

Puritan Bennett™

980 Series Ventilator



Puritan Bennett™ 980 Series Ventilator Service Manual

Rx
ONLY

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Symbols



This device is for sale by or on the order of a physician



Manufacturer—Ventilator manufacturer

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1. Puritan Bennett™ 980 Series Ventilator Service Manual

1.1. Overview

This manual contains information for servicing the Puritan Bennett™ 980 Series Ventilator. Before servicing the ventilator, thoroughly read both the operator's manual and service manual.

Contact Technical Services for any faults or diagnostic codes not listed in this manual, or for any repairs that cannot be completed by following the steps described in the document.

1.2. Intended Audience

This manual provides information to Covidien trained service technicians for maintenance and service or repair of the ventilator. Field service of the ventilator is limited to the service activities described in this manual.

1.3. Document Conventions

- Items shown in **bold** font are contained as entries in the glossary.
- Alarms are shown in ALL CAPITAL letters.

1.4. Obtaining Technical Assistance

For technical information and assistance or to order parts, contact Technical Services at +1 800 255 6774 or call a local technical representative. Reference the following table for service centers in the USA and other countries.

If unable to correct a problem while using the ventilator, contact Technical Services at +1 800 255 6774 or a local technical representative.

When calling Technical Services, or a local technical representative, have the BDU and GUI serial numbers available, as well as the firmware version number of the ventilator system.

The ventilator's configuration is available by touching the wrench icon on the GUI screen. Have this information available whenever requesting technical assistance.

See [Table 1](#) for Service Centers, addresses, telephone, and fax numbers:

Table 1. US and International Service Centers, by Region

US and International Service Centers			
Medtronic Service & Repair C-Mill Jan Campertstraat 21A, Building K Heerlen, 6416 SG The Netherlands			
EMEA	Medtronic Austria GmbH [T] 01 20609 1143 [F] 01 20609 2457 rs.customercareserviceandre-pairaustria@medtronic.com	Medtronic Belgium [T] 0220 08260 [F] 0270 06690 techservices.csBelgium@medtronic.com	Medtronic Czech Republic rs.servicerepairczech@medtronic.com
	Medtronic Danmark A/S [T] +45 43 68 21 71 [F] +45 43 31 48 99 rs.customercareserviceandre-pairdenmark@medtronic.com	Medtronic Deutschland GmbH [T] +49 6951709670 [F] +49 69299571608 rs.customercareserviceandre-pairgermany@medtronic.com	Medtronic Finland OY [T] +358 972519288 [F] +358 972522072 rs.customercareserviceandre-pairfinland@medtronic.com
	Medtronic France SAS [T] +33 151 323 510 [F] +33 157 327 010 rs.customercareserviceandre-pairfrance@medtronic.com	Medtronic Hungary rs.servicerepairhungary@medtronic.com	Medtronic Ireland [T] +353 0 1 4073173 [F] +353 0 1 9075668 rs.customercareserviceandre-paireireland@medtronic.com
	Medtronic Israel [T] +972 4 6309423 [F] +97 2774704093 service.repair.israel@medtronic.com	Medtronic Italia S.p.A [T] +39 02 91 483320 [F] +39 02 91 294863 rs.customercareserviceandre-pairitaly@medtronic.com	Medtronic Kingdom of Saudi Arabia rs.servicerepairsaudi@medtronic.com
	Medtronic Norge AS [T] +47 24159887 [F] +47 23024955 rs.customercareserviceandre-pairnorway@medtronic.com	Medtronic Polska [T] +48 223060034 [F] +48 223060853 rs.customercareserviceandre-pairpoland@medtronic.com	Medtronic Portugal Lda. [T] +351 21 761 62 44 [F] +351 800 781385 rs.customercareserviceandre-pairportugal@medtronic.com
	Medtronic Romania rs.servicerepairromania@medtronic.com	Medtronic Russia [T] +7 495 139 7337 [F] +7 495 580 7378 service.repair.russia@medtronic.com	Medtronic Medikal Teknoloji Ticaret Ltd. Şti. [T] +90 212 6223 500 [F] +90 212 6720 722 service.repair.turkey@medtronic.com
	Medtronic Slovakia rs.servicerepairslovakia@medtronic.com	Medtronic South Africa [T] +27 11 542 9584 [F] +27 86 604 8360 service.repair.southafrica@medtronic.com	Medtronic Spain S.L. [T] +34 91 275 48 54 [F] +34 91 276 89 33 rs.customercareserviceandre-pairspain@medtronic.com
EMEA (continued)	Medtronic Sverige AB [T] +46 8517 61573 [F] +46 8502 52110 rs.customercareserviceandre-pairsweden@medtronic.com	Medtronic Switzerland [F] +41 44 511 16 34 rs.customercareserviceandre-pairswitzerland@medtronic.com	Medtronic UK [T] +44 0 2030271757 [F] +44 0 2036848869 rs.customercareserviceandre-pairuk@medtronic.com

Table 1. US and International Service Centers, by Region (continued)

US and International Service Centers			
Central America And Puerto Rico	Covidien Puerto Rico Palmas Industrial Park Road 869 Km 2.0 Bdlg. #1 Cataño, PR 00962 [T] 787-993-7250 Ext. 7222 & 7221 [F] 787-993-7234 Email: Ivonne.perez@medtronic.com	Covidien Panama Parque Industrial Costa del Esta Calle Primera, Edificio # 109 Panama City, Panama [T] (507) 264-7337 [F] (507) 236-7408 Email: aisha.reina@medtronic.com	Covidien Costa Rica Global Park, Parkway 50 La Aurora de Heredia Costa Rica [T] 506 2239 5386 [F] 506 2239 5319 Email: Christopher.corella@medtronic.com
	Medtronic Mexico Insurgentes Sur # 863, Piso 16 Col. Nápoles Del. Benito Juarez Mexico, D.F. 03810 Mexico [T] 5255 5804 1524 [F] 5255 5536 1326 E-mail: dl.serviciotecnico-mexicity@ medtronic.com		
North and South America	Covidien Argentina Aguero 351 Capital Federal - 1171 ABC, Argentina [T] 5411 4863 5300 [F] 5411 4863-4142	Covidien Brazil Av. Das Nações Undias 12995 Andar 23 - Brooklin São Paulo, SP Brasil 04578-000 [T] 5511 2187 6200 [F] 5511 2187 6380 Email: suporte@covidien.com	Medtronic Canada 99 Hereford St Brampton, ON L6Y 0R3 Canada [T] 888-879-0977 Option 2 for Technical Service
	Covidien Chile Camino lo Boza (Ex 8395) Puduhuel Santiago Chile [T] +562 739 3000 [F] +562 783 3149	Covidien Colombia Edificio Prados de la Morea Carretera Central Del Norte (Cra 7a)Kilometro 18, Chia-Cundinamarca Bogota, Colombia [T] +571 619 5469 [F] +571 619 5425	Covidien USA 2101 Faraday Ave Carlsbad, CA 92008 [T] +1 800 255 6774 (option 4) VentTechSupport@ covidien.com

Table 1. US and International Service Centers, by Region (continued)

US and International Service Centers			
Asia Pacific	Covidien Asia Singapore Regional Service Centre 15 Pioneer Hub, #06-04 Singapore 627753 [T] +65 6578 5288 [F] +65 6515 5260	Medtronic Australia Technical Services 52A Huntingwood Drive Huntingwood, NSW 2148 Australia [T] 1 800 336 693 rs.anzserviceandrepairs@medtronic.com	Covidien China 2F, Tyco Plaza 99 Tian Zhou Rd Shang Hai 200233 P.R. China [T] +86 4008 1886 86 [F] +86 2154 4511 18
	Covidien Hong Kong Unit 12 - 16, 18/F BEA Tower Millennium City 5 4187 Kwun Tong Road Kwum Tong, Kowloon, Hong Kong [T] +852 3157 7299 [F] +852 2838 0749	Covidien India SAS Tower, 4th Floor, Sector-38 Adjacent to Medanta Hospital Gurgaon, Haryana, India, 122001 [T] +91-124-4709800; [T] +18001029800 [F] +91-124-4206850	Covidien India 10th Floor Building No 9B DLF Cyber City Phase III Gurgaon Haryana - 122002 India [T] +91 1244 709800 [F] +91 1244 206850
	Covidien Japan Inc. Technical Support Center 83-1, Takashimadaira 1-Chome Itabashi-ku, Tokyo 175-0082 Japan [T] +81 0 3 6859 0120 [F] +81 0 3 6859 0142	Covidien Korea 5F, Hibrand Living Gwan, #215, Yangjae-Dong, Seocho-Gu Seoul, Korea [T] +822 570 5459 [F] +822 570 5499	Covidien Malaysia B-23-1, Level 23, The Ascent, Paradigm, No.1, Jalan SS7/26A, Kelana Jaya, Petaling Jaya, Selangor Darul Ehsan, Malaysia, 47301 [T] 1 800 22 2911
	Covidien New Zealand Cnr Manu Tapu Dr & Joseph Hammond Pl. Auckland Airport New Zealand [T] + 64 508 489 264	Covidien Taiwan 2F.,No.2,sec. 1, Dunhua S. Rd.,Songshan Dist., Taipei City 105,Taiwan R.O.C. [T] +886 2 218-36000 [F] +886 2 2752-3688	Covidien Thailand 319 Chamchuri Square 17th Floor, Unit 1-8, Phayathai Road Pathumwan, Bangkok 10330, Thailand [T] +66 2 207 3 100 [F] +66 2 207 3 101

1.5. Safety Term Definitions

This section contains safety information for users, who should always exercise appropriate caution while using the ventilator.

Table 2. Safety Term Definitions

Safety Term	Definition
Warning	Warnings alert users to potential serious outcomes (death, injury, or adverse events) to the patient, user, or environment.
Caution	Cautions alert users to exercise appropriate care for safe and effective use of the product.
Note	Notes provide additional guidelines or information.

1.6. Warnings

Warning: Only qualified personnel trained in the maintenance of this ventilator may service the ventilator, its components, or its accessories.

Warning: To avoid an electrical shock hazard, remove all power to the ventilator: disconnect from the AC power source, remove all batteries, and turn off all ventilator power switches prior to servicing the ventilator. Follow accepted safety practices for electrical equipment when testing or making equipment adjustments or repairs.

Warning: To prevent potential injury, refrain from contact with hot surfaces inside the ventilator.

Warning: Ensure that the circuit being used does not have a pressure relief valve anywhere between the ventilator and the patient as this may prevent the ventilator alarms from working properly.

Warning: To prevent injury or death, before entering Service mode, ensure that a patient is not connected to the ventilator. Ventilatory support is not available in Service mode.

Warning: To avoid injury, do not clean components in the inspiratory gas pathway. Clean components in the expiratory gas pathway according to the methods described in the Puritan Bennett™ 980 Series Ventilator Operator's Manual. Ensure that the gas supply is dry.

Warning: To minimize potential injury, use applicable personal protective equipment prior to servicing the ventilator.

Warning: The LCD panel contains toxic chemicals. Do not touch broken LCD panels. Physical contact with a broken LCD panel can result in transmission or ingestion of toxic substances.

Warning: Do not allow liquid or sprays to penetrate the ventilator or cable connections. Unless otherwise specified, the ventilator or its components should never be immersed in any liquid, and any pooled liquid on the device should be wiped away to prevent ingress into the ventilator.

Warning: Observe all applicable local governing ordinances and recycling regulations when disposing of the ventilator, battery and any of its components.

Warning: If the ventilator fails an electrical safety test, an electrocution hazard may exist. Do not proceed to the next electrical safety test without correcting the problem and retesting the ventilator.

Warning: To avoid oxygen hazards, adhere to the standards of the institution for good oxygen hazard practices. This includes, but is not limited to, the following list:

- Use only oxygen-compatible lubricants.
- Ensure a sparing application of oxygen-compatible lubricants.

Warning: To prevent potential injury, lock the front casters prior to working on the ventilator. To prevent potential tipping, do not push the ventilator with locked casters.

1.7. Cautions

Caution: To avoid the possibility of damage to ventilator components or interrupted ventilator operation, always service the ventilator on a level surface in its upright orientation.

Caution: To prevent damage to electrostatic discharge ESD-sensitive components, always follow your institution's ESD guidelines when servicing the ventilator.

Caution: Lock the ventilator casters to prevent inadvertent movement of the ventilator during routine maintenance or when ventilator is on an incline.

Caution: Use only the cleaning agents specified in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.

Caution: To prevent internal damage to ventilator components, do not soak or spray any portion of the ventilator with solvent, alcohol, or any other cleaning agent.

Caution: When replacing the air and oxygen filter bowls and filter elements, hand-tighten to avoid damage.

1.8. Notes

Note: Federal law (U.S.A.) restricts the sale of this device except by or on the order of a physician.

Note: For a comprehensive list of warnings, cautions, and notes, see Chapter 1 of the Puritan Bennett™ 980 Series Ventilator Operator's Manual.

1.9. Electrostatic Discharge (ESD) Control

Follow ESD controls and precautions whenever performing repairs on the ventilator to prevent ESD damage to the static-sensitive microelectronic components and assemblies in the ventilator.

Electrostatic discharge can permanently damage static-sensitive microelectronic components or assemblies during handling, even without direct contact to the component or assembly. ESD damage might show up at a later time. It can manifest as a premature catastrophic failure of a component or assembly, or as an intermittent failure, all of which can be difficult and costly to locate.

- Use a static-dissipative system. Before opening the ventilator or removing its panels, always wear ESD protection. Properly connect the static-dissipative mat to a reliable ground.
- Follow correct procedures when using a static-dissipative mat. Place tools, test equipment, and the static-sensitive device on the static-dissipative mat before starting repairs. Conduct all work on the static-dissipative mat.
- Keep non-conducting materials away from the work area. Static charges from non-conducting material, (i.e. plastic containers, foam cups, synthetic clothing, cellophane tape, etc.) cannot be removed by grounding. These items must be kept away from the work area when handling static-sensitive devices.
- Handle static-sensitive components properly. Do not handle static-sensitive component connection points, connector pins, leads, or terminals.
- Follow correct procedures when using static-shielding bags. Store and transport all static-sensitive devices in static-shielding bags at all times. Never place more than one static-sensitive device in a static-shielding bag. Never place static-generating non-conducting material inside a static-shielding bag with a static-sensitive device. Place

any static-sensitive device in a static-shielding bag immediately after removal. Close the bag to ensure the shield is effective.

2. Self Tests

The ventilator has two self tests requiring operator intervention: short self test (SST) and extended self test (EST). SST calculates the ventilator breathing system (VBS) components' resistance and compliance values, and checks for leaks in the system. EST is designed to verify the ventilator's operational subsystem integrity. All required software to perform EST is resident on the ventilator. Inadequate air and oxygen gas sources, leaks, and occlusions are common sources of false failures. Always use known good test equipment for troubleshooting SST (good EVQ, exhalation bacteria filter, patient circuit and filter set) and EST (good EVQ, exhalation bacteria filter, and gold standard tube). If SST continues to fail, run EST to troubleshoot the system.

2.1. Self Test Prerequisites

Follow all identified guidelines when performing either self test. Inspect all equipment required for any self test to ensure it is not damaged in any way.

1. Collect all required equipment prior to performing any self test of the ventilator. Successful self test is not possible without the use of the equipment listed under each test.
2. Always disconnect the ventilator from the patient.
3. Connect the ventilator to AC power using the hospital-grade power cord.
4. Ensure both air and oxygen sources register pressure between 241 kPa and 599 kPa (35 psi and 87 psi).

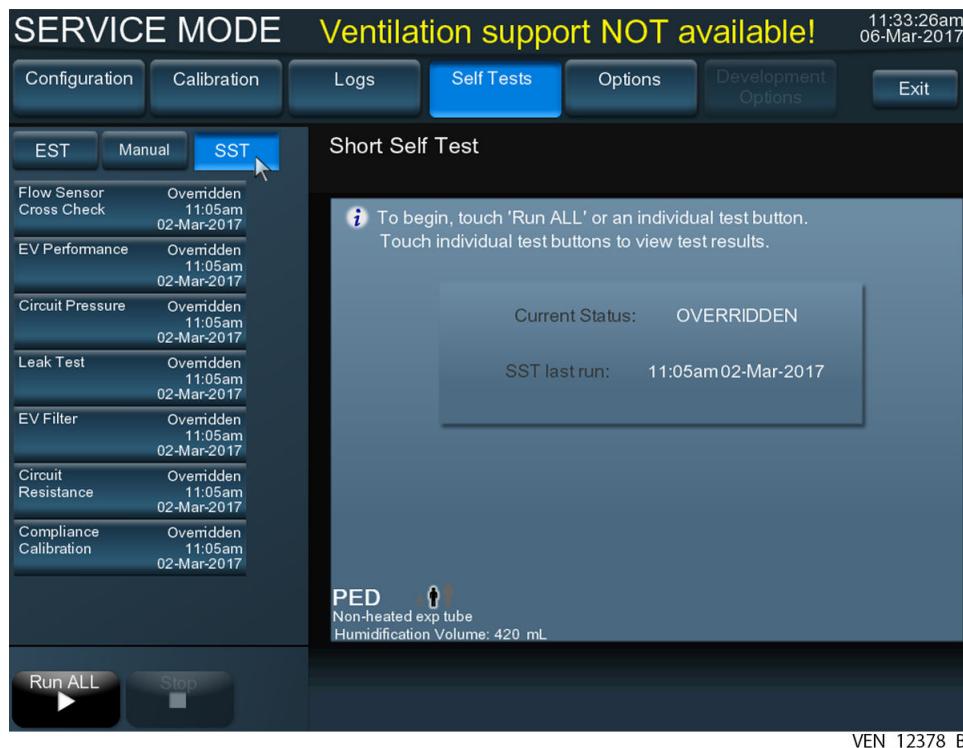
2.2. To perform SST

1. Review and perform all self test prerequisites. See [Table 18, page 69](#) if any repairs are required after SST or EST.
2. Collect the appropriate equipment. See [Equipment for SST, page 20](#).

Note: If the ventilator has not reached normal operating temperature from recent usage, allow it to warm up for at least 15 minutes in Service mode prior to running SST to ensure accurate testing.

3. Enter Service mode. See the Service Mode section in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
4. Connect air and oxygen to the appropriate inlets.
5. Verify that all calibration tests under the Calibration tab have passed.
6. Touch the Self Test tab ([Figure 1](#)).
7. Ensure that the patient wye is unblocked.
8. Touch SST.

Figure 1. Self Tests Menu: SST



9. For service troubleshooting, select HME.

Note: To ensure accurate circuit resistance measurement, ensure that the circuit is not obstructed and is properly connected to the ventilator.

10. Follow additional on-screen prompts to run SST. See the diagnostic codes in [Table 12, page 33](#) and [Table 13, page 44](#) for a description of results and suggested responses to outcomes or if an SST test fails.

Note: Errors are found in the ventilator's EST/SST Diagnostic Log.

2.3. SST Test Steps

Table 3. SST Test Steps

SS test	Function
Flow Sensor Cross Check	Tests O ₂ and Air Flow Sensors.
Exhalation Valve (EV) Performance	Tests the exhalation valve.
Circuit Pressure	Exercises delivery PSOL. Checks inspiratory and expiratory auto-zero solenoids. Cross-checks inspiratory and expiratory pressure transducers at various pressures.
Leak Test	Displays drop in circuit pressure in 10 s. Determines ability of circuit to hold pressure.
Exhalation Valve (EV) Filter	Checks for exhalation filter occlusion.
Circuit Resistance	Checks for inspiratory and expiratory limb occlusions, and calculates and stores the inspiratory and expiratory limb resistance parameters.

Table 3. SST Test Steps (continued)

SS test	Function
Compliance Calibration	Calculates the attached patient circuit compliance.
Proximal Flow Subsystem Test (Prox SST) ^a (when installed)	Verifies functionality of Proximal Flow subsystem.

^a A failure of this test does not prevent return to normal ventilation.

2.4. Short Self Test (SST)

SST verifies that the ventilator is ready for clinical use. All tests must run in sequence using the Run ALL SST button without interruption and successfully complete without any failures.

SST is a short and simple sequence of tests that takes about 5 minutes and verifies proper operation of breath delivery hardware (including pressure and flow sensors), checks the patient circuit (including tubing, humidification device, and filters) for leaks, and measures the circuit compliance and resistance. SST also checks the resistance of the exhalation filter. SST, in normal mode, can only be performed at start up, prior to initiation of ventilation.

Perform SST during any of the listed circumstances.

- Every 15 days
- With each new patient and between patients
- When changing the patient circuit configuration:
 - Changing the humidifier type
 - Adding or removing an in-line water trap
 - Using a different type or style of patient circuit
 - Installing a new or sterilized exhalation filter
- Following ventilator service or repair

The ventilator does not allow access to SST if it senses that a patient is connected.

During SST, the ventilator displays the current SST status, including the test currently in progress, results of completed tests, and measured data (where applicable). The ventilator logs SST results, and that information is available following a power failure. The ventilator disables several off-screen keys located on the bezel of the GUI during SST.

-  Audio paused¹
-  Alarm reset
-  Manual inspiration

¹ The terms "audio paused" and "alarm silence" are interchangeable.

-  Inspiratory pause

-  Expiratory pause

2.4.1. Equipment for SST

1. Collect the appropriate equipment required to run SST.
 - Patient circuit used for patient ventilation
 - Accessories (water traps, etc.)
 - Applicable exhalation filter and condensate vial for the selected SST circuit type
 - Humidifier, if applicable
2. Collect all other necessary items.
 - A stopper (number 1) to block the patient airway at the patient wye
 - Two gas sources (air and oxygen) connected to the ventilator) at a pressure between 241.3 kPa and 599.8 kPa (35 psi and 87 psi).

Note: If using Air Liquide™*, Dräger™*, and SIS air/oxygen hose assemblies, certain SST tests may fail when using supply pressures less than 345 kPa (50 psi), based on excessive hose restriction.

2.4.2. SST Sequence

For troubleshooting purposes, perform SST tests in any order desired. Prior to returning the ventilator to clinical use, however, all tests must be run in the order described without interruption by using Run ALL. All tests must complete with no failures. The service technician may choose to override an Alert under certain circumstances.

2.4.3. SST Results

SST reports results for each individual test.

Table 4. SST Test Step Results

Test Status	Meaning	Response
Pass	Individual SST test passed.	No need to do anything, unless prompted by the ventilator.
Alert	The test result is not ideal, but is not critical. If SST is in progress, it halts further testing and prompts for decision.	When the system prompts, select: Repeat Test, Next Test ^a , Exit SST.
Failed	The ventilator has detected a critical problem and SST cannot complete until the ventilator passes the failed test.	Eliminate leaks in the ventilator breathing system and re-run SST. Otherwise, service the ventilator and re-run SST.

^a **WARNING-** Completing SST with an Alert status for an individual test produces an Override SST button. Choose to override the Alert status and authorize ventilation only when absolutely certain this cannot create a patient hazard or add to risks arising from other hazards. To override the Alert, touch Override SST, then touch Accept.

2.4.4. SST Outcomes

When SST completes all tests, analyze and respond to the final SST outcome.

Table 5. Overall SST Outcomes

Test Status	Meaning	Response
PASS	All SST tests passed.	Touch Patient Setup to set up the patient for ventilation.
OVERRIDDEN	The ventilator detected one or more faults. Choose to override the Alert status and authorize ventilation only when absolutely certain this cannot create a patient hazard or add to risks arising from other hazards.	Check the patient circuit to determine the problem or restart SST with a different patient circuit. Troubleshoot per Table 12 and Table 13 .
FAIL	One or more critical faults were detected. The ventilator enters the SVO state and cannot be used for normal ventilation until SST passes.	Check the patient circuit to determine the problem or restart SST with a different patient circuit. Troubleshoot per Table 12 and Table 13 .

Selecting Override SST results in the following warning:

Warning: Choose to override the Alert status and authorize ventilation only when absolutely certain this decision cannot create a patient hazard or add to risks arising from other hazards.

A single circuit-leak test can be run, without changing the SST outcome.

If a complete SST is interrupted and ventilation was allowed before starting SST, normal ventilation is allowed if all of the following conditions are met:

- SST did not detect any failures or alerts before the interruption
- No other errors that would prevent ventilation occurred
- There were no changes to the circuit type at the start of the interrupted SST

During SST, the ventilator displays the current SST status, including the test currently in progress, and results of completed tests. The ventilator logs SST results, and that information persists following a power loss.

2.5. Extended Self Test (EST)

EST is an extensive sequence of tests that detect any system faults and verify the integrity of the ventilator's subsystems. All tests must run in sequence by touching the Run ALL button without interruption and successfully complete without any failures.

EST is a more thorough test than SST, and is designed to detect system faults. EST also checks ventilator subsystems including memory, safety system, front panel controls and indicators, digital and analog electronics, power supplies, transducers, and the ventilator's primary battery. EST testing takes about 15 minutes.

EST is required following any service listed in [Table 17](#) and [Table 18](#). The tables indicate the order in which to perform EST.

During EST, the ventilator displays current EST status, including the test currently in progress, results of completed tests, and measured data (where applicable). The ventilator logs EST results, and that information persists following power loss.

The ventilator disables several off-screen keys located on the bezel of the GUI during EST.

-  Audio paused
-  Alarm reset
-  Manual inspiration
-  Inspiratory pause
-  Expiratory pause

EST requires operator participation. The ventilator records EST results in the EST/SST Diagnostic Log.

Equipment for EST

- Covidien gold standard test circuit
- A number 1 stopper to block the circuit or internal filter
- Air and oxygen sources, both at 241kPa to 599 kPa (35 psi to 87 psi)
- An adult/pediatric exhalation filter

Note: To avoid failing the battery test in EST, ensure that batteries have at least 90% remaining capacity prior to running EST, as indicated on the ventilator's status display. To charge the battery, simply connect the ventilator to adequate AC power.

Note: Always perform EST with an adult exhalation filter installed. Attempts to run EST with a NeoMode filter can cause some EST tests to fail.

Note: If using Air Liquide™*, Dräger™*, and SIS air and oxygen hose assemblies, certain EST tests may fail when using supply pressures less than 345 kPa (50 psi), based on excessive hose restriction.

EST Sequence

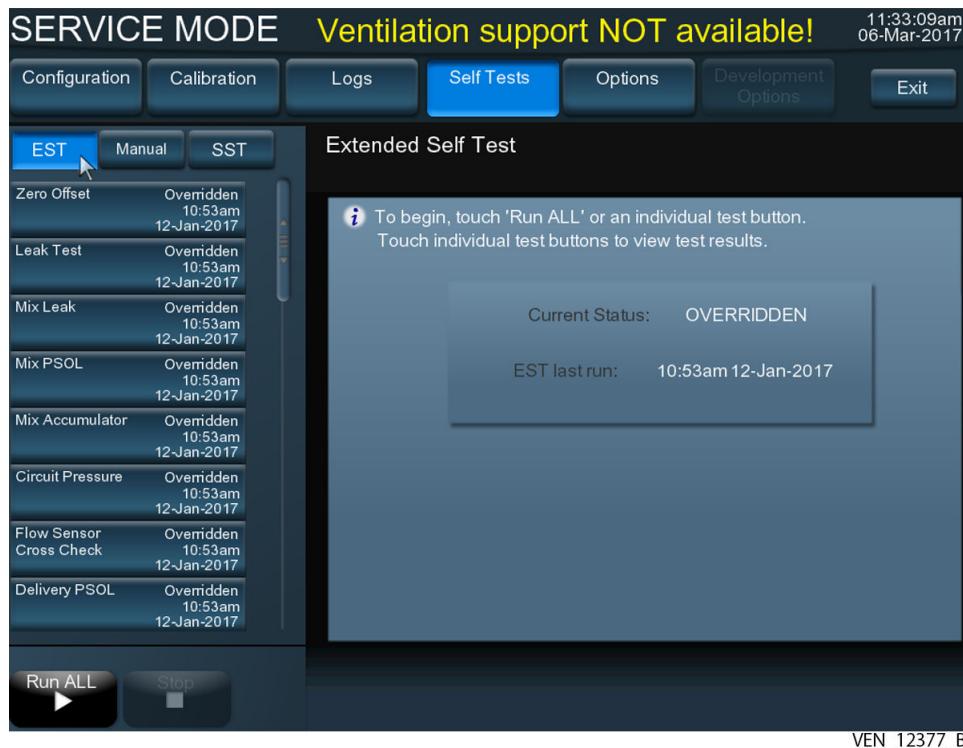
During troubleshooting, you may run tests either as a group or as single tests. Prior to returning the ventilator to clinical use, however, all tests must be run in the order described without interruption by using the Run ALL button. All tests must complete with no failures.

To perform EST

1. Review and perform all self test prerequisites. See [Table 18](#) if any repairs are required after SST or EST.
2. Collect the appropriate equipment. See Equipment for EST.
3. Enter Service mode. See section 3.7.4 in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
4. Verify all calibration tests under the Calibration tab have passed.
5. Connect air and oxygen to the appropriate inlets.

6. Touch the Self Test tab from the horizontal banner at the top of the GUI (Figure 2).
7. Touch the EST tab from the left-hand menu options.

Figure 2. Self Tests Menu: EST



8. Touch Run ALL to run all tests in sequence or select the desired individual test.
9. Touch Accept.
10. Follow the prompts to complete EST. The EST tests require operator intervention, and will pause indefinitely for a response. See [Table 6](#) for a list of the EST tests.
11. Test results post by the respective listed test. See the diagnostic codes in [Table 14](#) and [Table 15](#) for a description of results and suggested responses to outcomes or if an EST test fails.
12. Exit Service mode by turning off the ventilator.

[Table 6. EST Tests](#)

EST test step	Function
Zero Offset	Tests inspiratory and expiratory pressure transducers and flow sensors at ambient pressure.
Leak Test	Determines ability of system to hold pressure, checking for system leaks.
Mix Leak	Verifies integrity of the mix system and leaks are within the specified allowable limits.
Mix PSOL	Verifies mix PSOL liftoff current is within range.
Mix Accumulator	Verifies mix accumulator pressure sensor and overpressure switch function.
Circuit Pressure	Checks inspiratory and expiratory offsets using the autozero solenoids, cross-checks safety valve, inspiratory and expiratory pressure transducers at various pressures. Verifies the auto-zero solenoids function.
Flow Sensor Cross Check	Verifies all flow sensors and PSOLs at specified gas flow volumes and performs delivery PSOL liftoff calibration.
Delivery PSOL	Verifies delivery PSOL current sensor and commanded PSOL current.

Table 6. EST Tests (continued)

EST test step	Function
Exhalation Valve (EV) Loopback	Verifies exhalation valve current and loopback current are within a maximum range from each other.
Exhalation Valve (EV) Pressure Accuracy	Verifies exhalation valve seal and poppet friction are acceptable.
Exhalation Valve (EV) Performance	Verifies current versus pressure values in flash memory correspond with actual installed exhalation valve.
Exhalation Valve (EV) Velocity Transducer	Verifies the velocity transducer is sending a signal and the control circuit recognizes it. It does not verify the quality of the signal.
Safety System	Tests safety valve operation.
Backup Ventilation	Verifies backup ventilation systems: mix, inspiratory, and exhalation.
Communication	Verifies GUI communication ports function, both serial and Ethernet.
Internal Storage	Verifies internal storage device function.
Status Display	Verifies status display and LCD function, as well as communicating with the BD CPU, power distribution module, and compressor, if installed.
GUI Audio	Tests GUI visual and audio alarm indicators, cycling through each alarm status indication.
BD Audio	Verifies BD audio alarm is functional. Also verifies power fail capacitor can operate loss-of-power alarm.
Rotary Knob Test	Verifies knob rotation function.
Off-screen Key Test	Verifies GUI off-screen keys function, both by contact with each icon and by viewing the backlight.
Ventilator Battery	Tests ventilator battery and power distribution temperature, voltage, and additional functional tests.
Run only if DC compressor installed	
Compressor Battery	Tests compressor battery function, as well as compressor power system and fan function.
Compressor	Verifies overall compressor operation: pressure transducer, fan, motor, and pressure relief valve. Cross-checks pressure transducer against the air inlet pressure transducer.
Compressor Leak	Checks compressor system for leaks.
Compressor Performance	Tests compressor operational performance under load.

2.5.1. EST Results

EST reports results for each individual test.

Table 7. EST Test Step Results

Test status	Meaning	Response
Pass	Individual EST test passed	No need to do anything, unless prompted by the ventilator.
ALERT	The test result is not ideal, but is not critical. If EST is in progress, it halts further testing and prompts for decision.	When the system prompts, select: Repeat Test, Next Test, or Stop, then press ACCEPT.

Table 7. EST Test Step Results (continued)

Test status	Meaning	Response
Failed	EST not successfully passed.	Select: REPEAT TEST, NEXT TEST, or STOP, then press ACCEPT.
NEVER RUN	Test still requires successful Pass.	Run all EST tests.

2.5.2. EST Outcomes

When EST completes all tests, analyze and respond to the final EST outcome.

Table 8. Overall EST Outcomes

Final outcome	Meaning	Response
PASSED	All EST tests passed.	EST successfully completed. Select other Service mode functions or prepare for SST tests prior to returning the ventilator for patient usage.
OVERRIDDEN	ALERT status overridden by the user	Repair the ventilator per Table 14 and Table 15 and rerun EST.
FAIL	One or more critical faults were detected. The ventilator enters the SVO state and cannot be used for normal ventilation until EST passes. Service is required.	Repair the ventilator per Table 14 and Table 15 and rerun EST.

Touching Override EST results in the following warning:

Warning: Choose to override the alert status and authorize ventilation only when absolutely certain this decision cannot create a patient hazard or add to risks arising from other hazards.

3. Diagnostic Codes

The tables in this section contain diagnostic codes. The SST and EST diagnostic codes are found in the EST/SST Diagnostic Log.

The Power-On Self-Test (POST) and Background diagnostic codes are found in the System Diagnostic log.

Note: For any diagnostic code not contained in this document, or for any fault or failure that cannot be resolved by following the recommended corrective actions listed, contact Covidien Technical Services.

To view the diagnostic log

1. Touch the clipboard icon in the constant access icon area of the GUI. The log screen appears with tabs for the various logs.
2. Touch the tab for the desired log.
3. View the diagnostic code.

The diagnostic codes tables provide details regarding a particular code. Use the tables to determine the corrective action for a particular diagnostic code.

Note: Contact a local technical representative for any part replacement designated as (Covidien only).

Note: The second and third column headings in [Table 12, page 33](#) and [Table 14, page 45](#) are labeled using the same language as columns two and four of the ventilator's diagnostic log screens.

Note: If all the codes in [Table 11](#) appear together, replace the DC to DC convertor board.

3.1. POST and Background Diagnostic Codes

Every time the ventilator is powered on or resets and at the beginning of short self test (SST) and extended self test (EST), it performs power on self test (POST). POST checks the integrity of the GUI and breath delivery subsystems and communication channels without operator intervention. If POST detects a fault, the ventilator will attempt to log an entry to the system diagnostic log.

Additionally, the ventilator has an extensive system of continuous testing. If an error is detected in the background diagnostic system, at a minimum, the ventilator notifies the operator by posting an entry in the system diagnostic log

For all POST and background codes expect those listed in the tables below, run EST to troubleshoot. If the POST error is catastrophic and you cannot run EST, contact a local technical representative to replace the applicable CPU PCBA.

After any corrective action, reference [Table 18, page 69](#) for testing required for the specific repair performed. If any corrective action requires a part replacement listed in [Field Service Parts Replacement List, page 71](#), contact a local technical representative.

Note: If the diagnostic code description states a condition has been resumed, cleared or reset, no action is required.

Note: For battery troubleshooting guidelines and replacement, refer to the PB980 operator's manual.

Note: [Table 11, page 32](#) presents the correction action for a specific set of diagnostic codes.

Table 9. POST Diagnostic Codes

Code	Test/Event/Message displayed on ventilator	Corrective action																						
LP0125	Primary battery not installed	<ul style="list-style-type: none"> Insert primary battery. Power cycle ventilator. Check battery connection pin to ensure battery is properly seated. If the condition persists, replace the battery with one that is known to be functional. Replace the battery backplane PCBA. 																						
LP0127	Unable to read the expiratory flow sensor	<ul style="list-style-type: none"> Check exhalation valve flow sensor (EVQ) electrical connections. Restart the ventilator. If condition persists with a properly connected sensor, then run EST. Replace and recalibrate the EVQ. Check the tubing from Exhalation Flow Sensor Filter and its connection to Exhalation Sensor PCBA. 																						
KP0112	Ventilator inoperative test	Run EST, if KP0112 still fails replace BD CPU PCBA.																						
KP0115	DAC test	<ul style="list-style-type: none"> Identify the error sub-system using extended diagnostic code information. DAC Wrap Error: 0x40AABB – DAC Wrap Error, AA is the DAC Wrap Channel Id in Hex BBBB is the value at which it failed <table border="1"> <thead> <tr> <th>AA value</th> <th>Action</th> </tr> </thead> <tbody> <tr> <td>0x4B</td> <td>Replace Pneumatic Interface PCBA.</td> </tr> <tr> <td>0x53</td> <td></td> </tr> <tr> <td>0x57</td> <td></td> </tr> <tr> <td>0x5F</td> <td></td> </tr> <tr> <td>0x6A</td> <td>Replace Exhalation Sensor PCBA.</td> </tr> <tr> <td>0x72</td> <td></td> </tr> <tr> <td>0x2C</td> <td>Replace Mix Controller PCBA.</td> </tr> <tr> <td>0x34</td> <td></td> </tr> <tr> <td>0x3C</td> <td></td> </tr> <tr> <td>0x44</td> <td></td> </tr> </tbody> </table> <p>Example: 0x40440004 0x40 → DAC Wrap Error 44 → Mix DAC 0004 → is the value at which it failed 0004 → is the value at which it failed</p> <ul style="list-style-type: none"> After ensuring all cables and connectors are properly connected. Run complete EST to identify the analog system or part at fault. 	AA value	Action	0x4B	Replace Pneumatic Interface PCBA.	0x53		0x57		0x5F		0x6A	Replace Exhalation Sensor PCBA.	0x72		0x2C	Replace Mix Controller PCBA.	0x34		0x3C		0x44	
AA value	Action																							
0x4B	Replace Pneumatic Interface PCBA.																							
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0x72																								
0x2C	Replace Mix Controller PCBA.																							
0x34																								
0x3C																								
0x44																								

Table 9. POST Diagnostic Codes (continued)

Code	Test/Event/Message displayed on ventilator	Corrective action																		
KP0116	Analog devices test	<ul style="list-style-type: none"> Identify the error sub-system using extended diagnostic code information. Format: 0xTTCCCCCCC 0xTT → Sub test ID CCCCCC → Analog digital channel (See table) <table border="1"> <thead> <tr> <th>Start</th><th>End</th><th>Subsystem</th></tr> </thead> <tbody> <tr> <td>0x000000</td><td>0x000017</td><td>Power Distribution</td></tr> <tr> <td>0x000018</td><td>0x00002B</td><td>Compressor</td></tr> <tr> <td>0x00002C</td><td>0x00004A</td><td>Mix</td></tr> <tr> <td>0x00004B</td><td>0x000066</td><td>Pneumatic interface inspiratory</td></tr> <tr> <td>0x000067</td><td>0x00007A</td><td>Pneumatic interface expiratory</td></tr> </tbody> </table> <p>Example: 0x08000020 0x08 → SubTest Id 000020 Compressor SubSystem</p> <ul style="list-style-type: none"> After ensuring all cables and connectors are properly connected. Run complete EST to identify the analog system or part at fault. 	Start	End	Subsystem	0x000000	0x000017	Power Distribution	0x000018	0x00002B	Compressor	0x00002C	0x00004A	Mix	0x00004B	0x000066	Pneumatic interface inspiratory	0x000067	0x00007A	Pneumatic interface expiratory
Start	End	Subsystem																		
0x000000	0x000017	Power Distribution																		
0x000018	0x00002B	Compressor																		
0x00002C	0x00004A	Mix																		
0x00004B	0x000066	Pneumatic interface inspiratory																		
0x000067	0x00007A	Pneumatic interface expiratory																		
KP0120	Safe state system test	<ul style="list-style-type: none"> Ensure all modules and major subassemblies are properly seated and connected. Run EST. Replace exhalation valve assembly. Replace safety valve. Replace delivery PSOL. Replace delivery flow sensor. Replace Pneumatic Interface PCBA. 																		
KP0132	Power distribution subsystem test	<ul style="list-style-type: none"> Check/reseat the flat ribbon cable between the BD power controller PCBA and BD backplane PCBA. Run EST. Replace BD Power Controller PCBA. Replace DC to DC Converter PCBA. 																		
KP0133	Compressor subsystem test	<ul style="list-style-type: none"> Check compressor circuit breaker. Check compressor batteries. Run EST. Replace compressor Interface PCBA. Replace compressor power controller PCBA. 																		
KP0134	Mix subsystem test	<ul style="list-style-type: none"> Check/reseat all of the inspiratory flow module cables. Run EST. Replace mix controller PCBA. 																		

Table 9. POST Diagnostic Codes (continued)

Code	Test/Event/Message displayed on ventilator	Corrective action
KP0135	Inspiratory subsystem test	<ul style="list-style-type: none"> Run EST. Replace the pneumatic interface PCBA. Replace IFM PCBA.
KP0136	Exhalation Subsystem test	<ul style="list-style-type: none"> Check/reseat the exhalation module interconnect cable that connects to the BDU backplane PCBA. Run EST. Replace Exhalation Sensor PCBA.
XP0097	SAAS self test start	<ul style="list-style-type: none"> If repeatable, check GUI CPU PCBA to UI PCBA cable connections. Replace GUI UI PCBA. Replace GUI CPU PCBA.
KP0013/ XP0013	Watchdog timer test	No action required.

Table 10. Background Diagnostic Codes

Code	Test/Event /Message displayed on the ventilator	Corrective action
LB0002	Exhalation flow OOR	<ul style="list-style-type: none"> Check exhalation valve flow sensor (EVQ). Restart the ventilator. If condition persists with a properly connected sensor, then run EST. Replace and recalibrate EVQ, then run EST.
LB0011	Exhalation flow temp OOR	<ul style="list-style-type: none"> Check the exhalation valve low sensor thermistor. Ensure ventilator has been warmed up at ambient temperature for at least 15 minutes. Run a complete EST. Replace and recalibrate exhalation valve flow sensor, then run EST.
LB0021	Atmospheric pressure OOR	<ul style="list-style-type: none"> Perform atmospheric pressure calibration. Replace IFM PCBA.
LB0022	O2 sensor OOR	<ul style="list-style-type: none"> Replace oxygen sensor. Perform oxygen sensor calibration. Replace IFM PCBA.
LB0039	BD time of day clock failed	Replace the PB980 ventilator coin battery (battery, lithium, coin, 3V).
ZB0040	GUI time of day clock failed	Replace the PB980 ventilator coin battery (battery, lithium, coin, 3V).
LB0052	Loss of GUI communications	<ul style="list-style-type: none"> Check the system diagnostic log for other codes. If no other alert or failure codes are present, no action required. Replace the GUI CPU PCBA. Replace the communications backplane.

Table 10. Background Diagnostic Codes (continued)

Code	Test/Event /Message displayed on the ventilator	Corrective action
ZB0053	Loss of BD communications	<ul style="list-style-type: none"> Check the system diagnostic log for other codes. If no other alert or failure codes are present, no action is required. Replace the BD CPU PCBA. Replace the communications backplane.
ZB0071	GUI drops a waveform packet	No action required.
LB0094	Status display reported errors	<ul style="list-style-type: none"> Power cycle the ventilator. Check cable connections to the status display. Replace BD CPU PCBA.
LB0095	Loss of status display communication	<ul style="list-style-type: none"> Power cycle the ventilator. Check cable connections to the status display. Replace BD CPU PCBA.
LB0115	CO2 sensor fault	<ul style="list-style-type: none"> Check the cable connection to the CO2 sensor and check ventilator settings. Replace the CO2 sensor. Replace the capnostat module. Replace the options host PCBA 1.
LB0116	CO2 sensor zeroing initiated	No action required.
ZB0231	USB operational time error detected	No action required.
LB0232	BD NOVRAM operational time values out of range	Verify and set appropriate operational hours throughout the system for the CPU and the compressor.
LB0234	BD from GUI Operational time values out of range	Verify and set appropriate operational hours throughout the system for the CPU and the compressor.
ZB0235	GUI from BD operational time values out of range	Verify and set appropriate operational hours throughout the system for the CPU and the compressor.
LB0236	Operational times values out of range	Verify and set appropriate operational hours throughout the system for the CPU and the compressor.
LB0090	Mix inlet pressure OOR	Check hospital gas pressure connection.
LB0088	Proximal error	<ul style="list-style-type: none"> Ensure the proximal flow sensor is installed correctly and enabled. Replace the proximal flow sensor. Replace the mercury module on the options host PCBA.
ZB0118	Video lock error	Check UI to BDU backplane interconnect cable connection.
LB0182	High air inlet pressure	Check air input gas supply pressure is less than or equal to 87psi.
LB0183	High O2 inlet pressure	Check oxygen input gas supply pressure is less than or equal to 87psi.
LB0099	Mix air flow OOR	<ul style="list-style-type: none"> Update to the PB980 R7.1 software or later, if not installed. Run EST.
LB0100	Mix O2 flow OOR	<ul style="list-style-type: none"> Update to the PB980 R7.1 software or later, if not installed. Run EST.

Table 10. Background Diagnostic Codes (continued)

Code	Test/Event /Message displayed on the ventilator	Corrective action
ZB0191	Unable to save config files to USB	No action required.
ZB0192	Unable to load config files from USB	No action required.
LB0023	O2 sensor OOR reset	No action required.
ZB0035	Touch screen blocked	No action required.
ZB0036	Touch screen resumed	No action required.
ZB0117	UI board communications error	No action required.
ZB0119	UI heartbeat error	No action required.
ZB0178	Offscreen keys driver event	No action required.
ZB0179	Logs media failure	No action required.
ZB0180	Logs initialization failure	No action required.
ZB0181	Logs transaction failure	No action required.
ZB0191	Unable to save configuration files to USB	No action required.
XB0080	Init loss of BD communication	No action required.
LB0070	Task monitor	No action required.
ZB0103	USB failure	<ul style="list-style-type: none"> • Complete the external ports test in Service mode. • Replace the USB. • Replace the GUI CPU PCBA. • Replace the line interface board.
UXXXXX	Assertion	No action required.
DXXXXX	Assertion	No action required, unless the code reoccurs.

Table 11. Background Diagnostic Code Group

Code	Test/Event /Message displayed on the ventilator
LB0022	O2 sensor OOR
LB0194	Inspiratory 24 V OOR
LB0130	Mix 24 V OOR
LB0126	Mix 5 V OOR
LB0127	Mix 5 V OOR
LB0129	Mix 12 V supply OOR
LB0121	PI 3.3 V scaled OOR
LB0125	PE 3.3 V ref scaled OOR
LB0021	Atmospheric pressure OOR
KB0004	Expiratory motor current OOR

3.2. SST Diagnostic Codes

Inadequate air and oxygen gas sources, leaks, and occlusions are common sources of false failures. Always use known good test equipment for troubleshooting SST (good EVQ, exhalation bacteria filter, patient circuit and filter set) and EST (good EVQ, exhalation

bacteria filter, and gold standard tube). If SST continues to fail, run EST to troubleshoot the system.

Table 12. SST Diagnostic Codes

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AS0022	SST Flow Sensor cross check	No O ₂ connected	Alert	Test: Verifies that oxygen is connected. Alert: No O ₂ supply is connected.	Connect the oxygen supply.
AS0023	SST Flow sensor cross check	No air connected	Alert	Test: Verifies that air is connected. Alert: No air supply is connected.	Connect the air supply.
AS0305	SST Leak	System Leak Alert	Alert	Test: Verifies the system pressure drop over time.	<ol style="list-style-type: none"> 1. Check or replace the exhalation filter. Note: For reusable exhalation filters, verify that the internal o-ring is present and installed correctly. 2. Remove and reseat the exhalation filter seal. 3. Check or reseat the EVQ. 4. Check the F5 filter for occlusions and proper seating. 5. Verify that the exhalation valve diaphragm is not soiled or damaged. 6. Run exhalation valve calibration.
AS0405	SST Exhalation Filter	Occluded expiratory filter	Alert	Test: Calculates pressure drop across the exhalation filter and verifies that the filter is not occluded.	<ol style="list-style-type: none"> 1. Verify that there are no occlusions in the exhalation compartment. 2. Use a known good exhalation filter. 3. Verify that the EVQ diaphragm is not soiled or damaged.
AS0408	SST Exhalation Filter	Occluded expiratory compartment	Alert	Test: Verifies that the pressure drop across the exhalation compartment is within range.	<ol style="list-style-type: none"> 1. Verify that there are no occlusions in the exhalation compartment. 2. Use a known good exhalation filter. 3. Verify that the EVQ diaphragm is not soiled or damaged. 4. Run exhalation valve calibration.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AS0411	SST Exhalation Filter	Low expiratory filter ΔP	Alert	Test: Verifies that the pressure drop across the exhalation compartment is within range.	<ol style="list-style-type: none"> 1. Verify that there are no occlusions in the exhalation compartment. 2. Use a known good exhalation filter. 3. Verify that the EVQ diaphragm is not soiled or damaged.
AS0503	SST Circuit Resistance	Occluded inspiratory limb	Alert	Test: Determines inspiratory limb pressure drop and checks for an occlusion.	<ol style="list-style-type: none"> 1. Use a known good external inspiratory filter. 2. Check the internal inspiratory filter. 3. Check circuit tubing for restrictions.
AS0506	SST Circuit Resistance	Occluded expiratory limb	Alert	Test: Determines expiratory limb pressure drop and checks for an occlusion.	<ol style="list-style-type: none"> 1. Check the expiratory limb for occlusions. 2. Use a known good patient circuit and exhalation filter.
AS0507	SST Circuit Resistance	Unable to reach min peak flow	Alert	Test: Characterizes inspiratory limb resistance over a range of flows using either gas.	<ol style="list-style-type: none"> 1. Ensure that the exhalation limb is connected. 2. Check for leaks in the VBS. 3. Check for kinked or occluded patient tubing. 4. Remove and reseat the exhalation filter seal. 5. Check or reseat the EVQ. 6. Check the F5 filter for occlusions and proper seating. 7. Verify that the EVQ diaphragm is not soiled or damaged. 8. Run exhalation valve calibration.
AS0511	SST Circuit Resistance	Unable to reach min peak flow	Alert	Test: Characterizes total circuit resistance over a range of flows using either gas.	<ol style="list-style-type: none"> 1. Ensure that the exhalation limb is connected. 2. Check for leaks in the VBS. 3. Check for kinked or occluded patient tubing. 4. Remove and reseat the exhalation filter seal. 5. Check or reseat the EVQ. 6. Check the F5 filter for occlusions and proper seating. 7. Verify that the EVQ diaphragm is not soiled or damaged. 8. Run exhalation valve calibration.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AS0513	SST Circuit Resistance	Insp limb resistance low	Alert	Test: Characterizes inspiratory limb resistance over a range of flows using either gas.	Check for leaks in the VBS or for a disconnected circuit.
AS0514	SST Circuit Resistance	Exp limb resistance low	Alert	Test: Characterizes expiratory limb resistance over a range of flows using either gas.	Check for leaks in the VBS or for a disconnected circuit.
AS0605	SST Circuit Compliance	Excessive compliance	Alert	Test: Characterizes the patient circuit for compliance.	<ol style="list-style-type: none"> 1. Ensure that the patient circuit type matches the selected SST patient circuit. 2. Ensure that the drain bag clamp is closed.
AS0607	SST Circuit Compliance	Compliance low	Alert	Test: Characterizes the patient circuit for compliance.	<ol style="list-style-type: none"> 1. Ensure that the inspiratory filter is attached. 2. Verify that there are no leaks or occlusions in the VBS. 3. Use a known good patient circuit. 4. Ensure that the patient circuit type matches the selected SST patient circuit.
AS0609	SST Circuit Compliance	Excessive compliance	Alert	Test: Characterizes the patient circuit for compliance.	Use a known good patient circuit.
AS0611	SST Circuit Compliance	Compliance low	Alert	Test: Characterizes the patient circuit for compliance	<ol style="list-style-type: none"> 1. Ensure that the inspiratory filter is attached. 2. Verify that there are no leaks or occlusions. 3. Use a known good VBS.
AS0700	SST Prox	SST: NOT INSTALLED	Alert	The ventilator did not detect a prox module attached and skipped the test.	N/A
AS0701	SST Prox	Comm. Error	Alert	Test: system recognition	<ol style="list-style-type: none"> 1. Power cycle the ventilator. 2. Reseat the options host PCBA. 3. Replace the proximal flow PCBA (Covidien only).
AS0703	SST Prox	Demo Mode Square Wave Failed	Alert	Test: proximal flow system communications	<ol style="list-style-type: none"> 1. Power cycle the ventilator. 2. Reseat the options host PCBA. 3. Replace the proximal flow PCBA (Covidien only).

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AS0704	SST Prox	P-atm Cross Check Failed	Alert	Test: Measure the ventilator and prox module barometric pressure readings.	<ol style="list-style-type: none"> 1. Calibrate the ventilator's atmospheric pressure transducer. 2. Power cycle the ventilator. 3. Reseat the options host PCBA. 4. Replace the proximal flow PCBA (Covidien only).
AS0705	SST Prox	Autozero and Leak Test Failed	Alert	Test: Checks the pneumatic path for prox functionality. See Table 13, page 44 for details on information or possible causes and corrective actions for this diagnostic code.	See Table 13, page 44 for details on information or possible causes and corrective actions for this diagnostic code.
AS0707	SST Prox	Pressure Cross Check Failed	Alert	Test: Performs a pressure cross check of the proximal flow system. Alert: See Table 13, page 44 for details on information or possible causes and corrective actions for this diagnostic code.	See Table 13, page 44 for details on information or possible causes and corrective actions for this diagnostic code.
AS0708	SST Prox	Flow Sensor Cross Check Failed	Alert	Test: Performs a flow sensor cross check of the proximal flow system.	<ol style="list-style-type: none"> 1. Verify proper proximal flow sensor tubing connection. 2. Verify proper connection between the proximal flow PCBA and the options panel. 3. Replace the proximal flow PCBA (Covidien only). 4. Replace the options host PCBA (Covidien only).
AS0710	SST Prox	Operator Skipped Prox Test	Alert	Test: A proximal flow sensor is connected, but the operator chooses not to run the prox SST.	Run SST with the proximal flow test.
AS0711	SST Prox	Purge Error	Alert	Test: purge procedure	<ol style="list-style-type: none"> 1. Power cycle the ventilator. 2. Reseat the options host PCBA. 3. Replace the proximal flow PCBA (Covidien only).

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AS0712	SST Prox	Purge Error	Alert	Test: purge procedure Alert: Read prox reservoir pressure.	1. Power cycle the ventilator. 2. Reseat the options host PCBA. 3. Replace the proximal flow PCBA (Covidien only).
AS0713	SST Prox	Purge Error	Alert	Test: purge procedure	1. Power cycle the ventilator. 2. Reseat the options host PCBA. 3. Replace the proximal flow PCBA (Covidien only).
AS0714	SST Prox	Purge Error	Alert	Test: purge procedure	1. Power cycle the ventilator. 2. Reseat the options host PCBA. 3. Replace the proximal flow PCBA (Covidien only).
AS0715	SST Prox	Purge Error	Alert	Test: purge procedure	1. Power cycle the ventilator. 2. Reseat the options host PCBA. 3. Replace the proximal flow PCBA (Covidien only).
AS0805	SST Leak	System Leak Alert	Alert	Test: Check for leaks.	Verify that there are no leaks or occlusions.
FS0001	SST Flow Sensor Cross Check	Unable to establish stable flow	Failure	Test: flow stability	1. Verify that adequate source gas is present. Note: May view BDU status display in Service mode to verify a stable gas input. 2. Verify that there are no leaks in the patient circuit.
FS0002	SST Flow Sensor Cross Check	Inspiratory flow sensor OOR	Failure	Test: flow accuracy	Verify that adequate source gas is present. Note: May view BDU status display in Service mode to verify a stable gas input.
FS0003	SST Flow Sensor Cross Check	Exhalation flow sensor OOR	Failure	Test: flow accuracy	1. Verify that there are no leaks in the patient circuit. 2. Use a known good EVQ. 3. Ensure that the EVQ is properly seated.
FS0004	SST Flow Sensor Cross Check	Mix flow sensor OOR	Failure	Test: flow accuracy	Verify that adequate source gas is present. Note: May view BDU status display in Service mode to verify a stable gas input.
FS0005	SST Flow Sensor Cross Check	PSOL current OOR	Failure	Test: PSOL current accuracy	1. Verify that adequate source gas is present. Note: May view BDU status display in Service mode to verify a stable gas input. 2. Verify that there are no leaks in the patient circuit.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FS0021	SST Flow Sensor Cross Check	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FS0024	SST Flow Sensor Cross Check	AC power not detected	Failure	Test: AC power connection	1. Connect AC power. 2. Reset AC mains circuit breaker.
FS0101	SST EV Performance	Exhalation Valve Not Calibrated	Failure	Test: EV calibration	Run exhalation valve calibration.
FS0102	SST EV Performance	Unable to establish stable flow	Failure	Test: flow stability	1. Check or replace the EVQ. 2. Install the EVQ reprocessing kit. 3. Run flow sensor calibration while in normal ventilation mode (US only).
FS0103	SST EV Performance	Pressure OOR	Failure	Test: pressure accuracy	1. Check or replace the exhalation filter. N Note: For reusable exhalation filters, verify that the internal o-ring is present and installed correctly. 2. Remove and reseat the exhalation filter seal. 3. Check or reseat the EVQ. 4. Check the F5 filter for occlusions and proper seating.
FS0105	SST EV Performance	LVDT temp OOR	Failure	Test: motor temperature	1. Replace the EVQ. Rerun the flow sensor calibration, exhalation valve calibration, EST and SST. 2. Replace the exhalation valve assembly. Rerun flow sensor calibration, exhalation valve calibration, EST and SST. 3.
FS0121	SST EV Performance	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FS0124	SST EV Performance	AC power not detected	Failure	Test: AC power connection	1. Connect AC power. 2. Reset AC mains circuit breaker
FS0201	SST Circuit Pressure	Inspiratory Zero offset OOR	Failure	Test: pressure offset	Run EST.
FS0202	SST Circuit Pressure	Expiratory Zero offset OOR	Failure	Test: pressure offset	Run EST.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FS0203	SST Circuit Pressure	Target pressure not achieved	Failure	Test: pressure stability	<ol style="list-style-type: none"> Verify that there are no leaks, tubing disconnects, or occlusions. Run EST, noting all failures and looking for components common to all of the failures. Replace the applicable PCBA containing the components common to all of the failures (IFM PCBA for SOL1, PI, and PSV failures; exhalation valve assembly for SOL2 and PE failures).
FS0204	SST Circuit Pressure	Inspiratory and Safety Valve pressure sensor difference outside test limits	Failure	Test: SV pressure accuracy	<ol style="list-style-type: none"> Verify that there are no leaks, tubing disconnects, or occlusions. Run EST, noting all failures and looking for components common to all of the failures. Replace the applicable PCBA containing the components common to all of the failures (IFM PCBA for SOL1, PI, and PSV failures; exhalation valve assembly for SOL2 and PE failures).
FS0205	SST Circuit Pressure	Inspiratory and exhalation pressure sensor difference outside test limits	Failure	Test: pressure sensor cross check	<ol style="list-style-type: none"> Verify that there are no leaks, tubing disconnects, or occlusions. Run EST, noting all failures and looking for components common to all of the failures. Replace the applicable PCBA containing the components common to all of the failures (IFM PCBA for SOL1, PI, and PSV failures; exhalation valve assembly for SOL2 and PE failures).
FS0206	SST Circuit Pressure	Inspiratory auto zero solenoid not operational	Failure	Test: inspiratory pressure offset	<ol style="list-style-type: none"> Verify that there are no leaks, tubing disconnects, or occlusions. Run EST, noting all failures and looking for components common to all of the failures. Replace the applicable PCBA containing the components common to all of the failures (IFM PCBA for SOL1, PI, and PSV failures; exhalation valve assembly for SOL2 and PE failures).

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FS0207	SST Circuit Pressure	Exhalation auto zero solenoid not operational	Failure	Test: exhalation pressure offset	<ol style="list-style-type: none"> Verify that there are no leaks, tubing disconnects, or occlusions. Run EST, noting all failures and looking for components common to all of the failures. Replace the applicable PCBA containing the components common to all of the failures (IFM PCBA for SOL1, PI, and PSV failures; exhalation valve assembly for SOL2 and PE failures).
FS0221	SST Circuit Pressure	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FS0224	SST Circuit Pressure	AC power not detected	Failure	Test: power detection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FS0303	SST Leak	Unable to establish pressure	Failure	Test: circuit leak	<ol style="list-style-type: none"> Ensure that the patient wye is securely blocked. Verify that there are no leaks, tubing disconnects, or occlusions
FS0304	SST Leak	System Leak Failure	Failure	Test: circuit leak	<ol style="list-style-type: none"> Check or replace the exhalation filter. Note: For reusable exhalation filters, verify that the internal o-ring is present and installed correctly. Remove and reseat the exhalation filter seal. Check or reseat the EVQ. Check the F5 filter for occlusions and proper seating. Verify that the EVQ diaphragm is not soiled or damaged. Run exhalation valve calibration.
FS0321	SST Leak	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FS0324	SST Leak	AC power not detected	Failure	Test: power connection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FS0401	SST Exhalation Filter	Unable to establish stable flow	Failure	Test: flow stability	<ol style="list-style-type: none"> 1. Check or replace the exhalation filter. NOTE: For reusable exhalation filters, verify that the internal o-ring is present and installed correctly. 2. Remove and reseat the exhalation filter seal. 3. Check or reseat the EVQ. 4. Check the F5 filter for occlusions and proper seating. 5. Replace delivery flow sensor.
FS0403	SST Exhalation Filter	Occluded expiratory compartment	Failure	Test: exhalation filter resistance test	<ol style="list-style-type: none"> 1. Verify that there are no occlusions in the exhalation compartment. 2. Use a known good exhalation filter. 3. Verify that the exhalation valve diaphragm is not soiled or damaged. 4. Run EST. 5. Run exhalation valve calibration.
FS0404	SST Exhalation Filter	Occluded expiratory filter	Failure	Test: exhalation filter resistance	<ol style="list-style-type: none"> 1. Verify that there are no occlusions in the exhalation filter. 2. Verify that there is unrestricted vertical movement of the exhalation valve poppet. CAUTION: Improperly rotating the poppet could damage the exhalation valve. 3. Run EST. 4. Run exhalation valve calibration. 5. Replace the exhalation valve assembly.
FS0406	SST Exhalation Filter	Patient circuit not disconnected	Failure	Test: circuit connection	Disconnect the circuit from the exhalation filter.
FS0407	SST Exhalation Filter	Patient circuit not reconnected	Failure	Test: circuit connection	<ol style="list-style-type: none"> 1. Connect the circuit. 2. Verify that there are no leaks in the exhalation limb or EVQ.
FS0410	SST Exhalation Filter	Low expiratory filter ΔP	Failure	Test: exhalation filter resistance	<ol style="list-style-type: none"> 1. Verify that there are no leaks in the exhalation filter. 2. Pressure transducer fault. 3. Run EST. 4. Run exhalation valve calibration.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FS0421	SST Exhalation Filter	No Gas Connected	Failure	Test: gas connection No air and O ₂ supplies are connected.	Connect air and oxygen supplies.
FS0424	SST Exhalation Filter	AC power not detected	Failure	Test: AC connection	1. Connect AC power. 2. Reset AC mains circuit breaker.
FS0501	SST Circuit Resistance	Unable to establish stable flow	Failure	Test: flow stability	1. Verify that there are no leaks on the exhalation side of the ventilator. 2. Replace the delivery flow sensor.
FS0502	SST Circuit Resistance	Occluded inspiratory limb	Failure	Test: inspiratory limb pressure	1. Verify that there are no inspiratory limb occlusions. 2. Replace the circuit.
FS0504	SST Circuit Resistance	Unable to reach min peak flow	Failure	Test: flow stability	1. Verify that there are no kinks or occlusions in the patient tubing. 2. Check the inspiratory flow sensor.
FS0505	SST Circuit Resistance	Occluded expiratory limb	Failure	Test: expiratory limb pressure	1. Verify that there are no expiratory limb occlusions. 2. Replace the circuit. 3. Check the exhalation valve. 4. Check the EVQ.
FS0508	SST Circuit Resistance	Insp limb resistance low	Failure	Test: inspiratory limb resistance	Check or replace the internal and external inspiratory filters.
FS0509	SST Circuit Resistance	Exp limb resistance low	Failure	Test: expiratory limb resistance	1. Check the exhalation valve. 2. Verify that there are no leaks in the exhalation limb. 3. Check the EVQ.
FS0510	SST Circuit Resistance	Unable to reach min peak flow	Failure	Test: flow stability	1. Verify that there are no leaks in the patient circuit. 2. Check the inspiratory flow sensor.
FS0512	SST Circuit Resistance	Wye not Blocked	Failure	Test: pressure build Low pressure in the inspiratory limb.	1. Block the wye. 2. Verify that there are no leaks or occlusions in the patient circuit.
FS0521	SST Circuit Resistance	No Gas Connected	Failure	Test: gas connection Failure: No air and O ₂ supplies are connected.	Connect air and oxygen supplies.
FS0524	SST Circuit Resistance	AC power not detected	Failure	Test: AC connection AC power is not connected.	1. Connect AC power. 2. Reset AC mains circuit breaker.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FS0601	SST Circuit Compliance	Unable to pressurize circuit	Failure	Test: circuit compliance Failure: System cannot pressurize to one of the test pressure points	<ol style="list-style-type: none"> Verify that there are no leaks or occlusions in the patient circuit. Run EST and verify that all pneumatics tests pass.
FS0602	SST Circuit Compliance	Unable to pressurize circuit	Failure	Test: circuit compliance	<ol style="list-style-type: none"> Verify that there are no leaks or occlusions in the patient circuit. Run EST and verify that all pneumatics tests pass.
FS0603	SST Circuit Compliance	Compliance calculation failure	Failure	Test: pressure build Wye is not blocked, causing a circuit leak.	<ol style="list-style-type: none"> Block the wye. Verify that there are no leaks or occlusions in the patient circuit.
FS0604	SST Circuit Compliance	Excessive compliance	Failure	Test: circuit compliance Failure: Excessive circuit compliance.	Ensure that the drain bag clamp is closed or that the condensate vial drain cap is installed.
FS0606	SST Circuit Compliance	Compliance low	Failure	Test: circuit compliance	Use a known good patient circuit.
FS0608	SST Circuit Compliance	Excessive compliance	Failure	Test: circuit compliance	Use a known good patient circuit.
FS0610	SST Circuit Compliance	Compliance low	Failure	Test: circuit compliance	Use a known good patient circuit.
FS0621	SST Circuit Compliance	No Gas Connected	Failure	Test: gas connection Air and O ₂ supplies are not detected.	<ol style="list-style-type: none"> Connect the air and oxygen supplies. Verify that there are no occlusions in the ventilator inlet gas filter and water trap. Verify that there are no occlusions in the ventilator external water trap (if applicable). Verify that there are no restrictions in the air and oxygen supplies.
FS0624	SST Circuit Compliance	AC power not detected	Failure	Test: power connection AC power is not connected.	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FS0709	SST Prox	Gas not connected	Failure	Test: gas connection	Ensure that the proximal flow sensor is properly connected at the wye as instructed.
FS0721	SST Prox	No Gas Connected	Failure	Test: gas connection	Ensure that the proximal flow sensor is properly connected at the wye as instructed.
FS0724	SST Prox	AC power not detected	Failure	Test: power connection AC power is not connected.	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.

Table 12. SST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FS0803	SST Leak	Unable to establish pressure	Failure	Test: circuit pressure	<ol style="list-style-type: none"> 1. Ensure that the patient wye port is securely blocked. 2. Verify that there are no leaks in the VBS.
FS0804	SST Leak	System Leak Failure	Failure	Test: circuit leak	<ol style="list-style-type: none"> 1. Ensure that the patient wye port is securely blocked. 2. Verify that there are no leaks in the VBS.
FS0821	SST Leak	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FS0824	SST Leak	AC power not detected	Failure	Test: power connection AC power is not connected.	<ol style="list-style-type: none"> 1. Connect AC power. 2. Reset AC mains circuit breaker.

^a The ventilator's diagnostic log screen shows "Test/Event".
^b The ventilator's diagnostic log screen shows "Notes".

3.3. Detailed SST Information

Table 13. Detailed SST Code Information

Code	Information or possible cause	Corrective action
AS0705	<p>Alert:</p> <ol style="list-style-type: none"> 1. Wait for prox to enter idle mode. 2. With the pump off, dump reservoir pressure to ambient. 3. Verify the reservoir pressure. 4. Verify that the prox is waiting for autozero. 5. Autozero the prox flow pressure transducer and verify the prox pressure. 6. Enable the prox purge test. 7. Verify that the prox is building pressure. 8. Read reservoir pressures via P1 and P2. 9. Verify that the P1 and P2 pressures are reading the target values. 10. Pause and read the reservoir pressure again. 11. Verify the prox flow reading. 12. Verify that prox is in idle mode. 13. Verify prox flow end reading. 14. Verify the prox pressure end reading. 	<ol style="list-style-type: none"> 1. Check or replace SOL2. 2. Verify proper tubing connections from SOL2 to the proximal flow system. 3. Verify that R4 is present. 4. Verify proper connections at the proximal flow subsystem's accumulator. 5. Replace the options host PCBA (Covidien only). 6. Replace the proximal flow PCBA (Covidien only).
AS0707	<p>Alert:</p> <ol style="list-style-type: none"> 1. Suspend purge. 2. Prompt user to remove inspiratory filter and to connect tubing. 3. Run prox autozero test and verify that it passes. 4. Read inspiratory pressure. 5. Read proximal pressure. 	<ol style="list-style-type: none"> 1. Verify proper proximal flow sensor tubing connection. 2. Verify proper connection between the proximal flow PCBA and the options panel. 3. Replace the proximal flow PCBA (Covidien only). 4. Replace the options host PCBA (Covidien only).

3.4. EST Diagnostic Codes

Note: The second and third column headings in [Table 12](#) and [Table 14](#) are labeled using the same language as columns two and four of the ventilator's diagnostic log screens. See Chapter 8 of the Puritan Bennett™ 980 Series Ventilator Operator's Manual for instructions on viewing ventilator diagnostic logs.

