



## Oxygen System

# OPERATOR & SERVICE MANUAL

NSN: 6515-01-588-3083  
PN 9400-SEQ  
MODEL 3000



CAIRE Inc.

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9735-SEQ H



|  |  |
|--|--|
|  | <b>WARNING: DO NOT OPERATE THIS EQUIPMENT WITHOUT FIRST READING AND UNDERSTANDING THIS MANUAL. IF YOU ARE UNABLE TO UNDERSTAND THE WARNINGS AND INSTRUCTIONS, CONTACT YOUR EQUIPMENT PROVIDER BEFORE ATTEMPTING TO USE THIS EQUIPMENT; OTHERWISE, INJURY OR DAMAGE MAY RESULT.</b> |
|--|--|

## DEFINITION OF SYMBOLS PAGE / WARNING PAGE

|  |  |
|--|--|
|  | <b>WARNING: INDICATES A HAZARDOUS SITUATION THAT, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.</b> |
|--|--|

|  |   |
|--|---|
|  | <b>CAUTION: Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.</b> |
|--|---|












|  |  |
|--|--|
| <b>NOTE: Indicates information considered important, but not hazard-related (e.g. messages relating to property damage).</b> |  |
|--|--|

## SYMBOLS USED IN THE OPERATION OF SAROS



Symbols are frequently used on equipment in preference to words with the intention of reducing any possibility of misunderstanding caused by language differences. Symbols can also permit easier comprehension of a concept within a restricted space.

| ISO 7000; GRAPHICAL SYMBOLS FOR USE ON EQUIPMENT—INDEX AND SYNOPSIS |   |
|---|---|
|   | Portable operating temperature is -10C to 40C. Base operating temperature range is 10C-40C. Reg. # 0632 |
|   | Portable humidity range is 15 to 95%. Base humidity range is 30 to 75%. Reg. #2620                      |
|   | Keep away from rain, keep dry. Reg. # 0626  |
|   | Name and address of manufacturer. Reg. # 3082   |
|   | Date of Manufacture. Reg. #2497   |
|   | Caution, consult accompanying documents. Reg. # 0434A   |
|   | Catalog Number. Reg. # 2493   |
|   | Serial Number. Reg. # 2498  |
|   | This way up. Reg. # 0623  |
|   | Fragile, handle with care. Reg. # 0621  |
|   | Stacking height. Reg #2473  |

| ISO 7010: GRAPHICAL SYMBOLS—SAFETY COLORS AND SAFETY SIGNS—REGISTERED SAFETY SIGNS |   |
|--|---|
|  | Keep away from open flame, fire, sparks. Open ignition source and smoking prohibited. Reg. # P003   |
|  | Do not smoke near unit or while operating unit. Reg. # P002   |
|  | Type BF applied part (degree of protection against electric shock). Reg. # 5333   |
|  | Warning. Reg. # W001  |
|  | The instruction manual must be read. Reg. # M002  |
| INTERNAL SYMBOLS   |   |
|  | Keep away from flammable materials, oil and grease.   |
| O <sub>2</sub>   | Oxygen Output; The port from which the Oxygen flows and where the tubing or interface(standard nasal cannula) is connected.   |
|  | IEC Icon for DC Power (Input) Indicates equipment providing a particular degree of protection against electric shock, particularly regarding: Allowable leakage current; Reliability of a proper ground connection. |
| A  | Amperes (Current)   |
|  | Alternating Current (AC)  |

|   |   |
|---|---|
|          | Audible Alarm*; An audible indicator is provided to announce an audible alarm for the following: low purity after warm up, flow rate out of range, warm battery, battery communication lost, and low battery. |
|          | Alert (Yellow) Indicator*: When illuminated, this indicates an awareness condition or Caution.  |
|          | Alarm (Red) Indicator*: In Normal Mode, when illuminated, this indicates a Malfunction and the SAROS will stop operating. An immediate response is necessary and contact a Service Technician.                |
|          | ON/OFF (Standby); Powers the device ON or OFF, but does not directly disconnect the main power.   |
|          | Increase Flow Setting; Increases the flow setting by 1.0 LPM increments or by 1 pulse setting each time the button is pressed.  |
|          | Decrease Flow Setting; Decreases the flow setting by 1.0 LPM increments or by 1 pulse setting each time the button is pressed.  |
|          | Activates either Continuous Flow Mode or Pulse Flow Mode Operation.   |
|        | Utility; The Button that activates a utility menu to access information or to change settings.  |
|        | External Power is Present Indicator; Indicates the presence of external power.  |
|        | Battery Status Indicator; Shows the amount of charge remaining in the battery. When charging, battery displays as a “Waterfall” Effect.   |
| <b>21 CFR 801.15: CODE OF FEDERAL REGULATIONS<br/>TITLE 21</b>                            |   |
| <b>RX ONLY</b>  | Federal law restricts this device to sale by or on the order of a physician.  |
| <b>COUNCIL DIRECTIVE 2012/19/EU: WASTE ELECTRICAL<br/>AND ELECTRONIC EQUIPMENT (WEEE)</b> |   |
|        | WEEE  |

### IEC 60601-1: MEDICAL ELECTRICAL EQUIPMENT - PART 1: GENERAL REQUIREMENTS FOR BASIC SAFETY AND ESSENTIAL PERFORMANCE

|   |   |
|---|---|
|  | Classification; Class II Equipment, double insulated.                                       |
|  | Safety; Safety agency for CAN/CSA C22.2 No. 60601-1-08 M90 for medical electrical equipment |

\*Alarms for the SAROS are considered information only signals.

This product may be covered by one or more patents, US and international. Please visit our website below for the listing of applicable patents. Pat.: [patents.gtis.io](http://patents.gtis.io).

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## APPENDIX A



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## INDICATIONS FOR USE

SAROS OXYGEN SYSTEM IS INDICATED FOR THE ADMINISTRATION OF SUPPLEMENTAL OXYGEN. THE DEVICE IS NOT INTENDED FOR LIFE SUPPORT NOR DOES IT PROVIDE ANY PATIENT MONITORING CAPABILITIES. A PHYSICIAN HAS PRESCRIBED A SPECIFIC OXYGEN FLOW SETTING TO MEET AN INDIVIDUAL'S NEEDS. OXYGEN FLOW SETTINGS SHOULD BE ADJUSTED ONLY UNDER THE DIRECTION OF A PHYSICIAN.

|   |   |
|---|---|
|  | <b>WARNING: FEDERAL U.S. LAW RESTRICTS THIS DEVICE TO SALE BY OR ON THE ORDER OF A PHYSICIAN.</b> |
|---|---|

## INDICATIONS








|   |   |
|---|---|
|  | <p><b>WARNING: IN CERTAIN CIRCUMSTANCES, THE USE OF NON-PRESCRIBED OXYGEN CAN BE HAZARDOUS. THIS DEVICE SHOULD ONLY BE USED UNDER THE DIRECTION OF A PHYSICIAN OR QUALIFIED CLINICIAN.</b></p> <p><b>NOT FOR USE IN THE PRESENCE OF FLAMMABLE ANESTHETICS.</b></p> <p><b>AS WITH ANY ELECTRICALLY POWERED DEVICE, THE USER MAY EXPERIENCE PERIODS OF NON-OPERATION AS A RESULT OF ELECTRICAL POWER INTERRUPTION, OR THE NEED TO HAVE THE SAROS SERVICED BY A QUALIFIED TECHNICIAN. SAROS IS NOT APPROPRIATE FOR ANY PATIENT WHO WOULD EXPERIENCE ADVERSE HEALTH CONSEQUENCES AS THE RESULT OF SUCH TEMPORARY INTERRUPTION.</b></p> <p><b>USE OF AN OXYGEN MASK IS CONTRAINDICATED DUE TO THE POSSIBILITY OF REBREATHING EXHALED CARBON DIOXIDE.</b></p> |
|  | <b>WARNING: EXHAUST GAS MAY REACH HIGH TEMPERATURES DURING NORMAL OPERATIONS. USE CAUTION TO AVOID TOUCHING THE EXHAUST PORT OF THE SAROS WHILE IN USE.</b>   |



**NOTE:** Auditory alarms may not be heard in noisy environments and/or in tactical mode. Care providers must rely on visual indications to determine if there are any alarms or other system malfunctions. Care providers should monitor the SAROS for any alarm conditions.











