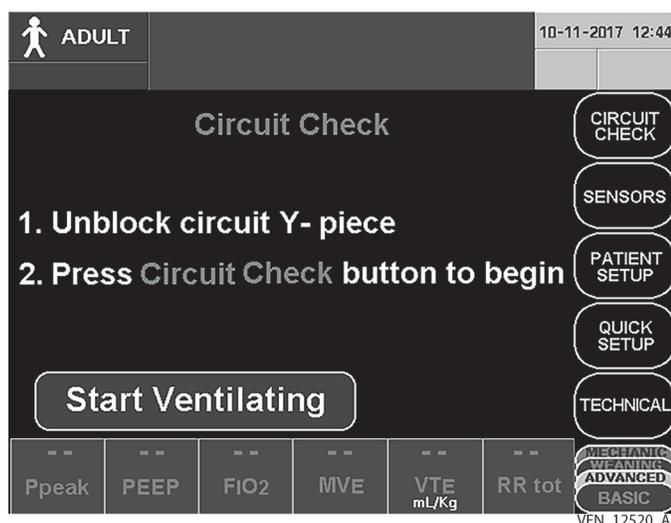
Figure 2-24. Circuit Check Screen



VEN_12139_A

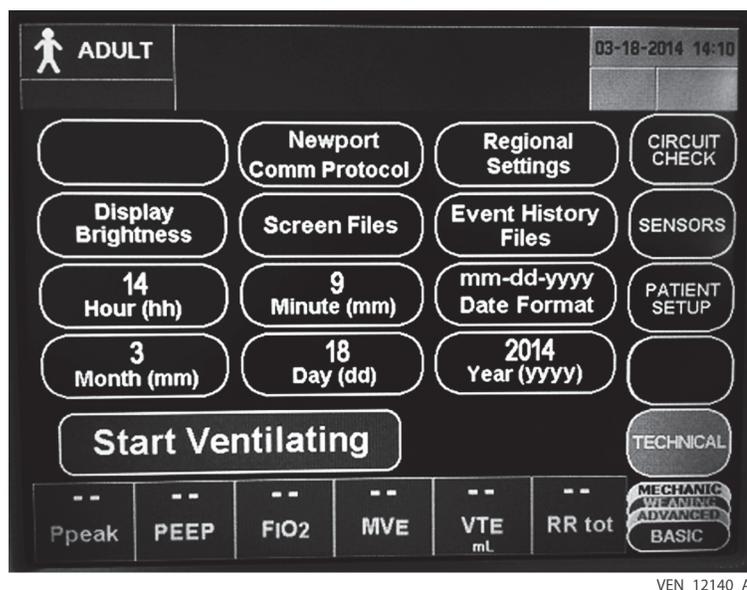
10. When the first step is completed, remove the cap occluding the patient circuit y-piece, then touch the *Circuit Check* button again to complete the test.

Figure 2-25. Circuit Check Screen (Step 2)



11. When the circuit test is completed successfully, the message "Circuit Check PASSED" is displayed.
12. If the circuit test failed, the message "Circuit Check FAILED" is displayed. Check the breathing circuit for leaks, and repeat the circuit check. If the circuit check fails again, contact the Technical Service Department for further assistance.
13. Press the *Setup & Calibration* button on the control panel.
14. Touch the *Technical* button on the screen (see [Figure 2-26](#)).

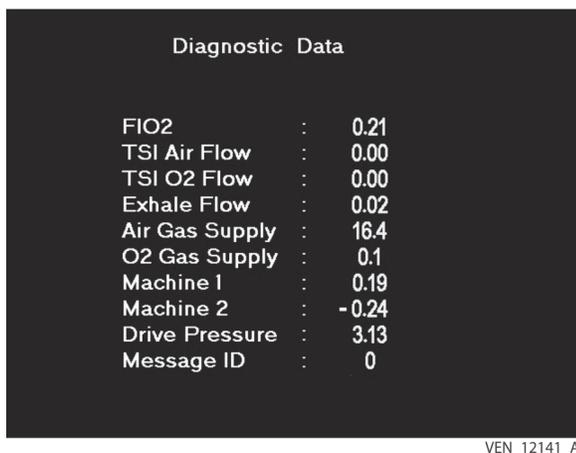
Figure 2-26. Technical Screen



15. Touch the *Regional Settings* button on the screen (see [Figure 2-26](#)).
16. Touch the *Altitude* button on the screen. The "_ ft/_ m" setting will start flashing.

17. While the numbers are flashing, rotate the *adjustment* knob to change the altitude level as appropriate (for example, if located at sea level, set altitude to “0 m / 0 ft”).
18. To confirm the selection, press *Accept*.
19. Wait 15 seconds to 20 seconds.
20. Turn the ventilator off.
21. To access the *Software Download/Diagnostics Mode* screen, press and hold the *Accept* button, and then turn on the ventilator.
22. Release the *Accept* button once the ventilator sounds a short beep.
23. Touch the *Start Diagnostics* button on the screen. The *Diagnostic Data* screen will appear, as shown in [Figure 2-27](#).

Figure 2-27. Diagnostic Data Screen



Diagnostic Data		
FIO2	:	0.21
TSI Air Flow	:	0.00
TSI O2 Flow	:	0.00
Exhale Flow	:	0.02
Air Gas Supply	:	16.4
O2 Gas Supply	:	0.1
Machine 1	:	0.19
Machine 2	:	-0.24
Drive Pressure	:	3.13
Message ID	:	0

VEN_12141_A

24. Press the *Trig Button* on the control panel.
25. Rotate the *adjustment* knob to change the value in the display window to “d9.”
26. Press *Accept*.
27. Occlude the breathing circuit from the y-piece using a cap (do not use test lung).
28. To start the exhalation flow sensor calibration (d9), press the *Manual Inflation* button.
29. Wait for 30 seconds to 1 minute until the “TSI Air flow:” and “Exhale Flow:” numbers start to increase gradually and the air flow is delivered from the ventilator. The exhalation flow sensor calibration requires 6 minutes to 10 minutes to complete (see [Figure 2-27](#)).
30. When the flow delivered from the ventilator stops and “Test Completed” appears on the screen, the exhalation flow sensor calibration is successfully completed (see [Figure 2-27](#)).
31. Turn the ventilator off.

32. Disconnect the medical-grade air source from the air inlet on the back panel of the ventilator.
33. Disconnect the AC power cord from the AC wall outlet.

If you have any questions, contact the Technical Service Department.

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3 Troubleshooting

3.1 Overview

This chapter provides information on troubleshooting the Newport™ e360 ventilator.

3.2 Troubleshooting Guide

Table 3-1. may provide guidance in determining the cause and possible corrective action for ventilator problems. Covidien does not guarantee that the suggested corrective action will solve the problem.

Contact the Technical Service Department for additional assistance.

Table 3-1. Troubleshooting Guide

Problem	Potential cause	Suggested action
Failed circuit check	Leak from patient circuit.	Inspect patient circuit.
	Leak from exhalation section.	Disassemble exhalation valve to inspect exhalation valve diaphragm and seal. Inspect exhalation valve adapter.
	Leak from inhalation section.	Tighten inhalation flow outlet. Tighten oxygen sensor. Inspect emergency relief diaphragm.
	Leak from tubing connection inside the ventilator.	Inspect pneumatic tubing inside the ventilator. Inspect TSI air/oxygen flow sensors assembly. Clean or replace emergency intake diaphragm. Inspect rubber seal between inhalation outlet block and mixer block.
Flow sensor error/bad	Defective exhalation flow sensor.	Replace exhalation flow sensor.
	Defective exhalation flow sensor cables, outside and inside.	Replace exhalation flow sensor cables, outside and inside.
	Defective cable from exhalation sensor board to main board.	Replace cable from exhalation sensor board to main board.
	Defective exhalation sensor board.	Replace the exhalation sensor board.

Table 3-1. Troubleshooting Guide (Continued)

Problem	Potential cause	Suggested action
Ventilator cannot achieve or maintain correct tidal volume, plateau pressure, or baseline pressure	Pressure relief valve regulator failure.	Perform the operational verification procedure to diagnose the problem. Replace any parts that may be defective.
	Crossover solenoid valve failure.	
	Machine zero solenoid valve failure.	
Pressure bar graph does not show pressure rise	Machine zero solenoid valve failure.	Replace solenoid or analog PCB.
	Analog board malfunction.	
Internal battery does not charge	Defective battery or battery charging hardware.	Replace internal battery or the DC-DC power supply PCB.
Loss of battery power	Battery missing, discharged, or defective. Defective battery hardware.	Recharge or replace battery. Replace DC-DC power supply PCB.
Low supply gas alarm	Supply pressure is not within specified range (30–90 psig).	Ensure that both gas supplies have a pressure of at least 30 psig.
	Faulty gas supply.	Verify gas sources are at correct pressures.
	Faulty transducer on analog board.	Replace analog board.
	Pressure regulator not set correctly or faulty.	Calibrate or replace regulator.
	Tube on transducer has become disconnected.	Verify all tubes are connected properly.
No flow or low flow from inspiratory port during inspiratory phase of a mandatory breath	Inlet regulator failure or PSOL valve failure.	Calibrate air and oxygen regulators; replace if calibration is not successful.
Ventilator cannot cycle, audible alarm on, and error message displayed in message window	Based on error message.	Calibrate PSOL valves; replace if calibration is not successful. Refer to Table 3-2. "Device Alert Messages."
Zero monitored exhaled flow	Flow sensor cable disconnected.	Reconnect cable to exhalation flow sensor. Verify that pins in cable connector are not damaged.
	Flow sensor defective.	Replace flow sensor.
	Defective exhalation flow sensor PCB.	Replace exhalation flow sensor PCB.
Monitored values for exhaled flows or volumes differ from settings	Occluded or missing bacteria filter.	Replace the bacteria filter.
	Dirty exhalation flow sensor.	Disassemble and clean the exhalation module, replace the exhalation flow sensor.
	Exhalation heater failure.	Feel the bacteria filter. If it is not warm to the touch, replace the exhalation heater.
	Vent settings for Circuit Type humidity setup are incorrect for humidifier system in use.	Correct Circuit Type selection in patient setup.

Table 3-1. Troubleshooting Guide (Continued)

Problem	Potential cause	Suggested action
Monitored FiO ₂ values differ from setting	Defective oxygen sensor. Defective analog board.	Replace the oxygen sensor. Replace analog board.
No audible alarm	Defective alarm speaker, sound processor board, or SBC.	Replace alarm speaker or sound processor board, or SBC.
Press F1 to continue is displayed on LCD during power on	Depleted battery on SBC board.	Replace battery on SBC board.
	Defective SBC.	Replace SBC board.
LCD shows white screen only	Corrupted files on CF card.	Replace CF card.
	Defective SBC board.	Replace SBC board.
LCD shows black screen only	Corrupted files on CF card.	Replace CF card.
	Defective SBC board.	Verify voltage on the fifth solder pad from the top, left side of connector LCD 1, is at least 2.5 volts. If not, replace SBC board.
	Defective display board.	Replace display board.
	Defective LCD display.	Replace LCD display.
Ventilator power resets	Defective SBC board.	Replace SBC board.
	Defective power sequence board.	Replace power sequence board.
Software fails to download	Faulty USB download sticks.	Replace USB software sticks.

3.3 Device Alert Messages

Table 3-2. defines the device alert violations and messages that may be displayed in the message window. The first line in the message window displays the date and time of the error; the second line displays the error message.

Table 3-2. Device Alert Messages

Device alert violation	Violation message	Priority level	Definitions
Control communications failure	Monitor μ P Failed	High	The monitor processor does not respond to a request from the control processor. The monitor processor is not running.
Control CPU failure	Control CPU Failed	High	The control processor on the main PCB is bad.
Control exception failure	M Internal System	High	The control processor has detected an abnormal operation, such as illegal instruction or division by zero, that was generated by the control software.
Control RAM failure	Control RAM Failed	High	Random access memory that is used by the control processor on the main PCB is damaged.

Table 3-2. Device Alert Messages (Continued)

Device alert violation	Violation message	Priority level	Definitions
Control ROM failure	Control ROM Failed	High	Read-only memory that stores the code of the control processor has an incorrect checksum.
Control task continuity failure	Control Tasks Failed	High	Software tasks of the control processor have operated out of sequence.
Dual RAM failure	Dual RAM Failed	High	Random access memory that is shared between the control and monitor processors is damaged.
Monitor communications failure	Control uP Failed	High	The control processor does not respond to a request from the monitor processor. The control processor is not running.
Monitor CPU failure	Monitor CPU Failed	High	The monitor processor on the main PCB is bad.
Monitor exception failure	C Internal System	High	The monitor processor has detected an abnormal operation, such as illegal instruction or division by zero, that was generated by the monitor software.
Monitor RAM failure	Monitor RAM Failed	High	Random access memory that is used by the monitor processor on the main PCB is damaged.
Monitor ROM failure	Monitor ROM Failed	High	Read-only memory that stores the code of the monitor processor has an incorrect checksum.
Monitor task continuity failure	Mon Task Failed	High	Software tasks of the monitor processor have operated out of sequence.
Power failure	Power Failure	High	DC power out of tolerance. Check +12 VDC, -12 VDC, and +5 VDC. (The ventilator may have been powered by internal battery until it was depleted and a device alert resulted.)
Pressure sensor error	Pressure Sensor Error	High	Loss of pressure to machine 1 or machine 2 pressure transducers. (Can be caused by disconnected tube, failure of rezero solenoid, or a faulty pressure transducer.)

4 Component Removal and Replacement

4.1 Overview

This chapter provides procedures for removing and replacing various components of the Newport™ e360 ventilator.

4.2 Key Components

4.2.1 Ordering

To order a component, refer to [Table B-1](#) for the appropriate part number. Note that [Table B-1](#) lists two part numbers for each component: a manufacturing part number and a service part number. The manufacturing part number is printed on the part; the service part number is needed to order the required spare part. For some components, the service part number is different from the manufacturing part number.

The manufacturing part number for each component is referenced throughout this manual.

4.2.2 Removing

Unless instructed otherwise, reinstall parts by reversing the disassembly procedure.

4.3 Preparation

Before repairing or servicing the ventilator, perform the following steps:

1. Disconnect the power.
2. Shut off or disconnect the air and oxygen gas supplies.
3. Put on an ESD wrist strap. Perform procedures in an ESD-safe environment.

4.4 Tools Required

- #0 Phillips screwdriver

- #1 Phillips screwdriver
- #2 Phillips screwdriver
- #1 flat screwdriver
- 5/64 in. hex key
- 7/32 in. nut driver or wrench
- 11 mm nut driver or wrench
- Torque wrench set for 8 in.-lbs
- Anti-static wrist strap
- Anti-static parts bin



WARNING:

To avoid the possibility of electric shock, do not touch the power supply transformer when servicing the ventilator.



WARNING:

These instructions are intended for use only by Covidien-trained service personnel. Do not perform any unauthorized modifications or repairs to the ventilator or its components.



Caution:

To avoid damaging equipment, always use standard electrostatic discharge (ESD) precautions, including an ESD wrist strap, when servicing the ventilator.



Note:

If the main board, display board, or single-board computer components are replaced, the ventilator software must be reloaded. Follow the [Software Upgrade Procedure](#) in section 2.10 to load software. Contact the Technical Service Department if you need a software kit.

4.5 Exhalation Valve and Exhalation Flow Sensor

4.5.1 Valve (EXH2105A) and Flow Sensor (FLS2101P)

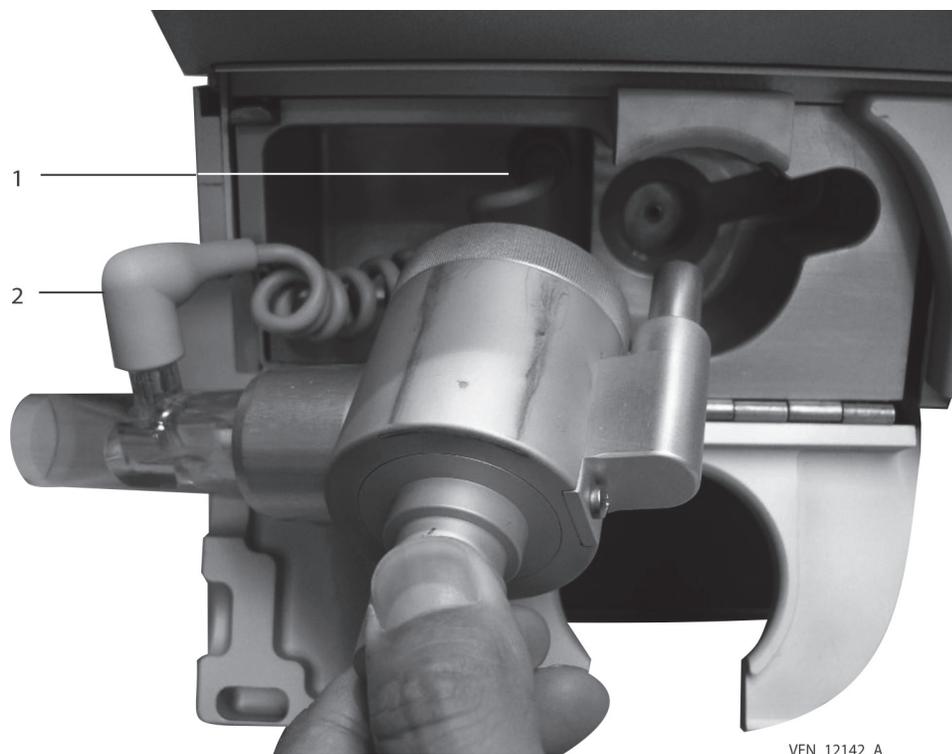


Caution:

The exhalation flow sensor is a precise yet delicate instrument. Take care when handling not to disturb the measuring wires. The life cycle of the sensor is limited, and will depend on observance of

safe handling precautions and the ability to calibrate the sensor. Always make sure that the flow sensor is completely dry before installation.

Figure 4-1. Exhalation Valve and Exhalation Flow Sensor



- | | | | |
|---|---|---|---|
| 1 | Flow sensor cable (GR-CBL2123P) connection to exhalation manifold | 2 | Flow sensor cable connection to exhalation flow sensor (FLS2101P) |
|---|---|---|---|

To replace the exhalation valve and exhalation flow sensor, refer to [Figure 4-1](#), and perform the following steps:

1. To expose the exhalation valve (EXH2105A) and the flow sensor (FLS2101P), open the front panel door on the lower left front of the ventilator.
2. Remove the exhalation valve by releasing the retaining latch.
3. Disconnect the flow sensor cable (GR-CBL2123P) from the plastic body of the flow sensor by pulling the cable straight up. Do not twist.
4. With a twisting motion, pull the plastic flow sensor away from the outlet of the exhalation valve.
5. Reinstall the flow sensor and exhalation valve by reversing steps 1-4.



Note:

To reconnect the cable to the sensor body, take care to line up the sensor port to the notch in the cable connector. Press together; do not twist.

4.5.2 Exhalation Flow Sensor Cable (Outside) (GR-CBL2123P)

To replace the exhalation flow sensor cable, perform the following steps:

1. Remove the exhalation valve and exhalation flow sensor by following the steps in section 4.5.1, "Valve (EXH2105A) and Flow Sensor (FLS2101P)."
2. Remove the exhalation flow sensor cable (outside) (GR-CBL2123P) from the exhalation manifold by pulling the collet of the cable connector.



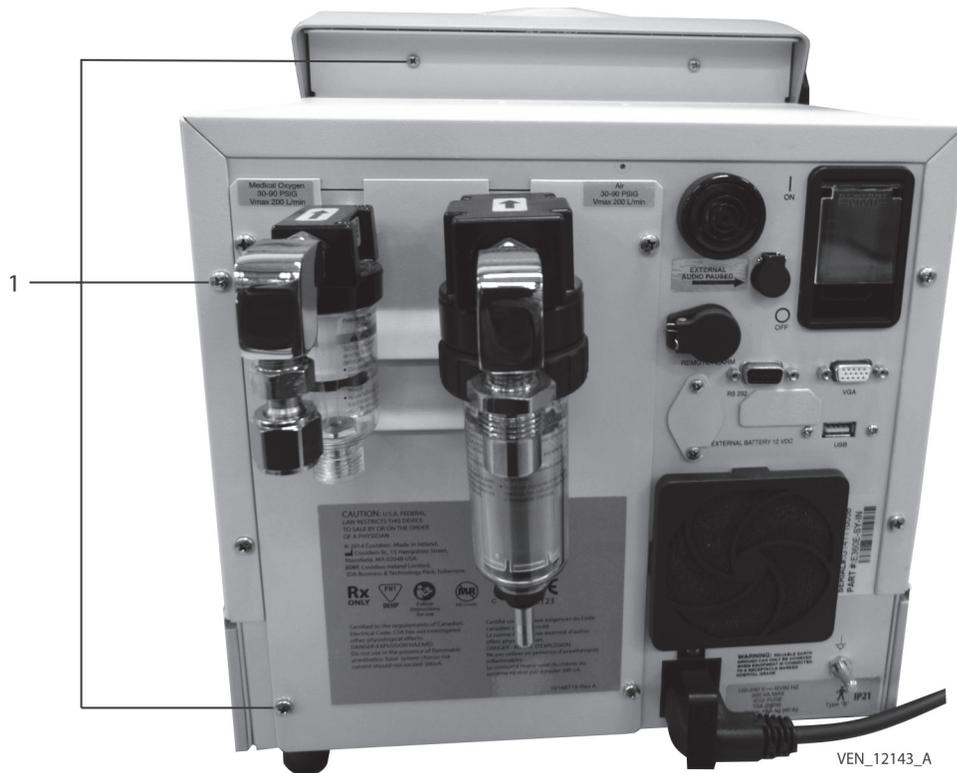
Note:

The lock mechanism of the connector can be easily released by pulling the collet of the connector. Do NOT disconnect the connector by pulling the wire.

3. Reinstall the cable to the exhalation manifold by aligning the key on the connector with the notch of the female connector on the exhalation manifold.

4.6 Top Cover (CVR2101M)

Figure 4-2. Top Cover



1 Screws (three of six securing cover to ventilator)

To remove and reinstall the top cover, refer to [Figure 4-2](#). and perform the following steps:

1. Rotate the ventilator so the rear of the ventilator is facing you.
2. Locate the six screws (three on each side) securing the cover to the ventilator and remove.
3. Grab the handles on the sides of the ventilator, pull the sides away from the chassis, and slide the cover off of the ventilator.
4. Reinstall the top cover by reversing steps 2 and 3.