Table 14. EST Diagnostic Codes

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AE0602	EST Leak Test	Delivery PSOL leak exceeds alert limit.	Alert	Test: forward leakage on the delivery PSOL.	Check or replace the delivery PSOL.
AE0605	EST Leak Test	Test circuit not connected	Alert	Test: Pressure difference between PI and PE is out of range.	Remove inspiratory block and connect test circuit.
AE0807	Off-screen Key Test	Screen Lock key LED failed	Alert	Test: off screen key LED on screen lock key is not on.	<ol style="list-style-type: none"> 1. Press the screen lock key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the touch screen. 3. Replace the GUI touch screen.
AE0808	Off-screen Key Test	Alarm Silence key LED failed	Alert	Test: off-screen key LED on audio paused key is not on.	<ol style="list-style-type: none"> 1. Press the audio paused key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the touch screen. 3. Replace the GUI touch screen.
AE0809	Off-screen Key Test	Key-panel LED backlight failed	Alert	Test: off screen key Bezel backlight brightness is not changing.	<ol style="list-style-type: none"> 1. Run the test again. 2. Reseat the ribbon cable between the user interface PCBA and the touch screen. 3. Replace the GUI touch screen.
AE1301	EST Delivery PSOL Test	Delivery PSOL current loopback reading OOR	Alert	Test: current accuracy Current is out of range.	Replace the delivery PSOL.
AE1501	EST Exhalation Valve Loop-back Test	Exhalation Valve Loopback current OOR	Alert	Test: Current accuracy Exhalation valve loopback current is out of range	<ol style="list-style-type: none"> 1. Run exhalation valve calibration. 2. Replace the exhalation valve assembly.
AE1604	EST EV Pressure Accuracy & Seal Test	Exhalation valve pressure OOR	Alert	Test: pressure comparison Exhalation pressure is out of range.	<ol style="list-style-type: none"> 1. Verify that there are no leaks. 2. Ensure that the EVQ is properly seated. 3. Replace the exhalation valve.
AE1901	Communication	Serial port malfunction	Alert	Test: loopback	<ol style="list-style-type: none"> 1. Reseat the communications line interface 1 PCBA. 2. Replace the communications line interface1 PCBA.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AE2100	Compressor Battery	EST: NOT INSTALLED	Alert	The ventilator did not detect a compressor installed and skipped the test.	N/A
AE2015	Ventilator Battery	Ventilator primary battery not charged	Alert	Test: battery charge Primary battery failed to charge.	1. Charge the battery for approximately 6 hours. 2. Replace the battery.
AE2115	Compressor Battery	Compressor primary battery not charged	Alert	Test: battery charge Primary battery failed to charge.	1. Charge the battery for approximately 6 hours. 2. Replace the battery.
AE2300	Compressor	EST: NOT INSTALLED	Alert	The ventilator did not detect a compressor installed and skipped the test.	
AE2301	Compressor	EST: NOT INSTALLED	Alert	The ventilator did not detect a compressor installed and skipped the test.	N/A
AE2307	Compressor	Motor speed out of range	Alert	Test: compressor motor speed	1. Verify proper compressor harness connections. 2. Replace the compressor assembly.
AE2400	Compressor Leak	EST: NOT INSTALLED	Alert	Ventilator did not detect a compressor attached and skipped the test.	N/A
AE2401	Compressor Leak	EST: NOT INSTALLED	Alert	Ventilator did not detect a compressor attached and skipped the test.	No action required.
AE2500	Compressor Performance	EST: NOT INSTALLED	Alert	The ventilator did not detect a compressor attached and skipped the test.	N/A
AE2501	Compressor Performance	EST: NOT INSTALLED	Alert	Ventilator did not detect a compressor attached and skipped the test.	No action required.
AE2506	Compressor Performance	Unable to maintain pressure	Alert	Test: Compressor accumulator pressure	1. Verify that there are no leaks or occlusions. 2. Replace the compressor motor. 3. Replace the compressor interface PCBA.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
AE2507	Compressor Performance	Unable to maintain flow	Alert	Test: flow stability	<ol style="list-style-type: none"> Verify that there are no crimps or occlusions in the compressor-to-BDU interconnect hose. Verify that the compressor-to-BDU SPI cable is properly connected. Replace the compressor interface PCBA. Replace the compressor assembly.
FE0001	Mix Leak	Air PSOL leak rate exceeds test limits	Failure	Test: PSOL leak	Replace the air PSOL.
FE0002	Mix Leak	O ₂ PSOL leak rate exceeds test limits	Failure	Test: PSOL leak	Replace the O ₂ PSOL.
FE0004	Mix Leak	Unable to establish stable accumulator pressure	Failure	Test: accumulator pressure Accumulator cannot reach pressure.	<ol style="list-style-type: none"> Verify that there are no leaks in the mix subsystem. Verify that there are no leaks in the mix accumulator pressure transducer tubing, SOL1, SOL2, accumulator check valves, and PS1.
FE0005	Mix Leak	Accumulator leak exceeds limit	Failure	Test: accumulator pressure drop	<ol style="list-style-type: none"> Verify that there are no leaks in the mix subsystem. Verify that there are no leaks in the mix accumulator pressure transducer tubing, SOL1, SOL2, accumulator check valves, and PS1.
FE0006	Mix Leak	Unable to pressurize accumulator	Failure	Test: accumulator pressure	<ol style="list-style-type: none"> Verify that there are no leaks in the mix subsystem. Verify that there are no leaks in the mix accumulator pressure transducer tubing, SOL1, SOL2, accumulator check valves, and PS1. Replace the delivery PSOL.
FE0007	Mix Leak	Air inlet pressure too high.	Failure	Test: source gas pressure Inlet air pressure is too high after air is disconnected.	<ol style="list-style-type: none"> Ensure that air is disconnected. NOTE: Do not use high pressure hoses containing internal check valves. Ensure that the compressor-to-BDU interconnect hose is not crimped.
FE0008	Mix Leak	Air inlet pressure sensor failure	Failure	Test: air side mix check valve reverse flow	<ol style="list-style-type: none"> Ensure that the mix check valve is oriented correctly. Replace the mix check valve.
FE0009	Mix Leak	O ₂ inlet pressure sensor failure	Failure	Test: O ₂ side mix check valve reverse flow	<ol style="list-style-type: none"> Ensure that the mix check valve is oriented correctly. Replace the mix check valve.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0010	Mix Leak	O ₂ inlet pressure too high	Failure	Test: source gas pressure	Ensure that O ₂ is disconnected. Note: Do not use high pressure hoses containing internal check valves.
FE0011	Mix Leak	Unable to reach target accumulator pressure using O ₂	Failure	Test: mix accumulator leak	Ensure that O ₂ is properly connected.
FE0012	Mix Leak	Exceeded target accumulator pressure using O ₂	Failure	Test: mix PSOL leak	Verify that there are no leaks in the mix accumulator subsystem: SOL1, SOL2, PMX tubing, mix accumulator check valve assembly, PS1, including o-rings.
FE0013	Mix Leak	Unable to reach target accumulator pressure using air	Failure	Test: mix PSOL leak	Ensure that air is properly connected.
FE0014	Mix Leak	Exceeded target accumulator pressure using air	Failure	Test: mix PSOL leak	<ol style="list-style-type: none"> Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0015	Mix Leak	O ₂ inlet pressure too low	Failure	Test: check valve reverse flow	Ensure that O ₂ is properly connected.
FE0016	Mix Leak	Inspiratory flow too high.	Failure	Test: mix PSOL leak	<ol style="list-style-type: none"> Verify that the flow sensor cable is installed correctly and is not damaged. Swap mix flow sensors to verify that the problem transfers to the other subsystem. Return the mix flow sensors to their original locations. Replace the defective flow sensor.
FE0017	Mix Leak	Unable to stabilize accumulator pressure	Failure	Test: options gas supply solenoid	Verify that the option gas supply pneumatic connections are secure (options host PCBA, proximal flow module).
FE0018	Mix Leak	Option Gas Supply Solenoid leak rate exceeded	Failure	Test: option gas supply solenoid	Verify that the option gas supply pneumatic connections are secure (options host PCBA, proximal flow module).
FE0021	Mix Leak	No Gas Connected	Failure	Test: gas connection Failure: No air and O ₂ supplies are connected.	Connect the air and oxygen supplies.
FE0024	Mix Leak	AC power not detected	Failure	Test: AC connection AC power is not connected.	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0101	Mix PSOL	Air PSOL has excessive leak	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0102	Mix PSOL	O ₂ PSOL has excessive leak	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0103	Mix PSOL	Air PSOL current OOR	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Verify that there are no source gas restrictions. Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0104	Mix PSOL	O ₂ PSOL current OOR	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Verify that there are no source gas restrictions. Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0107	Mix PSOL	Air PSOL maximum liftoff current exceeded	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Verify that there are no source gas restrictions. Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0108	Mix PSOL	O ₂ PSOL maximum liftoff current exceeded	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Verify that there are no source gas restrictions. Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0109	Mix PSOL	Air PSOL liftoff current OOR	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Verify that there are no source gas restrictions. Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0110	Mix PSOL	O ₂ PSOL liftoff current OOR	Failure	Test: mix PSOL liftoff	<ol style="list-style-type: none"> Verify that there are no source gas restrictions. Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0111	Mix PSOL	Mix air PSOL loop-back current OOR	Failure	Test: mix PSOL loop-back	<ol style="list-style-type: none"> Verify that there are no source gas restrictions. Swap mix PSOLs to verify that the problem transfers to the other subsystem. Return the mix PSOLs to their original locations. Replace the defective PSOL.
FE0121	Mix PSOL	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FE0124	Mix PSOL	AC power not detected	Failure	Test: AC connection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE0201	Mix accumulator	Unable to stabilize accumulator pressure	Failure	Test: pressure sensor	<ol style="list-style-type: none"> Verify that there are no leaks in the mix accumulator subsystem. Check that the mix and delivery PSOLs and flow sensors function via appropriate EST tests.
FE0203	Mix accumulator	Pressure OOR	Failure	Test: pressure sensor	Check or replace the IFM PCBA.
FE0204	Mix accumulator	Overpressure switch failed to activate	Failure	Test: pressure switch	<ol style="list-style-type: none"> Replace the IFM PCBA. Check or replace PS1.
FE0205	Mix accumulator	Overpressure switch failed to deactivate	Failure	Test: pressure switch	<ol style="list-style-type: none"> Check or replace PS1. Replace the IFM PCBA.
FE0221	Mix accumulator	No Gas Connected	Failure	Test: mix accumulator	Connect the air and oxygen supplies.
FE0224	Mix accumulator	AC power not detected	Failure	Test: mix accumulator	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE0301	EST Circuit Pressure Test	Inspiratory Zero offset OOR	Failure	Test: pressure transducer auto-zero	Replace the IFM PCBA.
FE0302	EST Circuit Pressure Test	Expiratory Zero offset OOR	Failure	Test: pressure transducer auto-zero	Replace the exhalation valve assembly.
FE0303	EST Circuit Pressure Test	Target pressure not achieved	Failure	Test: pressure cross check	<ol style="list-style-type: none"> Verify that there are no occlusions between PI and PE. Replace the IFM PCBA. Replace the exhalation valve assembly.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0304	EST Circuit Pressure Test	Inspiratory and Safety Valve pressure sensor difference outside test limits	Failure	Test: pressure cross check The safety valve pressure transducer is not within range.	Replace the IFM PCBA.
FE0305	EST Circuit Pressure Test	Inspiratory and exhalation pressure sensor difference outside test limits	Failure	Test: pressure cross check The exhalation pressure transducer is not within range.	1. Replace the exhalation valve assembly. 2. Replace the IFM PCBA.
FE0306	EST Circuit Pressure Test	Inspiratory auto zero solenoid not operational	Failure	Test: auto-zero solenoid Inspiratory auto-zero solenoid failed to provide PI an auto-zero offset within limits.	Replace the IFM PCBA.
FE0307	EST Circuit Pressure Test	Exhalation auto zero solenoid not operational	Failure	Test: auto-zero solenoid Expiratory auto-zero solenoid failed to provide PE an auto-zero offset within limits.	Replace the exhalation valve assembly.
FE0321	EST Circuit Pressure Test	No Gas Connected	Failure	Test: circuit pressure	Connect the air and oxygen supplies.
FE0324	EST Circuit Pressure Test	AC power not detected	Failure	Test: circuit pressure	1. Connect AC power. 2. Reset AC mains circuit breaker.
FE0401		Air Inlet pressure sensor zero offset OOR	Failure	Test: zero offset pressure	1. Ensure that the source gas is removed. 2. Ensure that R1 is unobstructed. 3. Ensure that the BDU-to-compressor interconnect hose is not crimped. 4. Replace the gas supply sensor PCBA.
FE0402	Zero Offset	O ₂ Inlet Pressure exceeded	Failure	Test: zero offset pressure	1. Ensure that the source gas is removed. 2. Replace the gas supply sensor PCBA.
FE0404	Zero Offset	Accumulator pressure sensor zero offset OOR	Failure	Test: zero offset pressure	1. Ensure that SOL1 (accumulator purge solenoid) is properly connected. 2. Replace the IFM PCBA.
FE0405	Zero Offset	Inspiratory pressure sensor zero offset OOR	Failure	Test: zero offset pressure	1. Ensure that tubing is properly connected to SOL4 and PI. 2. Replace the IFM PCBA.
FE0406	Zero Offset	Exhalation pressure sensor zero offset OOR	Failure	Test: zero offset pressure	1. Ensure that tubing is properly connected to SOL5 and PE. 2. Replace the exhalation valve assembly.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event^a	Message displayed/Notes^b	Response	Information or possible cause	Corrective action
FE0409	Zero Offset	Air mix flow sensor zero offset OOR	Failure	Test: flow offset	<ol style="list-style-type: none"> Verify that flow sensor cables are properly connected. Replace the air flow sensor.
FE0410	Zero Offset	O ₂ Mix flow exceeded	Failure	Test: flow offset	<ol style="list-style-type: none"> Verify that flow sensor cables are properly connected. Replace the O₂ flow sensor.
FE0412	Zero Offset	Inspiratory flow sensor zero offset OOR	Failure	Test: flow offset	<ol style="list-style-type: none"> Reseat the delivery PSOL to ensure that it is not leaking. Verify that there are no leaks at SOL3. Replace the delivery flow sensor. Replace the delivery PSOL.
FE0413	Zero Offset	Expiratory flow sensor zero offset OOR	Failure	Test: flow offset	<ol style="list-style-type: none"> Reseat the EVQ. Replace the EVQ.
FE0414	Zero Offset	Air still connected	Failure	Test: gas connection	Disconnect the air supply.
FE0415	Zero Offset	O ₂ still connected	Failure	Test: gas connection	Disconnect the oxygen supply.
FE0424	Zero Offset	AC power not detected	Failure	Test: AC power connection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE0501	EST Flow Sensor Cross Check	Unable to establish stable flow	Failure	Test: flow stability	<ol style="list-style-type: none"> Perform flow sensor calibration. Check or replace the delivery PSOL. NOTE: If the gold standard circuit is oscillating and chattering is heard, check the exhalation valve to determine if the valve poppet is fluttering. Check or replace the delivery flow sensor.
FE0502	EST Flow Sensor Cross Check	Inspiratory flow sensor OOR	Failure	Test: flow sensor cross check	<ol style="list-style-type: none"> Perform flow sensor calibration. Replace the delivery flow sensor.
FE0503	EST Flow Sensor Cross Check	Exhalation flow sensor OOR	Failure	Test: flow sensor cross check	<ol style="list-style-type: none"> Perform flow sensor calibration. Replace the EVQ.
FE0504	EST Flow Sensor Cross Check	Mix flow sensor OOR	Failure	Test: flow sensor cross check	<ol style="list-style-type: none"> Perform flow sensor calibration. Swap the mix flow sensors. Replace the appropriate sensor if the failure transfers to the other side.
FE0505	EST Flow Sensor Cross Check	PSOL current OOR	Failure	Test: delivery PSOL current	Replace the delivery PSOL.
FE0521	EST Flow Sensor Cross Check	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0524	EST Flow Sensor Cross Check	AC power not detected	Failure	Test: AC power connection	1. Connect AC power. 2. Reset AC mains circuit breaker.
FE0601	EST Leak Test	Delivery PSOL leak exceeds failure limit	Failure	Test: delivery PSOL leak	Replace the delivery PSOL.
FE0603	EST Leak Test	Unable to establish pressure	Failure	Test: leak test and check valve reverse flow	1. Perform flow sensor calibration. 2. Swap the mix flow sensors. 3. Replace the appropriate sensor if the failure transfers to the other side.
FE0604	EST Leak Test	Excessive Leak	Failure	Test: leak test	1. Leave the cork inserted in the ventilator outlet and rerun the test. If pressure does not build an hold, troubleshoot leaks in the inspiratory module by trying a new internal filter or a new oxygen sensor. 2. Replace the exhalation filter. 3. Reseat the EVQ. If the test still fails, try a known good EVQ.
FE0606	EST Leak Test	Inspiratory check valve reverse flow too low	Failure	Test: check valve reverse flow	Verify proper seating of the delivery (inspiratory) check valve.
FE0607	EST Leak Test	Inspiratory check valve reverse flow too high	Failure	Test: check valve reverse flow	1. Access the inspiratory module to remove the internal bacteria filter. 2. Look inside the outlet manifold to determine if the blue flapper component of the check valve is not seated properly. 3. Reseat the flapper and retest. 4. If the failure persists, replace the delivery check valve assembly.
FE0608	EST Leak Test	Unable to establish accumulator pressure	Failure	Test: delivery PSOL leak	Verify that the mix accumulator pressure transducer tubing is properly connected and not leaking.
FE0609	EST Leak Test	Unable to establish stable flow	Failure	Test: delivery PSOL leak	1. Replace the delivery PSOL. 2. Replace the delivery flow sensor.
FE0610	EST Leak Test	Safety Valve failed to open	Failure	Test: delivery PSOL leak	1. Verify the safety valve electrical connection. 2. Replace the safety valve. 3. Replace the IFM PCBA.
FE0611	EST Leak Test	Safety Valve cracking pressure OOR	Failure	Test: delivery PSOL leak	Replace the delivery PSOL

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0621	EST Leak Test	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FE0624	EST Leak Test	AC power not detected	Failure	Test: AC connection	<ol style="list-style-type: none"> 1. Connect AC power. 2. Reset AC mains circuit breaker.
FE0701	Internal Storage	No media driver	Failure	Test: internal storage Failure: Internal USB media driver is not found.	<ol style="list-style-type: none"> 1. Repeat the test approximately five times. 2. Replace the USB thumb drive (Covidien only). 3. Replace the communications line interface 2 PCBA (Covidien only). 4. Replace the GUI CPU PCBA (Covidien only).
FE0702	Internal Storage	File open error	Failure	Test: internal storage	<ol style="list-style-type: none"> 1. Repeat the test approximately five times. 2. Replace the USB thumb drive (Covidien only). 3. Replace the communications line interface 2 PCBA (Covidien only). 4. Replace the GUI CPU PCBA (Covidien only).
FE0703	Internal Storage	File write error	Failure	Test: internal storage	<ol style="list-style-type: none"> 1. Repeat the test approximately five times. 2. Replace the USB thumb drive (Covidien only). 3. Replace the communications line interface 2 PCBA (Covidien only). 4. Replace the GUI CPU PCBA (Covidien only).
FE0704	Internal Storage	File read error	Failure	Test: internal storage	<ol style="list-style-type: none"> 1. Repeat the test approximately five times. 2. Replace the USB thumb drive (Covidien only). 3. Replace the communications line interface 2 PCBA (Covidien only). 4. Replace the GUI CPU PCBA (Covidien only).
FE0705	Internal Storage	File cleanup error	Failure	Test: internal storage	<ol style="list-style-type: none"> 1. Repeat the test approximately five times. 2. Replace the USB thumb drive (Covidien only). 3. Replace the communications line interface 2 PCBA (Covidien only). 4. Replace the GUI CPU PCBA (Covidien only).

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0801	Off-screen Key Test	Screen brightness key failed.	Failure	Test: off screen key Screen brightness key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the brightness key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.
FE0802	Off-screen Key Test	Screen lock key failed.	Failure	Test: off screen key Screen lock key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the screen lock key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.
FE0803	Off-screen Key Test	Man Insp. key failed.	Failure	Test: off screen key Manual inspiration key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the manual inspiration key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.
FE0804	Off-screen Key Test	Alarm Reset key failed.	Failure	Test: off screen key Alarm Reset key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the alarm reset key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.
FE0805	Off-screen Key Test	Alarm Volume key failed.	Failure	Test: off screen key Alarm volume key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the alarm volume key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.
FE0806	Off-screen Key Test	Alarm Silence key failed.	Failure	Test: off screen key Audio paused key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the audio paused key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE0810	Off-screen Key Test	Insp. Pause key failed.	Failure	Test: off screen key Inspiratory pause key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the inspiratory pause key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.
FE0811	Off-screen Key Test	Exp. Pause key failed.	Failure	Test: off screen key Expiratory pause key is not pressed in 15 s or the key press event was not detected.	<ol style="list-style-type: none"> 1. Press the expiratory pause key on the bezel. 2. Reseat the ribbon cable between the user interface PCBA and the GUI touch screen. 3. Replace the GUI touch screen.
FE0901	Rotary Knob Test	Knob Malfunction	Failure	Test: knob Failure to detect knob rotation.	<ol style="list-style-type: none"> 1. Follow the ventilator prompts. 2. Replace the GUI rotary encoder.
FE1001	Status Display	Status display to BD comm failed	Failure	Test: status display At start-up, if no message has been received from the status display, a problem with the interface is declared.	<ol style="list-style-type: none"> 1. Cycle power and rerun the status display test. 2. Verify the cable connection at the BDU backplane PCBA and the status display PCBA. 3. Replace the BDU status display PCBA (Covidien only).
FE1002	Status Display	BD to status display comm failed	Failure	Test: status display BD reports that it is not communicating with the status display system.	<ol style="list-style-type: none"> 1. Cycle power and rerun the status display test. 2. Verify the cable connection at the BDU backplane PCBA and the status display PCBA. 3. Replace the BDU status display PCBA (Covidien only). 4. Replace the BD CPU PCBA (Covidien only).
FE1005	Status Display	Status display failed	Failure	Test: status display	<ol style="list-style-type: none"> 1. Cycle power and rerun the status display test. 2. Verify the cable connection at the BDU backplane PCBA and the status display PCBA. 3. Replace the BDU status display PCBA (Covidien only). 4. Replace the BD CPU PCBA (Covidien only).

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE1101	Primary Audio Alarm Test	Active Alarm Indicator failed	Failure	Test: GUI alarm User indicates one or more of the lights are not flashing in the 360° alarm indicator.	<ol style="list-style-type: none"> 1. Respond to the ventilator prompts appropriately. 2. Inspect the alarm cable for damage and proper connections. 3. Replace the GUI alarm LED PCBA. 4. Replace the GUI CPU PCBA (Covidien only).
FE1102	Primary Audio Alarm Test	Latched Alarm Indicator failed	Failure	Test: GUI alarm User indicates one or more of the lights are not continuously illuminated in the 360° alarm indicator.	<ol style="list-style-type: none"> 1. Respond to the ventilator prompts appropriately. 2. Inspect the alarm cable for damage and proper connections. 3. Replace the GUI alarm LED PCBA. 4. Replace the user interface PCBA (Covidien only). 5. Replace the GUI CPU PCBA (Covidien only).
FE1103	Primary Audio Alarm Test	Alternative gas Indicator failed	Failure	Test: GUI alarm User indicates alternative gas indicator light is not illuminated.	<ol style="list-style-type: none"> 1. Respond to the ventilator prompts appropriately. 2. Inspect the alarm cable for damage and proper connections. 3. Replace the GUI alarm LED PCBA. 4. Replace the user interface PCBA (Covidien only). 5. Replace the GUI CPU PCBA (Covidien only).
FE1104	Primary Audio Alarm Test	Low Alarm sound failed	Failure	Test: GUI alarm User indicates the Low priority alarm sound is not functioning.	<ol style="list-style-type: none"> 1. Respond to the ventilator prompts appropriately. 2. Verify the GUI alarm connection. 3. Replace the GUI alarm.
FE1105	Primary Audio Alarm Test	Medium Alarm sound failed	Failure	Test: GUI alarm User indicates the medium priority alarm sound is not functioning.	<ol style="list-style-type: none"> 1. Respond to the ventilator prompts appropriately. 2. Verify the GUI alarm connection. 3. Replace the GUI alarm.
FE1106	Primary Audio Alarm Test	High Alarm sound failed	Failure	Test: GUI alarm User indicates the high priority alarm sound is not functioning.	<ol style="list-style-type: none"> 1. Respond to the ventilator prompts appropriately. 2. Verify the GUI alarm connection. 3. Replace the GUI alarm.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE1201	BD Audio	Alarm cable malfunction	Failure	Test: BD alarm	<ol style="list-style-type: none"> If the alarm is audible, replace the power controller PCBA (Covidien only). If the alarm is not audible, check the BD alarm cable for damage and check the connections at the power controller PCBA and at the piezo alarm.
FE1202	BD Audio	Power fail cap OOR	Failure	Test: BD alarm	<ol style="list-style-type: none"> Ensure that the ventilator has been connected to adequate AC power and has been warmed up for a minimum of 15 minutes in Service mode. Replace the power controller PCBA (Covidien only).
FE1203	BD Audio	Power-Fail cap not discharging	Failure	Test: BD alarm	<ol style="list-style-type: none"> Repeat the BD audio test. Replace the power controller PCBA (Covidien only).
FE1208	BD Audio	Piezo alarm failure	Failure	Test: BD audio	<ol style="list-style-type: none"> Respond to the ventilator prompts appropriately. Check the BD audio alarm cable. Replace the BD audio alarm.
FE1321	EST Delivery PSOL Test	No Gas Connected	Failure	Test: delivery PSOL loopback	Connect the air and oxygen supplies.
FE1324	EST Delivery PSOL Test	AC power not detected	Failure	Test: delivery PSOL loopback	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE1401	Safety System	Unable to establish stable flow	Failure	Test: safety valve occlusion	Replace the safety valve.
FE1402	Safety System	Safety Valve Occluded	Failure	Test: safety valve occlusion	Replace the safety valve.
FE1403	Safety System	Safety Valve Loop-back current OOR	Failure	Test: safety valve loopback current	<ol style="list-style-type: none"> Replace the safety valve. Replace the pneumatic interface PCBA (Covidien only). Replace the IFM PCBA.
FE1421	Safety System	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FE1424	Safety System	AC power not detected	Failure	Test: AC connection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE1521	EST Exhalation Valve Loop-back Test	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FE1524	EST Exhalation Valve Loop-back Test	AC power not detected	Failure	Test: AC connection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE1601	EST EV Pressure Accuracy & Seal Test	Exhalation valve calibration required	Failure	Test: EV calibration	Perform exhalation valve calibration.
FE1602	EST EV Pressure Accuracy & Seal Test	Unable to establish flow	Failure	Test: EV pressure accuracy	<ol style="list-style-type: none"> 1. Perform flow sensor calibration. 2. Use a known good EVQ.
FE1603	EST EV Pressure Accuracy & Seal Test	Exhalation Flow too High	Failure	Test: exhalation valve pressure accuracy	<ol style="list-style-type: none"> 1. Ensure that the EVQ seal is correctly oriented. 2. Install a new exhalation flow sensor reprocessing kit. 3. Perform flow sensor calibration. 4. Use a known good EVQ.
FE1604	EST EV Pressure Accuracy & Seal Test	Exhalation valve pressure OOR	Failure	Test: Pressure accuracy	<ol style="list-style-type: none"> 1. Verify that there are no leaks. 2. Ensure that the EVQ is seated properly. 3. Replace the exhalation valve assembly
FE1605	EST EV Pressure Accuracy & Seal Test	LVDT Temp OOR	Failure	Test: LVDT temperature	Replace the exhalation valve assembly (assembly contains the LVDT).
FE1621	EST EV Pressure Accuracy & Seal Test	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FE1624	EST EV Pressure Accuracy & Seal Test	AC power not detected	Failure	Test: AC connection	<ol style="list-style-type: none"> 1. Connect AC power. 2. Reset AC mains circuit breaker. 3.
FE1701	EST EV Calibration Table Test	Exhalation Valve Not Calibrated	Failure	Test: EV calibration	Perform exhalation valve calibration.
FE1702	EST EV Calibration Table Test	Unable to establish stable flow	Failure	Test: flow stability	<ol style="list-style-type: none"> 1. Check or replace the EVQ. 2. Install the EVQ reprocessing kit. 3. Perform flow sensor calibration while in normal ventilation mode (US only).
FE1703	EST EV Calibration Table Test	Pressure OOR	Failure	Test: pressure accuracy	<ol style="list-style-type: none"> 1. Rerun exhalation valve calibration. 2. Replace the exhalation valve assembly.
FE1705	EST EV Calibration Table Test	LVDT temp OOR	Failure	Test: LVDT temperature	Replace the exhalation valve assembly (assembly contains the LVDT).
FE1721	EST EV Calibration Table Test	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FE1724	EST EV Calibration Table Test	AC power not detected	Failure	Test: AC connection	<ol style="list-style-type: none"> 1. Connect AC power. 2. Reset AC mains circuit breaker.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE1801	EST EV Velocity Transducer Test	Unable to establish flow	Failure	Test: EV damping	<ol style="list-style-type: none"> 1. Install and exhalation flow sensor reprocessing kit. 2. Perform flow sensor calibration. 3. Use a known good EVQ.
FE1802	EST EV Velocity Transducer Test	Exhalation velocity transducer OOR	Failure	Test: EV damping Exhalation pressure is out of range.	<ol style="list-style-type: none"> 1. Check the exhalation valve poppet for unrestricted vertical movement. Caution: Improperly rotating the poppet could damage the exhalation valve. 2. Perform exhalation valve calibration. 3. Replace the exhalation valve assembly.
FE1803	EST EV Velocity Transducer Test	Unable to stabilize position: Reseat the exhalation valve body	Failure	Test: EV mechanical position	<ol style="list-style-type: none"> 1. Check the exhalation valve poppet for unrestricted vertical movement. Caution: Improperly rotating the poppet could damage the exhalation valve. 2. Perform exhalation valve calibration. 3. Replace the exhalation valve assembly.
FE1821	EST EV Velocity Transducer Test	No Gas Connected	Failure	Test: gas connection	Connect the air and oxygen supplies.
FE1824	EST EV Velocity Transducer Test	AC power not detected	Failure	Test: AC connection	<ol style="list-style-type: none"> 1. Connect AC power. 2. Reset AC mains circuit breaker.
FE1902	Communication	GUI to BD ping failed on Ether1	Failure	Test: communication	<ol style="list-style-type: none"> 1. Replace the BD CPU PCBA (Covidien only). 2. Replace the GUI CPU PCBA (Covidien only). 3. Replace the BD backplane PCBA.
FE2001	Ventilator Battery	Card cage fan malfunction	Failure	Test: fan on or off Fan is not spinning.	<ol style="list-style-type: none"> 1. Check the fan cable and connection. 2. Replace the fan.
FE2002	Ventilator Battery	Ventilator primary battery not installed	Failure	Test: battery detection Primary battery reported an internal error during the test or is not actually installed when running the test.	<ol style="list-style-type: none"> 1. Verify that the primary battery is actually installed. 2. Install a fully charged battery.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE2003	Ventilator Battery	Ventilator primary battery malfunction	Failure	Test: battery function	<ol style="list-style-type: none"> Verify that the battery is fully charged. Charge the battery for a minimum of 6 hours. Replace the battery.
FE2004	Ventilator Battery	Ventilator primary battery temperature OOR	Failure	Test: battery temperature	Replace the battery.
FE2010	Ventilator Battery	Board temperature OOR	Failure	Test: card cage temperature	<ol style="list-style-type: none"> Verify that the fan is connected. Replace the power distribution PCBA (Covidien only).
FE2013	Ventilator Battery	AC power still detected	Failure	Test: battery discharge User failed to disconnect AC power when prompted to do so.	Disconnect AC power.
FE2014	Ventilator Battery	Ventilator extended battery installed	Failure	Test: extended battery status User failed to remove the extended battery when prompted to do so.	Remove the extended battery.
FE2016	Ventilator Battery	Ventilator primary battery voltage OOR	Failure	Test: battery voltage	<ol style="list-style-type: none"> Ensure that the battery is fully charged. Replace the battery.
FE2024	Ventilator Battery	AC power not detected	Failure	Test: AC power detection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE2102	Compressor Battery	Compressor primary battery not installed	Failure	Test: battery installation	<ol style="list-style-type: none"> Ensure that the compressor primary battery is installed. Verify that the compressor primary battery is fully charged. Replace the battery.
FE2103	Compressor Battery	Compressor primary battery malfunction	Failure	Test: battery function	<ol style="list-style-type: none"> Ensure that the compressor primary battery is installed. Charge the battery for a minimum of 6 hours. Replace the battery.
FE2104	Compressor Battery	Compressor primary battery temp OOR	Failure	Test: compressor primary battery temperature	Replace the battery.
FE2113	Compressor Battery	AC power still detected	Failure	Test: battery discharge User failed to disconnect AC power when prompted to do so.	Disconnect AC power.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE2114	Compressor Battery	Compressor extended battery installed	Failure	Test: extended battery status User failed to remove the extended battery when prompted to do so.	Remove the extended battery.
FE2116	Compressor Battery	Compressor primary battery voltage OOR	Failure	Test: battery voltage	<ol style="list-style-type: none"> 1. Ensure that the battery is fully charged. 2. Replace the battery.
FE2124	Compressor Battery	AC power not detected	Failure	Test: AC power detection	<ol style="list-style-type: none"> 1. Connect AC power. 2. Reset AC mains circuit breaker.
FE2201	Backup Ventilation	Unable to enable mix backup ventilation	Failure	Test: mix backup ventilation Failure: Failed to enable mix backup ventilation within 50 ms.	<ol style="list-style-type: none"> 1. Check or replace the mix air PSOL. 2. Check or replace the mix air flow sensor.
FE2202	Backup Ventilation	Mix backup ventilation failed to reach target pressure	Failure	Test: mix backup ventilation	<ol style="list-style-type: none"> 1. Check the PMX sensor pneumatic connections. 2. Replace the IFM PCBA.
FE2203	Backup Ventilation	No air delivery in mix backup ventilation	Failure	Test: mix backup ventilation	<ol style="list-style-type: none"> 1. Check or replace the mix air PSOL. 2. Check or replace the mix air flow sensor.
FE2204	Backup Ventilation	No O ₂ delivery in mix backup ventilation	Failure	Test: mix backup ventilation	<ol style="list-style-type: none"> 1. Check or replace the mix O₂ PSOL. 2. Check or replace the mix O₂ flow sensor.
FE2205 ^c	Backup Ventilation	O ₂ delivery when AIR expected	Failure	Test: mix backup ventilation	<ol style="list-style-type: none"> 1. Verify proper cable connections. 2. Swap the mix PSOLs to verify that the problem transfers to the other subsystem. 3. Replace the IFM PCBA. 4. Replace the mix module PCBA (Covidien only).
FE2206 ^c	Backup Ventilation	Air delivery when O ₂ expected	Failure	Test: mix backup ventilation	<ol style="list-style-type: none"> 1. Verify proper cable connections. 2. Swap the mix PSOLs to verify that the problem transfers to the other subsystem. 3. Replace the IFM PCBA. 4. Replace the mix module PCBA (Covidien only).
FE2207	Backup Ventilation	Unable to establish stable flow	Failure	Test: inspiratory backup ventilation	<ol style="list-style-type: none"> 1. Perform flow sensor calibration. 2. Replace the delivery flow sensor. 3. Replace the delivery PSOL.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE2208	Backup Ventilation	Delivery flow is higher than expected	Failure	Test: inspiratory backup ventilation	<ol style="list-style-type: none"> 1. Perform flow sensor calibration. 2. Replace the delivery flow sensor. 3. Replace the delivery PSOL.
FE2209	Backup Ventilation	Unable to enable inspiratory backup ventilation	Failure	Test: inspiratory backup ventilation	Check or replace SOL3.
FE2210	Backup Ventilation	Unable to establish stable pressure	Failure	Test: inspiratory backup ventilation	Check or replace the IFM PCBA.
FE2211	Backup Ventilation	Unable to establish stable flow	Failure	Test: inspiratory backup ventilation	<ol style="list-style-type: none"> 1. Perform flow sensor calibration. 2. Replace the delivery flow sensor. 3. Replace the delivery PSOL.
FE2212	Backup Ventilation	Unable to enable exhalation backup ventilation	Failure	Test: exhalation backup ventilation	Replace the exhalation valve assembly.
FE2213	Backup Ventilation	Exhalation backup ventilation current OOR	Failure	Test: exhalation backup ventilation	Replace the exhalation valve assembly.
FE2214	Backup Ventilation	Exhalation valve current OOR	Failure	Test: exhalation backup ventilation	Replace the exhalation valve assembly.
FE2215	Backup Ventilation	Pressure OOR	Failure	Test: exhalation backup ventilation	Replace the exhalation valve assembly.
FE2216	Backup Ventilation	Unable to reach minimum pressure	Failure	Test: exhalation backup ventilation	Replace the exhalation valve assembly.
FE2221	Backup Ventilation	No Gas Connected	Failure	Test: gas detection	Connect the air and oxygen supplies.
FE2224	Backup Ventilation	AC power not detected	Failure	Test: AC power detection	<ol style="list-style-type: none"> 1. Connect AC power. 2. Reset AC mains circuit breaker.
FE2302	Compressor	Wall air pressure detected	Failure	Test: gas detection	Disconnect wall air.
FE2303	Compressor	Unable to drain accumulator	Failure	Test: compressor accumulator pressure	<ol style="list-style-type: none"> 1. Check for crimps or occlusions in the compressor-to-BDU interconnect tubing. 2. Replace the compressor interface PCBA.
FE2304	Compressor	Pressure sensor zero offset out of range	Failure	Test: compressor sensor offset	Replace the compressor interface PCBA.
FE2305	Compressor	Fan speed out of range	Failure	Test: fan speed	Replace the compressor cooling fan.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE2306	Compressor	Motor speed at zero	Failure	Test: compressor motor speed	<ol style="list-style-type: none"> Verify that the compressor motor connections are correct. Verify that the compressor-to- BDU SPI cable is fully connected and not damaged. Replace the compressor assembly.
FE2308	Compressor	Pressure exceeded maximum value	Failure	Test: compressor accumulator pressure	Replace the compressor interface PCBA.
FE2309	Compressor	Target pressure not reached	Failure	Test: compressor accumulator pressure. See Table 15 for details on information or possible causes and corrective actions for this diagnostic code.	See Table 15 for details on information or possible causes and corrective actions for this diagnostic code.
FE2310	Compressor	Pressure sensor out of range	Failure	Test: compressor accumulator pressure	<ol style="list-style-type: none"> Verify that there are no leaks or occlusions. Ensure that the compressor pressure sensor tubing is properly connected. Replace the compressor interface PCBA. Replace the compressor assembly.
FE2311	Compressor	Unable to establish pressure	Failure	Test: compressor accumulator pressure	<ol style="list-style-type: none"> Verify that there are no leaks or occlusions. Ensure that the compressor pressure sensor tubing is properly connected. Replace the compressor interface PCBA.
FE2312	Compressor	Pressure exceeded maximum value	Failure	Test: compressor accumulator pressure	<ol style="list-style-type: none"> Replace the compressor accumulator pressure relief valve. Replace the compressor interface PCBA.
FE2324	Compressor	AC power not detected	Failure	Test: AC power detection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE2402	Compressor Leak	Wall air pressure detected	Failure	Test: gas detection	Disconnect wall air.

Table 14. EST Diagnostic Codes (continued)

Code	Test/Event ^a	Message displayed/Notes ^b	Response	Information or possible cause	Corrective action
FE2403	Compressor Leak	Unable to drain accumulator	Failure	Test: accumulator pressure	<ol style="list-style-type: none"> Verify that the compressor-to- BDU interconnect hose is not crimped. Verify that the tube is not crimped at the compressor accumulator pressure transducer. Replace the compressor interface PCBA.
FE2404	Compressor Leak	Target pressure not reached	Failure	Test: accumulator pressure	<ol style="list-style-type: none"> Verify proper compressor harness connections. Replace the compressor assembly.
FE2405	Compressor Leak	Excessive Leak	Failure	Test: accumulator pressure	Verify that there are no leaks in the compressor subsystem.
FE2424	Compressor Leak	AC power not detected	Failure	Test: AC power detection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.
FE2502	Compressor Performance	Wall air pressure detected	Failure	Test: gas detection	Disconnect wall air.
FE2503	Compressor Performance	Unable to drain accumulator	Failure	Test: accumulator pressure	<ol style="list-style-type: none"> Verify that the compressor-to- BDU interconnect hose is not crimped. Verify that the tube is not crimped at the compressor accumulator pressure transducer. Replace the compressor interface PCBA.
FE2504	Compressor Performance	Target pressure not reached	Failure	Test: accumulator pressure	<ol style="list-style-type: none"> Verify that there are no leaks or occlusions. Replace the compressor interface PCBA. Replace the compressor assembly.
FE2505	Compressor Performance	Unable to establish stable flow	Failure	Test: compressor flow stability See Table 15 for details on information or possible causes and corrective actions for this diagnostic code.	See Table 15 for details on information or possible causes and corrective actions for this diagnostic code.
FE2524	Compressor Performance	AC power not detected	Failure	Test: AC power detection	<ol style="list-style-type: none"> Connect AC power. Reset AC mains circuit breaker.

^a The ventilator's diagnostic log screen shows "Test/Event".^b The ventilator's diagnostic log screen shows "Notes".

c Ensure most recent software version is installed on ventilator. Contact Technical Services at +1 800 255 6774 or call local technical representative for assistance on software version

Table 15. Detailed EST Code Information

Code	Information or possible cause	Corrective action
FE2309	Test: compressor accumulator pressure Failure: Compressor accumulator pressure is too low.	1. Check and verify that the pressure transducer tubing is not kinked or leaking. 2. Verify that the compressor-to-BDU interconnect hose is properly connected. 3. Remove the compressor inlet muffler and rerun this test to determine if the muffler is too restrictive. 4. Replace the compressor interface PCBA. 5. Replace the compressor assembly.
FE2405	Test: compressor accumulator pressure Failure: Compressor is not able to hold constant accumulator pressure.	1. Verify that there are no leaks or occlusions. 2. Verify that the compressor motor turns on. 3. Replace the compressor interface PCBA.
FE2505	Test: compressor flow stability Failure: Compressor failed to establish stable flow.	1. Remove the inspiratory module and inspect the three o-rings installed on the pneumatic interface manifold for damage. If the leak persists, replace the three o-rings on this manifold. Note: The o-rings come in three different sizes. Order all three sizes. 2. Replace the compressor assembly. 3. Replace the compressor interface PCBA.

4. Performance Verification

Hospital biomedical technicians may use [Table 17](#) to determine the individual tests required and the order in which to perform them after performing preventive maintenance on the ventilator. Use [Table 18](#) after repairing the ventilator.

4.1. Periodic Preventive Maintenance

Warning: To ensure proper ventilator operation, perform preventive maintenance intervals as specified under the Operator Preventive Maintenance Frequency table listed in the Operator's manual and the Service Preventive Maintenance Frequency listed in [Table 16](#).

At ventilator startup, and in Service mode, the GUI and status display indicate when there are 500 hours or less before preventive maintenance is due.

Table 16. Service Preventive Maintenance Frequency

Frequency	Part	Maintenance
Every 12 months	Entire ventilator	<ul style="list-style-type: none">Run extended self test (EST)Test alarm system. See Operator's Manual Section 6.5.5 Alarm Testing.Perform electrical safety test and inspect ventilator for mechanical damage and for label illegibility.
	Primary and extended batteries	Perform battery test (as a part of EST in Service mode).
When ventilator location changes by 1000 feet of altitude	Atmospheric pressure transducer	Perform atmospheric pressure transducer calibration.
Every 3 years, or when battery test fails, or when EST indicates battery life has been exhausted	Primary battery	Replace primary batteries (ventilator and compressor). Actual battery life depends on the history of use and ambient conditions.
	Extended batteries	Replace extended batteries (ventilator and compressor). Actual battery life depends on the history of use and ambient conditions.
Every 10 000 operational hours	Internal inspiratory filter	Replace. Do not attempt to autoclave or reuse.
	BDU 10K PM kit, p/n 10097275	Replace the components included in the 10K PM kit. Fill out the PM label and attach to the device. See the Puritan Bennett™ 980 Series Ventilator Service Manual, Table 7-1 for information on tests required after installation of the BDU 10K PM Kit.
Every year from date of installation, or sooner as needed.	Oxygen sensor	<ul style="list-style-type: none">Replace the oxygen sensor as needed.Calibrate after replacement.Actual sensor life depends on operating environment. Operation at higher temperature or O2% levels will result in shorter sensor life.

Note: For installation, testing and charge sequence of the battery refer to the operator's manual.

4.2. Testing and Calibration Requirements After Performing Preventive Maintenance

Table 17. Sequence of Testing and Calibration Requirements After Performing Preventive Maintenance

Periodic and preventive maintenance	Perform procedures in the order of the numbers listed
Annual ventilator preventive maintenance	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Electrical safety test² 3. Flow sensor calibration 4. Exhalation valve calibration 5. Atmospheric pressure transducer Calibration 6. Extended self test (EST)³ 7. Vent inop test 8. Touch Screen calibration 9. Short self test (SST) 10. Oxygen sensor (OS) calibration
10 000-hour ventilator preventive maintenance	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Electrical safety test² 3. Flow sensor calibration 4. Exhalation valve calibration 5. Atmospheric pressure transducer Calibration 6. Extended self test (EST)³ 7. Vent inop test 8. Touch Screen calibration 9. Short self test (SST) 10. Oxygen sensor (OS) calibration 11. Performance verification test (PVT)⁴
10 000-hour compressor preventive maintenance	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Electrical safety test² 3. Extended self test (EST)³ 4. Short self test (SST)
Oxygen sensor replacement	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Oxygen sensor (OS) calibration 3. Extended self test (EST)³ 4. Short self test (SST)
Exhalation flow sensor (EVQ) replacement	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Flow sensor calibration 3. Exhalation valve calibration 4. Short self test (SST)

Table 17. Sequence of Testing and Calibration Requirements After Performing Preventive Maintenance (continued)

Periodic and preventive maintenance	Perform procedures in the order of the numbers listed
Coin Battery Replacement PM	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Electrical safety test² 3. Extended self test (EST)³ 4. Vent inop test 5. Short self test (SST)
<ol style="list-style-type: none"> 1. Perform ventilator warm-up for 15 minutes in Service mode. 2. Includes digital ground isolation testing. 3. Due to International Air Transportation requirements (IATA), new batteries are not shipped fully charged. To avoid failing the battery test in EST, ensure that batteries are at least 90% charged prior to running EST, as indicated by the ventilator's status display. To charge batteries, simply connect the ventilator to adequate AC power. 4. Warm up the PTS 2000 for at least 10 minutes prior to use. 	

Note: If the only test being run is an electrical safety test, there is no need to warm up the ventilator.

Table 18. Sequence of Testing and Calibration Requirements After a Repair or Part Replacement

After a repair or part replacement	Perform procedures in the order of the numbers listed
Communications backplane PCBA	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Electrical safety test² 3. External ports test 4. Extended self test (EST)^{3, 5}
<ul style="list-style-type: none"> • GUI alarm LED PCBA • GUI rotary encoder PCBA • GUI assembly • GUI audio alarm • GUI microphone 	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Electrical safety test² 3. Touchscreen calibration 4. Extended self test (EST)³
<ul style="list-style-type: none"> • AC module • BDU power supply • BDU fan • Power switch • AC indicator • BDU speaker • Compressor power supply • Compressor fan • Line interface I PCBA • BDU battery backplane PCBA • Compressor battery backplane PCBA • Compressor interface PCBA • DC to DC Converter PCBA 	<ol style="list-style-type: none"> 1. Ventilator Warm-up Cycle¹ 2. Electrical safety test² 3. Extended self test (EST)³

Table 18. Sequence of Testing and Calibration Requirements After a Repair or Part Replacement (continued)

After a repair or part replacement	Perform procedures in the order of the numbers listed
<ul style="list-style-type: none"> • BDU backplane PCBA • Options backplane PCBA • Inspiratory flow module PCBA • Gas supply sensors PCBA 	<ol style="list-style-type: none"> 1. Ventilator warm-up cycle¹ 2. Electrical safety test² 3. Flow sensor calibration 4. Exhalation valve calibration 5. Atmospheric pressure transducer Calibration 6. Extended self test (EST)³ 7. Vent inop test 8. Short self test (SST) 9. Oxygen sensor (OS) calibration 10. Performance verification test (PVT)⁴
<ul style="list-style-type: none"> • Compressor motor assembly • Compressor unloading solenoid • Compressor accumulator • Compressor accumulator pressure relief valve • Compressor check valve • Compressor dryer • Compressor muffler • Compressor heat exchanger • Compressor filters 	<ol style="list-style-type: none"> 1. Ventilator warm-up cycle¹ 2. Electrical safety test² 3. Extended self test (EST)³ 4. External ports test
<ul style="list-style-type: none"> • Mix air PSOL • Mix O2 PSOL • Delivery PSOL • Air flow sensor • O2 flow sensor • Delivery flow sensor • Exhalation valve assembly • Safety valve • Backup ventilation solenoid (SOL3) • Compressor air inlet check valve • Wall air inlet check valve • Air and oxygen check valve assembly • Relief valve, mix accumulator • Mix accumulator pressure switch • Mix-accumulator • Options supply solenoid • Mix accumulator purge solenoid • Breath delivery check valve 	<ol style="list-style-type: none"> 1. Ventilator warm-up cycle¹ 2. Electrical safety test² 3. Flow sensor calibration 4. Exhalation valve calibration 5. Atmospheric pressure transducer Calibration 6. Extended self test (EST)³ 7. Vent inop test 8. Short self test (SST) 9. Oxygen sensor (OS) calibration 10. Performance verification test (PVT)⁴

Table 18. Sequence of Testing and Calibration Requirements After a Repair or Part Replacement (continued)

After a repair or part replacement	Perform procedures in the order of the numbers listed
Any manifolds, any harnesses, any cables	<ol style="list-style-type: none"> 1. Ventilator warm-up cycle¹ 2. Electrical safety test² 3. Flow sensor calibration 4. Exhalation valve calibration 5. Atmospheric pressure transducer Calibration 6. Extended self test (EST)³ 7. Vent inop test 8. Short self test (SST) 9. Oxygen sensor (OS) calibration 10. Performance verification test (PVT)⁴
Coin Battery Replacement PM	<ol style="list-style-type: none"> 1. Ventilator warm-up cycle¹ 2. Electrical safety test² 3. Extended self test (EST)³ 4. Vent inop test 5. Short self test (SST)
	<ol style="list-style-type: none"> 1. Perform ventilator warm-up for 15 minutes in Service mode. 2. Includes digital ground isolation testing. 3. Due to International Air Transportation requirements (IATA), new batteries are not shipped fully charged. To avoid failing the battery test in EST, ensure that batteries are at least 90% charged prior to running EST, as indicated by the ventilator's status display. To charge batteries, simply connect the ventilator to adequate AC power. 4. Warm up the PTS 2000 for at least 10 minutes prior to use. 5. Confirm nurse call functionality, if used.

Note: Contact Technical Services for any fault or failure that cannot be resolved by following the recommended corrective actions in the SST or EST diagnostic codes tables ([Table 12](#) through [Table 15](#)). If any of the listed parts require replacement or if any of the listed services are required, or for any diagnostic code not contained in this document, contact Technical Services at 800 655 2774.

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4.3. Field Service Parts Replacement List

Note: The parts replacements and service procedures included in the following list must only be performed by local technical representative.

- Ventilator installation
- Software download
- PCBA replacements
 - BD CPU PCBA replacement
 - GUI CPU PCBA replacement
 - Mix controller
 - Pneumatic interface
 - BD power controller
 - BD power distribution

- DC compressor power controller
 - DC compressor power distribution
 - GUI user interface
 - Options host
 - Proximal flow module
- Status display
- Line interface II PCBA replacement or USB flash drive replacement
- **FPGA** update
- **CPLD** update
- Pendant mount installation
- Options installation

4.4. Required Equipment, Materials, and Forms

Use the following items listed or equivalent:

- Computer (PC), utilizing modern Windows based operating system
- Basic calculator
- Calibrated PTS 2000 pneumatic analyzer, 4-076185-00
- BreathLab PTS RPTS software application, 4-075356-00
- RS-232 cable, DB9 male to DB9 female, 4-074688-00
- USB 2.0 serial converter
- Calibrated electrical safety analyzer, Fluke ESA620
- Re/Flex filter, barbed, 4-074644-00
- Coupling, barbed, 4-003443-00 (3 required)
- Connector, 22 mm tubing junction with pressure port, 4-011521-00
- Tubing, silicone, 4 to 5 mm (3/16 in.) ID. by 7 to 8 cm (3 in.) long, 4-008577-00
- Connector, 4.8 mm (3/16 in.) ID to 3.2 mm (1/8 in.)ID tubing, 4-006104-00
- Patient circuit, adult
- Exhalation filter, adult, 980, 10063033 or 10043551
- Inspiratory filter 351U5856
- Flex tube, 22mm, (gold standard tube) 53.4 cm (21.0 in.), 4-018506-00, (2 required)
- Test lung, 1.0-liter, deluxe adult, white w/ restrictor, P/N LNG800P
- Test lung, 3.0-liter, N-3800006
- Test lung, 4.0-liter

- Test lung, Infant, 1.0-liter (CareFusion™* P/N 10107)
- Stopper, number 2, G-061574-00 or local supplier
- Stopper, number 1, 4-009523-00 or local supplier
- Adapter, 22mm OD / 15mm ID, 4-002902-00
- Adapter, 15mm OD conical x 22mm OD conical, included with neonatal breathing circuit or alternate supplier
- Calibrated digital multimeter (DMM) accurate to three decimal places (Fluke 87)
- Test leads (G-061567-00)
- Double banana jack (Pomona Electronics™* P/N 1330-2) configured with a $1\text{ k}\Omega \pm 1\%$ resistor connected between the leads

Note: If a Universal model or Neonatal model ventilator is undergoing testing, the following items are required:

- Tubing, silicone, 3 to 4 mm (1/8 in.) ID by 10 cm, (4 in.) long, 4-008578-00 or equivalent
- Neonatal exhalation filter, 980, 4-076900-00
- Adapter, neonatal exhalation filter, 980, 10043537
- Breathing circuit, neonatal, disposable, (DAR P/N 307/8447, CareFusion™*/Airlife™* P/N 7441-4S2, Hudson™* P/N 780-02), or equivalent

4.5. Verification Procedure

Before starting performance verification testing, first perform electrical safety testing, then perform component calibrations (See [Component Calibration, page 78](#)). Document electrical safety test, component calibration, and performance verification test results on the PVR form included in this manual ([Table 19](#)).

Note: To fill out the software/firmware fields in [Table 19](#), enter Service mode, Touch the configuration button, and then touch Part Number/Revision. Notice there are four pages of the Part Number/Revision field within that view. For serial number information, touch the Serial Number button.

Table 19. PB980 Ventilator Performance Verification Form

Customer name:	Operational time (hours)		
	Ventilator:		
Asset ID:	Compressor:		
Humidifier ID:	Device configuration (check one)		
	Universal <input type="checkbox"/>	Neonatal <input type="checkbox"/>	Adult/pediatric <input type="checkbox"/>
Service report:			
BDU serial number:	Matches electronic serial number : Yes <input type="checkbox"/> No <input type="checkbox"/>		
Compressor serial number:			
GUI serial number:	Matches electronic serial number : Yes <input type="checkbox"/> No <input type="checkbox"/> N/A <input type="checkbox"/>		
SOFTWARE/FIRMWARE	Pre-revision	Post-revision	
Ventilator software			

Table 19. PB980 Ventilator Performance Verification Form (continued)

BD FPGA			
BD CPLD			
GUI FPGA			
GUI CPLD			
Inspiratory/exhalation FPGA			
Compressor FPGA			
Mix FPGS			
(BD) power control FPGA			
Options host 1 FPGA			
User interface FPGA			
Audio flash			
GUI touch firmware			
Status display			
Ventilator warm-up cycle (15 minutes) <input type="checkbox"/> completed			
ELECTRICAL SAFETY TESTS			
Ground integrity	Test limit	Actual	
Ground resistance	<0.20 Ω	Ω	
Earth current leakage (AC + DC)			
Normal polarity, closed neutral	<300 μA	μA	
Reversed polarity, open neutral	<1000 μA	μA	
Reversed polarity, closed neutral	<300 μA	μA	
Normal polarity, open neutral	<1000 μA	μA	
Ground isolation test	Test limit	Actual	
Resistance measurement	>975 Ω	Ω	
SERVICE MODE TESTS/CALIBRATIONS			
Parameter	Result		
Atmospheric pressure calibration	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Touch screen calibration	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Flow sensor calibration	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Exhalation valve calibration	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Extended self test (EST)	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
External ports test	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Vent inop test	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Adult short self test (SST)	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Pediatric short self test (SST)	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Neonatal self test (SST)	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Oxygen sensor calibration	<input type="checkbox"/> Pass	<input type="checkbox"/> limited use	<input type="checkbox"/> N/A
ATMOSPHERIC PRESSURE TESTS			
Parameter	Actual	Calculated limits	Status (Pass/Fail/N/A)
PTS2000 Barometric Measurement (mmHg)		Lower= PTS2000 actual ×0.98–20.2	Upper= PTS2000 actual ×1.02+20.2

Table 19. PB980 Ventilator Performance Verification Form (continued)

Ventilator Barometric Pressure Reading		mmHg	mmHg	
CIRCUIT PRESSURE TESTS				
Pressure setting (cmH ₂ O)	Lower limit	Upper limit	Actual	Pass/Fail
10	6.64	13.37		
50	45.34	54.67		
100	93.71	106.29		
FLOW TESTS				
Flow setting (LPM)	Lower limit	Upper limit	Actual (SLPM) Air	Actual (SLPM) Oxygen
1	0.26	1.79		
5	3.77	6.32		
20	16.9	23.3		
60	52.0	68.6		
150 ^a	131	170		
BREATH DELIVERY TESTS (adult/pediatric)				
Note: For breath delivery tests, enter the actual (PTS2000) readings AND the PB980 ventilator V _{TE} readings for each test step.				
Adult SST with PTS 2000 passed: <input type="checkbox"/>				
VOLUME TESTS				
Parameter (V _T) (mL)	Lower limit	Upper limit	Actual (PTS2000)	Pass/Fail
25	11.0	39.0		
30	14.4	45.6		
50	34.0	66.0		
200	166	234		
300	254	346		
500	430	570		
600	518	682		
2500	2190	2810		
SPIROMETRY TESTS				
Parameter (V _T) (mL)	Lower limit: actual $\times 0.90\text{--}4$ mL	Upper limit: actual $\times 1.10\text{+}4$ mL	V _{TE} (from ventilator, mL)	Pass/Fail
25				
30				
50				
200				
300				
500				
600				
2500				
PRESSURE CONTROL TESTS				
Parameter (P) (cmH ₂ O)	Lower limit	Upper limit	Actual	Pass/Fail

Table 19. PB980 Ventilator Performance Verification Form (continued)

5	1.80	13.08		
10	6.64	18.12		
25	21.15	33.23		
90	84.04	99.72		
PEEP TESTS				
Parameter (PEEP)(cmH ₂ O)	Lower limit	Upper limit	Actual	Pass/Fail
5	2.72	7.28		
25	21.77	28.23		
45	40.82	49.18		
FiO₂ TESTS				
Parameter FiO ₂ (%O ₂)	Lower limit	Upper limit	Actual	Pass/Fail
90	84.8	95.3		
30	26.3	33.8		
BREATH DELIVERY TESTS (neonatal)				
Note: Perform if the neonatal option is present. Skip if the option is not present. Neonatal SST with PTS 2000 passed: <input type="checkbox"/>				
PRESSURE CONTROL TESTS				
Parameter (P) (cmH ₂ O)	Lower limit	Upper limit	Actual	Pass/Fail
5	1.80	8.20		
10	6.64	13.37		
20	16.31	23.69		
PEEP TESTS				
Parameter (PEEP) (cmH ₂ O)	Lower limit	Upper limit	Actual	Pass/Fail
5.0	2.72	7.28		
10.0	7.49	12.52		
Tester name:	Date:			
a Note: 150 LPM air flow test not applicable when using on-board compressor without access to external compressed air supply, however 150 LPM oxygen flow test shall be performed.				

4.5.1. Electrical Safety Testing

Electrical safety testing verifies that ground integrity and leakage current are within safe limits. Perform this test whenever the ventilator is serviced.

To perform the electrical safety test

1. Verify that the ventilator power switch is off.
2. Verify that the ground resistance measures within test limits specified in [Table 20](#). See Ground Integrity in this section for instructions on performing the ground resistance test.
3. If the ventilator is equipped with the compressor option, disconnect the external air supply from the ventilator and verify that pressure from the supply hose has been relieved.
4. Verify that the optional compressor (if applicable) is running. Failure to do so may produce an inaccurate total leakage current measurement.

5. Verify that the leakage current measures within test limits specified in [Table 20](#). See Current Leakage in this section for instructions on performing the current leakage test.
6. Test to IEC 60601 standard.

Warning: Do not perform any other tests while the ventilator is plugged into the ESA620 or any other electrical safety tester.

Note: Always record test results in the correct unit of measure:

- mA to μ A: $0.1 \text{ mA} = 100 \mu\text{A}$
- $m\Omega$ to Ω : $100 m\Omega = 0.10 \Omega$

Ground Integrity

To accurately measure ground integrity, the resistance measurement must be zeroed to cancel the test lead resistance. See [Figure 3](#). to perform the ground integrity tests.

To zero the resistance measurement

1. Connect a test lead with alligator clip from the 2 WIRE V/ Ω /A jack (item 1) to the "0/NUL" post adapter (item 2).
2. Press the " Ω " key (item 3).
3. Press the Low (F1) key (item 4).
4. Press the Zero Leads (F4) key (item 5) to zero the test lead resistance measurement.

To measure ground resistance

1. Turn the ventilator off.
2. Connect a test lead between the 2 WIRE V/ Ω /A jack (item 1) and a ground point of the ventilator.
3. Press the Low (F1) key (item 4) to measure the resistance (item 6).

Figure 3. Ground Integrity Test



Table 20. Electrical Safety Test Acceptance Criteria

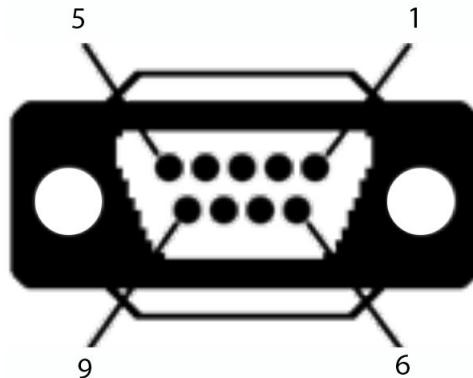
Ground integrity	Test limit		
Ground resistance	< 0.2 Ω		
Earth leakage (AC + DC)			
Condition	AC polarity	Neutral	Test limit (μA)
Normal	Normal	Closed	<300
Single fault		Open	<100
Normal	Reverse	Closed	<300
Single fault		Open	<100

To measure ground isolation resistance

1. Power off the ventilator and disconnect the power cord from the AC power source.
2. Ensure that all panels are in place and secured with their respective mounting hardware.

Using the DMM set to measure resistance, measure resistance between pin 5 of the DB9 serial port on the rear of the BDU and the chassis ground lug located near the ventilator power inlet. See [Figure 4.](#) for DB9 pin identification.

Figure 4. Pin IDs, DB9 Connector Female Mating Face



VEN_12304_A

3. Measurement must be $> 975 \Omega$ or ($> 0.975 \text{ k}\Omega$) to pass this test.

To troubleshoot ground isolation resistance value that is too low

1. Verify that AC power is disconnected and that the ventilator is powered off.
2. With the DMM still connected for the ground isolation measurement, disconnect various assemblies, subassemblies, cables and harnesses to isolate the cause of the low resistance measurement.

4.5.2. Component Calibration

The following calibrations and tests are included in this section:

- Atmospheric pressure transducer calibration
- Touch screen calibration
- Flow sensor calibration

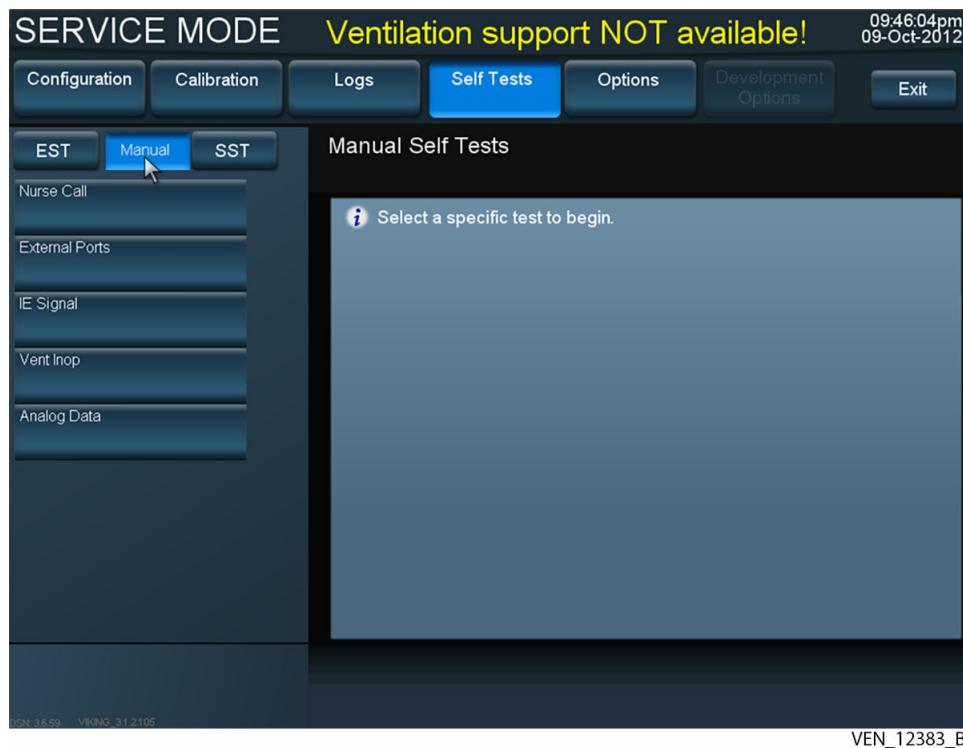
- Exhalation valve calibration
- Oxygen sensor calibration

Vent Inop Test

To perform the vent inop test

1. Install the exhalation filter and collector vial.
2. Connect the ventilator to compressed air and oxygen gas supplies 241.3 kPa to 599.8 kPa (35 psi to 87 psi).
3. Connect the ventilator to an AC power source.
4. Ensure that the power indicator illuminates.
5. Check that primary batteries are installed for both the ventilator and compressor.
6. Enter Service mode. See section 3.7.4 in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
7. Touch Self Tests.
8. Touch Manual.
9. Touch Vent Inop.

Figure 5. Self Tests Menu: Manual Tests



10. Follow all prompts, such as Accept or Cancel.

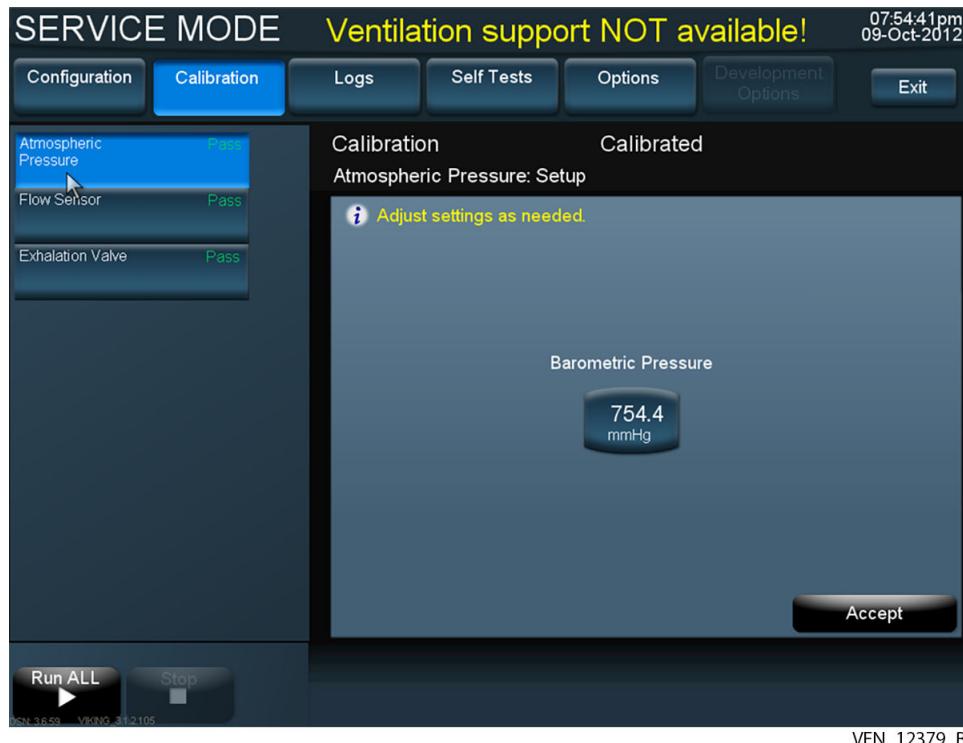
Atmospheric Pressure Transducer Calibration

The atmospheric pressure calibration calibrates the atmospheric pressure transducer, and requires an external barometer. Ensure that the pressure in the room is stable and not subject to pressure changes caused by door closures, heavy foot traffic, or changes in air caused by air conditioning systems or similar equipment. Any such environmental changes will result in an incorrect adjustment to the ventilator.

To calibrate the atmospheric pressure transducer

1. Enter Service mode. See section 3.7.4 in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
2. Touch the Calibration tab.
3. Touch Atmospheric Pressure.

Figure 6. Calibration Menu: Atmospheric Pressure



4. Follow all on-screen prompts.
5. Allow the barometric pressure reading to stabilize, then enter the pressure (in mmHg) measurement made by this external barometer as prompted.
(1 mmHg = 1.333 mbar = 0.1333 kPa = 0.019 psia)
6. Touch Accept.

Note: If the calibration fails, rerun it after correctly entering the barometric pressure. If the calibration continues to fail, call Technical Services.

Note: Atmospheric pressure calibration failure does not prevent ventilation. The upper limit is 830 mmHg and the lower limit is 510 mmHg.

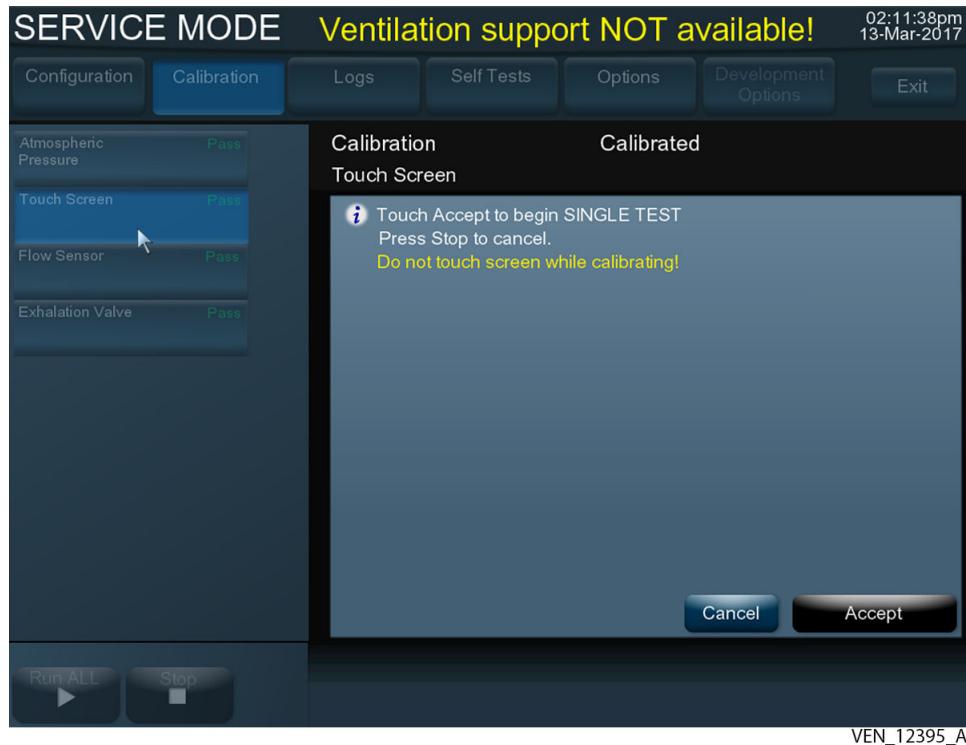
Touch Screen Calibration

Calibrating the touch screen tunes the sensitivity of the touch interface for optimal performance

To calibrate the touch screen

1. Enter Service mode. See section 3.7.4 in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
2. Touch Calibration.
3. Touch the Touch Screen button.

Figure 7. Calibration Menu: Touch Screen Calibration



4. Touch Start Cal.
5. Allow the ventilator time to perform calibration. Do not touch the touch screen during calibration.
6. Touch Accept. The message "Calibrated" appears upon successful completion.

Note: If the calibration fails, rerun it. If it continues to fail, see [Chapter 5](#).

Note: Touch screen calibration failure does not prevent ventilation.

Flow Sensor Calibration

The flow sensor calibration function builds a table of flow sensor offsets. The calibration requires a gold standard test circuit. A system leak is a common source of failure, particularly exhalation filter leaks.

Note: If the ventilator has not reached operating temperature from recent usage, allow ventilator to warm up for at least 15 minutes in Service mode before performing flow sensor calibration.

Note: It is very important the ventilator passes the EST leak test prior to a flow sensor calibration.

To calibrate the flow sensors

1. Connect air and oxygen to the appropriate inlets.
2. Ensure external gas sources can supply 200 L/min.
3. Confirm secure attachment of the exhalation filter collector vial components.
4. Securely attach the gold standard test circuit to both the to and from patient ports.
5. Enter Service mode. See section 3.7.4 in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
6. Touch the Calibration tab ([Figure 8](#)).

7. Touch Flow Sensor.

Figure 8. Calibration Menu: Flow Sensor Calibration



8. Touch Start Cal.
9. Touch Accept.
10. Follow all on-screen prompts.
11. If the calibration fails, verify firm attachment of the test circuit, secure connection of the exhalation filter, and ensure the system is free of leaks. Then rerun the test. Call Technical Services if the calibration continues to fail.

Exhalation Valve Calibration

The exhalation valve calibration function builds an exhalation valve table. The calibration requires a gold standard test circuit.

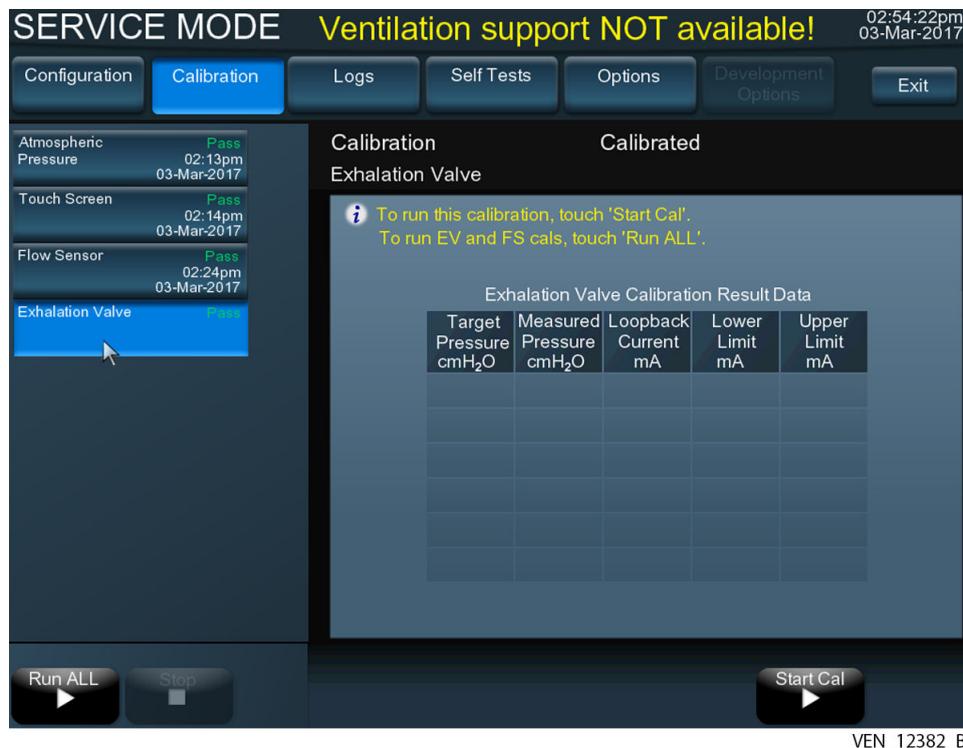
Note: If the ventilator has not reached operating temperature from recent usage, allow ventilator to warm up for at least 15 minutes in Service mode before performing this calibration.

Note: It is very important the ventilator passes the EST leak test prior to the exhalation valve calibration.

To calibrate the exhalation valve

1. Connect air and oxygen to the appropriate inlets.
2. Securely attach the gold test circuit to both the to and from patient ports.
3. Enter Service mode. See section 3.7.4 in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
4. Touch Calibration.
5. Touch Exhalation Valve.

Figure 9. Calibration Menu: Exhalation Valve Calibration



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6. Touch Start Cal.
7. Touch Accept.
8. Follow all on-screen prompts.
9. If the calibration fails, verify firm attachment of the test circuit, secure connection of the exhalation filter, the system is free of leaks, and then rerun the calibration. If the calibration continues to fail, call Technical Services.

Note: A system leak is a common source of failure, particularly exhalation filter leaks. Ensure the exhalation filter condensate vial is secured tightly, the drain port is capped, the filter is mounted securely to the ventilator, and the test circuit is securely attached.

Oxygen Sensor Calibration

Many service scenarios require calibration of the oxygen sensor. This calibration is not listed under the Calibration menu option in Service mode. the oxygen sensor calibration is performed in normal ventilation mode.

Note: If the ventilator has not reached operating temperature from recent usage, allow ventilator to warm up for at least 15 minutes in Service mode before performing this calibration.

Note: The oxygen sensor can possess three states: Enabled, Disabled, and Calibrate. The oxygen sensor is enabled at ventilator start-up regardless if New Patient or Same Patient setup is selected.

To enable, or disable the oxygen sensor

1. Enter normal ventilation mode.
2. Touch Vent Setup.
3. Touch More Settings from the available tabs.
4. Touch Enable or Disable, corresponding to the desired oxygen sensor function.

5. Touch Accept.

To calibrate the oxygen sensor

1. Enter normal ventilation mode.
2. Touch Vent Setup.
3. Touch More Settings from the available tabs.
4. Touch Calibrate for the oxygen sensor. The remaining time for calibration appears as a moving blue bar in the patient data area.
5. Allow the full 2 minutes to elapse for the calibration to complete.

To test the oxygen sensor calibration

1. Connect the ventilator's oxygen hose to a known good 100% oxygen source.
2. Calibrate the oxygen sensor as described.
3. Connect the oxygen hose to a second known good 100% oxygen source.
4. Set O₂% to each of the following values, and allow 1 minute after each for the monitored value to stabilize: 21%, 40%, 90%.
5. Watch the GUI to ensure that the value for the delivered oxygen is within 3% of each setting within 1 minute of selecting each setting.