## CONTRAINDICATIONS

### SAFETY GUIDELINES

These are Warnings and Cautions that apply to hazards or unsafe practices that could result in serious injury or property damage.

|   |   |
|---|---|
|  | <b>WARNING: FEDERAL U.S. LAW RESTRICTS THIS DEVICE TO SALE BY OR ON THE ORDER OF A PHYSICIAN.</b>   |
|  | <b>WARNING: DO NOT USE SAROS IF IT HAS A DAMAGED POWER CORD OR PLUG.</b>  |
|  | <b>WARNING: DO NOT DROP OR INSERT ANY OBJECTS INTO ANY OPENING ON THE DEVICE.</b>   |
|  | <b>WARNING: DO NOT BLOCK THE AIR INLET OR THE EXHAUST VENT OF THE SAROS WHEN IT IS ON A SOFT SURFACE, SUCH AS A LITTER, BED, CHAIR, CARPET, COUCH OR VEHICLE SEAT.</b>  |
|  | <b>WARNING: DO NOT COVER THE DEVICE WITH A BLANKET, TOWEL OR SHEET, ETC.</b>  |
|  | <b>WARNING: DO NOT STORE THE SAROS WITH THE BATTERY INSTALLED IN THE UNIT.</b>  |
|  | <b>WARNING: DO NOT REMOVE THE COVER. THERE ARE NO USER-SERVICEABLE PARTS INSIDE THE DEVICE. ONLY QUALIFIED SERVICE PERSONNEL SHOULD REMOVE THE COVER OF THE DEVICE.</b> |

|   |   |
|---|---|
|  | <b>WARNING: DO NOT MODIFY THIS EQUIPMENT WITHOUT AUTHORIZATION OF THE MANUFACTURER.</b>   |
|  | <b>WARNING: DO NOT OPERATE THE DEVICE, COMPONENTS OR ACCESSORIES ON WET SURFACES OR IN STANDING WATER AND DO NOT SUBMERSE IN WATER.</b> |

|   |  |
|---|--|
|    | <b>CAUTION:</b> Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.  |
|    | <b>CAUTION:</b> Keep SAROS and the power cord away from hot surfaces or open flames.   |
|    | <b>CAUTION:</b> SAROS should be located in a well-ventilated area to allow for adequate air intake.  |
|    | <b>CAUTION:</b> Avoid the intake of airborne pollutants, smoke and fumes.  |
|    | <b>CAUTION:</b> ONLY use this device with accessories specified by, or recommended by CAIRE Inc.   |
|    | <b>CAUTION:</b> If SAROS has been dropped, damaged or exposed to water, please contact a qualified technician for inspection or possible repair of the device.                 |
|   | <b>CAUTION:</b> When using SAROS in any vehicle, be sure it is properly secured, belted or restrained.   |
|  | <b>CAUTION:</b> LOCATE OXYGEN SUPPLY TUBING AND ALL POWER CORDS IN A MANNER TO PREVENT TRIPPING HAZARDS.   |
|  | <b>CAUTION:</b> DO NOT PLACE THE SAROS IN A SMALL, ENCLOSED SPACE, SUCH AS A BATHROOM, CLOSET, BAG OR BOX WITH THE OXYGEN CANNULA OR TUBING LEADING OUT OF THE ENCLOSED SPACE. |
|  | <b>CAUTION:</b> DO NOT EXPOSE THE DEVICE TO TEMPERATURES OUTSIDE OF THE SPECIFIED RANGE OF OPERATING OR STORAGE TEMPERATURES AS THIS MAY DAMAGE THE DEVICE.                    |










NOTE: THIS DEVICE DOES EXHAUST NITROGEN GAS. HOWEVER, THIS EXHAUST IS NOT SUFFICIENT TO DISPLACE OXYGEN IN THE OPERATING ENVIRONMENT. NO ADDITIONAL SAFETY PRECAUTIONS NEED TO BE TAKEN TO ACCOUNT FOR THE NITROGEN EXHAUST.

NOTE: PROTECT ELECTRICAL POWER CORDS FROM SHARP EDGES OR ELECTRICAL SHOCK AND SERIOUS PHYSICAL INJURY MAY OCCUR.

NOTE: ONLY USE THE CAIRE INC. SUPPLIED AC POWER ADAPTER AND 24 VDC CABLE WITH THE SAROS. USE OF ANY OTHER AC POWER ADAPTER OR DC CABLE MAY BE HAZARDOUS, CAUSE SERIOUS DAMAGE TO THE SAROS AND WILL VOID THE WARRANTY.

NOTE: AVAILABILITY OF AN ALTERNATE, OR BACK-UP, SOURCE OF SUPPLEMENTAL OXYGEN IS RECOMMENDED IN CASE OF A POWER OUTAGE OR A MECHANICAL FAILURE OF THE DEVICE.

## BATTERY SAFETY

|   |  |
|---|--|
|    | <b>WARNING: DO NOT DISASSEMBLE, PUNCTURE, OR CRUSH THE BATTERY. BATTERY ELECTROLYTES MAY BE TOXIC IF SWALLOWED AND CAN BE HARMFUL TO SKIN AND EYES. KEEP THE BATTERY AWAY FROM CHILDREN.</b> |
|    | <b>WARNING: DO NOT SHORT-CIRCUIT THE BATTERY'S METAL CONTACTS WITH METALLIC OBJECTS, SUCH AS KEYS OR COINS. THIS MAY CAUSE SPARKS OR EXCESSIVE HEAT TO BE GENERATED.</b>                     |
|    | <b>WARNING: USE OF A DAMAGED BATTERY MAY CAUSE PERSONAL INJURY.</b>  |
|    | <b>WARNING: THE BATTERY MAY EXPLODE AND CAUSE POTENTIAL INJURY IF EXPOSED TO A FIRE, OR DISPOSED OF IN A FIRE.</b>   |
|    | <b>WARNING: EXPOSING THE BATTERY TO WATER OR OTHER LIQUIDS MAY CAUSE PERSONAL INJURY.</b>  |
|    | <b>CAUTION: DO NOT EXPOSE THE BATTERY TO TEMPERATURES ABOVE 140° F (60°C), SUCH AS IN A VEHICLE PARKED IN THE SUN ON A HOT DAY.</b>  |
|    | <b>CAUTION: IT IS NOT RECOMMENDED THAT THE BATTERY IS CHARGED BELOW 41° F (5° C) OR ABOVE 104° F (40° C).</b>  |
|   | <b>CAUTION: ONLY USE THE BATTERY FOR ITS INTENDED PURPOSE.</b>   |
|  | <b>CAUTION: PUSH LOCKING/UNLOCKING BUTTON BEFORE BATTERY INSTALLATION.</b>   |



## 1.0 INTRODUCTION

### 1.1 GENERAL INFORMATION

This manual will familiarize you with information regarding the SAROS Oxygen System, Model 3000.

#### INTRODUCTION

The SAROS Oxygen System, Model 3000 with autoSAT® Technology (hereafter referred to as SAROS) is a portable medical device used to extract oxygen from the atmosphere, concentrate it to greater than 90% and flow it through the oxygen outlet port. The device will operate in Continuous flow or Pulse flow modes. In Continuous Flow Mode the oxygen is provided at a constant flow rate of 1, 2, or 3 LPM. In Pulse flow Mode, oxygen is supplied in a bolus at the beginning of each inspiration, providing a selectable range setting of flow between 16 ml and 96 ml, in increments of 16 ml.

SAROS is BTP (Body, Temperature, and Pressure) compensated. It delivers oxygen by accounting for difference between ambient conditions and those found in the patient's lungs (37°C).

SAROS operates from external AC power, 24VDC or from a rechargeable Battery. The system includes a "Smart Battery" charger that recharges the Battery whenever the SAROS is connected to external power. The system monitors and controls both the power source and the Battery Charger.

SAROS has a five minute warm up/stabilization period during which no alerts or codes are to be expected.

#### WARRANTY

SAROS: 1 year or 1,000 hours, whichever comes first.

Battery: 1 year.

Power Supplies: 1 year.