4.7 Front Panel Assembly

Figure 4-3. Front Panel Assembly



VEN_12144_A

- 1 Screws (two of four securing front panel assembly to chassis)

To remove and reinstall the front panel assembly, refer to [Figure 4-3](#). and perform the following steps:

1. Remove the top cover by following the procedure in section 4.6, "[Top Cover \(CVR2101M\)](#)."
2. Locate the four screws (two on each side) securing the front panel assembly to the chassis of the ventilator and remove.
3. Carefully pull the front panel assembly forward and away from the ventilator chassis.

4. Locate and remove the following cables:
 - GR-CBL2101A from J2 on GR-PCB2100A
 - GR-CBL2118A from J13 on GR-PCB2100A
 - GR-CBL2148A from J8 on GR-PCB2100A
 - PT00095462 from J10 on GR-PCB2100A
 - 10105498 air and oxygen PSOL valve cables from J705 (air) and J706 (oxygen) on GR-PCB2100A
 - GR-CBL2107A from J708 on GR-PCB2100A
 - GR-CBL2127A from J9 on GR-PCB2100A
 - GR-CBL2155A from CN4 and C9 SBC2105A.
5. After all the cables from step 4 are disconnected, fully remove the front panel assembly and set on a stable surface.
6. Reinstall the front panel by reversing steps 2 through 5.



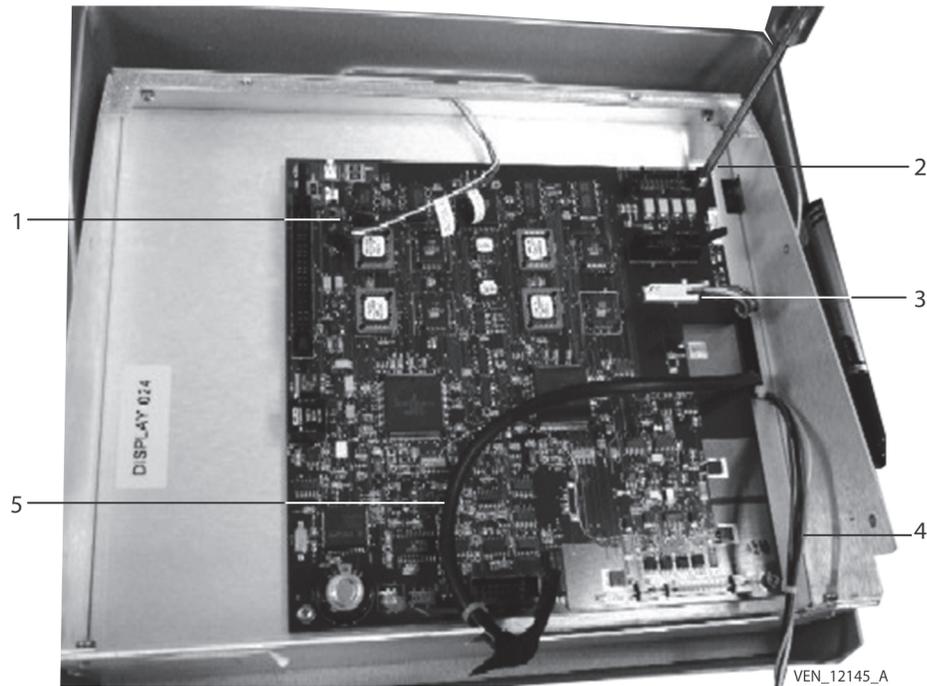
Note:

There is a small hole adjacent to J9 on GR-PCB2100A. The hole polarizes the connector.

4.8 Main Board and Main Board Support

4.8.1 Main Board (GR-PCB2100A)

Figure 4-4. Main Board



- | | | | |
|---|--|---|-------------------------------|
| 1 | GR-CBL2137A and GR-CBL2138A connected to P308 and P309 on GR-PCB2100A | 4 | Cable GR-CBL2112A to SBC2105A |
| 2 | Screw and washer (one of four securing main board to main board support) | 5 | LCD cable (GR-CBL2155A) |
| 3 | GR-CBL212A connected to J4 on GR-PCB2100A | | |

To replace the main board, refer to [Figure 4-4](#). and perform the following steps:

1. Remove the front panel assembly by following the procedure in section [4.7](#), "[Front Panel Assembly](#)".
2. Remove cable GR-CBL2121A from J4 on GR-PCB2100A.
3. Remove cable GR-CBL2137A from P308 and GR-CBL2138A from P309 on GR-PCB2100A.
4. Remove the four screws and washers securing the main board to the main board support.
5. Place the main board in an ESD-safe container.
6. Reinstall the main board by reversing steps 2 through 5, referencing the systems wiring diagram in [Appendix C](#).

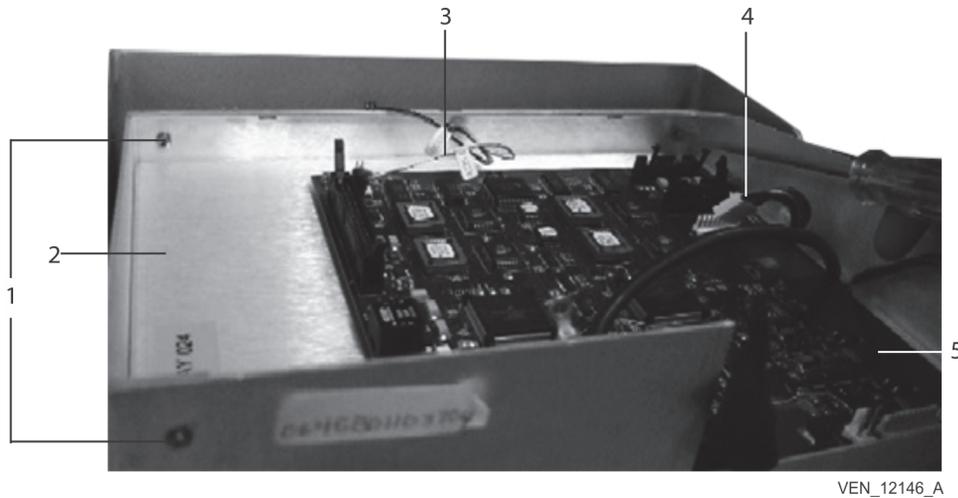


Note:

If the main board GR-PCB2100A is replaced, the ventilator software must be reloaded, and d1, d2, d4, and d9 calibrations performed. Refer to section 2.10 for the *Software Upgrade Procedure* and Chapter 5 for calibration procedures.

4.8.2 Main Board Support (CVR2103M)

Figure 4-5. Main Board Support (CVR2103M)



- | | | | |
|---|-----------------------------|---|--|
| 1 | Screws | 4 | GR-CBL2121A connected to J4 on GR-PCB2100A |
| 2 | CVR2103M | 5 | Main board (GR-PCB2100A) |
| 3 | GR-CBL2137A and GR-CBL2138A | | |

To remove and reinstall the main board support, refer to *Figure 4-5.* and perform the following steps:

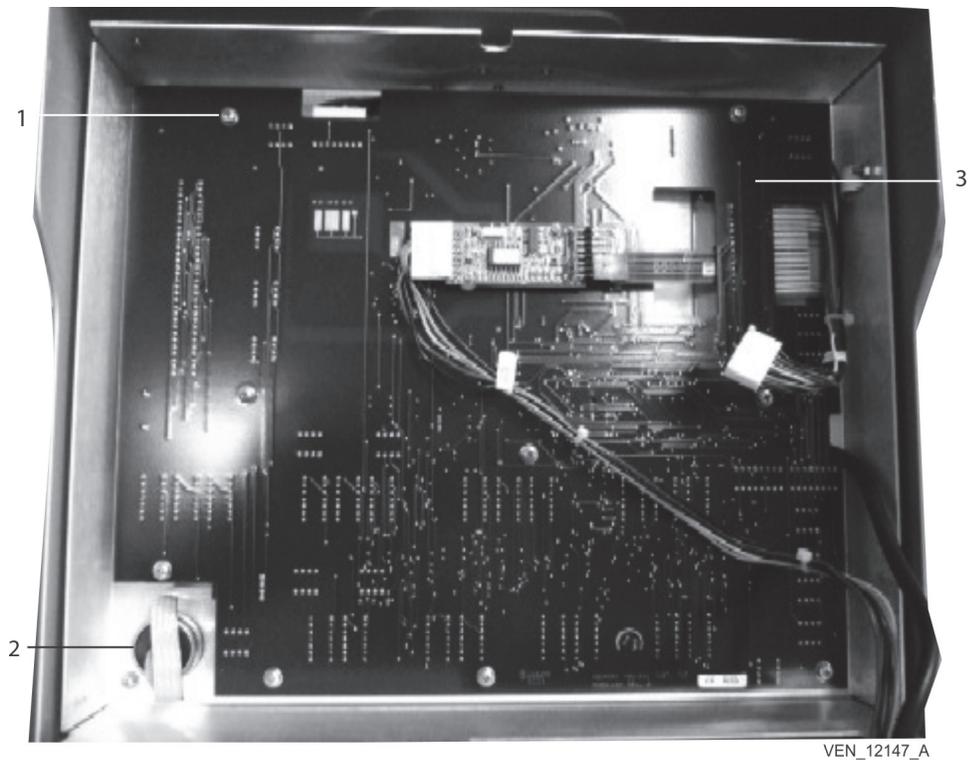
1. Remove the front panel assembly by performing the procedure in section 4.7, "*Front Panel Assembly.*"
2. Remove cable GR-CBL2121A from J4 on GR-PCB2100A.
3. Remove cables GR-CBL2137A and GR-CBL2138A from the top LEDs.
4. Remove the four screws (two on each side) and washers (two on each side) securing the main board support to the front panel assembly.
5. Carefully lift up on the main board support, and feed cables GR-CBL2155A and GR-CBL2121A through the cutout on the main board support.
6. Place the main board support with the main board in an ESD-safe container.
7. Reinstall the main board support by reversing steps 2 through 6.

**Note:**

Cable GR-CBL2137A connects from P308 on GR-PCB2100A to the top red LED. Cable GR-CBL2138A connects from P309 on GR-PCB2100A to the top amber LED.

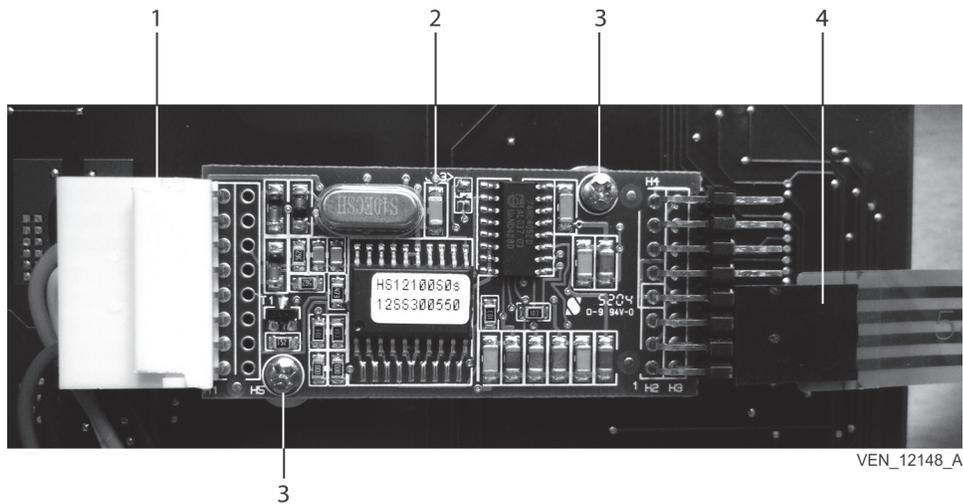
4.9 Display Board (GR-PCB2109A)

Figure 4-6. Display Board (GR-PCB2109A)



- | | | | |
|---|--|---|-------------|
| 1 | Screw (one of nine securing display board) | 3 | GR-PCB2109A |
| 2 | Encoder cable and J209 | | |

Figure 4-7. Touch Screen Board (PCB2105P) (PCB2105P-M for e360T Model)



- | | | | |
|---|---|---|-----------------------|
| 1 | GR-CBL2147A (GR-CBL2149A for e360T model) | 3 | Screw |
| 2 | PCB2105P (PCB2105P-M for e360T model) | 4 | Four-pin ribbon cable |

To replace the display and touch screen boards, refer to [Figure 4-6.](#) and [Figure 4-7.](#) , and perform the following steps:

1. Remove the main board support by performing the steps in section [4.8, "Main Board and Main Board Support."](#)
2. Remove the four-pin ribbon cable from header H2 on the touch screen interface board (PCB2105P/ PCB2105P-M for e360T model).
3. Remove cable GR-CBL2147A (GR-CBL2149A for e360T model) from header H1 on the touch screen interface board.
4. Remove the nine screws and washers securing GR-PCB2109A to the chassis of the display assembly.
5. Carefully lifting up on the display board from the lower left corner near the encoder, locate and remove the cable of the encoder from J209 on GR-PCB2109A.
6. Remove the lamp cable of LCD 10139301 from JP204 on GR-PCB2109A.
7. Remove the front panel membrane cable from JP202 on GR-PCB2109A by pushing on the tab.
8. Place the display board in an ESD-safe container.
9. Reinstall the display board and touch screen board by reversing steps 2-8.



Note:

If the display board GR-PCB2109A is replaced, the ventilator software must be reloaded. Refer to section [2.10](#) for the [Software Upgrade Procedure.](#)

4.10 Touch Screen Interface Board (PCB2105P) (PCB2105P-M for e360T model)

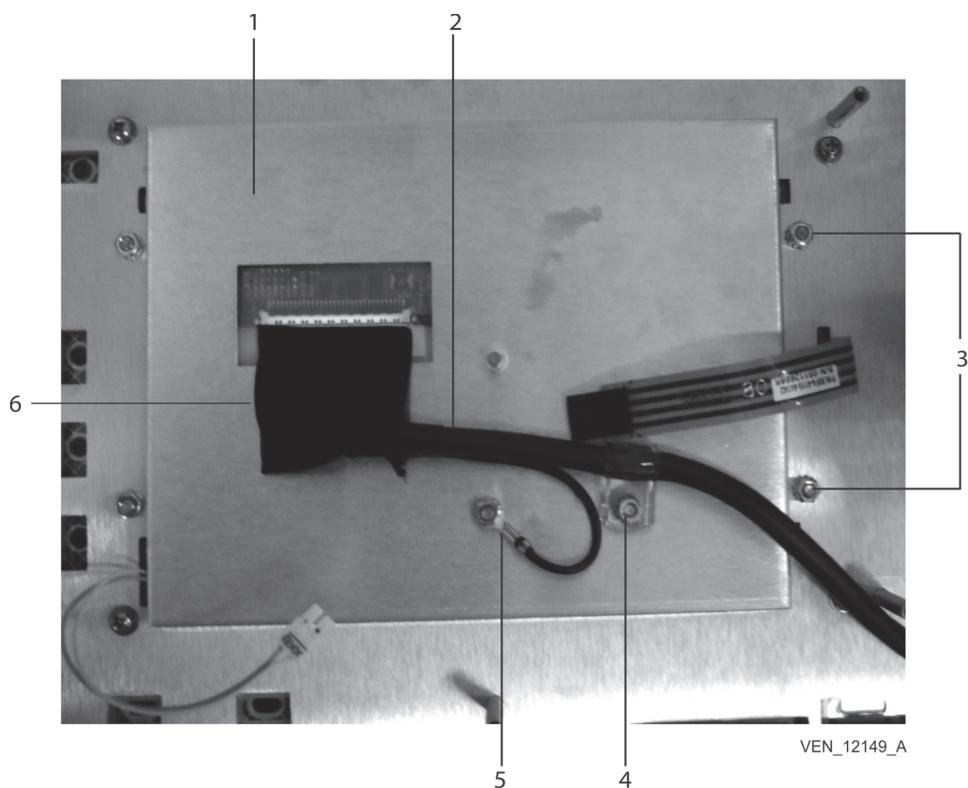
To replace the touch screen board, refer to [Figure 4-7](#), and perform the following steps:

1. Remove the display board by performing the procedure in section 4.9, "[Display Board \(GR-PCB2109A\)](#)."
2. Locate and remove the two screws, washers, and nuts securing the touch screen interface board to the display board.
3. Reinstall the touch screen interface board by reversing step 2.

4.11 Large LCD Cable and LCD Display

4.11.1 Large LCD Cable (GR-CBL2155A)

Figure 4-8. Large LCD Cable (GR-CBL2155A)



- | | | | |
|---|---|---|-------------------------|
| 1 | LCD housing (BKT2104M) | 4 | Cable restraint and nut |
| 2 | GR-CBL2155A | 5 | Ground wire and nut |
| 3 | Nuts (two of four securing LCD housing BKT2104M to front panel cover) | | |

To replace the LCD cable, refer to Figure 4.10 and perform the following steps:

1. Remove the display board by performing the procedure in section 4.9.
2. Using a 7/32 inch nut driver, remove the nut securing the ground wire of GR-CBL2155A to the LCD housing BKT2104M.
3. Using a 7/32 inch nut driver, remove the nut securing the cable restraint for GR-CBL2155A to the LCD housing BKT2104M.
4. Gently lift the cable away from the LCD housing, releasing it from the double-sided tape.
5. Pull cable GR-CBL2155A away from connector CN1 on the rear of the LCD display.
6. To reinstall the LCD cable, perform the following steps:
 - a. Carefully align the cable connector with CN1 on the LCD display.
 - b. Bend the cable up.
 - c. Push the connector onto CN1.
 - d. Press the connector onto the double-sided tape.
 - e. Reverse steps 2 and 3.

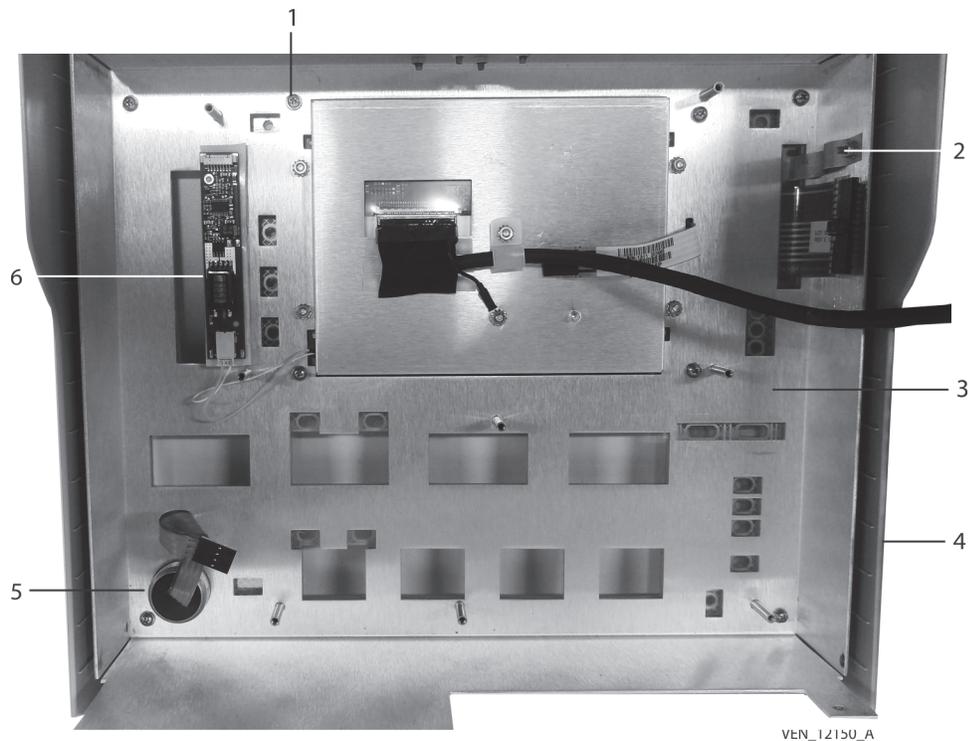
4.11.2 LCD Display (10139301)

To replace the LCD display, refer to [Figure 4-8.](#) and [Figure 4-9.](#) , and perform the following steps:

1. Remove the LCD cable by performing the procedure in section 4.11.1, "[Large LCD Cable \(GR-CBL2155A\).](#)"
2. Remove the four nuts and washers securing the LCD housing (BKT2104M) to the CVR2104M.
3. Remove the four screws securing the BKT2104M to the LCD display (10139301).
4. Reinstall the LCD display by reversing steps 2 and 3.

4.12 Front Panel Cover (CVR2104M)

Figure 4-9. Front Panel Cover (CVR2104M)



1	Screw (one of eight securing cover)	4	BZL2108M
2	Nut securing flat ribbon ground cable	5	Adjustment knob located on front panel
3	CVR2104M	6	Backlight inverter PCB

To remove and reinstall the front panel cover, refer to [Figure 4-9](#) and perform the following steps:

1. Remove the display board by performing the procedure in section 4.9, "Display Board (GR-PCB2109A)."
2. Using a 51/64 inch hex key, remove the set screw securing the adjustment knob to the encoder.
3. Remove the adjustment knob.
4. Remove the eight screws and washers securing the CVR2104M to the front panel bezel (BZL2108M).
5. Remove the nut securing the flat ribbon ground cable to the side of the front panel cover (CVR2104M).
6. Pull the front panel cover away from the front bezel and place in an ESD-safe container.
7. Reinstall the front panel cover by reversing steps 2 through 6.

4.13 Optical Encoder (GR-ENC1800P)

To replace the optical encoder, perform the following steps:

1. Remove the front panel cover by performing the procedure in section [4.12, "Front Panel Cover \(CVR2104M\)."](#)
2. Using an 11 mm wrench, remove the nut and washer securing the encoder to the front panel cover (CVR2104M).
3. Reinstall the optical encoder by reversing step 2.



Note:

When securing the encoder with the nut and washer, tighten the nut to 8 in/lbs of torque.

4.14 Alarm LEDs (GR-CBL2137A and GR-CBL2138A)

To replace the alarm LEDs, perform the following steps:

1. Remove the front panel cover by performing the steps in section [4.12, "Front Panel Cover \(CVR2104M\)."](#)
2. For each of the alarm LEDs, remove the two screws securing the boards to the CVR2104M.
3. Reinstall the alarm LEDs by reversing step 2.

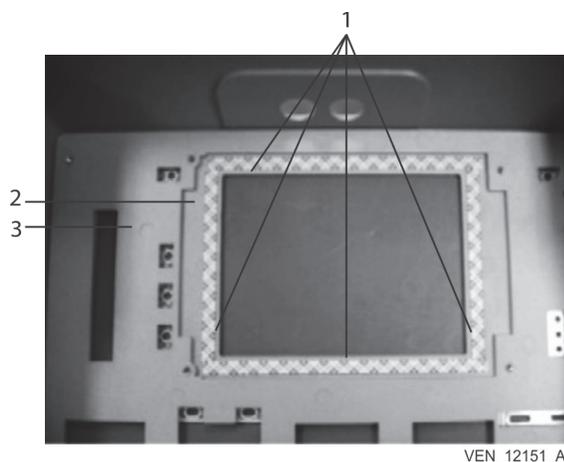


Note:

The red LED is GR-CBL2137A, and the amber LED is GR-CBL2138A.