4.5.3. PTS 2000 Setup

To set up the PTS 2000 ([Figure 10](#))

1. Attach the silicone barbed coupling to the high flow inlet port of the PTS 2000.
2. Attach the 22 mm tubing connector with pressure port to the barbed coupling.
3. Attach another barbed coupling to the 22 mm tubing connector.
4. Attach the barbed Re/Flex filter to the barbed coupling, ensuring that the flow direction arrow on the filter housing faces the PTS 2000.
5. Connect one end of a short piece of 3/16 in. ID tubing to the pressure port on the 22 mm tubing junction.
6. Connect the 4.8 mm (3/16 in.) by 3.2 mm (1/8 in.) tubing connector to the other end of the 4.8 mm (3/16 in.) ID tubing.
7. Connect the 4.8 mm (3/16 in.) by 3.2 mm (1/8 in.) tubing connector to one end of a short piece of 3.2 mm (1/8 in.) ID tubing.
8. Connect the other end of the 3.2 mm (1/8 in.) ID tubing to the (+) low pressure port on the front of the PTS 2000.
9. Connect the USB serial converter to a USB port on the PC.
10. Connect the serial cable to the USB serial converter.
11. Connect other end of the USB serial converter to the serial port at the rear of the PTS 2000.
12. Power on the PTS 2000 and allow a 10-minute warm-up.
13. Perform oxygen sensor calibration per the PTS 2000 user's manual if the calibration has not yet been performed the same day.

Note: Set the PTS 2000 to REMOTE OPERATION mode before launching the BreathLab PTS RPTS application software.

Note: For the PTS 2000 to communicate with the PC when using the RPTS application, the USB port must be set to COM1 on the PC for the USB serial converter.

Figure 10. PTS 2000



4.5.4. Ventilator Setup

To set up the ventilator

1. If not already warmed up, warm up the ventilator for a minimum of 15 minutes in Service mode.
2. Install the adult exhalation filter, inspiratory filter, and the PTS 2000 in series with the two longest sections of the reusable adult patient circuit as shown in [Figure 11](#).
3. Connect the ventilator to compressed air (if available) and oxygen gas supplies 241.3 kPa to 599.8 kPa (35 psi to 87 psi).
Note: If a compressed air source is not available, performance verification may be completed by running the optional compressor, if equipped.
4. Connect the ventilator power cord to an AC power source and verify that the AC power indicator is illuminated.
5. Verify that the primary battery is installed in the ventilator and the compressor, if equipped.
6. Perform EST and SST as described in section 1.10, and perform all required calibrations, as described in section 1.13.2.

Figure 11. PVT Ventilator Setup



Atmospheric Pressure Accuracy

To perform the pressure accuracy measurement

1. Set the PTS 2000 to measure BAROMETRIC in mmHg.
2. Record the PTS 2000 barometric pressure measurement on the PVR form.
3. Calculate the atmospheric pressure test limits using the following equations and record those limits on the PVR form:
 - Atmospheric pressure upper limit = PTS 2000 barometric reading $\times 1.02 + 20.2$ mmHg
 - Atmospheric pressure lower limit = PTS 2000 barometric reading $\times 0.98 - 20.2$ mmHg
4. Touch Calibration.
5. Touch Atmospheric Pressure.
6. Record the ventilator atmospheric pressure reading onto the PVR form.
7. Verify that the barometric pressure reading from the ventilator recorded on PVR form is within the calculated test limits stated in the previous equations.

Circuit Pressure Accuracy

To perform the circuit pressure accuracy measurement

1. Touch Self Tests > Manual > Manual PVT–Pressure.
2. Touch Start Test.
3. Touch Accept to confirm or Cancel to exit.
4. Record the low pressure reading from the PTS 2000 on the PVR form for each pressure setting specified in [Table 21](#).
5. Touch Accept.

6. Verify that the measured pressures are within the test limits specified in [Table 21](#).

Table 21. Circuit Pressure Tests

Pressure setting (cmH ₂ O)	Lower limit (cmH ₂ O)	Upper limit (cmH ₂ O)
10	6.64	13.37
50	45.34	54.67
100	93.71	106.29

7. Touch Cancel to exit the test.

Note: Circuit pressure accuracy tests can be performed at either 21% O₂ or 100% O₂ settings. It is not necessary to perform the pressure tests for both 21% O₂ or 100% O₂.

Gas Flow Accuracy

To perform the gas flow accuracy measurement

1. Set the PTS 2000 to measure High Flow, Air, SLPM.
2. Touch Self Tests > Manual > Manual PVT-Flow.
3. Touch Start Test.
4. Touch Accept to confirm or Cancel to exit.
5. Allow the PTS 2000 percent oxygen measurement to stabilize below 25% before recording air flow measurements.
6. Record the high flow reading from the PTS 2000 on the PVR form for each air flow setting specified in [Table 22](#) (150 LPM air flow setting is not applicable when operating on compressor without a wall air source available).
7. Touch Accept.
8. Set the PTS 2000 to measure High Flow, O₂, SLPM.
9. Touch Accept to confirm or Cancel to exit.
10. Allow the PTS 2000 percent oxygen measurement to stabilize above 94% before recording oxygen flow measurements.
11. Record the high flow reading from the PTS 2000 on the PVR form for each oxygen flow setting specified in [Table 22](#).
12. Touch Accept.
13. Verify that the measured flows are within the test limits specified in [Table 22](#).

Table 22. Flow Tests

Flow setting (L/min)	Lower limit (SL/min)	Upper limit (SL/min)
1	0.26	1.79
5	3.77	6.32
20	16.9	23.3
60	52.0	68.6
450*	131	170

*150 L/min air flow test is not applicable when using the compressor without access to an external compressed air supply, however, the 150 L/min oxygen flow test must be performed.

Breath Delivery Accuracy (adult/pediatric)

Figure 12. Adult/pediatric Breath Delivery Accuracy Test Setup



Setup for breath delivery accuracy tests

1. Connect the ventilator's adult inspiratory filter to the PTS 2000 high flow inlet port through the adult patient circuit inspiratory limb.
2. Connect the adult patient circuit wye to the PTS 2000 high flow outlet port through the gold standard tube.
3. Connect the adult patient circuit wye to the adult expiratory filter through the adult patient circuit expiratory limb.
4. Perform SST for Adult circuit type and HME humidification type.
5. Use a number 1 stopper when instructed to block the wye.

Volume Accuracy

1. Configure the ventilator per the parameters listed in [Table 23](#) for each V_T setting.
2. Set the PTS 2000 to measure volume, air/O₂ mix, mL, BTPS, flow-by tare 0.
3. Set the PTS 2000 trigger level (threshold) as specified in [Table 23](#) for each volume setting.

Table 23. Volume Test Settings

Parameter	Setting 1	Setting 2	Setting 3	Setting 4	Setting 5	Setting 6	Setting 7	Setting 8
V_T (mL)	25	30	50	200	300	500	600	2500
PBW (kg)	15	15	15	15	50 ^a	50	85 ^a	85
Mode	A/C	A/C	A/C	A/C	A/C	A/C	A/C	A/C
Mandatory type	VC	VC	VC	VC	VC	VC	VC	VC
Trigger type	P-Trig	P-Trig	P-Trig	P-Trig	P-Trig	P-Trig	P-Trig	P-Trig
P_{SENS} (cmH ₂ O)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
f (1/min)	30	30	20 ^a	20	20	20	10 ^a	10
V_{MAX} (L/min)	5	5	5	12 ^a	18 ^a	30 ^a	45 ^a	120 ^a
$O_2\%$	30	30	30	30	30	30	30	30
Flow pattern	square	square	square	square	square	square	square	square
$T_{PL}(S)$	0.2	0.2	0.6	0.6	0.6	0.6	0.0 ^a	0.0
PEEP (cmH ₂ O)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Test lung (L)	1.0	1.0	1.0	1.0	1.0	1.0	3.0 ^a	3.0
PTS 2000 trigger level (threshold) (SLPM)	3	3	3	8 ^a	12 ^a	20 ^a	28 ^a	40 ^a

^a These footnotes denote changes in settings when progressing from left to right through the table.

4. Set the ventilator alarm limits to minimum and maximum.
5. Set Apnea V_T to maximum.
6. Set up the ventilator as shown in [Figure 13](#). with the test lung specified in [Table 23](#) for each VT_T setting.

Figure 13. Volume Test Setup



VEN_12308_A

7. After a minimum of twelve breaths delivered for each V_T setting listed in [Table 23](#), record the volume measurement from the PTS 2000 and V_{TE} from the ventilator on the PVR form.
8. Verify that each delivered volume measured by the PTS 2000 and recorded on the PVR form is within the test limits listed in [Table 24](#).

Table 24. Volume Test Limits

Volume setting (mL)	Lower limit (mL)	Upper limit (mL)
25	11.0	39.0
30	14.4	45.6
50	34.0	66.0
200	166	234
300	254	346
500	430	570
600	518	682
2500	2190	2810

9. Calculate upper and lower test limits using the following formulas for V_{TE} and record those limits on the PVR form:
 - V_{TE} upper limit = PTS 2000 volume measurement $\times 1.10$ mL +4 mL
 - V_{TE} lower limit = PTS 2000 volume measurement $\times 0.90$ mL -4 mL
10. Verify that each recorded volume for V_{TE} is within the calculated test limits.
11. Place the ventilator into standby state.

Pressure Control Accuracy

1. Connect the 4-liter test lung to the patient circuit wye using the gold standard tube as shown in [Figure 14](#).

Figure 14. Pressure Control Accuracy Setup



- Configure the ventilator per the parameters specified in [Table 25](#) for each P_i setting.

[Table 25. Pressure Control Test Settings](#)

Parameter	Setting 1	Setting 2	Setting 3	Setting 4
P_i (cmH ₂ O)	5	10	25	90
PBW (kg)	15	15	85 ^a	85
Mode	A/C	A/C	A/C	A/C
Mandatory type	PC	PC	PC	PC
Trigger type	P-Trig	P-Trig	P-Trig	P-Trig
P_{SENS} (cmH ₂ O)	5	5	5	5
f (1/min)	30	30	20 ^a	20
T_i (s)	1.0	1.0	1.0	1.0
Rise time%	50	50	50	50
$O_2\%$	21	21	21	21
PEEP	0	0	0	0

^a These footnotes denote changes in settings when progressing from left to right through the table.

- Set the PTS 2000 to measure Low Pressure in cmH₂O.
- Set the ventilator alarm limits to minimum and maximum values.

5. After a minimum of five breaths delivered (10 seconds) for each P_i setting listed in [Table 25](#), record the maximum low-pressure measurement from the PTS 2000 on the PVR form.
6. Verify that each maximum low pressure measurement from the PTS 2000 recorded on the PVR form is within the test limits specified in [Table 26](#).

Table 26. Pressure Control Test Limits

Pressure setting, P_i (cmH ₂ O)	Lower limit (cmH ₂ O)	Upper limit (cmH ₂ O)
5	1.8	13.08
10	6.64	18.12
25	21.15	33.23
90	84.04	99.72

7. Place the ventilator into standby state.

PEEP Accuracy

1. Use the same ventilator setup as for the previous test (pressure control accuracy).
2. Configure the ventilator per parameters listed in [Table 27](#) for each PEEP setting.

Table 27. PEEP Test Settings

Parameter	Setting 1	Setting 2	Setting 3
PEEP (cmH ₂ O)	5.0	25.0	45.0
P_i (cmH ₂ O)	25	25	25
T_i (s)	1.0	1.0	1.0
PBW (kg)	50	50	50
Mode	A/C	A/C	A/C
Mandatory type	PC	PC	PC
Trigger type	P-Trig	P-Trig	P-Trig
P_{SENS} (cmH ₂ O)	5.0	5.0	5.0
f (1/min)	20	20	20
Rise time%	50	50	50
O ₂ %	21	21	21

3. Set the ventilator alarm limits to minimum and maximum values.
4. Set the PTS 2000 to measure Low Pressure in cmH₂O.
5. After a minimum of five breaths delivered (15 seconds) for each PEEP setting listed in [Table 27](#), record the baseline low pressure measurement from the PTS 2000 on the PVR form.
6. Verify that each low pressure measurement from the PTS 2000 recorded on the PVR form is within the test limits listed in [Table 28](#).

Table 28. PEEP Test Limits

Pressure setting (PEEP) (cmH ₂ O)	Lower limit	Upper limit
5	2.72	7.28
25	21.77	28.23
45	40.82	49.18

7. Place the ventilator into standby state.

FIO₂ Mix Accuracy

1. Connect the ventilator and the PTS 2000 with the reusable adult patient circuit, gold standard circuit and 1.0 liter adult test lung as shown in [Figure 15](#).

Figure 15. FIO₂ Mix Accuracy Setup



2. Configure the ventilator per parameters listed in [Table 29](#) for each O₂% setting.

Table 29. FIO₂ Mix Test Settings

Parameter	Setting 1	Setting 2
O ₂ %	90	30
PBW (kg)	50	50
Mode	A/C	A/C
Mandatory type	VC	VC
Trigger type	P-Trig	P-Trig
P _{SENS} (cmH ₂ O)	5.0	5.0
V _T (mL)	500	500
f (1/min)	20	50
MAX(L/min)	30	30
Flow pattern	square	square
T _{PL} (S)	0.0	0.0
PEEP	0.0	0.0

3. Set the ventilator alarm limits to minimum and maximum values.
4. After a minimum of 2 minutes of breath delivery for each O₂% setting listed in [Table 29](#), record the oxygen concentration measurement from the PTS 2000 onto the PVR form.
5. Verify that there are no high or low O₂% alarms active during each test.

- Verify that each O₂% measurement from the PTS 2000 recorded on the PVR form is within the test limits specified in [Table 30](#).

Table 30. FiO₂ Test Limits

FiO ₂ setting (%)	Lower limit (%)	Upper limit (%)
90	84.8	95.3
30	26.3	33.8

- Place the ventilator into standby state.

Breath Delivery Accuracy (neonatal)

Note: Perform neonatal tests only if the ventilator is configured with the NeoMode option.

Pressure control and PEEP test setup

- Set up the ventilator with the adult inspiratory filter, disposable neonatal exhalation filter and neonatal breathing circuit ([Figure 16](#)).
- Connect the neonatal breathing circuit wye to a 22mm OD / 15mm OD adapter and attach it to the barbed coupling on the filter placed on the high flow inlet port of the PTS 2000 ([Figure 16](#)).
- Connect one end of the gold standard tube to the high flow outlet port of the PTS 2000.
- Connect other end of the gold standard tube to the 22mm OD / 15mm ID adapter ([Figure 16](#)).
- Perform SST, for neonate patient circuit type and HME humidification type.
- When instructed to block the wye, use a number 1 stopper to block the 15 mm ID port of the 22mm OD / 15mm ID adapter ([Figure 16](#)).

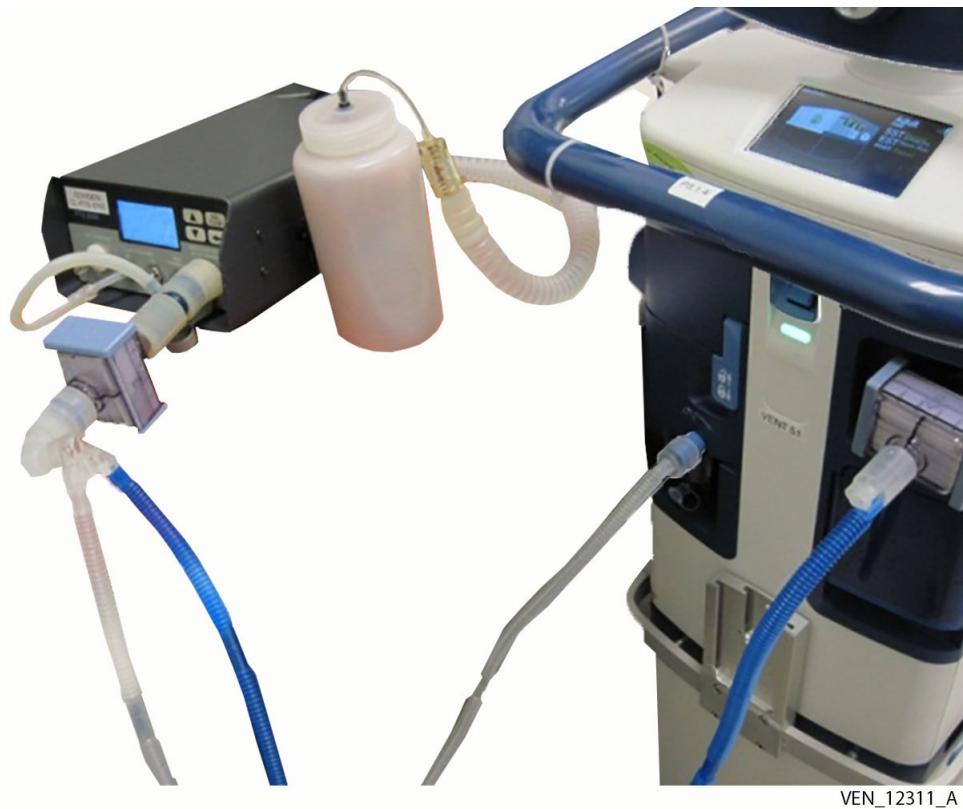
Figure 16. Neonatal Breath Delivery Accuracy Test Setup



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7. For all neonatal verification tests, connect the 1.0 liter infant test lung to the high flow outlet port through the gold standard tube and 22mm OD / 15mm ID adapter. ([Figure 17](#)).

Figure 17. Infant Test Lung



Pressure Control Accuracy

1. Configure the ventilator with the parameters specified in [Table 31](#) for each P_i setting.

[Table 31. Neonatal Pressure Control Settings](#)

Parameter	Setting 1	Setting 2	Setting 3
P_i (cmH ₂ O)	5	10	20
PBW (kg)	3	3	3
Mode	A/C	A/C	A/C
Mandatory type	PC	PC	PC
Trigger type	TRIG	TRIG	TRIG
SENS (L/min)	1.0	1.0	1.0
f (1/min)	60	60	60
T _i (s)	0.6	0.6	0.6
Rise time%	75	75	75
O ₂ %	21	21	21
PEEP (cmH ₂ O)	0.0	0.0	0.0

2. Set the ventilator alarm limits to minimum and maximum values.
3. After a minimum of thirty breaths are delivered (30 seconds) for each P_i setting listed in [Table 31](#), record the maximum low pressure measurement from the PTS 2000 on the PVR form.

- Verify that each maximum low pressure measurement from the PTS 2000 recorded on the PVR form is within the test limits specified in [Table 32](#).

Table 32. Neonatal Pressure Control Test Limits

Pressure setting, P_t (cmH ₂ O)	Lower limit (cmH ₂ O)	Upper limit (cmH ₂ O)
5	1.80	8.20
10	6.64	13.37
20	16.31	23.69

PEEP Accuracy

- Configure the ventilator with parameters specified in [Table 33](#) for each PEEP setting.

Table 33. Neonatal PEEP Test Settings

Parameter	Setting 1	Setting 2
PEEP	5.0	10.0
P_t (cmH ₂ O)	10	10
T _i (S)	0.6	0.6
PBW (kg)	3	3
Mode	A/C	A/C
Mandatory type	PC	PC
Trigger type	TRIG	TRIG
SENS(L/min)	1.0	1.0
f(1/min)	30	30
Rise time%	50	50
O ₂ %	21	21

- Set the ventilator alarm limits to minimum and maximum values.
- After a minimum of fifteen breaths are delivered (30 seconds) for each PEEP setting listed in [Table 33](#), record the baseline low and high pressure measurement from the PTS 2000 on the PVR form.
- Verify that each low pressure and high pressure measurement from the PTS 2000 recorded on the PVR form is within the test limits specified in [Table 34](#).

4

Table 34. Neonatal PEEP Test Limits

Pressure setting, PEEP (cmH ₂ O)	Lower limit (cmH ₂ O)	Upper limit (cmH ₂ O)
5.0	2.72	7.28
10.0	7.49	12.52

4.6. Resetting Ventilator and Compressor PM Hours

Note: The messages shown in Figure 1-20. through Figure 1-22. appear based on the minimum ventilator **and** compressor hours. For example, if preventive maintenance for the ventilator is due in 4000 hours, and preventive maintenance for the compressor is due in 20 hours, the status display will show the image in Figure 1-21. with 20 hours displayed in the message.

The ventilator's status display indicates when preventive maintenance (PM) for the ventilator and compressor (if installed) is due (Figure 1-20.). Both the ventilator and compressor preventive maintenance intervals are 10 000 hours. The status display indicates when preventive maintenance is due for the ventilator and the compressor. There are three indicators appearing at four different times:

- **Preventive Maintenance is due**—The status display text is **yellow** in color and the message appears when the PM due hours reach 0 (Figure 1-20.).
- **Preventive Maintenance is due**—The status display text is **yellow** in color and the message appears when the time remaining for preventive maintenance is ≤ 10 hours.

Figure 18. Status Display Preventive Maintenance Due Status Display Indicator



Note: Notice that the same status display image (Figure 1-20.) appears when preventive maintenance due hours reach 0 **and** when preventive maintenance due hours are ≤ 10 .

Preventive maintenance due in X hours—The status display text is **yellow** in color and the message appears when preventive maintenance is due where X is any number of hours ≤ 500 . (Figure 1-21.).

Figure 19. Preventive Maintenance Due in ≤ 500 Hours Status Display Indicator



Note: Although the image shown in Figure 1-21. shows preventive maintenance due in 500 hours, the actual image could show any number of hours ≤ 500 .

Preventive maintenance due in X hours—The status display text is **green** in color and the message appears when X is any number of hours > 500 (Figure 1-22.).

Figure 20. Preventive Maintenance Due in Hours >500 Status Display Indicator



Note: Although the image shown in Figure 1-22. shows preventive maintenance due in 4000 hours, the actual image could show any number of hours >500.

To reset PM hours

1. Enter Service mode. See section 3.7.4 in the Puritan Bennett™ 980 Series Ventilator Operator's Manual.
2. Touch the Configuration tab, then touch Operational Time from the list that appears.

Figure 21. Operational Time Screen



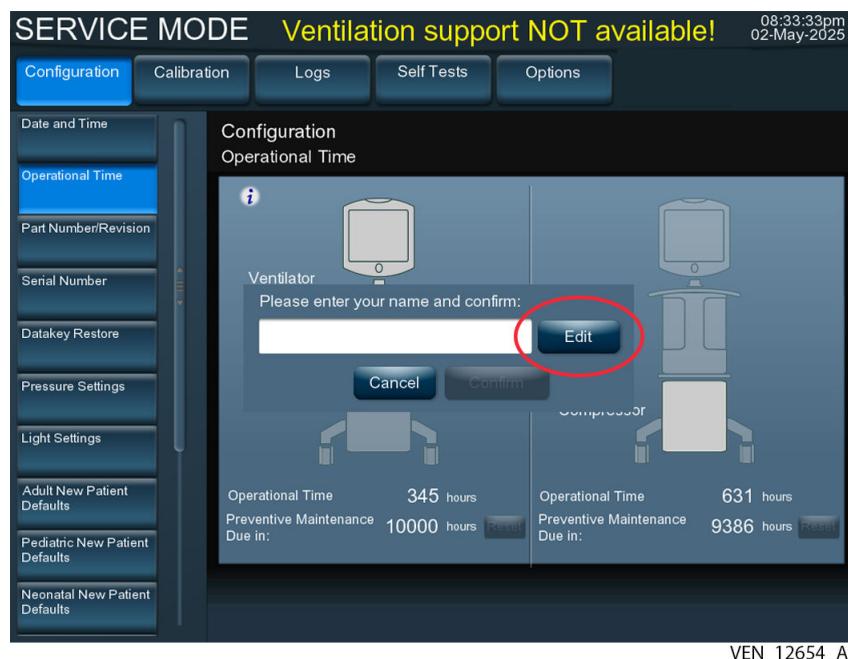
3. Touch the ventilator or compressor Reset button for the unit's PM hours you wish to reset (ventilator or compressor). A message appears stating the PM hours for the ventilator or compressor will be reset, and asks you if you want to proceed.

Figure 22. PM Hours Reset Confirmation Message



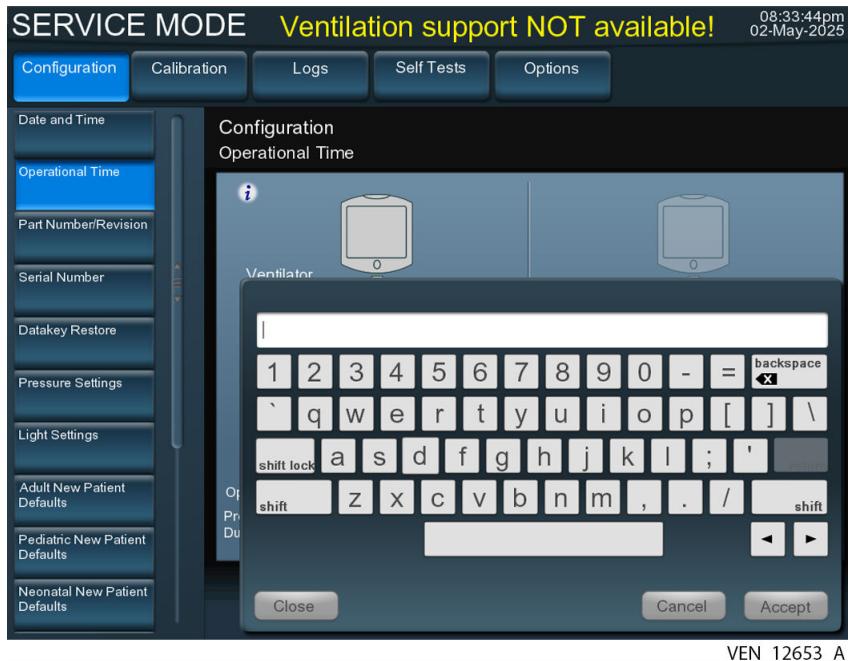
4. Touch the Yes button to proceed. Upon touching Yes, a screen appears, allowing you to enter your name.

Figure 23. Name Entry Screen



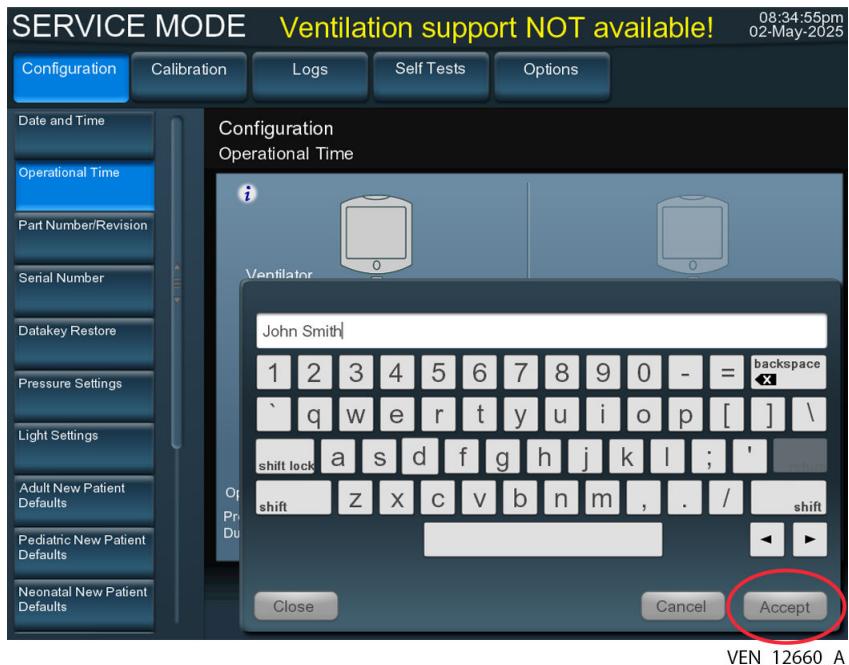
5. Touch the Edit button. A virtual keyboard appears, allowing you to type your name.

Figure 24. Virtual Keyboard



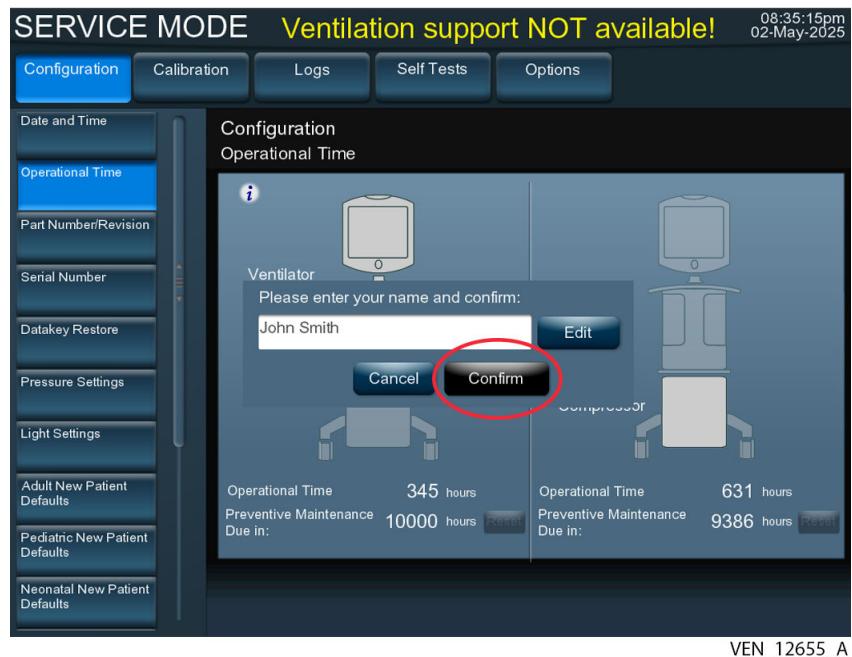
- Type your name using the virtual keyboard.

Figure 25. Name Entry



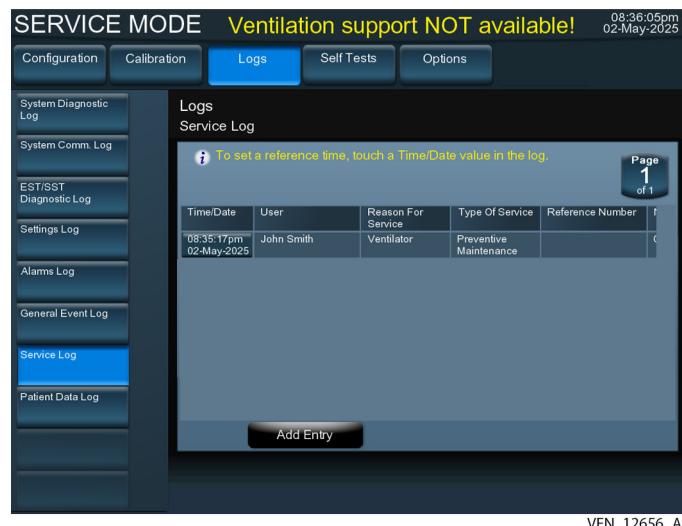
- Touch the Accept button. A screen appears allowing to confirm your entry.
- Touch the Confirm button. The ventilator or compressor Preventive Maintenance Due hours resets to 10 000.
- Verify that the PM hours reset action was recorded in the service log, by touching the Logs tab at the top of the GUI screen and then touching the Service Log tab.

Figure 26. Name Entry Confirmation Screen



10. To reveal additional information, swipe the screen to the left.

Figure 27. Service Log Entry for PM Hours Reset



5. Ventilator Repair

5.1. Overview

This chapter provides Covidien-trained service technicians with information on how to repair the Puritan Bennett™ 980 Series ventilator. Repair procedures include removal, installation, and adjustment of major sub-assemblies and component parts. See section 7.4 and section 7.7 of the Puritan Bennett™ 980 series operator's manual for details related to ventilator cleaning.

Visit www.medtronic.com/covidien/support/product-manuals to obtain the Puritan Bennett™ 980 series operator's manual.

[Overview, page 103](#)

[Repair Prerequisites and Required Equipment, page 103](#)

[General Repair Guidelines, page 106](#)

[Specific Repair Guidelines, page 106](#)

[Post-service Procedures, page 108](#)

[Patient system and accessories, page 108](#)

[Breath Delivery Unit \(BDU\) Assembly, page 109](#)

[Inspiratory Module, page 133](#)

[Exhalation Module, page 173](#)

[Card Cages and Related BDU PCBA, page 184](#)

[Coin Battery Replacement Instructions, page 186](#)

[BDU Power, page 196](#)

[Graphic User Interface \(GUI\), page 207](#)

[3rd Generation Graphic User Interface \(GUI\), page 207](#)

[4th Generation Graphic User Interface \(GUI\), page 225](#)

[DC Compressor, page 243](#)

[Base, page 276](#)

5.2. Repair Prerequisites and Required Equipment

Warning: To ensure proper servicing and avoid the possibility of physical injury, only Covidien-trained service technicians should attempt to service or make authorized modifications to the ventilator. Only Covidien-trained service technicians should open the chassis, remove and replace components, or make adjustments. If the medical facility does not have a qualified service technician, contact Technical Services or local technical representative.

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

Warning: To avoid an electrical shock hazard while servicing the ventilator, be sure to remove all power to the ventilator by disconnecting the power source and turning off all

ventilator power switches before servicing. Follow accepted safety practices for electrical equipment when testing or making equipment adjustments, or repairs.

Warning: Before attempting to open or disassemble, disconnect the power cord to avoid possible injury.

Warning: To avoid electrocution never touch the ventilator's internal components, including the battery, and any person simultaneously.

Warning: To prevent possible personal injury, always disconnect the oxygen source from the ventilator before service.

Warning: To prevent potential injury, lock the front casters prior to installing or removing ventilator components.

Warning: To prevent potential injury, refrain from contact with hot surfaces inside the ventilator.

Warning: When servicing the ventilator, review and adhere to all posted and stated safety warning and caution labels on the ventilator, its components, and any service equipment or materials used. Failure to adhere to such warnings and cautions at all times may result in injury or property damage.

Warning: The LCD panel contains toxic chemicals. Do not touch broken LCD panels.

Physical contact with a broken LCD panel can result in transmission or ingestion of toxic substances.

Warning: Follow accepted safety procedures for electrical equipment when making connections, adjustments, or repairs.

Warning: Use personal protective equipment whenever exposure to toxic fumes, vapor, dust particles, blood pathogens, and other transmittable diseases and hazardous material can be expected. If in doubt, consult an environmental health and safety specialist or an industrial hygienist before servicing the ventilator.

Warning: Use only Covidien-recommended cleaning agents identified in the product-related documentation. Use all cleaning solutions and products with caution. Read and follow the instructions associated with the cleaning agents/disinfectants.

Warning: Use only Covidien replacement parts when servicing the ventilator.

Warning: Do not clean any gas pathway with a liquid cleaner. Use only the allowable cleaning and disinfecting agents for use on other parts of the ventilator.

Warning: Use the test data sheet to ensure the monitoring system passes all safety, performance, and functional tests prior to use in a clinical setting.

Caution: Ensure the work surface is clean and free of debris.

Caution: Observe electrostatic discharge (ESD) precautions prior to opening the chassis or handling any internal components.

Caution: Do not over-tighten screws. Over-tightening can strip out screw holes, rendering them useless.

Note: Do not dispose of parts by placing in the regular trash. Dispose of parts in accordance with local guidelines and regulations or contact Covidien to arrange for disposal.

Only a Covidien-trained service technician may disassemble the ventilator to its major component parts. The supported replacement level is to the printed circuit board assembly (PCBA) and major subassembly level. After isolating the problem to a suspected PCBA, follow the procedures for disassembly, then replace the original suspect PCBA with a

known good PCBA. Verify the symptom disappears and ensure the ventilator passes all performance tests. If the symptom persists, swap the known good PCBA with the original suspect PCBA and continue troubleshooting.

1. Always remove all batteries.
2. Always disconnect the ventilator from AC power until completion of reassembly. This pertains to the entire ventilator, including the GUI, BDU, and Base.
3. Always disconnect air and oxygen hoses from the ventilator.
4. Prepare a clean, static-free work surface large enough to accommodate the ventilator and its subassemblies. A container with cover to retain screws and small parts is also helpful.

Required Tools

- Allen wrench, .050
- Allen wrench, 3 mm
- Allen wrench set, 3/32 to 5/32
- Ball-end hex driver, long-handled, 3/32 to 5/32
- Diagonal cutters
- Gloves, Latex or alternate
- Grease, Krytox^{TM*}
- Nut driver, 3/16-in.
- Nut driver, 5/16-in.
- Nut driver, 11/32-in.
- Pliers, needle-nose
- Screwdriver, flat-blade 1/8 to 1/4 inch
- Screwdriver, Phillips-head P0 to P2
- Screwdriver, Phillips-head P2, ratcheting, right angle
- Static-dissipative field service kit (includes wrist strap, static dissipative mat, and earth (ground) cord)
- Wrench, adjustable: 12inch/capable of 1.5 inch grip

Required Accessories

Follow all general repair guidelines when repairing any portion of the ventilator.

See [page 106](#) and the applicable specific repair guidelines.

Use the following accessories when performing the extended self test after completing all ventilator repairs:

- Gold standard test circuit
- Stopper to block patient wye

5.3. General Repair Guidelines

Follow these general guidelines when servicing the ventilator. The repair sections assume compressed gas sources, the patient system, flex arm, and humidifier are already removed from the ventilator.

- Adhere to ESD guidelines when servicing electrostatic discharge (ESD) sensitive components to prevent any damage to them or the ventilator.
- Use only recommended tools, test equipment, and service materials when servicing the ventilator.
- Perform all applicable cleaning and inspection procedures while repairing the ventilator.
- Visually inspect any removed ventilator parts, including those removed to gain access to a suspected faulty part. Inspect the exposed area behind the removed parts as well. Clean removed parts to facilitate further inspection as necessary.
- Investigate and determine the cause of any detected abnormality. Repair the unit or contact Technical Services for help in diagnosing unresolved symptoms.
- Replace or repair all parts that are worn, missing, damaged, cracked, corroded, burnt, warped, bent, disfigured, or broken.
- Do not over-tighten screws during reassembly. Damage to components may occur due to over-tightening of screws.
- Leak-test pneumatic parts where indicated, following the procedure identified in this chapter.
- Follow all local governing ordinances and recycling instructions for any ventilator parts or components.

Safety Checks

Covidien-trained service personnel should perform Extended Self Test (EST) on the ventilator after any servicing of the ventilator.

Documentation of Maintenance and Repair

Covidien-trained service personnel can manually enter the service date, time, and nature of repair/preventive maintenance performed into the log using a keyboard provided on the GUI interface.

To manually document a service or preventive maintenance activity

1. Enter Service mode.
2. Select the Logs tab.
3. Select the Service Log tab.
4. Select Add Entry; using the buttons to the right of each line, complete the entry.
5. Touch Accept when complete.

5.4. Specific Repair Guidelines

Repair-related Cleaning

Cleaning guidelines pertain to parts that require cleaning while servicing the ventilator. For procedures on periodic cleaning and sterilization of the ventilator and accessories, refer to the Puritan Bennett™ 980 ventilator operator's manual. For periodic cleaning and inspection procedures that are required during a ventilator's performance verification, refer to Chapter 5 in this manual. Replace all identified parts that cannot be cleaned.

- Clean ventilator exterior surfaces before disassembly with approved cleaning and disinfecting agents. Use a clean, lint-free cotton cloth. Allow cleaned ventilator parts and surfaces to air-dry.
- Vacuum the ventilator interior using static-resistive equipment. Do **not** clean the ventilator interior or exterior surface with compressed air.

Electrical Cables and Pneumatic Tubing Repair

- To ensure proper reassembly, note or label wire and tube positions before disconnecting parts.
- To avoid damaging a silicone tube when removing from a fitting, turn the tube while pulling outward using steady pressure.
- Install all tubes, harnesses, or cables using tie wraps as specified. Ensure wiring does not interfere with and cannot be damaged by hinged or moving ventilator parts.

Adhesive Usage

Warning: Always replace damaged warning, caution, and identification labels. Failure to do so may result in personal injury or equipment/property damage.

- First remove any adhesive residue using a suitable scraping tool that won't scratch the surface of the part or ventilator, then clean the scraped surface thoroughly with Isopropyl alcohol. Ensure the application area is free of dust and grease; then apply pressure, ensuring adhesive contact and bonding. Eliminate any trapped air bubbles.
- Exercise care when using any cleaners and solvents since they might cause personal injury or damage to ventilator surfaces. Use in a well-ventilated area.
- Replace any damaged warning and caution labels.

Leak Test

Caution: Replacing some ventilator components requires the use of leak detector fluid to ensure a good gas seal. Use extreme caution when using a leak detector in the vicinity of electronics. Thoroughly dry all components following the use of a leak detector.

To perform a leak test

1. Connect compressed gas sources to ventilator.
2. Using small brush, apply leak detector fluid to pneumatic connections.
3. If a connection leaks, repair and retest module.
4. Dry all leak detector fluid from chassis.

Electrostatic Discharge (ESD) Control

Follow ESD controls and precautions whenever performing repairs on the ventilator to prevent ESD damage to the static-sensitive microelectronic components and assemblies in the ventilator.

Electrostatic discharge can permanently damage static-sensitive microelectronic components or assemblies during handling, even without direct contact to the component

or assembly. ESD damage might show up at a later time. It can manifest as a premature catastrophic failure of a component or assembly, or as an intermittent failure, all of which can be difficult and costly to locate.

- Use a static-dissipative system. Before opening the ventilator or removing its panels, always wear ESD protection. Properly connect the static-dissipative mat to a reliable ground.
- Follow correct procedures when using a static-dissipative mat. Place tools, test equipment, and the static-sensitive device on the static-dissipative mat before starting repairs. Conduct all work on the static-dissipative mat.
- Keep nonconducting materials away from the work area. Static charges from nonconducting material, (i.e. plastic containers, foam cups, synthetic clothing, cellophane tape, etc.) cannot be removed by grounding. These items must be kept away from the work area when handling static-sensitive devices.
- Handle static-sensitive components properly. Do not handle static-sensitive component connection points, connector pins, leads, or terminals.
- Follow correct procedures when using static-shielding bags. Store and transport all static-sensitive devices in static-shielding bags at all times. Never place more than one static-sensitive device in a static-shielding bag. Never place static-generating nonconducting material inside a static-shielding bag with a static-sensitive device. Place any static-sensitive device in a static-shielding bag immediately after removal. Close the bag to ensure the shield is effective.

Replacement Part Ordering

Properly identify both the ventilator version and part prior to ordering parts. Order the next higher assembly for unavailable or out of stock parts. Retain each defective part and compare it with the replacement part for compatibility.

5.5. Post-service Procedures

After completion of any ventilator preventive maintenance or repair, always perform the required tests listed in [Table 17](#) or [Table 18](#) (appropriate for the type of service performed) before returning the ventilator to clinical usage.

5.6. Patient system and accessories

Warning: Connectors and tubes with barbed cuff fittings are intended for use only with like fittings. They are not interchangeable with ISO-standard cone and socket fittings.

Combining these two fitting types may not create a leak-tight connection. Use adapters to connect barbed cuff fittings with ISO-standard cone and socket fittings.

For replacement of clinician-replaceable accessories, reference the Accessories chapter in the Operator's Manual after reviewing the following list.

1. Exhalation filtration system
2. Inspiratory bacteria filters
3. Patient circuit
4. Test lung

5. Drain bag tubing
6. Wall air water trap, condensate vial and vial parts
7. Humidifier bracket
8. Air hose, flex arm assemblies
9. Rechargeable batteries

5.7. Breath Delivery Unit (BDU) Assembly

Warning: Use extreme care when moving the BDU or GUI. Do not jar or drop them. Lock the BDU latch to secure the BDU in place on the base.

Follow all general repair guidelines when repairing any portion of the ventilator.

See [General Repair Guidelines, page 106](#) and the applicable specific repair guidelines. Use the following content list to locate the proper area within this section.

[Overview, page 109](#)

[BDU Assembly, page 110](#)

[BDU Right Panel, page 113](#)

[BDU Left Panel, page 113](#)

[BDU Rear Panel, page 114](#)

[BDU Front Panel, page 115](#)

[BDU Front, Side, and Rear Panel Components, page 117](#)

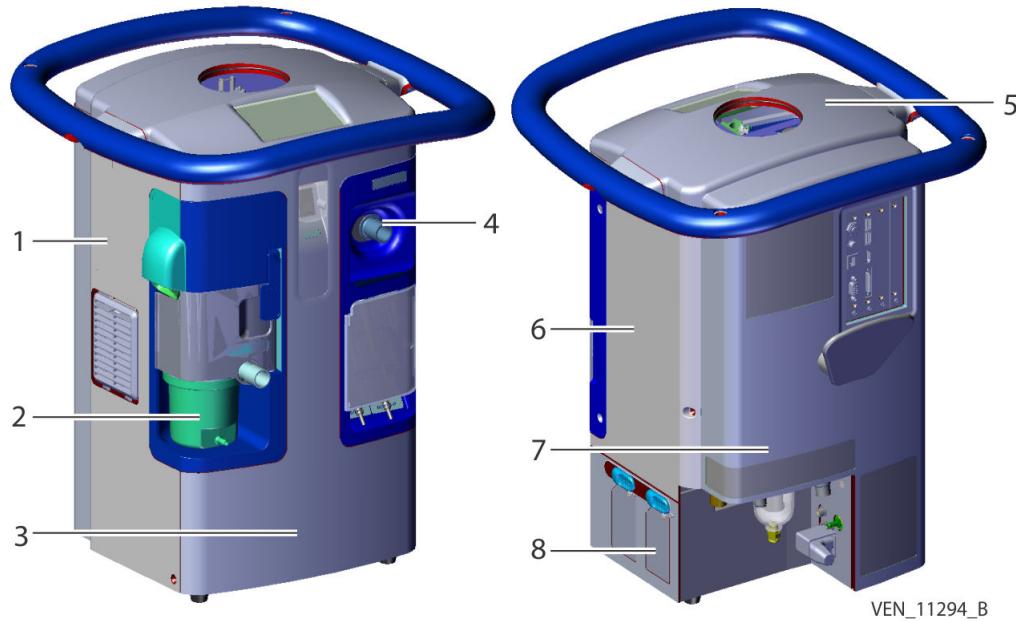
[To replace the BDU top cap assembly, page 122](#)

[BDU Floor and Base Plate Components, page 129](#)

5.7.1. Overview

This section addresses removal and replacement of the BDU assembly and its sub-assemblies and does not require removal or replacement in a particular sequence. See [page 110](#) for details on replacing the entire BDU assembly.

Figure 28. BDU Panels



1. BDU left panel (See [BDU Left Panel, page 113.](#))
2. Exhalation module (See [Exhalation Module, page 173.](#))
3. BDU front panel (See [BDU Front Panel, page 115.](#))
4. Inspiratory module (See [Inspiratory Module, page 133.](#))
5. BDU top cap (See [To replace the BDU top cap assembly, page 122.](#))
6. BDU right panel (See [BDU Right Panel, page 113.](#))
7. BDU rear panel (See [BDU Rear Panel, page 114.](#))
8. BDU batteries (See [BDU Power, page 196.](#))

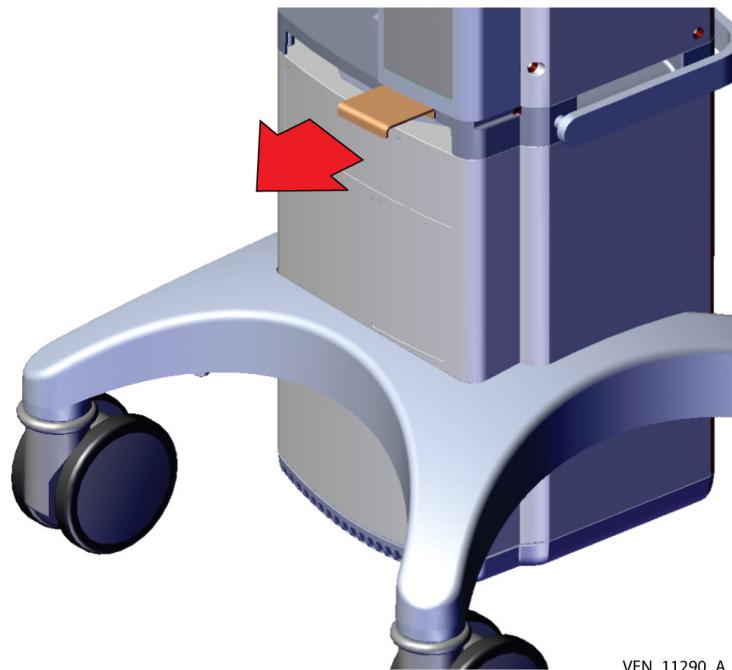
5.7.2. BDU Assembly

Warning: Lifting the BDU assembly off the base requires two people. Request assistance prior to lifting the BDU assembly.

5.7.2.1. To lift the BDU assembly off the base

1. Remove the GUI assembly. See [page 209.](#)
2. At the rear of the ventilator, pull out the locking handle below the BDU rear panel.

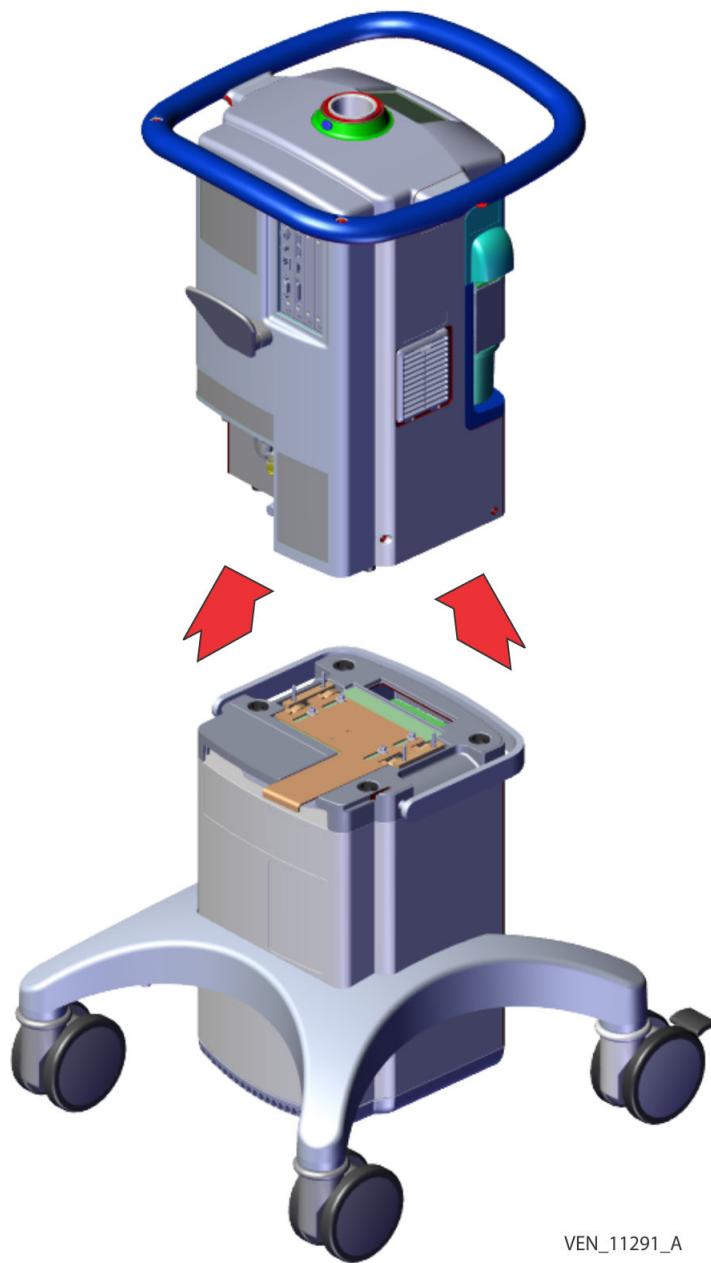
Figure 29. Locking Clip



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3. Lift the BDU assembly away from the base assembly, supporting it securely without damaging any connections.
4. Lift out the data cable, compressor power cable, and pneumatic tube from the compressor slot while ensuring the BDU is properly supported.
5. Lift the BDU assembly away from the base.

Figure 30. Lifting the BDU Assembly Off the Base



6. Move the BDU assembly to a work surface, ensuring the front feet and cables extend out over the lip of the surface.

Note: Do not set the BDU assembly on a surface that does not allow it to extend just beyond the surface edge to permit cabling and hoses to dangle undamaged.

5.7.2.2. To replace the BDU assembly on the base

1. Lift the BDU assembly off the work surface.
2. Align the BDU assembly to the base.
3. Set the BDU assembly down on the base and push the locking handle until it snaps into place.

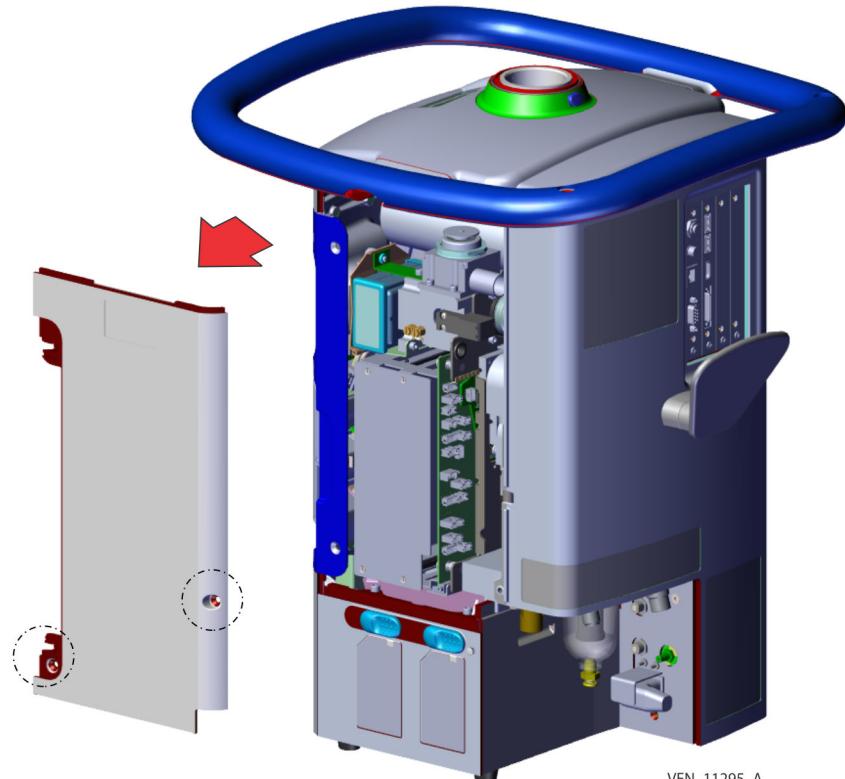
4. Replace the GUI assembly. See [page 209](#).

5.7.3. BDU Right Panel

5.7.3.1. To remove the BDU right panel

1. Remove the two screws securing the inspiratory door to the BDU right panel.
2. Loosen the two screws that secure the BDU right panel in place.

Figure 31. BDU Right Panel



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3. Remove the BDU right panel.

5.7.3.2. To replace the BDU right panel:

1. Fit the BDU right panel up under the lip of the top cap until the screws align with the nuts contained in the chassis.
2. Tighten the two screws securing the BDU right panel.
3. Tighten the two screws securing the inspiratory door to the BDU right panel.

5

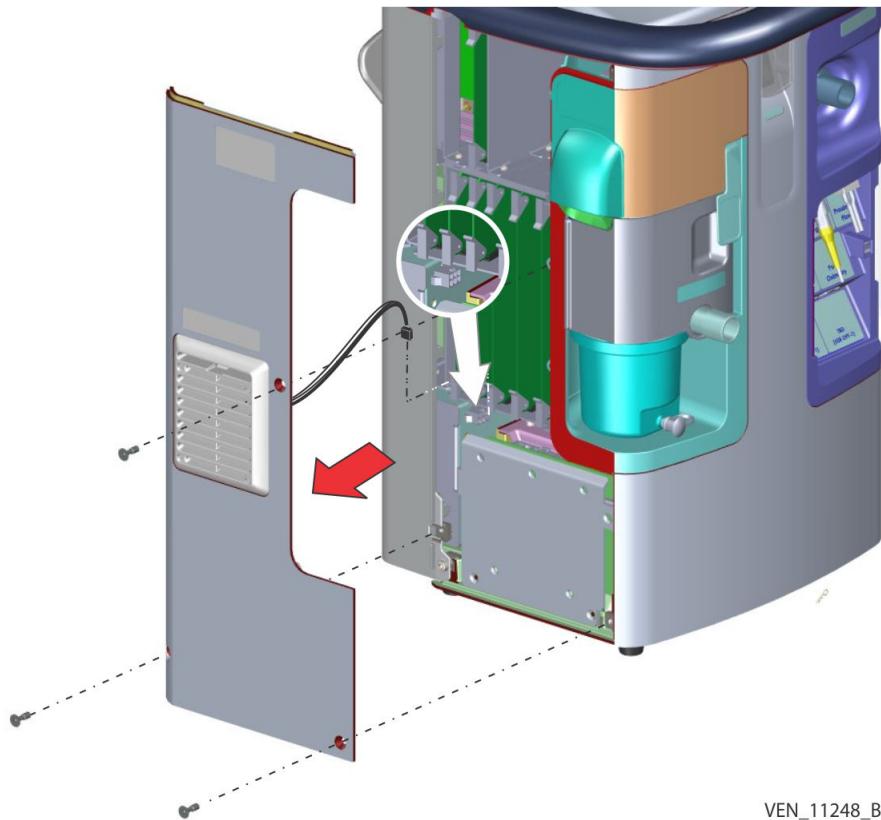
5.7.4. BDU Left Panel

5.7.4.1. To remove the BDU left panel with fan assembly

1. Loosen the two bottom screws securing the BDU left panel.
2. Loosen the screw that secures the middle BDU left panel.

3. Support the panel while disconnecting the fan cable from the P1 connector on the power distribution PCBA.

Figure 32. BDU Left Panel



4. Remove the BDU left panel. See [page 113](#).

5.7.4.2. To replace the BDU left panel

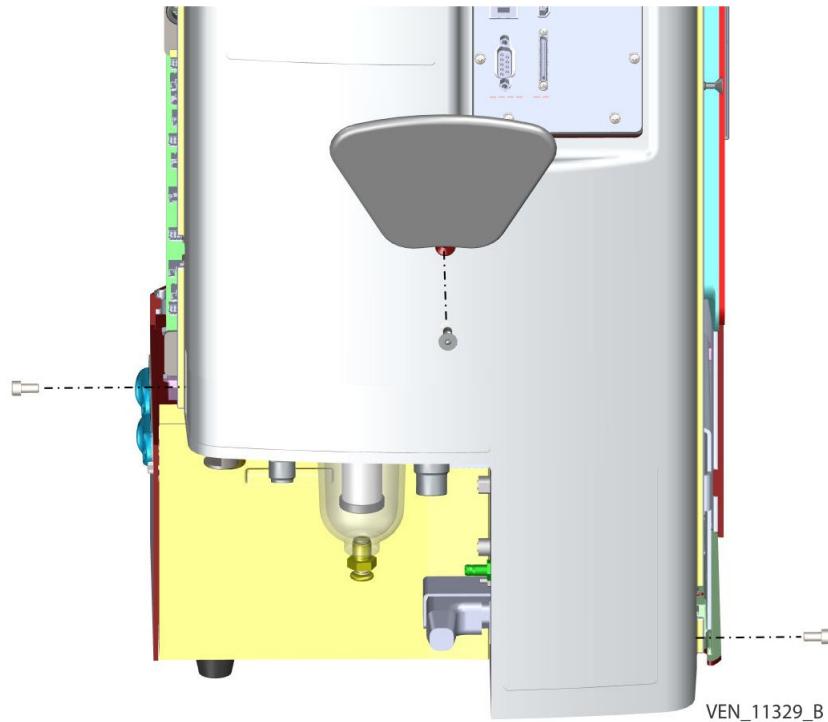
1. Reconnect the fan cable to the P1 connector while supporting the BDU left panel.
2. Lift the BDU left panel up under the lip of the top cap until the bottom screws align with the nuts contained in the chassis.
3. Tighten the screw that secures the middle BDU left panel.
4. Tighten the two remaining bottom screws.

5.7.5. BDU Rear Panel

5.7.5.1. To remove the BDU rear panel

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the two screws located on either side closest to the bottom of the left and right panel openings that secure the BDU rear panel.

Figure 33. BDU Rear Panel



4. Remove the central screw located under the cord wrap assembly.

5.7.5.2. To replace the BDU rear panel

1. Lift the BDU rear panel up under the lip of the top cap until the screws align with the nuts contained in the chassis.
2. Tighten the central screw located under the cord wrap assembly.
3. Tighten the two bottom screws located on either side closest to the bottom of the left and right panel openings.
4. Replace the BDU right panel. See [page 113](#).
5. Replace the BDU left panel. See [page 114](#).

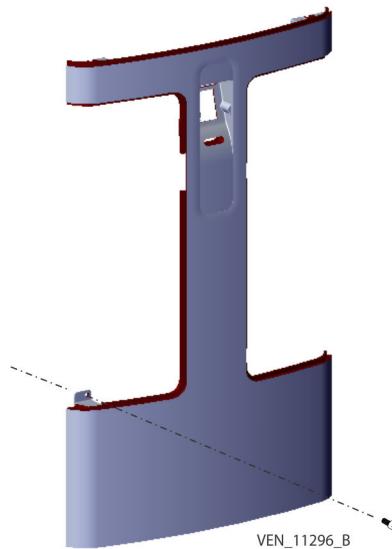
5.7.6. BDU Front Panel

5.7.6.1. To remove the BDU front panel

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the GUI assembly. See [page 208](#).
5. Remove the inspiratory module. See [page 141](#).
6. Remove the exhalation module. See [page 177](#).
7. Remove the top cap assembly. See [page 121](#).
8. Remove the options card cage PCBAs, if any populate the options card cage. See [page 195](#).

9. Remove the options card cage. See [page 195](#).
10. Lift the entire BDU assembly off the base. See [To lift the BDU assembly off the base, page 110](#).
11. Move the BDU assembly to a work surface, ensuring the front feet and cables extend out over the lip of the surface.
12. Disconnect the AC power switch and its components. See [BDU Front Panel, page 115](#).
13. Remove the ten screws, five on each side with three along each side of the spine and two along the bottom of each side, holding the front panel to the BDU chassis spine.
14. Remove the front three screws holding the front panel to the bottom of the BDU floor.

Figure 34. Removed Front Panel



15. Remove the AC power switch and its components. See [page 117](#).
16. Remove the inspiratory door assembly. See [page 136](#).

5.7.6.2. To replace the BDU front panel

1. Replace the inspiratory door assembly. See [page 137](#).
2. Replace the AC power switch and its components. See [page 117](#).
3. Lift the BDU front panel and align it to the BDU chassis.
4. Tighten the top two screws holding the front panel to the BDU chassis spine.
5. Tighten the three bottom screws holding the front panel to the BDU floor.
6. Tighten the eight screws, four on each side, holding the front panel to the BDU chassis spine.
7. Reconnect the AC power switch and its components. See [page 118](#).
8. Replace the BDU assembly on the base. See [page 112](#).
9. Replace the options card cage. See [page 195](#).

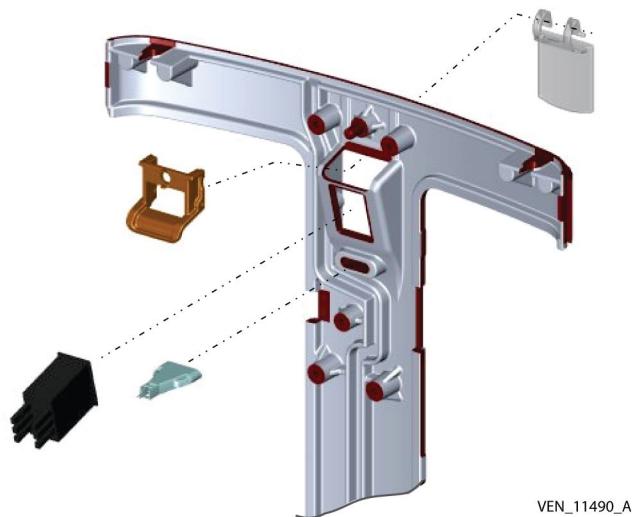
10. Replace the options card cage PCBAs, if any populated the options card cage. See [page 195](#).
11. Replace the top cap assembly. See [page 122](#).
12. Replace the exhalation module. See [page 178](#).
13. Replace the inspiratory module. See [page 143](#).
14. Replace the GUI assembly. See [page 209](#).
15. Replace the BDU rear panel. See [page 115](#).
16. Replace the BDU left panel. See [page 114](#).
17. Replace the BDU right panel. See [page 113](#).

5.7.7. BDU Front, Side, and Rear Panel Components

Follow all general repair guidelines when repairing any portion of the BDU field replaceable units (FRUs) or sub-assemblies. See [page 106](#) and the applicable specific repair guidelines. This section addresses removal and replacement of various sub-assemblies.

5.7.8. BDU Front Panel Components

Figure 35. Exploded View of Front Panel Components



5.7.8.1. AC Power Switch Components

5.7.8.2. To remove the AC power switch and its components

1. Remove the BDU left panel. See [page 113](#).
2. Remove the exhalation module. See [page 177](#).
3. Remove the AC indicator, if desired. See [page 118](#).
4. Disconnect the AC power switch cable from the AC power switch.
5. Press one of the prongs at the top of the AC power switch cover inward until it releases from the front panel.
6. Tip outward and downward as both sides release, pulling gently to remove.

7. Pinch inward on all four prongs at the backside of the AC power switch.
8. Push the AC power switch outward through the front panel.

5.7.8.3. To replace the AC power switch and its components

1. Insert the connector of the AC power switch cable through the opening in the front panel.
2. Reconnect the connector to the AC power switch.
3. Set the AC power switch with the ON position to the top.
4. Align the AC power switch to the opening in the front panel.
5. Press the AC power switch through the front panel until the prongs snap in place.
6. Press the AC power switch cover upward into its slot until it snaps into place in front of the AC power switch.
7. Replace the AC indicator, if removed. See [page 118](#).
8. Replace the exhalation module. See [page 178](#).
9. Replace the BDU left panel. See [page 114](#).

5.7.8.4. AC Indicator

5.7.8.5. To remove the AC indicator

1. Remove the BDU left panel. See [page 113](#).
2. Remove the exhalation module. See [page 177](#).
3. Disconnect the AC power indicator cable by pressing its release latch.
4. Pinch both prongs at the sides of the AC indicator inward.
5. Push the AC indicator out through the front panel.

5.7.8.6. To replace the AC indicator

1. Insert the power LED cable through the opening in the front panel.
2. Connect the AC power LED connector. Reconnect the power LED cable to the AC indicator.
3. Align the AC indicator to the opening in the front panel.
4. Press the AC indicator in through the front panel until the prongs snap in place.
5. Replace the AC power switch. See [page 118](#).
6. Replace the exhalation module. See [page 178](#).
7. Replace the BDU left panel. See [page 114](#).

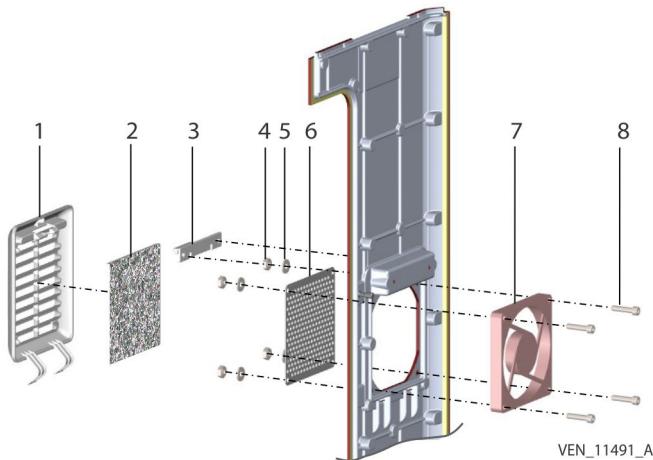
5.7.9. BDU Left Panel Components

Warning: To prevent potential injury, follow the preventive maintenance schedule for the fan and fan filter.

A minimum replacement schedule for the fan and fan filter is at 10 000 hours of usage. It is included in the 10 000 hour preventive maintenance (PM) kit. See [Table 17](#) for tests required after performing preventive maintenance.

Most BDU repairs require removal of the BDU left panel. See [page 113](#).

Figure 36. Exploded View of Fan Components



- | | |
|-----------------------|-----------|
| 1. BDU fan grill | 5. Washer |
| 2. Fan filter | 6. Screen |
| 3. Fan grill retainer | 7. Fan |
| 4. Nut | 8. Screws |

5.7.9.1. BDU fan grill and fan filter

5.7.9.2. To remove the fan grill, fan grill retainer, and fan filter

1. Remove the BDU left panel. See [page 113](#).
2. Press upward to release the top retaining prong of the fan grill, while tipping downward.
3. Swivel the fan grill outward on the two bottom retaining prongs.
4. Remove the fan grill retainer, if desired, by removing the two screws.
5. Remove the fan grill by lifting it away from the BDU left panel.
6. Remove the fan filter.

5.7.9.3. To replace the fan grill, grill retainer, and fan filter

1. Insert both prongs of the fan grill through the BDU left panel.
2. Replace the fan filter.
3. Replace the BDU left panel. See [page 114](#).

5.7.9.4. BDU fan screen and fan

5.7.9.5. To remove the fan screen and fan

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU fan grill. See [page 119](#).
3. Remove the fan filter. See [page 119](#).

4. Remove the four screws and nuts retaining the fan on the outside and the fan screen on the inside of the left panel.
Note: Confirm the fan cable orientation.
5. Remove the fan screen.
6. Rotate the left panel.
7. Remove the fan.

5.7.9.6. To replace the fan screen and fan

1. Hold the fan against the inside of the left panel with the cable to the top of the panel and facing outward away from the panel.
2. Replace the four screws of the fan, pressing each through its respective hole.
3. Reach around to the opposite side of the left panel, threading on the fan screen.
4. Tighten the nuts onto the screws.
5. Replace the fan grill and filter. See [page 119](#).
6. Replace the BDU left panel. See [page 114](#).

5.7.10. BDU Top Cap Components

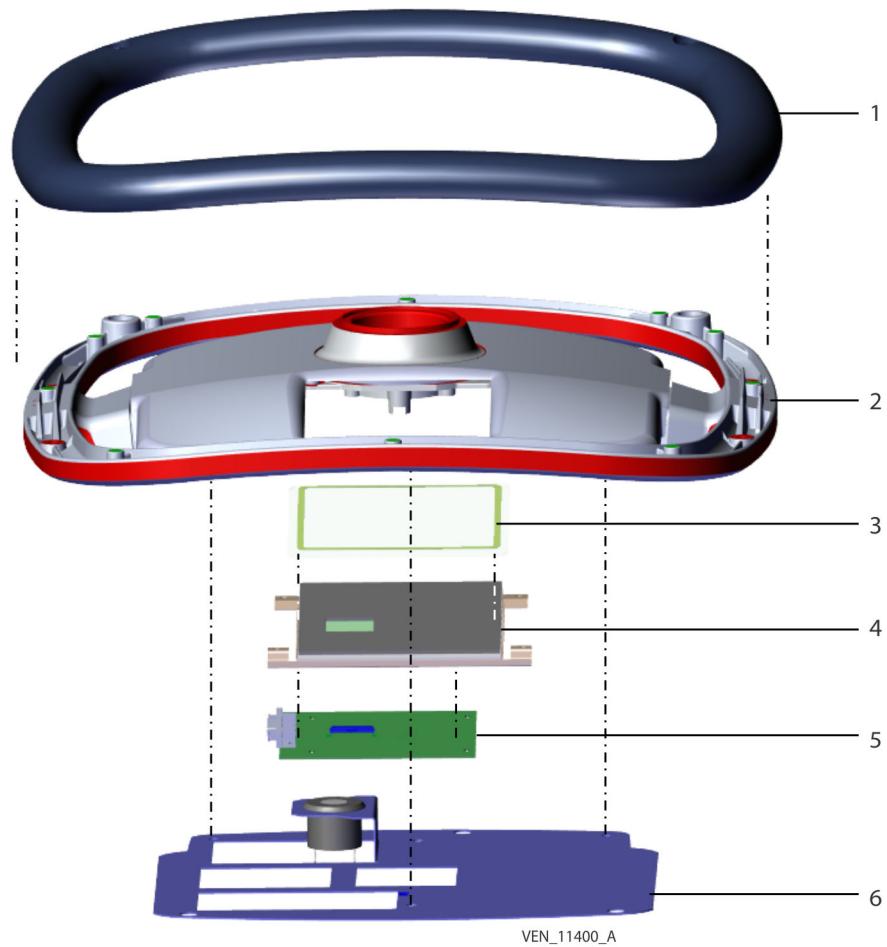
Follow all repair guidelines when repairing any portion of the ventilator. See [page 106](#) and the applicable specific repair guidelines.

The BDU top cap is the prime interface between the GUI and the BDU assemblies.

5.7.10.1. BDU Top Cap Assembly

The BDU top cap assembly houses the status display, the GUI rotator assembly, and also retains the piezo alarm.

Figure 37. Exploded View of BDU Top Cap

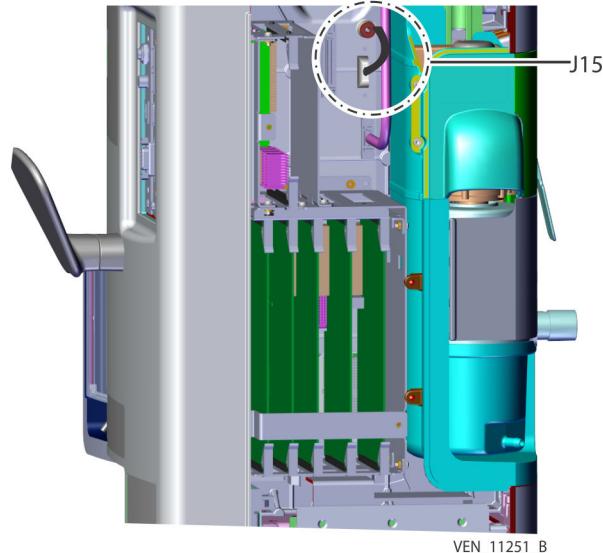


- 1. Top handle
- 2. Bottom handle assembly
- 3. Status display window
- 4. Status display LCD panel and bracket
- 5. Status display PCBA
- 6. Top cap shield and piezo alarm

5.7.10.2. To lift off the BDU top cap assembly

1. Remove the exhalation flow sensor assembly. See [page 176](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU left panel. See [page 113](#).
4. Remove the BDU rear panel. See [page 114](#).
5. Remove the GUI assembly. See [page 208](#).
6. Remove the inspiratory module. See [page 141](#).
7. Loosen the status display cable screws.
8. Disconnect the status display cable from the J15 connector on the main PCBA backplane.