## 1.2 SAROS OXYGEN SYSTEM SPECIFICATIONS

|                                       |  |
|---------------------------------------|--|
| Dimensions                            |  |
| • With battery                        | 26.80" long x 4.375" diameter (68.1 cm long x 11.1 cm diameter)  |
| • Without battery                     | 23.25" long x 4.375" diameter (59.1 cm long x 11.1 cm diameter)  |
| Weight                                |  |
| • With Battery                        | 12.25 pounds (5.56 kg)   |
| • Without Battery                     | 10.00 pounds (4.54 kg)   |
| Flow Settings                         |  |
| • Continuous Flow                     | 1, 2, 3 LPM  |
| • Pulse flow                          | 16, 32, 48, 64, 80, 96 ml  |
| Continuous Flow Accuracy              | 1LPM: +/- 0.4 LPM<br>2LPM: +/- 10%<br>3LPM: +/- 10%  |
| Oxygen concentration                  | 93% +/- 3% for all flow settings   |
| Maximum System Pressure               | 15 psig (204.7 kPa)  |
| Oxygen Output Pressure                | 4.0 psig (128.9 kPa) nominal   |
| Oxygen Concentration Status Indicator | Green Light = Normal Operation<br>Yellow Light Flashing = Warning or Caution, less than 85% $\pm$ 3%<br>Red Light = Abnormal Operation, less than 70% $\pm$ 5%   |
| Nominal Sound Level                   | <59 dB(A)  |
| Operating Environment                 |  |
| • Temperature                         | 32° F to 109° F (0° to 43°C)   |
| • Humidity                            | 10% to 95%, Non-condensing, 82.4°F (28°C) Maximum Dew point  |
| Storage Environment                   |  |
| • Temperature                         | -4° F to 140° F (-20° to 60°C)   |
| • Humidity                            | Up to 95% Non-condensing   |
| Nominal Power                         |  |
| 3 LPM Continuous Flow                 | ≤130 Watts   |
| Nominal Battery operating time        |  |
| at 3 LPM Continuous Flow              | 30 Minutes   |
| Battery Life                          | 80% Nominal Capacity after 200 Charge/Discharge cycles   |
| Continuous Flow Indication            | Expressed in liters per minute (LPM)   |
| Audible Alarm Indicators              | <ul style="list-style-type: none"> <li>• Loss of Power/Hot Battery</li> <li>• Low Battery/Warm Battery</li> <li>• Low Oxygen Output</li> <li>• No breath detection</li> <li>• O2 Flow Outside Normal Limits</li> <li>• Low 9V battery</li> <li>• Unit Malfunction</li> </ul> |
| Back-Up Alarm Power                   | 9V Internal Battery  |
| Filters                               | Air Inlet Filter, HEPA and Exhaust Filter  |
| Device Classification                 | IEC Class I, Type BF Applied Part, IPX1  |

Table 1-1. SAROS Specifications

|                              |   |
|------------------------------|---|
| Pulse Settings               | 16, 32, 48, 64, 80, 96 ml   |
| autoSAT Technology           | Servo-control to maintain consistent FiO2   |
| Trigger Sensitivity          | Adjustable settings of 1 (most sensitive), 2 and 3 (least sensitive)  |
| Trigger Criteria             | Cannula pressure has dropped below the trigger point (typically between 0.15 – 0.45 Cm of H2O of negative pressure) |
| Minimum time between breaths | 1.25 seconds (max. 3 consecutive breaths)   |
| Response to Missing Breaths  | Switch to Continuous Mode if no inspiration has been detected for 60 seconds with an audible alarm.                 |

Table 1-2. Pulse Mode Specifications

| Bolus Size ml ( $\pm 15\%$ ) | Max Breath Rate |
|------------------------------|-----------------|
| 16                           | 40              |
| 32                           | 40              |
| 48                           | 40              |
| 64                           | 40              |
| 80                           | 37              |
| 96                           | 31              |

NOTE: At breath rate above Max Breath Rate, bolus size will be reduced proportionally.

Table 1-3. Bolus Volume and Breath Rates

|                | AC Power Supply          | 24 VDC Cable |
|----------------|--------------------------|--------------|
| Input Voltage  | 100- 240 VAC, 50 – 60 Hz | 20 – 28 VDC  |
| Input Power    | 245 – 260 VA             | 10 A         |
| Output Voltage | 24 VDC                   | -            |
| Output Power   | 200 W                    | -            |

Table 1-4. Power Accessory Specifications

|                       |   |
|-----------------------|---|
| Output Voltage        | 14.6 VDC  |
| Capacity              | 88.8 W-hours  |
| Battery Life          | 80% Nominal Capacity after 200 Charge/Discharge cycles            |
| Battery Recharge Time | 2.4 hours to achieve 80% capacity from a fully discharged battery |

Table 1-5. Battery Specifications

| SAROS System and SAROS Concentrator, Model 3000 |   |
|---|---|
| Safety  | IEC 60601-1 :1988 + A1 :1991 + A2 :1995 + Corrigendum (6/95) EN 60601-1(1990) + A1(1993) + A2(1995) + A12(1993) + A13(1996) + Corrigenda (7/94)   |
| Electromagnetic Compatibility                   | FCC 15B (Sec. 107 & 109), EN55011, EN60601-1-2 :2001, EN6100-3-2, EN61000-3-3, IEC61000-4-2, IEC61000-4-3, IEC61000-4-4, IEC61000-4-5, IEC61000-4-6, IEC61000-4-8, IEC61000-4-11, IEC 60601-1- 2 :2001, RTCA DO 160 |
| AC Power Supply                                 |   |
| Safety  | IEC 60601-1:1988 + A1:1991 + A2:1995  |
| Electromagnetic Compatibility                   | FCC 15B (Sec. 107 & 109), EN55011, EN60601-1-2 :2001, EN6100-3-2, EN61000-3-3, IEC61000-4-2, IEC61000-4-3, IEC61000-4-4, IEC61000-4-5, IEC61000-4-6, IEC61000-4-8, IEC61000-4-11, EN55014-1                         |
| 24 VDC Cable                                    |   |
| Safety  | Portions of IEC 60601-1:1988 + A1:1991 + A2:1995  |
| Electromagnetic Compatibility                   | FCC 15B (Sec. 109), EN55011, EN60601-1-2 :2001, IEC61000-4-2, IEC61000-4-3, IEC61000-4-4, IEC61000- 4-6, IEC 60601-1-2 :2001  |
| Battery   |   |
| Safety  | UL60950-1, IEC 60601-1:1988 + A1:1991 + A2:1995, IEC 62133, UN Transportation Tests T1-T8   |
| Electromagnetic Compatibility                   | EN 61000-6-3 :2001 (EN55022 :1998+A1 :2001+A2 :2003), EN61000-6-1 :2001, EN61000-4-2 :1995+A1 :1998, EN61000-4-3 :2002  |

Table 1-6. Independent Safety Testing

**List of Items Furnished**

| Concentrator  | Standard Power Sources  |   |
|---|---|---|
|  |  | AC Power Adapter<br>(9726-SEQ)                |
|   |  | AC Power Adapter Cord<br>(3588-SEQ)           |
|   |  | 24 VDC Cable<br>(9727-SEQ)                    |
|   |  | Battery<br>(9723-SEQ;<br>reorder PN 20952897) |

Table 1-7. SAROS

Also includes: Nasal Cannulas (2), Operator and Service Manual, a spare HEPA and air intake filter.  
No additional parts required for standard operation.

## 2.0 INTRODUCTION TO YOUR SAROS OXYGEN SYSTEM

This operator & Service Manual will inform you about the use and care of the SAROS and its standard components. Please read thoroughly all of the information in this manual before operating the SAROS and receive proper training on the use and care of this device.

A PHYSICIAN HAS PRESCRIBED SUPPLEMENTAL OXYGEN AS PART OF A TREATMENT PLAN TO MEET AN INDIVIDUAL'S CLINICAL NEEDS. OXYGEN FLOW MODES AND SETTINGS SHOULD BE ADJUSTED ONLY UNDER THE ADVICE OF A PHYSICIAN OR CLINICIAN.

A representation of the major features of the SAROS hardware interface are shown below:

- Membrane Panel containing:
  - Five tactile buttons allow control of all user controllable settings
  - Five variable intensity LED indicators provide overall status
  - An 8 character LCD display shows settings
- 9V Battery
- Oxygen Outlet Port
- External Power Connector
- Battery
- Simplified User Instructions Label
- Main / Rating Label
- Air Inlet Filter
- HEPA Filter

### 2.1 DESCRIPTION OF THE SAROS (9400-SEQ) ASSEMBLY—SHIPPABLE

Become familiar with the key features of the SAROS and the user control panel.