4.15 Touch Screen (GR-PNL2105P)

Figure 4-10. Touch Screen Panel (GR-PNL2105P)



- | | | | |
|---|------------------------------------|---|----------|
| 1 | Inside edge of touch screen window | 3 | BZL2108M |
| 2 | TAP2100P | | |



Caution:

Removal of the touch screen (GR-PNL2105P) will destroy the screen. Do not remove it unless you have a replacement touch screen.

To replace the touch screen, refer to [Figure 4-10](#) and perform the following steps:

1. Remove the LCD display by performing the procedure in section [4.11, "Large LCD Cable and LCD Display."](#)
2. Using a flathead screwdriver, pry the touch screen away from the front bezel (BZL2108M).
3. Remove the tape and adhesive from the front bezel, and wipe clean with isopropyl alcohol.
4. To install a new touch screen (GR-PNL2105P), perform the following steps:
 - a. Apply four pieces of double-sided tape (TAP2100P) around the perimeter of the bezel, 0.10 in. from the inside edge. Press the tape firmly onto the bezel.
 - b. To expose the adhesive, peel back the protective cover on the double-sided tape.
 - c. Carefully place the new touch screen onto the tape, and press firmly.
5. Clean the inside panel of debris and fingerprints.
6. Reinstall the LCD display (GR-PNL2105P) by following the procedure in section [4.11.2, "LCD Display \(10139301\)."](#)

4.16 Pneumatics Panel Assembly and Components

4.16.1 Panel Assembly (SVO2101A)

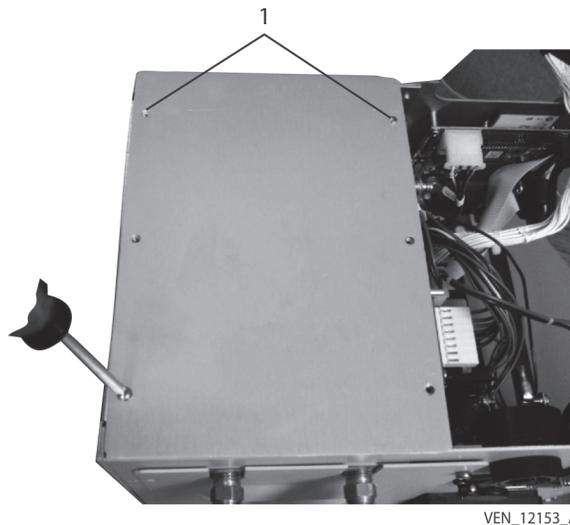
**Note:**

For China, the panel assembly part number is SVO2111A.

To remove and reinstall the panel assembly, refer to [Figure 4-11](#), [Figure 4-12](#), and [Figure 4-13](#), and perform the following steps:

1. Remove the top cover and front cover assembly by performing the procedure in sections [4.6](#), "[Top Cover \(CVR2101M\)](#)" and [4.7](#), "[Front Panel Assembly](#)."
2. Remove the six screws (three on each side) securing the pneumatics cover (CVR2106M).

Figure 4-11. Pneumatics Cover



1 Screws (two of six securing CVR2106M)

3. Remove the two screws securing the cover (CVR2115M) and gasket (GKT2101M).

Figure 4-12. Cover (CVR2115M) and Gasket (GKT2101M)



4. Remove the yellow tube and the blue tube from the air and oxygen inlet manifold (BLK2115M).
5. Remove the four screws (two on each side) securing the pneumatics panel (PNL2102M).

Figure 4-13. Pneumatics Panel

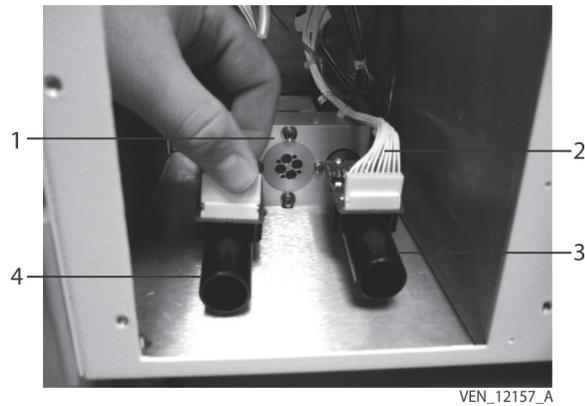


1 Screws (two of four securing PNL2102M)

6. Remove the yellow tube and the blue tube from the air and oxygen PSOL valves by disassembling the luer lock connectors.
7. While supporting the pneumatics panel, slide the panel away from the ventilator.
8. To reinstall the panel assembly and components, perform the following steps:
 - a. Supporting the pneumatics panel, align the air and oxygen flow sensors with the flow sensor manifold block.
 - b. Continuing to provide support, secure two screws on top for the pneumatics panel (once secured, it is safe to release support).
 - c. Reverse steps 2 through 6.

4.16.2 Air and Oxygen Inspiratory Flow Sensors (GR-FTD2100P and GR-FTD2101P)

Figure 4-14. Inspiratory Flow Sensors



- | | | | |
|---|---|---|----------------------------------|
| 1 | Mixing block (BLK2107M) | 3 | Air flow sensor (GR-FTD2100P) |
| 2 | Cable GR-CBL2116A connected to J1 on flow sensors | 4 | Oxygen flow sensor (GR-FTD2101P) |

To replace the flow sensors, refer to [Figure 4-14](#) and perform the following steps:

1. Remove the pneumatics panel assembly by performing the procedure in section 4.16, "[Pneumatics Panel Assembly and Components](#)."
2. Remove cable GR-CBL2116A from connector J1 on the flow sensor.
3. Remove the flow sensors from the mixing block (BLK2107M) by pulling the flow sensor straight out of the mixing block.
4. Reinstall the flow sensors by reversing steps 2 and 3.

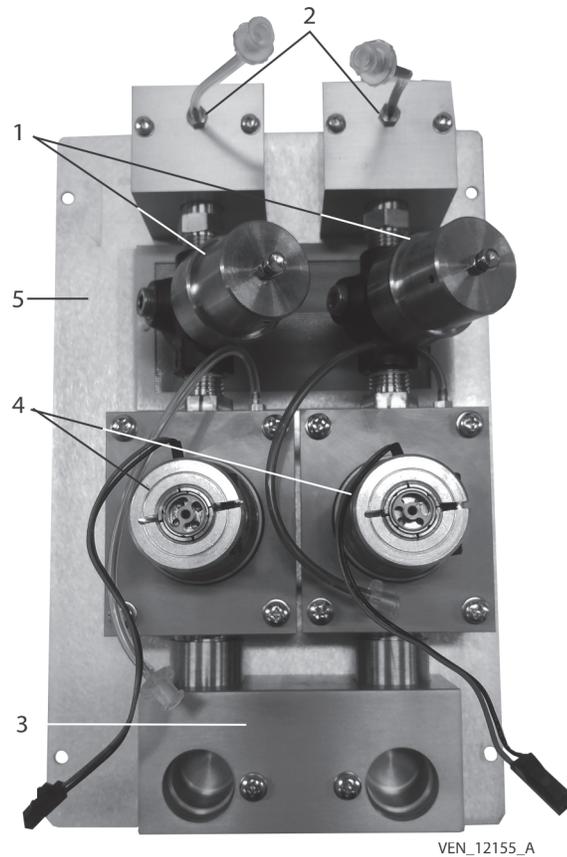


Note:

If either of the flow sensors are replaced, calibrations d1 or d2 must be performed. Refer to Chapter 5 for d1 and d2 calibration.

4.16.3 Regulators, Inlet Blocks, and Flow Sensor Block

Figure 4-15. Pneumatics Panel Assembly



- | | | | |
|---|------------------------------|---|-----------------------|
| 1 | Inlet regulator (REG1800P) | 4 | PSOL valves |
| 2 | Inlet block (BLK2115M) | 5 | Back panel (PNL2102M) |
| 3 | Flow sensor block (BLK2101M) | | |



Note:

To replace the regulators, inlet blocks, or the flow sensor block, all screws securing the pneumatic assembly to the back plate must be removed.

To replace the regulators, inlet blocks, and the flow sensor block, refer to *Figure 4-15.* and perform the following steps:

1. Remove the pneumatic panel assembly by performing the procedure in section 4.16, *"Pneumatics Panel Assembly and Components."*
2. Remove the four screws (two per inlet block) securing the air and oxygen inlet blocks to PNL2102M.
3. Remove the eight screws (four per valve) securing the air and oxygen PSOL valves to PNL2102M.

4. Remove the two screws securing the flow sensor block to PNL2102M.
5. Lift the assembly away from the panel (PNL2102M).
6. Disassemble each component as needed.
7. Reassemble by reversing steps 2 through 5.

**Note:**

Ensure the PSOL valves and regulators are aligned during reassembly.

**Note:**

If the regulators are replaced, regulator calibration must be performed. Refer to Chapter 5 for regulator calibration.

4.16.4 PSOL Valves (10113777)

**Note:**

While all units built after serial number N14360727000 use PSOL valves, older units may contain servo valves. This procedure describes the replacement of the PSOL valves. Contact the Technical Service Department for information on replacing servo valves.

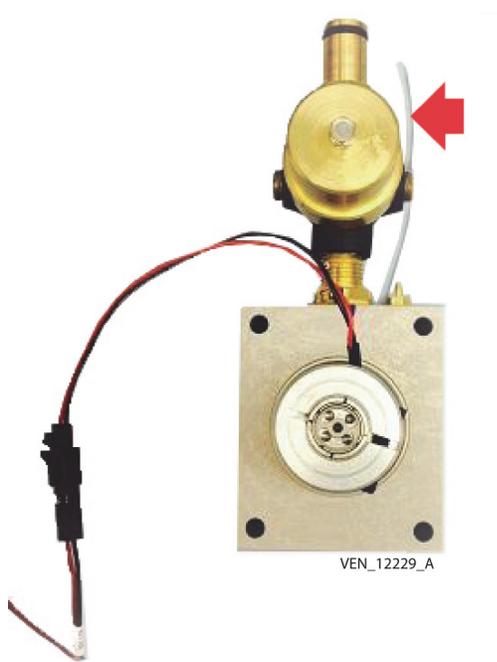
**Note:**

To replace the PSOL valves, all screws securing the pneumatic assembly to the back plate must be removed. The replacement process is the same for both the air and oxygen PSOL valves.

To replace the PSOL valves, refer to *Figure 4-15*, and perform the following steps:

1. Remove the pneumatic panel assembly by performing the procedure in section 4.16, "*Pneumatics Panel Assembly and Components*."
2. Remove the four screws (two per inlet block) securing the air and oxygen inlet blocks to PNL2102M.
3. Remove the eight screws (four per valve) securing the air and oxygen PSOL valves to PNL2102M.
4. Remove the two screws securing the flow sensor block to PNL2102M.
5. Lift the assembly away from the panel (PNL2102M).
6. Separate the regulator and the PSOL from the water trap and outlet pneumatic block.
7. Remove the nylon string that holds the PSOL in place.

Figure 4-16. PSOL and Nylon String



8. Separate the PSOL from the pneumatic block.
9. Replace the PSOL, making sure to verify the following occurs:
 - The o-rings are free of particulates, which can cause leaks.
 - The nylon string is reinserted so that three inches of it protrudes from the PSOL.
10. Reassemble by reversing steps 2 through 8.



Note:

Ensure the PSOL valves and regulators are aligned during reassembly.

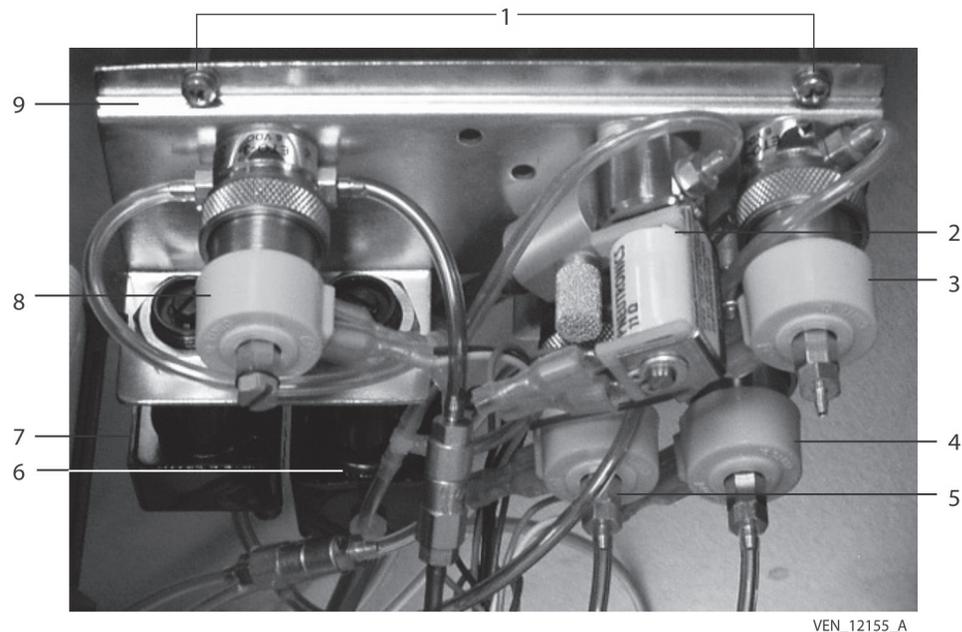


Note:

If either of the PSOL valves are replaced, calibrations d1 or d2 must be performed. Refer to Chapter 5 for d1 and d2 calibration.

4.16.5 Regulator and Solenoid Assembly (GR-BKT2105A)

Figure 4-17. Regulator and Solenoid Assembly (GR-BKT2105A)



VEN_12155_A

- | | | | |
|---|---|---|---|
| 1 | Screws securing GR-BKT2105A to ventilator | 6 | Exhalation PSOL regulator (REG1701P) |
| 2 | Exhalation PSOL valve (VLV1806P) | 7 | Safety regulator (REG1802P) |
| 3 | Emergency relief solenoid (SOL1501P) | 8 | Crossover solenoid (SOL1501P) |
| 4 | Machine 1 pressure rezero solenoid (SOL1501P) | 9 | Regulator and solenoid assembly (GR-BKT2105A) |
| 5 | Machine 2 pressure rezero solenoid (SOL1501P) | | |

To remove and reinstall the regulator and solenoid assembly, refer to [Figure 4-17](#), and the system pneumatic diagram in [Appendix C](#), and perform the following steps:

1. Remove the pneumatics panel assembly by performing the procedure in [section 4.16, "Pneumatics Panel Assembly and Components."](#)
2. Remove the yellow tubing from the air inlet block (BLK2115M) and the blue tubing from the oxygen inlet block (BLK2115M). Refer to [Figure 4-15](#).
3. Remove the clear tubing from the top port of the pressure transducer (XD105) (machine 1 pressure) on the analog board (GR-PCB2110A).
4. Remove the clear tubing from the exhaust port of the rezero solenoid (SOL1501P) for machine pressure 1.

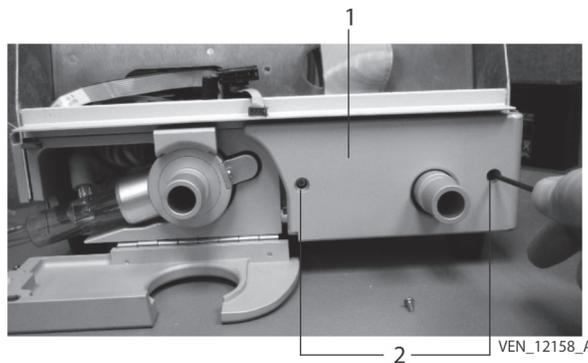
5. Remove the green tubing from the bottom port of the pressure transducer (XD106) (machine 2 pressure) on the analog board.
6. Remove the green tubing from the exhaust port of the rezero solenoid for machine pressure 2.
7. Remove the blue tubing from the exhalation PSOL valve (VLV1806P) and the tee connector.
8. Remove the green tubing from the IN port of the emergency relief solenoid (SOL1501P) and the cross tee connector.
9. Remove the two screws and washers securing GR-BKT2105A to the ventilator.
10. Reinstall the regulator and solenoid assembly by reversing steps 2-9.

4.17 Main Flow Outlet Block (GR-BLK2108A)

To replace the outlet block, refer to [Figure 4-18.](#) and [Figure 4-19.](#) , and perform the following steps:

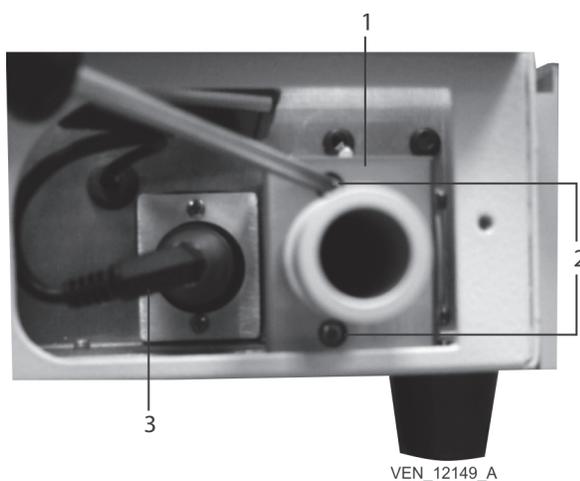
1. Remove the two screws securing DOR2112M to the front of the ventilator.

Figure 4-18. Door (DOR2112M)



1 Door (DOR2112M) 2 Screws

2. Remove the two screws securing BLK2108M to the ventilator.

Figure 4-19. Outlet Block (BLK2108M)

- | | | | |
|---|-------------------------------|---|--------------------------------------|
| 1 | Outlet block
(GR-BLK2108A) | 3 | Oxygen sensor cable
(GR-CBL2109A) |
| 2 | Screws | | |

3. Pull BLK2108M away from the ventilator, and remove the two tubes.
4. Reinstall the outlet block by reversing steps 2 and 3.

4.18 Oxygen Sensor (SEN2103P)

Figure 4-20. Oxygen Sensor (SEN2103P)

To replace the oxygen sensor, refer to [Figure 4-19](#) and [Figure 4-20](#), and perform the following steps:

1. Remove the oxygen sensor cable (GR-CBL2109A) from the oxygen sensor (SEN2103P) by unscrewing the connector on the cable.
2. Remove the oxygen sensor by pulling it out.



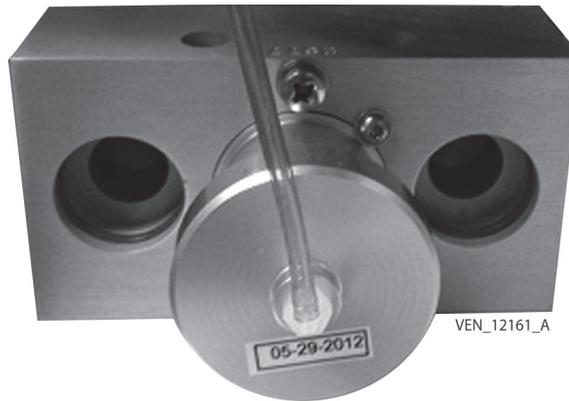
Note:

On older model ventilators, the oxygen sensor may be screwed in; if so, remove by turning it counterclockwise.

3. Reinstall the oxygen sensor by reversing steps 1 and 2.

4.19 Inhalation Outlet Block and Mixing Block Assembly

Figure 4-21. Inhalation Outlet Block and Mixing Block

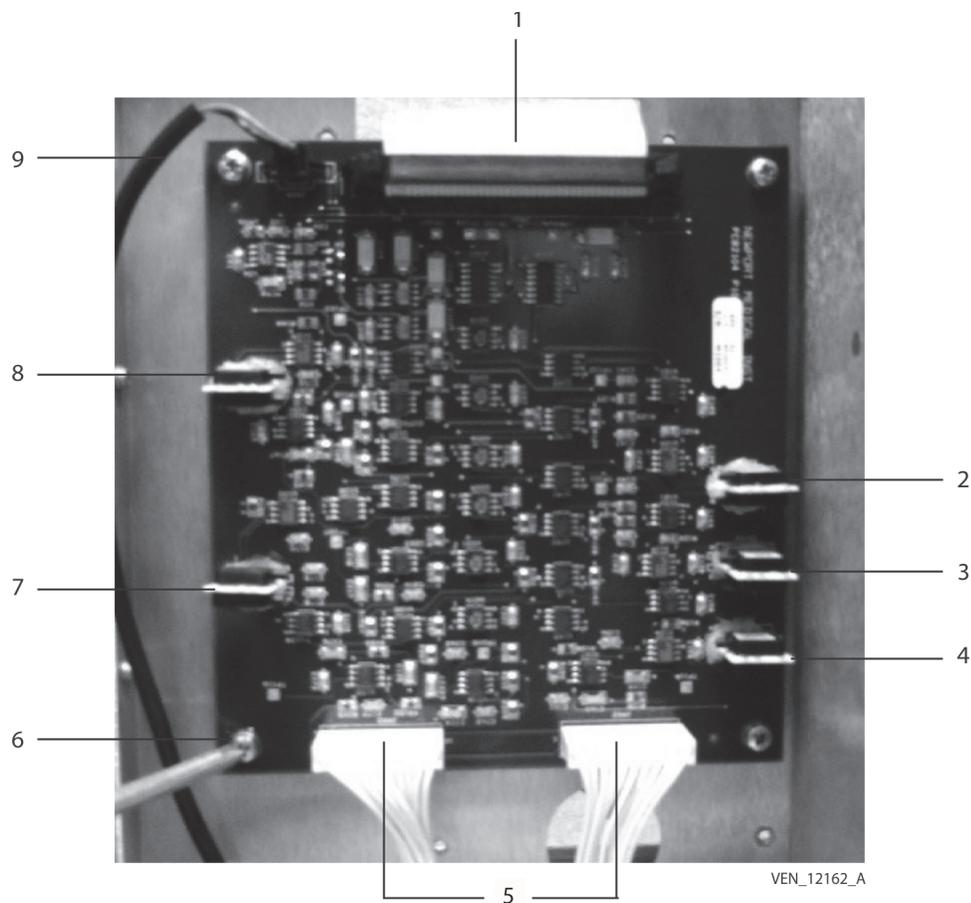


To remove and reinstall the inhalation outlet block and the mixing block, refer to [Figure 4-21](#). and perform the following steps:

1. Remove the oxygen sensor by performing the procedure in section [4.18](#), "[Oxygen Sensor \(SEN2103P\)](#)."
2. Remove the two screws on top of the mixing block (BLK2107M).
3. Remove both the mixing block and inhalation block (BLK2119M) from the ventilator.
4. Remove the two screws and washers securing the mixing block to the inhalation outlet block.
5. Separate the mixing block from the inhalation outlet block.
6. Reinstall the inhalation outlet block and mixing block by reversing steps 2 through 5.