Figure 38. J15 Connector Location

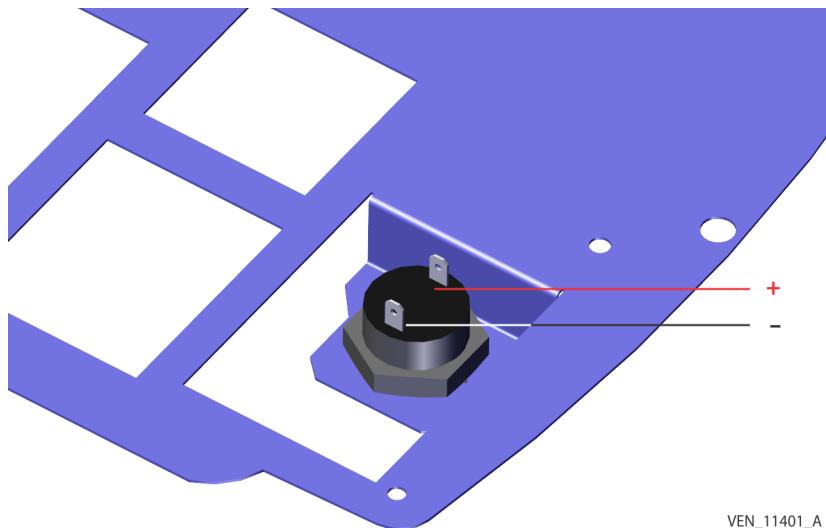


9. Remove the GUI assembly. See [page 208](#).
10. Remove the screw retaining the BDU top cap to the BDU just above the exhalation module by reaching through the exhalation module with a long-reach driver.
11. Remove the remaining screws retaining the BDU top cap to the BDU.
12. Support the BDU top cap while disconnecting the two piezo alarm cables from the spades, noting the positive and negative terminals.
13. Set BDU top cap aside.

5.7.10.3. To replace the BDU top cap assembly

1. Orient the BDU top cap so the display panel faces the front of the chassis.
2. Insert one of the rear screws and the other forward screw, leaving enough clearance to use as locating pins during replacement.
3. Align BDU top cap to the chassis.
4. Support the GUI while reconnecting the two piezo alarm cable spades to the proper positive (+ to red) and negative (- to black) terminals based on the label markings.

Figure 39. Piezo Alarm Cabling



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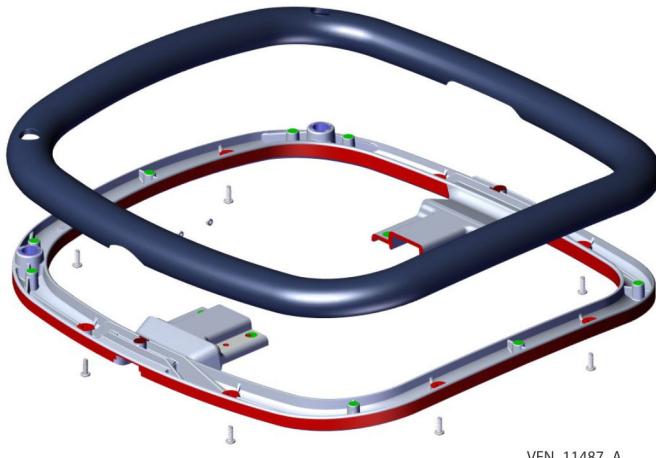
5. Tighten all screws retaining the BDU top cap to the BDU.
6. Connect the alarm status display cable to the J15 connector on the main PCBA backplane.
7. Replace the GUI assembly. See [page 209](#).
8. Replace the BDU rear panel. See [page 115](#).
9. Replace the BDU left panel. See [page 114](#).
10. Replace the BDU right panel. See [page 113](#).
11. Replace the exhalation flow sensor assembly. See [page 176](#).

5.7.10.4. BDU Top Cap Handle

5.7.10.5. To separate the BDU top cap handle

1. Remove all eight screws from the underside of the top cap handle.
2. Pry the handle apart.

Figure 40. Separated Handle



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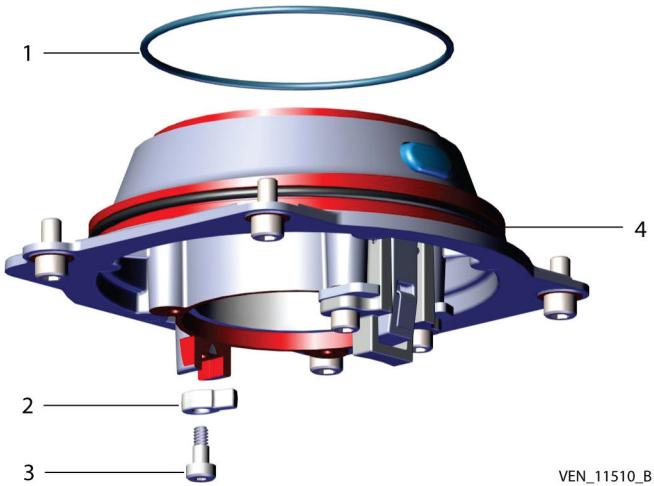
5.7.10.6. To reattach the BDU top cap handle

1. Align the top handle to the bottom handle.
2. Press firmly downward.
3. Tighten all eight screws in the underside of the top handle.

5.7.10.7. GUI Rotator Assembly

The GUI rotator assembly retains the GUI post and allows users to swivel the GUI for easy viewing of the touch screen.

Figure 41. Exploded View of GUI Rotator Assembly



- | | |
|---------------------------|-------------------|
| 1. O-ring | 3. Shoulder screw |
| 2. GUI post rotation stop | 4. O-ring |

5.7.10.8. To remove and separate components of the GUI rotator assembly

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the GUI assembly. See [page 208](#).
5. Remove the top cap assembly. See [page 121](#).
6. Rotate the top cap so the top cap shield is accessible.

Note: Any inversion of the top cap releases this o-ring at the top of the GUI rotator. Replace this o-ring prior to replacing the GUI assembly.

7. Remove the two screws at the front corners of the top cap shield.
8. Lift off the top cap shield.
9. Remove all four screws from the GUI rotator assembly.
10. Remove both o-rings, if desired.
11. Remove the rotation stop, if desired.

5.7.10.9. To replace the GUI rotator assembly

1. Tighten the rotation stop into place using the shoulder screw.
2. Orient the GUI rotator assembly so the blue latch button faces the rear of the top cap, away from the status display.
3. Press through the hole in the housing while supporting the entire top cap.
4. Tighten the four screws.
5. Replace both o-rings, if removed. The first o-ring resides in the groove just under the lip of the external portion of the rotator assembly. The second, smaller o-ring simply rests on the top of the assembly in the groove between the internal ridge and the external ridge
Note: Any inversion of the top cap releases the o-ring at the top of the GUI rotator. Replace this o-ring prior to replacing the GUI assembly.
6. Replace the top cap shield, routing the status display cable through the middle hole closest to the handle.
7. Replace the top cap assembly. See [page 122](#).
8. Replace the GUI assembly. See [page 209](#).
9. Replace the BDU rear panel. See [page 115](#).
10. Replace the BDU left panel. [page 114](#).
11. Replace the BDU right panel. See [page 113](#).

5.7.10.10. Piezo alarm and alarm cable

5.7.10.11. To remove the piezo alarm and alarm cable

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the GUI assembly. See [page 208](#).
5. Remove the top cap assembly. See [page 121](#).

Note: To disconnect the other end of the piezo alarm cable requires disconnection from the BD power controller PCBA. See [page 202](#).

6. Rotate the top cap so the top cap shield is accessible.
7. Remove the two screws at the front corners of the top cap shield.
8. Lift off the top cap shield.
9. Loosen the nut retaining the piezo alarm.

5.7.10.12. To replace the piezo alarm and alarm cable

1. Insert the piezo alarm through the top cap shield.
2. Tighten the retaining nut.
3. Replace the top cap shield.
4. Tighten the two screws at the front corners of the top cap shield.
5. Replace the top cap assembly. See [page 122](#).

Note: To reconnect the other end of the piezo alarm cable requires reconnection to the BD power controller PCBA. See [page 202](#).

6. Replace the GUI assembly. See [page 209](#).
7. Replace the BDU rear panel. See [page 115](#).
8. Replace the BDU left panel. See [page 114](#).
9. Replace the BDU right panel. See [page 113](#).

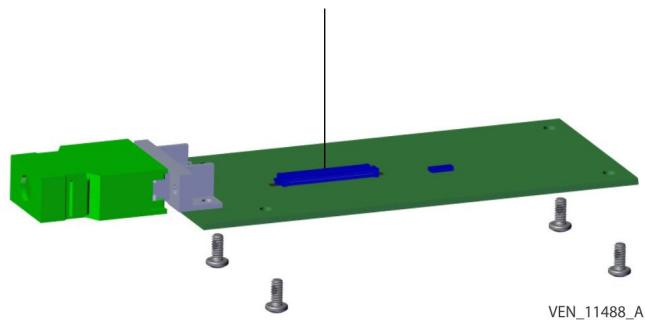
5.7.11. Status Display Components

5.7.11.1. Status Display Interface (SDI) PCBA

5.7.11.2. To remove the status display user interface PCBA

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the GUI assembly. See [page 208](#).
5. Remove the top cap assembly. See [page 121](#).
6. Rotate the top cap so the top cap shield is accessible.
7. Remove the two screws at the front corners of the top cap shield.
8. Lift off the top cap shield.
9. Remove four screws from the SDI PCBA standoffs.
10. Remove the status display cable from the (J1) connector.
11. Carefully release the ZIF connector from (J3), also releasing the flex-cable connection.

Figure 42. Status Display Interface ZIF Connector



5.7.11.3. To replace the status display user interface PCBA

1. Align the flex-cable to the (J3) ZIF connector.
2. Fully seat the flex-cable in the (J3) ZIF connector.
3. Evenly press down on both sides of the ZIF connector until it latches in place.
4. Reconnect the status display cable to the (J1) connector.
5. Align the SDI PCBA to the standoffs.
6. Tighten the four screws.

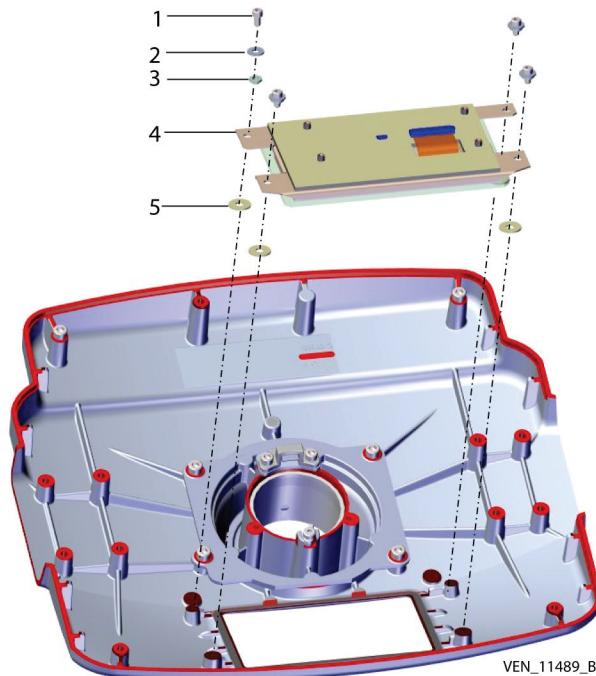
7. Replace the top cap shield.
8. Tighten the two screws at the front corners of the top cap shield.
9. Replace the top cap assembly. See [page 122](#).
10. Replace the GUI assembly. See [page 209](#).
11. Replace the BDU rear panel. See [page 115](#).
12. Replace the BDU left panel. See [page 114](#).
13. Replace the BDU right panel. See [page 113](#).

5.7.11.4. To remove the status display bracket, LCD, and window

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the GUI assembly. See [page 208](#).
5. Remove the top cap assembly. See [page 121](#).
6. Remove the SDI PCBA. See [page 126](#).
7. Remove the screws, plastic washers, and shoulder washers securing the status display bracket to the corner standoffs.

Note: The shoulder washers slide down into the bracket holes. Orient the same way with the shoulder up during replacement.

Figure 43. Exploded View of Status Display



- | | |
|---|-------------------|
| 1. Screw | 4. Bracket |
| 2. Plastic washer | 5. Plastic washer |
| 3. Shoulder washer | |
| 8. Lift off the remaining plastic washers underneath. | |

9. Separate the status display bracket and LCD from the top cap housing.
10. Remove the window, if required.

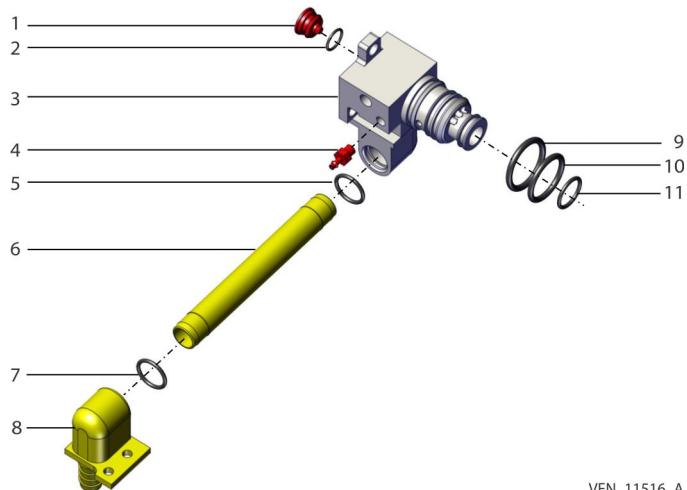
5.7.11.5. To replace the status display bracket, LCD, and window

1. Replace the window, if removed.
2. Peel the screen protector off the status display LCD, if replacing.
3. Pass the flex cable from the status display LCD through the status display bracket.
4. Replace four plastic washers, centering them on the corner standoffs.
5. Align the status display bracket to the window in the top cap housing.
6. Set the status display bracket down on the four plastic washers on the standoffs without disturbing the washers.
7. Place the four screws, plastic washers, and shoulder washers on the four corner standoffs.
8. Gently tighten the four screws.
9. Replace the SDI PCBA. See [page 126](#).
10. Tighten the four screws on the top cap shield.
11. Replace the top cap assembly. See [page 122](#).
12. Replace the GUI assembly. See [page 209](#).
13. Replace the BDU rear panel. See [page 115](#).
14. Replace the BDU left panel. See [page 114](#).
15. Replace the BDU right panel. See [page 113](#).

5.7.12. BDU Floor and Base Plate Components

5.7.12.1. BDU Floor Components

Figure 44. Pneumatic Interface Components



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- | | |
|----------------------------|---------------------|
| 1. Inspiratory module plug | 7. O-ring |
| 2. O-ring | 8. BDU adapter tube |
| 3. Pneumatic interface | 9. O-ring |
| 4. Hose connector | 10. O-ring |
| 5. O-ring | 11. O-ring |
| 6. Transfer tube | |

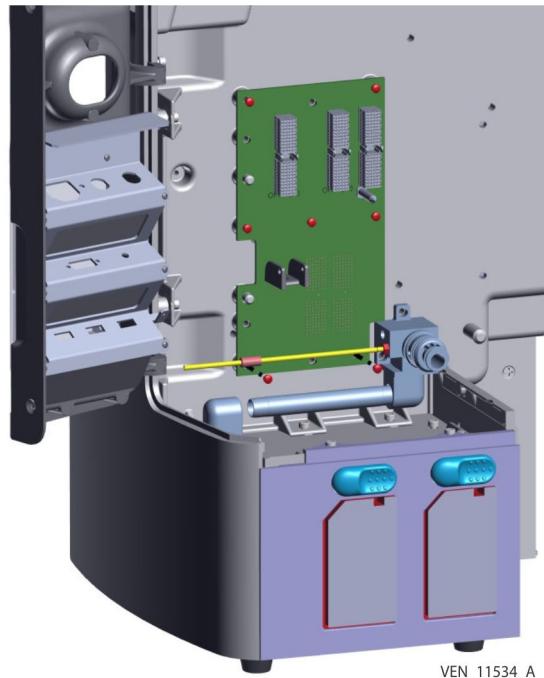
Note: 9 in. tubing not shown

5.7.12.2. To remove and replace barb tube adapter components

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the options card cage. See [page 195](#).
5. Remove the two screws connecting the pneumatic interface to the BDU spine, closest to the BDU floor.
6. Slide the pneumatic interface off the BDU adapter tube, retaining the o-ring.
7. Remove the options supply tubing and restrictor by pulling on the tubing attached to the hose connector, if desiring their removal.

Note: The restrictor is directional. Locate the arrow on the restrictor and ensure it remains pointing towards the inspiratory door panel and routes through the options card cage grommet and connect to the pin within the options card cage.

Figure 45. Options Supply Tubing and Restrictor



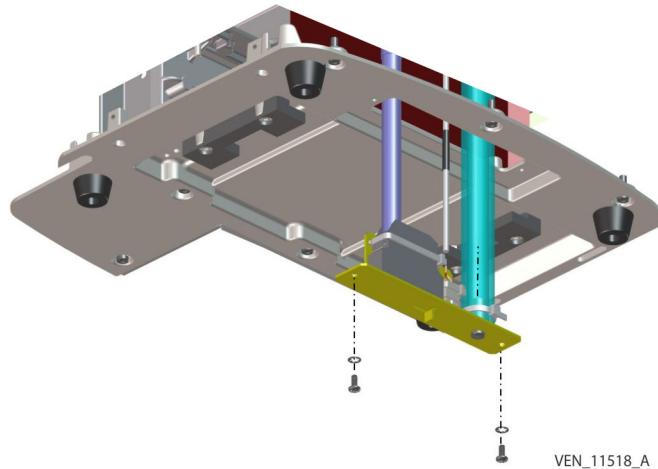
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8. Remove the two screws connecting the BDU tube adapter to the BDU floor.
9. Slide the BDU tube adapter off the other end of the transfer tube, retaining the left o-ring.
10. Extract the BDU tube adapter off the hose.
 - a. Lift the tube adapter above the BDU floor, to access the hose and its wire tie.
 - b. Cut the wire tie.
 - c. Pull the hose off the BDU tube adapter barb.

5.7.12.3. To remove and replace interconnect cables

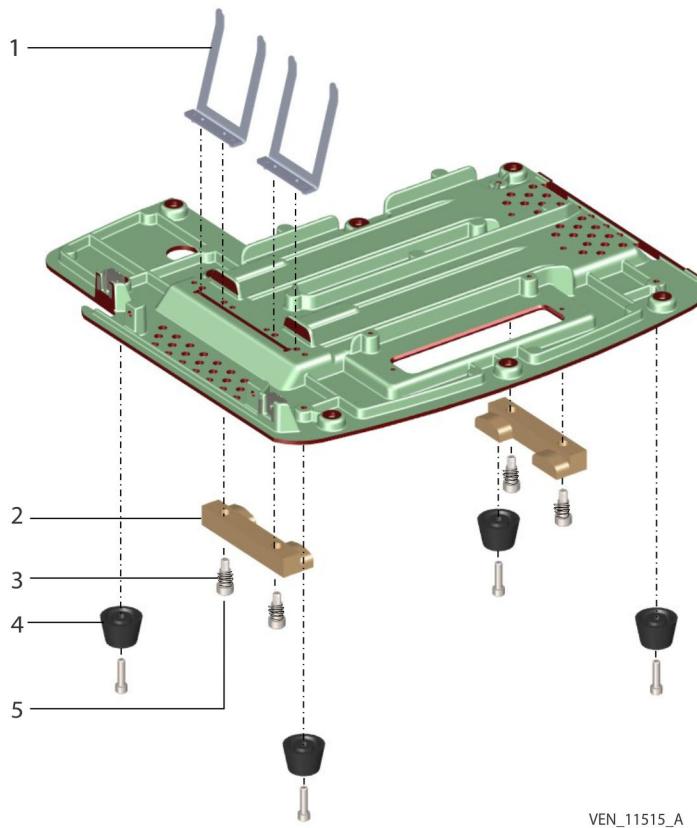
1. Remove the BDU assembly. See [page 110](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU left panel. See [page 113](#).
4. Remove the BDU rear panel. See [page 114](#).
5. Remove the options card cage. See [page 195](#).
6. Reaching under the front of the BDU floor, remove the two screws of the interconnect retainer plate in the very front center of the floor, catching the lock washers.
7. Remove any of the desired components.
 - a. Remove the wire tie, disconnecting the tubing from bottom of BDU to interconnect plate.
 - b. Remove the wire tie, disconnecting backplane to power controller cable.
 - c. Remove the ground strap and wire tie, disconnecting the AC module cable.

Figure 46. Interconnect Retainer Plate Cables and Pneumatic Hose



5.7.13. BDU Base Plate Components

Figure 47. BDU Base Plate Components



- 1. Battery eject spring
- 2. BDU universal base latch
- 3. Spring
- 4. Rubber foot
- 5. Shoulder screw

5.7.13.1. To remove and replace BDU assembly rubber feet

1. Lift the BDU assembly off the caster base. See [page 110](#).

2. Insert all four screws onto each replacement rubber foot.
3. Tip the BDU assembly slightly backward, ensuring the BDU assembly cannot tip over, to access two of the feet.
4. Remove each screw.
5. Remove the related rubber foot.
6. Tighten the replacement rubber foot into place.
7. Repeat with another replacement rubber foot.
8. Rotate the BDU assembly for access to the last two rubber feet and repeat the process for the other two screws.

To remove and replace universal base latches

1. Lift the entire BDU assembly off the caster base. See [page 110](#).
2. Remove the two shoulder screws and springs retaining each of the two universal base latches from the underside of the base plate of the BDU assembly.
3. Load the two shoulder screws with their respective springs.
4. Tighten the two universal base latches to the underside of the base plate of the BDU assembly.
5. Replace the entire BDU assembly onto the caster base. See [page 112](#).

To remove a battery eject spring

1. Lift the entire BDU assembly off the base. See [page 110](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU right panel. See [page 113](#).
4. Remove the two screws retaining the battery door panel with a 9/64 driver.
5. Lift both to the right and upwards to remove the battery door panel.
6. Remove the shoulder screws and springs retaining the left universal base latch from the underside of the base plate of the BDU assembly.
7. Remove the two screws for each desired eject spring from the underside of the BDU floor.
8. Remove the battery eject spring by reaching in through the battery door panel opening.

To replace a battery eject spring

1. Replace the battery eject spring aligning the pins on its underside to the holes in the base.
2. Tighten the two screws for the desired eject spring in through the underside of the BDU floor.
3. Tighten the shoulder screws and springs retaining the left universal base latch from the underside of the base plate of the BDU assembly.
4. Slide the battery door panel into its slot.
5. Tighten the two screws retaining the battery door panel.
6. Replace the BDU right panel. See [page 113](#).

7. Replace the BDU left panel. See [page 114](#).
8. Replace the entire BDU assembly onto the base. See [page 112](#).

5.8. Inspiratory Module

Follow all general repair guidelines when repairing any portion of the ventilator. See [page 106](#), and the applicable specific repair guidelines. Use the following content list to locate the proper area within this section.

[Overview, page 133](#)

[Inspiratory Door Assembly, page 134](#)

[Inspiratory Module Primary Filters, page 138](#)

[Inspiratory Module Assembly, page 141](#)

[Mix Assembly, page 144](#)

[Delivery Assembly, page 149](#)

[Inlet Manifold Assembly, page 161](#)

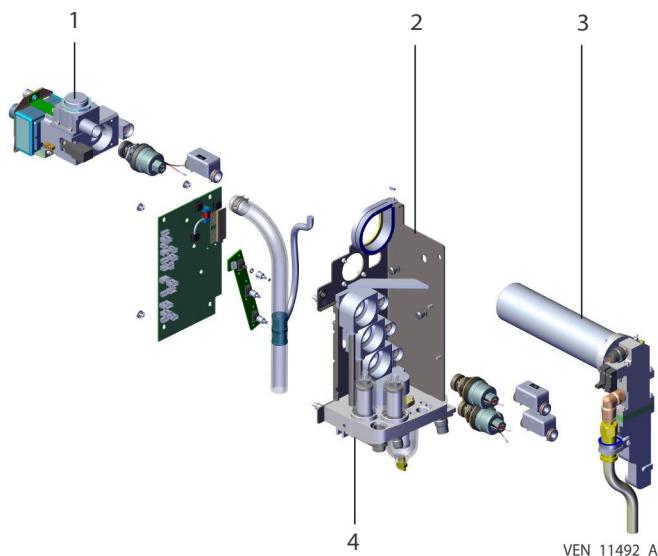
[Inspiratory Module Cabling and Hoses, page 166](#)

[Inspiratory Module PCBAs, page 169](#)

5.8.1. Overview

This section addresses removal and replacement of various major BDU inspiratory module parts.

Figure 48. Exploded View of Inspiratory Module



- | | |
|----------------------|----------------------------|
| 1. Delivery assembly | 3. Mix assembly |
| 2. Chassis | 4. Inlet manifold assembly |

5.8.2. Inspiratory Door Assembly

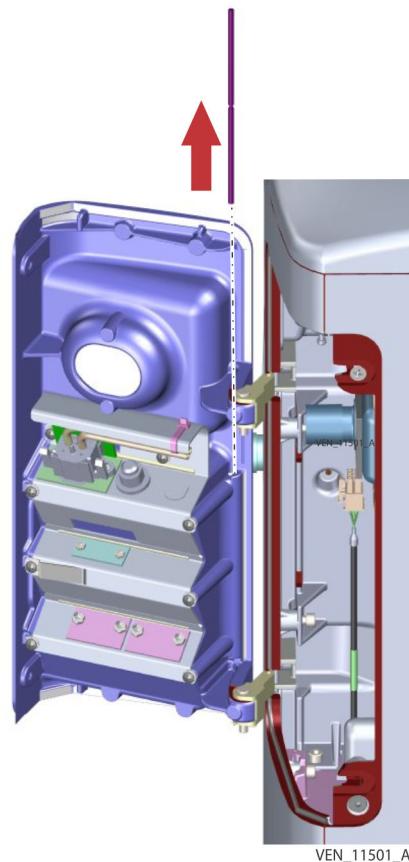
5.8.2.1. Patient Options Access Door

5.8.2.2. Patient Options Access Door and Access Door Hinge Rod

5.8.2.3. To remove the patient options access door and access door hinge rod

1. Remove the two screws securing the inspiratory door to the BDU right panel.
2. Extract the hinge rod by lifting the patient options access door hinge rod upward until it clears the top of the access door housing and out of the inspiratory door.

Figure 49. Removing the Hinge Rod

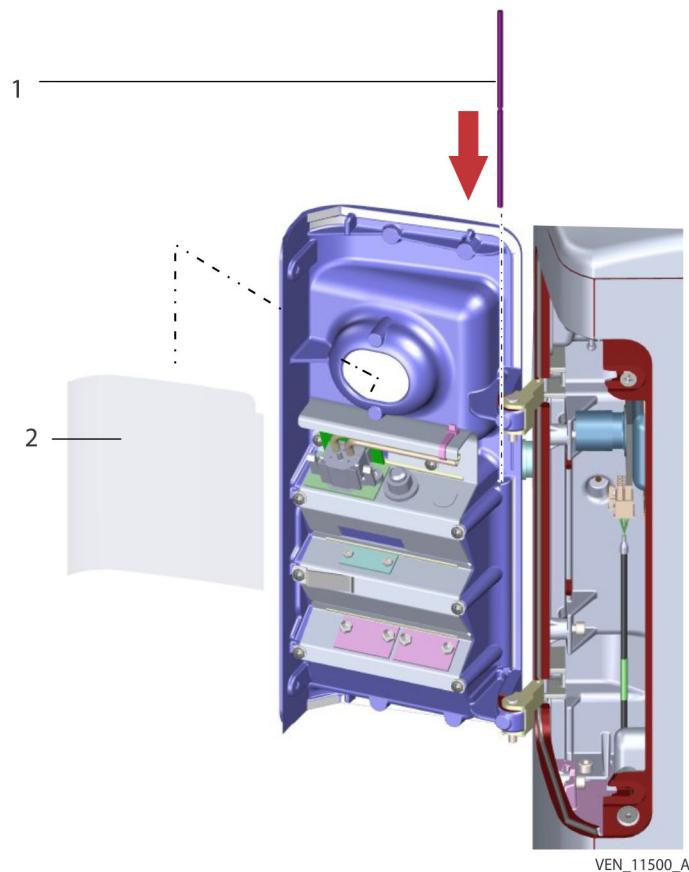


3. Remove the patient options access door.

5.8.2.4. To replace the patient options access door and access door hinge rod

1. Replace the patient options access door.
2. Replace the hinge rod by pressing the patient options access door hinge rod downward through the inspiratory door and access door housing.

Figure 50. Exploded View of Inspiratory Module



1. Hinge rod

2. Patient options access door

5.8.2.5. Patient Options Access Door Catch Spring

5.8.2.6. To remove the patient options access door catch spring

1. Open the patient options access door.
2. Loosen the screw retaining the patient options access door catch spring.
3. Remove the patient options access door catch spring.

5.8.2.7. To replace the patient options access door clip

1. Insert the screw through the patient options access door catch spring.
2. Tighten the screw retaining the patient options access door catch spring.
3. Close the patient options access door.

5.8.2.8. Door Panel Option Components

5.8.2.9. To remove door panel cover and cover plate option components

1. Remove the two screws securing the inspiratory door to the BDU right panel.
2. Open the patient options access door.

3. Loosen the screws for the appropriate options panel cover plate while holding the nuts and cover plate on the opposite side.
 - Proximal flow patient options cover and panel
 - Pulse oximetry/pulse patient options cover and panel
 - USB patient options cover and panel
4. Remove the cover plate.
5. To replace an options panel, remove the related screws from the desired panel.

5.8.2.10. To replace door panel cover and cover plate option components

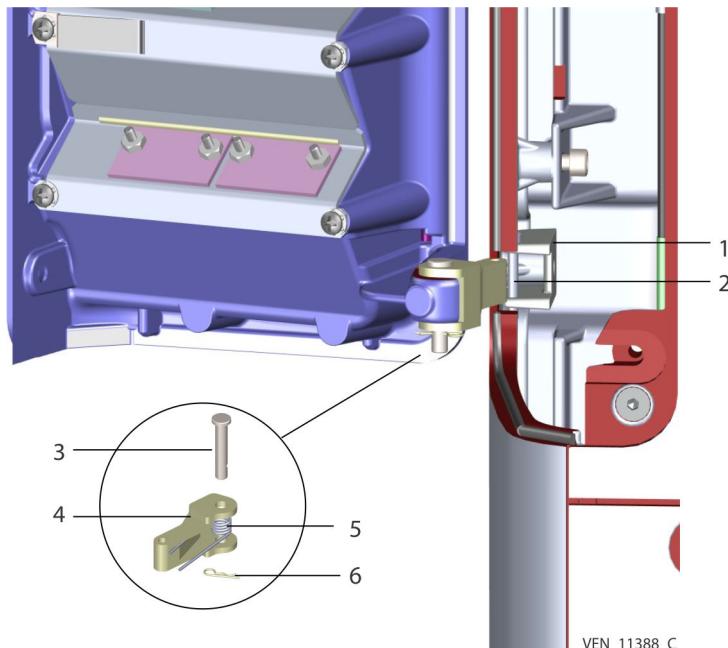
1. To replace an options panel, replace the desired panel with the related screws.
2. Align the appropriate options panel cover to the patient options slot.
3. Tighten the screws for the appropriate options panel cover while holding the nuts on the opposite side.
 - Proximal flow patient options cover and panel
 - Pulse oximetry/pulse patient options cover and panel
 - USB patient options cover and panel
4. Tighten the two screws securing the inspiratory door to the BDU right panel.

5.8.2.11. Inspiratory Door Panel

5.8.2.12. To remove the BDU inspiratory door panel and sub-assemblies

1. Remove the BDU left panel. See page 113.

Figure 51. Inspiratory Door Hinge Components



1. Half hinge
 2. Headed clevis pin
 3. Clevis pin
 4. Torsion spring
 5. BDU inspiratory door hinge linkage
 6. Cotter pin
2. Remove the cotter pins from the clevis pin on each inspiratory door hinge linkage.
 3. Remove the bottom headed clevis pin.
 4. Retain the included torsion spring.
 5. Remove the top headed clevis pin while supporting the door panel.
 6. Retain the included torsion spring.
 7. Remove the cotter pins from the top and bottom headed clevis pins of each half hinge.
 8. Remove the top clevis pin from the half hinge.
 9. Remove the bottom clevis pin from the half hinge.
 10. Remove the BDU inspiratory door hinge linkage.
 11. Remove the socket head cap screw, retaining each half hinge.
 12. Remove each half hinge.

5.9. To replace the inspiratory door panel and sub-assemblies

1. Align the bottom half hinge to the BDU inspiratory door hinge linkage.
2. Replace the bottom and top headed clevis pins, connecting the BDU inspiratory door hinge linkage to the related half hinge.
3. Replace the bottom and top cotter pins.
4. Replace the bottom and top larger clevis pins, connecting the BDU inspiratory door to the BDU inspiratory door hinge linkage, while replacing a torsion spring on each

- clevis pin after insertion through the top of the hinge and prior to the cotter pin reaching the other end of the hinge.
5. Replace each half hinge.
 6. Retain each half hinge with the socket head cap screw.
 7. Align the door panel to the door hinge receptacle.
 8. Replace the BDU left panel. See [page 114](#).
 9. Tighten the two screws securing the inspiratory door to the BDU right panel.

5.10.1. Inspiratory Module Primary Filters

Note: For any handling of new filters, wear clean gloves.

5.10.1.1. External Inspiratory Filter

Warning: In order to reduce the risk of infection, always use the ventilator with inspiratory and expiratory bacteria filters.

Warning: Do not attempt to use inspiratory or expiratory filters designed for use with ventilators other than the Puritan Bennett 980 Series Ventilator.

Warning: Refer to the filter's instructions for use for details such as cleaning and sterilization requirements, filtration efficiency, proper filter usage, and maximum filter resistance, particularly when using aerosolized medications.

Warning: Refer to the filter instructions for use (IFU) for information on reusable filter cleaning and sterilization and filter efficiency.

Warning: Do not re-use disposable inspiratory or expiratory filters, and dispose according to your institution's policy for discarding contaminated waste.

Caution: Ensure both inspiratory and expiratory filters are properly attached to the ventilator.

5.10.1.2. To install the inspiratory filter

1. Attach the inspiratory filter to the To Patient port.
2. Ensure the direction of flow arrow is pointing outward, toward the patient circuit's inspiratory limb.

5.10.1.3. Internal Inspiratory Filter Components

5.10.1.4. To replace the internal inspiratory filter

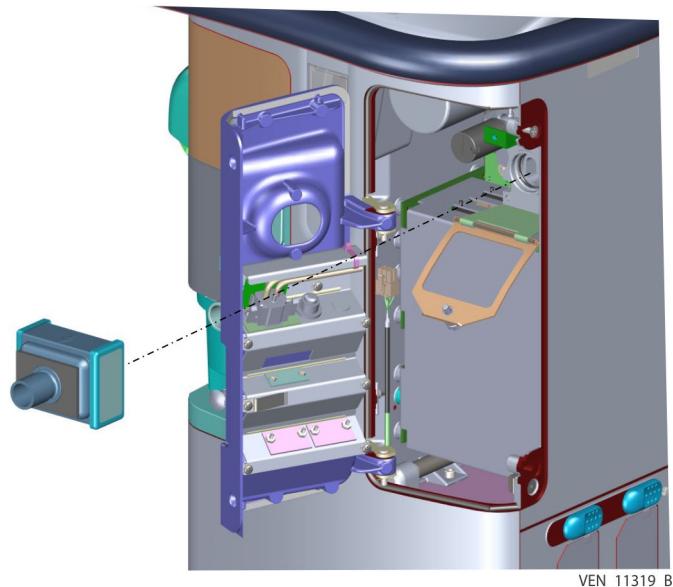
1. Press inward until fully connecting with the breath delivery manifold.
2. Hold the internal inspiratory filter retainer closed against the filter clip.
3. Hand tighten the captive screw on the inspiratory filter retainer.
4. Tighten the two screws securing the inspiratory door to the BDU right panel.

5.10.1.5. To remove the internal inspiratory filter

1. Remove the two screws securing the inspiratory door to the BDU right panel.

2. Open the internal inspiratory filter retainer door by loosening the captive screws until the door swings open on its hinge.

Figure 52. Opened Retainer Door, Internal Inspiratory Filter Removed



3. Pull outward until it releases from the breath delivery manifold.

5.10.1.6. Air Filter Bowl and Filter Element

A minimum replacement schedule for the filter element is at 10 000 hours of usage. It is included in the 10 000 hour PM kit. See Table 1-13. for required test after performing preventive maintenance.

Figure 53. Air Filter Bowl and Filter Element



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- | | |
|-------------------|------------------------------|
| 1. O-ring | 4. Air filter bowl |
| 2. Filter element | 5. Spring-loaded drain valve |
| 3. O-ring | |

5.10.1.7. To remove the air filter bowl and filter element

1. Press the spring-loaded drain valve to vent any air in the air filter bowl.
2. Remove the air filter bowl by turning counterclockwise.
3. Grasp the plastic collar closest to the inlet manifold and turn counterclockwise to remove the filter element and its o-ring. Use care when removing the filter element so it does not tear.

Note: When replacing the filter bowls and filter elements, hand-tighten to avoid damage.

5.10.1.8. To replace the air filter bowl and filter element

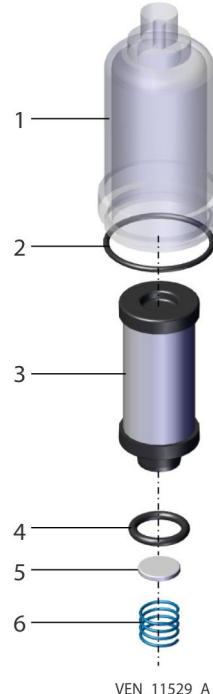
1. Grasp the plastic collar closest to the inlet manifold and turn clockwise to hand-tighten the filter element on the inlet manifold.
2. Hand-tighten the air filter bowl by turning clockwise.

5.10.1.9. Oxygen filter bowl and filter element

5.10.1.10. To remove the oxygen filter bowl and filter element

1. Remove the BDU right panel. See [page 113](#).
2. Disengage the safety valve vent tube from the inlet manifold to gain access to oxygen filter bowl.

Figure 54. Oxygen Filter



- | | |
|-----------------------|------------------|
| 1. Oxygen filter bowl | 4. O-ring |
| 2. O-ring | 5. Bronze filter |
| 3. Filter element | 6. Spring |

3. Disengage the safety valve vent tube from the inlet manifold to gain access to oxygen filter bowl.
4. Remove the filter bowl by turning counterclockwise.
5. Grasp the plastic collar closest to the inlet manifold and turn counterclockwise to remove the filter element and its o-ring. Use care when removing the filter element so it does not tear.
6. Retrieve the bronze filter and spring.

Note: When replacing the filter bowls and filter elements, hand-tighten to avoid damage.

5.10.1.11. To replace the oxygen filter bowl and filter element

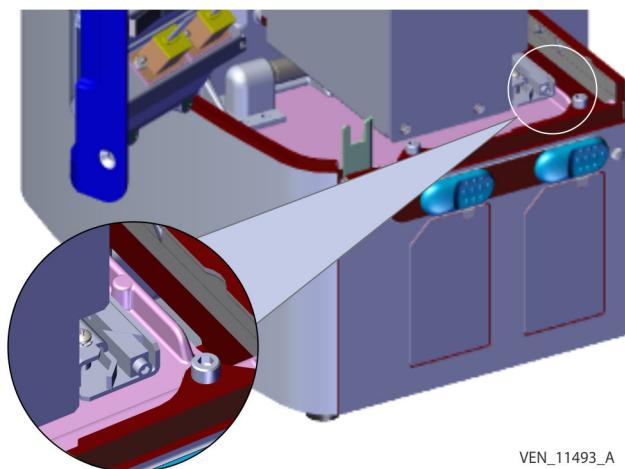
1. Replace the filter spring.
2. Replace the bronze filter, ensuring the smooth side faces up towards the filter element.
3. Grasp the plastic collar closest to the inlet manifold and turn clockwise to hand-tighten the filter element on the inlet manifold.
4. Hand-tighten the oxygen filter bowl by turning clockwise.
5. Reattach the safety valve vent tube from the inlet manifold just above the oxygen inlet fitting.
6. Replace the BDU right panel. See [page 113](#).

5.10.2. Inspiratory Module Assembly

5.10.2.1. To remove the inspiratory module

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Loosen the hex screw on the wedge lock to the front of the guide rail by the base of the card cage. The figure is shown without the inspiratory module for ease of wedge lock identification.

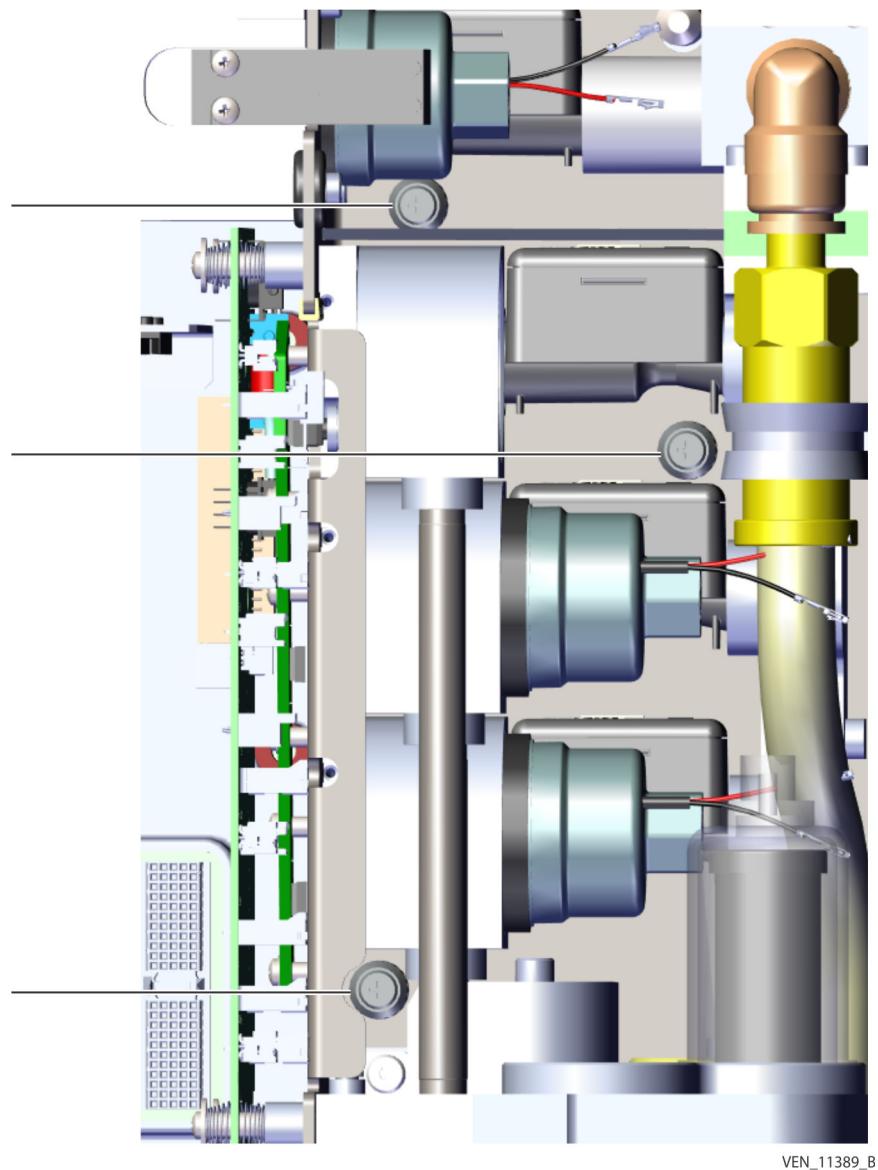
Figure 55. Wedge Lock and Guide Rail Insert



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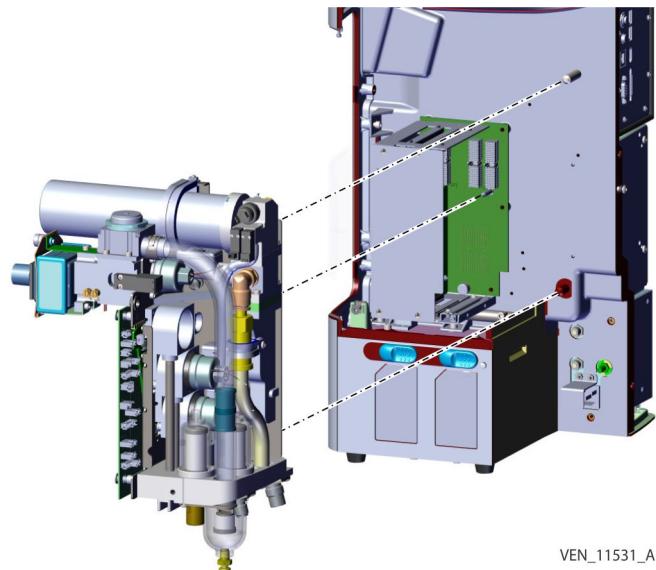
5. Loosen the three captive screws at the back of the inspiratory module.

Figure 56. Locations of Inspiratory Module Captive Screws



6. Grasp the inspiratory module, supporting the accumulator at the top and the bottom base.

Figure 57. Inspiratory Module Removal



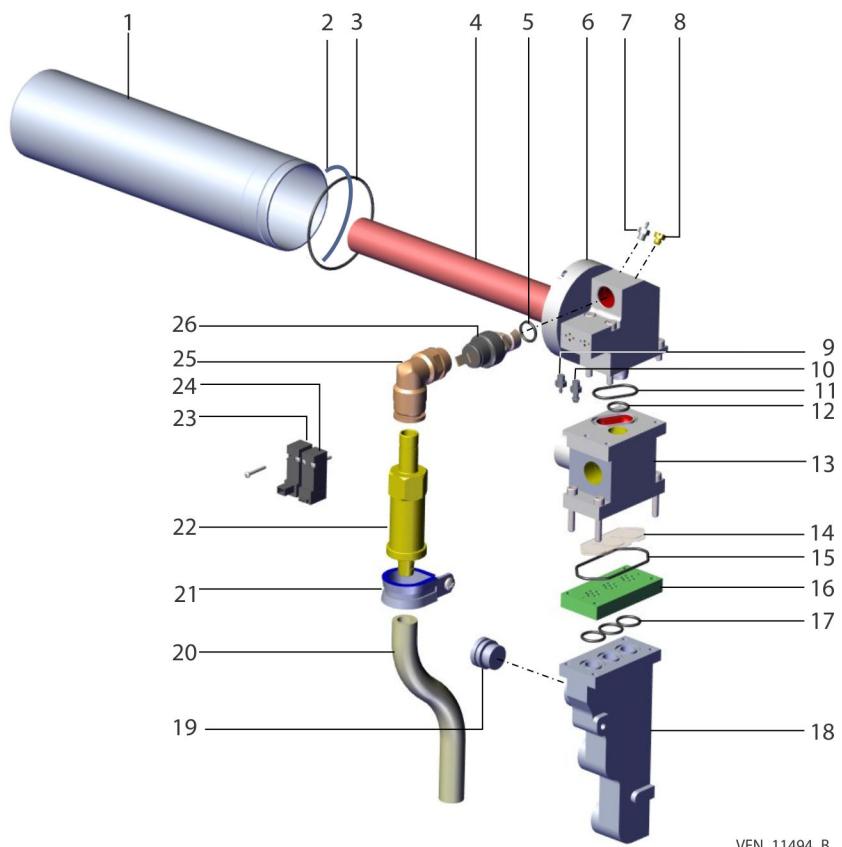
7. Firmly pull outward, rocking the inspiratory module off the retaining pins in the chassis housing.
Note: Removal of the inspiratory module may be difficult since the fit to the retaining pins is very snug.
8. Slide out the inspiratory module along the bottom guide rail.
9. Place on the static-resistive mat.

5.10.2.2. To replace the inspiratory module

1. Support the inspiratory module.
2. Align the inspiratory module to the chassis alignment pins.
3. Slide along the bottom guide rail until it rests against the ventilator chassis.
4. Tighten the three captive screws.
5. Tighten the Allen-head screw on the wedge lock.
6. Replace the BDU rear panel. See [page 115](#).
7. Replace the BDU right panel. See [page 113](#).
8. Replace the BDU left panel. See [page 114](#).

5.10.3. Mix Assembly

Figure 58. Mix Assembly



- | | |
|--|--|
| 1. Accumulator cylinder | 14. Mix flap valve |
| 2. Nylon rod | 15. O-ring |
| 3. O-ring | 16. Flap check valve manifold |
| 4. Accumulator mix tube | 17. O-ring |
| 5. O-ring | 18. Mix collector manifold |
| 6. Manifold assembly and 2 sets screws | 19. Options port plug and o-ring |
| 7. Hose connector | 20. Tygon™* tubing, hose clamp (not shown) |
| 8. Brass plug | 21. Rubber cushion P-clamp and screw |
| 9. Hose connector | 22. Pressure relief valve |
| 10. Hose connector | 23. Purge solenoid and screws |
| 11. O-ring 24 Options supply solenoid | 24. Options supply solenoid |
| 12. O-ring 25 Swivel elbow fitting | 25. Swivel elbow fitting |
| 13. Mix manifold chamber | 26. Pressure switch |

5.10.3.1. To remove the mix assembly

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).

4. Remove the inspiratory module. See [page 141](#).
5. Place on the static-resistive mat.
6. Rotate the inspiratory module until the chassis backplane is accessible.
7. Remove the two screws retaining the mix assembly to the inspiratory chassis.
8. Rotate the inspiratory module until the PSOLS are visible.
9. Disconnect any related cables prohibiting removal of the mix assembly, including sensor and pressure switch cables.
10. Disconnect the related tubing from the nibs on the pressure relief valve.
11. Remove the lock washer and nut from the upper P-clamp.
12. Lift away the mix assembly after rocking the assembly off all flow sensors.
13. Ensure all flow sensors remain on the inspiratory flow module PCBA, rather than coming with the mix assembly. Should any detach from the inspiratory flow module PCBA, reseat them.

5.10.3.2. To replace the mix assembly

1. Seat the mix assembly onto all flow sensors, ensuring proper alignment.
2. Tighten the upper P-clamp lock washer and nut.
3. Reconnect the related tubing from the nibs on the pressure relief valve.
4. Reconnect any related cables prohibiting removal of the mix assembly, including sensor and pressure switch cables.
5. Rotate the inspiratory module until the chassis backplane is accessible.
6. Tighten the two screws to retaining the mix assembly to the inspiratory chassis.
7. Replace the inspiratory module. See [page 143](#).
8. Replace the BDU rear panel. See [page 115](#).
9. Replace the BDU right panel. See [page 113](#).
10. Replace the BDU left panel. See [page 114](#).

5.10.3.3. To remove the accumulator cylinder

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Loosen the lock nut from the P-clamp.
6. Remove the nylon rod entirely from its notch on the accumulator manifold.
7. Extract the accumulator cylinder from the accumulator manifold.

5.10.3.4. To replace the accumulator cylinder

1. Slide the accumulator cylinder over the mix tube and into the accumulator manifold until it cannot be pushed any further.
2. Insert the nylon rod into its notch on the accumulator manifold until it stops.

3. Continuously rotate the accumulator cylinder until the nylon rod completes its route in its groove and only the initial piece of the nylon rod is visible.
4. Tighten the P-clamp in place with the lock nut.
5. Replace the inspiratory module. See [page 143](#).
6. Replace the BDU rear panel. See [page 115](#).
7. Replace the BDU right panel. See [page 113](#).
8. Replace the BDU left panel. See [page 114](#).

5.10.3.5. Manifold Assembly

Options Supply and Accumulator Purge Solenoids

Both solenoids attach to the manifold assembly, readily accessible from the right side of the inspiratory module.

To remove the options supply or accumulator purge solenoid

1. Remove the BDU right panel. See [page 113](#).
2. Disconnect the 4-pin cable from the (P15) connector for the options supply solenoid or the 2-pin cable from the (P18) connector for the accumulator purge solenoid on the inspiratory flow module PCBA.
3. Remove the two screws from the desired solenoid.

Note: Retain the solenoid port gasket as part of the solenoid.

To replace the options supply or accumulator purge solenoid

1. Ensure the options supply or accumulator purge solenoid, which ships with both screws and a gasket, still retains the supplied solenoid port gasket, which seals against the manifold assembly.
2. Align the replacement solenoid to the holes in the manifold assembly housing.
3. Tighten the two screws on the replacement solenoid.
4. Reconnect the 4-pin cable to the (P15) connector for the options supply solenoid or the 2-pin cable from the (P18) connector for the accumulator purge solenoid on the inspiratory flow module PCBA.
5. Replace the BDU right panel. See [page 113](#).

5.10.3.6. Pressure switch

5.10.3.7. To remove the pressure switch

1. Remove the BDU right panel. See [page 113](#).
2. Disconnect the 3-pin cable from the pressure switch and the (P9) connector for the pressure switch on the inspiratory flow module PCBA.
3. Remove the pressure switch by rotating it counterclockwise, ensuring it retains the pressure switch o-ring.

5.10.3.8. To replace the pressure switch

1. Replace the pressure switch o-ring on the pressure switch.

2. Replace the pressure switch by rotating it clockwise until it is against the manifold assembly.
3. Reconnect the 3-pin cable to the pressure switch and the (P9) connector for the pressure switch on the inspiratory flow module PCBA.
4. Replace the BDU right panel. See [page 113](#).

5.10.3.9. Hose connectors and brass plug

5.10.3.10. To remove and replace the hose connectors and brass plug

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Rotate the entire inspiratory module assembly while supporting the mix assembly until the backplane rests on the static-resistive mat with the PSOLs facing front.
6. Loosen the desired hose connector or brass plug.
7. Tighten the replacement hose connector or brass plug.
8. Replace the inspiratory module. See [page 143](#).
9. Replace the BDU rear panel. See [page 115](#).
10. Replace the BDU right panel. See [page 113](#).
11. Replace the BDU left panel. See [page 114](#).

5.10.3.11. Swivel Elbow Fitting or Accumulator Pressure Relief Valve

5.10.3.12. To remove the swivel elbow fitting or accumulator pressure relief valve

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Remove the accumulator pressure relief valve vent tube from the inlet manifold.
6. Slide the tube clamp off the accumulator pressure relief valve.
7. Loosen the screw from the rubber cushioned P-clamp.
8. Rotate the relief elbow away from the inspiratory module.
9. Remove the accumulator pressure relief valve tube by pulling downward.
10. Remove the accumulator pressure relief valve by pulling downward.
11. Remove the swivel elbow fitting, if desired, by pulling outward.

5.11. To replace the swivel elbow fitting or accumulator pressure relief valve

1. Replace the swivel elbow fitting, if removed.
2. Insert the accumulator pressure relief valve into the swivel elbow.

3. Rotate the relief elbow towards the inspiratory module.
4. Slip the rubber cushioned P-clamp into position, tightening the screw.
5. Replace the vent tube, sliding the tube clamp onto the accumulator pressure relief valve.
6. Replace the inspiratory module. See [page 143](#).
7. Replace the BDU rear panel. See [page 115](#).
8. Replace the BDU right panel. See [page 113](#).
9. Replace the BDU left panel. See [page 114](#).

5.12.1.1. Mix Chamber and Mix Collector Manifolds

Select only the desired component for replacement, but complete all other instructions, since disassembly of both manifolds occurs in any case.

5.12.1.2. To remove mix chamber and mix collector manifold components

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Rotate the entire inspiratory module assembly while supporting the mix assembly until the chassis rests on the static-resistive mat with the PSOLs facing front.
6. Lift away the safety valve vent tube from the inlet manifold.
7. Loosen both long screws just above hose connectors and both short screws just below the hose connector and brass plug to release the manifold assembly from the mix manifold assemblies.
8. Remove both o-rings from the top of the mix manifold chamber.
9. Loosen all four screws securing the mix collector between the mix manifold chamber and the mix collector manifold.
10. Remove all three o-rings from the top of the mix collector.
11. Remove the mix flap valve and oval seal o-ring from the underside of the mix collector, noting the orientation of the mix flap valve notches.
12. Remove the screw plug and its related o-ring from the mix collector.

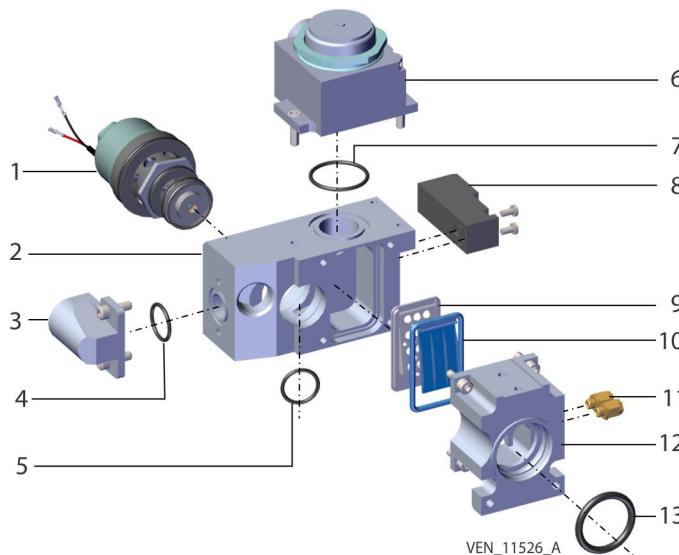
5.12.1.3. To replace mix chamber and mix collector manifold components

1. Replace the screw plug and its related o-ring in the mix collector manifold.
2. Align the mix flap valve notches, matching the original orientation, over the dowel pins on the mix collector.
3. Replace the oval seal o-ring into the groove on the mix collector.
4. Replace all three o-rings on the top of the mix collector.
5. Tighten all four screws sandwiching the mix collector between the mix manifold chamber and the mix collector manifold.
6. Replace both o-rings on the top of the mix manifold chamber.

7. Tighten both long screws just above hose connectors and both short screws just below the hose connector and brass plug to attach the manifold assembly to the mix manifold assemblies.
8. Replace the safety valve vent tube into the inlet manifold.
9. Replace the inspiratory module. See [page 143](#).
10. Replace the BDU rear panel. See [page 115](#).
11. Replace the BDU right panel. See [page 113](#).
12. Replace the BDU left panel. See [page 114](#).

5.12.2. Delivery Assembly

Figure 59. Delivery Outlet Manifold



- | | |
|----------------------------------|--------------------------------------|
| 1. Delivery PSOL | 8. BUV solenoid, screws |
| 2. Delivery manifold | 9. Outlet check valve seat |
| 3. PSOL mix elbow, screws | 10. Outlet checking flap valve |
| 4. O-ring | 11. Hose fitting |
| 5. Oxygen sensor o-ring | 12. Delivery outlet manifold, screws |
| 6. Safety valve assembly, screws | 13. O-ring |
| 7. O-ring | |

5.12.2.1. To remove the delivery assembly

1. Remove the BDU right panel door. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Rotate the inspiratory module until the PSOLs are pointed upward.
5. Slide down the hose clamp to remove the large hose from the safety valve.
6. Remove the mix assembly. See [page 144](#).
7. Remove all four screws retaining the breath delivery assembly to the chassis.

5.12.2.2. To replace the delivery assembly

1. Rotate the inspiratory module until the PSOLs are pointed upward.
2. Replace all four screws retaining the delivery assembly to the chassis.
3. Replace the mix assembly.
4. Replace the large hose from the safety valve after sliding the hose clamp until it is only on the hose.
5. Replace the inspiratory module. See [page 143](#).
6. Replace the BDU right panel door. See [page 113](#).

5.12.2.3. Oxygen (O_2) Sensor

Warning: To prevent potential injury, follow the preventive maintenance schedule for the oxygen sensor.

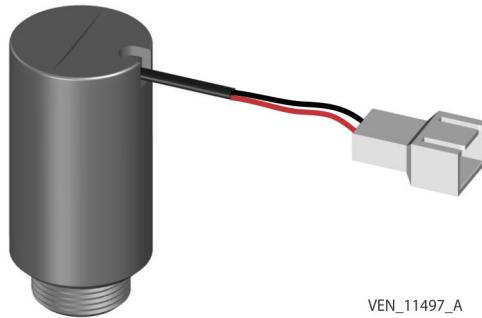
The recommended replacement frequency for the oxygen sensor is one year from installation or sooner, if necessary.

Note: Locate the expiration date on the packaging of the new oxygen sensors. Do not install if the date of desired installation is past the expiration date on the packaging.

5.12.2.4. To remove the Oxygen Sensor

1. Remove the two screws securing the inspiratory door to the BDU right panel.
2. Remove the internal inspiratory filter. See [page 138](#).

Figure 60. Oxygen (O_2) Sensor



VEN_11497_A

3. Disconnect the oxygen cable.
4. Rotate the oxygen sensor counterclockwise until completely removed.

5.12.2.5. To replace the Oxygen Sensor

1. Ensure the o-ring is present on the oxygen sensor.
2. Rotate the oxygen sensor clockwise until completely seated without over-tightening.
3. Reconnect the oxygen cable.
4. Secure the inspiratory door panel.

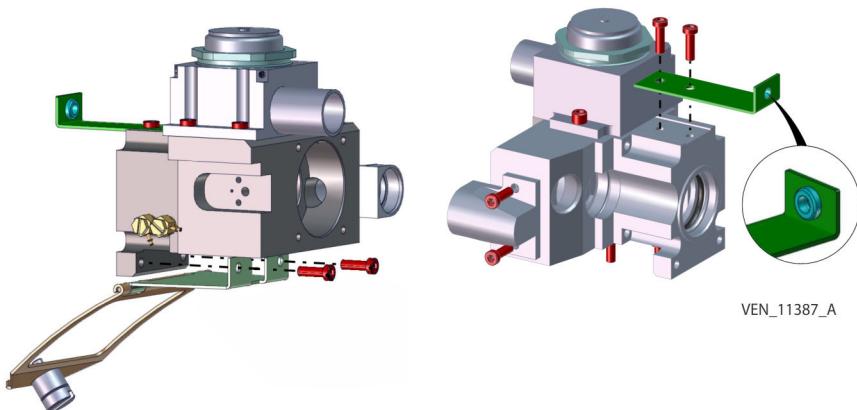
5.12.2.6. Delivery Outlet Manifold

5.12.2.7. Inspiratory filter retainer and filter clip

To remove the internal inspiratory filter retainer and filter clip

1. Remove the internal inspiratory filter. See [page 138](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the inspiratory module. See [page 141](#).
4. Remove the internal inspiratory filter. Place on the static-resistive mat.
5. Remove the two screws from the filter clip, if desired.
6. Remove the two screws from the filter retainer, if desired.

Figure 61. Filter retainer (left) and filter clip (right)



To replace the internal inspiratory filter retainer and filter clip

1. Tighten the two screws for the filter retainer, if removed.
2. Tighten the two screws for the filter clip, if removed.
3. Remove the internal inspiratory filter. See [page 138](#).
4. Rotate the inspiratory module until the PSOLs are visible.
5. Replace the inspiratory module. See [page 143](#).
6. Replace the BDU right panel. See [page 113](#).
7. Replace the internal inspiratory filter. See [page 138](#).

5.12.2.8. Safety valve assembly

To remove the safety valve assembly

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Rotate the inspiratory module until the accumulator is visible.
5. Release the safety valve vent tube from its hole in the inlet manifold.
6. Remove the mix assembly. See [page 144](#).

7. Release the safety valve vent tube hose clamp from the vent tubing, sliding the hose clamp down the tubing until it rests only on the tube and is off the safety valve.
8. Pull outward until the vent tubing is free from the safety valve.
9. Remove the three screws holding the safety valve assembly onto the breath delivery manifold.
10. Retain or replace the o-ring, as required.

To replace the safety valve assembly

1. Replace or reinstall the o-ring to the breath delivery manifold.
2. Align the safety valve to the three screw holes machined into the housing.
3. Tighten the three screws.
4. Rotate the inspiratory module until the PSOLs are visible.
5. Replace the mix assembly. See [page 145](#).
6. Reconnect the vent tubing.
7. Slide the hose clamp back up the vent tubing until it clamps it securely onto the safety valve.
8. Rotate the inspiratory module until the accumulator is visible.
9. Replace the inspiratory module. See [page 143](#).
10. Replace the BDU right panel. See [page 113](#).

5.12.2.9. Delivery manifold

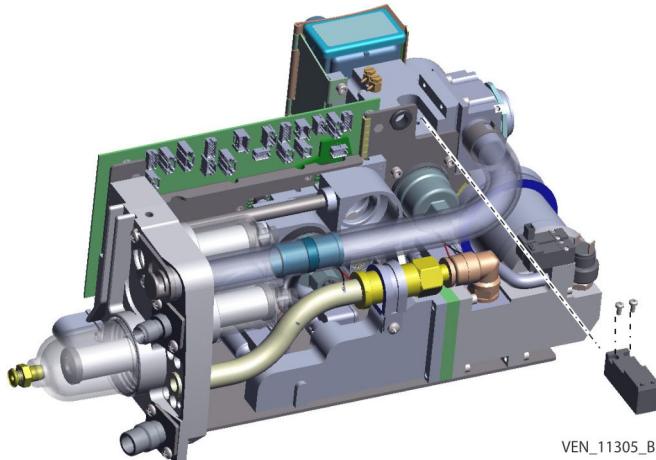
5.12.2.10. To remove and replace the delivery manifold o-ring

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Rotate the inspiratory module until the safety valve is visible.
4. Place on the static-resistive mat.
5. Remove the two screws from the PSOL elbow.
6. Remove the o-ring between the PSOL elbow and the delivery manifold.
7. Replace the new o-ring in the groove on the delivery manifold.
8. Tighten the two screws from the PSOL elbow.
9. Remove the inspiratory module. See [page 141](#).
10. Remove the BDU right panel. See [page 113](#).

5.12.2.11. To remove the BUV solenoid

1. Remove the BDU right panel. See [page 113](#).
2. Disconnect the 4-pin cable from the (P6) connector on the inspiratory flow module PCBA.
3. Remove the two screws from the BUV solenoid.

Figure 62. BUV Solenoid



4. Examine the delivery manifold for solenoid o-rings, which should remain with the solenoid.

5.12.2.12. To replace the BUV solenoid

1. Ensure the BUV solenoid retains its supplied solenoid o-rings.
2. Align the BUV solenoid to the holes in the housing.
3. Tighten the two supplied screws on the BUV solenoid.
4. Reconnect the 4-pin cable to the (P6) connector on the inspiratory sensor module PCBA.
5. Replace the BDU right panel. See [page 113](#).

5.12.2.13. To remove the check valve outlet seat and outlet checking flap valve

1. Remove the internal inspiratory filter. See [page 138](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the inspiratory module. See [page 141](#).
4. Set on the static-resistive mat.
5. Remove the delivery assembly. See [page 149](#).
6. Rotate the delivery assembly so the outlet manifold is up, the filter retainer open.
7. Remove the four screws connecting the outlet manifold assembly to the delivery manifold assembly.
8. Remove both the check valve outlet seat and outlet checking flap valve, noting the orientation of both.

5.12.2.14. To replace the check valve outlet seat and outlet checking flap valve

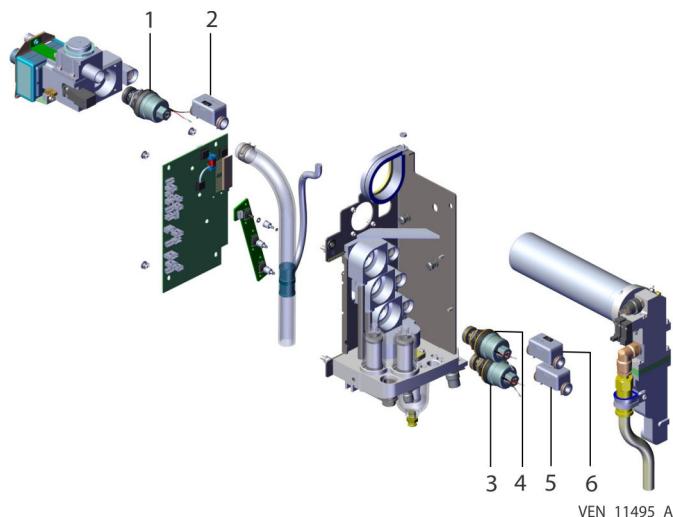
1. With the outlet manifold up, replace the check valve outlet seat in the delivery manifold, orienting it so the flap opens upward.
2. Replace the outlet checking flap valve on top of the check valve outlet seat into the delivery manifold, orienting it so the ribs are up and the flap opens upward, fitting it tightly into the manifold groove.

3. Tighten the four screws connecting the outlet manifold assembly to the delivery manifold assembly.
4. Replace the delivery assembly. See [page 150](#).
5. Replace the inspiratory module. See [page 143](#).
6. Replace the BDU right panel. See [page 113](#).

5.12.2.15. Proportional Solenoid (PSOL) Valves and Flow Sensors

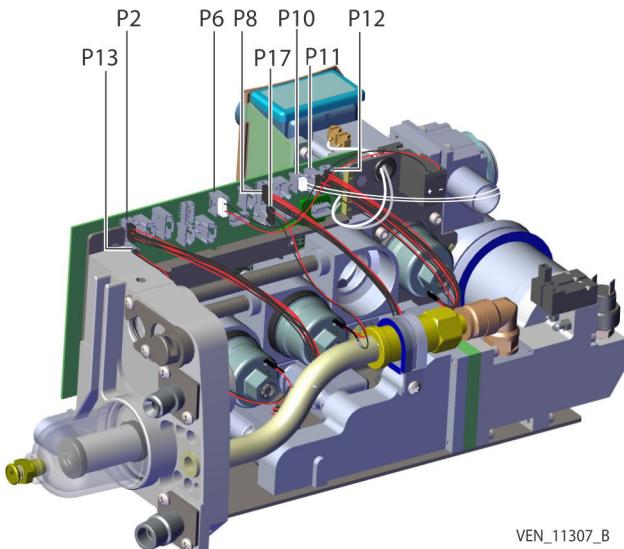
Proportional Solenoid (PSOL) valves meter the flow of gas to achieve the desired mix in the Mix Module. The flow through each PSOL is monitored by separate flow sensors to ensure the accuracy of the mix.

Figure 63. PSOL Locations



- | | |
|-------------------------|-----------------------|
| 1. Delivery PSOL | 4. Oxygen PSOL |
| 2. Delivery flow sensor | 5. Air flow sensor |
| 3. Air PSOL | 6. Oxygen flow sensor |

Figure 64. PSOL and Flow sensor cable connections



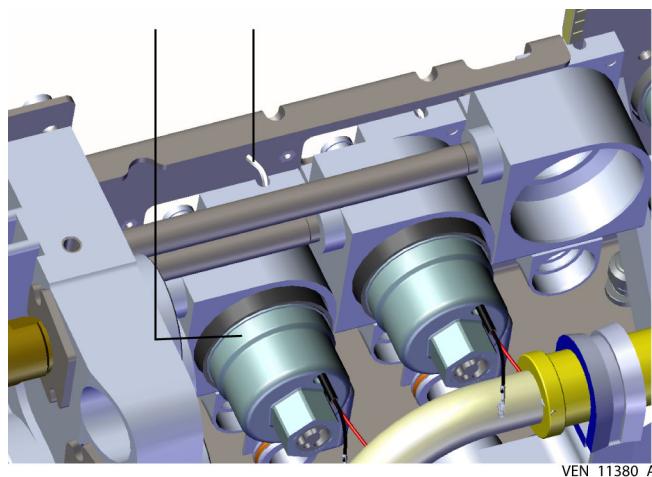
1. P2 10-pin air flow sensor
2. P6 4-pin BUV solenoid valve
3. P8 10-pin oxygen flow sensor
4. P10 3-pin safety valve
5. P11 3-pin delivery PSOL
6. P12 10-pin delivery flow sensor
7. P13 3-pin air PSOL
8. P17 3-pin oxygen PSOL

5.12.2.16. Air Mix (Air) PSOL

5.12.2.17. To remove the Air PSOL

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Release the safety valve vent tube from the inlet manifold.
5. Remove the air filter. See [page 140](#).
6. Disconnect the 3-pin air PSOL wire from the (P13) connector on the inspiratory flow module PCBA.
7. Extract the nylon rod that secures the PSOL.

Figure 65. Air PSOL and Nylon Rod



8. Extract the air PSOL and its related o-rings from the manifold using a non-marring tool.

5.12.2.18. To replace the Air PSOL

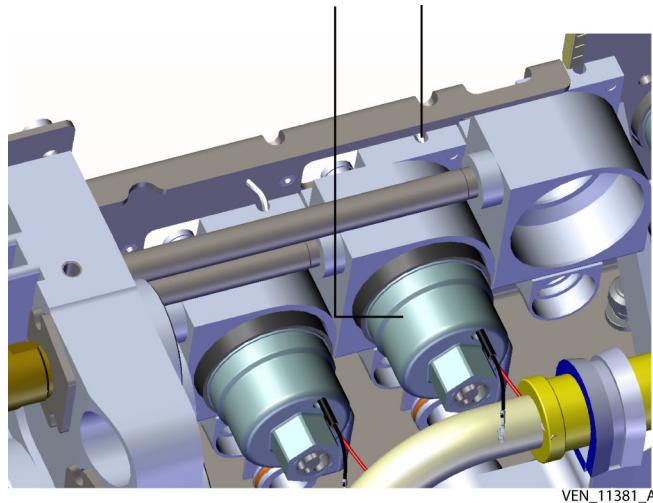
1. Press inward on the air PSOL and its related o-rings until fully seated in the PSOL manifold.
2. Insert the nylon rod that secures the air PSOL until reaching its original position.
3. Reconnect the 3-pin air PSOL wire to the (P13) connector on the inspiratory flow module PCBA.
4. Replace the air filter. See [page 140](#).
5. Replace the safety valve vent tube in the inlet manifold.
6. Replace the inspiratory module. See [page 143](#).
7. Replace the BDU right panel. See [page 113](#).

5.12.2.19. Oxygen Mix (Oxygen) PSOL

5.12.2.20. To remove the Oxygen PSOL

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Release the large safety valve vent tube from the inlet manifold.
5. Disconnect the 3-pin oxygen PSOL wire from the (P17) connector on the inspiratory flow module PCBA.
6. Extract the nylon rod that secures the oxygen PSOL.

Figure 66. Oxygen PSOL and Nylon Rod



7. Extract the oxygen PSOL and its related o-rings from the manifold using a non-marring tool.

5.12.2.21. To replace the Oxygen PSOL

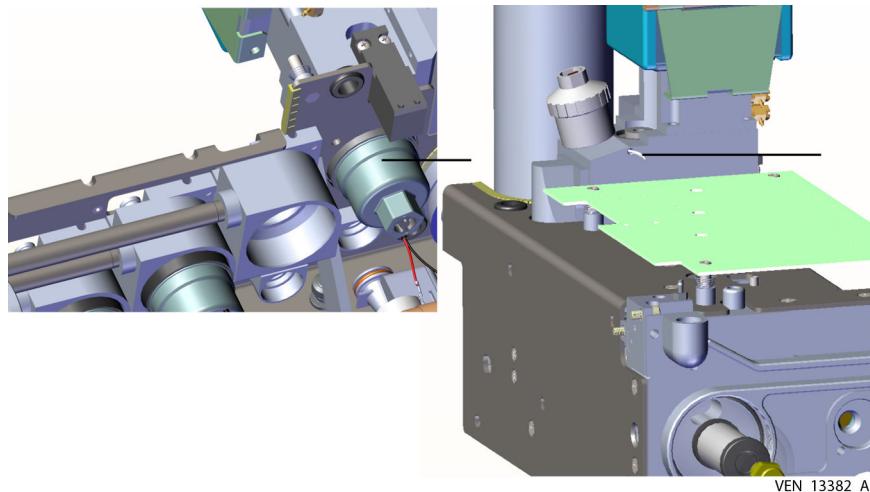
1. Press inward on the oxygen PSOL and its related o-rings until fully seated into the manifold.
2. Insert the nylon rod that secures the oxygen PSOL until reaching its original position.
3. Reconnect the 3-pin oxygen PSOL wire to the (P17) connector on the inspiratory flow module PCBA.
4. Replace the safety valve vent tube in the inlet manifold.
5. Replace the inspiratory module. See [page 143](#).
6. Replace the BDU right panel. See [page 113](#).