#### ADDITIONAL PARTS

24 VDC Cable: 9727-SEQ

AC Power Supply: 9726-SEQ with Power Cord 3588-SEQ

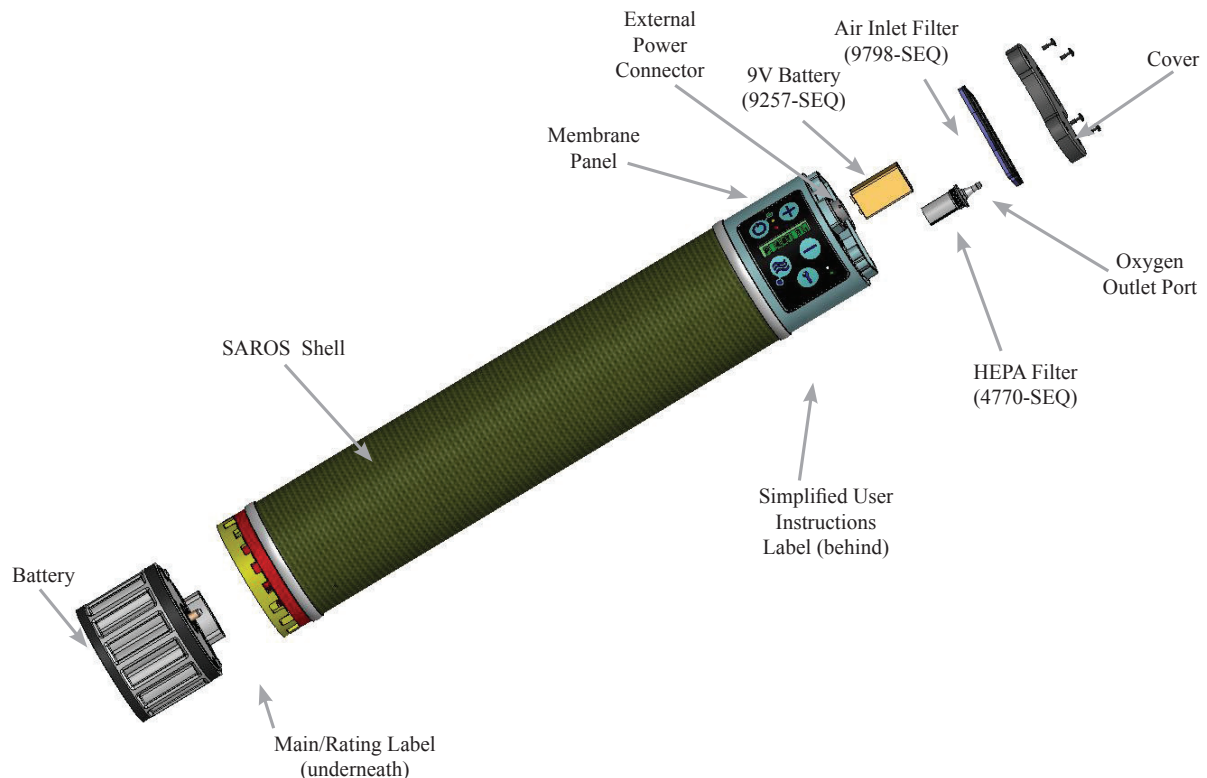


Figure 2-1. SAROS Components

FRONT – CONTROL PANEL



BACK – SIMPLIFIED INSTRUCTIONS



TOP



BOTTOM – WITHOUT BATTERY

Main/Rating Label



BOTTOM WITH BATTERY

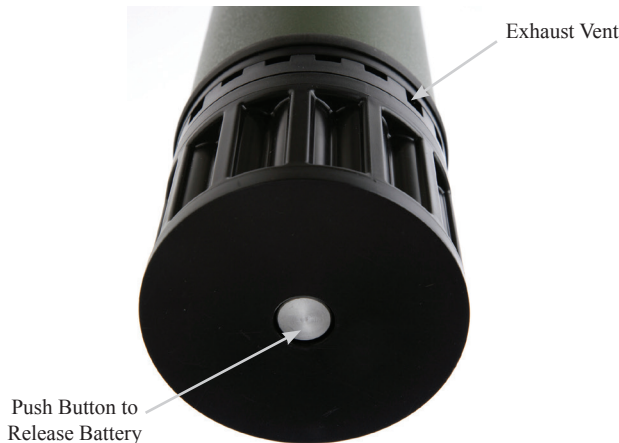


Figure 2-2. SAROS Components

Input/Output Connections

**Oxygen Outlet Port:** Oxygen supply tubing or a cannula is attached to this port.

**Air Inlet Filter:** Ambient air is drawn into the device through the air inlet located at the top of the device. This air inlet filter prevents dust /debris from entering the SAROS and should be cleaned regularly.

**External Power Connector:** The SAROS AC Power Adapter or 24 VDC Cable connects to this receptacle.

**Exhaust Vent:** Exhaust air from the SAROS leaves the device from this vent.



## 2.2 USER CONTROLS AND SYSTEM STATUS INDICATORS

The SAROS User Control Panel displays important operating information. This section will help you understand this operating information.

**Normal Mode** provides all LED indications with full brightness, full audio indicator sound and LCD backlight. The system always starts up in Normal Mode. Normal Mode can be changed to Tactical Mode by depressing the Utility Button and then the Decrease button to change from TACT=ON to TACT=OFF. Normal Mode is indicated by an “N” on the LCD.

**Tactical Mode** is provided for operation where noise and light may compromise a situation. In these situations, the LED indicators will be off and the audio indicator sound is reduced. Tactical Mode can be changed to Normal Mode by depressing the Utility Button and then the Decrease button to change from TACT=ON to TACT=OFF. Tactical Mode is indicated by a “T” on the LCD.

**Green, Yellow, and Red Indicators** on the front panel indicate the operating condition of the device. For additional information on these indicators see the Alerts, Alarms and Troubleshooting Table in this manual.









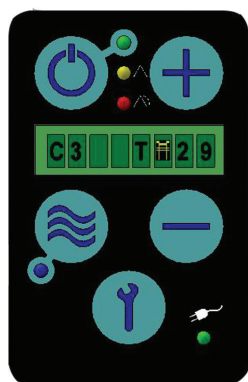
|   |   |
|---|---|
|    | ON/OFF (Standby) Button -Green Indicator: This button powers the device ON or powers it OFF. The Green Indicator is illuminated when the device is powered ON and operating in the Normal Mode and off when operating in Tactical Mode.   |
|    | Increase or Decrease Flow Setting Button: Use these buttons to set the flow or to make selections in the Utility Menu.  |
|    | Delivery Mode Button and Indicator (Blue): The SAROS contains a button to toggle between Continuous Flow and Pulse Flow mode. The Pulse Flow mode activates autoSAT Technology – as breath rate changes, the system adjusts to provide a consistent bolus size. The Pulse Flow Mode allows a significant increase in operating time when powered by a Battery. When the Pulse Flow Mode is activated, the blue Flow Mode Indicator illuminates and a pulse of oxygen is delivered with each inspiratory effort. When the pulse of oxygen is delivered, the flow mode indicator turns off. |
|   | ALERT (Yellow) Indicator - Low and Medium Priority Alerts: In Normal Mode, when illuminated, this indicates a low priority awareness condition or Caution. Continue to use your system and refer to the Alerts, Alarms, and Troubleshooting Table for the proper response. A flashing yellow indicates a medium priority alert. A prompt response is necessary. In Tactical Mode, a blinking star “*” indicates an alert.   |
|  | ALARM (Red) Indicator – High Priority Alarms: In Normal Mode, when illuminated, this indicates a high priority alarm condition. An immediate response is necessary. Refer to the Alerts, Alarms, and Troubleshooting Table and contact a qualified service technician. In Tactical Mode, a blinking star “*” indicates an alert.  |
|   | Buzzer: An audible alarm (or buzzer) is used to alert you to the operating condition of the device, either a warning or failure, and to confirm a valid key press by the user.  |
|  | Flow Setting Indicator: This is the main focus on your control panel. A clinician will correctly set the prescribed flow for either the CX - Continuous Flow Mode at X LPM (1, 2 or 3) and/or the PXXX - Pulse Flow Mode XXX ml (16, 32, 48, 64, 80, 96) settings. Each time the device is turned ON, it will operate at C3 (3 LPM) continuous flow in the Normal Display Mode.   |
|  | Battery Status Gauge: This indicator displays the charge remaining in the Battery. When the Battery is fully charged all 5 gray bars are illuminated. Each gray bar represents approximately 20% of the total Battery charge. When the Battery is being charged, the charge indicator bars will waterfall. If the Battery is not installed, or if it is improperly installed, the Battery Status Gauge will not be illuminated and Time on Battery is not displayed.  |
|  | External Power is Present Indicator: When the SAROS is properly plugged in and is using the AC or 24 VDC Cable, this indicator will illuminate on the User Control Panel in Normal Mode.  |

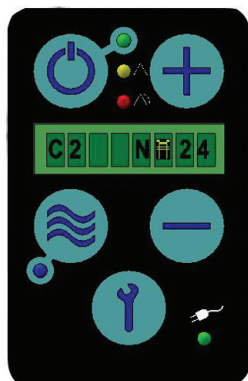
Table 2-1. User Controls and Indicators

## Examples of LCD display at Power Up



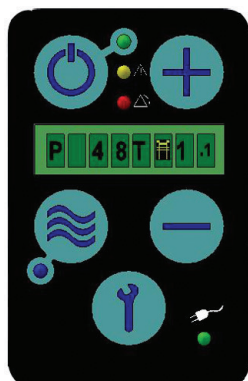
Example of LCD Display indicates the following information:  
Continuous Flow at 3 LPM, Tactical Mode, Battery between 81% and 100% of capacity, 29 minutes of battery operating time remains. Battery symbol is animated with a waterfall effect when charging.

## Example of LCD display during Continuous Mode



Example of LCD Display indicates the following information:  
Continuous Flow at 2 LPM, Normal Mode, Battery between 61% and 80% of capacity, 24 minutes of battery operating time remains.