4.20 Analog Board (GR-PCB2110A)

Figure 4-22. Analog Board (GR-PCB2110A)



1	Flat cable (GR-CBL2118A)	6	Screw and washer (one of four securing the board)
2	Blue tube (XD103)	7	Orange tube (XD107)
3	Yellow tube (XD102)	8	Green tube (XD106)
4	Clear tube (XD105)	9	Oxygen sensor cable (GR-CBL2109A)
5	Flow sensor cables		

To replace the analog board, refer to [Figure 4-22](#), and perform the following steps:

1. Remove the regulator and solenoid assembly by performing the procedure in section 4.16.5, "[Regulator and Solenoid Assembly \(GR-BKT2105A\)](#)."

2. Remove the following tubes from GR-PCB2110A:
 - Orange tube (exhalation valve pressure from XD107)
 - Green tube (exhalation valve pressure from XD106)
 - Blue tube (regulated oxygen pressure from XD103)
 - Yellow tube (regulated air pressure from XD102)
 - Clear tube (patient breathing circuit pressure from XD105)



Note:

For all transducers, the tubes are connected to the high pressure port connector. For transducers XD106 and XD107, the tubings are connected to the bottom ports of the transducers. For transducers XD102, XD103, and XD105, the tubings are connected to the top ports of the transducers.

3. Remove flat cable GR-CBL2118A from J401 on GR-PCB2110A.
4. Remove oxygen sensor cable GR-CBL2109A from J404 on GR-PCB2110A.
5. Remove air and oxygen flow sensor cables GR-CBL2116A from J402 and J403 on GR-PCB2110A.
6. Remove the four screws and washers securing GR-PCB2110A to the ventilator.



Note:

If your unit has the old-style analog PCB (PCB2104A), order GR107036 to update the unit.

7. Reinstall the analog board by reversing steps 2 through 6.

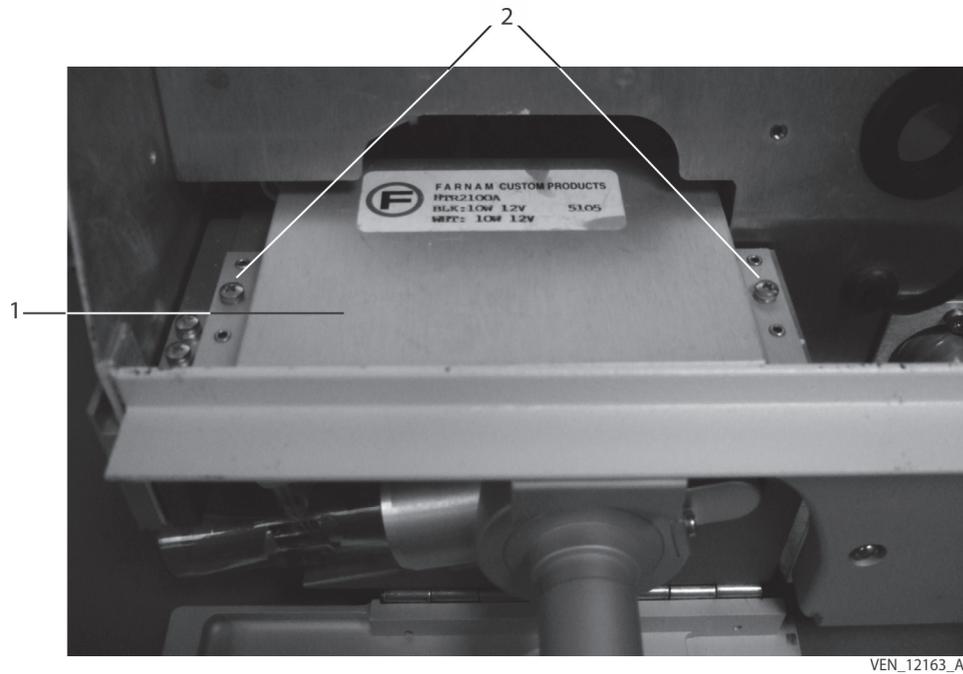


Note:

If the analog board is replaced, a d5 calibration must be performed. Refer to Chapter 5 for the d5 calibration.

4.21 Heater Assembly (GR-HTR2100A)

Figure 4-23. Heater Assembly (GR-HTR2100A)



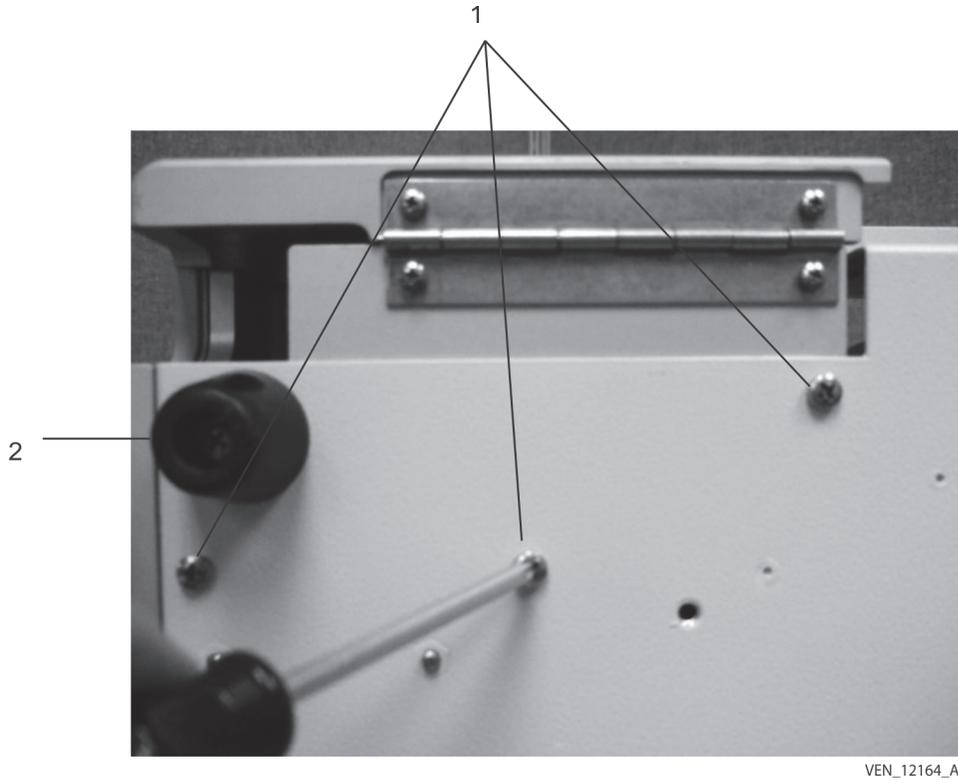
1 Heater (HTR1200A) 2 Screws and washers

To replace the heater assembly, refer to [Figure 4-23](#), and perform the following steps:

1. Remove the front panel assembly by performing the procedure in section [4.7, "Front Panel Assembly."](#)
2. Remove the screws securing heater GR-HTR2100A to the exhalation manifold.
3. Remove the heater cables from the power supply board (GR-PCB2101A) connectors J107 and J108.
4. Remove the heater.
5. Reinstall the heater assembly by reversing steps 2 through 4.

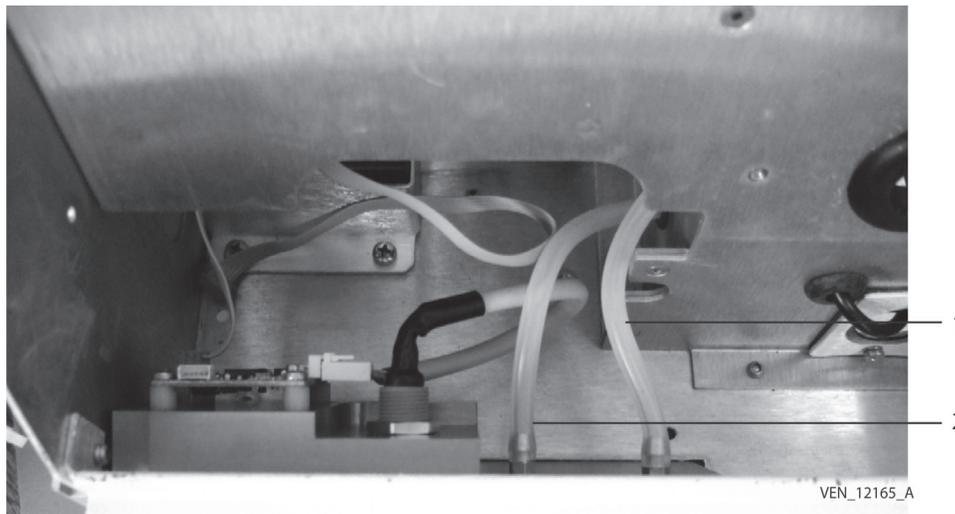
4.22 Exhalation Manifold

Figure 4-24. Location of Screws and Bumper



- 1 Screws
- 2 Bumper (BMP2100P)

Figure 4-25. Removal of Exhalation Manifold



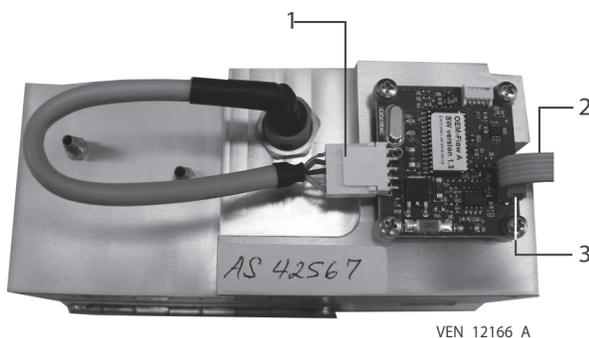
- 1 Machine 2 pressure line
- 2 Exhalation valve drive line

To remove and reinstall the exhalation manifold, refer to [Figure 4-24.](#) and [Figure 4-25.](#) , and perform the following steps:

1. Turn the ventilator so the bottom of the unit is facing upward.
2. Remove the three screws securing the exhalation manifold to the base of the ventilator.
3. Remove the screw and washer securing the bumper (BMP2100P) to the bottom of the ventilator.
4. Remove the exhalation valve drive line and the machine 2 pressure line from the rear of the exhalation manifold (see [Figure 4-23.](#)).
5. Remove the exhalation manifold from the ventilator.
6. Reinstall the exhalation manifold by reversing steps 2 through 5.

4.23 Exhalation Flow Sensor Board (GR-PCB2103P)

Figure 4-26. Exhalation Flow Sensor Board (GR-PCB2103P)



- | | | | |
|---|--|---|---|
| 1 | GR-CBL2124P connected to K5 on GR-PCB2103P | 3 | Polarization hole for K1 on GR-PCB2103P |
| 2 | CBL2122A connected to K1 on GR-PCB2103P | | |

To replace the exhalation flow sensor board, refer to [Figure 4-26.](#) and perform the following steps:

1. Remove the exhalation manifold by performing the procedure in section 4.22, "[Exhalation Manifold.](#)"
2. Remove cable GR-CBL2127A from K1.
3. Remove GR-CBL2124P from K5 on GR-PCB2103P.
4. Remove the two screws and washers securing GR-PCB2103P to the exhalation manifold.
5. Remove GR-PCB2103P.
6. Reinstall the exhalation flow sensor board by reversing steps 1 through 5.

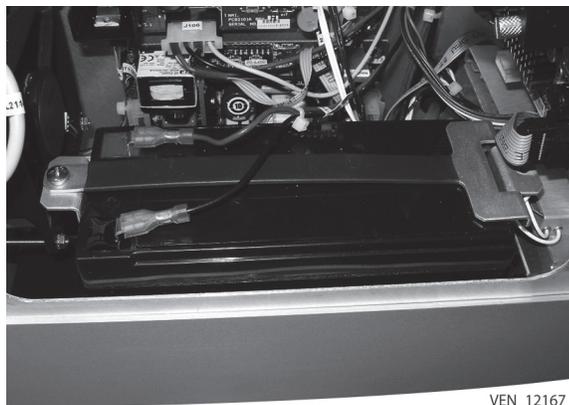


Note:

There is a small hole adjacent to K1 on GR-PCB2103P. The hole polarizes the connector.

4.24 Battery (BAT2100A)

Figure 4-27. Battery (BAT2100A)

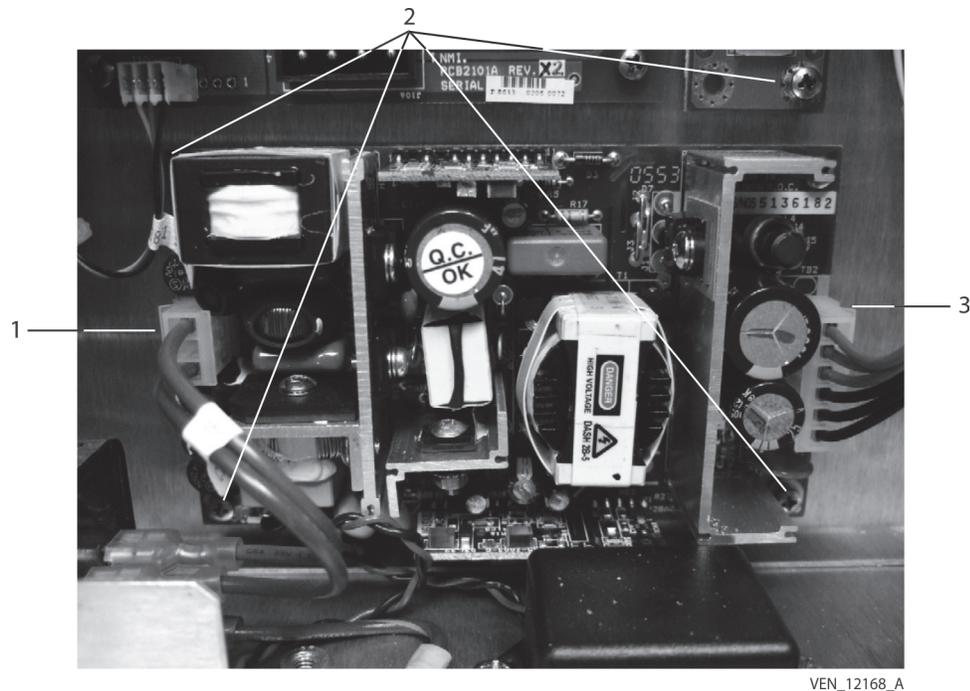


To replace the battery, refer to [Figure 4-27](#), and perform the following steps:

1. Remove the top cover by performing the steps in section 4.6, "[Top Cover \(CVR2101M\)](#)."
2. Remove the battery wires from the positive and negative terminals.
3. Remove the screw securing the battery bracket to the ventilator.
4. Lift the bracket off of the ventilator.
5. Remove the battery by lifting it up and out.
6. Reinstall the battery by reversing steps 2 through 5.

4.25 AC/DC Power Supply (PWR2100P)

Figure 4-28. AC/DC Power Supply (PWR2100P)



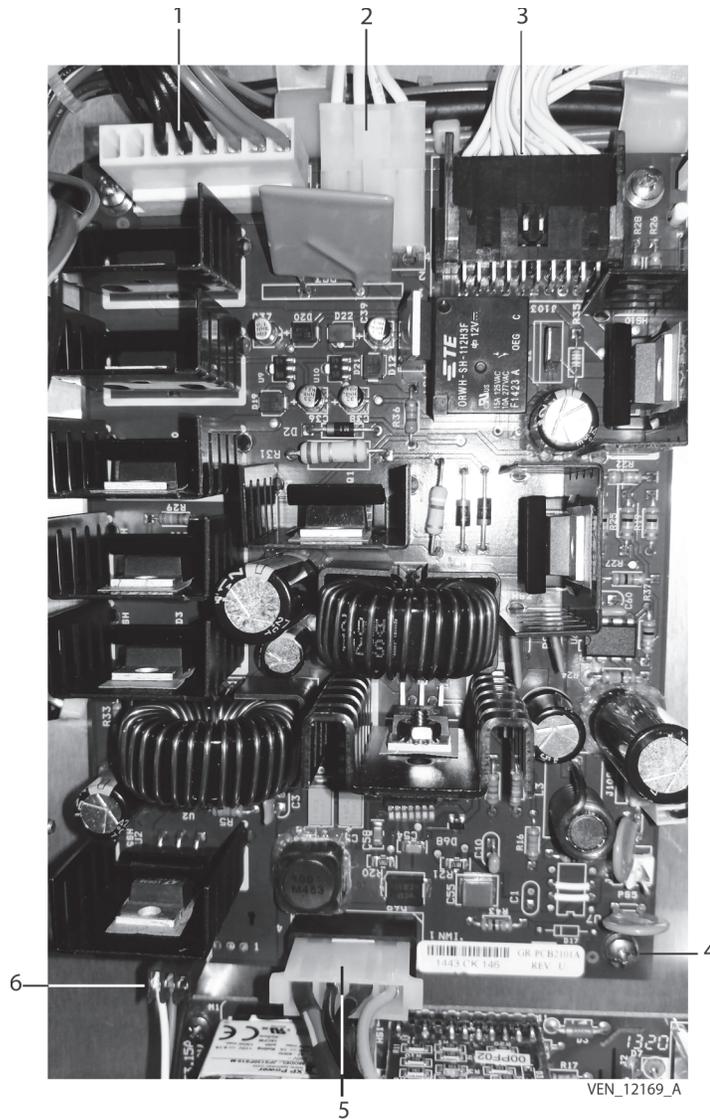
- 1 Cable GR-CBL2115 connected to TB1 3 Cable GR-CBL2103 connected to TB2
 2 Screws and washers

To replace the AC/DC power supply, refer to [Figure 4-28](#), and perform the following steps:

1. Remove the battery by performing the procedure in section [4.24](#), "[Battery \(BAT2100A\)](#)."
2. Remove cable GR-CBL2115A from connector TB1.
3. Remove cable GR-CBL2103A from connector TB2 on PWR2100P.
4. Remove the four screws and washers securing PWR2100P to the ventilator.
5. Remove PWR2100P.
6. Reinstall the power supply by reversing steps 2 through 5.

4.26 DC to DC Power Supply (GR-PCB2101A)

Figure 4-29. DC to DC Power Supply (GR-PCB2101A)



1	GR-CBL2103A at J104	4	Screw and washer (one of four)
2	GR-CBL2111A at J01	5	GR-CBL2127A at J106
3	GR-CBL2101A at J103	6	GR-CBL2119A at J102

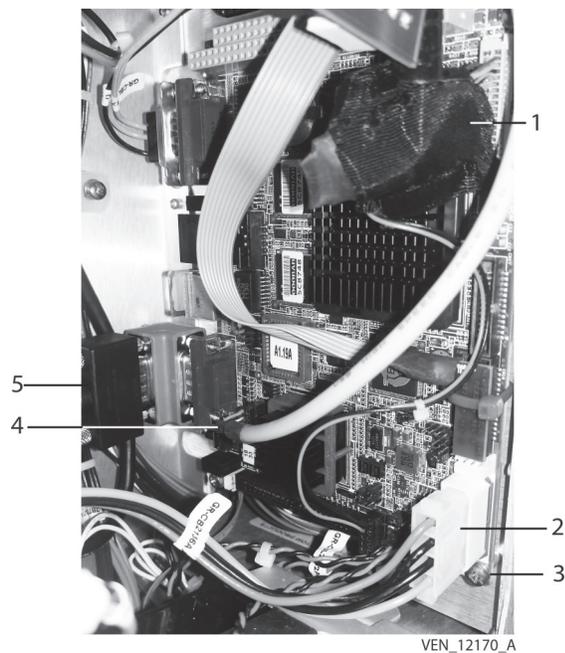
To replace the DC to DC power supply, refer to [Figure 4-29](#), and perform the following steps:

1. Remove the battery by performing the procedure in section [4.24](#), “[Battery \(BAT2100A\)](#).”
2. Remove the following cables:

- GR-CBL2101A from J103 on GR-PCB2101A
 - GR-CBL2103A from J104 on GR-PCB2101A
 - GR-CBL2135A from J101 on GR-PCB2101A
 - GR-CBL2119A from J102 on GR-PCB2101A
 - GR-CBL2127A from J106 on GR-PCB2101A
 - White and black cables from J107 and J108 on GR-PCB2101A
 - GR-CBL2126A from J8 on GR-PCB2101A
3. Remove the four screws and washers securing GR-PCB2101A to the ventilator.
 4. Reinstall the power supply by reversing steps 2 and 3.

4.27 Single-Board Computer (SBC2105A)

Figure 4-30. Single-Board Computer (SBC2105A)



- | | | | |
|---|--------------------------------------|---|------------------------------------|
| 1 | Cable GR-CBL2155A to LCD connector | 4 | Cable GR-CBL2150A to USB connector |
| 2 | Cable GR-CBL2119A to power connector | 5 | Cable CBL2104A to VGA connector |
| 3 | Screw and washer (one of four) | | |

To replace the single-board computer, refer to [Figure 4-30](#), and perform the following steps:

1. Remove the battery by performing the procedure in section [4.24](#), "[Battery \(BAT2100A\)](#)"
2. Remove the following cables:
 - CBL2104A from VGA connector on SBC
 - GR-CBL2155A from CN4 connector and CN9 on SBC
 - GR-CBL2136A from power connector on SBC
 - GR-CBL2147A from CN5 and CN19
 - GR-CBL2149A CN14 on SBC (for the e360T model only)
 - GR-CBL2104A from adapter ADP3222P on CN12 on SBC
 - GR-CBL2150A from USB connector CN15 on SBC
 - GR-CBL2153A from COM1 connector CN19 on SBC
3. Remove the four screws and washers securing SBC2105A to the ventilator.
4. Remove SBC2105A.
5. Reinstall the single-board computer by reversing steps 2 through 4.



Note:

If your unit has the old-style single-board computer (SBC2100P), order FSK2110A for e360 or FSK2111A for e360T to update the unit.

4.28 Power Sequence Board (GR-PCB2107A)

To replace the power sequence board, perform the following steps:

1. Remove the battery by performing the procedure in section [4.24](#), "[Location of Screws and Bumper](#)."
2. Disconnect the following cables:
 - a. GR-CBL2136A from J302 on the power sequence board.
 - b. Disconnect GR-CBL2152A from J303 on the power sequence board.
 - c. Disconnect GR-CBL2111A from J201 on the power sequence board.
 - d. Disconnect GR-CBL2135A from J202 on the power sequence board.
 - e. Disconnect GR-CBL2126A from J301 on the power sequence board.
3. Remove the two screws securing GR-PCB2107A to the side of the ventilator.
4. Remove the board.
5. Reinstall the power sequence board by reversing steps 2-4.