5.12.2.22. Delivery PSOL

5.12.2.23. To remove the Delivery PSOL

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Release the safety valve vent tube from the inlet manifold.
5. Disconnect the 4-pin delivery PSOL wire from the (P11) connector on the inspiratory flow module PCBA.
6. Extract the nylon rod that locked the delivery PSOL into place.

Figure 67. Front and Rear Access to Delivery PSOL and Nylon Rod



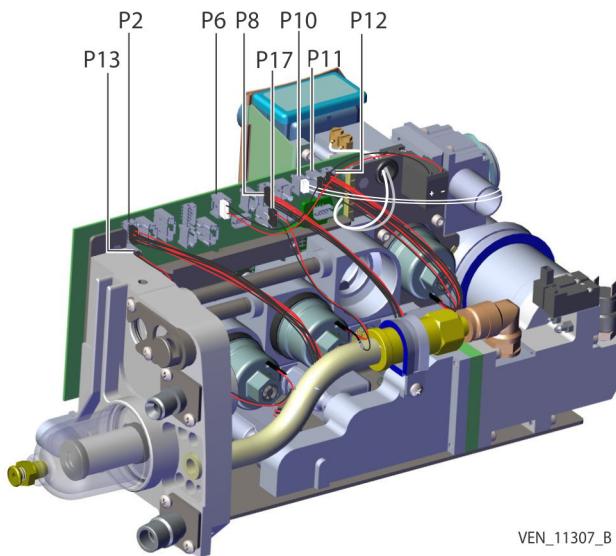
7. Extract the delivery PSOL and its related o-rings from the manifold using a non-marring tool.

5.12.2.24. To replace the Delivery PSOL

1. Press inward on the delivery PSOL and its related o-rings until fully seated into the manifold.
2. Continue pushing the nylon rod that locks the delivery PSOL into place until reaching its original position.
3. Reconnect the 4-pin delivery PSOL wire to the (P11) connector on the inspiratory flow module PCBA.
4. Replace the safety valve vent tube in the inlet manifold.
5. Replace the inspiratory module. See [page 143](#).
6. Replace the BDU right panel. See [page 113](#).

5.12.2.25. Flow Sensors

Figure 68. PSOL and Flow Sensor Cable Connections



VEN_11307_B

1. P2 10-pin air flow sensor
2. P6 4-pin BUV solenoid valve
3. P8 10-pin oxygen flow sensor
4. P10 3-pin safety valve
5. P12 10-pin delivery flow sensor
6. P13 3-pin air PSOL
7. P17 3-pin oxygen PSOL
8. P11 3-pin delivery PSOL

5.12.2.26. To remove the delivery, oxygen, or air flow sensor

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Set on the static-resistive mat.
4. Release the large safety valve vent tube from the inlet manifold.
5. Remove two screws from the inspiratory module chassis retaining the mix assembly.
6. Loosen the lock nut from the P-clamp.
7. Slide the mix assembly away from the inspiratory module, ensuring all flow sensors remain attached to the inspiratory flow module PCBA.
8. Detach the flow sensor cable connection for the desired flow sensor from the inspiratory flow module PCBA.
9. Extract the flow sensor.

5

5.12.2.27. To replace the delivery, oxygen, or air flow sensor

1. Orient the desired flow sensor, ensuring the flow direction arrow points in the proper flow direction and both o-rings are properly positioned.

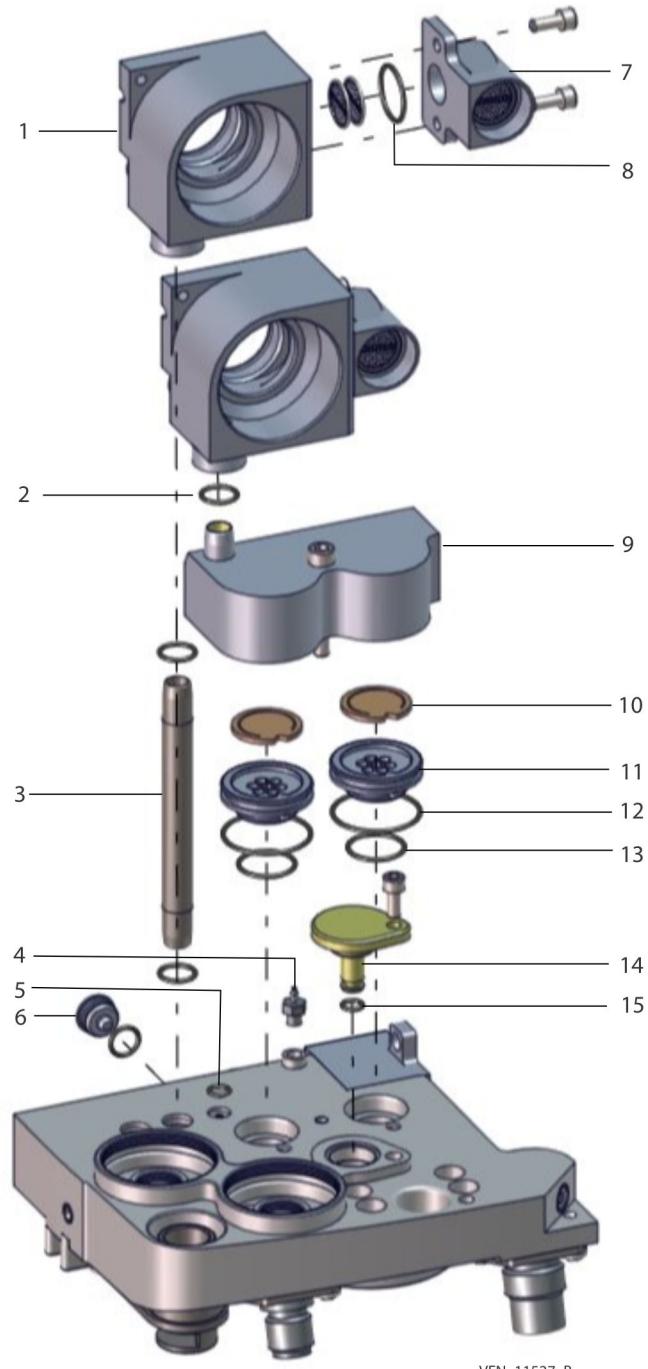
Figure 69. Proper Flow Direction Orientation and O-ring Placement



2. Press the flow sensor all the way into the orifice.
3. Connect the flow sensor cable to the appropriate connector on the inspiratory flow module PCBA.
4. Slide the mix assembly into the P-clamp on the inspiratory module, ensuring all flow sensors align and mate properly on both sides.
5. Tighten the lock nut on the P-clamp.
6. Tighten the two screws retaining the mix assembly on the inspiratory module chassis.
7. Reinsert the safety valve vent tube in the inlet manifold.
8. Replace the inspiratory module. See [page 143](#).
9. Replace the BDU right panel. See [page 113](#).

5.12.3. Inlet Manifold Assembly

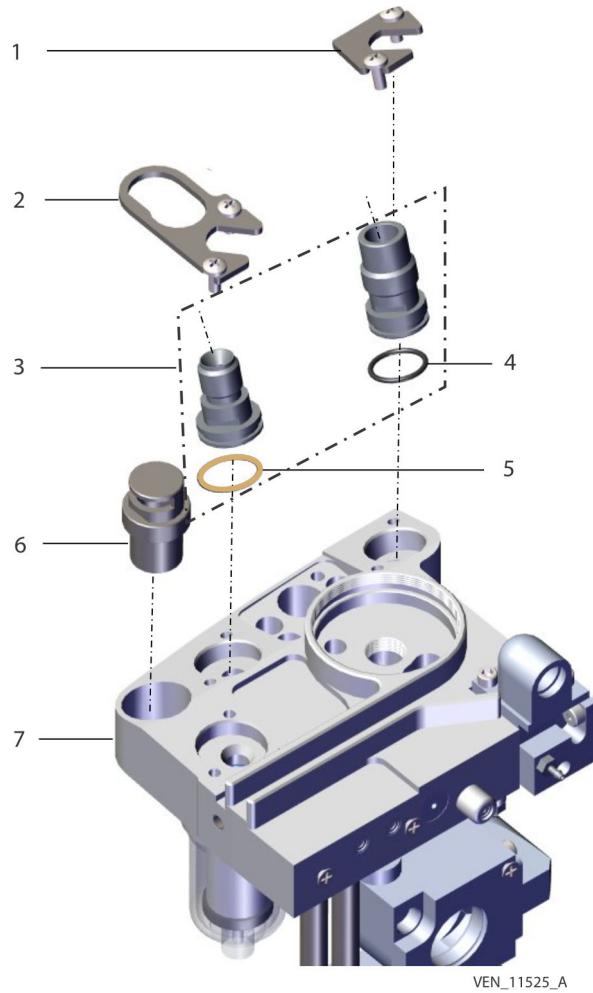
Figure 70. Upper Inlet Manifold



VEN_11527_B

1. PSOL manifolds
2. O-ring
3. Transfer tubes
4. Barb fitting
5. O-ring
6. Plug
7. Manifold
8. O-ring
9. Check valve manifold
10. Air inlet flap valve
11. Check valve air inlet seat
12. O-ring
13. O-ring
14. HF Option port plug
15. O-ring

Figure 71. Lower Inlet Manifold



- | | |
|--------------------------------------|--------------------------|
| 1. Fitting retainer, screws | 5. O-ring, natural |
| 2. Deflector retainer, screws | 6. Oxygen deflector plug |
| 3. Inspiratory Module inlet fittings | 7. Inlet manifold |
| 4. O-ring, black | |

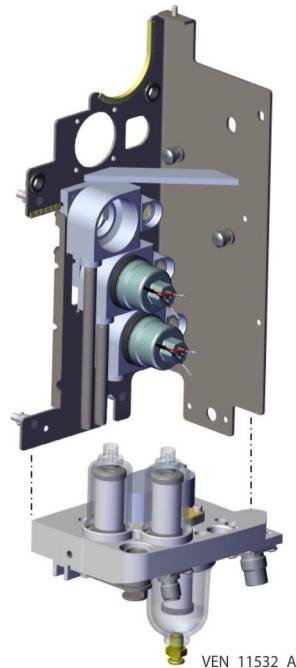
5.12.3.1. Inspiratory Module Chassis

5.12.3.2. To remove the inspiratory module chassis from the inlet manifold

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Set on the static-resistive mat.
4. Remove the mix assembly. See [page 144](#).
5. Remove the air and oxygen flow sensors. See [page 159](#).
6. Remove the safety valve assembly. See [page 151](#).
7. Remove the inspiratory flow module PCBA. See [page 169](#).
8. Remove the Gas Supply Sensor PCBA. See [page 171](#).
9. Remove the four screws retaining the chassis to the inlet manifold assembly.

10. Lift the chassis assembly still containing the mix PSOL manifold assemblies off the transfer tubes.

Figure 72. Lifting Chassis Assembly from Inlet Manifold Assembly



11. Remove the transfer tubes.

5.12.3.3. To reconnect the inspiratory module chassis to the inlet manifold

1. Apply Krytox™* grease to either end of each transfer tube.
2. Replace the o-rings and transfer tubes in the appropriate location on the inlet manifold assembly.
3. Place the inspiratory module chassis assembly still containing the mix PSOL manifold back onto the transfer tubes.
4. Tighten the four screws to secure the chassis to the inlet manifold assembly.
5. Replace the Gas Supply Sensor PCBA. See [page 172](#).
6. Replace the Inspiratory Flow Sensor PCBA. See [page 170](#).
7. Replace the safety valve assembly. See [page 152](#).
8. Replace the air and oxygen flow sensors. See [page 159](#).
9. Replace the mix assembly. See [page 145](#).
10. Replace the inspiratory module. See [page 143](#).
11. Replace the BDU right panel. See [page 113](#).

5.12.3.4. PSOL manifold

See [To remove the options supply or accumulator purge solenoid, page 146](#) for instructions on either mix PSOL removal.

5.12.3.5. To remove the mix PSOL elbow or transfer tube

1. Remove the BDU right panel. See [page 113](#).

2. Remove the inspiratory module. See [page 141](#).
3. Set on the static-resistive mat.
4. Remove the mix assembly. See [page 144](#).
5. Remove the air and oxygen flow sensors. See [page 159](#).
6. Remove the safety valve assembly. See [page 151](#).
7. Remove the Inspiratory Flow Sensor PCBA. See [page 169](#).
8. Remove the Gas Supply PCBA. See [page 171](#).
9. Remove the two screws related to the desired mix PSOL.
10. Remove the two screws to the manifold elbow.
11. Remove the o-ring from the PSOL manifold.
12. Remove the transfer tube from the PSOL manifold.

5.12.3.6. To replace the mix PSOL elbow or transfer tube

1. Replace the transfer tube into the PSOL manifold and inlet manifold assembly, if removed.
2. Apply Krytox grease to the ends of the related transfer tube.
3. Replace the o-ring and transfer tube in the appropriate location on the inlet manifold assembly.
4. Place the chassis assembly still containing the mix PSOL manifold assemblies back onto the transfer tube.
5. Press the o-ring back into the groove in the PSOL manifold.
6. Tighten the two screws to the manifold elbow.
7. Tighten the two screws related to the desired mix PSOL.
8. Replace the Gas Supply Sensor PCBA. See [page 172](#).
9. Replace the inspiratory flow module PCBA. See [page 170](#).
10. Replace the safety valve assembly. See [page 152](#).
11. Replace the air and oxygen flow sensors. See [page 159](#).
12. Replace the mix assembly. See [page 145](#).
13. Replace the inspiratory module. See [page 143](#).
14. Replace the BDU right panel. See [page 113](#).

5.12.3.7. Check valve manifold

5.12.3.8. To remove the air inlet flap valve and check valve seat

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Set on the static-resistive mat.
6. Remove the chassis. See [page 162](#).

7. Remove the screw retaining the manifold plug assembly to the inlet manifold assembly.
8. Remove both silicon check valve assemblies, which includes the air inlet flap valve, the check valve seat, and both o-rings, noting the nib in the air inlet check valve seat and where it mates to the hole in the inlet manifold assembly.

5.12.3.9. To replace the air inlet flap valve and check valve seat

1. Replace both silicon check valve assemblies, which includes the air inlet flap valve, the check valve seat, and both o-rings, locating the nib in the air inlet check valve seat in the inlet manifold assembly hole.
2. Tighten the screw retaining the manifold plug assembly to the inlet manifold assembly.
3. Replace the chassis. See [page 163](#).
4. Replace the inspiratory module. See [page 143](#).
5. Replace the BDU rear panel. See [page 115](#).
6. Replace the BDU right panel. See [page 113](#).
7. Replace the BDU left panel. See [page 114](#).

5.12.3.10. Inlet manifold

5.12.3.11. To remove and replace the HF option port plug and hose connection

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Set on the static-resistive mat.
6. Remove the chassis. See [page 162](#).
7. Remove the screw retaining the option port plug assembly, ensuring the o-ring is still attached.
8. Remove the hose connection just behind the manifold plug assembly, if desired.
9. Tighten the new hose connection onto the inlet manifold assembly, if removed.
10. Place the o-ring on the new HF option port plug.
11. Tighten the screw retaining the option port plug assembly.
12. Replace the chassis. See [page 163](#).
13. Replace the inspiratory module. See [page 143](#).
14. Replace the BDU rear panel. See [page 115](#).
15. Replace the BDU right panel. See [page 113](#).
16. Replace the BDU left panel. See [page 114](#).

5.12.3.12. To remove and replace the inlet assembly fittings or oxygen deflector plug

1. Remove the BDU left panel. See [page 113](#).

2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Set on the static-resistive mat.
6. Remove the inspiratory module chassis. See [page 162](#).
7. Remove the two retainer's screws for the desired fitting or plug.
8. Extract the desired fitting or plug.
9. Slide the retainer around the collar of the replacement fitting or plug.
10. Tighten the two retainer's screws.
11. Replace the chassis. See [page 163](#).
12. Replace the inspiratory module. See [page 143](#).
13. Replace the BDU rear panel. See [page 115](#).
14. Replace the BDU right panel. See [page 113](#).
15. Replace the BDU left panel. See [page 114](#).

5.12.4. Inspiratory Module Cabling and Hoses

5.12.4.1. To remove inspiratory module cabling

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Rotate the inspiratory module until the appropriate cable is accessible.
5. Remove from the desired cable from the listed connector on the inspiratory flow module PCBA. See [page 169](#).
6. For flow sensor cables, follow the steps listed below.
 - Lift out or remove the vent tube above the air filter bowl.
 - Remove the desired cable from the connector.
7. For the oxygen sensor cable, follow the steps listed below.
 - Remove the cable from the (P7) connector on the inspiratory flow module PCBA.
 - Remove the tubing from the nib on the accumulator manifold.
 - Insert tubing through the rubber grommet to allow for the cable connector.
 - Insert the cable through the rubber grommet.
8. For the pressure switch cable, remove from the cable from the (P9) connector on the Inspiratory Sensor PCBA and from the spades on the pressure switch.
9. For the gas supply sensor cable, follow the steps listed below.
 - Remove the cable from the (P16) connector on the inspiratory flow module PCBA.
 - Remove the cable from the (P1) connector on the Gas Supply Sensor PCBA.

5.12.4.2. To replace inspiratory module cabling

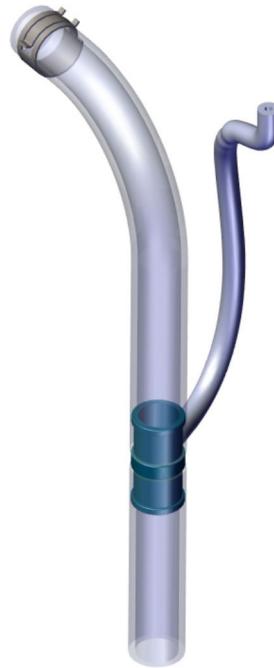
1. For the gas supply sensor cable, follow the steps listed below.
 - Replace the cable from the (P1) connector on the Gas Supply Sensor PCBA.
 - Replace the cable from the (P16) connector on the inspiratory flow module PCBA. See [page 169](#).
2. For the pressure switch cable, replace from the cable from the (P9) connector on the inspiratory flow module PCBA and the two spade connectors on the pressure switch.
3. For the oxygen sensor cable, follow the steps listed below.
 - Insert the cable through the rubber grommet.
 - Insert tubing through the rubber grommet to allow for the cable connector.
 - Replace the tubing from the nib on the accumulator.
 - Replace the other end of the cable from the oxygen sensor.
 - Replace the cable from the (P7) connector on the inspiratory flow module PCBA.
4. For flow sensor cables, follow the steps listed below.
 - Replace the desired cable from the connector.
 - Replace the vent tube above the air filter bowl.
5. Replace from the desired cable from the listed connector on the inspiratory flow module PCBA. See [page 169](#).
6. Replace the inspiratory flow module PCBA. See [page 170](#).
7. Replace the inspiratory module. See [page 143](#).
8. Replace the BDU right panel. See [page 113](#).

5.12.4.3. To remove inspiratory module hoses and tubing

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Rotate the inspiratory module until the appropriate hoses are accessible.
5. For inlet manifold hose, follow the steps listed below.
 - Remove the 11.5 in. long tubing from the nib closest to the accumulator connector on the accumulator manifold assembly.
 - Follow the tubing down to the hose connector barb on the inlet manifold assembly to gently remove the 11.5 in. long hose off the hose connector just behind the manifold plug assembly.
6. For the inspiratory flow module PCBA tubing, follow the steps listed below.
 - Remove the 7 in. long tubing from the nib on the (PS2) connector on the inspiratory flow module PCBA.

- Remove the 7 in. long tubing from the nib on the (S01) connector on the inspiratory flow module PCBA.
 - Remove both ends of the 7 in. long tubing from the barbs on the outlet manifold assembly pneumatic fittings.
 - Insert both tubes out through the outside rubber grommet above the inspiratory flow module PCBA.
 - Remove the 9 in. long tubing from the nib on the (PS4) connector on the inspiratory flow module PCBA.
 - Remove the other end of the 9 in. long tubing from the pneumatic fitting barbs on the accumulator manifold assembly.
 - Insert the tubing out through the inside rubber grommet above the inspiratory flow module PCBA.
 - Remove the tubing between the (PS1) and (S01) nibs on the inspiratory flow module PCBA.
7. For the vent hoses, follow the steps listed below.
- Remove the larger vent tube from the safety valve by releasing the hose clamp and lifting the other end out of the inlet manifold assembly.

Figure 73. Vent Tube



- Remove the other end of the 10.25 in. long tubing from the related pneumatic fitting barb on the accumulator manifold assembly.
 - Remove the smaller vent hose by releasing the hose clamp from the accumulator pressure relief valve and lifting the other end out of the inlet manifold assembly.
8. Replace the inspiratory module. See [page 143](#).

9. Replace the BDU right panel. See [page 113](#).

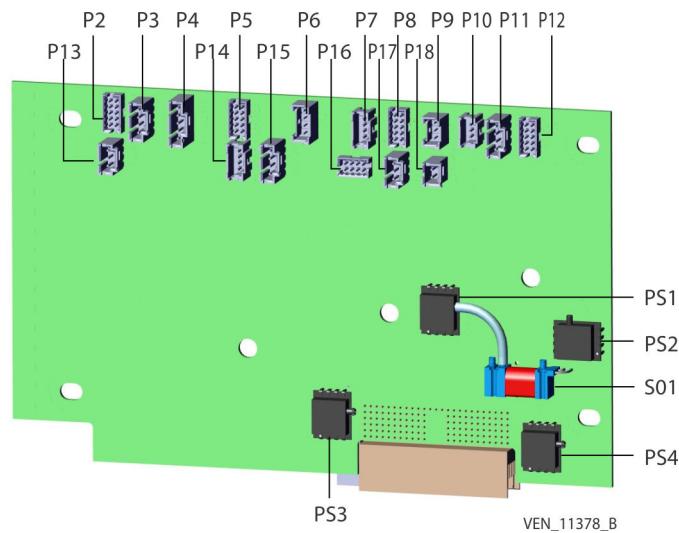
5.12.5. Inspiratory Module PCBA

5.12.5.1. Inspiratory Flow Module PCBA

5.12.5.2. To remove the inspiratory flow module PCBA

1. Remove the BDU right panel. See [page 113](#).
2. Remove the inspiratory module. See [page 141](#).
3. Place on the static-resistive mat.
4. Rotate the inspiratory module until the inspiratory flow module PCBA is visible.
5. Disconnect the following cables from the inspiratory flow module PCBA.

Figure 74. Inspiratory Flow Module PCBA Connections¹

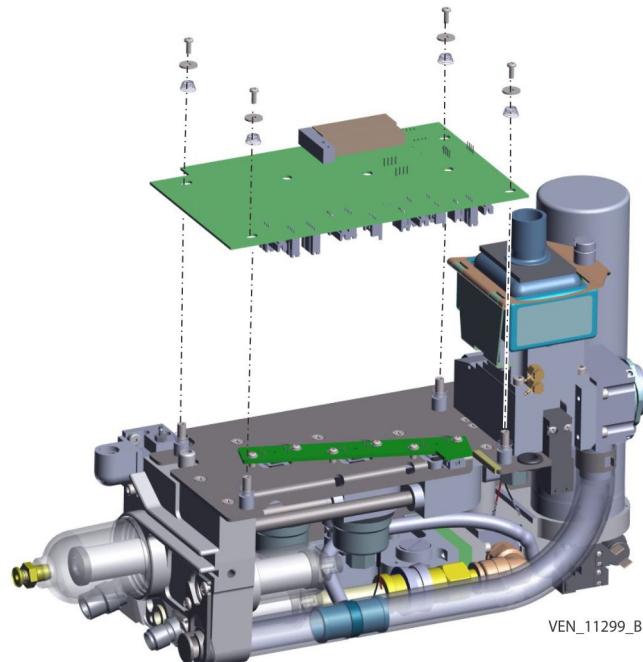


1. P2 10-pin air flow sensor
 2. P6 4-pin BUV solenoid valve
 3. P7 4-pin oxygen sensor
 4. P8 10-pin oxygen flow sensor
 5. P9 3-pin pressure switch
 6. P10 3-pin safety valve
 7. P11 3-pin delivery PSOL S01
 8. P12 10-pin delivery flow sensor
 9. P13 3-pin air PSOL
 10. P15 4-pin options gas supply solenoid
 11. P16 8-pin gas supply sensor
 12. P17 3-pin oxygen PSOL
 13. P18 2-pin accumulator purge solenoid
 14. PS1 to S01 tube
 15. PS2 Outlet manifold tube
 16. PS4 Accumulator manifold tube
6. Rotate the inspiratory module until the inspiratory flow module PCBA is visible.
 7. Loosen the four screws.

Note: Retain all washers, springs and screws.

¹ The P3, P4, P5, and P13 slots are not in use at this time, nor is the PS3.

Figure 75. Removing the Inspiratory Flow Module PCBA

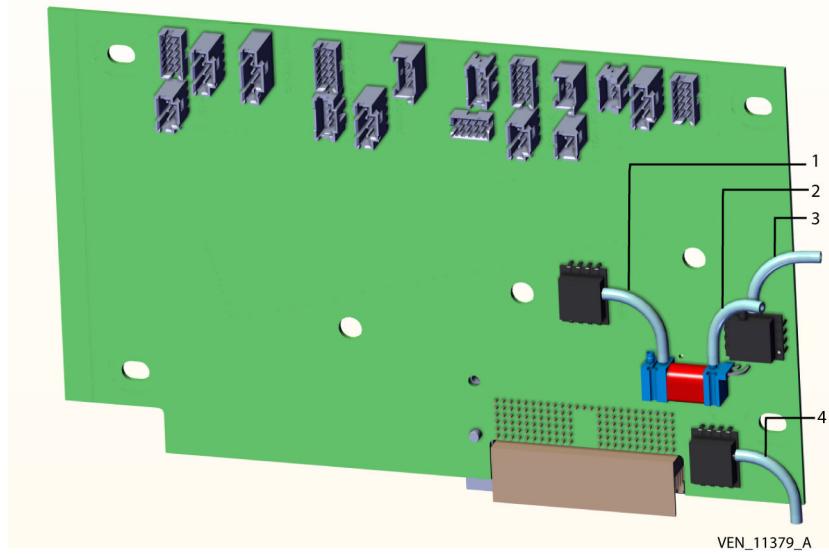


8. Carefully remove all four screws, retaining the washers and springs beneath each screw.
9. Place on the static-resistive mat.
10. Ensure the remaining four springs and retaining washers beneath the inspiratory flow module PCBA remain on the standouts.
11. Remove the inspiratory flow module PCBA, noting the routing of the three tubes for reassembly.
12. Disconnect the two tubes connected to the delivery manifold from the inspiratory flow module PCBA.
13. Disconnect the tube connected to the accumulator manifold from the inspiratory flow module PCBA.

5.12.5.3. To replace the inspiratory flow module PCBA

1. Fully insert the tubing onto the appropriate transducer body.

Figure 76. Inspiratory Flow Module PCBA Tubing Connections (4)



1. PS1 to S01
2. S01 to outlet manifold assembly
3. PS2 to outlet manifold assembly
4. PS4 to accumulator manifold assembly
2. Ensure the large end of each of the four springs face the PCBA above the retaining washers on the standouts.
3. Place onto the four standouts.
4. Replace the remaining four springs, ensuring the large end of the spiral faces the PCBA on each standout.
5. Replace a washer and then screw on each standout.
6. Tighten the four screws.
7. Reconnect the following cables to the inspiratory flow module PCBA.
8. Replace the inspiratory module. See [page 143](#).
9. Replace the BDU right panel. See [page 113](#).

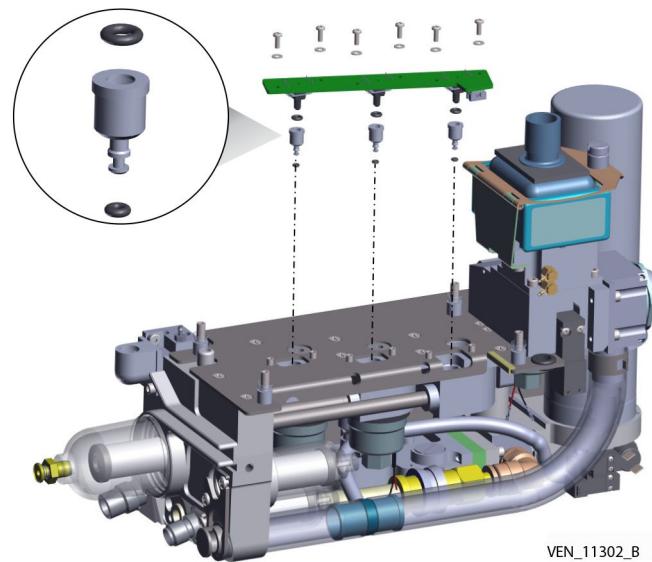
5.12.5.4. Gas Supply Sensor PCBA Components

5.12.5.5. To remove the Gas Supply Sensor PCBA and pressure tap couplers

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Disconnect the 8-pin Gas Supply Sensor PCBA cable from the (P1) connector on the inspiratory flow module PCBA.
6. Place on the static-resistive mat.
7. Remove the inspiratory flow module PCBA. See [page 169](#).
8. Place on the static-resistive mat.

9. Remove the six screws.

Figure 77. Removing Gas Supply Sensor PCBA, Pressure Tap Couplers



10. Pull gently to release the Gas Supply Sensor PCBA.

Note: The Gas Supply Sensor PCBA retains pressure tap couplers surrounded on either side by o-rings. These connect solidly with the PSOLs through the module housing.

11. Extract the pressure tap couplers from the Gas Supply Sensor PCBA pressure transducers.

5.12.5.6. To replace the Gas Supply Sensor PCBA

1. Place the Gas Supply Sensor PCBA on the static-resistive mat.
2. Press the pressure tap couplers onto the Gas Supply Sensor PCBA pressure transducers.
3. Align the PCBA to the top row of pass-through holes in the inspiratory module chassis.
4. Press the pressure tap couplers on the Gas Supply Sensor PCBA pressure transducers until they connect with the metal housing insets behind the PSOLs.
5. Tighten the six screws.
6. Replace the inspiratory flow module PCBA. See [page 170](#).
7. Reconnect the 8-pin Gas Supply Sensor PCBA cable to the (P1) connector on the inspiratory flow module PCBA.
8. Replace the inspiratory module. See [page 143](#).
9. Replace the BDU rear panel. See [page 115](#).
10. Replace the BDU left panel. See [page 114](#).
11. Replace the BDU right panel. See [page 113](#).

5.13. Exhalation Module

Warning: Damaging the hot film wire or thermistor in the exhalation flow sensor's center port can cause the ventilator's spirometry system to malfunction.

Caution: To avoid damage to the exhalation flow sensor element:

- Do not touch the hot film wire or thermistor in the exhalation flow sensor's center port.
- Do not vigorously swish fluid through the exhalation flow sensor's center port while immersed.
- Do not forcefully blow compressed air or any fluid into the exhalation flow sensor's center cavity.
- Do not drop the exhalation flow sensor assembly or handle roughly during disinfection or storage.

Follow all general repair guidelines when repairing any portion of the ventilator.

See [page 106](#), and the applicable specific repair guidelines. Use the following content list to locate the proper area within this section.

[Overview, page 173](#)

[Exhalation Consumable Components, page 174](#)

[Exhalation Flow Sensor Assembly, page 175](#)

[page 177](#)

[Exhalation Module Bezel and Filter Door, page 178](#)

[Exhalation Valve Assembly, page 180](#)

[Exhalation Sensor PCBA, page 181](#)

[Exhalation module cable, page 183](#)

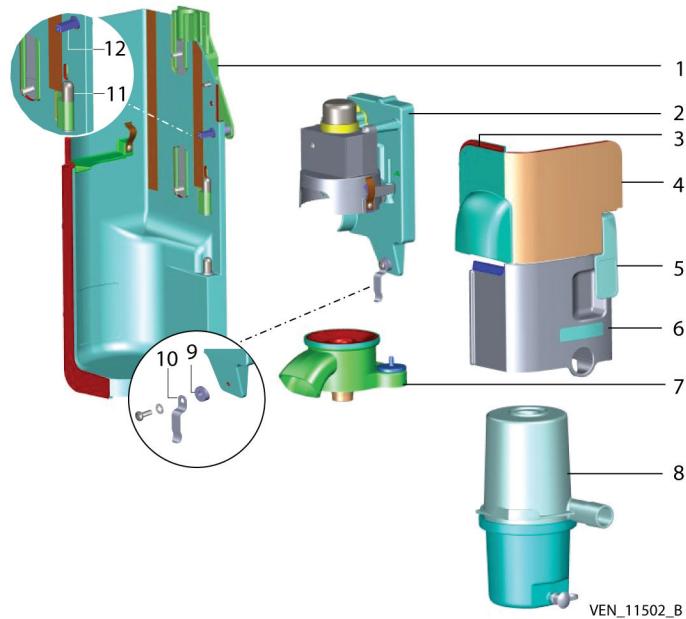
[Exhalation Module Chassis, page 184](#)

[Overview](#)

5.13.1. Overview

This section addresses removal and replacement of various major BDU exhalation module subassemblies.

Figure 78. Expiratory Filter (Adult/Pediatric shown)



- | | |
|------------------------------|--|
| 1. Exhalation module chassis | 7. Exhalation flow sensor |
| 2. Exhalation valve assembly | 8. Expiratory filter (adult/pediatric shown) |
| 3. Upper rear bezel | 9. Lift lever pivot |
| 4. Upper front bezel | 10. Filter door pivot |
| 5. Lift lever | 11. Clip-on finger |
| 6. Exhalation filter door | 12. Finger spacer |

5.13.2. Exhalation Consumable Components

5.13.2.1. Expiratory Filter

Warning: In order to reduce the risk of infection, always use the ventilator with inspiratory and exhalation bacteria filters.

Warning: Do not attempt to use inspiratory or expiratory filters designed for use with ventilators other than the Puritan Bennett 980 Series Ventilator.

Warning: Refer to the filter's instructions for use for details such as cleaning and sterilization requirements, filtration efficiency, proper filter usage, and maximum filter resistance, particularly when using aerosolized medications.

Warning: Refer to the filter Instructions For Use (IFU) for information on reusable filter cleaning and sterilization and filter efficiency.

Warning: Do not re-use disposable inspiratory or expiratory filters, and dispose according to your institution's policy for discarding contaminated waste.

Caution: Ensure both inspiratory and expiratory filters are properly attached to the ventilator.

5.13.2.2. To replace the Adult/Pediatric expiratory filter

1. If necessary, remove the exhalation limb of patient circuit from the expiratory filter.
2. Raise the exhalation filter latch to unlock. This raises the exhalation valve assembly and allows the filter door to swing away from the ventilator.
3. Open the exhalation filter door.
4. Remove the existing expiratory filter.
5. Insert the new expiratory filter by sliding it along the tracks in the door. Ensure the From Patient port aligns with the cutout in the door and points away from the ventilator.
6. Close the exhalation filter door.
7. Lock the expiratory filter latch to secure the expiratory filter.

5.13.2.3. Exhalation Flow Sensor Assembly

Warning: Damaging the hot film wire or thermistor in the exhalation flow sensor's center port can cause the ventilator's spirometry system to malfunction.

Caution: To avoid damage to the exhalation flow sensor element:

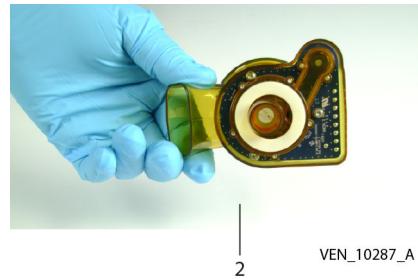
- Do not touch the hot film wire or thermistor in the exhalation flow sensor's center port
- Do not vigorously swish fluid through the exhalation flow sensor center port while immersed.
- Do not forcefully blow compressed air or any fluid into the exhalation flow sensor's center cavity.
- Do not drop the exhalation flow sensor assembly or handle roughly during disinfection or storage

The exhalation flow sensor assembly contains the exhalation valve body, exhalation flow sensor, exhalation valve diaphragm, exhalation filter seal, and pressure sensor filter. The expected service life for the exhalation flow sensor assembly is 25 disinfection cycles.

Figure 79. Exhalation Flow Sensor Assembly Top



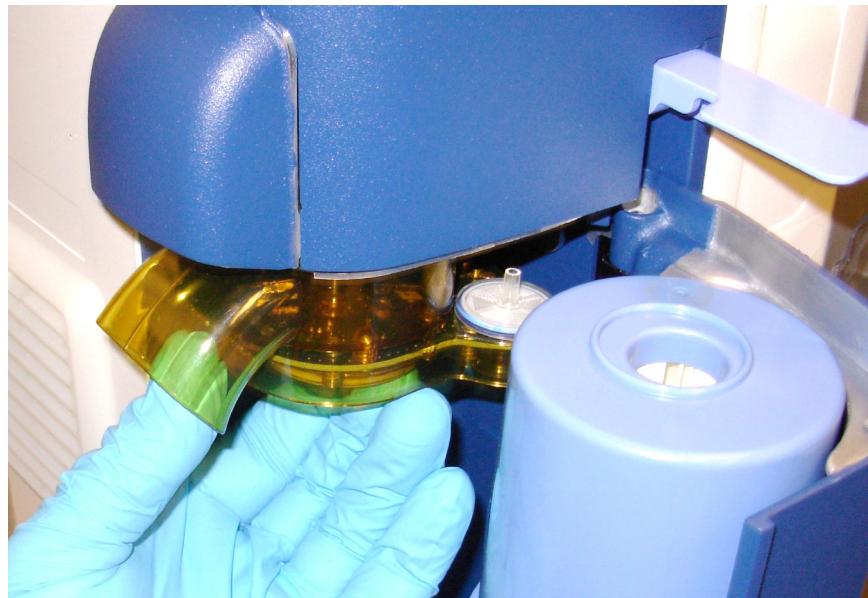
Figure 80. Exhalation Flow Sensor Assembly Bottom



5.13.2.4. To remove the exhalation flow sensor assembly

1. Raise the exhalation filter latch to unlock. This raises the exhalation valve assembly and allows the filter door to swing away from the ventilator.
2. Open the exhalation filter door.
3. With thumb inserted into the plastic exhalation port and four fingers under the exhalation flow sensor assembly, pull down until it snaps out. To avoid damaging the hot wire element, do not insert fingers into the center port.

Figure 81. Exhalation Flow Sensor Removal



5.13.2.5. To replace the exhalation flow sensor assembly

1. With thumb inserted into the plastic exhalation port and four fingers under the exhalation flow sensor assembly press inward until it snaps in place.
2. Close the filter door.
3. Lock the exhalation filter latch.

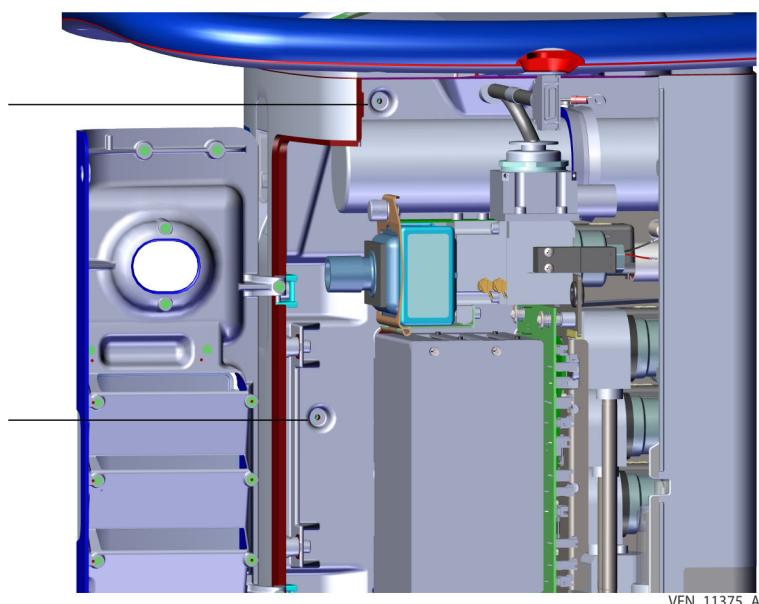
5.13.3. Exhalation Module

5.13.3.1. To remove the exhalation module

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Rotate the ventilator to access the right side, since the screws retaining the exhalation module extend through the chassis spine from the inspiratory module side.
5. Loosen the two screws until free of the exhalation module.

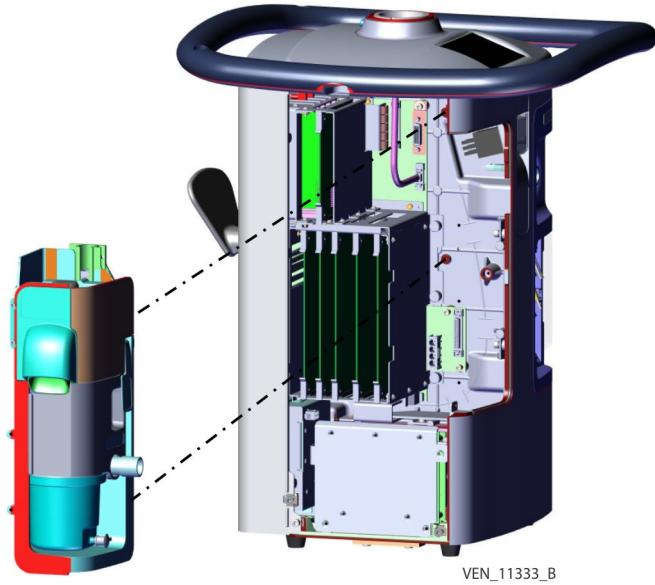
Note: Leaving the screws in the chassis spine makes replacement of the exhalation module easier.

Figure 82. Screws Location for Exhalation Module Release



6. Rotate the ventilator to access the left side.
7. Compress the spring clips on the cable connector to release the exhalation sensor cable from the (J13) connector on the backplane.
8. Pull the exhalation module to the front while also exerting outward pressure.

Figure 83. Removal of Exhalation Module



5.13.3.2. To replace the exhalation module

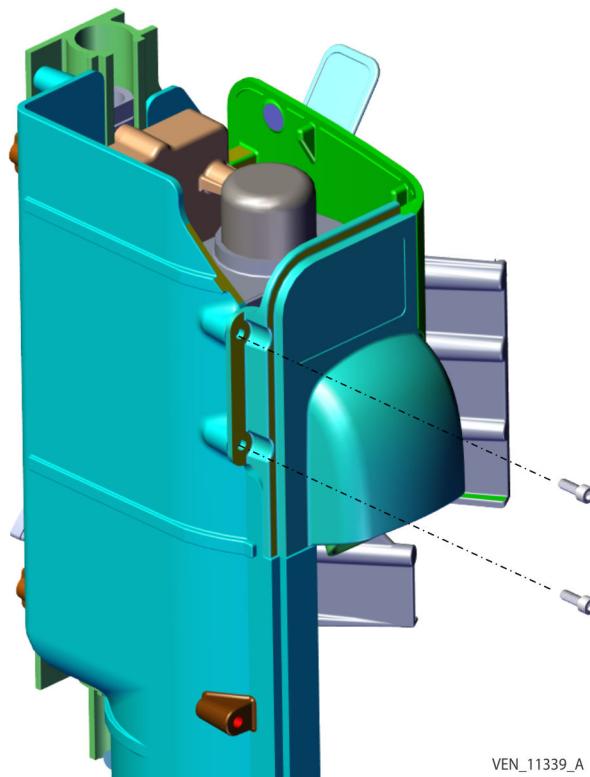
1. Connect the exhalation module cable to the (J13) connector on the backplane while supporting the exhalation module.
2. Align the exhalation module to the opening in the chassis on the left side of ventilator, ensuring a solid fit after aligning it flush with outer edge of the chassis.
3. Exert an inward pressure on the exhalation module.
4. Ensure a solid fit after aligning it flush with the outer chassis of the ventilator.
5. Support the exhalation module on the right side of the ventilator while tightening the two screws on the right side of the ventilator.
6. Replace the BDU rear panel. See [page 115](#).
7. Replace the BDU left panel. See [page 114](#).
8. Replace the BDU right panel. See [page 113](#).

5.13.4. Exhalation Module Bezel and Filter Door

5.13.4.1. To remove the exhalation bezels

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the exhalation module. See [page 177](#).
5. Remove the exhalation flow sensor. See [page 176](#).
6. Remove the exhalation module cable. See [page 183](#).
7. Remove the two screws that connect the upper front and rear bezels.

Figure 84. Upper Front and Rear Bezel Removal



8. To separate the upper front and rear bezels, remove the screw, washer, and lock washer connecting them.

5.13.4.2. To replace the exhalation bezels

1. To connect the upper front and rear bezels, replace the screw, washer, and lock washer connecting them.
2. Tighten the two screws that retain the upper front and rear bezel.
3. Replace the exhalation module cable. See [page 183](#).
4. Replace the exhalation flow sensor. See [page 176](#).
5. Replace the exhalation module. See [page 178](#).
6. Replace the BDU rear panel. See [page 115](#).
7. Replace the BDU left panel. See [page 114](#).
8. Replace the BDU right panel. See [page 113](#).

5.13.4.3. To remove and replace the filter door

1. Raise the exhalation filter latch to unlock. This raises the exhalation valve assembly and allows the filter door to swing away from the ventilator.
2. Open the exhalation filter door.
3. Remove the expiratory filter.
4. Remove the filter door by lifting it off the filter pivot.
5. Replace the filter door by sliding it back on the filter pivot.

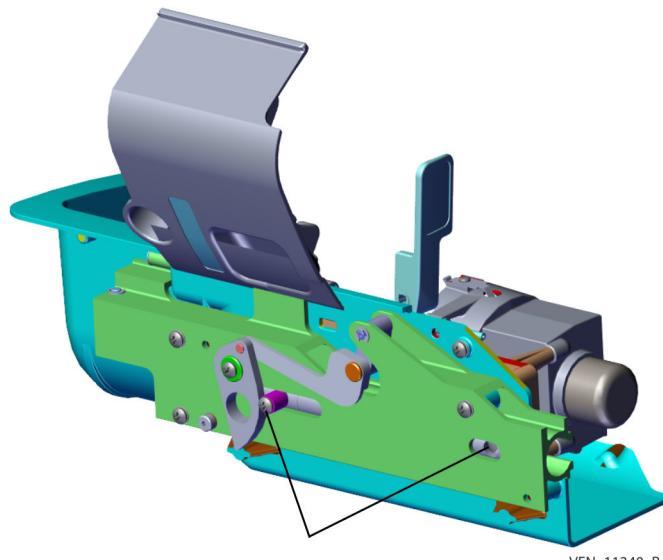
6. Replace the expiratory filter.
7. Close the expiratory filter door.
8. Lock the exhalation filter latch to secure the expiratory filter.

5.13.5. Exhalation Valve Assembly

5.13.5.1. To remove the exhalation valve assembly

1. Remove the BDU right panel. [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the exhalation module. See [page 177](#).
4. Remove the exhalation flow sensor. See [page 176](#).
5. Remove the exhalation module cable. See [page 183](#).
6. Remove the door holder bracket and its angled spacer and screw.
7. Remove the exhalation bezels. See [page 178](#).
8. Remove the screw located above the latch mechanism.

Figure 85. Location of Exhalation Valve Assembly Screws



9. Remove the two screws until the exhalation valve assembly comes free.

5.13.5.2. To replace the exhalation valve assembly

1. Align the exhalation valve assembly to the backplane of the housing.
2. Replace the door holder bracket, retaining the angled spacer in proper orientation, while tightening the screw.
3. Tighten the screw located above the latch mechanism while supporting the exhalation valve assembly.
4. Replace the exhalation bezels. See [page 179](#).
5. Replace the exhalation module cable. See [page 183](#).
6. Replace the exhalation flow sensor. See [page 176](#).

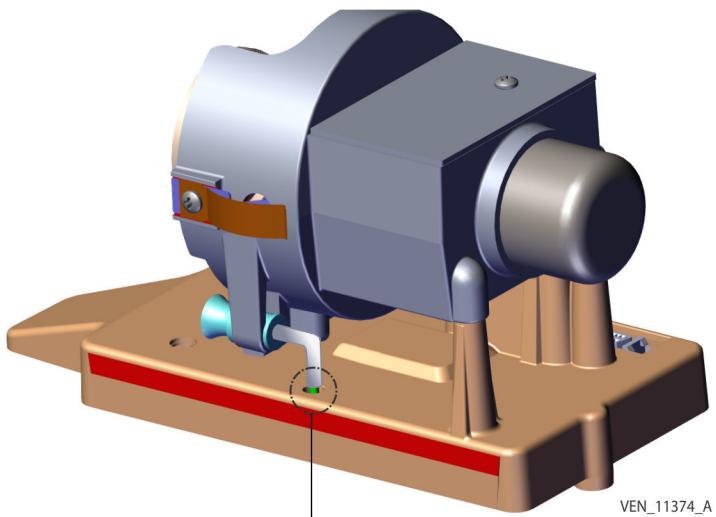
7. Replace the exhalation module. See [page 178](#).
8. Replace the BDU left panel. See [page 114](#).
9. Replace the BDU right panel. See [page 113](#).

5.13.6. Exhalation Sensor PCBA

5.13.6.1. To remove the exhalation sensor PCBA

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the exhalation module. See [page 177](#)
5. Remove the exhalation flow sensor. See [page 176](#).
6. Remove the exhalation module cable. See [page 183](#).
7. Remove the exhalation valve assembly. See [page 180](#).
8. Disconnect the pressure tap from the pressure port nib.

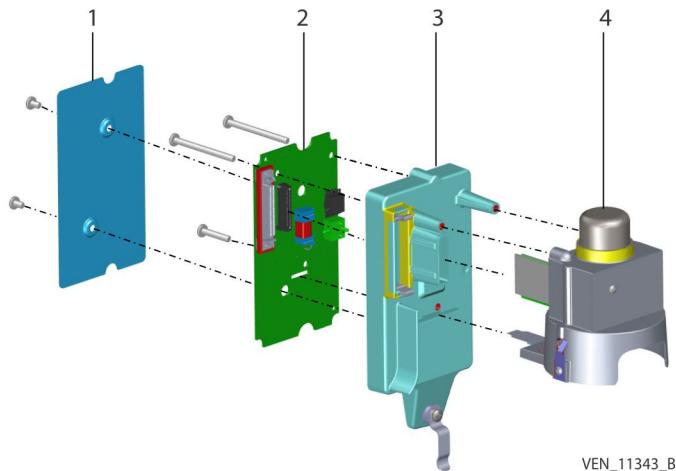
Figure 86. Pressure Tap and Pressure Port Nib



VEN_11374_A

9. Place PCBA-side up on a static-resistive mat.
10. Remove all metal tape surrounding the bottom of the assembly.
11. Remove the two screws retaining the housing door.

Figure 87. Exhalation Valve Assembly



VEN_11343_B

1. Exhalation valve housing door
 2. Exhalation Sensor PCBA
 3. Exhalation sensor PCBA housing
 4. Exhalation valve
12. Set aside on a static-resistive mat.
 13. Carefully release the flex cable from the (J3) ZIF connector.
 14. Remove the longer and shorter screws retaining the exhalation sensor PCBA.
 15. Ensuring the cable connection points straight downward, pull the exhalation sensor PCBA off the snap fit (J2) connector.
Note: Retain the upper assembly on the housing, if possible. If not, insert the flex cable and fixed PCBA through their respective openings.
 16. Set aside on a static-resistive mat.

5.13.6.2. To replace the exhalation sensor PCBA

1. Properly orient the exhalation sensor PCBA to the holes and housing.
2. Insert the flex cable and the fixed PCBA through the slots.
3. Gently and firmly press inward to connect the exhalation sensor PCBA to the (J2) connector on exhalation valve assembly. DO NOT force the connection.
4. Fully seat the flex cable into the (J3) ZIF connector.
5. Press the (J3) ZIF connector evenly closed.
6. Replace the short screw closest to the ZIF connector, partially tightening it.
7. Replace the long screws closest to the edge of the plate, partially tightening them.
8. Tighten all three screws.
9. Replace the housing door.
10. Tighten the two screws.
11. Replace the metal tape, ensuring all surfaces are properly sealed.
12. Reconnect the pressure tap to the pressure port nib.
13. Align the exhalation valve housing door to the remainder of the module.
14. Place PCBA-side up on a static-resistive mat.
15. Tighten the two screws on the slider.
16. Reconnect the exhalation module cable to the exhalation valve assembly.

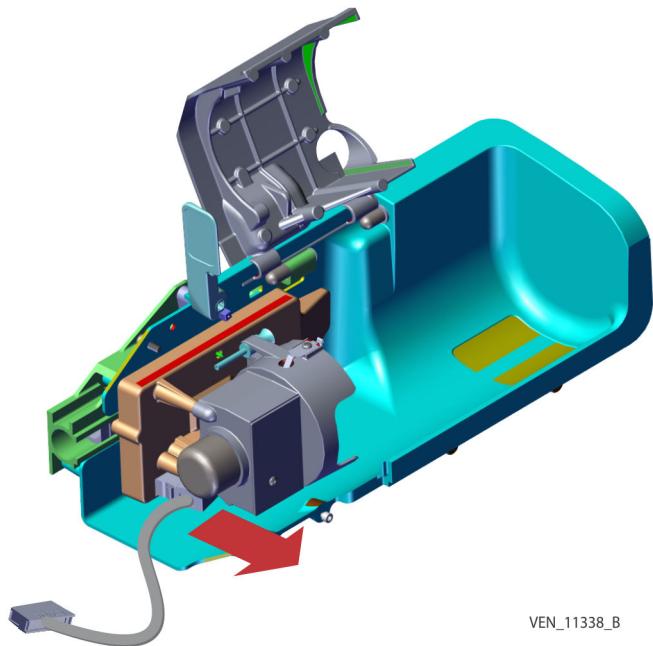
17. Replace the exhalation valve assembly. See [page 180](#).
18. Replace the exhalation module cable. See [page 183](#).
19. Replace the exhalation flow sensor. See [page 176](#).
20. Replace the exhalation module. See [page 178](#).
21. Replace the BDU left panel. See [page 114](#).
22. Replace the BDU right panel. See [page 113](#).

5.13.7. Exhalation module cable

5.13.7.1. To remove the exhalation module cable

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove exhalation module. See [page 177](#).
4. Remove the exhalation door, expiratory filter, and exhalation flow sensor.
5. Remove the exhalation bezels. See [page 178](#).
6. Compress the spring clips to release the (J1) connector.
7. Pull outward to remove the exhalation module cable.

Figure 88. Exhalation Module Cable Removal



VEN_11338_B

5

5.13.7.2. To replace the exhalation module cable

1. Ensure proper orientation and alignment of the angled connector of the exhalation module cable.
2. Press the connector inward until it completely connects to the (J1) connector on the exhalation valve assembly.
3. Replace the exhalation door and expiratory filter.

4. Replace the exhalation bezels. See [page 179](#).
5. Replace exhalation module. See [page 178](#).
6. Replace the BDU left panel. See [page 114](#).
7. Replace the BDU right panel. See [page 113](#).

5.13.8. Exhalation Module Chassis

5.13.8.1. To remove the exhalation module chassis

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the exhalation module. See [page 177](#).
4. Remove the expiratory filter. See [page 138](#).
5. Remove the exhalation flow sensor. See [page 176](#).
6. Remove the exhalation module cable. See [page 183](#).
7. Remove the exhalation valve assembly. See [page 180](#).
8. Remove the two screws connecting the upper front and rear bezel.
9. Rotate the exhalation chassis so the latching mechanism to the right of the lift handle is visible.
10. Remove the screw, washer, and lock washer retaining the upper front and rear bezel.
11. Slide the lift handle off its shaft after identifying its orientation.

5.13.8.2. To replace the exhalation module chassis

1. Align the exhalation module chassis to the inner wall of the BDU chassis.
2. Slide the lift handle on its shaft, ensuring it is in the same position as at removal.
3. Replace the screw, washer, and lock washer connecting the upper and lower bezel.
4. Rotate the exhalation chassis so the latching mechanism to the right of the door latch is visible.
5. Replace the two screws retaining the upper front and rear bezel.
6. Replace the exhalation valve assembly. See [page 180](#).
7. Replace the exhalation module cable. See [page 183](#).
8. Replace the exhalation flow sensor. See [page 176](#).
9. Replace the expiratory filter. See [page 175](#).
10. Replace the exhalation module. See [page 178](#).
11. Replace the BDU left panel. See [page 114](#).
12. Replace the BDU right panel. See [page 113](#).

5.13.9. Card Cages and Related BDU PCBA

Warning: To prevent electrostatic discharge (ESD) and potential fire hazard, do not use anti-static or electrically conductive hoses or tubing in or near the ventilator breathing system.

Caution: To prevent damage to electrostatic discharge ESD-sensitive components, always follow ESD guidelines when servicing the ventilator. Adhere to ESD control techniques when repairing ESD sensitive components.

Follow all general repair guidelines when repairing any portion of the ventilator.

See [page 106](#), and the applicable specific repair guidelines. Use the following content list to locate the proper area within this section.

[Overview, page 185](#)

[Coin Battery Replacement Instructions, page 186](#)

[Communications PCBAs, page 191](#)

[Main PCBAs, page 192](#)

[BDU Card Cage, page 192](#)

[Main Backplane PCBA, page 192](#)

[Communications Backplane PCBA, page 194](#)

[Options PCBAs, page 195](#)

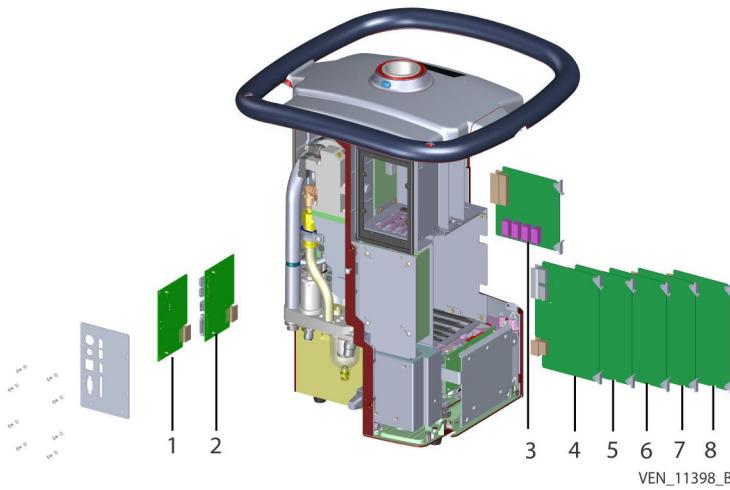
[Options Card Cage, page 195](#)

[Options Backplane PCBA, page 195](#)

5.13.9.1. Overview

This section addresses removal and replacement of various card cage and card cage printed circuit board assemblies (PCBAs). Access to the PCBAs is quite simple. Access to PCBA backplanes requires removal of the relevant card cages.

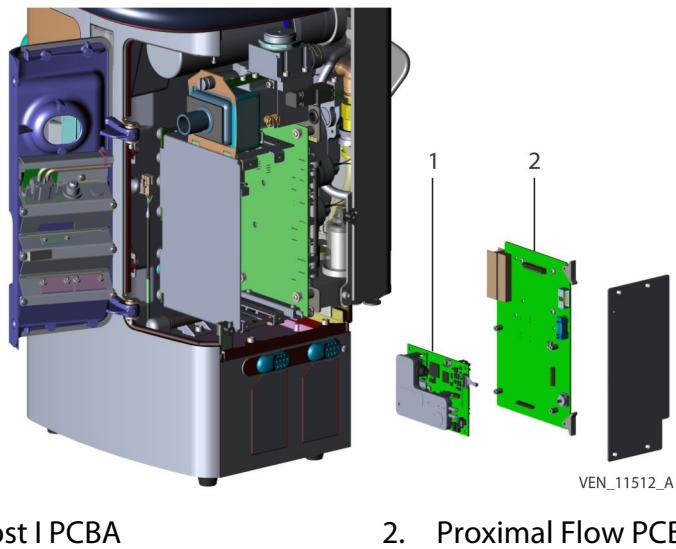
Figure 89. BDU Card Cage PCBAs



1. Line 1 user interface PCBA
2. Line 2 user interface PCBA
3. Communications backplane PCBA
4. Mix controller PCBA
5. Pneumatics user interface PCBA
6. Breath Delivery Unit (BDU) CPU PCBA²
7. Graphical user interface (GUI) CPU PCBA¹
8. DC-DC Converter PCBA

² Item contains one coin battery. For more information see [Coin Battery Replacement Instructions, page 186](#).

Figure 90. Options Card Cage



1. Options Host I PCBA

2. Proximal Flow PCBA

5.13.9.2. Coin Battery Replacement Instructions

Caution: A nonconductive tool is required to remove the coin battery. Conductive tools may cause a short circuit across the battery and are **not** recommended.

Note: The coin batteries maintain vital ventilator information like the date and time and ventilator settings during power off conditions.

Note: It is recommended that both coin batteries be replaced when either one requires replacement.

Note: Dispose of removed coin batteries in accordance with local guidelines and regulations.

Tools needed:

- a static-dissipative field service kit (4-018149-00)
- a hex driver T-handle (1/8)
- a nonconductive, ESD safe tool

1. Carefully remove the BDU left panel (3 screws) and disconnect the fan cable P1 connector as detailed in the service manual.
2. Remove the GUI and BDU CPU PCBAs from the card cage by pressing the card ejectors to release it from the backplane.

Coin Battery Removal

There are two types of coin battery holders: the current style shown in [Figure 91](#) and the previous style shown in [Figure 92](#).

Figure 91. 980 Coin Battery Current Style Holder



VEN_12854_A

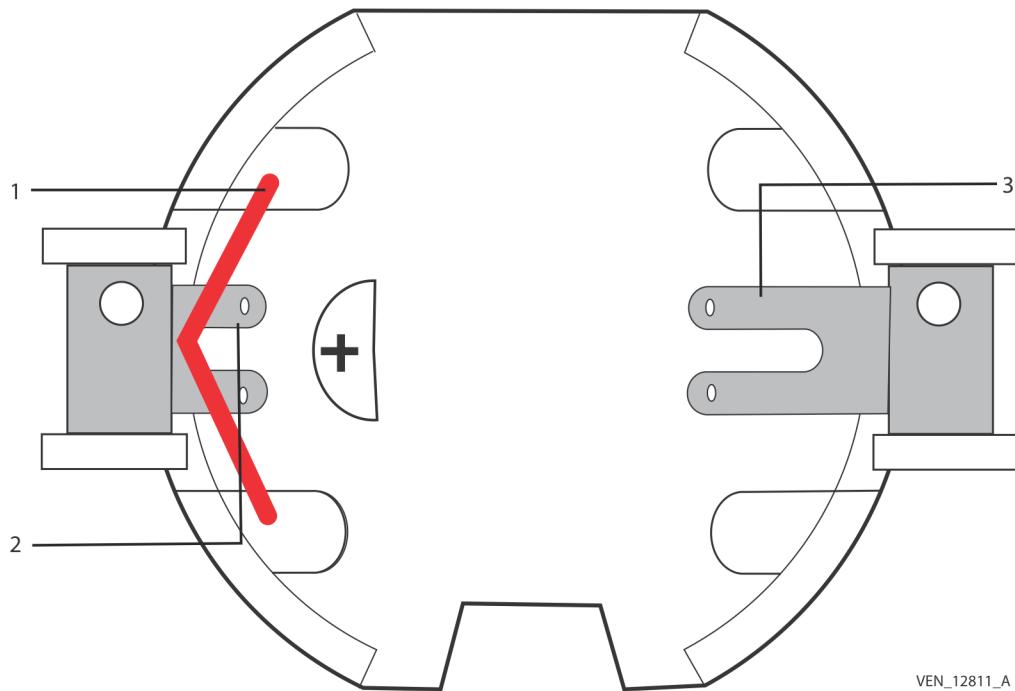
Figure 92. 980 Coin Battery Previous Style Holder



VEN_12809_A

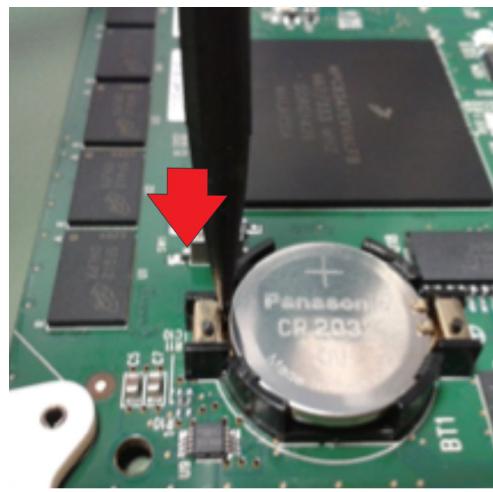
Note: The removal and installation procedures are the same between the two styles. Care must be taken not to damage the holders or the boards when replacing coin batteries. The previous style holder has contacts that go over the battery that are not on the current style holder.

Figure 93. Battery Holder Details



1. The current style holder does not have positive contacts over the coin battery.
 2. On the previous style the positive holder contact goes over the coin battery.
 3. The negative holder contact goes under the coin battery.
1. Remove the old coin battery from the PCBA according to these instructions:
 - a. Gently, vertically insert the head of the non-conductive tool between the coin battery and the negative contact of the battery holder as seen in [Figure 94](#).

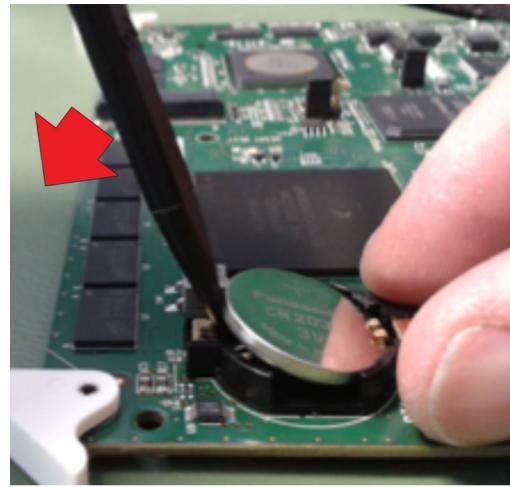
Figure 94. Old Coin Battery Removal



VEN_12808_A

- b. Gently turn the non-conductive tool to the side as seen in [Figure 95](#). The battery should come out of the PCBA holder.

Figure 95. Old Coin Battery Capture



VEN_12848_A

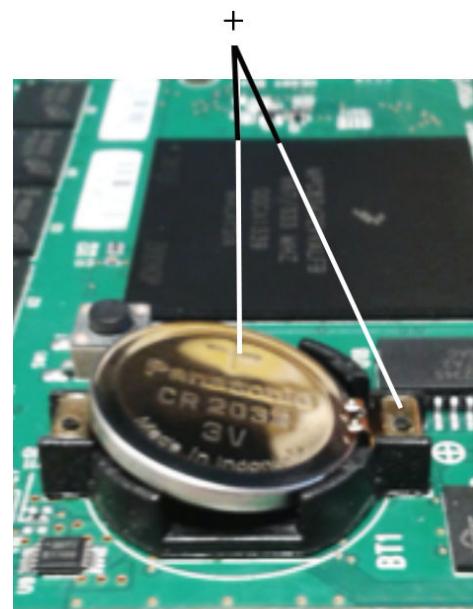
Caution: Be careful not to damage the battery holder contacts.

2. Capture the battery immediately as it comes out of the PCBA holder to prevent it short circuiting to the PCBA and remove it from the ventilator as seen in [Figure 95](#).

Coin Battery Insertion

1. When handling new coin batteries, keep the battery surfaces clean and free from contamination. Remove any protective film that may be attached to the back of new batteries. The coin battery may be wiped with a dry clean cloth to clean the coin battery surfaces.
2. Insert a new coin battery into the PCBA battery holder according to these instructions:
 - a. Position the new coin battery under the positive contact of the battery holder as seen in [Figure 96](#).

Figure 96. New Coin Battery Insertion



VEN_12810_A

- b. Ensure the coin battery is inserted with its positive terminal (+) facing away from the PCBA as seen in [Figure 96](#).
- c. Gently press down on the coin battery near the battery holder negative contact as seen in [Figure 97](#).

Figure 97. New Coin Battery Installation



VEN_12846_A

- d. The battery will snap into place as seen in [Figure 98](#).

Figure 98. New Coin Battery Installed



VEN_12847_A

3. Carefully re-insert the CPU PCBAs back into the ventilator card cage.
4. When replacement of both coin batteries is complete, carefully reassemble by reconnecting the fan cable P1 connector, replacing the BDU left panel (three screws) as detailed in the service manual, and then reinserting all battery packs. Reconnect AC power and gas supplies.

Ventilator Date and Time Set-up and Check:

1. Power on the ventilator in normal operation.
2. Touch the configuration icon (wrench) & press the Date /Time Change tab.

3. Set the date and time to the current date and time and press Accept then Close. Set up non-default, New Patient ventilator parameters and touch Accept.
4. Power down the ventilator. Allow the ventilator to shut down completely.
5. Power up the ventilator in normal operation.
6. Verify that the ventilator maintains the current date and time and programmed ventilator settings.

Ventilator Check

Upon completion of the date, time, and settings check, conduct the following additional tests on the ventilator in the order shown per the PB980 service manual before returning it to patient use:

Coin Battery Replacement PM	Tests
1	Ventilator Warm-up Cycle ^a
2	Electrical Safety Test ^b
—	Software Download
—	FPGA update
—	CPLD update
—	Flow Sensor Calibration
—	Expiratory Valve Calibration
—	Atmospheric Pressure Transducer Calibration
3	Extended Self Test (EST)
4	Vent Inop Test
—	Touchscreen Calibration
—	External Ports Test
5	Short Self Test (SST)
—	Oxygen Sensor (OS) Calibration
—	Performance Verification Test (PVT)

^a Perform ventilator warm-up for 15 minutes in Service mode.

^b Includes digital ground isolation testing.

5.13.9.3. Communications PCBA

To remove the communications PCBA

1. Rotate the cord wrap assembly on the rear panel away from the Input/Output (I/O) cover panel.
2. Remove the eight screws retaining the I/O cover panel.
Note: Remove line user interface PCBA left to right.
3. Extract each PCBA from its slot.
4. Set each aside in a static-resistive bag.

5

To replace the communications PCBA

1. Align each PCBA to each respective slot in the card cage.
Note: Reinstall line user interface PCBA from right to left.

2. Insert each PCBA in its slot, connector-side down, proceeding from the right to left.
3. Align the I/O cover panel to the opening in the rear panel.
4. Tighten the eight screws retaining the I/O cover panel.
5. Rotate the cord wrap assembly on the rear panel back to the upward position.

5.13.9.4. Main PCBAs

To remove the main PCBAs

1. Remove the BDU left panel. See [page 113](#).
2. For each PCBA, press the card ejectors to release each card from the backplane.
3. Set each aside in a static-resistive bag.

To replace the main PCBAs

1. Insert each PCBA to each respective slot in the BDU card cage.
2. Replace the BDU left panel. See [page 114](#).

5.13.9.5. BDU Card Cage

To remove the BDU card cage

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the BDU card cage PCBAs. See [page 191](#) and [page 192](#).
5. Loosen the four captive screws.
6. Slide the card cage assembly off the two alignment pins on the BDU chassis spine.

To replace the BDU card cage

1. Align to the two alignment pins on the BDU chassis spine.
2. Tighten the four captive screws.
3. Replace the BDU card cage PCBAs. See [page 191](#) and [page 192](#).
4. Replace the BDU rear panel. See [page 115](#).
5. Replace the BDU right panel. See [page 113](#).
6. Replace the BDU left panel. See [page 114](#).

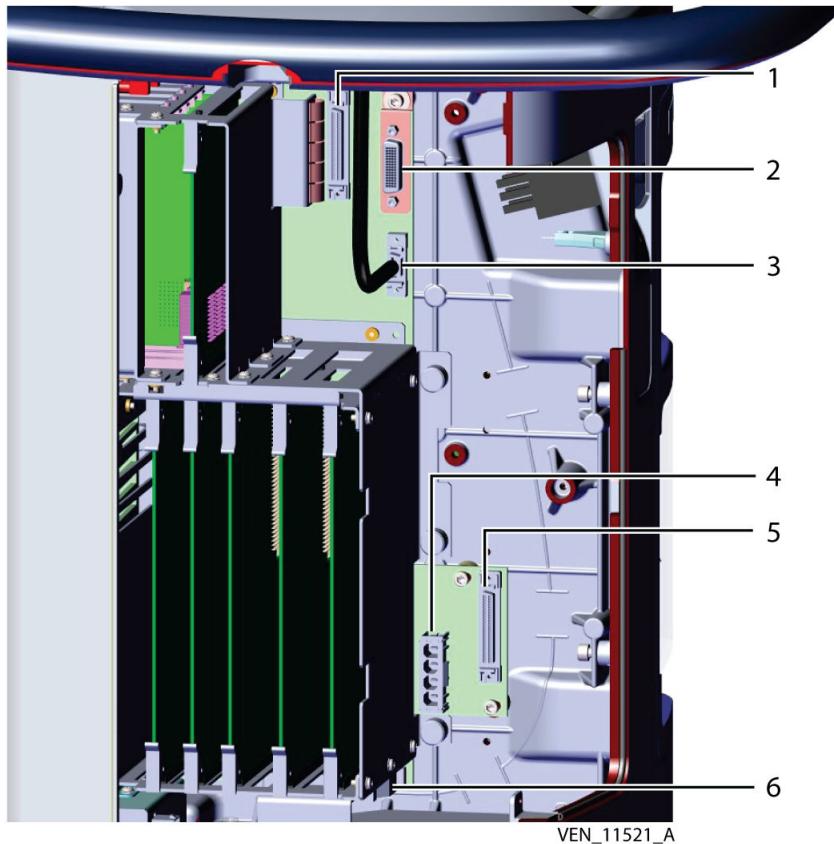
5.13.9.6. Main Backplane PCBA

To remove the main backplane PCBA

1. Remove the line user interface PCBAs. See [page 191](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU right panel. See [page 113](#).
4. Remove the BDU rear panel. See [page 114](#).

5. Disconnect the following cables from the listed connectors with the exception of the BD power controller backplane ribbon cable on the (J18) connector.