## Example of LCD display during Pulse Mode





Example of LCD Display indicates the following information:  
Pulse mode at bolus size of 48 mL, Tactical Mode, Battery between 61% and 80% of capacity, 1.1 hours of battery operating time remains. Battery symbol is animated with a waterfall effect when charging.

### 2.3 RECOMMENDED OPERATING ENVIRONMENTS

The following chart provides important information concerning the recommended operating environments, or operating conditions, for optimum use of the device.

|                               |  |
|-------------------------------|--|
| Operating Temperature         | 0° C to 43° C  |
| Operating Humidity            | 10% - 95% at an 82.4° F (28° C) dew point  |
| Transport/Storage Temperature | -4° F to 140° F (-20° C to 60° C)<br>Humidity: Up to 95% Non-Condensing  |
| Electrical                    | Use no extension cords or electrical outlets controlled by a switch.   |
| Altitude                      | 0 – 18,000 feet (0 - 5,486 meters)   |
| Placement                     | DO NOT block the air inlet or the exhaust vent. Place device a minimum of 3 inches (7.5 cm) away from walls, draperies, furniture, other equipment, etc. |
| Environment                   | Must be smoke, pollutant, and fume free.   |
| Operating Time                | 24-hours per day when connected to an external AC Power Adapter or 24 VDC Cable.   |

Table 2-2. Recommended Operating Environments

|   |  |
|---|--|
|    | <b>WARNING: OPERATING THE SAROS OUTSIDE OF THE RECOMMENDED OPERATING TEMPERATURE ENVIRONMENT MAY NEGATIVELY IMPACT DEVICE PERFORMANCE, MAY CAUSE DAMAGE TO THE DEVICE AND WILL VOID THE WARRANTY IF THIS OCCURS.</b> |
|    | <b>WARNING: OPERATING THE SAROS UNDER HIGH AMBIENT TEMPERATURE CONDITIONS MAY RESULT IN HIGH PRODUCT GAS TEMPERATURE.</b>  |
| NOTE: When moving the SAROS from an extreme temperature environment, please allow time for your device to acclimate to the recommended operating temperature environment. |  |

#### OPERATION CHARACTERISTICS AT EXTREME TEMPERATURES

SAROS has been designed to optimally operate at temperatures between 0°C – 43°C. When operating the system in environments outside these temperatures, the system performance is characterized as follows:

While operating in temperatures between -13°C – 0°C and 43°C – 49°C, SAROS is capable of maintaining flow and purity in continuous and pulse flow modes, while operating on all power sources with the exception of Battery charging.

While operating in temperatures above 49°C the purity of the oxygen may fall below 90% and the operating time on the battery may be reduced. If SAROS is operating on external power at this temperature, the system may not transition to battery operation due to the safety circuit in the Battery being too hot. During discharge, the SAROS software will shut the system down if internal battery cell temperature exceeds 59°C. While the Battery is charging, software will interrupt charger operation when the internal battery temperature exceeds 40°C or temperature is less than 5°C.

While operating in temperatures up to 60°C, the purity of the oxygen may fall below 90% and the unit may not operate on battery due to the high temperature and internal safety circuit in the battery. If the unit does operate on battery, the time may be greatly reduced.

#### THE PROPER LOCATION

Select a location for the device that avoids the intake of smoke, fumes and pollutants. Correct placement of the device should allow intake of air through the air inlet filter at the top and allow exhaust air to freely leave the exhaust vent at the bottom of the device.

Locate the device such that the alarms can be heard and position the oxygen supply tubing in such a way that it does not kink or occlude. Keep the SAROS at least five (5) feet (1.5 m) away from hot, sparking objects or open flames.

DO NOT locate the device near flammable materials or cleaning agents or in the direct path of any heat source, such as a stove, range, heat register or vehicle heater.

### 3.0 PREPARATION FOR USE AND INSTALLATION

#### Pre-Delivery Check List

Before delivering the device, check and log the status of the following:

Parts Inventory – Verify that each SAROS is provided with the following items:

- SAROS Concentrator
- AC Power Cord
- AC Power Adapter
- 24 VDC Cable
- Battery
- Nasal Cannulas (2)
- Operator and Service Manual
- Spare Filter Set

#### 3.1 BATTERY INSTALLATION ONTO SAROS

1. Remove connector and pin caps.
2. Press the Latching Pin Release Button inward on the bottom of the Battery prior to installing onto the SAROS.

**NOTE:** It is important to depress the latching pin release button prior to installation.

3. Insert the Battery onto the SAROS by aligning the Battery Connector of the Battery into the connector opening at the bottom of the unit. Battery is properly engaged when the latch pin is snapped into place.



Figure 3-1. Battery Installation

#### 3.2 LOCATING THE SAROS

Place the SAROS in a well-ventilated area. Be sure the air inlet and exhaust vent are not obstructed.

Position the SAROS so all audible and visual indicators or alarms can be easily seen and heard.

Connect the AC Power Adapter to External Power Receptacle located on top of the device and plug the device into a grounded AC Power outlet, connect to a DC Power source with the 24 VDC Cable, or be sure there is a fully charged Battery installed.

#### 3.3 SAROS PERFORMANCE VERIFICATION TEST

It is recommended that the SAROS performance verification test be performed upon initial receipt of the device to confirm proper operation before the unit is distributed or used in the field. The full procedure is listed in section 6.6 on page 35–37.

## 4.0 THEORY OF OPERATION

### BASIC THEORY OF OPERATION

SAROS Oxygen System uses a variable speed compressor to provide both positive and negative air pressure and is driven by a Brushless DC Motor (BLDC) and drive system.

The ATF® Concentrator Module accepts positively and negatively pressurized air and extracts oxygen from this air using the Pressure Swing Adsorption (PSA) process. The ATF module sub-components consist of patented rotary valves, manifold, housing, sieve beds, and a stepper motor / gear drive system. The rotary valve system channels the gas in a sequential manner to each of the sieve beds. Each bed is pressurized to force the oxygen through the sieve and into the product tank while most of the nitrogen is separated and remains in the sieve. Once the process is maximized then the sieve beds are purged of the nitrogen. The purged nitrogen is then vented to atmosphere through the exhaust vent. The process is continuously repeated in each sieve bed.

The flow of produced oxygen passes from the product tank to a flow and concentration monitoring and control system which utilizes a proprietary ultrasonic flow and concentration sensor. It then continues through a flow control valve to accurately control the flow of oxygen in continuous and pulse flow modes. The oxygen then passes through a HEPA filter and is delivered to the oxygen outlet port.

The oxygen flow rate and mode are selected by the user. In continuous flow mode, oxygen is delivered continuously at rates of 1, 2, and 3 LPM and, in pulse flow mode; a bolus is delivered at the beginning of each inspiration with selectable volume delivery approximately equivalent to rates between 16 and 96 mL.

The SAROS electronic system, together with embedded operational firmware, provide the means to manage power, control oxygen production, monitor safety functions and interface with the user. Power management functions include switching between various power inputs, driving the compressor, ATF stepper motor, and proportional valve, monitoring battery status and charging when power is available from an external source. System management functions include monitoring all flow, pressures, concentrations and safety functions. User Interface components such as buttons, illuminated indicators, LCD display and audio transducer are also monitored or controlled. The User Interface informs the user of the system status, allows the user to select a continuous flow or pulse mode flow setting and the ability to set the desired flow rate. The Utility Button on the User Interface also allows the User to obtain information about the system – hours of operation, software version and 9V battery status - or make selections on various features such as Tactical or Normal Mode, Trigger Sensitivity Adjustments, Buzzer Loudness and LCD Brightness and Contrast.

### ATF® CONCENTRATOR MODULE

The SAROS Oxygen System, Model 3000 with autoSAT Technology uses a passive system to separate oxygen from air. Air flows into the SAROS where it is filtered and then enters the compressor. Pressurized air flows from the compressor into the ATF Concentrator Module where it is separated into oxygen and nitrogen components. The air separation process uses a rotary valve system to force air through a series of pressurized sieve beds. Through a process known as “pressure swing adsorption,” nitrogen molecules are collected on an adsorbent material or zeolite allowing the concentrated oxygen to be forced through a sieve bed into the product tank. The nitrogen molecules are then purged from the adsorbent material using a vacuum pressure cycle.

Oxygen flows from the product tank through a sensor that measures flow and concentration and then through a HEPA filter. A flow control valve regulates the flow of concentrated oxygen. The process is continuously repeated during operation.

### COMPRESSOR

The SAROS compressor is a two-head variable speed compressor driven by a highly efficient Brushless DC (BLDC) motor. When air flows into the compressor, it passes through an air inlet filter that filters out impurities. Using one head, the compressor takes in filtered air, compresses it and channels the compressed gas to the ATF Module. The second head pulls a vacuum on the ATF module and exhausts nitrogen rich gas through an exhaust outlet muffler to suppress the noise and then to the exhaust vent at the bottom of the device.