5 Calibration Procedures

5.1 Overview

The purpose of these procedures is to provide instructions and acceptance/rejection criteria to calibrate the Newport™ e360 ventilator.

This section describes how to use the ventilator's diagnostic mode to calibrate the ventilator. The diagnostic mode can also be used for troubleshooting (see Chapter 3 for more information on troubleshooting).



WARNING:

Authorized Covidien-trained service personnel must perform all service and repairs on the ventilator.



WARNING:

Hazardous voltages are present inside the ventilator. Disconnect electrical power, air, and oxygen sources before attempting any disassembly. Failure to do so could result in injury to service personnel or damage to equipment.



Note:

To prevent damage from ESD and possible failure of the ventilator, ALWAYS use standard anti-static practices when working inside the ventilator, or when handling circuit boards and any other electronic components.

5.2 Calibration Equipment

Verify that all test equipment is in current calibration status. To calibrate the ventilator, you will need the following:

- Reusable breathing circuit (PBC340A) or equivalent
- Cap to plug the end of the breathing circuit (CAP100P) or equivalent
- Clean, dry, regulated medical air and oxygen supplies at 50 ±2 psig



Note:

To perform the calibration procedures correctly, the gas supply pressure must be regulated to 50 ±2 psig. The gas supplies can support a minimum constant flow of 180 L/min.

- Power source of 100–240 V AC, 50/60 Hz
- High-pressure gauge for reading from 0–60 psig, or equivalent
- Low-pressure gauge for reading from 0–200 cmH₂O, or equivalent
- Pressure syringe tool (TOL1952P) or equivalent
- 1/4 inch open-ended wrench
- 5/16 inch open-ended wrench
- Medium-size flat head screwdriver
- Low-pressure calibration tool (TOL2108A)

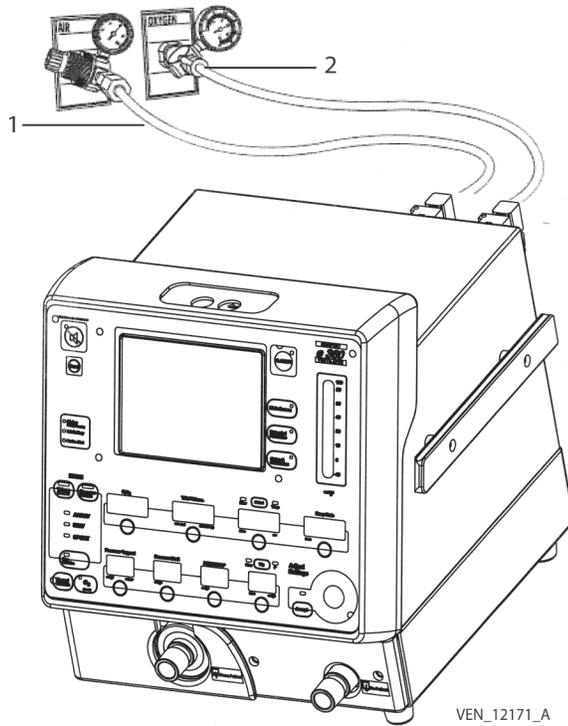


Caution:

The accuracy of all test equipment (electronic or pneumatic) used for verification or calibration procedures should be certified annually by a testing laboratory before use.

5.3 Setup

Figure 5-1. Newport™ e360 Ventilator Connected to Gas Sources



1 Air supply 2 Oxygen supply

1. Visually inspect the ventilator for cosmetic defects, damage, or missing items.
2. Before removing the top cover, unplug the ventilator from the AC power and gas sources.
3. Remove the six screws on the back panel that secure the top cover to the ventilator.
4. Remove the top cover by performing the steps in section 4.6, "[Top Cover \(CVR2101M\)](#)."
5. Reconnect the AC power to the ventilator.
6. Connect both air and oxygen supply gas sources to the ventilator.
7. Verify supply gas sources are at 50 ± 2 psig.
8. Prior to starting the calibration procedure, verify that all test equipment is in current calibration status.

5.4 Diagnostic Mode

Most of the calibrations on the ventilator are performed in the diagnostic mode. This mode enables you to perform PSOL valve, exhalation valve, and regulator calibrations.

Table 5-1. Diagnostic Mode

Diagnostic mode	Calibration
d0	N/A
d1	Air PSOL valve
d2	Oxygen PSOL valve
d3	Manual flow adjustment
d4	Exhalation PSOL valve
d5	Analog PCB
d6	N/A
d7	N/A
d8	N/A
d9	Exhalation flow sensor

To enter diagnostic mode, perform the following steps:

1. Confirm the ventilator is off and connected to AC power.
2. Press and hold the *Accept* button while turning on the ventilator.
3. Release the *Accept* button when the logo screen is displayed.
4. Wait for a few minutes until the *Software Download/Diagnostics Mode* screen is displayed (see [Figure 2-19](#)).

5. Touch *Start Diagnostics* on the touch screen (see [Figure 2-19](#)). After a series of short beeps, the *Diagnostic Data* screen is displayed.

5.5 Procedures

Most calibrations rely on the analog PCB being accurately calibrated first. The analog PCB has five transducers, and each one must be calibrated according to the procedure in this section. After the analog PCB has been properly calibrated, proceed with the remaining calibrations.

To perform the calibrations successfully, it is very important that the air and oxygen gas supply are regulated to 50 ± 2 psig and that the supply is capable of supporting a minimum of 180 L/min of constant flow.

To begin calibrations, attach the patient circuit to the ventilator.



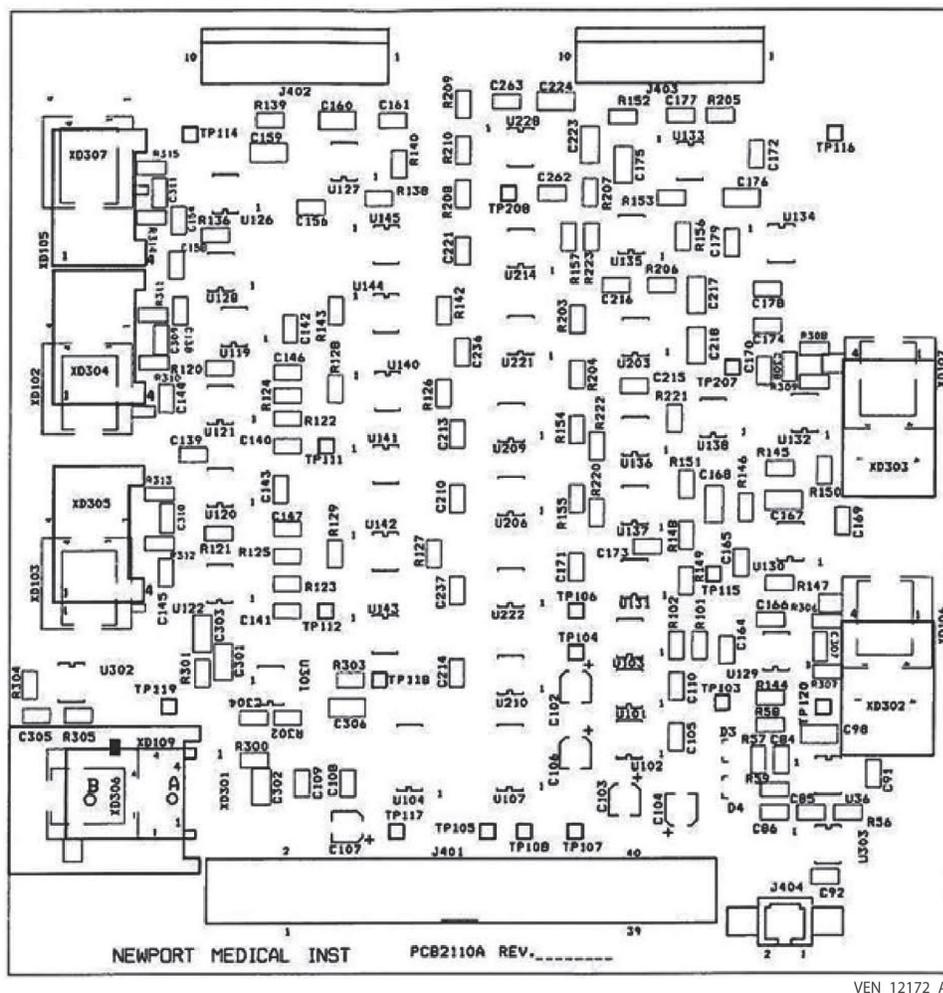
WARNING:

Observe ESD precautions throughout the following procedures for analog PCB and pneumatics calibrations.

5.5.1 Analog PCB Calibration: d5

To locate the transducers on the analog PCB, see [Figure 5-2](#).

Figure 5-2. Analog PCB



1. Enter diagnostics mode by performing the steps in section 5.4, "Diagnostic Mode." "d0" is displayed in the *Trig* window on the control panel and "0" is displayed in the *Flow/Insp* window.
2. Press the button below the *Trig* window. The display will blink.
3. While the display is blinking, turn the *Adjustment* knob to change the setting from "d0" to "d5".
4. To confirm the selection, press the *Accept* button.

**Note:**

Steps 5 to 15 are to calibrate zero pressure offset of the exhalation drive pressure transducer (XD107).

**Note:**

Reference [Table 5-2](#). for tubing, transducer, and zero pressure offset values.

Table 5-2. Zero Offset Calibration

Zero setting					
Transducer ID	LCD display	t Insp	Pressure	Tolerance	Tube color
XD107	Drive Pressure	0	3.00	±0.05	Orange
XD106	Machine 2	2	0.00 cmH ₂ O	±0.05	Green
XD105	Machine 1	4	0.00 cmH ₂ O	±0.05	Clear
XD102	Air Gas Supply	6	0.0 psig	±0.1	Yellow
XD103	O ₂ Gas Supply	8	0.0 psig	±0.1	Blue

5. Remove the orange tubing from transducer XD107 on the analog PCB.
6. Set respiratory rate to 128.
7. To start the offset calibration, press the *Manual Inflation* button. The message “Start Calibration” is displayed.
8. Verify the *t Insp* setting is “0”. If not, perform the following steps:
 - a. Press the button below the *Flow / t Insp* window. The display will blink.
 - b. While the display is blinking, turn the adjustment knob to adjust the *t Insp* setting to “0”.
 - c. To confirm the selection, press the *Accept* button.
9. Press the button below the *Resp Rate* window. The display will blink.
10. While the display is blinking, turn the adjustment knob to adjust the value.
11. Press the *Accept* button to confirm the selection.
12. After the *Accept* button is pressed, the value of Drive Pressure displayed on the touch screen changes.
 - As the setting of *Resp Rate* increases, the value of Drive Pressure will decrease after the *Accept* button is pressed.
 - As the setting of *Resp Rate* decreases, the value of Drive Pressure will increase after the *Accept* button is pressed.



Note:

A *Resp Rate* setting of “0” cannot be further decreased. Consequently, the value of Drive Pressure cannot be increased. In this case, first increase the setting of *Resp Rate* to a high value and then decrease it. Always press *Accept* when the adjustment of the *Resp Rate* setting is made.

13. Repeat steps 8 to 12 to obtain a Drive Pressure reading of 3.00 ±0.05.

14. Press the *Manual Inflation* button to confirm the selection. The message “Calibration Complete” is displayed.
15. Reset the respiratory rate to 128.
16. To calibrate the zero pressure offset of machine 2 pressure transducer (XD106), repeat steps 5 to 13, with the following differences:
 - a. Remove the green tubing from transducer XD106.
 - b. Adjust the setting of *t Insp* to “2”.
 - c. Calibrate the value of machine 2 to 0.00 ± 0.05 cmH₂O.
17. To calibrate the zero pressure offset of machine 1 pressure transducer (XD105), repeat steps 5 to 13, with the following differences:
 - a. Remove the clear tubing from transducer XD105.
 - b. Adjust the setting of *t Insp* to “4”.
 - c. Calibrate the value of machine 1 to 0.00 ± 0.05 cmH₂O.
18. To calibrate the gain of exhalation drive pressure (XD107), machine 2 (XD106), and machine 1 (XD105), connect the low-pressure calibration test jig tool (TOL2108A) as follows:
 - a. Connect the orange tube from TOL2108A to XD107 on GR-PCB2110A.
 - b. Connect the green tube from TOL2108A to XD106 on GR-PCB2110A.
 - c. Connect the clear tube from TOL2108A to XD105 on GR-PCB2110A.
 - d. Connect one of the clear, large ID tubes to a calibrated pressure gauge.
 - e. Connect the other clear, large ID tube to the pressure syringe (TOL1952P).

**Note:**

Reference [Table 5-3](#). for tubing, transducer, and pressure gain values.

Table 5-3. Gain Calibration

Gain setting						
Transducer ID	LCD display	t Insp	Pressure	Tolerance	Designation	Tube color
XD107	Drive Pressure	1	110 cmH ₂ O	±1.0	Bottom Port	Orange
XD106	Machine 2	3	110 cmH ₂ O	±1.0	Bottom Port	Green
XD105	Machine 1	5	110 cmH ₂ O	±1.0	Top Port	Clear
XD102	Air Gas Supply	7	25 psig	±0.1	Top Port	Yellow
XD103	O ₂ Gas Supply	9	25 psig	±0.1	Top Port	Blue

**Note:**

If pressure is only applied to transducer XD105 during this calibration, a device alert will occur when the pressure to XD105 is 20 cmH₂O higher than the pressure to XD106. A device alert can be only cleared by turning off and on the ventilator.

19. Adjust the pressure syringe so that 110 cmH₂O is displayed on the calibrated pressure gauge.
20. Adjust *t Insp* to "1" (Drive Pressure).
21. Press the *Manual Inflation* button. The message "Start Calibration" is displayed.
22. Press the button below the *Resp Rate* window. The display will blink.
23. While the display is blinking, turn the adjustment knob to adjust the value.
24. Press the *Accept* button to confirm the selection. The value of Drive Pressure displayed on the screen changes.
25. Repeat steps 22 and 23 to obtain a Drive Pressure reading of 110.00 ±1.0 cmH₂O.
26. Press the *Manual Inflation* button to confirm the selection. The message "Test Completed" is displayed.
27. Reset the respiratory rate to 128.
28. Set *t Insp* to "3" (Machine 2).
29. Press the *Manual Inflation* button. The message "Start Calibration" is displayed.
30. Repeat steps 22 and 23 to obtain a Drive Pressure reading of 110.00 ±1.0 cmH₂O.
31. Press the *Manual Inflation* button to confirm the selection. The message "Test Completed" is displayed.
32. Reset the respiratory rate to 128.
33. Set *t Insp* to "5" (Machine 1).
34. Press the *Manual Inflation* button. The message "Start Calibration" is displayed.
35. Repeat steps 22 and 23 to obtain a Drive Pressure reading of 110.00 ±1.0 cmH₂O.
36. Press the *Manual Inflation* button to confirm the selection. The message "Test Completed" is displayed.
37. Reset the respiratory rate to 128.
38. Disconnect the low pressure calibration tool (TOL2108A) from the analog board.
39. Reconnect the following tubes from inside the ventilator:
 - Orange tube to XD107

- Green tube to XD106
 - Clear tube to XD105
40. Using the same method as above, calibrate the zero pressure offset of the air gas supply pressure transducer (XD102).
 - a. Remove the yellow tubing from transducer XXD102.
 - b. Adjust the setting of *t Insp* to "6".
 - c. Calibrate the value of *Air Gas Supply* to 0.0 ± 0.1 psig.
 41. Using the same method as above, calibrate the gain of air gas supply pressure transducer (XD102).
 - a. Adjust the setting of *t Insp* to "7".
 - b. Tee in a calibrated pressure gauge and apply a pressure of 25 psig to the top port of transducer XD102.
 - c. Using the setting for *Resp Rate*, calibrate the value of *Air Gas Supply* to 25.0 ± 0.1 psig.
 - d. Reconnect the yellow tubing to the top port of transducer XD102.
 42. Using the same method as above, calibrate the zero pressure offset of oxygen gas supply pressure transducer (XD103).
 - a. Remove the blue tubing from transducer XD103.
 - b. Adjust the setting of *t Insp* to "8".
 - c. Calibrate the value of *Oxygen Gas Supply* to 0.0 ± 0.1 psig.
 43. Using the same method as above, calibrate the gain of oxygen gas supply pressure transducer (XD103).
 - a. Adjust the setting of *t Insp* to "9".
 - b. Tee in a calibrated pressure gauge and apply a pressure of 25 psig to the top port of transducer XD103.
 - c. Calibrate the value of *Oxygen Gas Supply* to 25.0 ± 0.1 psig.
 - d. Reconnect the blue tubing to the top port of transducer XD103.
 44. Turnoff the ventilator.
 45. Disconnect the air and O₂ gas supplies, and AC power.

5.5.2 Pneumatics Calibration



Note:

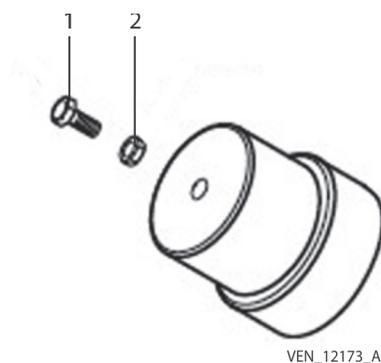
Before proceeding with the pneumatics calibration, the analog PCB in the ventilator must already be calibrated.

**Note:**

To calibrate air/oxygen inlet regulators, and the safety regulator, use the diagnostic mode d3 (manual flow adjustment).

Air Inlet Regulator

1. Connect the air and oxygen gas supplies, and AC power to the ventilator.
2. Enter diagnostic mode by performing the procedure in section 5.4, "Diagnostic Mode."
3. Touch "Start Diagnostics" on the screen.
4. Press the button below the *Trig* window. The display will blink.
5. While the display is blinking, turn the adjustment knob to change the setting from "d0" to "d3".
6. Press the *Accept* button to confirm the selection.
7. Press *Select* above the *Flow/t Insp* window.
8. To select *Flow*, press the *Accept* button.
9. To enable manual flow adjustment, press the *Manual Inflation* button.
10. Press the button below the *Flow / t Inst* window. The display will blink.
11. To obtain a flow of 3 L/min, turn the *adjustment* knob to change the setting from "0" to "3".
12. Press the *Accept* button to confirm the selection.
13. Verify the value of *Air Gas Supply* is 15.5 ± 0.5 psig. If not, adjust the air inlet pressure regulator:
 - a. Using a 1/4" open-ended wrench, loosen the bottom lock nut (see [Figure 5-3](#)).
 - b. Using a 1/4" open-ended wrench, rotate the top adjustment bolt clockwise to increase the pressure or counterclockwise to decrease it.
 - c. When the value of *Air Gas Supply* is 15.5 ± 0.5 psig, secure the bottom lock nut.

Figure 5-3. Air/Oxygen Pressure Regulators Adjustment

1 Adjustment bolt 2 Lock nut

14. Adjust *Flow* as shown in [Table 5-4](#) , and verify that the expected regulated pressure for each flow setting is within tolerance.

Table 5-4. Air Flow and Pressure Settings

Flow setting	Air inlet pressure
3 L/min	15.0-16.0 psig
100 L/min	12.0-14.5 psig
180 L/min	>9.5 psig

Oxygen Inlet Regulator

1. While in diagnostic mode d3, adjust FiO_2 to 100% (1.00) oxygen.
2. Adjust *Flow* to 3 L/min.
3. Adjust the oxygen inlet regulator pressure to 15.5 ± 0.5 psig by following steps 11 through 13 in the section titled "[Air Inlet Regulator](#)."
4. Adjust *Flow* as shown in [Table 5-5](#) , and verify that the expected regulated pressure for each flow setting is within tolerance.

Table 5-5. Oxygen Flow and Pressure Settings

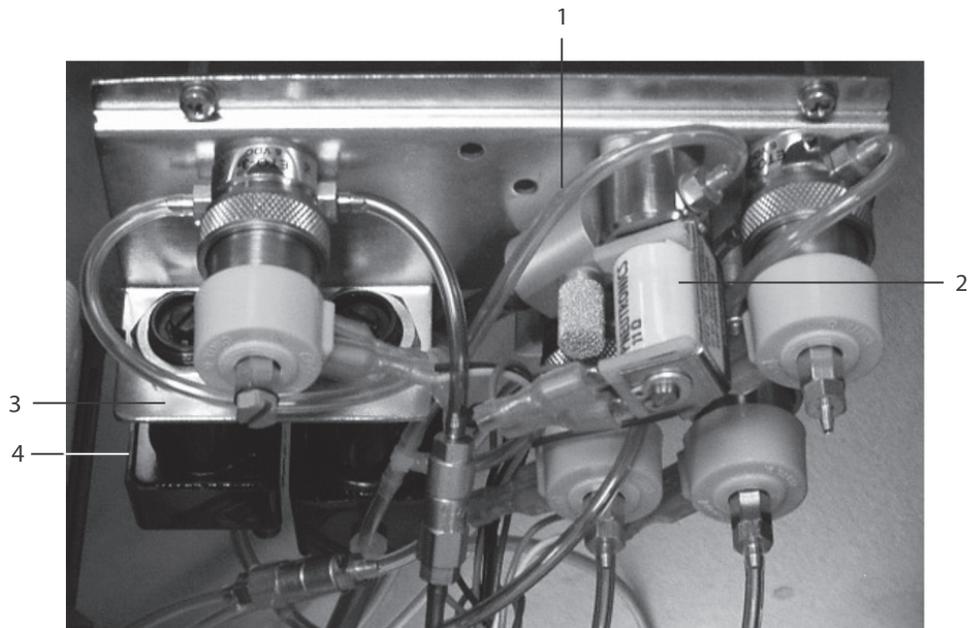
Flow setting	Oxygen inlet pressure
3 L/min	15.0-16.0 psig
100 L/min	12.0-14.5 psig
180 L/min	>9.5 psig

5. Adjust *Flow* to 0 L/min and FiO_2 to 21% (0.21) once the calibration is complete.

Exhalation PSOL Regulator

1. Remove the orange tubing from the IN exhalation PSOL valve port and connect to a calibrated high pressure gauge (see [Figure 5-4.](#)).
2. Using a flat head screwdriver, adjust the exhalation PSOL regulator, which is located near the exhalation PSOL valve, to between 15.0 psig and 15.5 psig.
3. Reconnect the orange tubing to the IN exhalation PSOL valve port.