Figure 99. Main Card Cage Connections



1. J13 Exhalation module cable
2. J14 GUI user interface (UI) cable
3. J15 Status display cable
4. J16 AC Module power distribution cable
5. J17 Power controller compressor backplane cable
6. J18 BD power controller backplane ribbon cable
6. Remove the communications backplane PCBA. See [page 194](#).
7. Remove the main PCBAs. See [page 192](#).
8. Loosen the five captive screws that secure the BDU card cage to the BDU chassis spine.
9. Remove the BDU card cage and the attached main backplane PCBA assembly by rocking it gently off the pneumatics connectors extending through the BDU chassis spine.
10. While supporting the card cage and backplane assembly, remove the power distribution to BD backplane cable from the (J18) connector on the backplane.
11. Place on a static-resistive mat.
12. Remove the eight screws that secure the main backplane PCBA to the BDU card cage.
13. Set the main backplane PCBA aside in a static-resistive bag.

To replace the main backplane PCBA

1. Align the main backplane PCBA to the holes in the BDU card cage.
2. Tighten the eight screws securing the main backplane PCBA to the BDU card cage.
3. While supporting the card cage and backplane assembly, replace the power distribution to BD backplane cable onto the (J18) connector on the main backplane PCBA.
4. Replace the main PCBAs. See [page 192](#).
5. Replace the main backplane PCBA. See [page 192](#).
6. Loosen the five captive screws that secure the BDU card cage to the BDU chassis spine.
7. Reconnect the remaining cables from the listed connectors.
 - J13 Exhalation module cable
 - J16 AC Module power distribution cable
 - J14 GUI user interface (UI) cable
 - J17 Power controller compressor backplane cable
 - J15 Status display cable
8. Firmly seat the BDU card cage and the attached main backplane PCBA assembly on the pneumatics connectors extending through the BDU chassis spine.
9. Replace the BDU rear panel. See [page 115](#).
10. Replace the BDU left panel. See [page 114](#).
11. Replace the BDU right panel. See [page 113](#).
12. Replace the line user interface PCBAs. See [page 191](#).

5.13.9.7. Communications Backplane PCBA

To remove the communications backplane PCBA

1. Remove the line user interface PCBAs. See [page 191](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU right panel. See [page 113](#).
4. Remove the BDU rear panel. See [page 114](#).
5. Pull outward to disconnect the communications backplane PCBA from the main backplane PCBA.
6. Set the communications backplane PCBA aside in a static-resistive bag.

To replace the communications backplane PCBA

1. Align the communications backplane PCBA to the far right slot in the upper portion of the BDU card cage.
2. Slide it into the slot along the guide rail.
3. Replace the BDU rear panel. See [page 115](#).
4. Replace the BDU right panel. See [page 113](#).

5. Replace the BDU left panel. See [page 114](#).
6. Replace the line user interface PCBAs. See [page 191](#).

5.13.9.8. Options PCBA

To remove an options PCBA

1. Remove the BDU right panel. See [page 113](#).
2. Remove the four screws on the options card cage cover.
3. Pull outward on the PCBA.
Note: If removing the Proximal Flow PCBA, disconnect the options gas supply sensor tube and all other applicable wiring to the options door panel.
4. Set each options PCBA aside in a static-resistive bag.

To replace an options PCBA

1. Orient the options PCBA, ensuring it is aligned to the proper connector.
2. Press into place.
3. Reconnect the options gas supply tubing and all applicable wiring after reinserting the Proximal Flow PCBA, if removed.
4. Replace the options card cage cover.
5. Replace the BDU right panel. See [page 113](#).

5.13.9.9. Options Card Cage

To remove the options card cage

1. Remove the BDU right panel. See [page 113](#).
2. Loosen the four screws from the options cover.
3. Remove all options PCBAs contained in the options card cage. See [page 195](#).
4. Loosen the four captive screws at the back of the options cage.
5. Pull outward off the guide pins.

To replace the options card cage

1. Press the card cage inward onto the guide pins.
2. Hand-tighten the four captive screws at the back of the options cage.
3. Replace options PCBAs. See [page 195](#).
4. Tighten the four screws of the options cover.
5. Replace the BDU right panel. See [page 113](#).

5.13.9.10. Options Backplane PCBA

To remove the options backplane PCBA

1. Remove the BDU left panel. See [page 113](#).
2. Remove the BDU right panel. See [page 113](#).

3. Remove the BDU rear panel. See [page 114](#).
4. Remove the inspiratory module. See [page 141](#).
5. Remove the Options card cage. See [page 195](#).
6. Remove the five screws securing the options backplane PCBA to the BDU chassis spine.
7. Pull outward off the connector extending through the BDU chassis spine.
8. Set the options backplane PCBA aside in a static-resistive bag.

To replace the options backplane PCBA

1. Align the PCBA to the connector extending through the BDU chassis spine.
2. Press into place.
3. Replace the five screws securing the options backplane PCBA.
4. Replace the Options card cage. See [page 195](#).
5. Replace the BDU rear panel. See [page 115](#).
6. Replace the BDU left panel. See [page 114](#).
7. Replace the BDU right panel. See [page 113](#).

5.14. BDU Power

Follow all general repair guidelines when repairing any portion of the ventilator.

See [page 106](#), and the applicable specific repair guidelines. Use the following content list to locate the proper area within this section.

[Overview, page 196](#)

[BDU Battery Door Panel Assembly, page 199](#)

[Power PCBAs, page 202](#)

[Power Module Assembly, page 204](#)

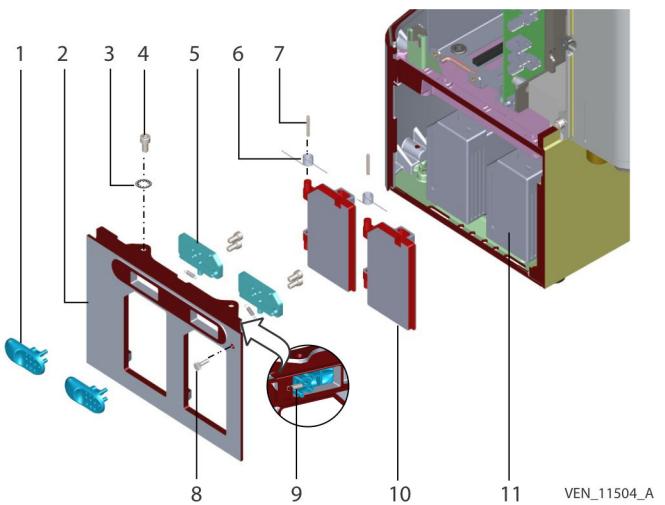
[BDU Power Supply, page 205](#)

[AC Power Module, page 206](#)

5.14.1. Overview

Access to BDU power requires access to either side, or to both sides, depending on the items slated for repair.

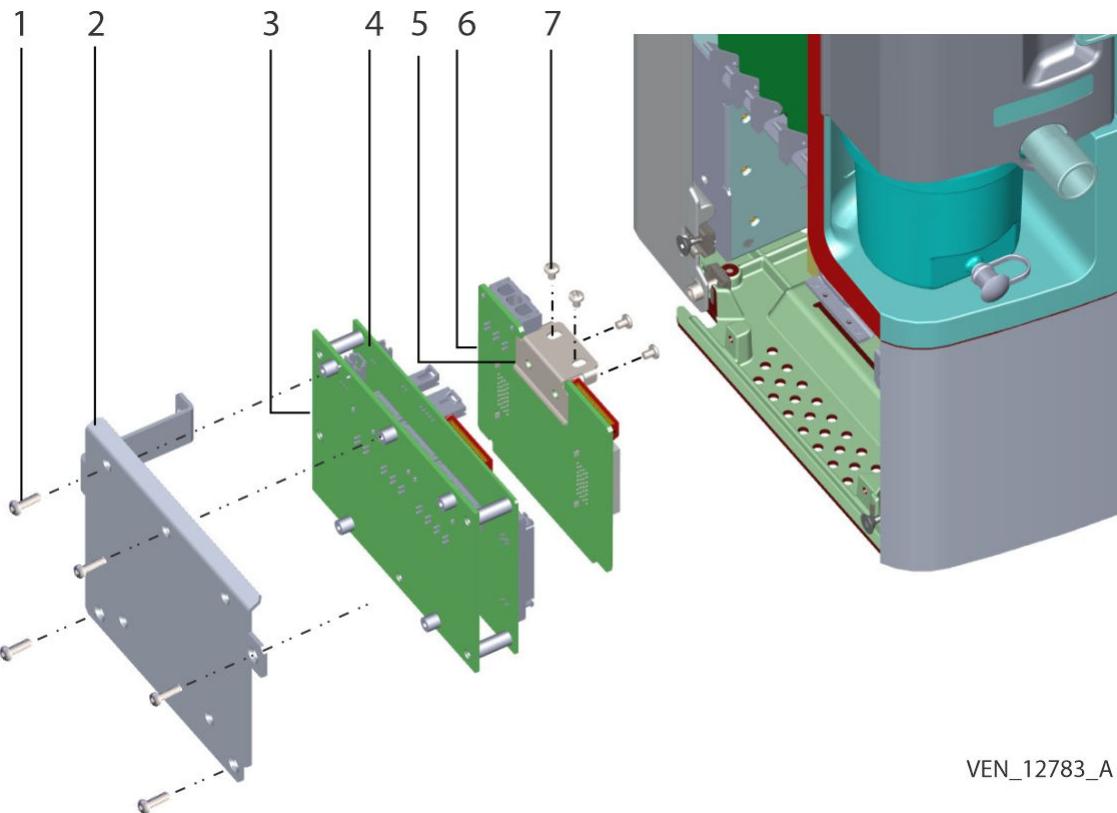
Figure 100. BDU Power Components, left side



- | | |
|------------------------------|------------------------------|
| 1. Battery door slider latch | 7. Door spring pivot pin |
| 2. Battery panel | 8. Captive thumb screw |
| 3. Internal star washer | 9. Extension spring |
| 4. Socket head screw | 10. Battery cover plate door |
| 5. Slider latch retainer | 11. Battery pack |
| 6. Torsion spring | |

Note: Verify the presence of lock washers designed to ground the batteries. If any are missing they can be ordered in quantities of two (Part number 10081046).

Figure 101. BDU Power Components, right side



- 1. Bracket mounting screws (4)
- 2. Bracket
- 3. BD power distribution PCBA
- 4. BD power controller PCBA
- 5. Backplane bracket
- 6. BD battery backplane PCBA
- 7. Pan-head Phillips screw (4)

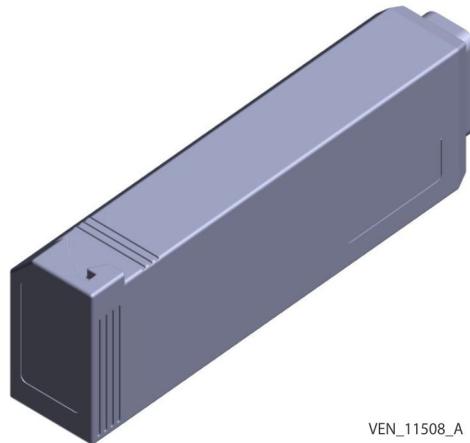
5.14.2. Battery Pack

5.14.2.1. To remove a battery pack

1. Ensure the battery panel door slider latch is unlocked. If it is locked, loosen the thumb screw to release it.
2. Press the slider latch to the left, flipping open the battery panel door and partially ejecting the battery pack.
3. Withdraw the battery pack while grasping top and bottom.

Note: The battery pack is long and heavy, so plan on using both hands to support the battery pack after withdrawing it from the ventilator.

Figure 102. Battery Pack



VEN_11508_A

5.14.2.2. To replace a battery pack

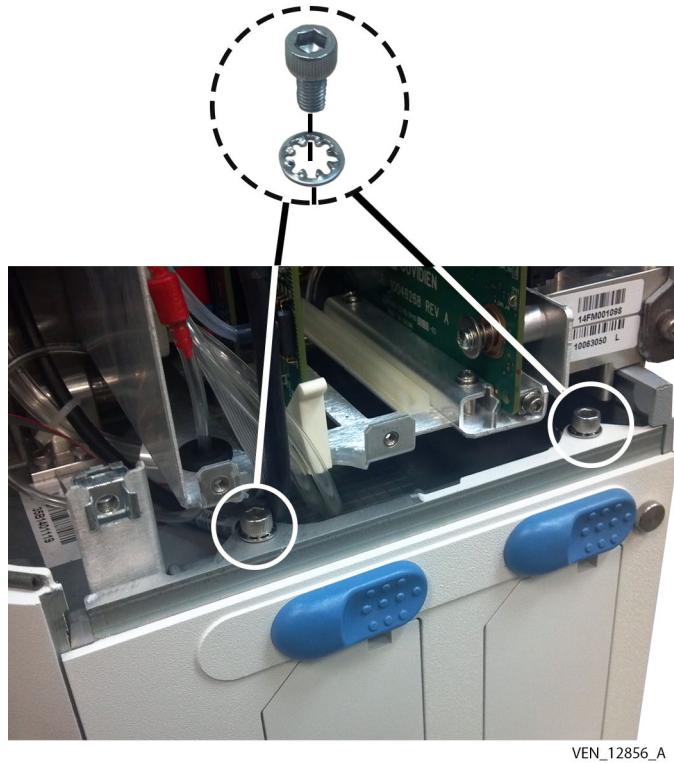
1. Ensure the battery panel door slider latch is unlocked.
2. Press the battery pack inward through the battery panel door until it locks in place.

5.14.3. BDU Battery Door Panel Assembly

5.14.3.1. To remove the BDU battery door panel assembly

1. Remove the BDU right panel. See [page 113](#).
2. Remove the top two screws and washers from the battery panel door assembly.

Figure 103. Battery Door Panel Screw Locations

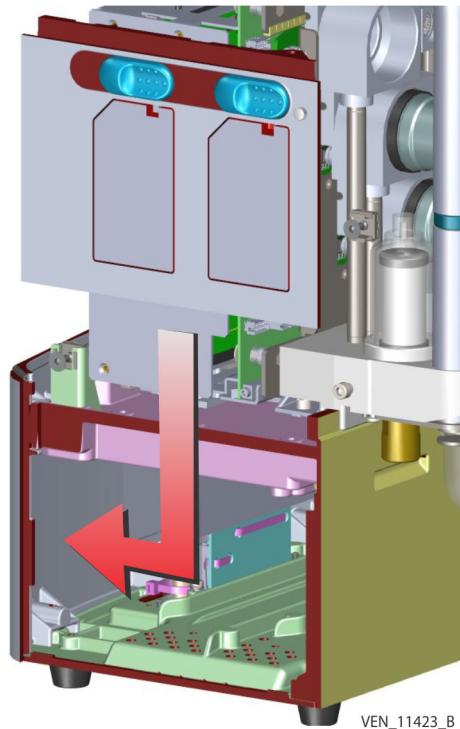


3. Slide right while lifting upward to release the assembly from the left retaining groove and base slots in the chassis.

5.14.3.2. To replace the battery door panel assembly

1. Slide the battery door panel assembly down and to the left into the retaining groove and base slots of the chassis.

Figure 104. Battery Door Panel Alignment



VEN_11423_B

2. Tighten the top two screws down into the battery panel door assembly.
3. Replace the BDU right panel. See [page 113](#).

5.14.3.3. To remove the BDU battery door panel components

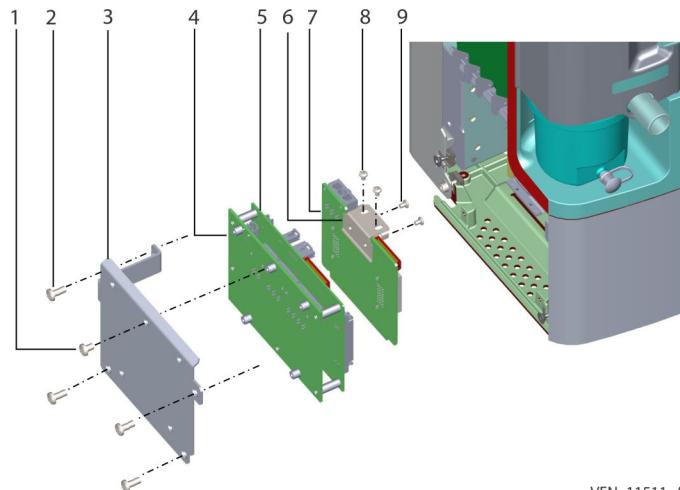
1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU battery door panel assembly. See [page 199](#).
3. Place the battery door panel assembly on its face.
4. Follow the listed steps for replacing the battery cover slider latch.
 - a. Remove the two screws from the battery cover slider latch retainer, while retaining the slider latch on the opposite.
 - b. Lift off the battery cover slider latch retainer.
 - c. Detach the extension spring from the battery cover slider latch.
 - d. Remove the battery cover slider latch.
 - e. Replace the battery cover slider latch.
 - f. Attach the extension spring from the battery cover slider latch.
 - g. Place the battery cover slider latch retainer.
 - h. Replace the two screws from the battery cover slider latch retainer, while retaining the slider latch on the opposite.
5. Follow the listed steps for replacing the captive thumb screw.
 - a. Remove the retaining ring by pushing the ring off the thumb screw.
 - b. Replace the thumb screw, pressing it through the battery cover plate door.
 - c. Replace the retaining ring by pushing the ring onto the thumb screw.

5.14.3.4. To replace battery door panel components

1. Slide the battery door panel assembly against the front panel while ensuring complete alignment of edges.
2. Tighten the top two screws down into the battery panel door assembly.
3. Replace the BDU right panel. See [page 113](#).

5.14.4. Power PCAs

Figure 105. Power PCBAs



VEN_11511_A

- | | |
|-----------------------------------|------------------------------|
| 1. Phillips screws (5) | 6. Battery backplane bracket |
| 2. Phillips screws (4) | 7. Battery backplane PCBA |
| 3. BDU power distribution bracket | 8. Phillips screws (2) |
| 4. Power distribution PCBA | 9. Phillips screws (2) |
| 5. BD power controller PCBA | |

5.14.4.1. To remove the BD power controller and BD power distribution PCBAs

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU power controller assembly. See [page 204](#).
4. Loosen the four screws retaining the BD power controller and BD power distribution PCBAs.
5. Label and remove all cable connections to the BD power controller and BD power distribution PCBAs.
6. Place on a static-resistive mat.
7. To remove just the BD power controller PCBA, loosen the five screws from their standoffs.
8. To remove just the BD power distribution PCBA, first remove the power controller PCBA.
9. Remove the five screws retaining the BD power distribution PCBA.

5.14.4.2. To replace the BD power controller and BD power distribution PCBA

1. To replace just the BD power controller PCBA, tighten the five Phillips-head screws from their standoffs.
2. Align the bracket to the BD power distribution PCBA standoffs, if removed.
3. Tighten the five screws retaining the BD power distribution PCBA, if removed.
4. To replace the BD power distribution PCBA.
5. Reconnect all seven cable connections to the BD power controller and power distribution PCBA.
6. Tighten the four screws retaining the BD power controller and power distribution PCBA.
7. Tuck cables back in position.
8. Replace the BDU left panel. See [page 114](#).

5.14.4.3. To remove the battery backplane PCBA

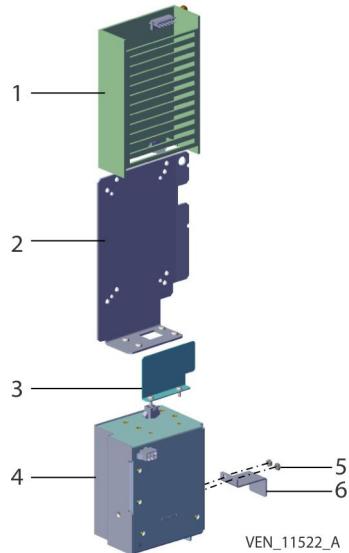
1. Remove the BDU left panel. See [page 113](#).
2. Remove the BD power controller and BD power distribution PCBA. See [page 202](#).
3. Disconnect the remaining cables.
 - a. power distribution/battery backplane BD cable
 - b. battery backplane cable
4. Loosen the top two screws retaining the battery backplane.
5. Lift out of its slot in the BDU base plate.

5.14.4.4. To replace the battery backplane PCBA

1. Align the battery backplane PCBA to its slot so it is flush with the BDU base plate.
2. Slide the battery backplane PCBA into place.
3. Reconnect the appropriate cables.
4. Tighten the top two screws retaining the battery backplane.
5. Replace the BD power controller and BD power distribution PCBA. See [page 203](#).
6. Tuck all cables back in position.
7. Replace the BDU left panel. See [page 114](#).

5.14.5. Power Module Assembly

Figure 106. Power Module Assembly



- | | |
|--------------------------------|---------------------------------------|
| 1. BDU power supply | 4. AC power module assembly |
| 2. Power supply mounting plate | 5. Screws |
| 3. Cable protection bracket | 6. AC module cable protection bracket |

Call Technical Services to verify correct part numbers when replacing the AC Power Module or Power Supply.

5.14.5.1. To remove and replace the power cord

1. Remove the two screws from the AC module cable protection bracket.
2. Remove the power cord.
3. Replace the power cord.
4. Tighten the two screws to secure the AC module cable protection bracket.

5.14.5.2. To remove the BDU power module assembly

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. From the right side of the ventilator, remove the two screws from the chassis wall near the power inlet.
5. From the rear of the ventilator, remove the screw from the rear spine of the BDU chassis at the top of the power module assembly.
6. Disconnect the compressor power cable and BDU Power Supply and AC Module cable from the power module.

5.14.5.3. To replace the BDU power module assembly

1. Align the entire power module assembly to the chassis.

2. Reconnect the compressor power cable and BDU Power Supply and AC Module cable to the power module.
3. Slide the cables into position between the assembly and the BDU chassis.
4. Loosely tighten all three screws to align the power module assembly: two through the chassis wall on the left side of the ventilator and one on the rear spine of the ventilator.
5. Tighten down all screws.
6. Replace the BDU rear panel. See [page 115](#).
7. Replace the BDU left panel. See [page 114](#).
8. Replace the BDU right panel. See [page 113](#).

5.14.6. BDU Power Supply

5.14.6.1. To remove the power supply mounting plate

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the BDU power controller assembly. See [page 204](#).
5. Remove the two screws from the cable protection bracket.
6. Remove the four screws from the power supply mounting plate backplane.
7. Disconnect the cable connecting the power supply to the AC power inlet assembly.
8. Remove the four screws connecting the power supply mounting plate to the AC power inlet assembly.

5.14.6.2. To replace the power supply mounting plate

1. Tighten the four screws connecting the power supply mounting plate to the AC power inlet assembly.
2. Reconnect the cable connecting the power supply to the AC power inlet assembly.
3. Tighten the four screws of the power supply mounting plate backplane.
4. Tighten the two screws of the cable protection bracket.
5. Replace the BDU power controller assembly. See [page 204](#).
6. Replace the BDU rear panel. See [page 115](#).
7. Replace the BDU left panel. See [To page 114](#).
8. Replace the BDU right panel. See [page 113](#).

5.14.6.3. To remove the power supply

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the BDU power supply assembly. See [page 204](#).
5. Disconnect the BDU power cables.

6. Remove the four screws to the power supply bracket.

5.14.6.4. To replace the power supply

1. Reconnect the BDU power cables.
2. Tighten the four screws on the power supply bracket.
3. Replace the BDU power supply assembly. See [page 204](#).
4. Replace the BDU rear panel. See [page 115](#).
5. Replace the BDU left panel. See [page 114](#).
6. Replace the BDU right panel. See [page 113](#).

5.14.7. AC Power Module

5.14.7.1. To remove the AC power module

1. Remove the BDU right panel. See [page 113](#).
2. Remove the BDU left panel. See [page 113](#).
3. Remove the BDU rear panel. See [page 114](#).
4. Remove the power supply assembly. See [page 204](#).
5. Remove the AC/DC power supply module. 6. Loosen the two screws retaining the AC module cable protection bracket.
6. Remove the AC module cable protection bracket.
7. Remove the four screws holding the AC power module to the BD power supply and the power supply mounting plate.
8. Disconnect the power supply harness guard and compressor power cable.
9. Remove the four screws that attach the AC power module to the power supply bracket.

5.14.7.2. To replace the AC power module

1. Align the AC power module to the power supply bracket.
Note: The power supply bracket extends towards the back beyond the AC power module by design. The hole for the harness connector centers the power supply bracket to the AC power module.
2. Press AC power module to the BD power supply connector.
3. Tighten the four screws securing the AC power module.
4. Replace the AC module cable protection bracket.
5. Tighten the two screws retaining the AC module cable protection bracket.
6. Connect the power supply harness.
7. If removed, align the power supply harness guard to the outside of the BD power controller assembly.
8. If removed, replace the two screws of the power supply harness guard, tightening.
9. Properly orient with the BDU power controller assembly facing the inner wall of the chassis.
10. Tighten the four screws to secure the BDU power controller assembly.

11. Replace the BDU power supply assembly. See [page 204](#).
12. Replace the BDU rear panel. See [page 115](#).
13. Replace the BDU left panel. See [page 114](#).
14. Replace the BDU right panel. See [page 113](#).

5.15. Graphic User Interface (GUI)

Determine your GUI configuration by viewing the GUI serial number on the back of the GUI assembly. GUI serial numbers 35G14xxxx – 35G18xxxx are from the 3rd generation GUI design. GUI serial numbers beginning with 35G19xxxx represent the current, 4th generation GUI. Contact Technical Support for more information.

See [GUI Assembly, page 287](#) for details on the 3rd generation and 4th generation GUI parts

Figure 107. GUI Serial Number



VEN_10320_A

5.15.1. 3rd Generation Graphic User Interface (GUI)

See [GUI Assembly, page 287](#) for details on the 3rd generation and 4th generation GUI parts.

Warning: The monitoring screen contains toxic chemicals. Do not touch a broken monitoring screen. Physical contact with a broken monitoring screen can result in transmission or ingestion of toxic substances.

Follow all general repair guidelines when repairing any portion of the ventilator.

See [page 106](#), and the applicable specific repair guidelines. Use the following content list to locate the proper area within this section.

[Overview, page 208](#)

[GUI Touch Screen Components, page 210](#)

[User Interface PCBA, page 211](#)

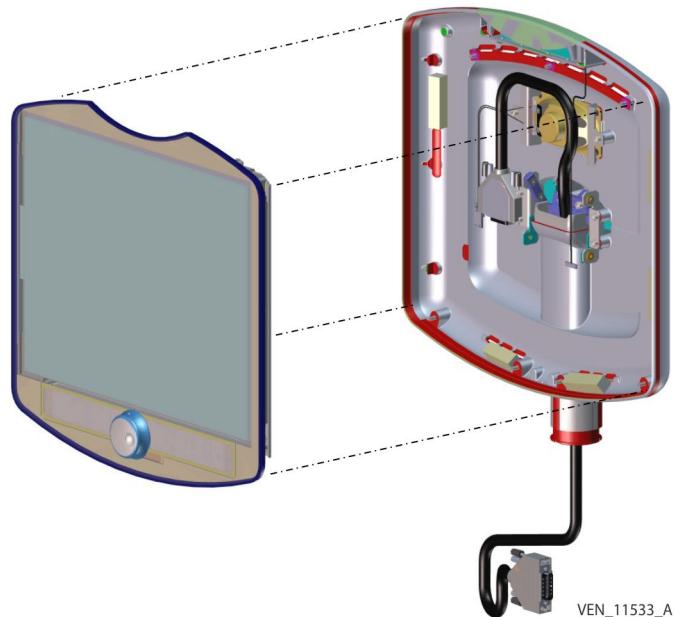
[Touch Screen Controller PCBA, page 213](#)

[Encoder PCBA, page 215](#)
[GUI Microphone Assembly, page 218](#)
[GUI Rear Housing Components, page 218](#)
[360 Omni-directional Alarm \(Alarm\) Assembly, page 221](#)
[Speaker, page 222](#)
[GUI Hinge Assembly, page 223](#)
[Graphical User Interface \(GUI\) to BDU Cable, page 224](#)

5.15.1.1. Overview

This section addresses removal and replacement of various major graphical user interface (GUI) sub-assemblies.

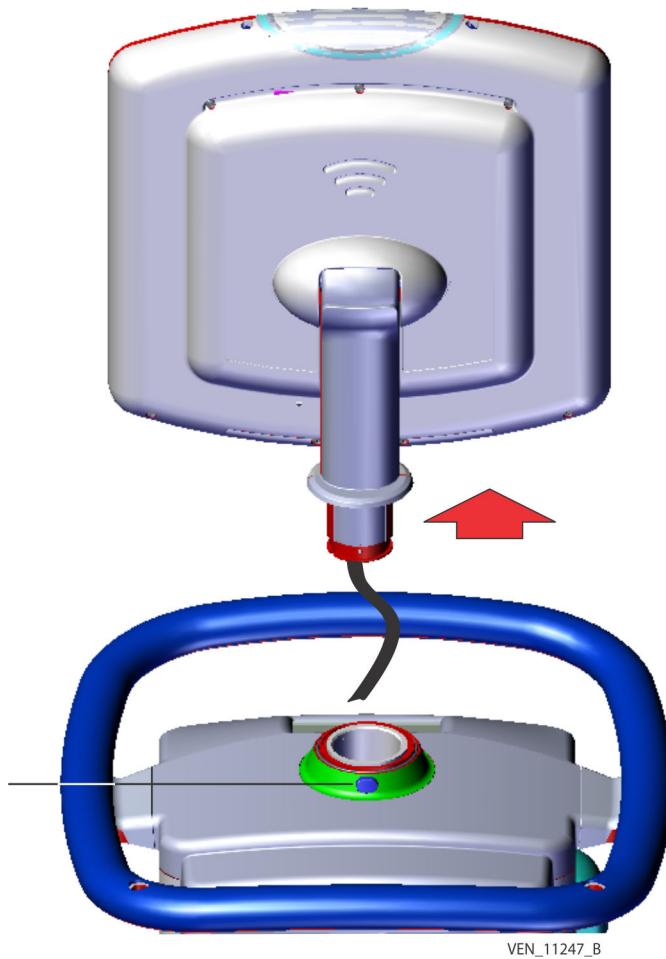
Figure 108. GUI Separation: Touch Screen and Rear Housing



To remove the GUI assembly from the top cap

1. Remove the BDU left panel. See [page 113](#).
2. Loosen the GUI cable.
3. Pull outward to disconnect the GUI cable from the (J14) connector on the main PCBA backplane.
4. Firmly grasp GUI post beneath the touch screen.
5. Press blue release latch at the base of the GUI post.

Figure 109. Blue Release Latch



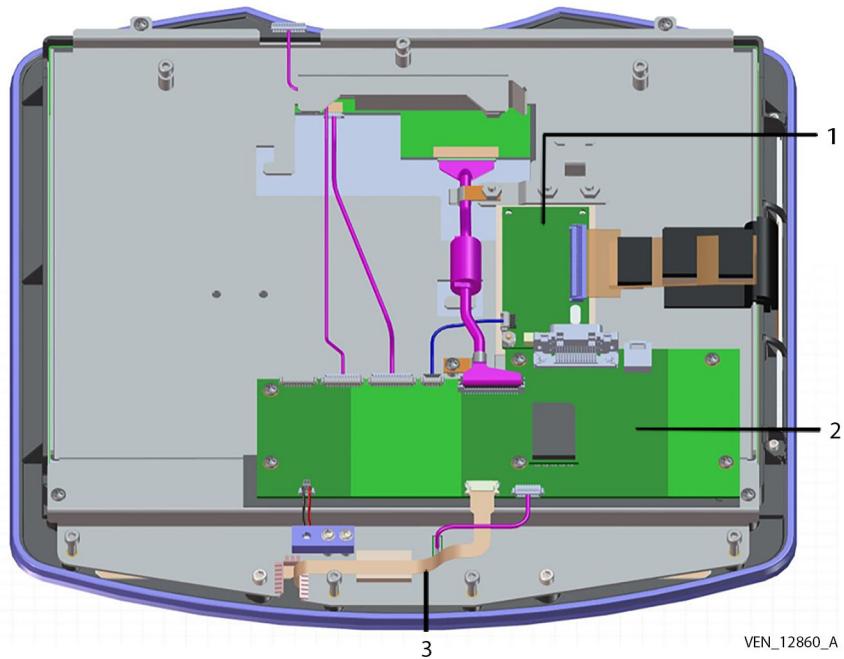
6. Lift the GUI post out its base in the top cap.
7. Support the GUI assembly.
8. Route the GUI cable up through ventilator top cap.
9. Place the GUI assembly face down on a pad taller than the button and placed on a cleared static-resistive mat.

To replace the GUI assembly on the top cap

1. Grasp the GUI assembly.
2. Position the GUI above the post hole in the top cap.
3. Route the GUI cable down through the top cap until the GUI cable connector runs straight outside the chassis.
4. Lower the GUI assembly into the post hole in the top cap, keeping hands and fingers clear.
5. Rotate the GUI assembly on the top cap until the blue release latch engages.
6. Connect the GUI cable to the (J14) connector on the main backplane in the BDU card cage.

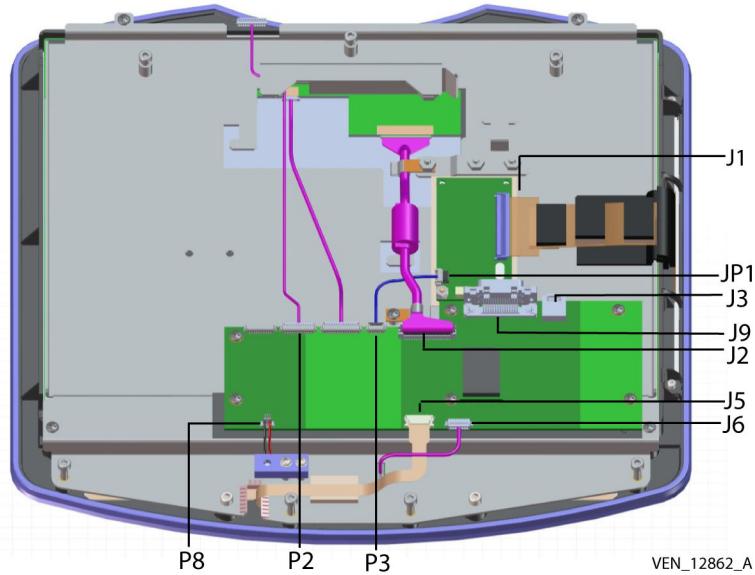
5.15.1.2. GUI Touch Screen Components

Figure 110. GUI PCBAs



1. Touch screen controller PCBA
2. User interface PCBA
3. Encoder PCBA (located under GUI back chassis)

Figure 111. GUI Cabling Connections



- J1 Touch screen flex cable to Touch screen controller PCBA
- JP1 Touch screen controller PCBA to user interface PCBA
- J3 Alarm speaker to user interface PCBA
- J9 Alarm LED PCBA to user interface PCBA

- J2 Touch screen to user interface PCBA
- J5 Button sensor flex cable to user interface PCBA
- J6 Encoder PCBA to user interface PCBA
- P2 Alarm LED PCBA to user interface PCBA
- P3 Touch screen controller PCBA to user interface PCBA
- P8 Microphone to user interface PCBA

To remove the GUI touch screen assembly

1. Remove the GUI assembly. See [page 208](#).
2. Remove the GUI rear housing. See [page 219](#).
3. Disconnect the remaining six cable connections still attached to the user interface PCBA.
4. Clip all wire ties securing cables to the GUI back chassis.
5. Remove the four screws securing the GUI back chassis to the touch screen.
6. Remove the ground strap screw from the GUI back chassis, retaining the washer underneath the ground lug.
7. Disconnect all cables listed for the touch screen controller PCBA.
 - a. Disconnect connector (J1) on touch screen controller PCBA.
 - b. Disconnect (J5) on UI PCBA.
 - c. Disconnect encoder cable from encoder PCBA.

To replace the GUI touch screen assembly

1. Insert the seven cables from the touch screen through the shield.
2. Lower GUI back chassis onto the touch screen assembly.
3. Reconnect all cables.
4. Adhere black foam tape to the top of the flex-cable to match tape already on the GUI back chassis.
5. Tighten the four screws on the corners of the GUI back chassis.
6. Reconnect the seven cables to the touch screen through the GUI back chassis.

User Interface PCBA

To remove the user interface (UI) PCBA

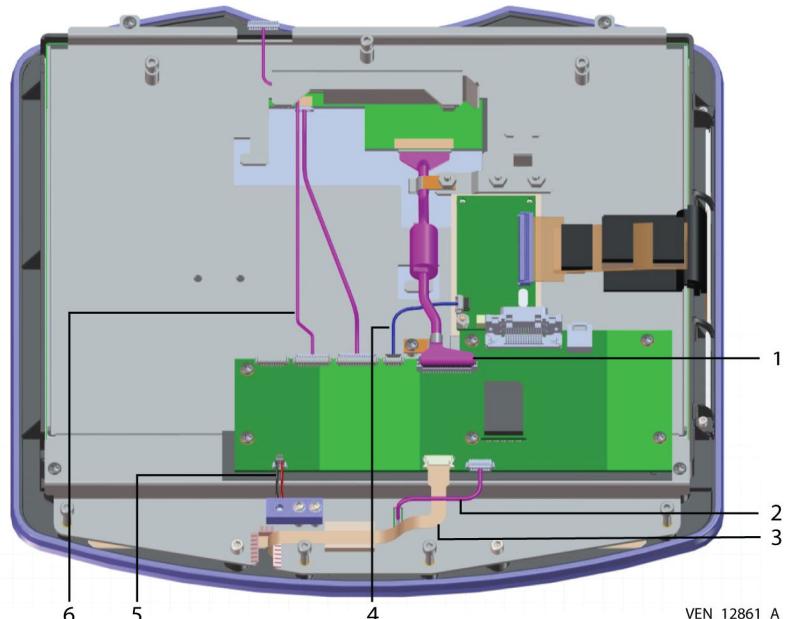
1. Remove the GUI rear housing. See [page 219](#).
2. Disconnect the following cables from the UI PCBA.
 - 4-pin cable from the (J3) connector (already disconnected during separation)
 - 5-pin touch screen controller cable from the (P3) connector
 - 8-pin encoder cable from the (J6) connector
 - 40-pin touch screen cable from the (J2) connector

- touch screen flex-cable from the (J5) ZIF connector
 - D-shell cable from the (J9) connector (already disconnected during separation)
 - 2-pin microphone cable from the (P8) connector
3. Remove the six screws from the UI PCBA.

To replace the user interface (UI) PCBA

1. Align the UI PCBA to its standoffs.
2. Tighten the six screws.
3. Reconnect the following cables to the UI PCBA.

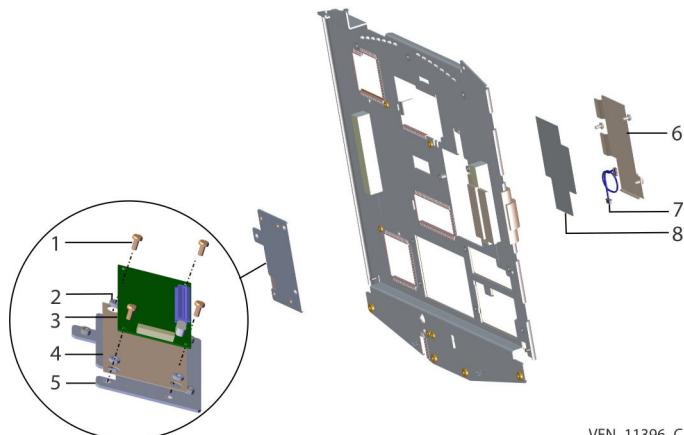
Figure 112. User Interface (UI) PCBA Connections



- | | |
|--------------------------------|---|
| 1. J2 LCD to UI cable | 4. P3 Touch screen controller to UI cable |
| 2. J6 Encoder to UI cable | 5. P8 Microphone cable |
| 3. J5 Button Sensor Flex cable | 6. P2 Alarm LED PCBA to user interface PCBA |
4. Replace the GUI rear housing. See [page 219](#).
 5. Replace the GUI assembly. See [page 209](#).

Touch Screen Controller PCBA

Figure 113. Touch Screen Controller PCBA Removal



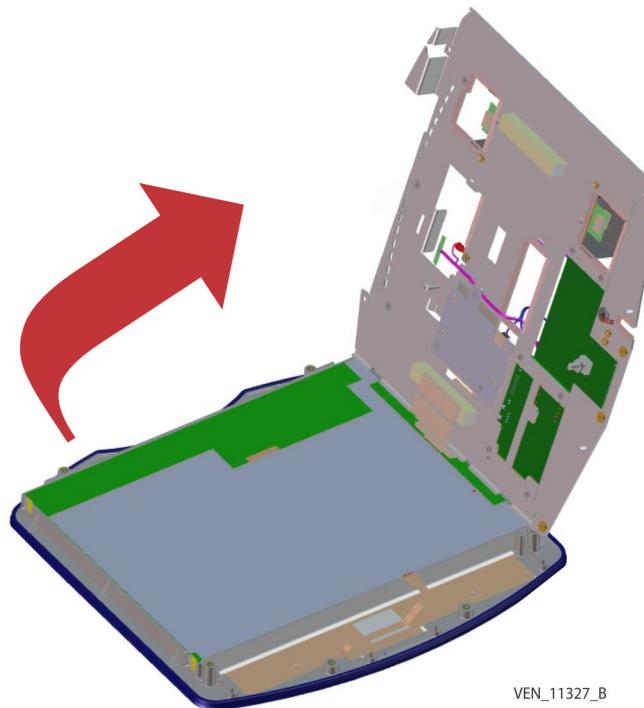
VEN_11396_C

- 1. Screws
- 2. Spacers
- 3. Touch screen controller PCBA
- 4. Adhesive insulator
- 5. Touch screen controller plate
- 6. Controller to UI cable shield and screws
- 7. Touch screen controller cable
- 8. Insulator shield

To remove the touch screen controller PCBA

1. Remove the GUI rear housing. See [page 219](#).
2. Remove the screw securing the controller to UI cable shield to the GUI back chassis.
3. Remove the two screws retaining the controller to UI cable shield.
Caution: Carefully lift up the right side of connector to release the touch screen display flex cable.
4. Disconnect the touch screen display flex cable from the (J1) connector and the related adhesive foam strips.
5. Remove the two screws securing the touch screen controller PCBA to the GUI back chassis.
6. Remove four screws to open the GUI back chassis.

Figure 114. Opening the GUI Back Chassis



7. Disconnect the touch screen controller to UI cable from the (JP1) connector.
8. Remove the four nylon screws.
9. Carefully remove the nylon spacers between PCBA and the touch screen controller plate.
10. Lift off the touch screen controller PCBA.

To replace the touch screen controller PCBA

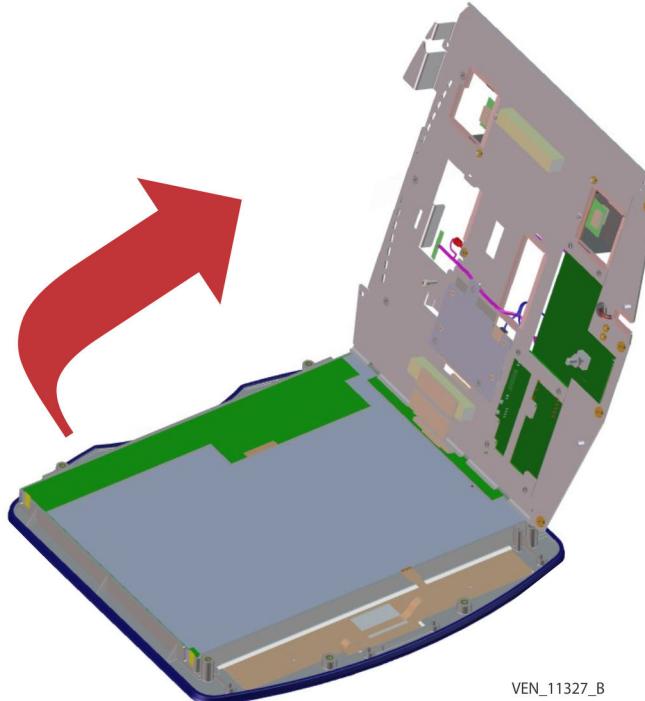
1. Replace the nylon spacers between the PCBA and the platform.
2. Align the touch screen controller PCBA to the holes.
3. Gently tighten the four nylon screws.
4. Reconnect the touch screen controller to UI cable to the (JP1) connector.
5. Tighten the four screws to secure the GUI back chassis to the touch screen.
6. Loosely replace the two screws securing the touch screen controller PCBA to the GUI back chassis.
7. Fully seat the touch screen display flex cable in the (J1) connector, locking the flex connector down onto the flex cable.
8. Allow the touch screen flex cable to properly align itself.
9. Completely tighten the two screws securing the touch screen controller PCBA to the GUI back chassis.
10. Replace the adhesive pads.
11. Replace the controller to UI cable shield over the touch screen controller PCBA.
12. Tighten the screw securing the controller to UI cable shield to the GUI back chassis.
13. Replace the GUI rear housing. See [page 219](#).

Encoder PCBA

To remove the encoder PCBA

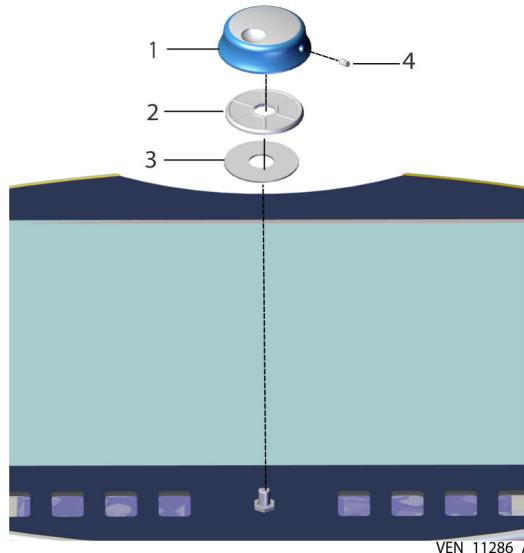
1. Remove the GUI rear housing. See [page 219](#).
2. Follow all the directions for removing the touch screen assembly. See [page 211](#).
3. Remove four screws to open the GUI back chassis without removing the touch screen flex cable connection.

Figure 115. Opening the GUI Back Chassis



4. Remove the encoder cable, setting it aside.
5. Close the GUI back chassis without pinching any of the wires.
6. Rotate the touch screen on its back while keeping the GUI back chassis and the touch screen together.
7. Release the setscrew on the knob, turning only one or two turns, since this is a short set screw.

Figure 116. Setscrew and Knob Components

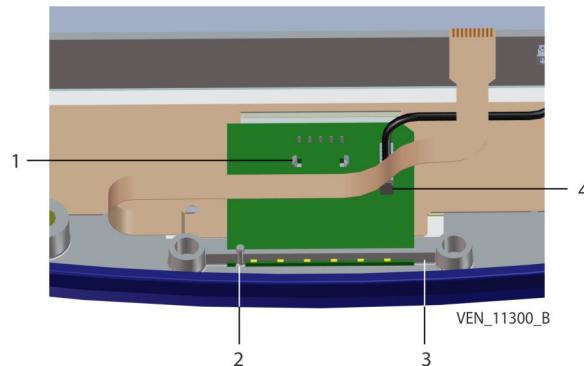


- 1. GUI knob
 - 2. GUI knob dust shield
 - 3. Dust shield adhesive pad
 - 4. Setscrew
8. Remove the rotary knob by rocking it back and forth. Do not exert too much pressure.
9. Lift off the dust cover.
10. Remove the dust shield adhesive pad.
11. Clean all adhesive residue from the touch screen and allow the touch screen time to dry.
12. Remove the encoder nut.
13. Rotate the touch screen on its face again while keeping the GUI back chassis and the touch screen together.
14. Lift the GUI back chassis, resting on an adjacent surface.
15. Remove the encoder PCBA.

To replace the encoder PCBA

1. Pass the encoder PCBA through the touch screen assembly.
2. Align so the notch rests on the location pin between the two closest standoffs.

Figure 117. Notch Location Over Standoff



1. Encoder PCBA
 2. Chassis location pin
 3. Retaining bar
 4. GUI encoder cable
3. Tighten the encoder nut onto the encoder prong.
 4. Close the GUI back chassis without pinching any of the wires.
 5. Reconnect the encoder cable to the (P1) connector.
 6. Reconnect the seven cables to the touch screen through the GUI back chassis.
 - 4-pin cable from (J3) (disconnected during separation)
 - 5-pin touch screen controller cable from (P3)
 - 8-pin encoder cable from (J6)
 - 40-pin touch screen cable from (J2)
 - Touch screen flex-cable from (J5)
 - ZIF D-shell cable from (J9) (disconnected during separation)
 - 2-pin microphone cable from (P8)
 7. Tighten the four screws on the corners of the GUI back chassis.
 8. Tighten the five screws around the edges of the GUI back chassis.
 9. Adhere black foam tape to the top of the flex-cable to match tape already on the GUI back chassis.
 10. Rotate the touch screen on its back while keeping the GUI back chassis and the touch screen together.
 11. Tighten the encoder nut.
 12. Dry the touch screen surface surrounding the encoder nut, ensuring it is free of oil and dirt.
 13. Place a new dust shield adhesive pad over the encoder nut, exposed adhesive side down.
 14. Press downward to ensure complete contact with the touch screen.
 15. Peel back the protective cover to expose the top adhesive layer.
 16. Align the dust cover directly over the encoder nut and adhesive.
 17. Press downward to ensure complete contact with the adhesive.
 18. Align the rotary knob so the setscrew contacts the flat surface of the shaft.
 19. Press the rotary knob down onto the shaft.

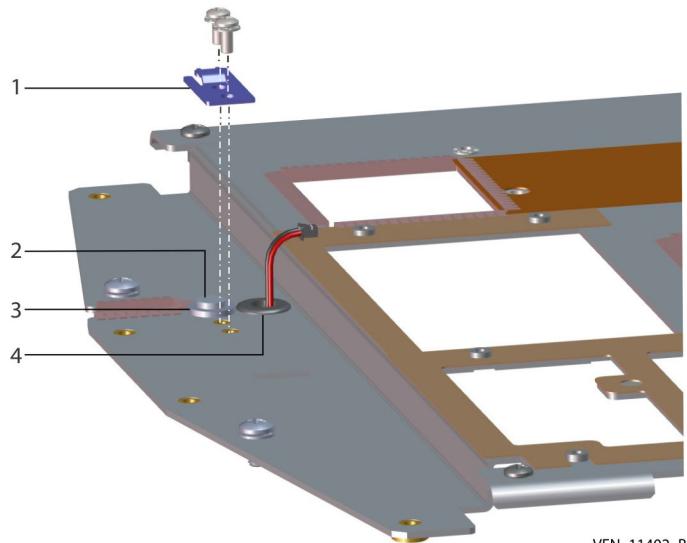
20. Tighten the rotary knob setscrew to secure in place. Do not over-tighten.
21. Replace the GUI rear housing. See [page 219](#).
22. Replace the GUI assembly. See [page 209](#).

GUI Microphone Assembly

To remove the microphone assembly

1. Disassemble the GUI assembly chassis. See [page 208](#).
2. Remove all six connectors.
3. Remove the GUI back chassis.
4. Route the microphone cable down through the inner grommet.

Figure 118. Microphone and Cable Routing



VEN_11402_B

1. Screws, bracket
2. Microphone
3. Washer
4. Grommet
5. Rotate the GUI back chassis onto its face.
6. Remove the black foam tape from the underside of the housing.
7. Extract the microphone from the outer grommet.

To replace the microphone assembly

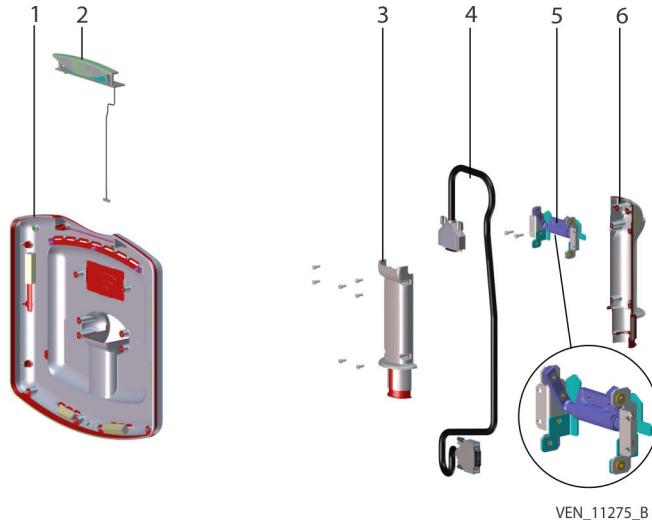
1. Remove the protective cover from the microphone assembly.
2. Route the microphone cable through the outer grommet.
3. Gently draw the microphone head through to the top of the outer grommet.
4. Route the microphone cable through the inner grommet.
5. Rotate the GUI back chassis onto its face.
6. Place a strip of black foam tape over the microphone wire between the grommets.

5.15.1.3. GUI Rear Housing Components

The following section includes the listed components.

1. See [page 223](#) for GUI Post.
 - a. See [page 223](#) for GUI Hinge Assembly.
 - b. See [page 224](#) for Graphical User Interface (GUI) to BDU Cable.
2. See the following references for GUI audio.
 - a. See [page 222](#) for Speaker.
 - b. See [page 218](#) for GUI Microphone Assembly.

Figure 119. Rear Housing Components



VEN_11275_B

- | | |
|--|---------------------------------|
| 1. GUI rear housing | 4. LCD to UI GUI cable assembly |
| 2. 360 omni-directional alarm assembly | 5. GUI hinge assembly |
| 3. Front GUI post | 6. Rear GUI post |

To disassemble the GUI assembly rear housing

1. Remove the GUI assembly. See [page 208](#).
2. Remove the three shorter upper screws and four longer lower screws on the rear of the GUI housing.
3. Separate the touch screen assembly from the rear GUI housing using a suitable tool to gently push against the front panel through lower screw hole.
4. Lift and support the lower rear GUI housing.
5. Disconnect the following cables from the UI PCBA, removing any tie wraps used to secure cables to the housing.
 - a. (J3) connector on the UI PCBA from the speaker cable
 - b. (J9) connector on the UI PCBA from the GUI cable
 - c. (P2) connector on the Alarm LED PCBA from the Alarm LED cable
6. Place the GUI rear housing on a static-resistive mat.
7. Place the touch screen on a raised surface, keeping the knob free from pressure.

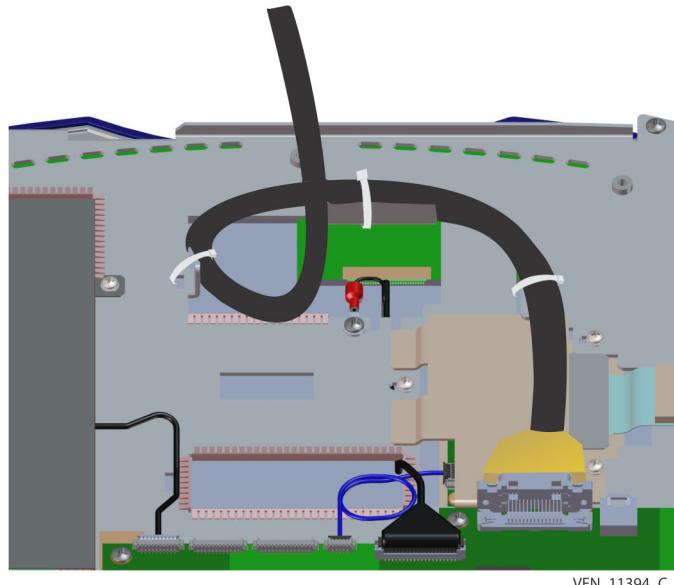
5

To reassemble the GUI assembly rear housing

1. Install the 360 omni-directional alarm assembly, if removed. See [page 222](#).
2. Install the speaker, if removed. See [page 222](#).

3. Reinstall the GUI guide post, the GUI cable, and the GUI hinge assembly.
4. Position the GUI assembly at an angle.
5. Lower the rear housing to reconnect the two-wire alarm cable, the GUI cable, and the speaker cable to the UI PCBA.
6. Reconnect the following cables to the UI PCBA, replacing any tie wraps used to secure cables to the housing.
 - a. (J3) connector on the UI PCBA to the speaker cable
 - b. (J9) connector on the UI PCBA to the GUI cable
 - c. (P2) connector on the Alarm LED PCBA to the Alarm LED cable
7. Secure the GUI cable to the inner shield using three cable ties.

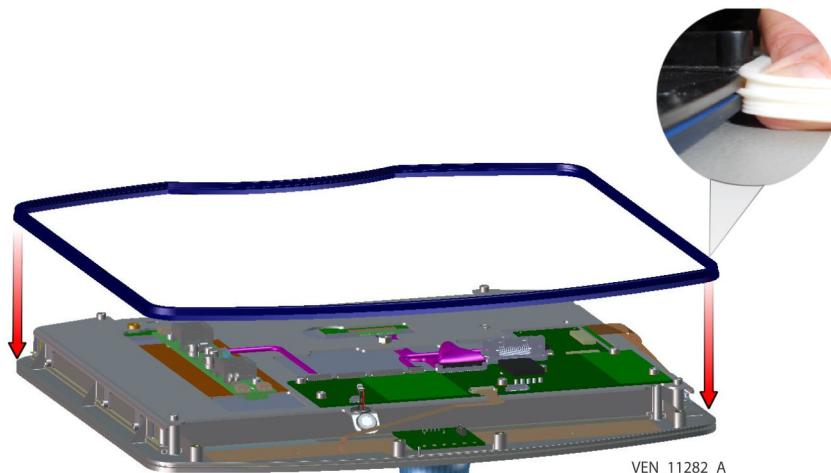
Figure 120. GUI Cable Ties



8. Reinstall the touch screen assembly into the front chassis housing.

Note: Ensure the touch screen gasket is fully inserted into the channel of the alarm status display assembly.

Figure 121. Touch Screen Gasket Replacement



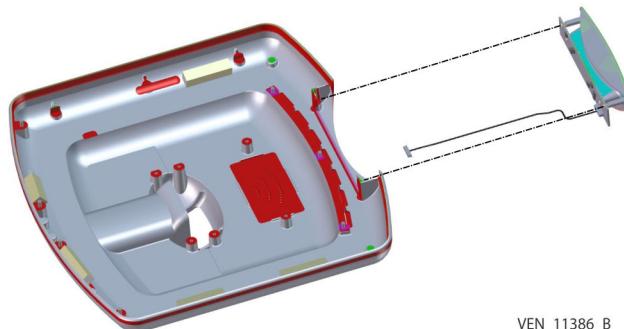
- a. Holding the entire assembly together, turn onto rear housing, lift bottom portion of touch screen assembly.
- b. Ensure gasket remains in place, and working from the top, push the touch screen into rear housing.
9. Holding the entire assembly together, rotate onto the static-resistive mat.
10. Replace the three upper screws and lightly tighten.
11. Replace the four lower screws and lightly tighten.
12. Tighten all screws on the GUI assembly.

360 Omni-directional Alarm (Alarm) Assembly

To remove and separate the alarm assembly

1. Remove the GUI assembly. See [page 208](#).
2. Disassemble the GUI chassis. See [page 219](#).
3. Set aside the front GUI assembly.
4. Disconnect the 12-pin straight cable from the (P1) connector.
5. Remove the outermost two screws from the alarm assembly.

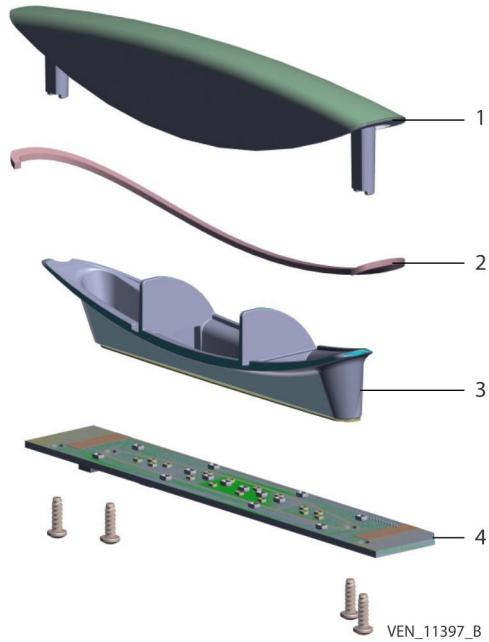
Figure 122. Separation of Alarm Assembly from Rear Housing



VEN_11386_B

6. After removing from the rear housing, remove the two remaining screws from the alarm assembly.

Figure 123. Exploded view of the alarm assembly



1. 360-degree alarm lens
2. 360-degree alarm gasket
3. 360-degree alarm reflector
4. Alarm LED PCBA and 360-degree alarm insulator
7. Set aside on a static-resistive mat.

To replace the alarm assembly

1. Align the 360-degree alarm gasket to the edge of the rear housing.
Note: When reinstalling, ensure the 360-degree alarm gasket remains in the gasket retaining groove.
2. Assemble the components of the alarm assembly: the alarm lens, reflector, insulator and Alarm LED PCBA.
3. Center the alarm assembly to the cutout in the rear housing.
4. Tighten the two upper screws.
5. Tighten the two lower screws to secure the alarm assembly.
6. Replace the GUI rear housing. See [page 219](#).
Note: Ensure the touch screen gasket is cleanly inserted into the channel of the alarm status display assembly.
7. Replace the GUI assembly. See [page 209](#).

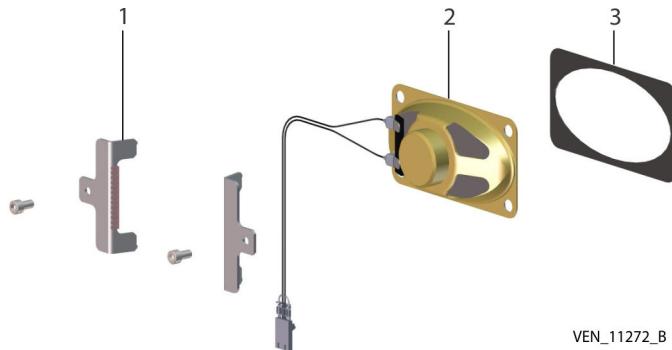
Speaker

To remove the speaker

1. Disassemble the GUI assembly chassis. See [page 208](#).
2. Remove both screws holding the speaker brackets in place.

3. Retain the left bracket's grommet. This grommet protects the speaker cable when it passes under the bracket.

Figure 124. Speaker, Brackets, and Gasket



1. Speaker brackets
2. Speaker
3. Speaker gasket
4. Remove the speaker and gasket.

To replace the speaker

1. Reattach the protective grommet onto the left bracket, if removed.
2. Align the speaker wire harness to the left.
3. Set the speaker and gasket face down inside the top and bottom alignment channels.
4. Route the speaker cable to the left and place left bracket with its protective grommet over the cable and against the outside of the speaker.
5. Tighten the left screw, ensuring cable remains free.
6. Set the right bracket on the outside of the speaker.
7. Tighten the right screw.

GUI Post

GUI Hinge Assembly

To remove the GUI hinge assembly

1. Remove the GUI assembly from the top cap. See [page 208](#).
 2. Disassemble the GUI chassis. See [page 219](#).
 3. Set aside the front GUI assembly.
 4. Remove the two screws that secure the ground straps to the GUI post and hinge assembly.
 5. Remove the four screws from the hinge assembly.
- Note:** The position of the hinge assembly is critical to the proper removal and re-installation of the GUI post and GUI cable.
6. Remove the hinge assembly from the GUI post containing the GUI cable.

To replace the GUI hinge assembly

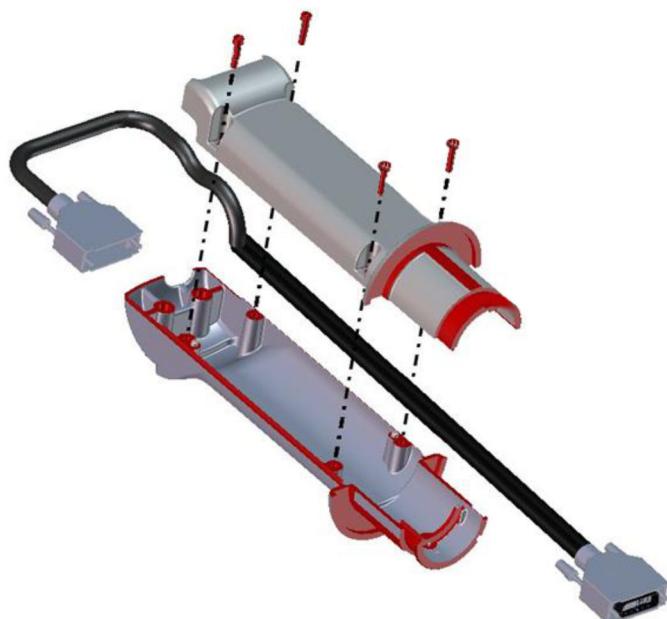
1. Route cable through rear GUI chassis.
2. Ensure the GUI post is firmly against the upper wall of the opening in the rear housing.
3. Insert hinge assembly and rotate into position.
4. Ensure the GUI cable routes neatly over the hinge assembly.
5. Slide the hinge assembly inward along the slots in the hinge assembly.
Note: The position of the hinge assembly is critical to the proper removal and re-installation of the GUI post and GUI cable.
6. Replace the two ground straps on top of the top standouts of the hinge assembly.
7. Tighten the four screws to hold the ground straps and hinge assembly in place.
8. Align the GUI post containing the GUI cable to the hinge assembly.
9. Tighten the two screws on other end of the ground strap onto the GUI post and hinge assembly.
10. Reassemble the GUI rear housing. See [page 219](#).
11. Replace the GUI assembly. See [page 209](#).

Graphical User Interface (GUI) to BDU Cable

To remove the graphical user interface (GUI) to BDU cable

1. Remove the GUI assembly. See [page 208](#).
2. Remove the GUI rear housing. See [page 219](#).
3. Remove the GUI post.
4. Separate the front and rear GUI post halves.

Figure 125. GUI Post Housings



VEN_11274_A

5. Remove the GUI cable.

To replace the user interface (GUI) cable

1. Place the GUI cable into the front housing of the GUI post.
2. Tighten the four screws.
3. Insert the GUI post assembly through the opening in the rear housing.
4. Ensure the GUI cable folds neatly over the hinge assembly.
5. Secure the GUI post to the hinge assembly using the two screws.
Note: The position of the hinge assembly is critical to the proper removal and re-installation of the GUI post and GUI cable.
6. Replace the GUI rear housing. See [page 219](#).
7. Replace the GUI assembly. See [page 209](#).

5.15.2. 4th Generation Graphic User Interface (GUI)

See [GUI Assembly, page 287](#) for details on the 3rd generation and 4th generation GUI parts.

Note: It is acceptable for the “Blue LED’s” to be non-continuous on the front side of GUI during GUI audio test section of EST.

Note: Some repair instructions are common between the 3rd and 4th generation GUI assemblies.

See [To remove the GUI assembly from the top cap, page 208](#).

See [To disassemble the GUI assembly rear housing, page 219](#).

See [To reassemble the GUI assembly rear housing, page 219](#).

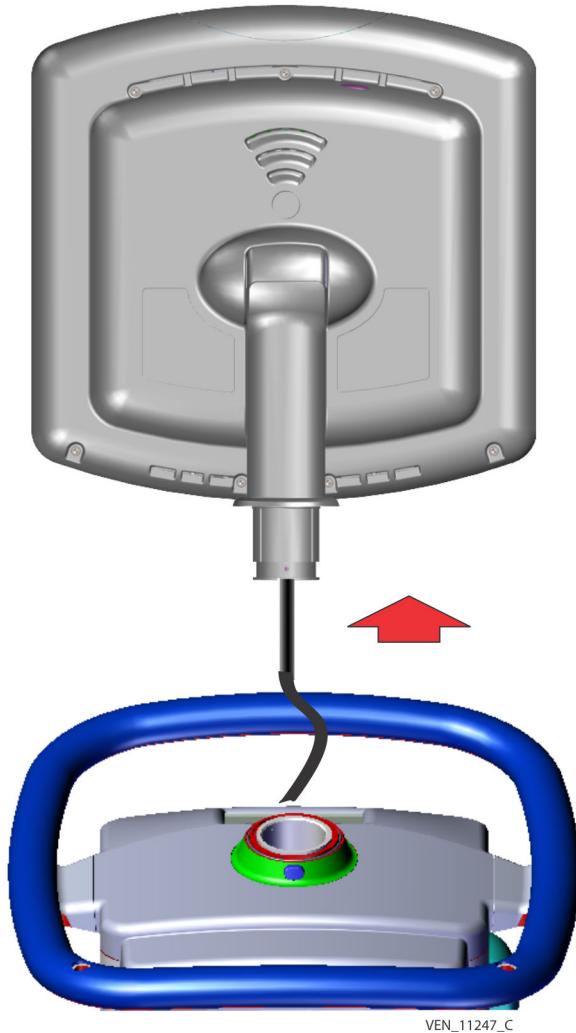
See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.1. Repair Instruction

To remove the GUI assembly from the top cap

1. Remove the BDU left panel.
2. Loosen the GUI cable.
3. Pull outward to disconnect the GUI cable from the (J14) connector on the Main PCBA backplane.
4. Firmly grasp GUI post beneath the touchscreen.
5. Press blue release latch at the base of the GUI post.

Figure 126. Blue Release Latch



6. Lift the GUI post out its base in the top cap.
7. Support the GUI assembly.
8. Route the GUI cable up through ventilator top cap.
9. Place the GUI assembly face down on a pad taller than the knob and placed on a static-resistive mat.

To replace the GUI assembly on the top cap

1. Grasp the GUI assembly.
2. Position the GUI above the post hole in the top cap.
3. Route the GUI cable down through the top cap until the GUI cable connector runs straight outside the chassis.
4. Lower the GUI assembly into the post hole in the top cap, keeping hands and fingers clear.
5. Rotate the GUI assembly on the top cap until the blue release latch engages.
6. Connect the GUI cable to the (J14) connector on the Main Backplane in the BDU card cage.

7. Replace the BDU Left Panel.

5.15.2.2. GUI Rear Housing Components

To disassemble the GUI rear housing.

Figure 127. GUI Separation: Touchscreen and Rear Housing

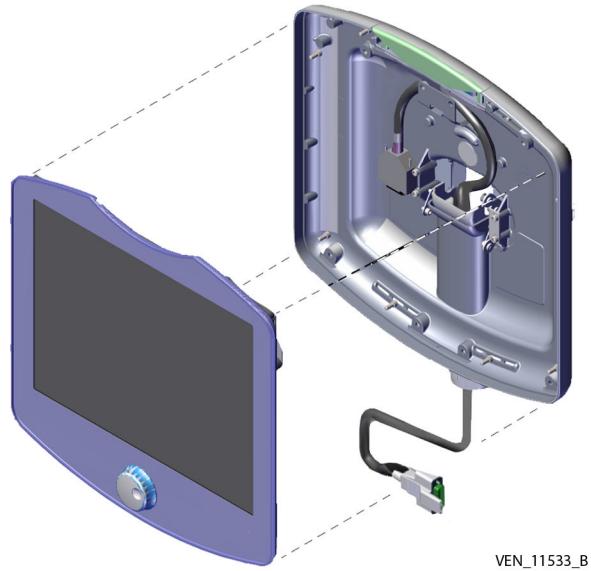
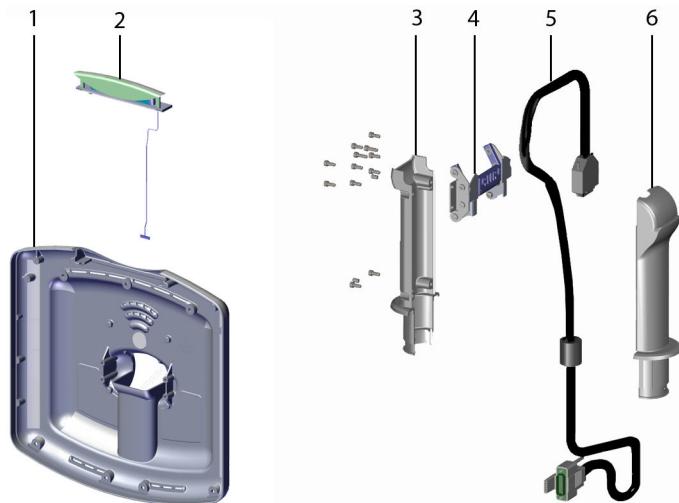


Figure 128. Rear Housing Components



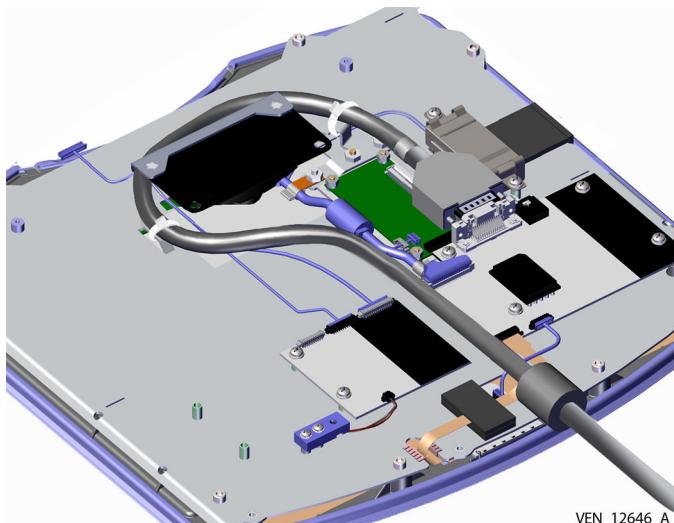
- | | |
|--|--|
| 1. GUI rear housing
2. 360 omni-directional alarm assembly
3. Front GUI post | 4. GUI hinge assembly
5. LCD to UI GUI cable assembly
6. Rear GUI post |
|--|--|
1. Remove the GUI assembly. See [page 208](#).
 2. Remove the seven (7) screws from the rear housing.
 3. Separate the touchscreen assembly from the GUI rear housing using a suitable tool to gently push against the front panel through lower screw hole.
 4. Lift and support the lower GUI rear housing.

5. Remove the two (2) cable ties that secure the GUI cable to the GUI back panel.
6. Disconnect the following cables from the UI PCBA.
 - a. (J9) connector on the UI PCBA to BDU cable
 - b. (P2) connector on the Alarm LED cable
7. Place the GUI assembly face down on a pad taller than the knob and placed on a static-resistive mat.

To reassemble the GUI rear housing

1. Install the 360 omni-directional alarm assembly, if removed. See [page 208](#).
2. Reinstall the GUI post, the GUI cable, and the GUI hinge assembly if removed.
3. Position the GUI rear housing at an angle.
4. Reconnect the following cables to the UI PCBA, replacing any tie wraps used to secure cables to the housing.
 - a. (J9) connector on the UI PCBA to the BDU cable
 - b. (P2) connector on the Alarm LED cable
5. Secure the GUI cable to the GUI back panel using two (2) cable ties.

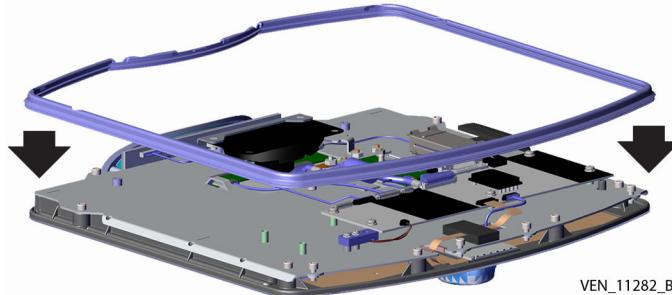
Figure 129. GUI Cable Ties



6. Reinstall the touchscreen by lowering the GUI rear housing onto the touchscreen assembly.

Note: Ensure the touchscreen gasket is fully inserted into the channel of the alarm status display assembly.