### BRUSHLESS COMPRESSOR MOTOR DRIVER (BCMD)

The BCMD drives the compressor motor based on the input power from either the battery, the AC Power Adapter or the 24 VDC Cable.

### COOLING FAN

A cooling fan is installed in the SAROS to provide forced air cooling to the various components in the system that generate heat.



## POWER BOARD

The Power Board takes external power that comes into the SAROS from the AC Power Adapter, 24 VDC Cable or Battery and monitors and controls power distribution to the rest of the SAROS system. The Power Board also drives the cooling fan.

## SYSTEM BOARD

The System Board is the center of nearly all the SAROS functions. The System Board is a micro controller-based system that monitors system dynamics such as temperatures, pressures, ATF stepper motor and proportional valve, product flow and concentration, and the Users' input, indicators and buzzer operation and external communications. It measures temperature of the oxygen, compressor motor, ambient temperature, and ATF temperature, BCMD, Power Board and the Battery.

The System Board utilizes a proprietary ultrasonic flow and concentration sensor and a flow control valve to accurately control the flow oxygen in the various flow delivery modes.

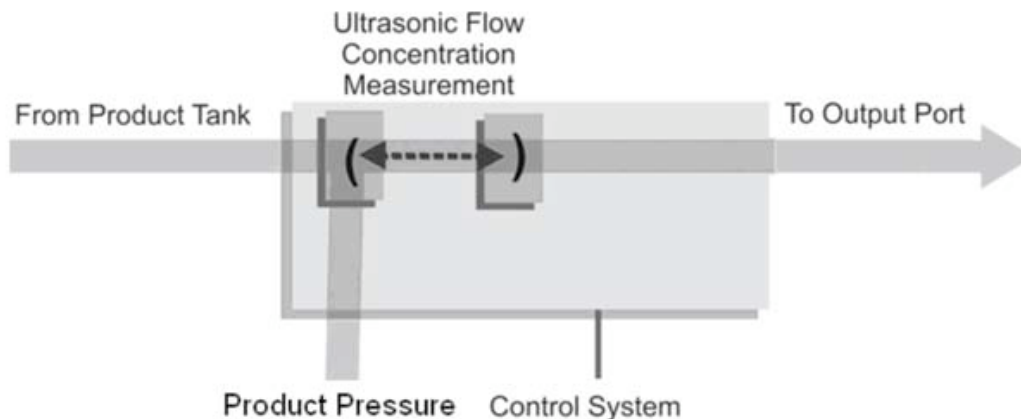


Figure 4-1. System Board Diagram

## CONTROL PANEL

The Control Panel provides a user interface consisting of a membrane panel keyboards, Liquid Crystal Display (LCD), external power present indicator, Battery capacity indicator, alarm status indicators, and a buzzer. The user interface informs the user of the system status and allows the user to set the desired flow modes and flow rate – continuous or pulse, display mode – normal or tactical, set up system parameters and acquire system information.



## CONTINUOUS FLOW MODE

The user may set the SAROS oxygen flow rate and mode. Continuous Flow Mode delivers a constant flow of oxygen to the Oxygen Outlet Port at settings of 1, 2, and 3 LPM. Within the SAROS, concentrated oxygen is stored in a product tank at pressures in the range of 5 – 9 psi and is back-pressure compensated. This pressure gives Continuous Flow Mode the capability to deliver the indicated flow rate to the patient even if extension tubing is used, up to 50 feet long. In addition, the SAROS Continuous Flow Mode is fully compatible with humidifier use.



### PULSE FLOW MODE WITH autoSAT TECHNOLOGY

The SAROS Pulse Flow Mode with autoSAT Technology delivers a high flow of oxygen at the very beginning of each inspiratory effort. The approach is based on the manner in which gas is delivered into a patient's airway. The user may select pulse volume delivery rates between 16 and 96 ml. Pulse durations vary between 100 milliseconds and 500 milliseconds due to dead space considerations. Maximum cannula length is 7 feet.

The fundamental approach to triggering and controlling the oxygen bolus in Pulse Flow Mode is: The user may select pulse trigger sensitivity in settings 1 (most sensitive), 2, or 3 (least sensitive). The pulse will be triggered when the system meets all the following criteria: The cannula pressure has dropped below the trigger point (typically between 0.15 and 0.45 cm H<sub>2</sub>O). At least 1.25 seconds has passed since the last pulse began.



The SAROS autoSAT Technology consistently maintains the FiO<sub>2</sub> by adjusting to the patient's respiratory rate. As their rate increases, the autoSAT feature servo controls the device to automatically increase oxygen output to ensure uninterrupted delivery of the set bolus volume. autoSAT provides the patient with unparalleled performance without limiting available oxygen, enabling the system to automatically adjust to increased oxygen demands that often occur.

**NOTE:** To Equipment Provider: The following oxygen administration accessories are recommended for use with the Oxygen Concentrator:

- Nasal Cannula with 7 feet (2.1 m) of tubing: PN 5408-SEQ
- CAIRE offers the OxySafe™ as an optional accessory. This is intended to be used in conjunction with the SAROS concentrator. For customers in regions requiring compliance to EN ISO 8359:1996-Amendment 1:2012, this accessory will meet this need.

The OxySafe is a thermal fuse to stop the flow of gas in the event that the downstream cannula or oxygen tubing is ignited and burns to the OxySafe. It is placed in-line with the nasal cannula or oxygen tubing between the patient and the oxygen outlet of the SAROS.

For proper use of the OxySafe, always refer to the manufacturer's instructions (included with each OxySafe kit).

CAIRE offers an OxySafe kits that includes a cannula headpiece, OxySafe, and 7' tubing: PN 20628667.

## UTILITY MODE



A User or Service Technician can access the Utility Mode function by pressing using the Utility Button on the control panel. All information is displayed on the LCD. Advance to the next feature in the Utility Mode by depressing the Utility Button. The "+" or "-" button is used to toggle when a feature is selected. Pressing the Flow Mode button takes you back one step.

## SERVICE MODE FUNCTIONS

Factory maintenance or service updates may sometimes be required on the SAROS. Factory and qualified factory-trained technicians can access service mode software functions by using the Service Port located on the top of the unit.

## POWER SUPPLIES

SAROS may operate from either an AC Power Adapter, 24 VDC Cable or Battery. When power is available from an external supply, the SAROS will draw from the external source rather than depleting the Battery. Connection to external power is indicated when the External Power Present Indicator located on the Control Panel is illuminated.

### AC POWER ADAPTER

The AC Power Adapter is a universal input type, capable of accepting 100 – 240 VAC, 50/60 Hz. It is capable of delivering up to 200W at 24 VDC output. The input cord requires a grounded receptacle. Country specific cords may be used with the AC Power Adapter, as the supply is equipped with a universal input receptacle. When used in a medical care facility, international safety standards require the use of hospital grade AC power cord with the SAROS.

The AC Power Adapter contains protection circuits for output over-current, input over-voltage, and internal over-temperature conditions. If any of these conditions exist, output power will be a Loss of Power Alarm. Refer to Alert, Alarms and Troubleshooting Table. These three conditions are self-resetting, such that output power will resume when protection circuits fall back into acceptable operating ranges.



To adapt the SAROS to 220 VAC, just utilize the country cord or a plug adapter. An inverter to step up voltage/current is not needed.

### 24 VDC CABLE

The 24 VDC Cable is intended for use with 24 volt power sources, such as those found in various vehicles.



## RECHARGEABLE BATTERY

The Battery allows operating the SAROS away from AC or DC power. The Battery used with the SAROS contains Lithium Ion battery cells, similar to those used in laptop computers and cell phones. The SAROS Battery is approximately 88.8 W-hours in capacity and provides an output voltage of 12V to 16.6V. The Battery connects to the bottom of the SAROS and is secured by a mechanical latching mechanism. The Battery can be recharged when the SAROS is connected to the AC Power Adapter or the 24 VDC Cable. The Battery Gauge indicator on the SAROS LCD will have a “waterfall” effect when the Battery is charging. The fastest way to recharge the Battery is using the AC Power Adapter.



The Battery has an integral safety circuit that prevents over charge, over discharge or damage due to an external short circuit of the pack. An Integral fuel gauge communicates battery voltage, current, charge state, and temperature. Based on the voltage supplied by the Battery, the system is configured to optimize battery charging by regulating the charging voltage and current as follows:

| Battery Pack Output Voltage (VDC) | Charging Voltage (VDC) | Charging Current (A) |
|-----------------------------------|------------------------|----------------------|
| < 10.0                            | FAULT                  | FAULT                |
| 10.0 – 11.9                       | 16.6                   | 0.55 to 0.70         |
| > 12.0                            | 16.6                   | 5.60                 |

Table 4-1. Battery Pack

When the SAROS is operating on Battery power, the LCD displays an estimate of the amount of time the unit can operate at the current settings, within +/- 5 minutes. When the SAROS is operating on Battery and the time on battery falls below 15 minutes, the LCD time on battery characters will flash to indicate a low battery condition.