Figure 5-4. Exhalation PSOL/Safety Regulator



VEN_12174_A

- | | |
|---|---|
| <ol style="list-style-type: none"> 1 Orange tubing to exhalation PSOL valve IN port 2 Exhalation PSOL valve | <ol style="list-style-type: none"> 3 Exhalation PSOL regulator 4 Safety regulator |
|---|---|

Safety Regulator

1. While in diagnostics mode d3, adjust *Flow* to 3 L/min.
2. Disconnect the patient circuit from the exhalation valve, and connect it to the Y-piece of the patient circuit. This creates a closed loop.
3. Tee in a low-pressure gauge in the patient circuit.
4. Using a flat head screwdriver, adjust the safety regulator (see [Figure 5-4.](#)) to obtain a *machine 1* pressure reading of 140 ±5 cmH₂O on the screen.

5. Adjust *Flow* to 0 L/min once the calibration is complete.
6. To disable the manual flow adjustment, press the *Manual Inflation* button.

Air PSOL Valve: d1

**Caution:**

Do not attempt to perform air PSOL valve calibration unless instructed by the Technical Service Department or if one of the following conditions occurred:

- Replacement or readjustment of air inlet regulator
- Replacement of air PSOL valve
- Replacement of analog PCB
- Replacement of main PCB

**Caution:**

Do not attempt to perform air PSOL valve calibration unless the air gas supply is regulated to 50 ±2 psig and capable of supporting a minimum of 180 L/min of constant flow.

1. Enter diagnostics mode by following the procedure in section 5.4, "*Diagnostic Mode*."
2. Touch "Start Diagnostics" on the screen.
3. Press the button below the *Trig* window. The display will blink.
4. While the display is blinking, turn the adjustment knob to change the setting from "d0" to "d1".
5. Press the *Accept* button to confirm the selection.
6. Disconnect the patient circuit from the ventilator.
7. To initiate air PSOL valve calibration, press the *Manual Inflation* button.
 - The ventilator will go through a calibration maneuver that slowly increases and then decreases flow twice.
 - The value of *TSI Air Flow* displayed on the screen will slowly change as the delivered flow changes.
8. Wait several minutes for the calibration to complete, and the message "Test Completed" to be displayed.

**Note:**

If the message "Calibration Failed: Valve Leaks more than 50 cc" is displayed after the d1 is complete, the PSOL valve needs to be replaced.

Oxygen PSOL Valve: d2



Caution:

Do not attempt to perform oxygen PSOL valve calibration unless instructed by the Technical Service Department or if one of the following conditions occurred:

- **Replacement or readjustment of oxygen inlet regulator**
- **Replacement of oxygen PSOL valve**
- **Replacement of analog PCB**
- **Replacement of main PCB**



Caution:

Do not attempt to perform oxygen PSOL valve calibration unless the oxygen gas supply is regulated to 50 ± 2 psig and capable of supporting a minimum of 180 L/min of constant flow.

1. Enter diagnostics mode by following the procedure in section 5.4, "*Diagnostic Mode*."
2. Touch "Start Diagnostics" on the screen.
3. Press the button below the *Trig* window. The display will blink.
4. While the display is blinking, turn the adjustment knob to change the setting from "d0" to "d2".
5. Press the *Accept* button to confirm the selection.
6. Disconnect the patient circuit from the ventilator.
7. To initiate oxygen PSOL valve calibration, press the *Manual Inflation* button.
 - The ventilator will go through a calibration maneuver that slowly increases and then decreases flow twice.
 - The value of *TSI O2 Flow* displayed on screen will slowly change as the delivered flow changes.
8. Wait several minutes for the calibration to complete, and the message "Test Completed" to be displayed.



Note:

If the message "Calibration Failed: Valve Leaks more than 50 cc" is displayed after the d2 is complete, the PSOL valve needs to be replaced.

Exhalation Flow Sensor: d9

1. Turn off the ventilator.
2. Turn on the ventilator, and wait until the *Ventilation Standby* screen is displayed.

3. Occlude the patient circuit at the Y-piece using a cap (a filter and test lung are not required for this calibration).
4. To perform the circuit check, touch *Circuit Check* on the screen.
5. Confirm that the circuit check passes.
6. To start exhalation flow sensor calibration, perform the following steps:
 - a. Touch *Sensors* on the screen.
 - b. Press *Flow Sensor*.

**Note:**

You may need to perform step 6 several times to pass the exhalation flow sensor calibration.

7. Enter diagnostics mode by performing the steps in section 5.4, "*Diagnostic Mode*."
8. Set the ventilator to diagnostics mode "d9".
9. With the patient circuit occluded, press the *Manual Inflation* button to start the exhalation flow sensor calibration.
10. Wait for several minutes for the calibration to complete, and the message "Test Complete" to be displayed.

Exhalation PSOL Valve: d4

1. Enter diagnostics mode by following the procedure in section 5.4, "*Diagnostic Mode*."
2. Touch "Start Diagnostics" on the screen.
3. Press the button below the *Trig* window. The display will blink.
4. While the display is blinking, turn the adjustment knob to change the setting from "d0" to "d4".
5. Press the *Accept* button to confirm the selection.
6. With the patient circuit occluded, press the *Manual Inflation* button once. The message "Occlude the circuit" is displayed.
7. To start the calibration, press the *Manual Inflation* button again.
8. Wait for several minutes for the calibration to complete, and the message "Test Complete" to be displayed.

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6 Operational Verification

6.1 Overview

The operational verification procedure ensures that the Newport™ e360 ventilator is in proper operating condition.



WARNING:

Do not use the ventilator unless it passes the operational verification procedure.

6.2 Test Equipment

- Electrical safety test (EST) analyzer
- Certified calibration analyzer manufactured by TSI, Inc., or equivalent
- Oxygen analyzer
- Reusable patient breathing circuit (PBC340A), or equivalent
- Adult test lung (LNG800P) or adult test lung with RP20 airway resistor (LNG600A), or equivalent
- Adjustable (0-60 psig) dry, clean and regulated medical-grade air and oxygen gas supplies
- A cap to occlude the patient circuit Y-piece (CAP100P), or equivalent



Caution:

The accuracy of all test equipment (electronic or pneumatic) used for verification or calibration procedures should be certified annually by a testing laboratory before use.

6.3 Setup

Figure 6-1. Test Setup



1 Y-piece 2 Breathing circuit

1. Connect a reusable adult patient breathing circuit to the ventilator.
2. Attach a test lung to the patient breathing circuit Y-piece.
3. Connect the calibration analyzer with oxygen sensor between the main flow outlet and the patient breathing circuit.

4. Connect regulated adjustable air and oxygen gas supplies to ventilator inlets on the back of the ventilator.
5. Set regulators to 50 psig.
6. Use test form 10129540 to record the test data. Check the appropriate box or record the appropriate data on the operational verification procedure record sheet after each test is performed.

6.4 Electrical Safety Checks

6.4.1 Ground Resistance Test

1. Connect the AC power cord to the EST analyzer.
2. Connect the ground lead of the EST analyzer to the labeled equipotential connection on the back of the ventilator.
3. Perform the ground resistance check, and record the results on the record sheet. To pass, the ventilator ground resistance must be <0.1 .

6.4.2 Current Leakage Test

1. Turn the ventilator on.
2. Perform the current leakage check, and record the results on the record sheet. To pass, the measured current leakage must be $<300 \mu\text{A}$.

6.5 Operational Checks

Ensure the ventilator control panel is adjusted to the settings shown in [Table 6-1](#).



Note:

Adjustments are made with the touch-turn-accept method.

Table 6-1. Standard Test Settings

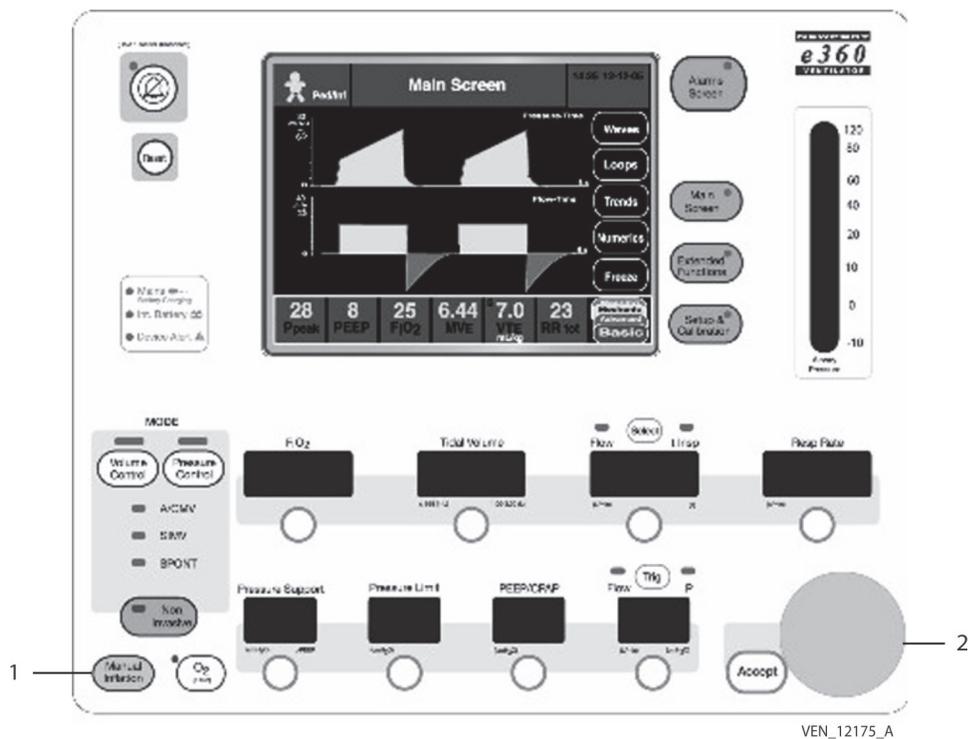
Control	Setting
Power	On
Patient type	Adult
Breath type	Volume control
Mode	A/CMV
FiO ₂	0.60
Flow	30 L/min
Tidal volume	500 mL
Resp rate	10 b/min
Pressure limit	5
Pressure support	0
Exp.threshold	Auto
Open exh.	Off
Flow wave	Square
Slope rise	5
Volume target	Off
PEEP	0
Trig	Pressure 3.0 cmH ₂ O
RR high alarm	110 b/min
MVE alarm	Low at 1 L/min, high at 50 L/min
Pause	Off
Paw alarm	Low at 10, high at 75
Leak comp.	Off
Circuit type	Test lung
Alarm loudness	1
Apnea alarm	60

**Note:**

Pressure readings should be set to either cmH₂O or mbar.

6.5.1 Front Panel LED Check

Figure 6-2. Front Panel Controls and Indicators

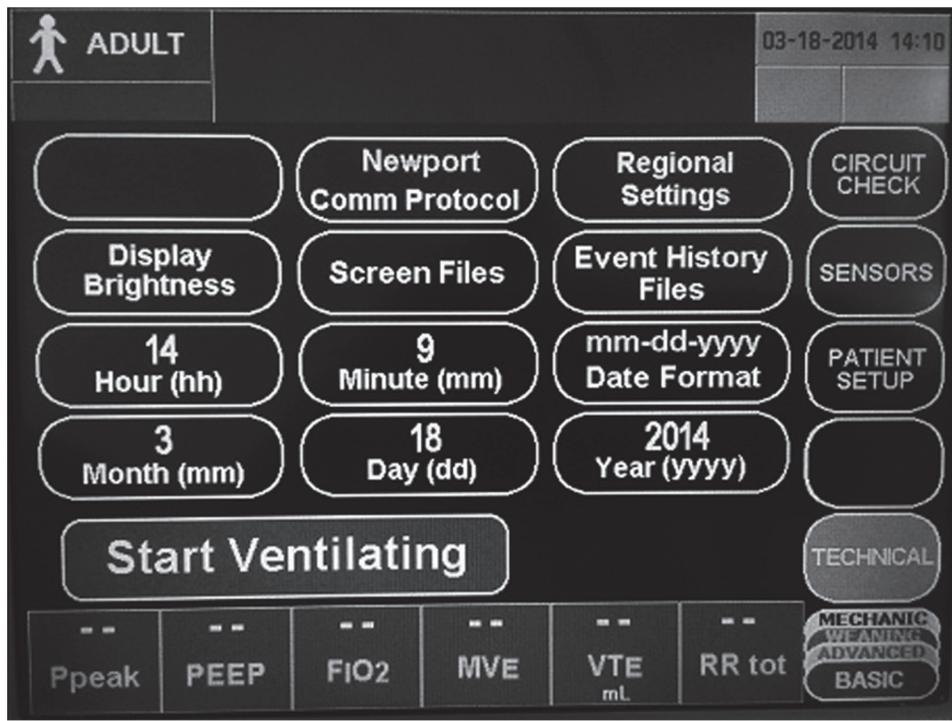


1 Manual inflation 2 Adjustment knob

1. Enter diagnostics mode by following the steps in section 5.4, "Diagnostic Mode."
2. Verify that all the control panel display lights are lit except for the alarm lamp located on top of the ventilator.
3. Turn off the ventilator.

6.5.2 Circuit Leak Test

Figure 6-3. Circuit Leak Test



VEN_12176_A



Note:

The circuit check test can only be performed in ventilation standby.

1. Remove test lung, if present, and occlude the end of the patient circuit Y-piece using CAP100P.
2. Turn on the ventilator.
3. Touch the *Circuit Check* button on the screen, and follow the on-screen instructions.
4. After the test is completed, verify that the message "PASSED" is displayed. Document the results on the record sheet.
5. Reattach the test lung.
6. To exit ventilation standby, touch the *Start Ventilating* button on the screen.

6.5.3 Exhalation Flow Sensor and FiO₂ Sensor Calibration

1. Touch the *Sensors* button on the screen.
2. Touch the *Flow Sensor* button on the screen, and follow the on-screen instructions.

3. Touch the O_2 Sensor button on the screen, and follow the on-screen instructions.

6.5.4 Loss of Gas Alarm

1. Set the ventilator to standard test settings.
2. Lower the air gas supply pressure to 20 psig.
3. Verify that there is no Loss of Gas alarm.
4. Lower the air gas supply pressure to 8 psig.
5. Verify that the audible alarm sounds, the red LED on the top of the ventilator flashes, and the message "Air Supply Loss" is displayed.
6. Set the air gas supply pressure to 50 psig.
7. Clear the alarm.
8. Repeat steps 1-7 for the oxygen gas source.
9. Shut off both gas supplies.
10. Verify that the audible alarm sounds, the red LED on the top of the ventilator flashes, and the message "Both Air/ O_2 Supply Loss" is displayed.
11. Turn on both gas supplies.
12. Clear the alarm.

6.5.5 FiO_2 Test

1. Set FiO_2 to 0.21.
2. Verify that the value of FiO_2 displayed on the screen, the FiO_2 reading measured by the oxygen analyzer, and the FiO_2 setting are within $\pm 3\%$ of each other. Document the readings on the record sheet.
3. Repeat steps 1 and 2 with F_iO_2 settings of 0.40, 0.60, and 0.80 (use the touch-turn-accept method to adjust settings).
4. Set F_iO_2 to 0.21.

**Note:**

Allow sufficient time for the calibration analyzer to stabilize at each setting before recording the calibration analyzer reading.

6.5.6 Main Flow

1. Remove the test lung from the patient circuit Y-piece.
2. Place the calibration analyzer at the inhalation outlet.
3. Set the calibration analyzer to flow measurement.
4. Press the button under the *Tidal Volume* window.
5. Use the touch-turn-accept method to adjust setting to 2.00 L.
6. To choose *Flow*, press the *Select* button at the top of the *Flow/t Insp* window.
7. Press the *Main Screen* button on control panel.
8. To display the numeric data, touch the *Numeric* button on the screen.

**Note:**

When the Insp Flow reading displayed on the *Numeric* screen is higher than expected flow, it could be caused by the peak flow delivered in the very beginning of the inspiratory phase. In this case, select *Flow Wave* on the *Extended Functions* screen, and then touch the *Freeze* button to read the actual flow value. To adjust the scale of the waveform, touch the flow axis on the screen, turn the adjustment knob to obtain a proper scale, and then touch the flow axis again to accept the change.

9. Set *Flow* to 5 L/min.
10. Verify that the value of Insp Flow displayed on the *Numeric* screen, the flow reading measured by the calibration analyzer, and the flow setting are within ± 1 L/min of each other. Document the results on the record sheet.

**Note:**

The flow reading measured by the calibration analyzer mentioned in steps 10 through 16 is the actual delivered measurement divided by 89%. This is because the ventilator automatically reduces the flow delivery by 11% of the set flow to compensate for humidifier use (BTPS compensation).

11. Set *Flow* to 10 L/min.
12. Verify that the value of Insp Flow displayed on the *Numeric* screen, the flow reading measured by the calibration analyzer, and the flow setting are within ± 1 L/min of each other. Document the results on the record sheet.
13. Set *Flow* to 50 L/min.
14. Verify that the value of Insp Flow displayed on the *Numeric* screen, the flow reading measured by the calibration analyzer, and the flow setting are within ± 4 L/min of each other. Document the results on the record sheet.
15. Set *Flow* to 80 L/min.

16. Verify the value of *Insp Flow* displayed on the *Numeric* screen, the flow reading measured by the calibration analyzer, and the flow setting are within ± 5 L/min of each other. Document the results on the record sheet.
17. Set F_iO_2 to 100% (1.00).
18. Set the calibration analyzer to oxygen flow measurement.
19. Repeat steps 9-15. Document the results on the record sheet.
20. Set F_iO_2 to 21% (0.21), *Flow* to 30 L/min, and *VT* (Tidal Volume) to 500.
21. Reattach the test lung.

**Note:**

Because the ventilator automatically compensates for humidifier use by lowering the flow by 11% (calibrated to BTPS), the calibration analyzer flow reading will be 11% lower than the ventilator's set flow rate if the calibration analyzer is not BTPS compensated.

6.5.7 Bias Flow

1. Set the ventilator to volume control SPONT:
 - a. Press the *Volume Control* button until SPONT LED is lit.
 - b. Press the *Accept* button to confirm the selection.
2. Set the calibration analyzer to air flow measurement.
3. Verify that the calibration analyzer measures a flow rate of 2.5 L/min to 3.5 L/min. Document the results on the record sheet.

6.5.8 Inspiratory Time

1. With the test lung still attached, place the calibration analyzer at the patient circuit Y-piece.
2. Set the calibration analyzer to inspiratory time measurement.
3. Set the ventilator to pressure control A/CMV:
 - a. Press the *Pressure Control* button until the A/CMV LED is lit.
 - b. Press the *Accept* button to confirm the selection.
4. Set *Pressure Limit* to 30 cmH₂O.
5. Set *t_{Insp}* to 0.25 seconds.

6. Verify that the value of t_1 (t_{Insp}) displayed on the *Numeric* screen, the inspiratory time reading measured by the calibration analyzer, and the t_{Insp} setting are within ± 0.05 seconds of each other. Document the results on the record sheet.
7. Set t_{Insp} to 0.50 seconds.
8. Verify that the value of t_1 (t_{Insp}) displayed on the *Numeric* screen, the inspiratory time reading measured by the calibration analyzer, and the t_{Insp} setting are within ± 0.10 seconds of each other. Document the results on the record sheet.

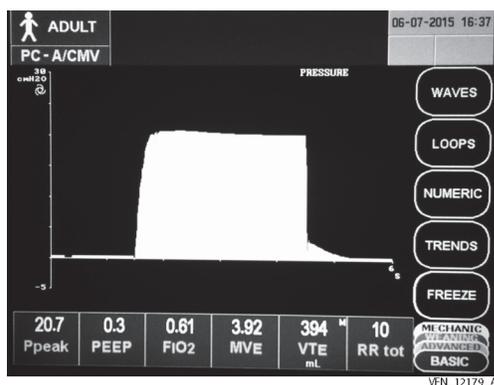
6.5.9 Respiratory Rate

1. Set the calibration analyzer to breath rate measurement (with 10 slpm).
2. Set t_{Insp} to 0.25 seconds.
3. Attach the test lung to the patient circuit Y-piece.
4. Set *Resp Rate* to 5 b/min.
5. Verify the value of RR_{tot} displayed on the calibration analyzer and the *Resp Rate* setting are within ± 1 b/min. Document the results on the record sheet.
6. Repeat step 4 with a *Resp Rate* setting of 20 b/min.
7. Set *Resp Rate* to 10 b/min.

6.5.10 Pressure Control

1. Set the ventilator to pressure control.
2. Set the calibration analyzer to peak pressure measurement in cmH_2O .
3. Set *Pressure Limit* to 20 cmH_2O , and t_{Insp} to 3.0 seconds.
4. Verify that the value of P_{peak} displayed on the *Numeric* screen, the peak pressure measured by the calibration analyzer, and the *Pressure Limit* setting are within $\pm 10\%$ of each other. Document the results on the record sheet.

Figure 6-4. Pressure Control Test



6.5.11 Pressure Support

1. Set the ventilator to pressure control SPONT.
2. Set *Trig* to P (pressure) and adjust to 0.5 cmH₂O.
3. Set *Pressure Support* to 20 cmH₂O.
4. Squeeze the test lung to trigger a breath.
5. Verify that the value of Ppeak displayed on the *Numeric* screen, the peak pressure measured by the calibration analyzer, and the *Pressure Support* setting are within $\pm 10\%$ of each other. Document the results on the record sheet.
6. Set *Pressure Support* to 0 cmH₂O.
7. Verify no pressure-supported breaths are delivered.

6.5.12 Pressure Trigger Sensitivity

1. Set *Pressure Support* to 10 cmH₂O.
2. Set *PEEP/CPAP* to 7 cmH₂O.
3. Set ventilator *Trig* to P (pressure) and adjust to 1.0 cmH₂O.
4. Manually squeeze and slowly release the test lung to create a dip in the pressure bar graph. Verify that the dip equals the *P Trig* setting when a pressure support breath is triggered.
5. Repeat step 4 with *P trig* setting of 3 cmH₂O.
6. Set *Pressure Support* to 0 cmH₂O.

6.5.13 PEEP/CPAP

1. Set the ventilator to the standard test settings, except set PEEP to 3 cmH₂O.
2. Set the calibration analyzer to PEEP measurement.

**Note:**

Allow three to four breaths at each setting for pressure to stabilize.

3. Verify that the value of PEEP displayed on *Numeric* screen, the pressure reading measured by the calibration analyzer, the pressure bar graph on the control panel, and the *PEEP/CPAP* setting are within ± 1 cmH₂O of each other. Document the results on the record sheet.
4. Repeat step 3 with a *PEEP* setting of 10 cmH₂O.
5. Set *Low Paw* alarm to 20 cmH₂O.
6. Repeat step 3 with a *PEEP* setting of 20 cmH₂O.
7. Set *PEEP* to 0 cmH₂O and *Low Paw* alarm to 10 cmH₂O.