Figure 130. Touchscreen Gasket Replacement

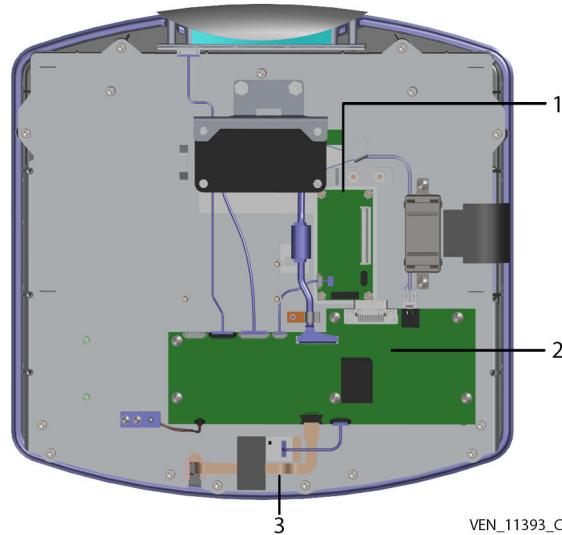


- a. Holding the entire assembly together, turn onto rear housing, lift bottom portion of touchscreen assembly.
- b. Ensure gasket remains in place, and working from the top, push the touch screen into rear housing.
7. Holding the entire assembly together, rotate onto the static-resistive mat.
8. Replace the seven (7) screws and lightly tighten.
9. Tighten all screws on the GUI assembly.

5.15.2.3. GUI Components

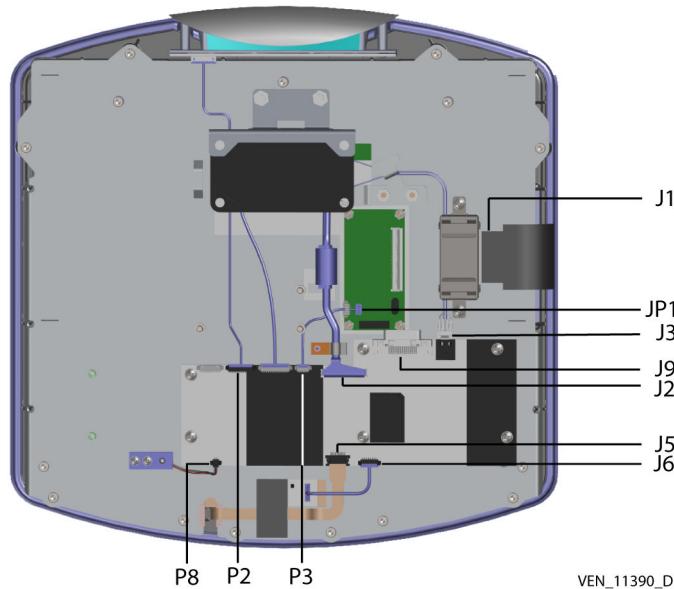
To remove the GUI touchscreen assembly

Figure 131. GUI PCBA



1. Touchscreen Controller PCBA
2. User Interface PCBA
3. Encoder PCBA (located under GUI back chassis)

Figure 132. GUI Cabling Connections



- J1 Touchscreen flex cable to Touchscreen Controller PCBA
- P2 Alarm LED PCBA to User Interface PCBA
- J2 Touchscreen to User Interface PCBA
- P3 Touchscreen Controller PCBA to User Interface PCBA
- J3 Alarm Speaker to User Interface PCBA
- P8 Microphone to User Interface PCBA
- J5 Button sensor flex cable to User Interface PCBA
- J6 Encoder PCBA to User Interface PCBA
- J9 GUI to BDU cable
- JP1 Touchscreen Controller PCBA to User Interface PCBA
 - 1. Remove the GUI assembly. See [page 208](#).
 - 2. Remove the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
 - 3. Disconnect the remaining cable connections still attached to the User Interface PCBA.
 - 4. Remove the screws securing the GUI back panel to the Touchscreen assembly.
 - 5. Disconnect all cables listed for the touchscreen controller PCBA.
Disconnect connector (J1) on touch screen controller PCBA.

To replace the GUI touchscreen assembly

1. Install GUI back panel onto the touchscreen assembly and tighten.
2. Connect all cables.
3. Reconnect the cables to the touchscreen through the GUI back chassis.

4. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).
5. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

User Interface PCBA

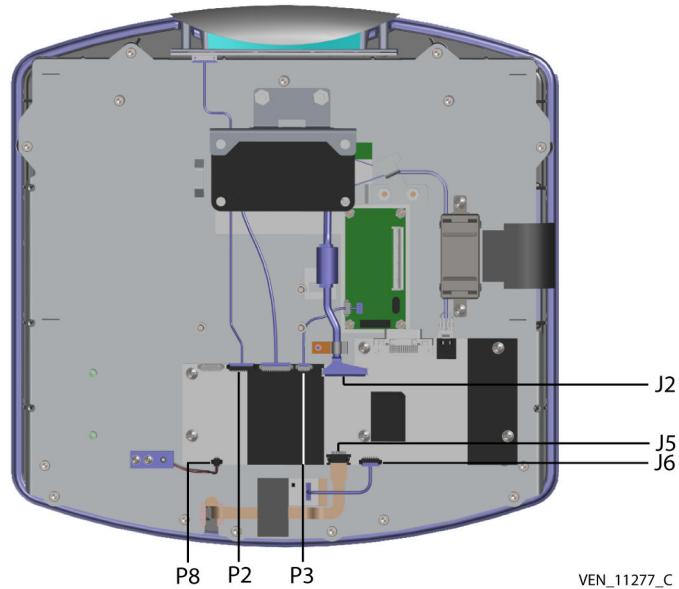
To remove the User Interface (UI) PCBA

1. Remove the GUI assembly. See [page 208](#).
2. Remove the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
3. Disconnect the following cables from the UI PCBA.
 - J3 Alarm Speaker to User Interface PCBA
 - P2 Alarm LED PCBA to User Interface PCBA
 - P3 Touchscreen Controller PCBA to User Interface PCBA
 - J6 Encoder PCBA to User Interface PCBA
 - J2 Touchscreen to User Interface PCBA
 - J5 Button sensor flex cable to User Interface PCBA
 - J9 GUI to BDU cable
 - P8 Microphone to User Interface PCBA
4. Remove the six (6) screws from the UI PCBA.

To replace the User Interface (UI) PCBA

1. Align the UI PCBA to its standoffs.
2. Install and Tighten six (6) screws.
3. Reconnect the following cables to the UI PCBA.

Figure 133. User Interface (UI) PCBA Connections

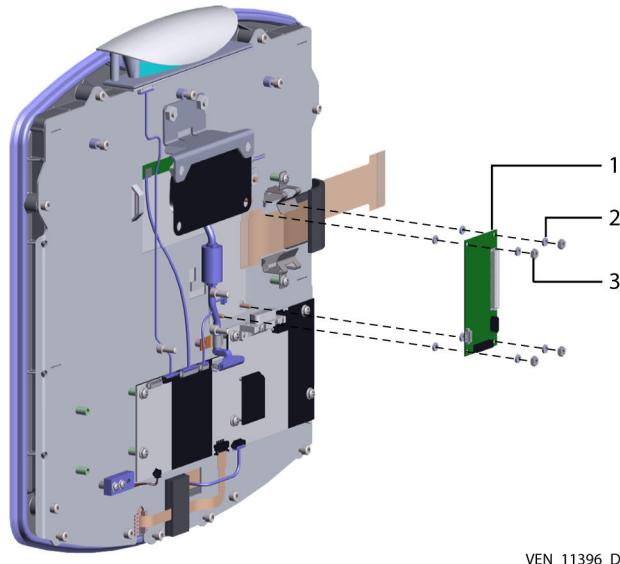


- J3 Alarm Speaker to User Interface PCBA
 - P2 Alarm LED PCBA to User Interface PCBA
 - P3 Touchscreen Controller PCBA to User Interface PCBA
 - J6 Encoder PCBA to User Interface PCBA
 - J2 Touchscreen to User Interface PCBA
 - J5 Button sensor flex cable to User Interface PCBA
 - P8 Microphone to User Interface PCBA
4. Replace the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).
 5. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.5. Touchscreen Controller PCBA

To remove the Touchscreen Controller PCBA

Figure 134. Touchscreen Controller PCBA Removal



VEN_11396_D

1. Touchscreen controller PCBA
 2. Spacer
 3. Nut
1. Remove the GUI assembly. See [page 208](#).
 2. Remove the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
- Note:** Carefully lift up the right side of connector to release the touchscreen display flex cable.
3. Disconnect the touchscreen flex cable from the (J1) connector.
 4. Disconnect the touchscreen controller to UI cable from the (JP1) connector.
 5. Remove the four (4) nylon nuts.
 6. Carefully remove the four (4) nylon spacers.
 7. Lift off the Touchscreen Controller PCBA.
 8. Remove four (4) nylon spacers from threaded studs.

To replace the Touchscreen Controller PCBA

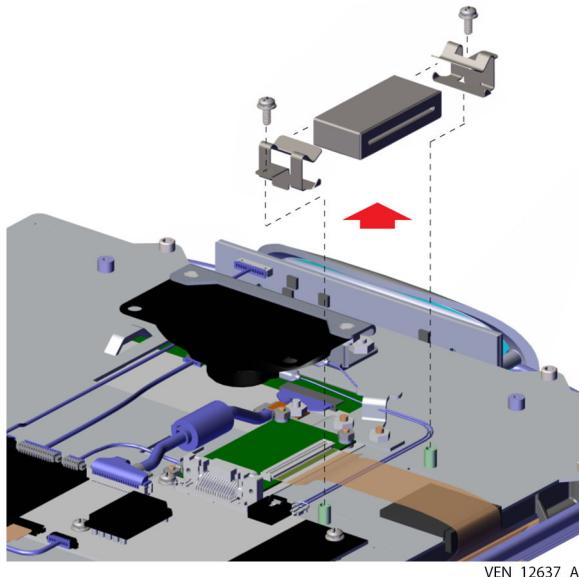
1. Replace four (4) nylon spacers on threaded studs.
2. Align the Touchscreen Controller PCBA holes to the threaded studs and replace the four (4) nylon spacers.
3. Install and tighten the four (4) nylon nuts.
4. Reconnect the touchscreen controller to UI cable to the (JP1) connector.
5. Fully seat the touchscreen display flex cable in the (J1) connector, locking the flex connector down onto the flex cable.
6. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).

7. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.6. Flex cable Ferrite

To remove the Flex Cable Ferrite

Figure 135. Exploded Ferrite and clips



1. Remove the GUI assembly. See [page 208](#).
2. Remove the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
3. Disconnect the Flex-Cable from the Touchscreen Controller PCBA (exploded view shows flex-cable still connected)
4. Remove 2 screws
5. Remove 2 clips from Ferrite.
6. Remove the Ferrite from the Flex Cable

To replace the Flex Cable Ferrite

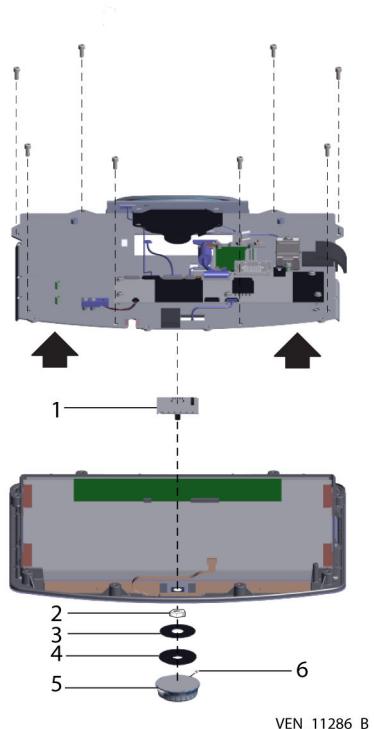
1. Replace 2 clips on the Ferrite.
2. Replace the Flex Cable through the Ferrite.
3. Replace 2 screws.
4. Reconnect the Flex-Cable to the Touchscreen Controller PCBA.
5. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).
6. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.7. Encoder PCBA

To remove the Encoder PCBA

1. Remove the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
2. Follow all the directions for removing the touchscreen assembly. See [To remove the GUI touchscreen assembly, page 229](#).
3. Release the setscrew on the knob, turning only one (1) or two (2) turns, since this is a short set screw.

Figure 136. Setscrew and Knob Components



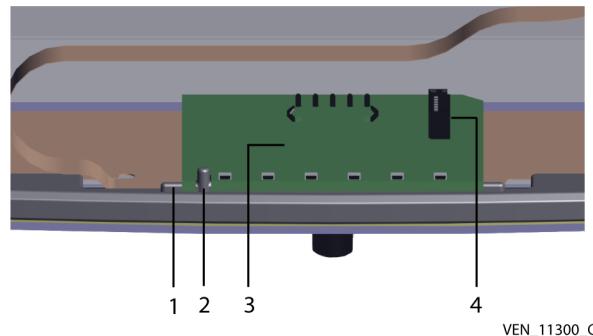
VEN_11286_B

1. Encoder PCBA
2. Hex nut
3. Dust shield adhesive pad
4. Remove the rotary knob by rocking it back and forth. Do not exert too much pressure.
5. Lift off the dust cover.
6. Remove the dust shield adhesive pad.
7. Clean all adhesive residue from the touchscreen and allow the touchscreen time to dry.
8. Loosen the encoder nut.
9. Rotate the touchscreen on its front while keeping the GUI back panel and the Touchscreen Assembly together.
10. Remove the encoder cable, setting it aside.
11. Lift the GUI back panel and set aside.
12. Remove encoder nut, then the encoder PCBA.

To replace the Encoder PCBA

1. Pass the encoder PCBA through the touchscreen assembly.
2. Align so the notch rests on the location pin between the two (2) closest standoffs.

Figure 137. Notch Location Over Standoff



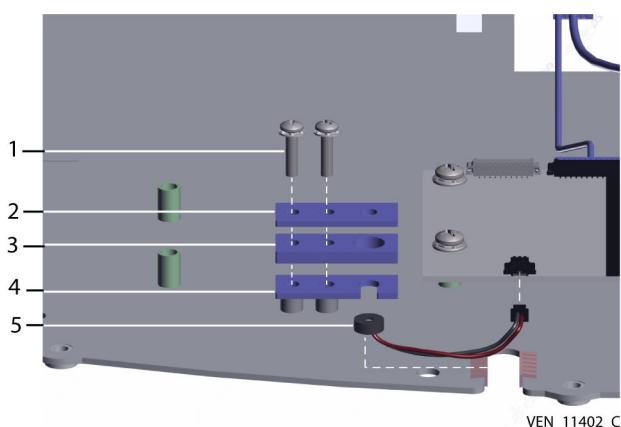
1. Retaining bar
2. Alignment Pin
3. Tighten the encoder nut onto the encoder prong.
4. Reinstall the back panel.
5. Reconnect the encoder cable to the (P1) connector.
6. Reconnect the seven cables to the touchscreen through the GUI back chassis.
 - J3 Alarm Speaker to User Interface PCBA
 - P3 Touchscreen Controller PCBA to User Interface PCBA
 - J6 Encoder PCBA to User Interface PCBA
 - J2 Touchscreen to User Interface PCBA
 - J5 Button sensor flex cable to User Interface PCBA
 - J9 GUI to BDU cable
 - P8 Microphone to User Interface PCBA
7. Install the back panel, secure by tightening eight (8) screws.
8. Rotate the touchscreen on its back while keeping the GUI back panel and the touchscreen together.
9. Tighten the encoder nut.
10. Dry the touchscreen surface surrounding the encoder nut, ensuring it is free of oil and dirt.
11. Place a new dust shield adhesive pad over the encoder nut, exposed adhesive side down.
12. Press downward to ensure complete contact with the touchscreen.
13. Peel back the protective cover to expose the top adhesive layer.
14. Align the dust cover directly over the encoder nut and adhesive.
15. Press downward to ensure complete contact with the adhesive.
16. Align the rotary knob so the setscrew contacts the flat surface of the shaft.
17. Press the rotary knob down onto the shaft.

18. Tighten the rotary knob setscrew to secure in place. Do not over-tighten.
19. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).
20. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.8. GUI Microphone Assembly

To remove the microphone assembly

1. Remove the GUI assembly. See [page 208](#).
2. Remove the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
3. Figure 138. Microphone and Cable Routing



- | | |
|------------------------------|--------------------------------|
| 1. Screws | 4. Microphone Mounting Block |
| 2. Microphone Mounting Block | 5. Microphone/Microphone Cable |
| 3. Microphone Mounting Block | |
- Remove 2 screws.
4. Extract microphone from three mounting blocks.
 5. Disconnect microphone cable from UI PCBA.
 6. Extract the microphone.

To replace the microphone assembly

1. Remove the protective cover from the microphone assembly.
2. Reassemble microphone assembly.
3. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).
4. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.9. 360 Omni-directional Alarm (Alarm) Assembly

To remove and separate the Alarm Assembly

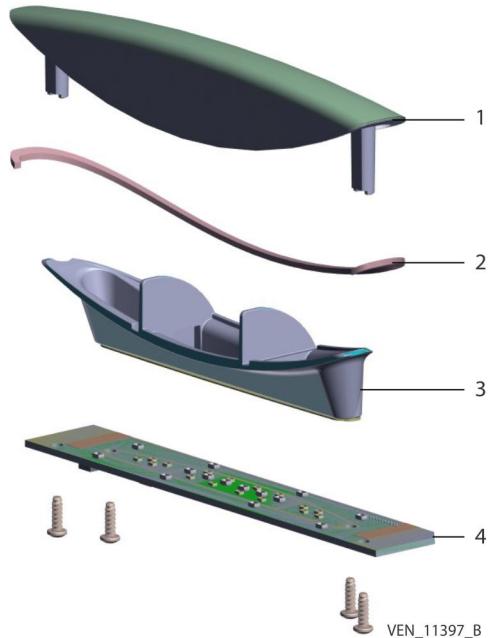
1. Remove the GUI assembly. See [page 208](#).
2. Remove the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
3. Disconnect the 12-pin straight cable from the (P2) connector.
4. Remove the four (4) screws from the alarm assembly.

Figure 139. Separation of Alarm Assembly from Rear Housing



VEN_12645_A

Figure 140. Exploded view of the alarm assembly



VEN_11397_B

1. 360-degree alarm lens
2. 360-degree alarm gasket
3. 360-degree alarm reflector
4. Alarm LED PCBA and 360-degree alarm insulator

5. Set aside on a static-resistive mat.

To replace the Alarm Assembly

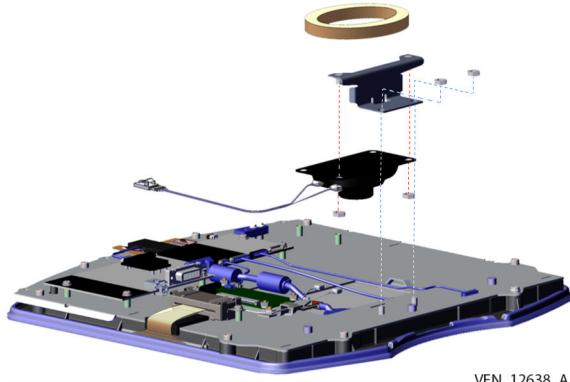
1. Align the 360-degree alarm gasket to the edge of the rear housing.
Note: When reinstalling, ensure the 360-degree alarm gasket remains in the gasket retaining groove.
 2. Assemble the components of the alarm assembly: the alarm lens, reflector, insulator and Alarm LED PCBA.
 3. Center the alarm assembly to the cutout in the rear housing.
 4. Tighten the two (2) upper screws.
 5. Tighten the two (2) lower screws to secure the alarm assembly.
 6. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).
- Note:** Ensure the touchscreen gasket is cleanly inserted into the channel of the alarm status display assembly.
7. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.10. Speaker

To remove the speaker

1. Remove the GUI assembly. See [page 208](#).
2. Disassemble the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
3. Unplug speaker cable from UI PCBA.
4. Remove 2 nuts holding speaker bracket to back panel.
5. Remove speaker gasket.
6. Remove 2 nuts holding speaker to speaker bracket

Figure 141. Speaker, Brackets, and Gasket



VEN_12638_A

1. Speaker gasket
2. Speaker bracket
3. Speaker
4. Nut

To replace the speaker

1. Reattach 2 nuts holding speaker to speaker bracket.
2. Replace speaker gasket.
3. Reattach 2 nuts holding speaker bracket to back panel.
4. Plug speaker cable from UI PCBA.
5. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).
6. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

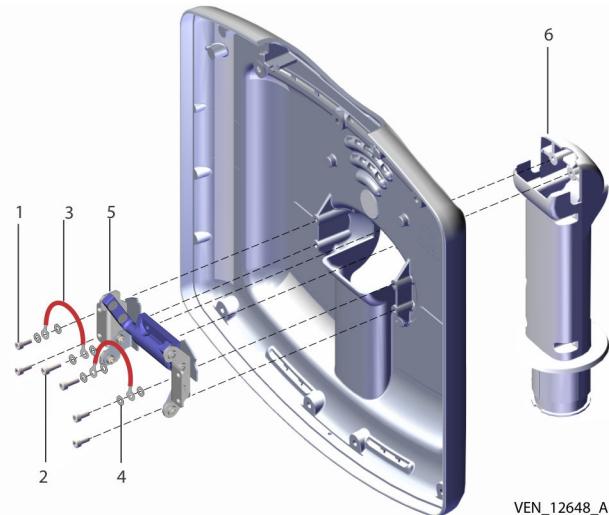
5.15.2.11. GUI Post

GUI Hinge Assembly

To remove the GUI hinge assembly

1. Remove the GUI assembly. See [page 208](#).
2. Disassemble the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
3. Set aside the front GUI assembly.

Figure 142. GUI Hinge Assembly



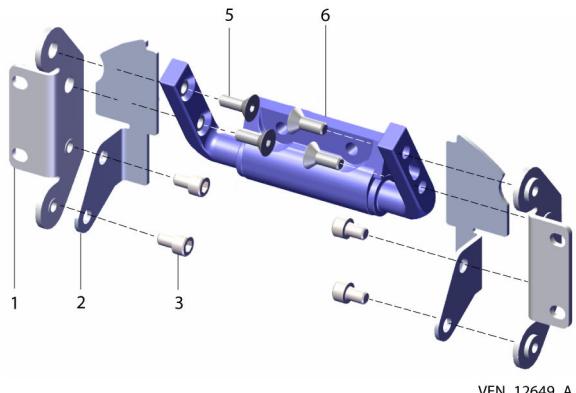
1. Screw
 2. Screw
 3. Grounding Strap
 4. Lock Washers
 5. Hinge Assembly
 6. GUI Post Assembly
4. Remove the two (2) screws that secure the ground straps to the GUI post and hinge assembly.
 5. Remove the four (4) screws that secure the hinge assembly to the GUI rear housing.

6. Remove the hinge assembly from the GUI post containing the GUI cable.
Note: The position of the hinge assembly is critical to the proper removal and reinstallation of the GUI post and GUI cable.
Note: If disassembling the hinge assembly, remove 4 screws to the hinge arm and 4 screws to the hinge brackets on either side of the hinge assembly.

To replace the GUI hinge assembly

1. Route cable through GUI rear housing.
2. Ensure GUI post is nested in the opening of the GUI rear housing.
Note: If reassembling the hinge assembly, apply Loctite (4-004189-00) and loosely install 4 screws to the hinge arm and 4 screws to the hinge brackets on either side of the hinge assembly. Tighten all 8 screws.

Figure 143. Exploded GUI Hinge Assembly



1. Hinge Bracket
2. Gap Fill Bracket
3. Screw
4. Screw
5. Hinge Assembly
3. Insert hinge assembly and rotate into position.
Note: The position of the hinge assembly is critical to the proper removal and reinstallation of the GUI post.
4. Replace the two (2) ground straps on top of the top standouts of the hinge assembly.
5. Apply Loctite (4-004189-00) and loosely install the four (4) screws to hold the ground straps and hinge assembly in place.
6. Apply Loctite (4-004189-00) and loosely install the two (2) screws on other end of the ground strap onto the GUI post and hinge assembly.
7. Center the GUI post within the opening of the GUI rear housing.
8. Tighten all six (6) screws previously installed loosely.
9. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).

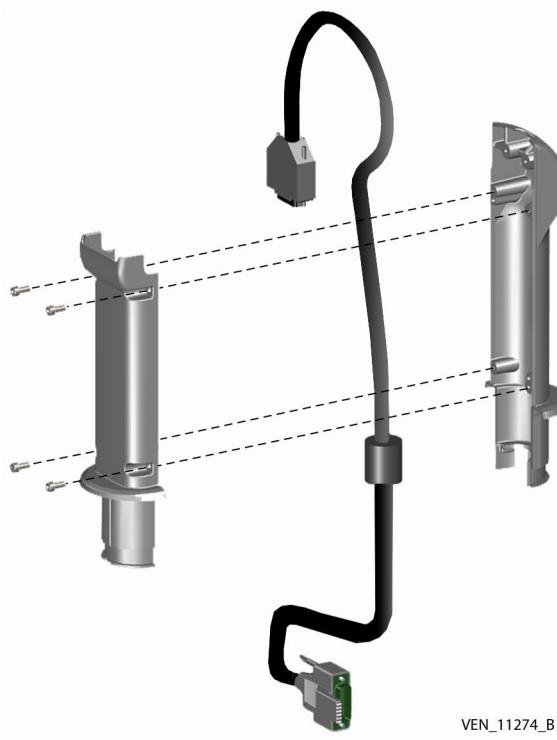
10. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.15.2.12. Graphical User Interface (GUI) to BDU Cable

To remove the Graphical User Interface (GUI) to BDU cable

1. Remove the GUI assembly. See [page 208](#).
2. Disassemble the GUI rear housing. See [To disassemble the GUI assembly rear housing, page 219](#).
3. Remove the GUI hinge assembly. See [To remove the GUI hinge assembly, page 240](#).
4. Separate the front and rear GUI post halves.

Figure 144. GUI Post Housings



5. Remove the GUI cable.

To replace the User Interface (GUI) cable

1. Place the GUI cable into the front housing of the GUI post.
2. Tighten the four (4) screws.
3. Insert the GUI post assembly through the opening in the rear housing.
4. Ensure the GUI cable folds neatly over the hinge assembly.
5. Secure the GUI post to the hinge assembly using the two (2) screws.
Note: The position of the hinge assembly is critical to the proper removal and reinstallation of the GUI post and GUI cable.
6. Reassemble the GUI rear housing. See [To reassemble the GUI assembly rear housing, page 219](#).

7. Replace the GUI assembly. See [To replace the GUI assembly on the top cap, page 226](#).

5.16. DC Compressor

Warning: Lifting the BDU assembly off the base requires two people. Request assistance prior to lifting the BDU assembly.

Note: Disconnect the ventilator AC power cord, BDU and compressor batteries, accessories, and high-pressure gases prior to servicing the PB980 DC Compressor.

Tools List:

- Static-dissipative field service kit, 4-018149-00
- Hex driver, T-handle, long shank, ball end, 5/32 inch
- Hex driver, T-handle, long shank, ball end, 7/64 inch
- Hex driver, T-handle, long shank, ball end, 9/64 inch
- Hex driver, T-handle, long shank, ball end, 1/8 inch
- Screwdrivers, Phillips: #0, #1 and #2
- Screwdriver, slotted: 3/16 inch
- Diagonal cutters or equivalent tool suitable for cutting cable tie-wraps
- 6 inch cable tie wraps
- Needle nose pliers
- Pliers suitable for hose clamp removal

5.16.1. Compressor Inlet Filter

The compressor inlet filter provides pre-filtration for the compressor dryer muffler. The inlet filter is in the top rear panel of the compressor. If necessary, remove and clean the filter more often than the recommended PM (Preventative Maintenance) schedule of every 250 hours. Some environments can cause particulate to collect more quickly.

5.16.2. Removing and Installing the Compressor Inlet Filter

1. To remove inlet filter, gently pull at one corner as seen in [Figure 145](#).

Figure 145. Compressor Inlet Filter

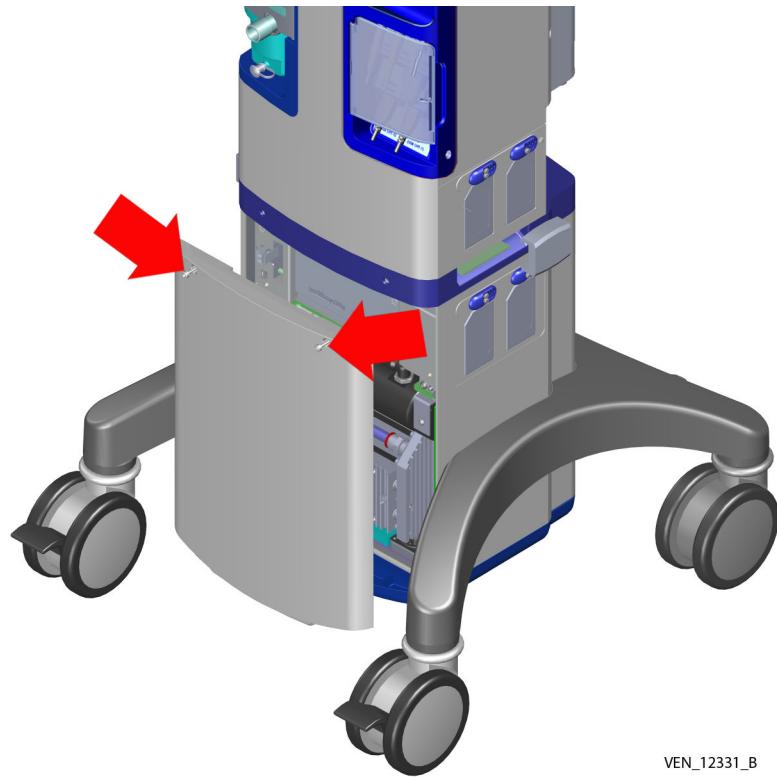


2. Wash the filter in a mild soap solution.
3. Rinse filter well and air dry thoroughly to ensure an unrestricted flow of air through the compressor compartment. Replace filter if damaged.
4. To install the inlet filter, align the clean dry filter over the opening in the rear panel of the compressor.
5. Gently tuck in the edges of the filter.

5.16.3. Removing the DC Compressor from the BDU

1. Lock the front casters.
2. Using a 5/32 hex wrench, unscrew the two captive screws to remove the compressor front panel as shown in [Figure 146](#).

Figure 146. Front Panel Captive Screws



VEN_12331_B

3. As seen in [Figure 147](#), disconnect the data cable connector from the compressor power module. Next, disconnect the power supply cable from its connector and remove the ground wire from its fastener.

Figure 147. Disconnection of Cables and Wires



8

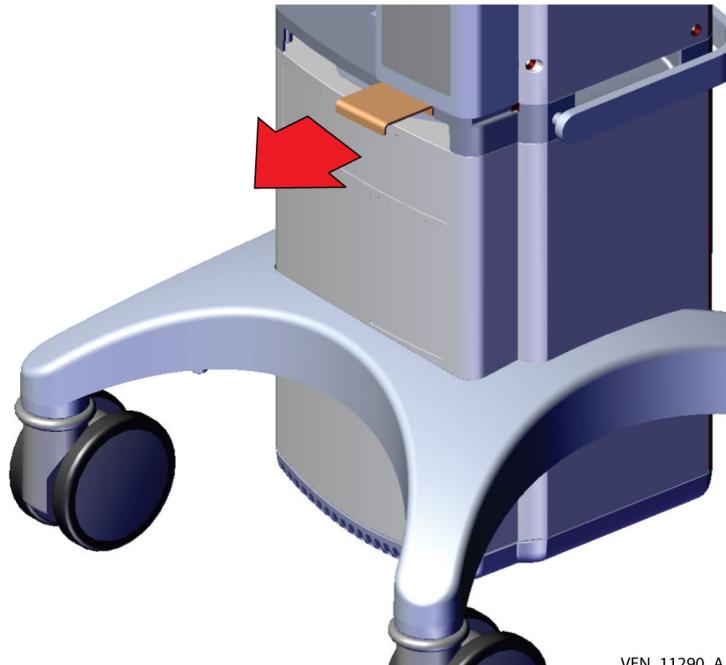
VEN_12495_A

1. Compressor to power distribution cable connection
2. Logic cable connection
3. Interface harness connection
4. Card cage panel
5. AC power cable
6. Pneumatic interface tube
7. Ground cable
8. Pneumatic interface pressure transducer connection

Note: When disconnecting the main compressor /ventilator interconnect tube for the first time, a loud venting pressure and noise is generated.

4. Grasp both ends of the air supply line tubing where they connect at the barbed connector.
5. Gently twist the tubing while pulling the ends apart.
6. Locate the latch above the right-hand side of the compressor inlet filter on the compressor chassis base. Pull the latch to unlock the BDU from the compressor chassis base as shown in [Figure 148](#).

Figure 148. BDU Release Latch



VEN_11290_A

7. Extract the data cable, power supply cable and air supply line from the protective foam pad.
8. With the casters in the locked position, grab the BDU front handrail and carefully tilt the BDU back.
9. While ensuring care not to damage the interconnects, pull the data cable, power supply cable and air supply line up through the compressor chassis opening so that the BDU is now completely disconnected from the compressor.
10. Carefully lay the BDU on the battery compartment side to avoid damaging the interconnect cables, the power cord retainer, or the exhalation compartment.
11. As seen in [Figure 149](#) the entire compressor base may be removed for ease of servicing. The power and pneumatics modules may also be independently removed from the compressor base.

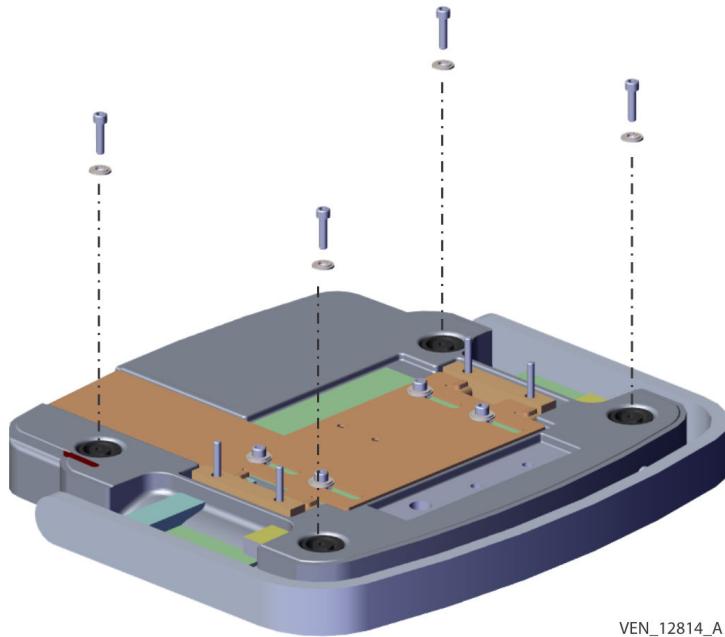
Figure 149. PB980 Caster Base Assembly



5.16.4. Replacing the Compressor Universal Base Assembly

1. Using a 5/32 hex wrench, remove the four screws and washers located in each corner of the universal base as seen in [Figure 150](#).

Figure 150. Universal Base Assembly



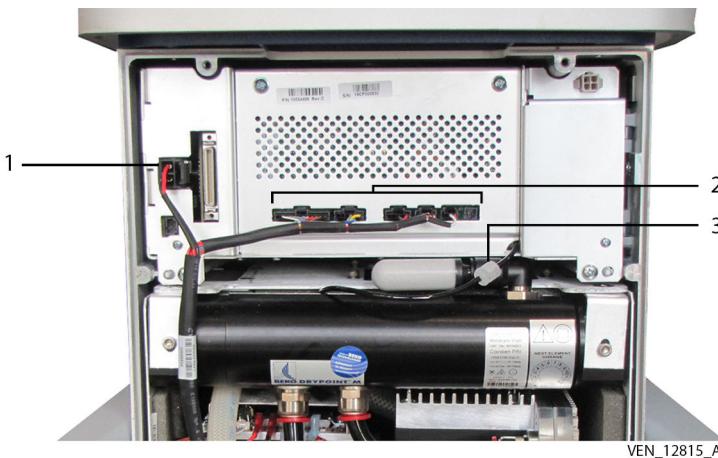
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2. Lift the universal base up to remove.
3. Put the new universal base in place.
4. Using a 5/32 hex wrench, screw in the four screws and washers located in each corner of the universal base.

5.16.5. Replacing the Compressor Interface PCBA

1. Disconnect the five cable connections at the compressor interface PCBA as seen in [Figure 151](#).

Figure 151. Compressor Connections

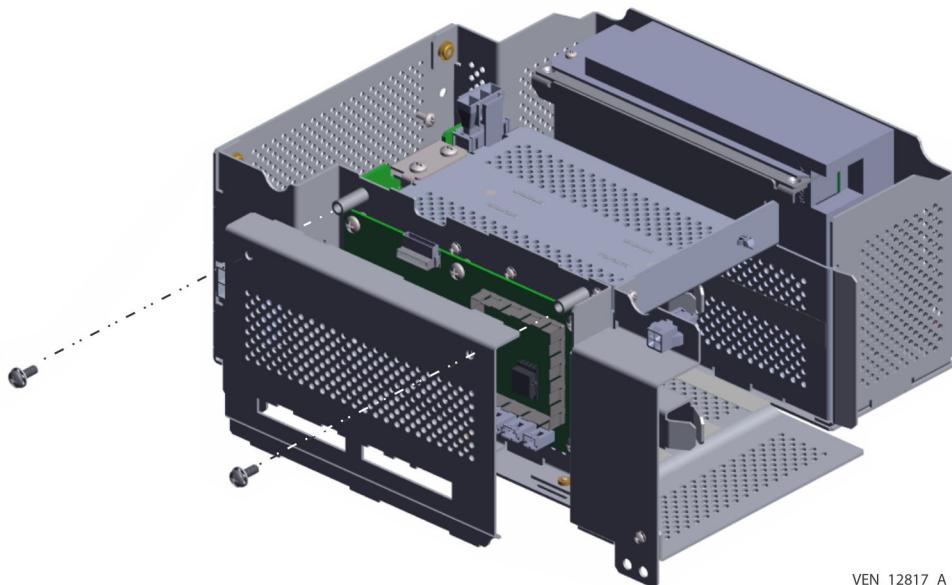


VEN_12815_A

1. Power distribution PCBA connection
2. Compressor interface PCBA connections
2. Disconnect the one cable connection at the power distribution PCBA.
3. Unscrew the white pneumatic Luer-Lok™ lock connection.
3. Luer-Lok™ connector

- Using a Phillips head screwdriver, remove the two screws and front cover to access the compressor interface PCBA as seen in [Figure 152](#).

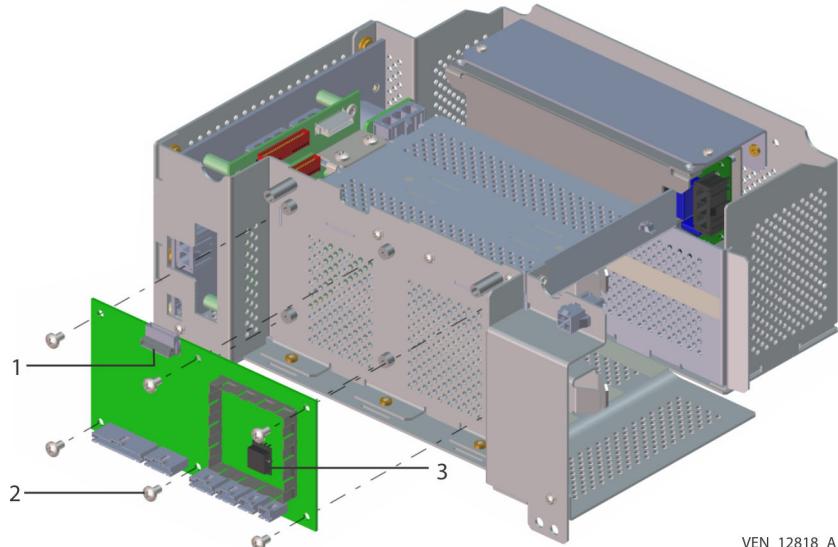
Figure 152. DC Compressor Interface PCBA Cover Plate



VEN_12817_A

- Disconnect the data cable and remove the six screws to replace the compressor interface PCBA as seen in [Figure 153](#).

Figure 153. Compressor Interface PCBA Removal



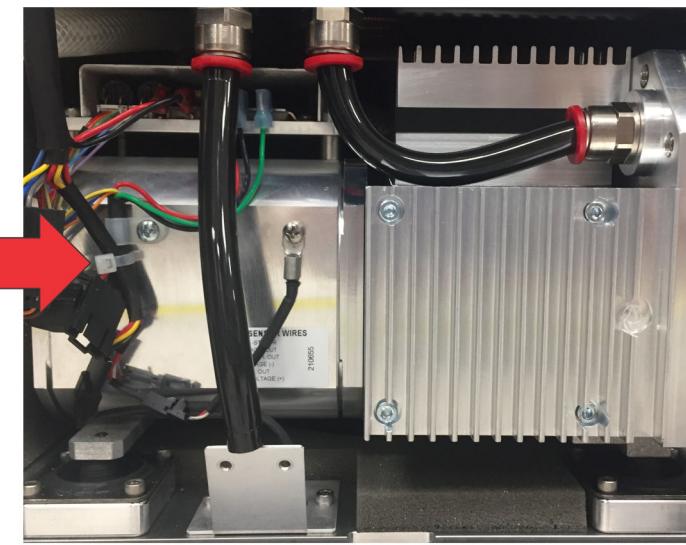
VEN_12818_A

- Cable connection
- Screws
- Compressor interface PCBA
- Reverse the disassembly procedures to install a new DC compressor interface PCBA.

5.16.6. Removing the Main Compressor Interconnect Harness

1. If not already unplugged, disconnect the six electrical connections to the power module (one at the power distribution PCBA and five electrical connections to the compressor interface PCBA).
2. Carefully cut the tie-wrap securing the main compressor harness to the compressor motor cable as seen in [Figure 154](#).

Figure 154. Main Compressor Harness Tie-Wrap

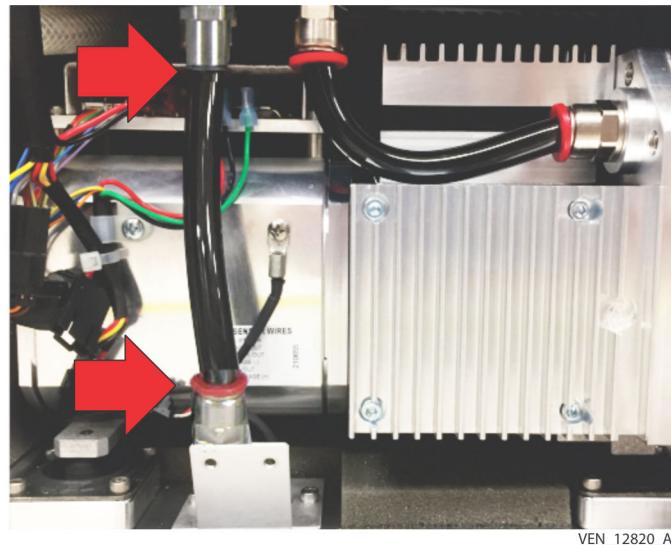


3. Disconnect the eight cable connectors down in the pneumatics module.
Note: As each cable is disconnected, label each connection for ease of reassembly later. Incorrect connections will result in equipment damage.
4. Perform these disassembly procedures in reverse order to replace or reinstall.
5. Install a tie-wrap to secure the main compressor harness to the compressor motor cable

5.16.7. Replacing the Solenoid

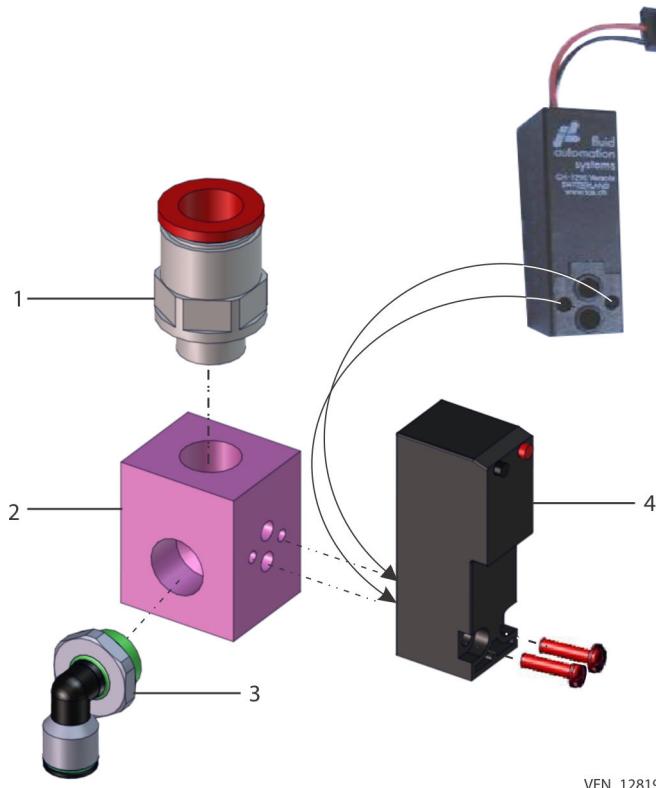
1. Disconnect one end of tube by pushing up on the locking ring below the dryer while pulling down on the tube as seen in [Figure 155](#).

Figure 155. Solenoid Tube Disconnection



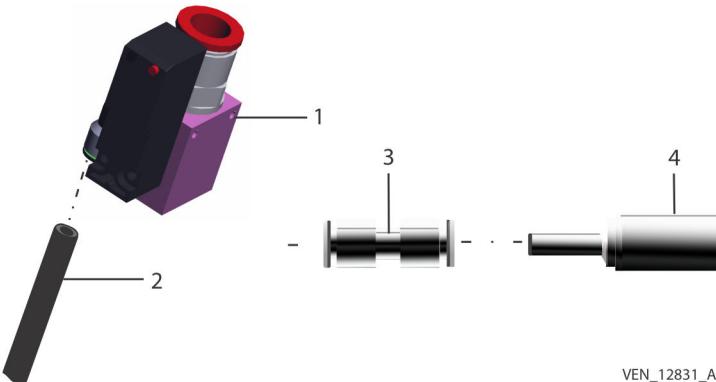
2. Disconnect the other end of the tube by depressing the locking ring on the solenoid assembly and then pulling the tube up and out.
3. Disconnect the solenoid from the main compressor harness.
4. Using a 7/64 hex wrench, remove the two screws securing the solenoid assembly to the bracket.
5. Carefully pull the tubing and muffler assembly up from the bottom pan while extracting the solenoid assembly out to the left of the bracket.
6. Discard the old assembly.
7. Assemble (1) (2) (3) (4) from kit PT00032079 FRU, UNLOAD SOLENOID ASSY, DC COMPRESSOR as shown in [Figure 156](#). Ensure solenoid (4) contains 2 new O-rings before assembly.

Figure 156. Unloading Solenoid Assembly



1. Unloading solenoid manifold connector
 2. Unloading solenoid manifold
 3. Elbow
 4. Unload solenoid
8. Insert the tubing (2) into the elbow fitting on the solenoid assembly(1), and install the muffler (4) onto the fitting (3) as seen in [Figure 157](#).

Figure 157. Unload Solenoid Vent Assembly



1. Unload solenoid assembly
 2. Vent tube
 3. Vent tube connector
 4. Muffler
9. As shown in [Figure 157](#), replace the straight connector and the washer at the dryer, as well as the tube between the solenoid assembly and the dryer.
10. Ensure no leaks are present with leak detector as seen in [Figure 158](#).

Figure 158. Unload Solenoid Assembly Leak Test



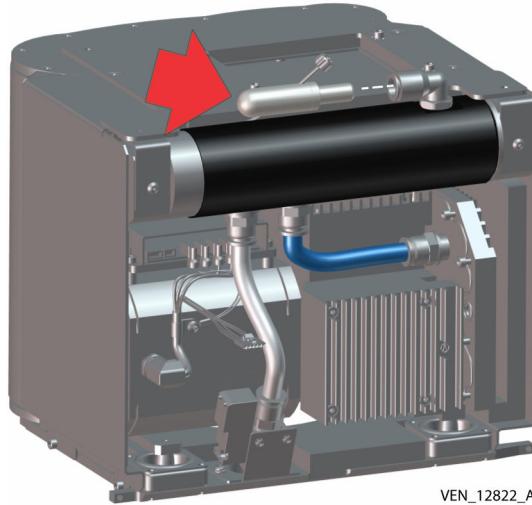
11. Reverse disassembly procedures to reinstall.

5.16.8. Removing the DC Compressor Power Module

Note: This procedure may be performed while the BDU is still attached to the compressor base.

1. Remove the dryer muffler by unscrewing it counterclockwise from the dryer as seen in [Figure 159](#). Be careful not to crack the muffler during removal. Retain the three white, plastic washers located between the muffler and the dryer.

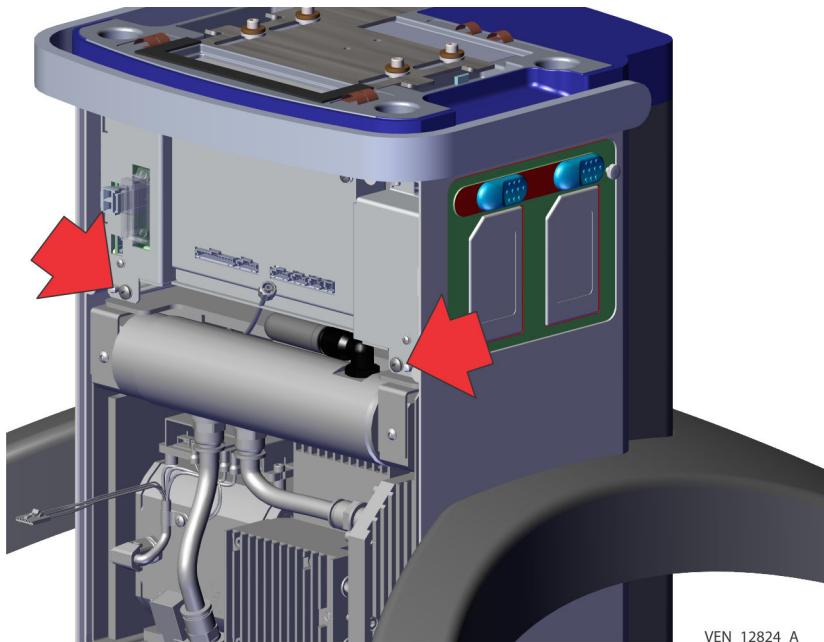
Figure 159. Dryer Muffler Removal



VEN_12822_A

2. Using a Phillips screwdriver, remove the two screws that secure the power module to the chassis guides as shown in [Figure 160](#).

Figure 160. Power Module Hardware Removal



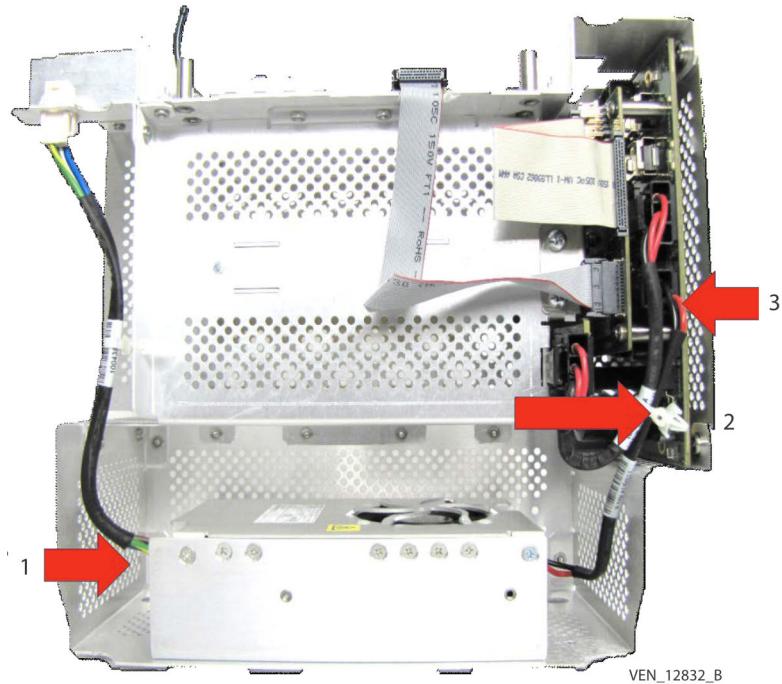
Note: Newer units are horizontal and screw into an elbow fitting as shown in [Figure 160](#). Older configurations will be vertical.

3. Ensure that the compressor batteries have been removed from the compressor battery compartment or else the power module will not come out. Slide the power module out towards you.

5.16.9. Removing the DC Compressor Power Supply

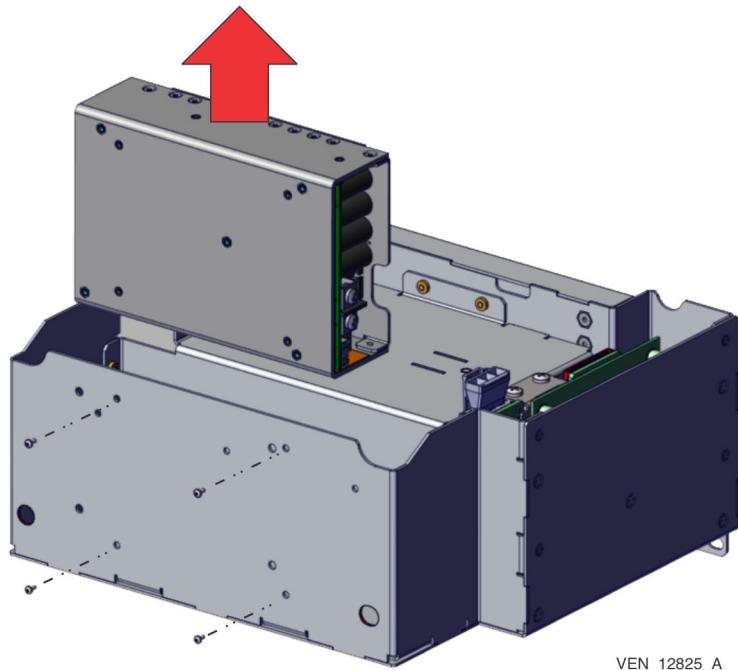
1. Disconnect the AC power cable (1) from the power supply as seen in [Figure 161](#).

Figure 161. Power Module Cable Disconnections



1. AC power cable from the power supply
2. Interconnect cable between the power supply and power distribution PCBA
3. Cut the tie-wrap from the battery backplane PCBA and power distribution PCBA cables (3).
3. Disconnect the interconnect cable between the power supply and power distribution PCBA (2).
4. Remove the four Phillips head screws to extract the power supply from the power module chassis [Figure 162](#).

Figure 162. Power Supply Removal



VEN_12825_A

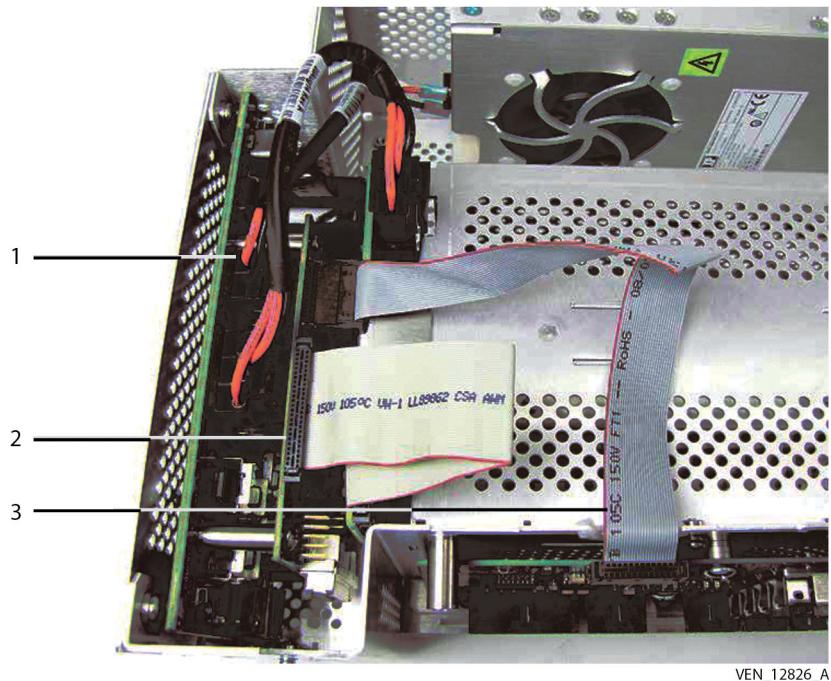
5. Reverse the disassembly procedures to install a new DC compressor power supply.
6. Reinstall a tie-wrap to secure the battery backplane and power distribution cables.

5.16.10. Removing the DC Compressor Battery Backplane PCBA

Note: Contact Technical Services if the power distribution and controller PCBA needs to be changed.

1. Disconnect the ribbon cable connected to the compressor interface PCBA and the power controller PCBA (shown in [Figure 163](#)). Be careful not to damage the power controller connector.

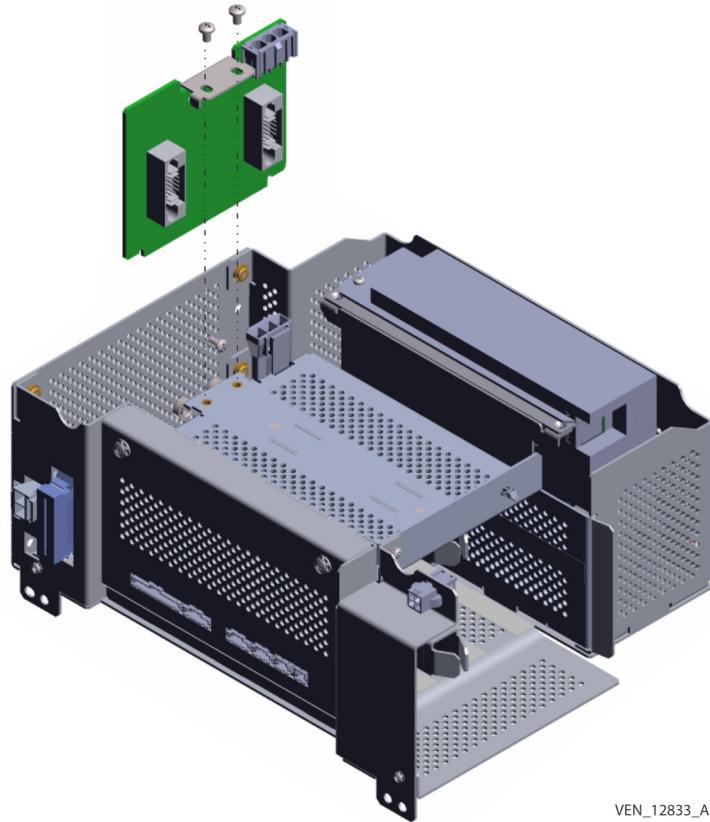
Figure 163. Power Module Cable Removal



VEN_12826_A

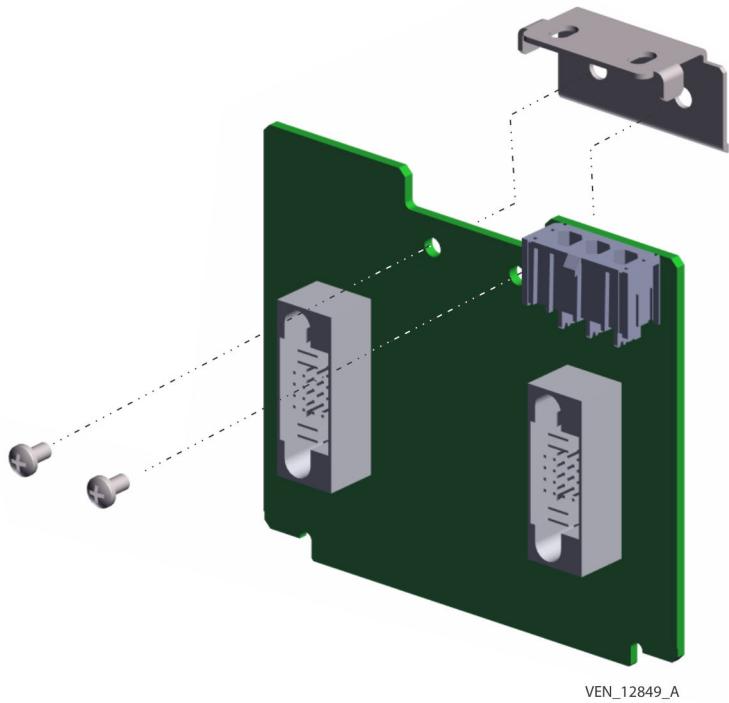
1. Ribbon cable connecting the compressor interface PCBA and the power controller PCBA
2. Power controller PCBA ribbon cable connected to the battery backplane PCBA
3. Unplug the power controller PCBA ribbon cable (2) connected to the battery backplane PCBA.
3. Disconnect the power distribution PCBA cable (3) connected to the battery backplane PCBA.
4. Remove the two Phillips head screws securing the battery backplane PCBA bracket to the power module chassis as seen in [Figure 164](#).

Figure 164. Compressor Battery Backplane



5. Pull the battery backplane PCBA straight up to remove.
6. Transfer the bracket assembly from the old battery backplane PCBA to its replacement as seen in [Figure 165](#).

Figure 165. Compressor Battery Backplane Assembly



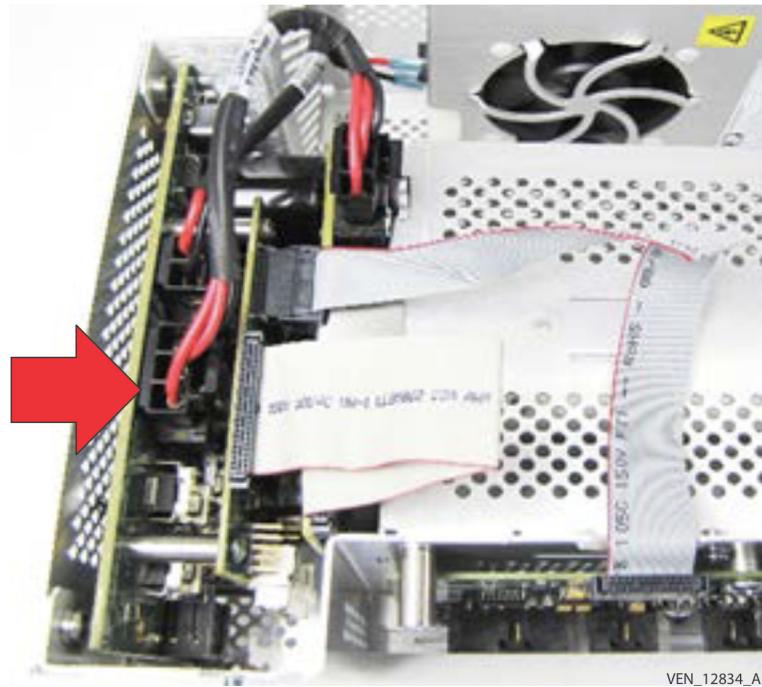
VEN_12849_A

7. Reverse the disassembly procedures to install the new battery backplane PCBA.

5.16.11. Removing the DC Compressor Power Distribution and Controller PCBA Assembly

1. Refer to [Removing the DC Compressor Battery Backplane PCBA, page 256](#) to remove the Battery Backplane PCBA and interconnect cables prior to removing the DC compressor power distribution and controller PCBA assembly.
2. Disconnect the power supply cable from the power distribution PCBA as seen in [Figure 166](#).

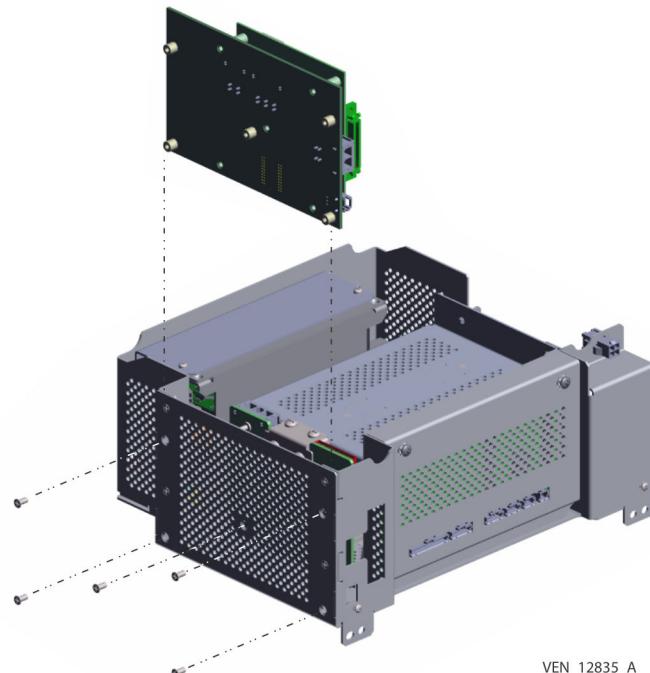
Figure 166. Power Distribution PCBA to Power Supply Cable



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3. Facing the front of the power module, remove the five Phillips head screws from the left side of the power module chassis as seen in [Figure 167](#).

Figure 167. DC Compressor Power Distribution and Controller PCBA Assembly Removal

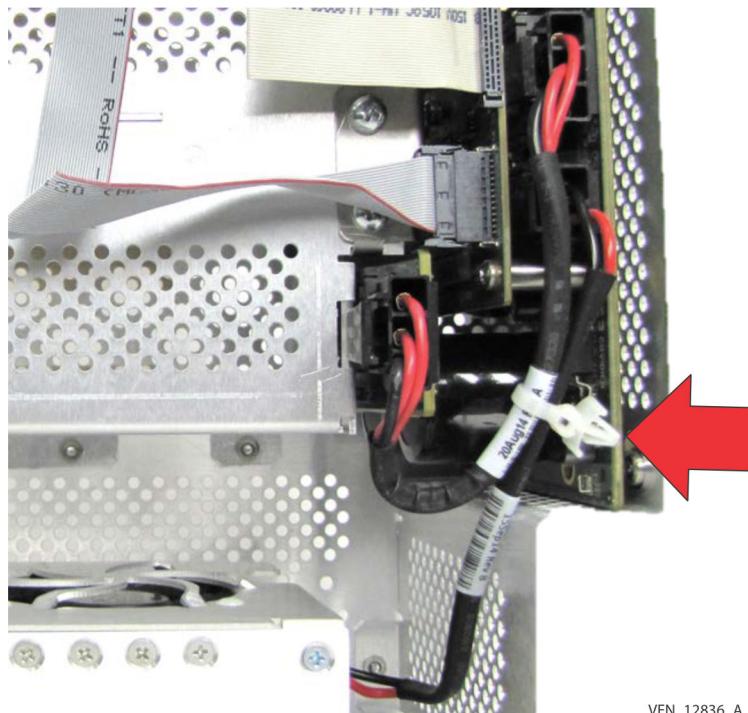


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4. Carefully pull the power distribution and controller PCBA assembly up and out of the power module.

5. Remove the five countersunk Phillips head screws securing the power controller PCBA and power distribution PCBA together. Gently disengage the power controller PCBA from the power distribution PCBA.
 6. After replacing the applicable board, reverse the disassembly procedures to reassemble.
- Note:** The power controller PCBA contains an FPGA (field programmable gate array) device that may require a software/firmware update to be performed whenever the power controller PCBA is replaced.
7. Install a new tie-wrap to secure the power supply and power distribution cables before reinstalling the power module as seen in [Figure 168](#).

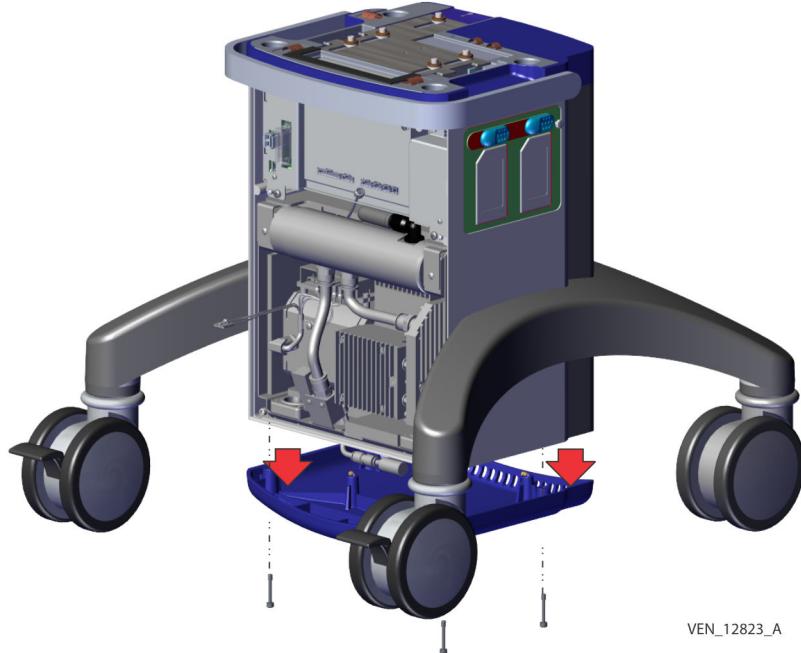
Figure 168. Tie-Wrap Installation



5.16.12. Removing the DC Compressor Bottom Plate Assembly

1. Using a right-angled 5/32" hex wrench, unfasten the four captive screws located in each corner of the DC Compressor Bottom Plate by turning the wrench clockwise. If necessary, prop one side of the compressor base assembly up to gain easier access to the screws (figure 25).

Figure 169. DC Compressor Bottom Plate Assembly Removal

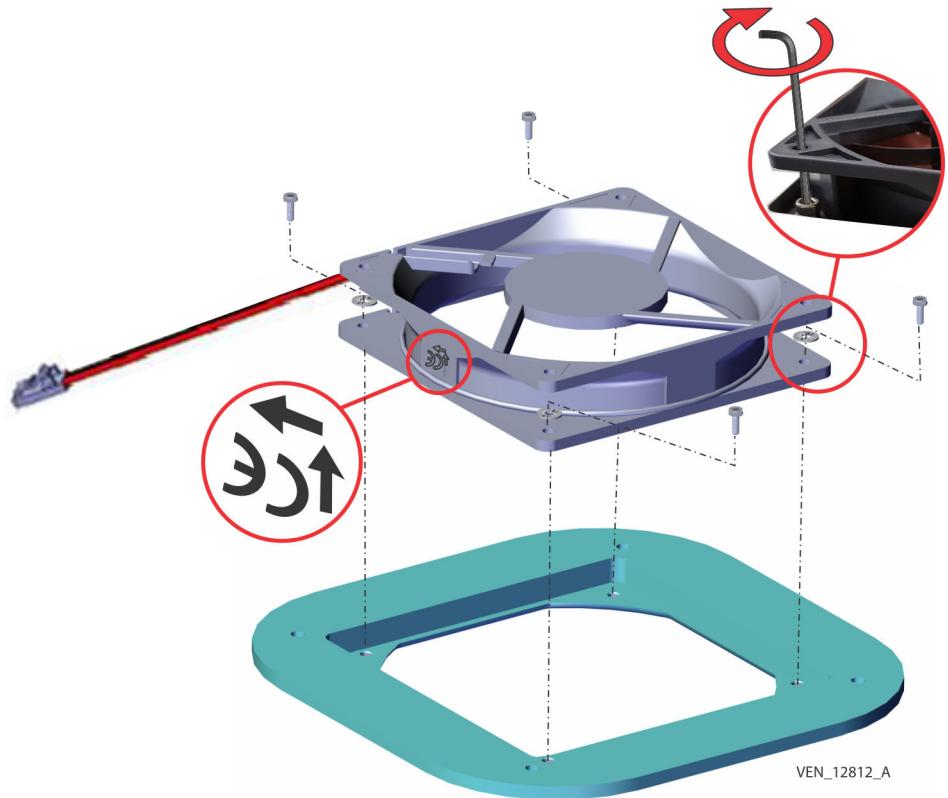


2. If not previously disconnected, disconnect the cooling fan cable from the main compressor harness.
3. Reverse disassembly procedures to reinstall. To prevent damage to the bottom plate inserts, do not over tighten the captive screws.

5.16.13. Replacing the DC Compressor Cooling Fan

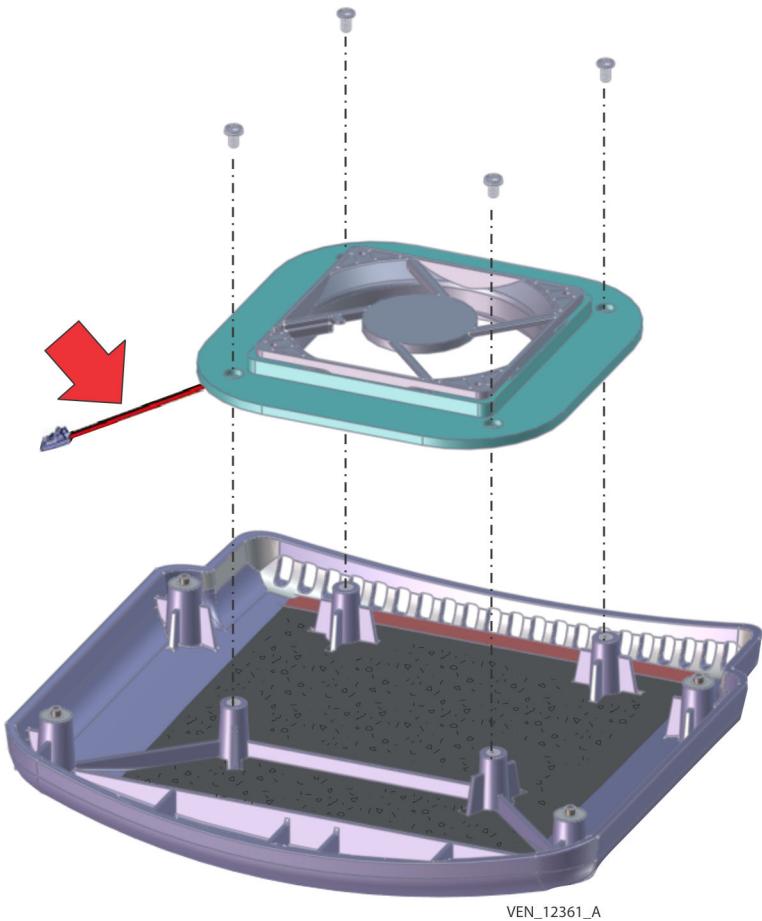
1. Remove the bottom plate as described in [page 261](#).
2. Remove the four Phillips head screws and washers to remove the fan retainer bracket as seen in [Figure 170](#).