The capacity of the SAROS Battery is determined by electronics and software. While the SAROS Battery allows the concentrator to operate at its full range of capabilities, the primary purpose of the Battery is to allow an autonomous system while moving between AC or DC power sources. The SAROS’s Battery, like all lithium ion batteries, is susceptible to permanent damage from excessive heat. Exposure to excessive heat may shorten the Battery’s service life.

The Battery contains multiple temperature sensors to monitor battery cell temperature. The amount of heat the Battery can safely endure varies depending on how the Battery is being used. During discharge, the SAROS software will shut the system down if internal battery cell temperature exceeds 59°C. While the Battery is charging, software will interrupt charger operation when the internal battery temperature exceeds 40°C or temperature is less than 5°C. In both of these cases, when internal battery cell temperature returns within these limits, the SAROS will resume normal operation. Operation near these temperature limits will not damage the Battery, but are in place to ensure that the service life of the Battery is preserved.

Heat in the Battery is generated during discharge, and can also be the result of operating the SAROS in high ambient temperatures. The amount of internally generated heat varies with the flow setting – higher flows induce greater Battery heating. While high ambient temperatures are typically the result of operation on a hot day, running the SAROS with inadequate ventilation can also cause additional heat. Always ensure that the SAROS is operated in a well-ventilated space, the Air Inlet Filter is clean, and intake and exhaust vents are unobstructed.

## CHARGING ALGORITHM

The charging algorithm is performed by the Power Board software and involves three basic decisions:






1. When to start charging
2. How fast to charge
3. When to stop charging

Charging begins when Battery voltage falls below 90% relative capacity. The charging current is limited by the charger capability and the rated capacity of the Battery. Under certain conditions, the SAROS may not have enough external power available to charge the batteries at the full rate. In this case, the charging rate will be limited to the available power. As the Battery accumu-

lates charge, the charging current required will eventually fall. Battery charging will cease when the Battery voltage is greater than 16V, charge current is less than 0.66A, and relative charge is greater than 93%.

The software will only charge when the Battery temperature is at or below 40°C. The software will always run the cooling fan whenever the charger is enabled. The Battery Charger is disabled and the cooling fan is set to maximum whenever the Battery temperature exceeds 40°C. The Battery charger is disabled when temperature is less than 5°C.



All lithium ion batteries self-discharge at very low rates when not in use. SAROS Batteries are shipped from CAIRE Inc. in a partially charged state (nominally 40%). Do not store the SAROS with the battery installed in the unit. Remove the battery from the unit when storing to prevent damage to the battery and the unit. CAIRE Inc. recommends a first in, first out rotation of Battery inventory for maximum service life.

|  |  |
|--|--|
|   | <b>WARNING: INDICATES A HAZARDOUS SITUATION THAT, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.</b>                                 |
|   | <b>WARNING: DO NOT OPEN OR HANDLE EXCEPT AT A STATIC FREE WORKSTATION. DO NOT REMOVE COVER WITHOUT ESD PROTECTION.</b>                         |
|   | <b>WARNING: DO NOT STORE THE SAROS WITH THE BATTERY INSTALLED IN THE UNIT.</b>   |
|   | <b>WARNING: WHEN PERFORMING SERVICE AND REPAIR PROCEDURES DO NOT TOUCH EXPOSED CIRCUITS DURING THE MAINTENANCE. DO NOT TOUCH MOVING PARTS.</b> |
|  | <b>CAUTION: The SAROS contains electrostatic sensitive components.</b>   |

## 5.0 OPERATING INSTRUCTIONS

### BEFORE OPERATING

This Operator & Service Manual serves as your reference to help you operate and maintain the device. If you have any questions or concerns please contact a qualified representative, or CAIRE Inc.

|   |  |
|---|--|
|  | <b>WARNING: PROTECT THE SAROS AND THE AC POWER ADAPTER AND 24 VDC CABLE FROM ALL FLUID SPILLS OR FLUID DRIPS TO AVOID POSSIBLE SHOCK HAZARDS.</b>              |
|  | <b>CAUTION: Always check that the air inlet and the exhaust vent of the device are not blocked and the air inlet filter is clean before using your device.</b> |

### POWERING ON YOUR SAROS

The SAROS comes complete with the concentrator, AC Power Adapter, power cord, 24 VDC Cable, Battery, and extra filters. The SAROS is a lightweight portable and stationary source of supplemental oxygen. The device is capable of being operated directly from three different power sources: AC power adapter, DC power supply, and battery. To power the SAROS on, connect a source of power and press and hold the ON/PFF button for 2–3 seconds.




### GENERAL CHARGING INFORMATION

The SAROS charges the Battery when external power (AC or DC) is present and when the Battery temperature is below a safe charging temperature. When external power is disconnected, the device will automatically switch over to the Battery, if installed and charged. When external power is restored, by plugging into an AC or DC outlet, the device will accept power from the external power source and recharge the Battery while operating the device if adequate AC or DC power is available.

|  |  |
|--|--|
|  | <b>WARNING: DO NOT TOUCH THE POWER CONNECTOR ON THE BOTTOM OF THE UNIT WITH THE BATTERY REMOVED AND WHEN THE DEVICE IS CONNECTED TO AN EXTERNAL AC OR DC POWER SOURCE.</b> |
|--|--|



### AC POWER ADAPTER

The SAROS includes a universal AC Power Adapter for use wherever standard AC power is available. To connect to an AC power source, be sure the AC Power Adapter device cord is securely inserted into the recessed power receptacle on the top of the device and that the AC power cord from the AC Power Adapter is plugged into a grounded AC outlet. When the device is plugged in properly, the External Power is Present Indicator will appear on the user control panel in Normal Mode.

|   |   |
|---|---|
|  | <b>CAUTION: The AC power cords used with the SAROS must meet the electrical requirements of the country where the device is used.</b> |
|  | <b>CAUTION: Use only with a grounded, 3-pin receptacle. Do not remove the grounding pin from the power cord.</b>                      |
|  | <b>CAUTION: Use only with CAIRE Inc. supplied power cords.</b>  |

### DC POWER SUPPLY

A 24 VDC Cable allows the system to operate from DC outlets, such as those found in vehicles. Start the vehicle. Insert the 24 VDC cable into the power receptacle on the top of the device. Next, insert the 24 VDC Cable plug into the DC power outlet in your vehicle. When the device is properly connected and receiving power from the DC power source, a green indicator light on the External Power is Present Indicator, on the control panel will illuminate in Normal Mode.

|   |  |
|---|--|
|  | <b>WARNING: SECURE THE SAROS AND THE DC POWER SUPPLY IN YOUR VEHICLE AND BE SURE THERE IS ADEQUATE AIR FLOW TO THE DEVICE AND THAT THE AIR INLET AND EXHAUST VENTS ARE NOT BLOCKED. BLOCKING OF THE AIR INLET OR EXHAUST VENT MAY IMPAIR DEVICE PERFORMANCE.</b> |
|  | <b>WARNING: DO NOT LEAVE THE SAROS OR 24 VDC CABLE PLUGGED INTO THE VEHICLE WITHOUT THE ENGINE RUNNING OR ATTEMPT TO START THE VEHICLE WHILE THE DC CABLE IS CONNECTED TO THE VEHICLE. DOING SO WILL DRAIN THE VEHICLE'S BATTERY.</b>                            |



**WARNING: IF THE VEHICLE'S DC POWER SOURCE DROPS BELOW 20.0 VOLTS (BROWNOUT CONDITION) THE SAROS WILL REVERT TO BATTERY OPERATION IF THE BATTERY IS PRESENT.**

### TYPICAL NEW BATTERY OPERATING TIME

Battery Operating Time: The remaining operating time of the Battery is displayed on the user control panel when in Battery mode. A variety of factors, such as flow setting, Pulse or Continuous Flow Mode, temperature or age will impact the operating time. The following table provides operating time estimates for the SAROS operating on a fully charged Battery given certain flow settings and nominal operating conditions.

| CONTINUOUS FLOW SETTING (LPM) | CONTINUOUS FLOW BATTERY OPERATING TIME | PULSE FLOW BATTERY OPERATING TIME | PULSE FLOW MODE SETTING (ML) |
|-------------------------------|--|-----------------------------------|------------------------------|
| 1.0                           | 1.1 hours                              | 1.2 hours                         | 16                           |
| 2.0                           | 45 min                                 | 1.1 hours                         | 32                           |
| 3.0                           | 30 min                                 | 53 min                            | 48                           |
|                               |  | 47 min                            | 64                           |
|                               |  | 46 min                            | 80                           |
|                               |  | 37 min                            | 96                           |

Table 5-1. Typical New Battery Operating Time

NOTE: Battery run time will degrade under high temperature use and as the battery cells age.