6.5.14 Manual Inflation

1. Set the ventilator to volume control SPONT.
2. Press the *Manual Inflation* button.
3. Verify that a manual breath is delivered while the button is pressed.

6.5.15 Inspiratory Tidal Volume

1. Set the ventilator to volume control A/CMV.
2. Set *Flow* to 30 L/min.
3. Press the *Main Screen* button on the control panel.
4. Touch the *Numeric* button on the screen.
5. Set the calibration analyzer to volume measurement in BTPS with a 10 L/min threshold.
6. Set *Tidal Volume* to 200 ml.
7. Verify that the value of VTI displayed on the *Numeric* screen, the tidal volume reading measured by the calibration analyzer, and the *Tidal Volume* setting are within $\pm 10\%$ of each other. Document the results on the record sheet.

8. Repeat step 7 with *Tidal Volume* settings of 500 ml and 1 L.

6.5.16 Expiratory Tidal Volume

1. If using the TSI certifier, connect the calibration analyzer at the patient wye on the patient circuit. If using a PTS2000, connect the calibration analyzer on the expiratory side of the breathing circuit.
2. Set *Tidal Volume* to 250 mL.
3. Verify that the value of VTE displayed on the *Numeric* screen is between 225-275 mL, and that the tidal volume reading measured by the calibration analyzer and the *Tidal Volume* setting are within $\pm 10\%$ of each other. Document the results on the record sheet.
4. Set *Tidal Volume* to 500 mL.
5. Verify that the value of VTE displayed on the *Numeric* screen is between 450-550 mL, and that the tidal volume reading measured by the calibration analyzer and the *Tidal Volume* setting are within $\pm 10\%$ of each other. Document the results on the record sheet.
6. Set *Tidal Volume* to 1.00 L.
7. Verify that the value of VTE displayed on the *Numeric* screen is between 900 mL to 1.1 L, and that the tidal volume reading measured by the calibration analyzer and the *Tidal Volume* setting are within $\pm 10\%$ of each other. Document the results on the record sheet.

6.5.17 Audio Paused

1. Create an alarm condition by changing the settings.
2. Wait for the alarm to sound.
3. Press the *Audio Paused* button, and verify the indicator lights up and the audible alarm stops.
4. Press the *Audio Paused* button again, and verify the indicator turns off and the audible alarm resumes.
5. Return the ventilator to standard test settings.
6. To clear alarm indicators, press the *Reset* button.
7. Document the results on the record sheet.

6.5.18 Loss of Power Alarm and Battery Operation

1. Disconnect the power cord from the AC power source.
2. Verify the following occurs:
 - The messages "AC Power Loss" and "Battery Back Up" are displayed in the message window

- The audible alarm sounds
 - The internal battery indicator illuminates
 - At least three bars on the charge bar graph light up
3. Reconnect the power cord to the AC power source.



Note:

To ensure that the internal battery remains functional, fully charge the battery at least every 3 months when the ventilator is not in use.

A Theory of Operations

A.1 Device Description

The Newport™ e360 ventilator employs a dual PSOL gas delivery system (one each for air and oxygen), a PSOL-controlled active exhalation valve, and a combination control panel interface and touch screen interface/graphics monitor (GUI). The electronically controlled inlet gas mixing system is superior to traditional pneumatic mixers that must exhaust gas from the system to consistently deliver precise oxygen concentrations. The dual PSOLs respond immediately to change the delivered FiO_2 when requested by the control system.

Approximately 60 minutes of operational backup power is available when the ventilator's internal battery is fully charged. In addition, the ventilator has remote alarm, external battery, VGA, and external audio paused connections plus an RS232 interface to connect to central monitoring systems and USB port for uploading software.

When the ventilator is turned on, the power on self-test (POST) verifies the integrity of the software and hardware of the ventilator, and is in standby until the user selects *Start Ventilating*. During operation, the ventilator performs regular pressure transducer calibrations and software tests to ensure accuracy of monitored and displayed data. A user-initiated circuit check performs a leak test of the breathing circuit system, and measures circuit compliance and resistance. User-initiated sensor calibration tests allow for calibration of the O_2 and exhalation flow sensors.

All breath types and modes include a range of ventilation and alarm settings appropriate for adult or pediatric/infant patients. The ventilator has settable alarm limits for high and low peak airway pressure, high and low expiratory minute ventilation/back-up ventilation, high respiratory rate, disconnect threshold, and apnea. There are built-in alarm limits for O_2 monitoring, low baseline pressure, high baseline pressure, sustained high baseline pressure, gas supply failure, device alert, and power switchover.

The ventilator monitors and displays the power source, volumes, peak flows, breath timing parameters (I:E ratio, respiratory rate, and inspiratory time), delivered oxygen concentration, and patient pressures (peak, plateau, mean airway, and baseline).

The ventilator has a built-in oxygen analyzer that can be calibrated with a push of a button.

During exhalation, the ventilator uses a bias flow to flush exhaled CO_2 and stabilize temperature, humidity, and baseline pressure in the patient breathing circuit. A stable baseline pressure between breaths helps to minimize auto-triggering.

The exhalation system is heated to prevent moist exhaled gas from condensing in the exhalation pathway. A bacteria filter should be used at the From Patient port to prevent contaminants in the exhaled gas from entering the exhalation system and contaminating the exhalation valve and flow sensor. Another filter should be placed at the To Patient port to prevent contamination of the inspiratory manifold when the emergency relief valve opens (in the case of a Device Alert alarm, Both Air/O₂ Supply Loss alarm, or Sustained High Baseline Pressure alarm that is accompanied by a blockage of the exhalation valve).

The heated exhalation system features an active exhalation valve with a low exhaled flow resistance for rapid return of circuit pressure to baseline and decreased potential for auto-PEEP.

A.2 Mandatory Breath Types

The ventilator offers these breath types:

- Volume Control
- Pressure Control
- Biphasic Pressure Release Ventilation*
- Volume Target Pressure Control*

* Not available on the S model

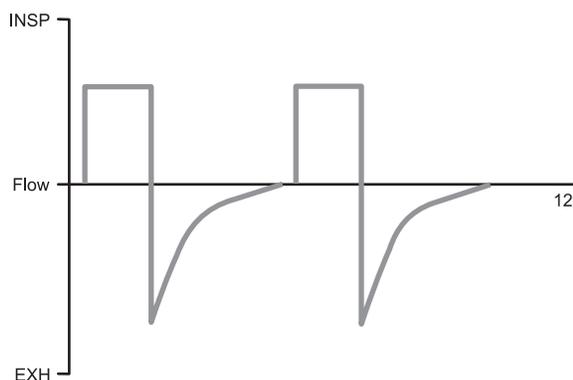
Table A-1. Control Selections for Mandatory Breaths

Mandatory breath type	Control panel selection	Advanced selection open exhalation	Advanced selection volume target
Volume Control	Volume Control	Not available	Off
Pressure Control	Pressure Control	Off	Off
Volume Target Pressure Control (VTPC)	Volume Control or Pressure Control	Off	On
Biphasic Pressure Release (BPRV)	Pressure Control	On	Off

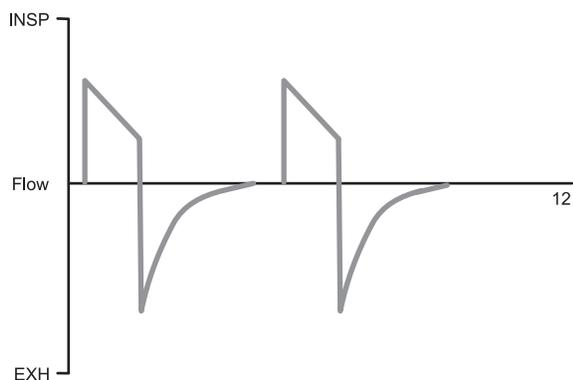
A.2.1 Volume Control

Volume Control ventilation provides time-cycled, volume-limited mandatory breaths. *Volume* and *Flow* (or inspiratory time) are user-set parameters and pressure is allowed to vary. The user has the option to select between two flow wave patterns for breath delivery in volume ventilation. The flow wave pattern function is accessed via the *Advanced* data set.

A square flow wave pattern delivers the set flow constantly until the set tidal volume is delivered. Reference [Figure A-1](#).

Figure A-1. Square Waveform in VCV

A descending ramp flow wave pattern delivers the set flow initially, decreases flow rate at a constant rate until 50% of the initial flow is reached, and then terminates flow delivery when the set tidal volume has been delivered. Reference [Figure A-2](#).

Figure A-2. Descending Ramp Flow Waveform in VCV

A.2.2 Pressure Control

Pressure Control ventilation provides time-cycled, pressure-limited mandatory breaths. Inspiratory *Pressure Limit* and *t_{Insp}* (inspiratory time) are set parameters with tidal volume and flow allowed to vary to meet the set parameters. The *Slope/Rise* may be adjusted via the *Advanced* data set. A Pressure Control inspiration terminates when the set inspiratory time has elapsed.



Note:

If the *Slope/Rise* control is set too low, breathing circuit pressure may not reach the pressure limit value by end inspiration.

A.2.3 Biphasic Pressure Release Ventilation (Open Exhalation Valve)

Biphasic Pressure Release mandatory breaths are similar to Pressure Control mandatory breaths except that the exhalation valve remains open during the inspiratory time. This allows the patient

the option of unrestricted spontaneous breathing even while pressure in the circuit is elevated to the pressure limit level. This type of ventilation is referred to as Biphasic Pressure Release Ventilation (BPRV)*. It is considered to be more comfortable for patients with an active respiratory drive who are ventilated with Pressure Control. Open exhalation valve is turned on via the *Advanced* data set to achieve BPRV breaths.

If a patient makes an expiratory effort, such as a cough, against a closed exhalation system (for example, open exhalation valve off) during the inspiratory phase of a pressure-controlled mandatory breath, airway pressure will rise above the target pressure. When open exhalation valve is on, the ventilator actively controls the exhalation valve so that excess pressure is vented out, the degree of pressure overshoot is minimized, and airway pressure is maintained close to the target pressure.

* not available on the S model

A.2.4 Volume Target (Volume Target Pressure Control—VTPC)

Volume Targeted Pressure Control* is a hybrid Pressure Control breath type where the ventilator attempts to achieve (target) a user-set tidal volume using the lowest Pressure Control level. These are much like Pressure Control mandatory breaths except that the Pressure Control level is managed breath-by-breath by the ventilator in steps of up to 3 cmH₂O/mbar. The pressure change in VTPC is limited to a level that is between 5 cmH₂O/mbar above *PEEP* and the *Pressure Limit* setting in order to try to achieve the targeted (user set) tidal volume within the (user set) inspiratory time. The set tidal volume is not guaranteed for each breath; it is a target.

The first VTPC mandatory breath delivered after *Volume Target* is turned on is at a pressure control level equal to *PEEP/CPAP*+5 cmH₂O/mbar.

Spontaneous breaths in VTPC/SIMV mode are Volume Target Pressure Support (VTPS) breaths.

* not available on the S model



Note:

If the *Slope/Rise* control is set too low, breathing circuit pressure may not reach the target pressure by the end of inspiration.

A.3 Spontaneous Breath Management in SIMV and SPONT Modes

There are two forms of spontaneous breath assistance on the ventilator in SIMV and SPONT modes, Pressure Support and Volume Target Pressure Support.

In Volume Control, Biphasic Pressure Release,* and Pressure Control SIMV, spontaneous breaths with Pressure Support are available. In Volume Target Pressure Control SIMV, spontaneous breaths are Volume Target Pressure Support breaths.

In SPONT, when Volume, BPRV, or Pressure Control mandatory breath type is selected, spontaneous breaths with Pressure Support are available.

In SPONT, when Volume Target Pressure Control* mandatory breath type is selected (*Volume Target* is on in *Advanced* data set), all spontaneous efforts are assisted by Volume Target Pressure Support.

* not available on the S model

A.3.1 Pressure Support

Pressure Support is available in SIMV and SPONT—Volume Control, BPRV,* and Pressure Control mandatory breath types only. For patient spontaneous efforts that trigger the ventilator, it delivers breaths with a constant pressure equal to PEEP/CPAP + Pressure Support. The breaths are delivered according to the user-selected settings for *Pressure Support*, *Slope/Rise*, and *PEEP/CPAP*.

Pressure-Support breaths are cycled off when one of three thresholds is attained: delivered flow declines to a set percent (%) of peak flow (user set via expiratory threshold in *Advanced* data set), the duration of the breath reaches the maximum inspiratory time (2.0 seconds for adult, 1.2 seconds for ped/infant), or pressure overshoot occurs, whichever comes first.

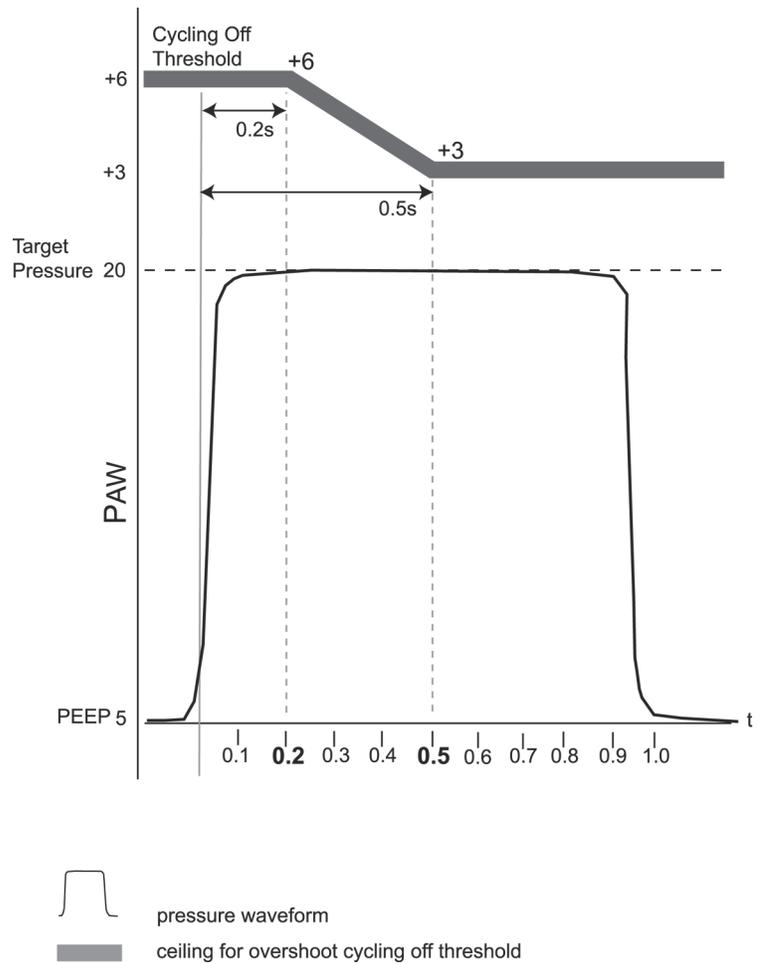
* not available on the S model



Note:

Reference [Figure A-3](#) for a graphical representation of the pressure overshoot cycling off threshold for Pressure Support and Volume Target Pressure Support breaths.

Figure A-3. Pressure Overshoot

**Note:**

If *Pressure Support* is set to zero, the ventilator raises the pressure in the patient circuit to a target pressure of 1.5 cmH₂O/mbar above the set PEEP/CPAP until the end of inspiration.

A.3.2 Volume Target Pressure Support (VTPS)

Volume Target Pressure Support* is available in SIMV and SPONT—Volume Target Pressure Control breath type only. For patient spontaneous breaths in the Volume Target Pressure Control SPONT and SIMV modes, the ventilator delivers breaths with a constant pressure in the breathing circuit at a pressure equal to a ventilator selected level between PEEP/CPAP+5 cmH₂O/mbar and the pressure limit, until the attainment of one of the three cycling off thresholds.

Each VTPS spontaneous breath is delivered according to the user-selected *Tidal Volume* and *Pressure Limit*, *Slope/Rise*, and *PEEP/CPAP* settings. These are very much like Pressure Support Spontaneous breaths but unlike the Pressure Support Spontaneous breaths delivered when Pressure Control, BPRV*, or Volume Control breath type are selected, the Pressure Support level is managed breath-

by-breath by the ventilator at the lowest level possible between 5 cmH₂O/mbar above PEEP/CPAP and the pressure limit setting in order to try to achieve the set tidal volume. The set tidal volume is not guaranteed for each breath; it is a target.

The target pressure of the first breath, when no target pressure has been established, is PEEP/CPAP+5 cmH₂O/mbar.

Volume Target Pressure Support (VTPS)* breaths are cycled off when one of three thresholds is attained: delivered flow declines to a set percent (%) of peak flow (user set via expiratory threshold in *Advanced* data set), the duration of the breath reaches the maximum inspiratory time (2.0 seconds for adult, 1.2 seconds for ped/infant) or pressure overshoot, whichever comes first. Reference [Figure A-3](#) for an illustration of pressure overshoot.

Take care to set the expiratory threshold so that the breath cycling off coincides with the end of patient effort or choose AUTO to allow FlexCycle to adjust the expiratory threshold setting breath by breath.

* not available on the S model

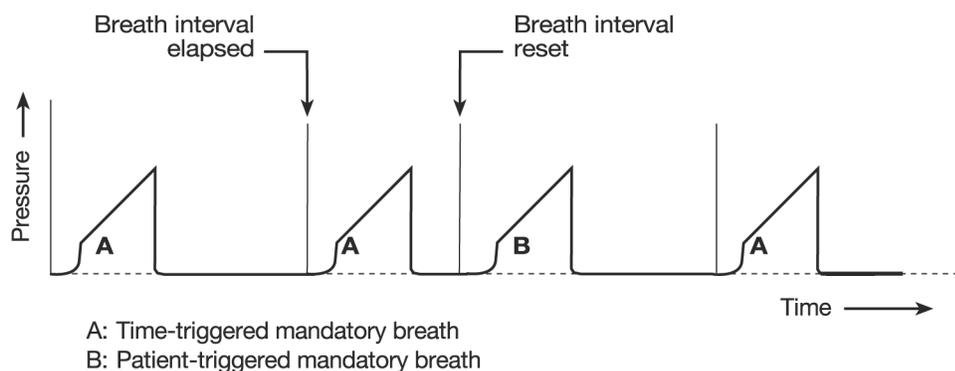
A.4 Ventilation Modes

Breath types include the choice of three modes:

- Assist/Control Mandatory Ventilation (A/CMV)
- Synchronized Intermittent Mandatory Ventilation (SIMV)
- Spontaneous (SPONT)

A.4.1 A/CMV

Figure A-4. A/CMV



In A/CMV, all breaths delivered to the patient are delivered according to the parameters set by the user. These are called mandatory breaths. The user may choose to Pressure Control, Volume Control, Biphasic Pressure Release,* or Volume Target Pressure Control* the mandatory breaths. All breaths may be time (ventilator triggered) or patient triggered.

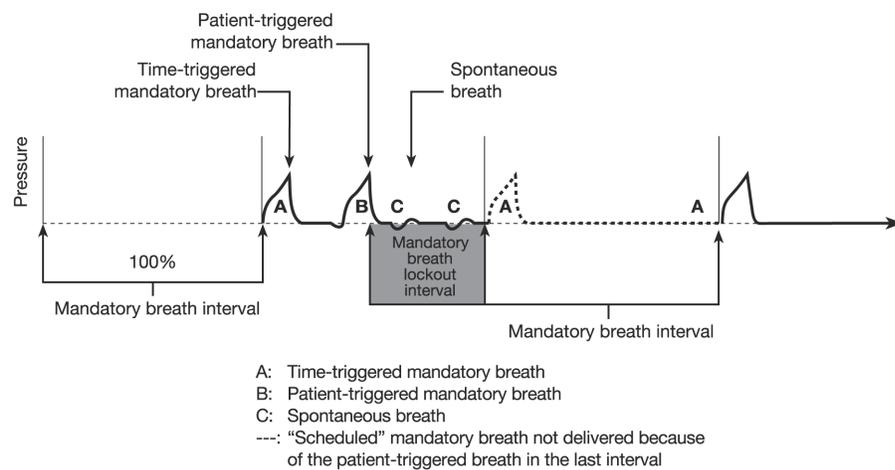
The *Resp Rate* (respiratory rate) setting determines the minimum number of time-triggered or patient-triggered mandatory breaths delivered each minute. The *Trig* setting determines the airway pressure or airway flow threshold that the patient's effort must reach in order to trigger these and additional mandatory breaths.

If the patient doesn't breathe or if the patient's efforts don't cause airway pressure or airway flow to reach the *Trig* threshold, the ventilator delivers the number of time-triggered breaths each minute selected via the *Resp Rate* setting.

* not available on the S model

A.4.2 SIMV

Figure A-5. SIMV



In SIMV, mandatory and spontaneous breaths may be delivered to the patient. The user may choose to Pressure Control, Volume Control, Biphasic Pressure Release* or Volume Target Pressure Control* the mandatory breaths. Mandatory breaths may be time or patient triggered. In Volume Control, Pressure Control, or Biphasic Pressure Release*, the user may choose Pressure Support to augment the spontaneous breaths.

When Volume Target Pressure Control* mandatory breath type is selected, all spontaneous breaths are Volume Target Pressure Support breaths.

The *Resp Rate* setting determines the total number of mandatory breaths delivered each minute and establishes a timing window that determines whether a patient trigger results in a mandatory breath or a spontaneous breath.

The *Trig* setting determines the airway pressure or airway flow threshold that the patient's effort must reach in order to trigger mandatory breaths and also to trigger spontaneous breaths in between mandatory breaths.

If there are no patient breathing efforts or if patient efforts fail to cause enough airway pressure or airway flow change to meet the set *Trig* threshold, the patient receives the number of time-triggered breaths each minute selected via the *Resp Rate* setting.

* not available on the S model

A.4.3 SPONT (Spontaneous)

In SPONT, all breaths delivered to the patient are spontaneous breaths. When Volume Control or Pressure Control breath types are selected, the user may choose to add Pressure Support to assist spontaneous efforts. When Volume Target Pressure Control* mandatory breath type is selected, all spontaneous efforts are assisted by Volume Target Pressure Support.

The *Trig* setting determines the airway pressure or airway flow threshold that the patient's effort must reach in order to trigger spontaneous breathing assistance from the ventilator.

If there are no patient efforts or if the patient efforts fail to cause enough airway pressure or airway flow change to meet the set *Trig* threshold, no spontaneous breathing assistance is provided.