Figure 170. DC Compressor Cooling Fan Removal



3. Invert the assembly. Remove the four screws and lock washers that secure the fan to the bracket using a 9/64 hex wrench.
4. Reinstall the fan ensuring the correct flow orientation of the fan.
5. Reinstall the fan and bracket assembly to the bottom plate ensuring that the fan cable is oriented toward the front of the cover.
6. Feed the fan harness up through the pneumatics module base plate opening as seen in [Figure 171](#).

Figure 171. Fan Assembly Orientation



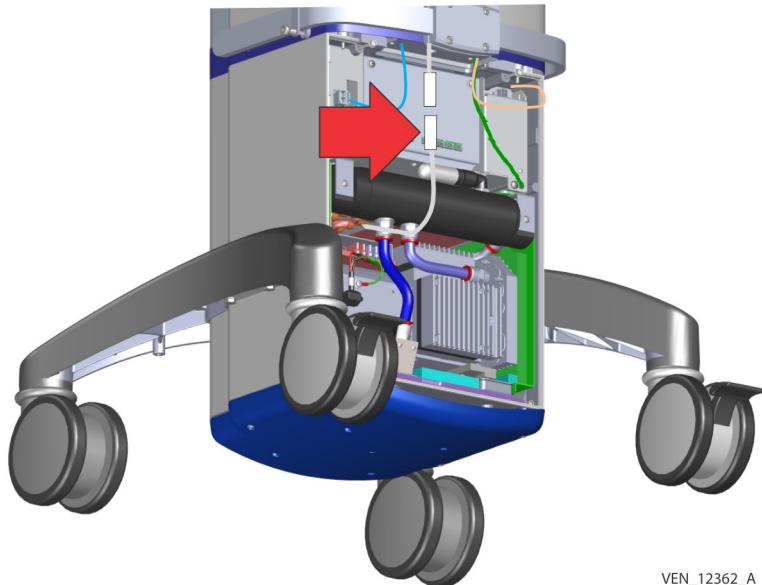
7. Reconnect the fan cable back to the main compressor interconnect harness.

5.16.14. Removing the Pneumatics Module

Note: If not already completed, perform the following steps to disconnect the BDU and DC compressor connections.

1. Loosen the air supply line hose clamp with a Phillips screwdriver.
Note: The compressor system may still be pressurized. When the air supply lines are disconnected, the system will depressurize. Please ensure caution when disconnecting the air supply line tubing at the barbed connector.
2. Grasp both ends of the air supply line tubing where they connect at the barbed connector. Gently twist the tubing while pulling the ends apart as shown in [Figure 172](#).

Figure 172. Compressor Air Supply Line Disconnect



3. Disconnect the main compressor harness connections to the power module as seen in [Figure 173](#).

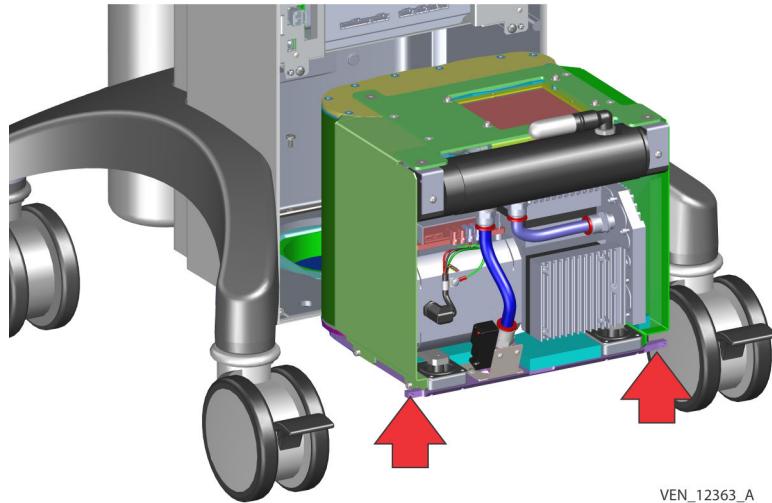
Figure 173. Power Module Electrical and Pneumatic Connection Removal



1. Compressor to power distribution cable connection
 2. Logic cable connection
 3. Interface harness connection
 4. Card cage panel
 5. AC power cable
 6. Pneumatic interface tube
 7. Ground cable
 8. Pneumatic interface pressure transducer connection
4. Unscrew the white Luer-Lok™* connector to disconnect the black compressor pressure tubing connection.
 5. If not already completed, refer to [Removing the DC Compressor Power Distribution and Controller PCBA Assembly, page 259](#) to remove the compressor bottom plate and disconnect the fan cable from the main compressor harness. Ensure that all wires are out of the way in preparation for removing the pneumatics module.

6. Refer to [Removing the Main Compressor Interconnect Harness, page 250](#) to remove the solenoid so that the tube and muffler assembly can be extracted out of the bottom compartment.
7. Using a 9/64 hex wrench, unfasten the two captive screws securing the pneumatics module to the chassis base as seen in [Figure 174](#).

Figure 174. Removing the Pneumatics Module

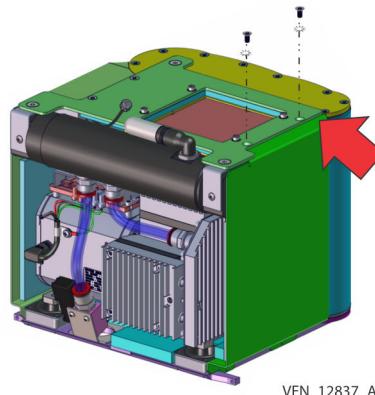


8. Pull the pneumatics module out towards you.
9. Reverse the disassembly procedures to reassemble.

5.16.15. Removing the Pneumatics Module Right Side Panel

1. Using a 7/64 hex wrench, remove the two black countersunk screws and star washers from the top of the pneumatics module as seen in [Figure 175](#).

Figure 175. Pneumatic Module Right Side Panel Removal

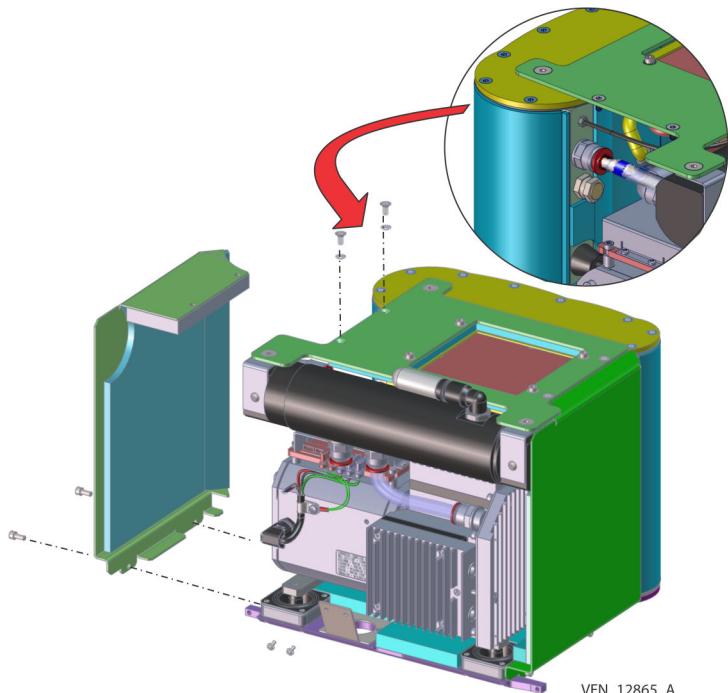


2. Using a 9/64 hex wrench, remove the two screws from the bottom of the right-side panel.
3. Remove the right-side panel.
4. Reverse the disassembly procedures to reinstall. When reinstalling, position the side panel under the top plate.

5.16.16. Removing the Pneumatics Module Left Side Panel

1. Using a 7/64 hex wrench, remove the two black countersunk screws and star washers from the top of the pneumatics module as seen in [Figure 176](#).

Figure 176. Pneumatic Module Left Side Panel Removal

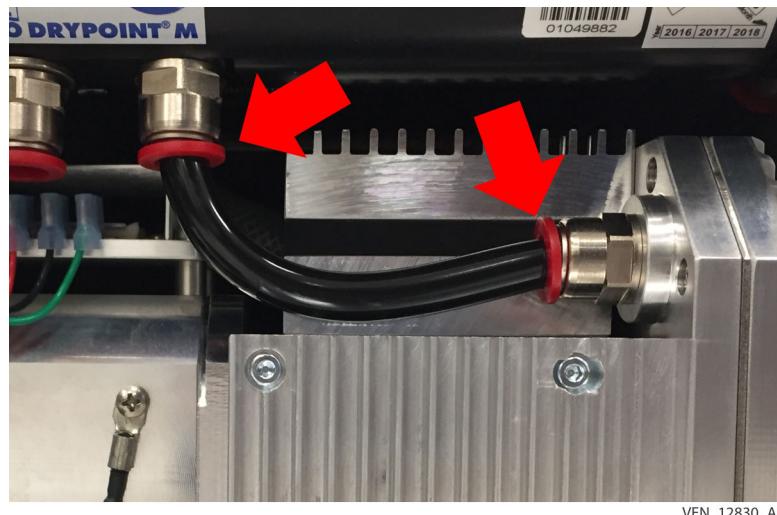


2. Using a 9/64 hex wrench, remove the two screws from the bottom of the left side panel.
3. Remove the left side panel.
4. Reverse the disassembly procedures to reinstall. When reinstalling, position the side panel under the top plate.

5.16.17. Replacing the Heat Exchanger and Dryer Assemblies:

1. Disconnect one end of the black tube connecting the dryer to the compressor by pushing the red ring in and pulling the tube down. Repeat this action on the other side to remove the tube as seen in [Figure 177](#).

Figure 177. Heat Exchange and Dryer Tube Replacement

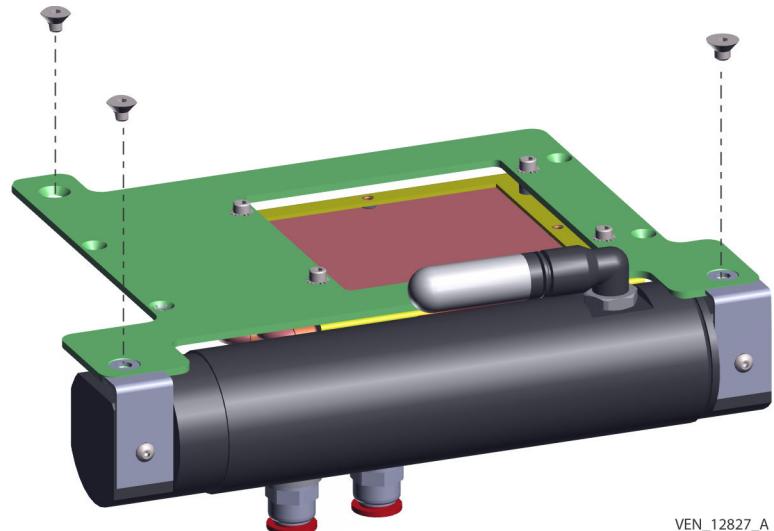


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2. Using a Phillips head screwdriver, remove the three large, countersunk screws from the pneumatics module top plate as seen in [Figure 178](#).

Note: The rear screw is a different thread than the front two, so do not mix them up.

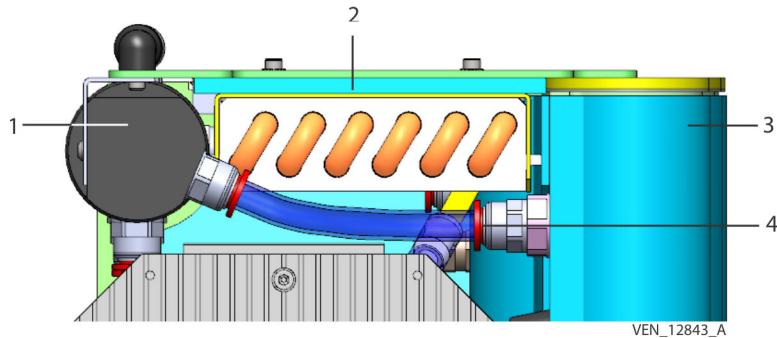
Figure 178. Heat Exchanger Screw Removal



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3. On the right side of the pneumatics module, disconnect the black tube connected to the accumulator by pressing the red locking ring in towards the accumulator and pulling the black tube out as seen in [Figure 179](#).

Figure 179. Pneumatic Module Major Assemblies

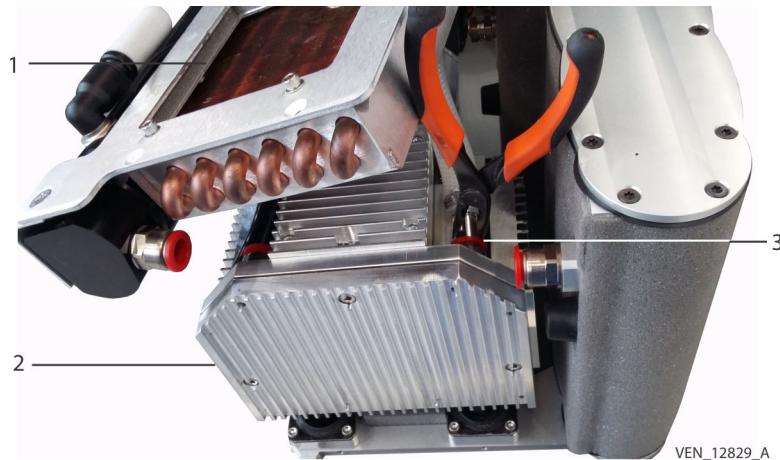


- | | |
|-------------------|---|
| 1. Dryer | 3. Accumulator |
| 2. Heat exchanger | 4. Accumulator to dryer interconnect tube |

- Warning:** The copper heat exchanger cooling fins are very sharp. Ensure care when handling this assembly to prevent damage to the equipment or yourself.
4. Carefully lift the heat exchanger assembly by the accumulator to access the compressor interconnect tube.
 5. Push the red ring in towards the compressor and pull the metal hose connector out as seen in [Figure 180](#).

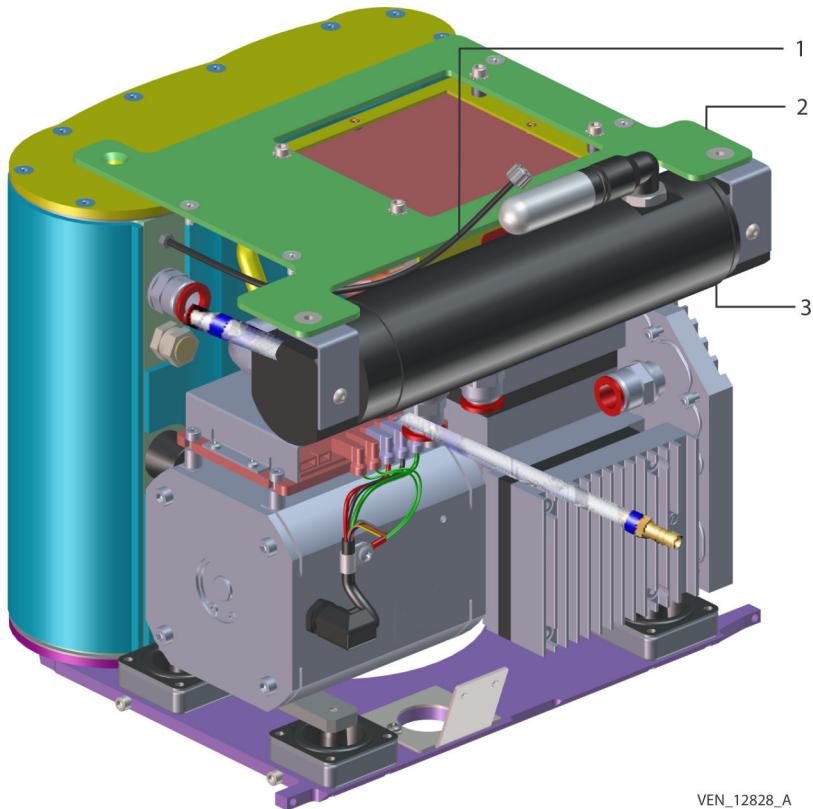
Note: When reinstalling this hose, fully depress the red ring and use a pair of needle nose pliers to push the hose firmly into the retainer. Perform a pull test to ensure the hose is fully engaged. Failure to fully engage the locking mechanism may result in leaks.

Figure 180. Compressor to Heat Exchanger Interconnect Tube Disconnection



1. Heat exchanger
2. Compressor
3. Compressor to heat exchanger interconnect tube
6. Lift the top plate to extract the black pressure tube with the white Luer-Lok™ connector from space between the dryer and heat exchanger assembly. Let the black tube and connector hang freely as seen in [Figure 181](#).

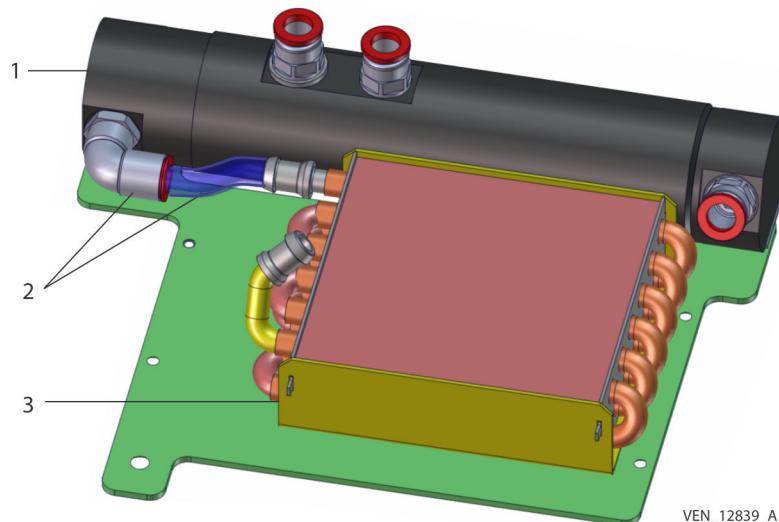
Figure 181. Heat Exchanger and Dryer Assemblies Replacement



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1. Accumulator pressure tube
2. Heat exchanger plate
3. Dryer assembly
7. Flip the dryer and heat exchanger assembly over to access the white interconnect tube.
8. Depress the red locking ring and pull the dryer away from the heat exchanger to disengage the two assemblies as seen in [Figure 182](#).

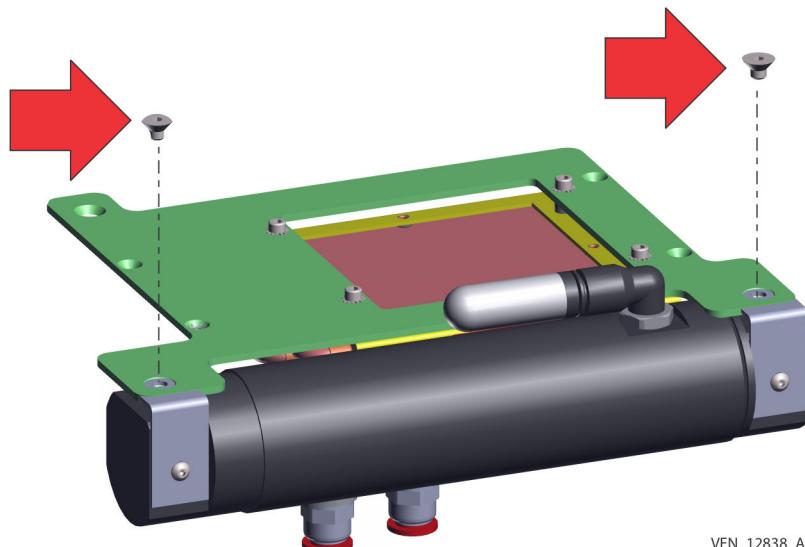
Figure 182. Heat Exchanger and Dryer Assembly Service



VEN_12839_A

1. Air dryer assembly
 2. Dryer tube
 3. Heat exchanger assembly
9. Use a 9/64 hex wrench to remove the four screws and washers securing the heat exchanger to the top plate.
10. Next, if replacing or servicing parts in the dryer assembly, transfer the applicable parts (brackets and black pressure tube) to the new dryer.
11. Reinstall the heat exchanger and dryer assembly by reversing disassembly procedures:
- a. Reconnect the dryer tube onto the heat exchanger.
 - b. Position the dryer brackets under the heat exchanger plate. Reinstall the dryer brackets back onto the heat exchanger plate with the two large countersunk screws. Leave the screws loose so that the pressure tube and Luer-Lok™* connector can be pulled forward later as seen in [Figure 183](#).

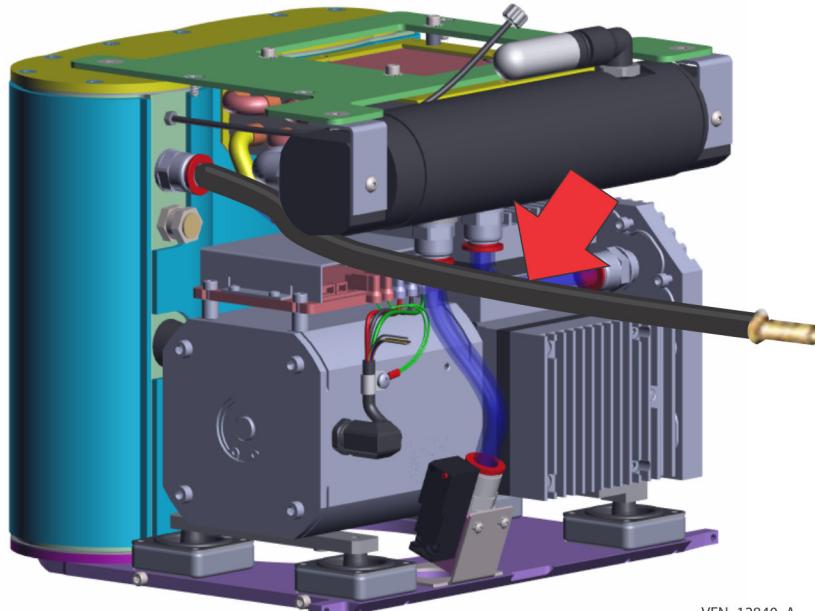
Figure 183. Heat Exchanger Screw Removal



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- c. Reconnect the heat exchanger tube back to the compressor in the heart of the assembly.
- d. Reconnect the dryer tube back to the accumulator on the right side of the module.
- e. Reconnect the dryer to compressor tube in the front of the assembly.
- f. Verify that all tubing connections are secure.
- g. Feed the black pressure tube with the white Luer-Lok™* connector through the gap between the dryer and the top plate so that the connector is hanging over the top of the dryer assembly as seen in [Figure 184](#).

[Figure 184. Repositioning the Compressor Hose Assembly](#)



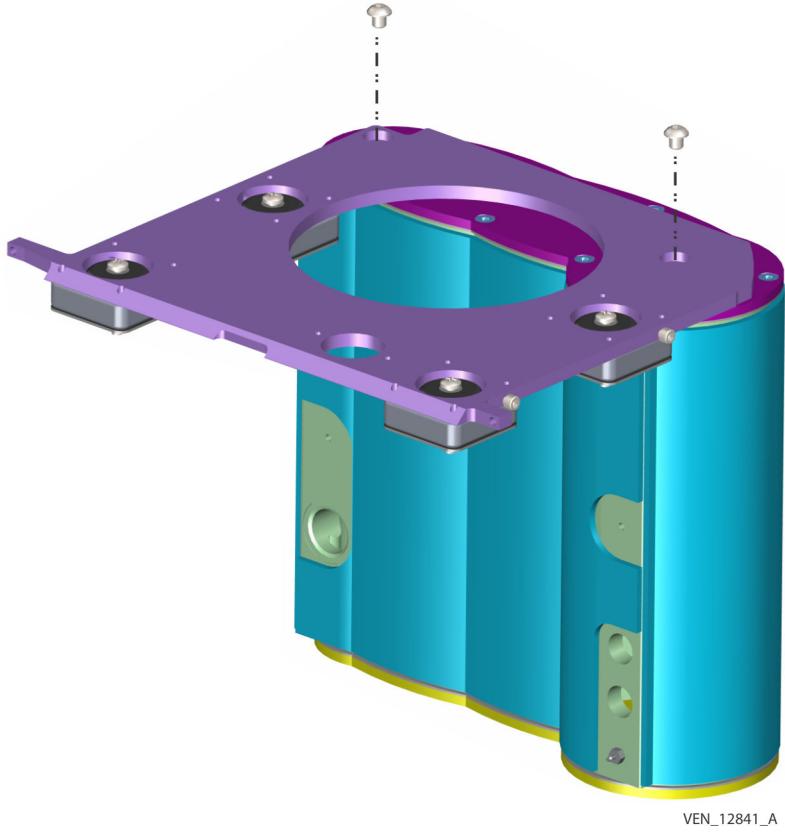
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- h. Ensure the tube is free and non-binding.
- i. Tighten the dryer bracket to top plate screws at the end when all connections have been completed and positioned properly. If there is difficulty re-securing the dryer brackets, reseat all connections to ensure that parts are properly aligned.

5.16.18. Replacing the Accumulator Assembly

1. Flip the compressor and accumulator assembly on its side to access the bottom compressor plate.
2. Using a 5/32 hex wrench, remove the two screws that secure the accumulator to the compressor plate as seen in [Figure 185](#).

Figure 185. Accumulator Assembly Replacement



VEN_12841_A

3. If replacing the accumulator, transfer the large, white silicone air supply hose and small, black pressure tube with the white Luer-Lok connector, as well as all other applicable parts to the new assembly. When reinstalling the white silicone hose, fully depress the red ring and push the metal fitting in as far as it will go. Perform a pull test to ensure the hose is securely engaged.
4. Reverse the disassembly procedures to reinstall.

5.16.19. Replacing the Compressor Assembly

Note: If not already completed, refer to [Replacing the Compressor Interface PCBA, page 248](#) to disconnect main Compressor Harness.

1. If the compressor motor that is being replaced has a grounding shunt (as shown in [Figure 186](#)): Carefully cut the tie-wrap securing the grounding shunt to the compressor motor cable (shown in [Figure 186](#)), and connect the grounding shunt to the motor controller power spade terminals (as shown in [Figure 187](#)).

Figure 186. Grounding Shunt and Compressor Motor Cable Tie-wrap

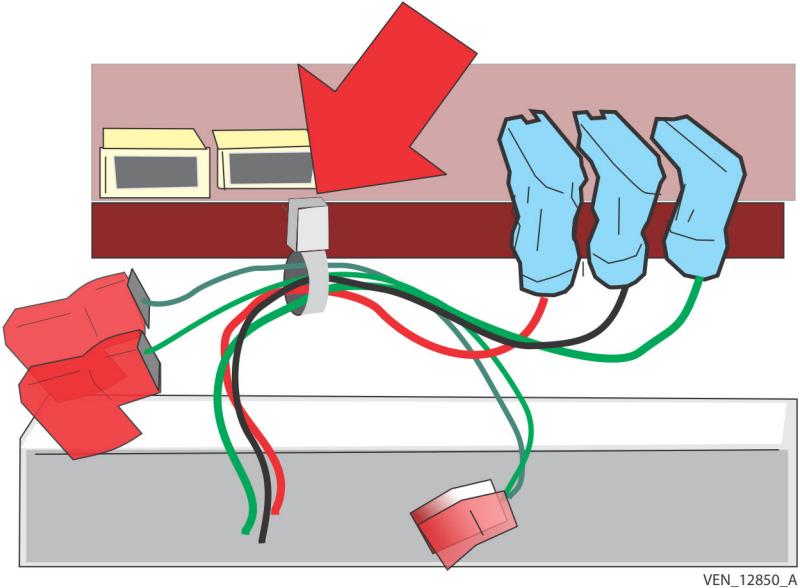
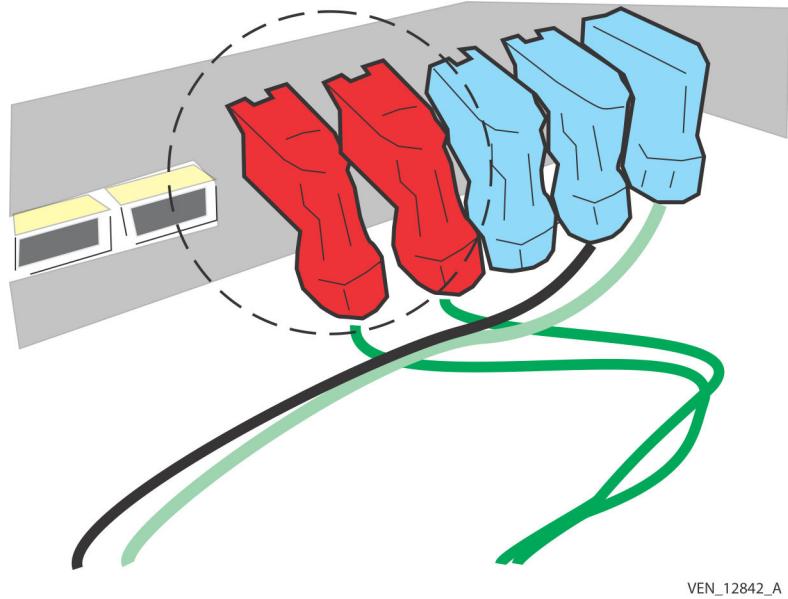
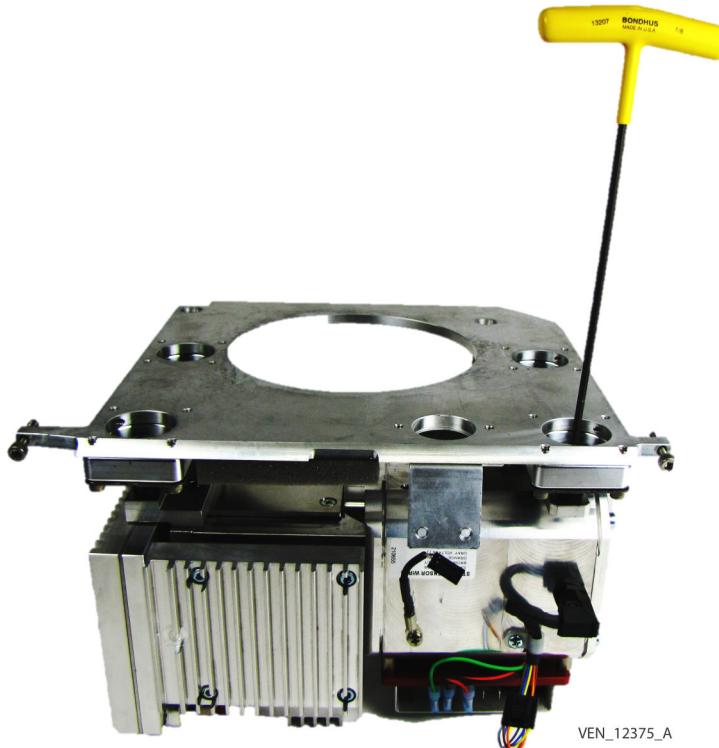


Figure 187. Grounding Shunt Connected to Motor Controller Power Spade Terminals



2. Carefully invert the compressor to access the compressor bottom plate as seen in [Figure 188](#).

Figure 188. Shock Mount Bolt Removal



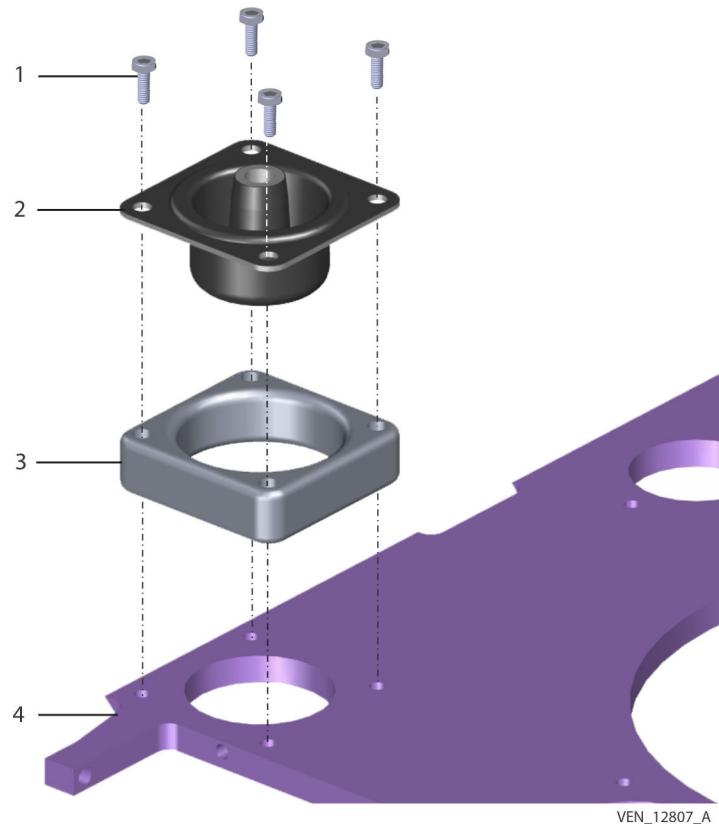
3. Using a 1/8 hex wrench, remove the four bolts securing the compressor to the shock mounts as seen in [Figure 188](#).
4. Compressor motor being returned for failure investigation should be packed in ESD packaging from replacement motor.
5. Reverse disassembly procedures to install the new compressor motor.

Note: When new motor is installed in the Compressor unit, ensure grounding shunt is tied back as shown in [Figure 186](#), with ring terminal end remaining connected to the motor housing. Grounding shunts are to be left disconnected for normal operation as shown in [Figure 186](#).

5.16.20. Replacing the Compressor Shock Mounts

1. Orient the compressor bottom plate right side up to access the four shock mounts.
2. Using a 9/64 hex wrench, remove the four bolts securing each shock mount to its bracket as seen in [Figure 189](#).

Figure 189. Compressor Shock Mount Replacement



1. Screws
 2. Vibration isolator
 3. Stand-off
 4. Plate, Base
3. Reverse disassembly procedures to install the new shock mounts. Ensure that the bolts are snug.

5.17. Base

Follow all general repair guidelines when repairing any portion of the ventilator. See [General Repair Guidelines, page 106](#), and the applicable specific repair guidelines. Use the following content list to locate the proper area within this section.

[Overview, page 276](#)

[Base, page 276](#)

[Universal Base Plate, page 277](#)

[Base Front Cover, page 279](#)

[Base Bottom Cover Assembly, page 279](#)

[Caster Base, page 279](#)

5.17.1. Overview

This section addresses removal and replacement of base parts.

5.17.2. Base

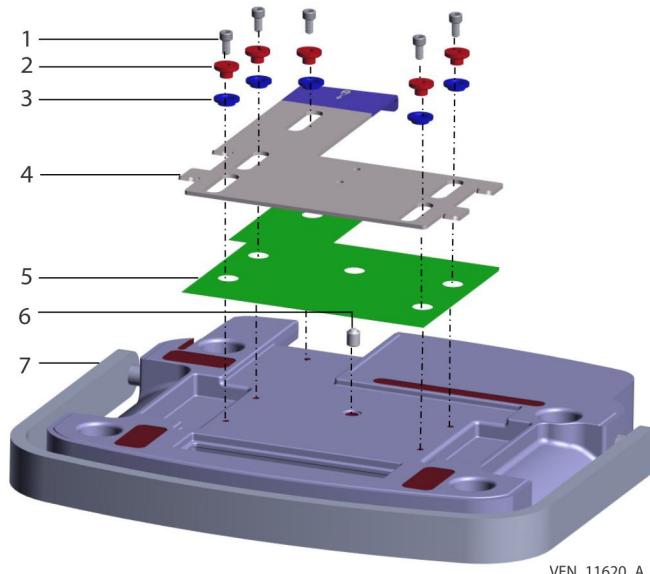
5.17.2.1. To separate the base from the BDU

1. Lock the ventilator casters.
2. Remove the BDU assembly to separate the base from the BDU. See [page 110](#).

5.17.2.2. To replace the BDU on the base

1. Replace the BDU assembly to separate the base from the BDU. See [page 112](#).
2. Unlock the ventilator casters.

5.17.3. Universal Base Plate



- | | |
|--------------------------|------------------------------|
| 1. Screws | 5. Universal base wear strip |
| 2. Shoulder washers | 6. Ball nose spring plunger |
| 3. Flat washers | 7. Universal base plate |
| 4. Universal slide plate | |

5.17.3.1. To remove the universal base plate

1. Separate the base from the BDU. See [page 277](#).
2. Remove the universal base slide plate. See [page 278](#).
3. Remove the four screws and washers retaining the universal base slide plate to the caster base.
4. Retain the foam directly below the universal base plate.
5. Retain the inlet filter, located against the metal back stop inside the base.

5.17.3.2. To replace the universal base slide plate

1. Replace the foam directly below the universal base plate in precisely the same order and same configuration.
2. Tighten the four screws and washers retaining the universal base slide plate to the base.
3. Replace the universal base slide plate. See [page 277](#).
4. Replace the BDU on the base. See [page 277](#).

5.17.3.3. Universal Base Slide Plate and Wear Strip

5.17.3.4. To remove the universal base slide plate and wear strip

1. Separate the base from the BDU. See [page 277](#).
2. Remove the four screws and washers retaining the universal base slide plate and wear strip to the base.
Note: Retain all washers and spacers located on each screw with that screw to ensure proper sequence.
3. Remove the universal base slide plate and wear strip.

5.17.3.5. To replace the universal base slide plate and wear strip

1. Replace the universal base wear strip, aligning with the cutaway in the universal base slide plate.
2. Replace the universal base slide plate, also aligning with the cutaway.
3. Hand-secure all washers and standoffs located on each screw in the proper sequence on each screw.
4. Tighten the four screws retaining the universal base slide plate to the base.
5. Replace the BDU on the base. See [page 277](#).
6. Unlock the casters.

5.17.3.6. Ball Nose Spring Plunger

5.17.3.7. To remove and replace the ball nose spring plunger

1. Separate the base from the BDU. See [page 277](#).
2. Remove the universal base slide plate. See [page 277](#).
3. Retain the foam directly below the universal base.
4. Retain the inlet filter, located against the metal back stop inside the universal base.
5. Remove the ball nose spring plunger located in the center of the universal base plate assembly.
6. Replace the ball nose spring plunger.
7. Replace the inlet filter, located against the metal back stop inside the universal base.
8. Replace the foam directly below the universal base.
9. Replace the universal base slide plate. See [page 278](#).

10. Replace the BDU on the base. See [page 277](#).

5.17.4. Base Front Cover

5.17.4.1. To remove and replace the base front cover

1. Separate the base from the BDU. See [page 277](#).
2. Remove the universal base slide plate. See [page 277](#).
3. Remove the two screws retaining the base front cover of the base.
4. Slide the base front cover back into place on the universal base assembly.
5. Tighten the two screws retaining the base front cover of the base.
6. Replace the universal base slide plate. See [page 278](#).
7. Replace the BDU on the base. See [page 277](#).

5.17.5. Base Bottom Cover Assembly

5.17.5.1. To remove the base bottom cover assembly

1. Separate the base from the BDU. See [page 277](#).
2. Rotate the base onto its side.
3. Remove all four screws and washers retaining the bottom cover to the base.
4. Remove the dampening sheets and foam from the base bottom cover assembly.

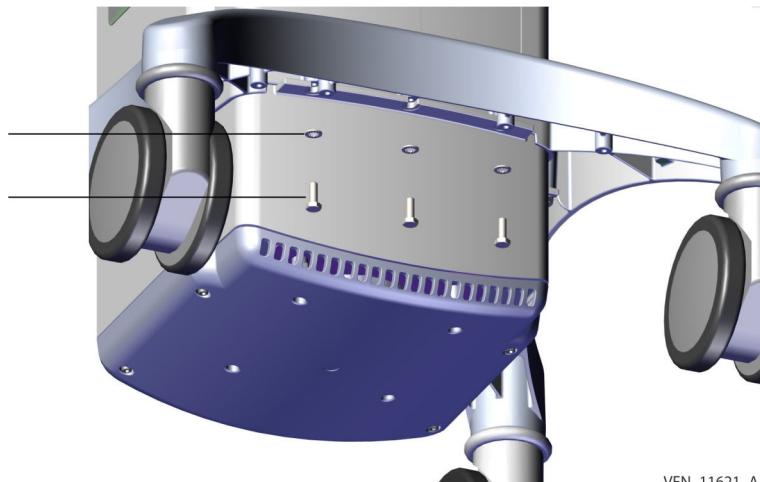
5.17.5.2. To replace the base bottom cover assembly

1. Replace the dampening sheets and foam to the base bottom cover assembly.
2. Replace each washer located on each screw.
3. Tighten all four screws securing the base bottom cover to the universal base assembly.
4. Rotate the base onto its casters.
5. Replace the BDU on the base. See [page 277](#).

5.17.6. Caster Base

5.17.6.1. To remove the caster base

1. Separate the base from the BDU. See [page 277](#).
2. Rotate the base onto its side.
3. Remove all nine screws and washers retaining the caster base to the chassis base.



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5.17.6.2. To replace the caster base

1. Replace each washer located on each screw.
2. Tighten all nine screws retaining the caster base assembly to the chassis base.
3. Rotate back onto its casters.
4. Replace the BDU on the base. See [page 277](#).

6. Parts List

6.1. Overview

This chapter provides Covidien-trained service personnel with exploded views and parts listings for the Puritan Bennett™ 980 series ventilator. Use this chapter as a reference for ordering replacement parts for both the patient system, ventilator system, and accessories.

Warning: When replacing filters, avoid ingress of particles into the ventilator and damage to the media to avoid contamination of the gas pathway or a potential ignition source.

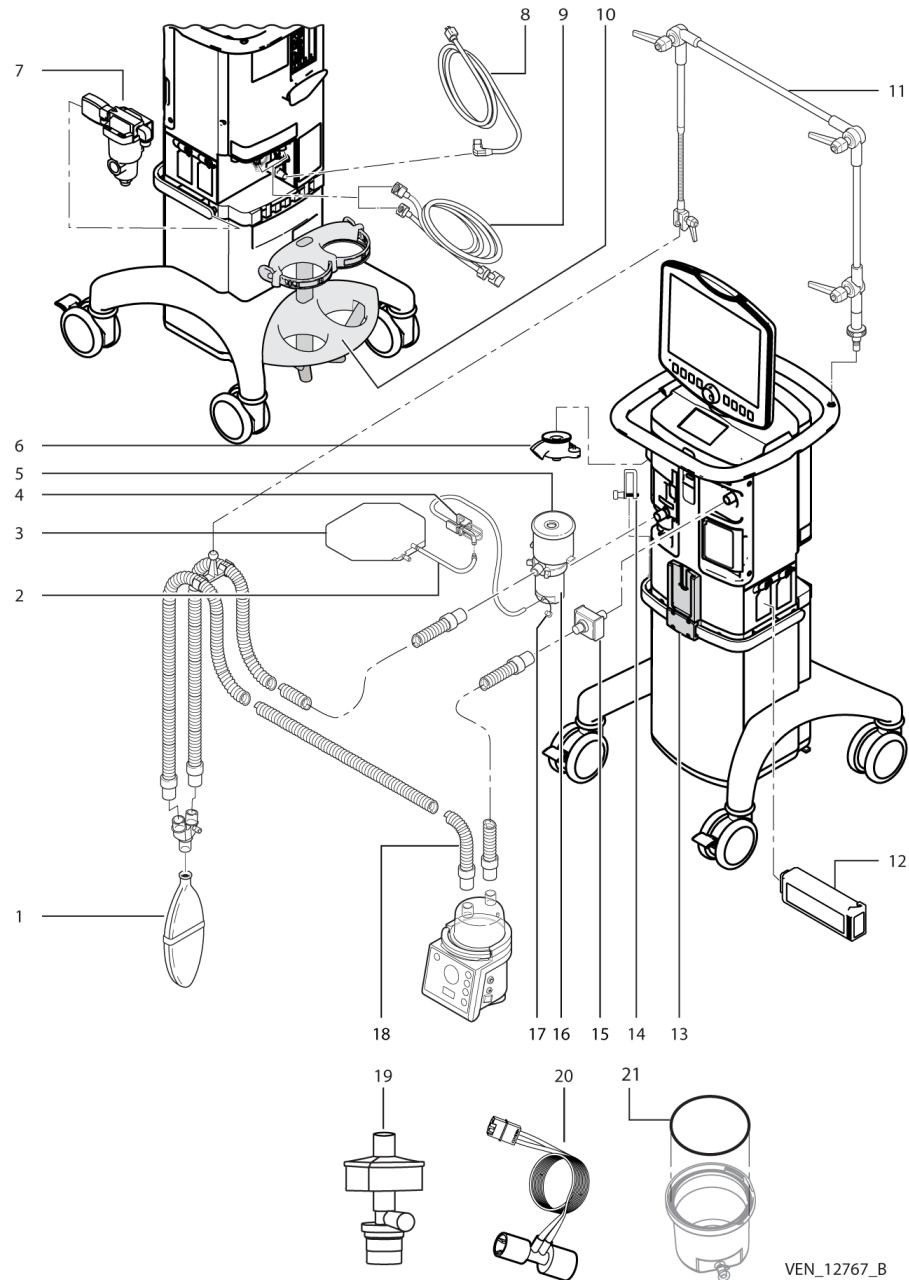
Note: Occasionally, part numbers change. If in doubt about a part number, contact your local technical representative.

Replacement Part Ordering:

Properly identify both the ventilator version and part prior to ordering parts. Order the next higher assembly for unavailable or out of stock parts. Retain each defective part and compare it with the replacement part for compatibility.

6.2. Ventilator Accessories

Figure 192. Ventilator Accessories



VEN_12767_B

Item number (Figure 192)	Accessory or option description	Part number
1	Test lung	4-000612-00
2	Drain bag tubing (package of 10)	4-048493-00
3	Drain bag (package of 25)	4-048491-00
4	Drain bag tubing clamp, reusable (package of 5)	4-048492-00

(continued)

Item number (Figure 192)	Accessory or option description	Part number
5	Pediatric-adult exhalation filtration system (carton of 12), disposable Pediatric-adult exhalation filtration system, reusable ^a	10043551 (disposable exhalation filtration system) 10063033 (reusable exhalation filtration only) 10063031 (condensate vial)
6	980 FRU, exhalation flow sensor	10097468
7	Wall air water trap	10086051
8	Power cord, 10A	Shown for reference, Refer to Power Cords, page 285 for country specific part number
9	Air Hose assembly	Shown for reference, Refer to Inspiratory Module Inlet Fitting Retainer Assembly, page 315 for country specific part number
	Oxygen hose assembly	Shown for reference, Refer to Inspiratory Module Inlet Fitting Retainer Assembly, page 315 for country specific part number
10	Cylinder mount for compressed air and O ₂ gas	10086050
11	Flex arm assembly	4-032006-00
12	Rechargeable lithium-ion battery	10086042
13	Humidifier bracket	10086049
14	Drain bag clip	10087138
15	Inspiratory bacterial filter, disposable, (carton of 50) (DAR)	351U5856
16	Condensate vial only	10063031
17	Condensate vial drain cap	4-074613-00

(continued)

Item number (Figure 192)	Accessory or option description	Part number
18	Patient circuit, adult dual heated wire, disposable, for F&P MR850 – (Medtronic/DAR) use with adapter 111/1149	304S14300
	Patient circuit, single heated wire, adult, disposable, for F&P MR850– (Medtronic/DAR) use with adapter 111/1146	304S1440Z
	Ventilator breathing circuit, adult, dual heated system, disposable, Fisher & Paykel-(Fisher & Paykel)2	Contact local supplier for availability in your region
	Ventilator breathing circuit, adult, dual heated, no water traps, disposable (Hudson RCI / Teleflex)2	Contact local supplier for availability in your region
	Assembly, patient circuit, with single water trap, heated inspiratory limb, pediatric, disposable for F&P MR850 (Medtronic/DAR) Adapter cable: 111/1146	3069S8987
	Assembly, patient circuit, dual heated wire, pediatric, disposable, F&P MR850 (Intersurgical)2	Contact local supplier for availability in your region
	Ventilator breathing circuit, pediatric, dual heated, disposable (Hudson RCI/Teleflex)2	Contact local supplier for availability in your region
	Assembly, patient circuit, neonatal, single heated wire, disposable, incubator use, for F&P MR850-(Medtronic/DAR) use with adapter 111/1146	Contact local supplier for availability in your region
	Assembly, patient circuit, neonatal, single heated wire, disposable, not for incubator use, for F&P MR850-(Medtronic/DAR) use with adapter 111/1146	307/8682
	Ventilator breathing circuit, neonatal, heated insp tube, disposable (Hudson RCI/Teleflex)2	Contact local supplier for availability in your region
19	Ventilator breathing circuit, neonatal, dual heated system, dual water traps, disposable (Hudson RCITM*/Teleflex)1	Contact local supplier for availability in your region
20	Ventilator breathing circuit, neonatal, dual heated system, disposable, Fisher & Paykel-(Fisher & Paykel)2	Contact local supplier for availability in your region
21	Neonatal exhalation filtration system, disposable, with condensate vial	4-076900-00
Not shown	Proximal Flow monitoring sensor (disposable, 10/box)	10047078
Not shown	O-ring seal, condensate vial, reusable (ANZ & OUS only)	10085527
Not shown	Exhalation valve module reprocessing kit (6/carton)	10086048

(continued)

Item number (Figure 192)	Accessory or option description	Part number
Not shown	Gold standard test circuit, 21 inch (for performing EST)	4-018506-00
Not shown	PB980 Exhaust Port Adapter	980EVQADAPT-30
Hardware options		
Not shown	Proximal Flow monitoring option	10084331
Not shown	980, USB flash drive	PT00011076

a Order **both** the reusable exhalation filter (part not available in the US) and the exhalation filter condensate vial (not included with the filter).

6.2.1. Power Cords

Item Number (Figure 193)	Power Cord Description	Part Number
1	Power cord, IEC, 10AA, right angle, hospital grade	10081056
2	Power cord, right angle, 12A, Japan	10087157
3	Orange power cord, 10A, right angle, Australia, medical	GR106800
3	Power cord, right angle, 10A, China	10087153
4	Power cord, 10A, right angle, Europe	10087155
5	Power cord, 10A, right angle, Old British, India, South Africa	10087152
6	Power cord, 10A, right angle, Israel	10087156
7	Power cord, 10A, right angle, Brazilian	10087160
8	Power cord, 10A, right angle, Switzerland	10087154
9	Power cord, 10A, right angle, UK/Ireland	10087159

6.9. Electronic Block Diagrams

Figure 260. Electronic Block Diagram

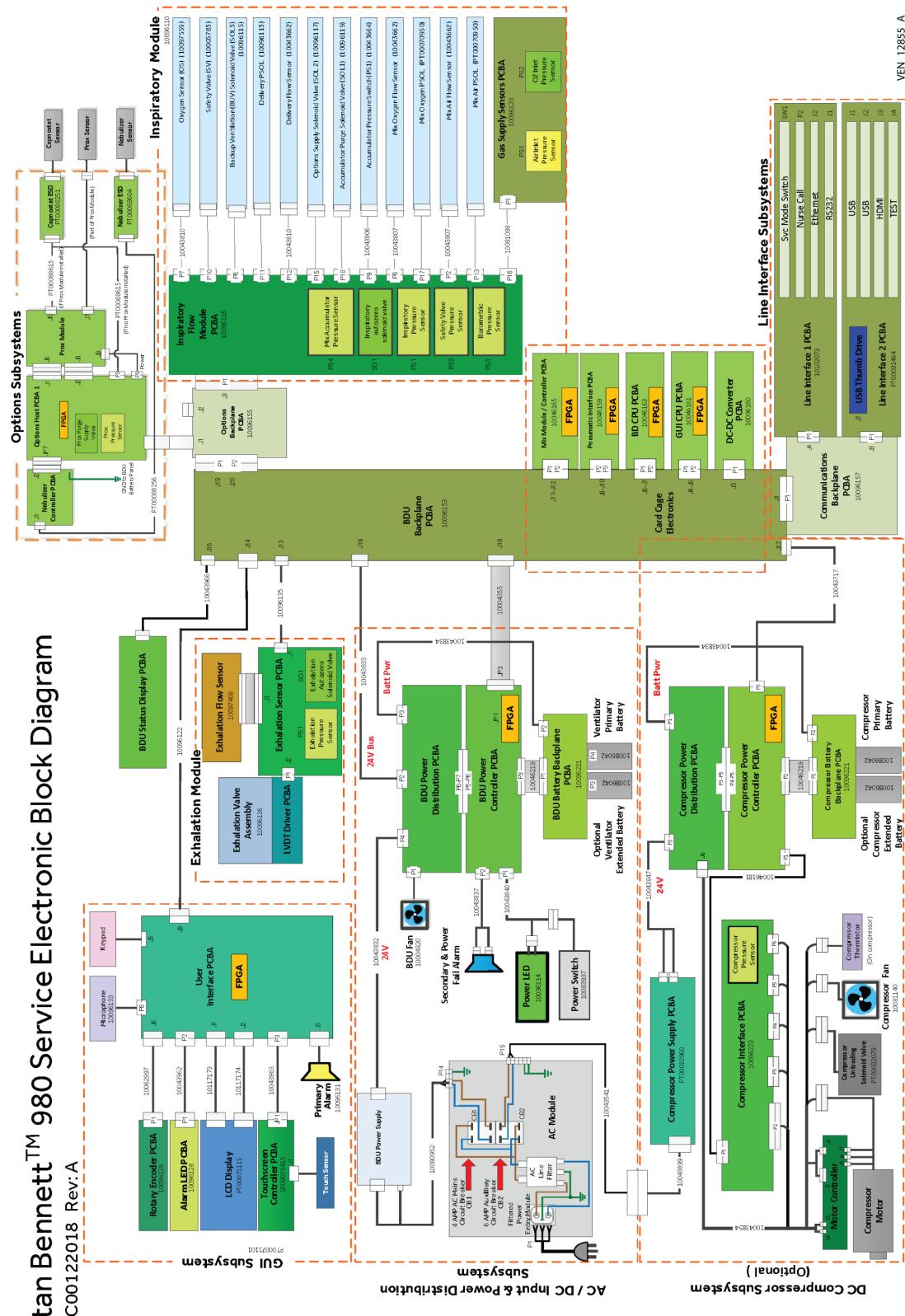


Figure 261. GUI Diagram Breakaway

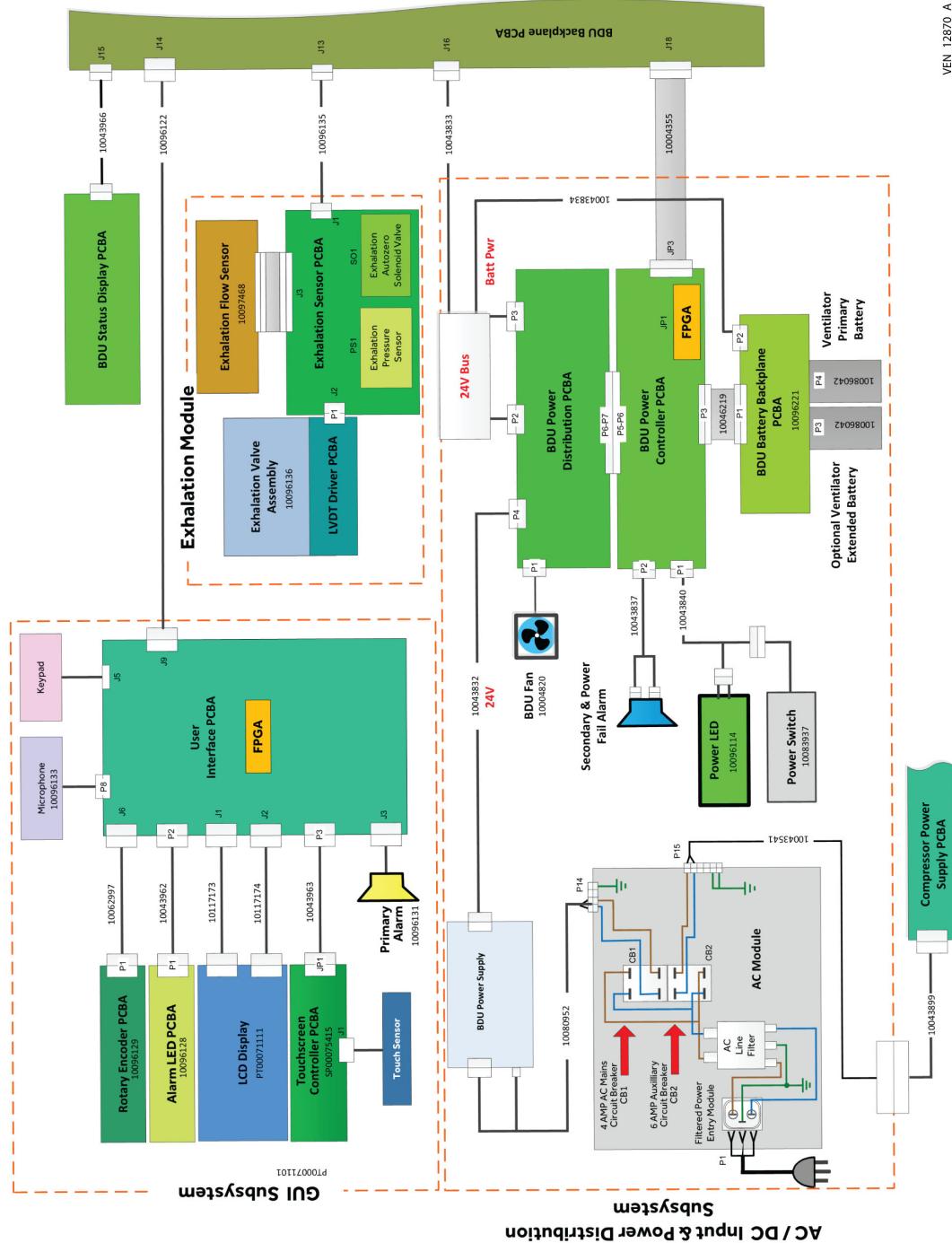


Figure 262. DC Compressor Diagram Breakaway

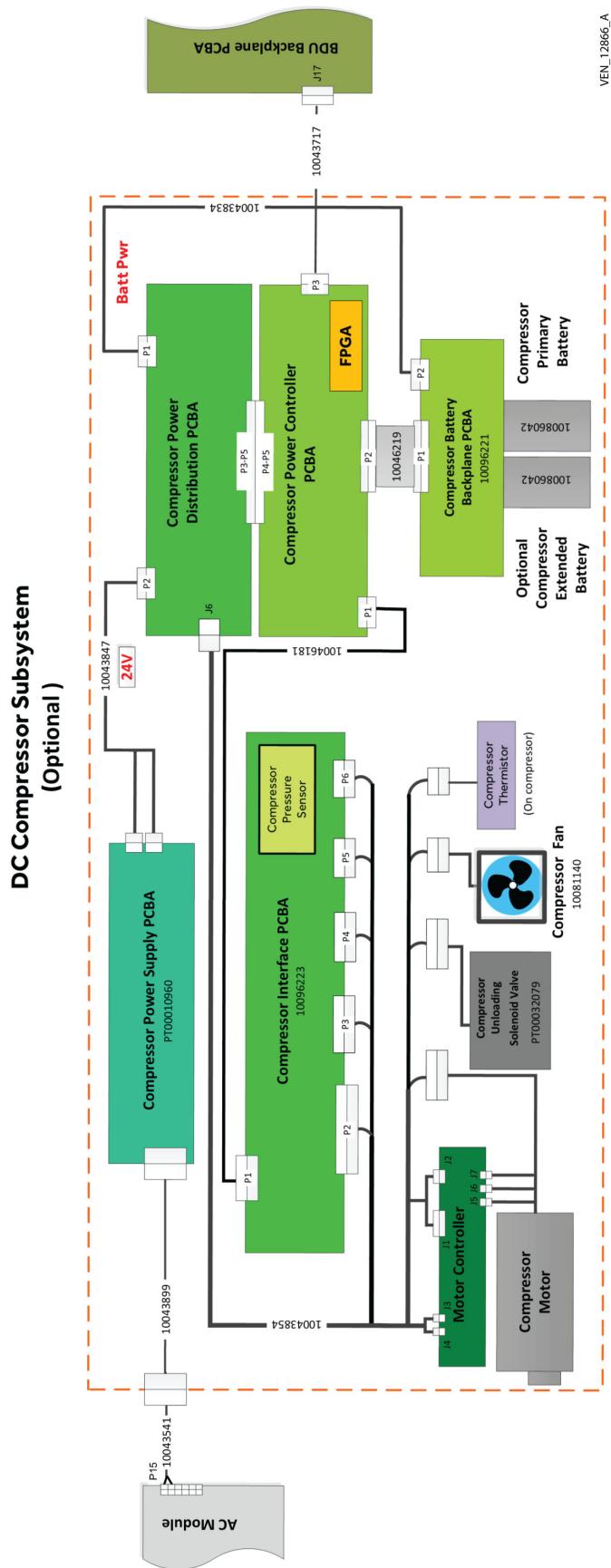


Figure 263. Inspiratory Diagram Breakaway

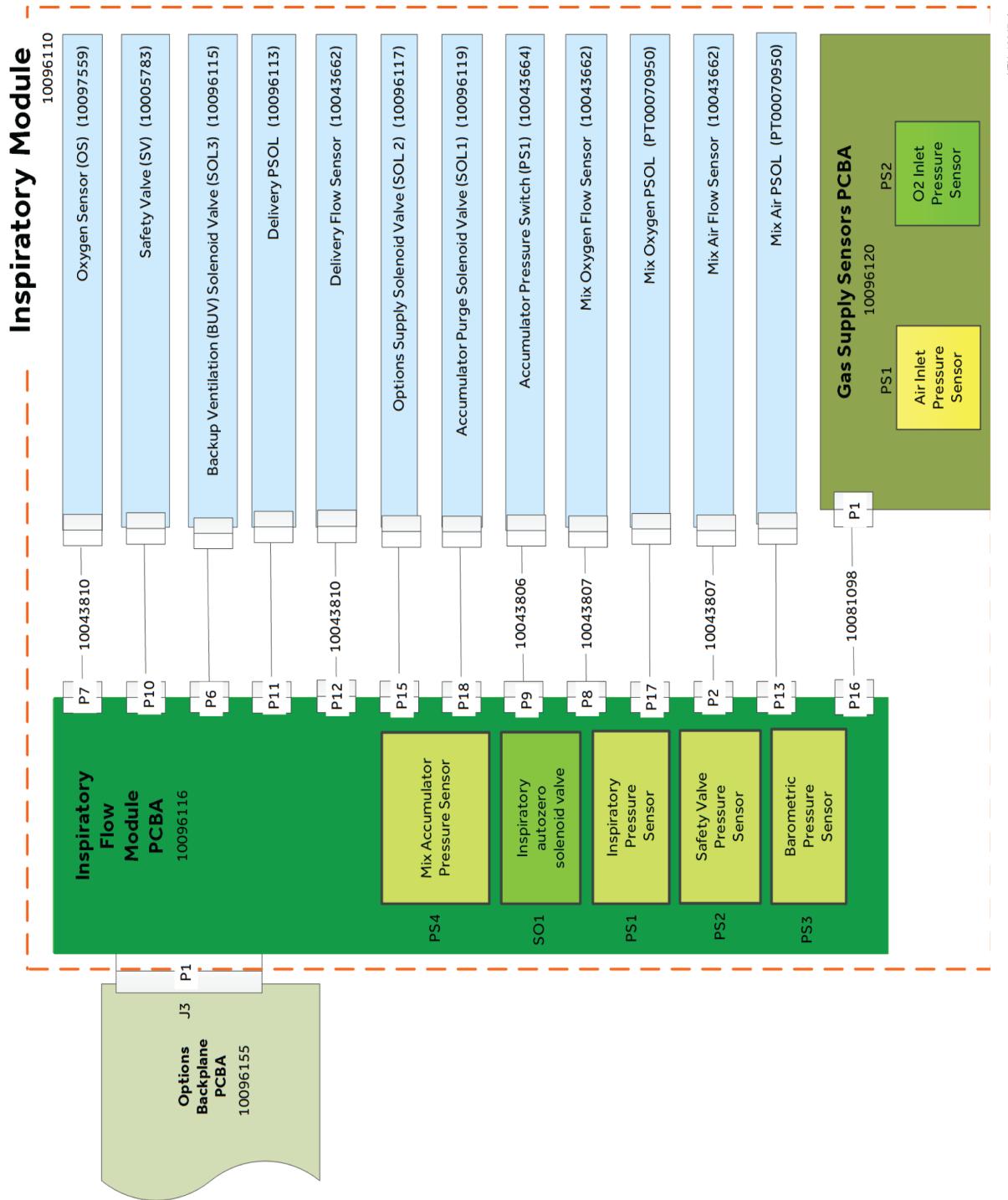
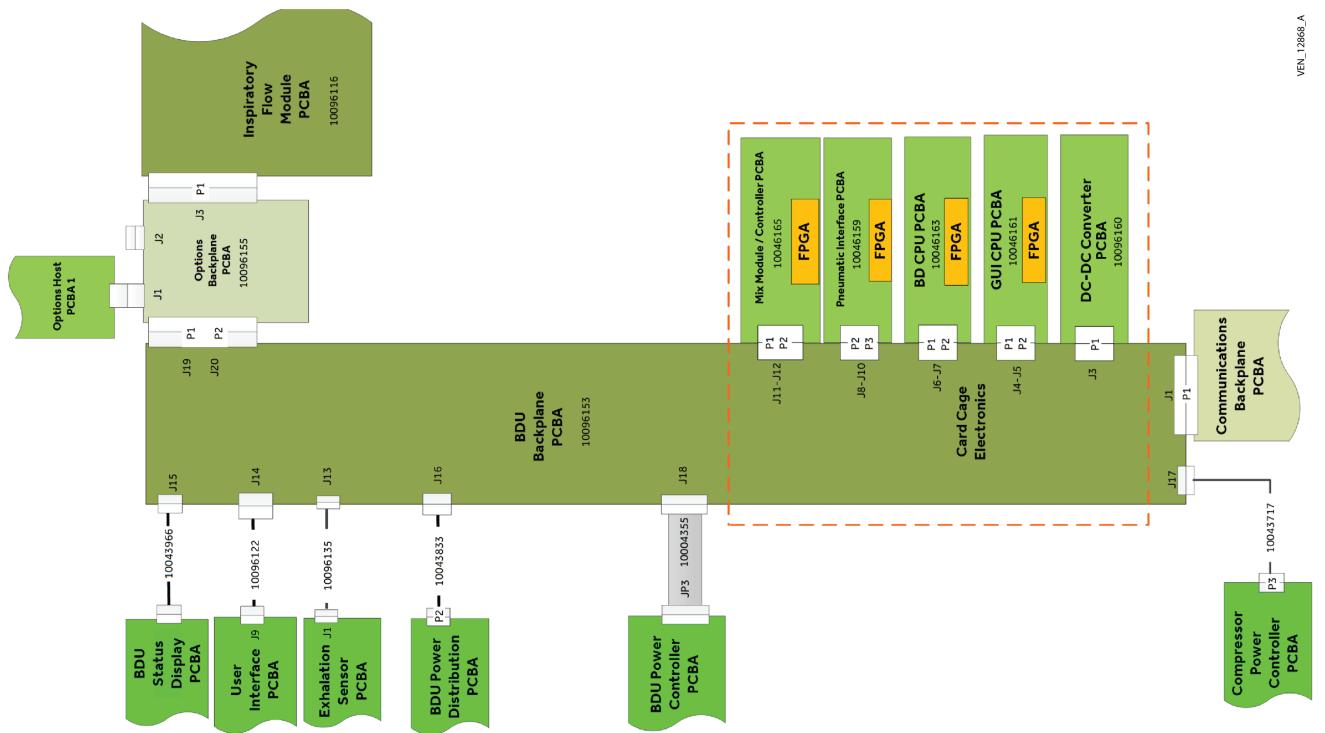
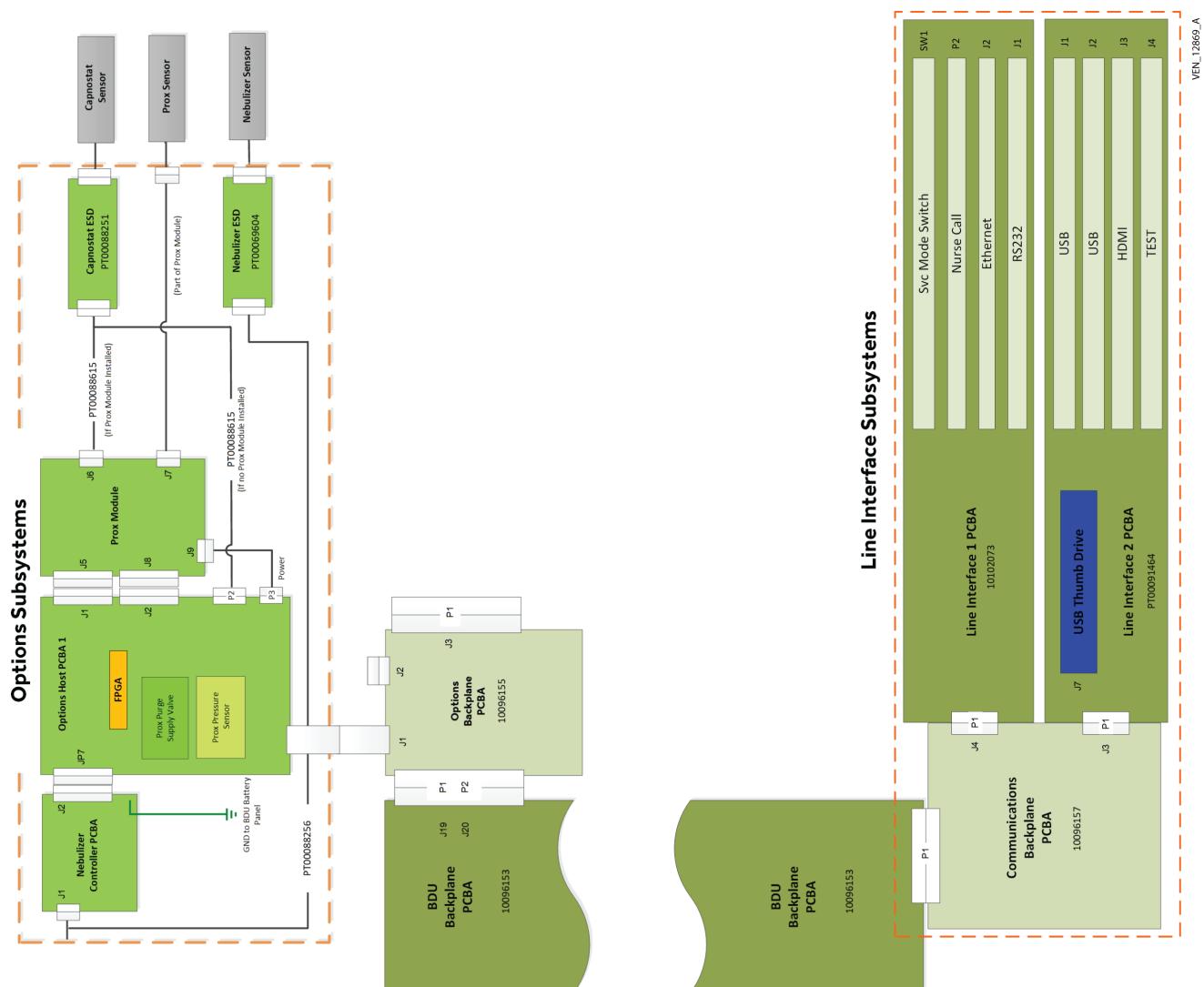


Figure 264. Main PCBA Diagram Breakaway



VEN_13868_A

Figure 265. Options Diagram Breakaway



7. Glossary

Table 35. Glossary

Term	Definition
Audio paused (alarm silence)	Used interchangeably with the term alarm silence, the 2-minute period that begins after the audio paused (alarm silence) key is pressed, where the audible portion of an alarm is muted.
CPLD	Complex programmable logic device.
ESD	Electrostatic discharge. ESD is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short, or dielectric breakdown. A buildup of static electricity can be caused by turbocharging or by electrostatic induction. The ESD occurs when differently-charged objects are brought close together or when the dielectric between them breaks down, often creating a visible spark.
EST	Extended self test. A comprehensive test of ventilator function, intended to be run by qualified service personnel.
EVQ	Exhalation flow sensor.
SST	Short self test. A test that checks circuit integrity, calculates circuit compliance and filter resistance, and checks ventilator function. Operator should run SST at specified intervals and with any replacement or alteration of the patient circuit.
FPGA	Field programmable gate array.
GUI	Graphical user interface. The ventilator's touch screen and display used to enter patient settings and alarm settings, including off-screen keys, soft keys, and knobs.
VBS	Ventilator breathing system. Includes the gas delivery components of the ventilator the patient circuit with tubing, filters, humidifier, and other accessories; and the ventilator's expiratory metering and measurement components.
LVDT	Linear variable differential transformer.

Table 36. Abbreviations

Abbreviation	Definition
AC, also ac	Alternating current. The movement of electrical charge that periodically reverses direction.
ASCII	American Standard Code for Information Interchange. A standard character encoding scheme.
BD	Breath delivery
BDU	Breath delivery unit
BOC	British Oxygen Company
BUV	Backup ventilation
CE	A certification mark issued under the authority of the European Common Market that indicates compliance with the Medical Device Directive, 93/42/ EEC.
cmH20	Centimeters of water
CSA	Canadian Standards Association
CPLD	Complex programmable logic device
DC, also dc	Direct current. The movement of electrical charge flowing in a single direction.
DISS	Diameter index safety system
EMC	Electromagnetic compatibility.

Table 36. Abbreviations (continued)

Abbreviation	Definition
EN	European norm (referring to the European Common Market).
ESD	Electrostatic discharge
EST	Extended self test
ETO	Ethylene oxide.
EVQ	Exhalation flow sensor
EXH	Exhalation
FIL	Fillister-head
FH	Flat-head
FRU	Field replaceable unit
FPGA	Field programmable gate array
GUI	Graphic user interface
HEX	Hexagonal
ID	Inside Diameter
IEC	International Electrotechnical Commission. A standards organization.
INSP	Inspiration
I/O	Input/output
ISO	International Standards Organization. A standards organization.
LCD	Liquid crystal display. A type of visual equipment-operator Interface.
LED	Light-emitting diode. A means of providing visual indications.
MRI	Magnetic resonance imaging
NIST	Non-interchangeable screw Thread
NHA	Next higher assembly
NVRAM, also NovRam	Non-volatile random access memory. Memory that is kept active across resets and power cycles and is not normally initialized at startup.
OD	Outside diameter
PAN	Panhead
PCBA	Printed circuit board assembly
P/N	Part number
PSOL	Proportional solenoid valve
POST	Power-on self test. Software algorithms to verify the integrity of application software and the hardware environment. Power-on self test generally occurs at power on, after power loss, or when the device detects an internal fault.
PVT	Performance verification Test
RAM	Random access memory
RTA	Ready-to-assemble
SIS	Sleeved index system

Table 36. Abbreviations (continued)

Abbreviation	Definition
SOC	Socket
SOL	Solenoid
SR	Split-ring
SST	Short self test



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