* not available on the S model

A.5 Safety Features

- Protection from overpressurization
- Protection from rebreathing exhaled gases

The ventilator's software allows the user to perform a pre-use leak, compliance, and resistance tests of the patient breathing circuit, humidifier, and filters. Other software-based selections include: breathing circuit compliance compensation of flow/volume delivery and monitoring on or off, circuit type in use (heated expiratory limb (high output), heated inspiratory expiratory limb (middle output), or HME), leak compensation on or off, set time and date, and adjust for operation at the local altitude.

All modes of ventilation and breath types on the ventilator include a range of settings appropriate for adult or pediatric/infant patients. To maximize patient safety, the control panel has an *Accept* button that must be pressed to activate any setting changes. This feature is to prevent accidental changes. The ventilator has settable alarm limits for high and low peak airway pressure, high and low expiratory minute volume, high respiratory rate, circuit disconnect threshold, and apnea. The Low Minute Volume alarm activates back-up ventilation, which increases respiratory rate in A/CMV and SIMV and provides pressure-controlled ventilation according to safe basic settings in SPONT mode in order to increase ventilation back to acceptable values during the alarm condition. In addition, there are built-in alarms limits for O₂ monitoring, low baseline pressure, high baseline pressure, sustained high baseline pressure, gas supply failure, device alert, and power switchover.

If a condition, such as low battery power during battery operation or component malfunction, occurs and the ventilator cannot maintain reliable operation, it declares a Device Alert alarm. This alarm cannot be silenced without first powering off the ventilator. An alarms and message bar on the GUI clearly displays all alarm and informational messages. An alarm lamp on the top of the device lights with all alarms. It can be viewed from 360°. In addition, a separate control panel indicator lights in case of a device alert.

The exhalation system is heated to prevent moisture in the exhaled gas from being condensed in the exhaled flow monitor system. It features low exhalation flow resistance to allow rapid return to

baseline pressure after a positive pressure breath, and decreased potential for auto-PEEP. A filter is used between the expiratory limb of the breathing circuit and the expiratory (From Patient) port to prevent contaminants in the exhaled gas from entering the exhalation system.

A.5.1 Protection From Overpressurization

In the case of a High Pressure alarm violation, Sustained High Baseline Pressure alarm violation with suspension of ventilation, Device Alert shutdown, Both Air/O₂ Supply Loss alarm shutdown or power off, the exhalation valve opens to allow the patient to exhale. The exhalation valve also opens any time breathing circuit pressure reaches 135 cmH₂O.

With exception of the High Pressure alarm, these same conditions cause the inspiratory emergency relief valve solenoid to be de-energized, which allows the circuit pressure to vent if it is above the relief valve cracking pressure of 4 cmH₂O. The relief valve also opens any time breathing circuit pressure reaches 140 cmH₂O.

A bacteria filter is placed between the inspiratory limb and the inspiratory (To Patient) port to prevent contaminants in the exhaled gas from entering the inspiratory manifold when the inspiratory emergency relief valve is de-energized.

A.5.2 Protection From Rebreathing Exhaled Gases

In the case of a Sustained High Baseline Pressure alarm violation, Device Alert shutdown, Both Air/O₂ Supply Loss alarm violation or power off, gas delivery to the patient will cease. The inspiratory manifold and exhalation valve systems are designed to protect the patient from rebreathing exhaled gas under this condition. A mechanical emergency intake valve in the inspiratory manifold allows the patient to breathe room air into the breathing circuit. The exhalation valve acts as a one-way valve allowing the patient to exhale but not inhale. This system provides fresh gas through the inspiratory limb and an easy route for exhalation through the exhalation valve in the case of ventilator shutdown. If the exhalation valve is blocked when the ventilator shuts down, the patient will exhale through the inspiratory emergency relief valve when pressure in the circuit reaches the cracking pressure of 4 cmH₂O.

A.6 Description of Functional Subsystems

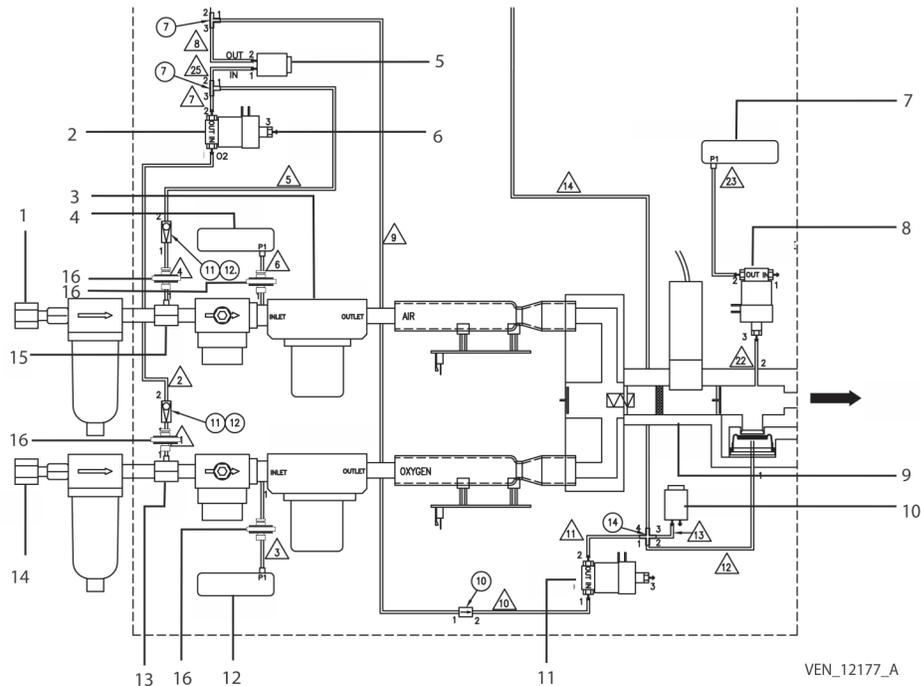
The ventilator includes the following subsystems:

- Inhalation system
- Exhalation system
- Electronics

A.6.1 Inhalation System

The inhalation system supplies gas according to the user-selected breath delivery settings.

Figure A-6. Newport™ e360 Ventilator Inhalation System



- | | | | |
|---|---------------------------|----|---------------------------|
| 1 | Air inlet | 9 | Inhalation block |
| 2 | Crossover solenoid | 10 | Safety regulator |
| 3 | PSOL valve air | 11 | Safety solenoid |
| 4 | Air regulated pressure | 12 | Pressure oxygen regulated |
| 5 | Exhalation regulator | 13 | Inlet block oxygen |
| 6 | Air | 14 | Oxygen inlet |
| 7 | Machine pressure 1 sensor | 15 | Inlet block air |
| 8 | Rezero valve machine 1 | 16 | Disk filters |

Supply gas enters the inlet filters (one for oxygen and one for air) at a pressure of 30 to 90 pounds per square inch gauge (psig). Each inlet filter traps particles as small as 40 microns and includes a water trap to collect any water from the supply gas.

The filtered supply gas then enters a regulator that regulates pressure from 30 to 90 psig down to 15 psi. Transducers monitor pressure at the regulators, and a pressure drop at either regulator generates a low inlet pressure alarm.

The regulated gas enters the PSOL valves, which are designed to supply gas to the patient circuit at the preset or ventilator managed flow. A PSOL valve calibration creates a lookup table of the currents required to generate the range of flows from the PSOL valve. The lookup table allows the ventilator to target the required flow as quickly as possible, and feedback from the flow sensor every 10 milliseconds allows the ventilator to refine flow delivery.

Because the lookup table is unique to each combination of regulator and PSOL valve, the PSOL valve calibration should be rerun when either component is replaced. Most of the gas pressure drops across the PSOL valves, and gas exiting the PSOL valves is close to patient pressure.

Check valves downstream of the PSOL valves prevent cross-contamination from the ventilator to the gas supplies.

The flow sensors are hot wire anemometers: as gas flows through the sensor, it cools the wire and increases its resistance. The flow sensor adjusts power to keep wire temperature constant, and the power required is directly proportional to the flow across the wire. Each flow sensor is factory-calibrated for air or oxygen.

Air and oxygen then enter the mixing chamber, where they are combined. The blended gas then exits to the patient circuit through the inspiratory manifold. The inspiratory manifold also includes the emergency intake valve and the emergency relief valve. These components are described in section [A.5](#).

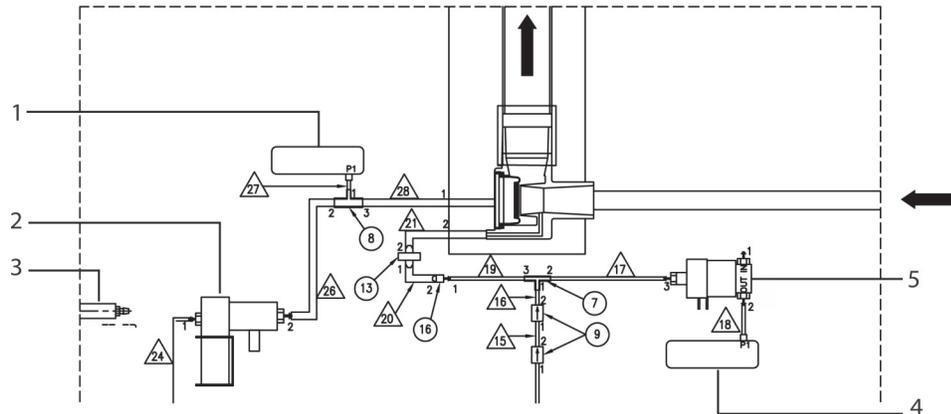
The oxygen sensor is mounted directly to the inspiratory manifold where it can monitor the delivered FiO_2 and compare it to the set FiO_2 . Because the oxygen sensor is sensitive to changes in atmospheric pressure and temperature, the ventilator calibrates the oxygen sensor, each time the *O₂ 3 min* button is activated and any time the monitored FiO_2 is greater than +0.07 from the set value. Ventilator software assigns an FiO_2 of 1.0 to the voltage read during calibration. The user may also initiate a calibration from a menu on the GUI.

During exhalation, the inhalation system supplies a bias flow of 3 L/min through the patient circuit to flush exhaled CO_2 and stabilize temperature, humidity, and baseline pressure. When either *Leak Compensation* or *Non Invasive* is turned on, the ventilator provides leak compensation by increasing flow above bias flow to maintain end expiratory flow near 3 L/min in the expiratory flow sensor. The maximum leak compensation level available when *Leak Compensation* is turned on varies for each patient category as follows: ped/infant = 8 L/min, adult = 15 L/min. Maximum leak compensation supplied by the *Non Invasive* function is 25 L/min.

Transducers monitor pressure in the inspiratory manifold and expiratory system. A transducer rezero solenoid maintains an accurate zero point for the pressure transducers by opening periodically to note the voltage that equals atmospheric (zero) pressure.

A.6.2 Exhalation System

The exhalation system measures the flows and volumes of gas exhaled from the patient circuit, measures pressure, and controls the exhalation valve to manage pressure in the breathing circuit and allow patient exhalation.

Figure A-7. Ventilator Exhalation System

VEN_12178_A

- | | | | |
|---|-----------------------|---|----------------------------|
| 1 | Drive pressure sensor | 4 | Machine pressure 2 sensors |
| 2 | Exhalation PSOL valve | 5 | Rezero valve machine 2 |
| 3 | Muffer | | |

Because gas delivered to and exhaled from the patient is humidified to near 100% relative humidity, the expiratory block includes a heater to prevent condensate from forming as the exhaled gas passes through the exhalation system.

The heater heats the expiratory block and flow sensor to prevent condensation. The exhalation flow sensor includes a hot wire sensor and a temperature compensation wire. By measuring the temperature exchange for the hot wire in the flow sensor the ventilator calculates the flow of the exhaled gas. The exhalation flow sensor requires a short calibration before it is put into use. The calibration is performed by the user at ventilator startup and may also be initiated by the user during ventilation if calibration is suspect.

Gas from the exhalation valve flows to the exhalation flow sensor. The exhalation valve includes a flexible silicone exhalation diaphragm, and drive pressure from the jet pump opens and closes the diaphragm to manage pressure in the breathing circuit and allow patient exhalation.

The exhalation solenoid is a small PSOL valve that controls pressure to the exhalation valve diaphragm by varying its outlet size. Gas from the exhalation solenoid enters the jet pump, where it flows through a jet nozzle to create drive pressure to the exhalation valve diaphragm. The low mass of the jet pump allows it to operate without the complications caused by oscillation of a larger part.

A pressure transducer at the exhalation valve provides feedback that tells the exhalation solenoid to increase or decrease its output to achieve the correct drive pressure. The exhalation solenoid associates an approximate PEEP with an approximate drive pressure. In case of a circuit disconnect, these reference pressures help avoid supplying excess pressure in the circuit after reconnection. Excess flow from the jet pump vents through the muffer.

A.6.3 Electronics

Power to the ventilator enters the AC inlet, which connects to the power supply. The power supply converts alternating current to direct current, and accepts any voltage or frequency within the specified range.

Direct current from the power supply enters the DC-DC PCB, which supplies operating voltage to other PCBs, includes circuitry for external battery connection and battery operation, and powers the fan, and heater.

The main PCB accepts input from the oxygen sensor and PSOL valves, acts as “motherboard” for the ventilator including the secondary (backup) alarm. The main PCB powers and receives signals from the analog PCB.

The analog PCB accepts signals from the flow sensors and includes all ventilator transducers. The solenoid PCB includes all valve controls (solenoids) except for the exhalation valve solenoid attached to the jet pump.

The single-board computer board includes all of the video interface, USB, RS232, primary audio alarm, and touch screen interfaces.

The display PCB controls the membrane buttons, LEDs, and the optical encoder. It also communicates with the monitor CPU on the main PCB.

The power sequence PCB provides power-on reset to the single-board computer when a power-on failure is detected. The power sequence PCB also provides over-current protection to the internal battery, as well as power-off delay to ensure data is saved before the ventilator shuts down.

B Ordering and Contact Information

B.1 Ordering Parts and Kits from Customer Service

This section lists field-replaceable parts kits for the Newport™ e360 ventilator.

Note that [Table B-1](#) lists two part numbers for each component: a manufacturing part number and a service part number. The manufacturing part number is printed on the part; the service part number is needed to order the required spare part. For some components, the service part number is different from the manufacturing part number.

For more information about parts or ordering, contact Covidien or your local Covidien representative. Refer to [Contact Information](#) on page 1-8.

Table B-1. Newport™ e360 Ventilator Spare Parts List

Description	Manufacturing part number	Service part number
Preventive maintenance kit	PMK360A	PMK360A
Overhaul kit	OVL360A	OVL360A
25 mm disk filter	FLT2102P	FLT2102P
Adapter, exhalation	ADP2105M	ADP2105M
Analog board	GR-PCB2110A	GR105706
Back pressure regulator	REG1802P	REG1802P
Battery assembly	BAT2100A	BAT2100S
Battery, lithium metal, 3V, coin, for SBC2105A	PT00055561	SPPT00055561
Bezel, front	BZL2108M	N/A
Buzzer	BZR2101P	BZR2101P
Cable assembly, speaker	GR-CBL2152A	GR-CBL2152A
Cable assembly, AC power input	GR-CBL2115A	GR-CBL2115A
Cable assembly, analog PCB	GR-CBL2118A	GR-CBL2118A
Cable assembly, battery and switch	GR-CBL2111A	GR-CBL2111A
Cable assembly, DC/DC to SBC and flow sensor	GR-CBL2127A	SPGR-CBL2127A

Table B-1. Newport™ e360 Ventilator Spare Parts List (Continued)

Description	Manufacturing part number	Service part number
Cable assembly, inhalation flow sensor	GR-CBL2116A	GR-CBL2116A
Cable assembly, main to back panel	PT00095462	SPGR-CBL2113A
Cable assembly, main to DC/DC	GR-CBL2101A	GR-CBL2101A
Cable assembly, main to display board	GR-CBL2121A	GR-CBL2121A
Cable assembly, main to top amber LED	GR-CBL2138A	SPGR-CBL2138A
Cable assembly, main to O2 sensor	GR-CBL2109A	GR-CBL2109A
Cable assembly, power supply to DC/DC	GR-CBL2103A	GR-CBL2103A
Cable assembly, main to single board	GR-CBL2148A	SPGR-CBL2148A
Cable assembly, main to solenoid assembly	GR-CBL2107A	GR-CBL2107A
Cable assembly, main to top red LED	GR-CBL2137A	SPGR-CBL2137A
Cable assembly, SBC to back panel VGA port	CBL2104A	CBL2104A
Cable assembly, SBC to touch panel controller	GR-CBL2147A	GR-CBL2147A
Cable assembly, USB TO SBC	GR-CBL2150A	GR-CBL2150A
Cable, ground	GR-CBL2144M	GR-CBL2144M
Cable, outside exhalation flow	GR-CBL2123P	GR-CBL2123P
Cable assembly, DC/DC fan	GR-CBL2119A	SPGR-CBL2119A
Cable, power sequence to GR-PCB2101A	GR-CBL2135A	GR-CBL2135A
Cable, power sequence to SBC	GR-CBL2136A	GR-CBL2136A
CD, e360 service manual	PT00073640	PT00073640
CF card for e360T	CF2107A	SPCF2107A
Diaphragm, exhalation valve	DIA1810M	DIA1810M
Display board	GR-PCB2109A	GR107022
Display, LCD	10139301	FG10102073
Emergency intake diaphragm (old configuration)	VLV100P	VLV100P
Emergency intake diaphragm (new configuration)	VLV2101M	VLV2101M
Emergency relief diaphragm	DIA1800M	DIA1800M
Exhalation flow sensor	FLS2101P	FLS2101P-C
Exhalation flow sensor board	GR-PCB2103P	SPGR-PCB2103P
Exhalation valve assembly	EXH2105A	SPEXH2105A
External backlight inverter	PT00088808	10156297
Exhalation PSOL regulator	REG1701P	REG1701P

Table B-1. Newport™ e360 Ventilator Spare Parts List (Continued)

Description	Manufacturing part number	Service part number
Exhalation PSOL valve	VLV1806P	SPVLV1806P
Fan filter, EMI	GR-FLT2100P	GR-FLT2100P
Finger guard and filter	GRD1800P	GRD1800P
Fuse – 2A slo-blo	GR-FUS1802Q	GR-FUS1802Q
Heater assembly	GR-HTR2100A	SPGR-HTR2100A
Inside exh. flow cable adult	GR-CBL2124P	GR-CBL2124P
Main board	GR-PCB2100A	GR107021
Module, power entry	FUH1800P	FUH1800P
Optical encoder	GR-ENC1800P	GR-ENC1800P
Oxygen sensor	SEN2103P	SEN2103P
Poppet assembly, exhalation valve	PPT1805A	SPPPT1805A
Power cord, North America	PWR1500P	PWR1500P
Power cord, EU	PWR1500P-EU	PWR1500P-EU
Power cord, Brazil	PWR2103P-BR	PWR2103P-BR
Power sequence board	GR-PCB2107A	GR105705
Power supply board	GR-PCB2101A	SPGR-PCB2101A
Power switch box assembly	SWI1810A	SWI1810A
PSOL valve	10113777	10119162
Regulator, inlet	REG1800P	REG1800P
Reusable filter for bacteria filter heater	4-006308-00	4-006308-00
SBC/GUI, e360 compact flash	CF2105A	SPCF2105A
Seal, poppet, exhalation valve	SEL1800M	SEL1800M
Single-board computer	SBC2105A	SPSBC2105A
Solenoid valve	SOL1501P	SPSOL1501P
Switch, power	SWI1800P	SWI1800P
Switching power supply	PWR2100P	SPPWR2100P
Touch screen controller	PCB2105P (PCB2105P-M for e360T model)	SPPCB2105P (PCB2105P-M for e360T model)
Touch screen panel	GR-PNL2105P	SPGR-PNL2105P
TSI flow sensor, air	GR-FTD2100P	SPGR-FTD2100P

Table B-1. Newport™ e360 Ventilator Spare Parts List (Continued)

Description	Manufacturing part number	Service part number
TSI flow sensor, oxygen	GR-FTD2101P	SPGR-FTD2101P
Venturi valve assembly	VLV1806A	SPVLV1806A
Water trap filter 1/4 in. NPT	WTR1800P	WTR1800P
Water trap 1/4 in. filter autodrain	WTR2103P	WTR2103P

Table B-2. Newport™ e360 Ventilator Field Service Kits

Description	Part number
e360 analog board w/ freescale field service kit	GR107036
e360 SBC internal battery upgrade kit	FSK2132A
e360 tubing field service kit	FSK2108A
e360T TST 8.3 software option upgrade kit	10142411
e360 UNV 8.3 software option upgrade kit	10142415
Element & o-ring kit for water trap WTR2103P	KIT2103P
Field service kit, emergency intake valve, e360 standard	FSK2103A
Field service kit, e360 SPSBC2105A	FSK2110A
Field service kit, e360T SPSBC2105A	FSK2111A
JAR filter kit (oxygen and air for older models)	JFK100P
Large water trap filter kit	FSK2106A
Regulator rebuild kit	RRK1800M

B.2 Contact Technical Support

If you need emergency technical support after business hours, please call and leave your name, phone number, and a detailed message in the voicemail. Our Technical Service team members will be paged and return your call shortly.

Refer to [Contact Information](#) on page 1-8.

B.3 Return Ventilator for Repair

To return your ventilator for repair, perform the following steps:

1. Obtain a returned goods authorization (RGA) number from the Technical Service Department at the numbers provided in [Contact Information](#). The RGA number helps to identify your repair and avoid service delays.
2. Unless instructed to do otherwise, remove all accessories from the ventilator except the inlet water traps. Do not send accessories to Covidien.
3. Package the ventilator in the original packing material, if available. If the original packing material is not available, call the Customer Service Department to order a replacement box. Package parts or accessories (if requested) for safe shipping (original packing materials are not required).

B.4 Submit a Product Complaint

If your ventilator is not functioning properly (malfunctions) or a part of your ventilator is defective, a product complaint report is required before any warranty replacement is authorized or an RGA number is issued. To submit a product complaint report, go to www.ventilators.com and click on Customer Support >Complaint Report. Fill out the form completely with as much detail as possible and submit it. A Technical Service team member will review your product complaint and contact you shortly to resolve the issues.

The product complaint report can also be used to request an RGA number for other returns or offer a product improvement suggestion.

Alternatively, you may submit a product complaint report by calling the Technical Service Department. Refer to [Contact Information](#) on page [1-8](#).

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C Diagrams

These are placeholder pages for the block and pneumatic diagrams. Insert the pages from the foldout pages file (e360_SVC_Ch9_ApxC.fm or PT00096056B00_AppC.pdf) in place of these pages.

The specific figures that appear on each page are listed below.

Figure C-1. Newport™ e360 Ventilator Electrical Block Diagram

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Figure C-2. Newport™ e360 Ventilator Pneumatic Diagram (SPD2100A)

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