**CAUTION: Store the battery in a cool and dry location. This will help to assure the longevity of the battery.**



**CAUTION: U.S. Department of Transportation (DOT) and United Nations (U.N.) regulations require the removal of the battery from the device for all international airline travel when the SAROS is checked as luggage. When shipping the SAROS, the battery must also be removed from the device and packaged properly.**



**CAUTION: Only replace the CAIRE Inc. battery supplied with the device with a CAIRE Inc. battery.**



**WARNING: DO NOT ATTEMPT TO OPEN THE BATTERY; THERE ARE NO SERVICEABLE PARTS INSIDE THE BATTERY.**



**WARNING: DO NOT STORE THE SAROS WITH THE BATTERY INSTALLED IN THE UNIT. RETURN THE BATTERY TO AN AUTHORIZED SERVICE CENTER OR CAIRE INC. FOR PROPER DISPOSAL.**



**WARNING: DO NOT DISASSEMBLE, INCINERATE, OR HEAT THE BATTERY ABOVE 140° F (60° C). THE BATTERY, USED IN THIS DEVICE, MAY PRESENT A RISK OF FIRE OR CHEMICAL BURN IF MISTREATED.**

### TYPICAL BATTERY RECHARGE TIME

The typical time to recharge your Battery, in order to achieve 80% capacity, from a fully discharged Battery is 1.5 hours, while operating at 3 LPM continuous flow.

If the Battery becomes too warm during discharging, recharging will not begin until the Battery sufficiently cools. Removing the Battery and allowing it to cool may expedite this cooling process.

### INITIAL BATTERY CHARGING

The new Battery supplied with the SAROS is not fully charged when it is shipped from the factory. Pushing the Test Button on the Battery will indicate the level of charge within. Before using the SAROS for the first time, fully charge the Battery.

Attach the Battery by aligning the connector on the battery to the mating part on the bottom of the SAROS. The Battery will click into place. Depress latching pin button prior to connecting battery.

Power the SAROS ON, with the AC Power Adapter plugged in, and the Battery correctly installed. With the device powered ON, allow the Battery to completely charge. The Battery is fully charged when the Battery Status Gauge Indicator on the Control Panel is completely illuminated or the device has been charging for a minimum of 5 hours.

**CAUTION: Do not leave the SAROS, or battery, in the seating area of a motor vehicle or in the trunk of a motor vehicle during a hot day.**

NOTE: The SAROS can be used when either discharging or recharging of the Battery is taking place.

NOTE: The storage temperature range for the device is -4° F (-20° C) to +140° F (+60° C) and 95% non-condensing humidity.

In the event of an external power interruption, the SAROS will automatically switch to the Battery operation. When external power is restored, the Battery will automatically start recharging. If the Battery is not present, or fully discharged, during an external power interruption, the SAROS will shut down.

### LOW BATTERY ALERTS

The table below describes the LCD Display and Alarm for Low Battery Conditions.

#### MINIMUM REMAINING TIME ON BATTERY

|                      | < 6 Minutes | 7 Minutes < X < 15 Minutes | > 15 Minutes |
|----------------------|-------------|----------------------------|--------------|
| Time Remaining (Min) | Flash       | Flash                      | Solid        |
| Battery Icon         | Flash       | Solid                      | Solid        |
| Alarm                | ON          | OFF                        | OFF          |

Table 5-2. Minimum Remaining Time on Battery

NOTE: Momentarily press the Utility Button to silence the Loss of Power alarm for 2 minutes. Connecting the SAROS to an external AC power supply will also eliminate this alarm.

When replacing the Battery without the device being externally powered, push the ON/OFF (Standby) to restart the SAROS.

### BATTERY INSTALLATION ONTO SAROS

1. Remove connector and pin caps.
2. Press the Latching Pin Release Button inward on the bottom of the Battery prior to installing onto the SAROS.

NOTE: It is important to depress the latching pin release button prior to installation.

3. Insert the Battery onto the SAROS by aligning the Battery Connector of the Battery into the connector opening at the bottom of the unit. Battery is properly engaged when the latch pin is snapped into place.



Figure 5-1. Battery Installation



## 5.1 OPERATING THE SAROS FOR THE FIRST TIME

### Step 1: Locating the SAROS.

Place the SAROS in a well-ventilated area. Be sure the air inlet and exhaust vent are not obstructed.

Position the SAROS so all audible and visual indicators or alarms can be easily seen and heard.

Connect the AC Power Adapter to External Power Receptacle located on top of the device and plug the device into a grounded AC Power outlet, connect to a DC Power source with the 24 VDC Cable, or be sure there is a fully charged Battery installed.

### Step 2: Power ON the Device and allow it to Warm Up

Oxygen Monitoring – The SAROS has an oxygen concentration status indicator (OCSI) built-in to the device. The OCSI continually monitors the oxygen output of the device.

Press and hold the “ON/OFF” Button to power ON your SAROS. The SAROS will start up in Normal Mode and Continuous Flow of 3 LPM. Allow five (5) minutes minimum for the device to reach its performance specifications. The five (5) minute warm up time is a stabilization period during which no alerts or codes are to be expected. If the device fails to reach its performance specifications after five (5) minutes, the unit will alarm according to the mode it is in.

### Step 3: Connect the oxygen supply tubing to the SAROS

Clean and Replace the cannula and oxygen supply tubing regularly, as recommended by the cannula manufacturer’s instructions.

### Step 4: Select the flow delivery mode

Press the Flow Mode button to select the desired flow mode – Continuous or Pulse. Pressing this button repeatedly will toggle you back and forth between the flow modes.

When operating in the Continuous Flow Mode, a continuous supply of oxygen measured in liters per minute (LPM) will flow from the Oxygen Outlet Port.

**NOTE:** When any Control Panel settings are changed, the SAROS re-enters a 5 minute stabilization mode during which no alarms are to be expected.



**WARNING: DO NOT USE SUPPLY TUBING OR CANNULA EXTENSIONS THAT ARE MORE THAN 50' (15.2M) IN LENGTH IN THE CONTINUOUS FLOW MODE. IN PULSE MODE, USE ONLY THE CANNULA WITHOUT EXTENSIONS.**

### PULSE FLOW MODE OPERATION:

When operating in Pulse Flow Mode and there is no inspiratory effort detected by the device after 60 seconds total time, the device will switch to the Continuous Flow Mode and will produce at an equivalent minute volume. The alert will cease at this time.

When operating in Pulse Flow Mode, a bolus of oxygen measured in mL will be delivered from the Oxygen Outlet Port, each time an inspiratory effort, or negative pressure, is detected.

### PULSE FLOW MODE FEATURES:

The SAROS Pulse Flow Mode delivers a high flow oxygen bolus at the beginning of each inspiration. Your SAROS Pulse Flow Mode has a feature, called autoSAT Technology and a Pulse Flow Mode Sensitivity Setting to easily trigger the oxygen bolus delivery.

These features are provided to ensure that patients can easily trigger a delivery of an oxygen bolus and that the oxygen bolus maintains consistency over higher breath rates.



autoSAT Technology provides a consistent bolus volume of oxygen as a patients' breath rate increases or decreases.

| <b>Pulse Setting<br/>Bolus Size (+/- 15%)</b> | <b>Maximum Breath Per Minute<br/>(bpm)</b> |
|---|--|
| 16  | 40   |
| 32  | 40   |
| 48  | 40   |
| 64  | 40   |
| 80  | 37   |
| 96  | 31   |

Table 5-3. Pulse Settings

NOTE: Bolus volume decreases as breath rate exceeds published range.

The Pulse Flow Sensitivity (P SENS) can be adjusted in the Utility Menu from 1–3. A setting of 1 is the most sensitive and a setting of 3 is the least.

|   |   |
|---|---|
|  | <b>WARNING: PULSE FLOW MODE SETTINGS MUST BE DETERMINED FOR EACH PATIENT INDIVIDUALLY. SETTINGS USED IN THE CONTINUOUS FLOW MODE MAY NOT APPLY, OR BE APPROPRIATE, IN THE PULSE FLOW MODE AND VICE VERSA.</b> |
|  | <b>WARNING: AS WITH ALL OXYGEN-CONSERVING TYPE DEVICES, THE SAROS MAY NOT BE ABLE TO DETECT ALL INSPIRATORY EFFORTS IN THE PULSE FLOW MODE.</b>   |

### Step 5: ADJUST THE FLOW SETTING TO THE PRESCRIBED LEVEL

Using the Flow Setting Buttons, adjust the flow setting to the prescribed setting.

NOTE: When any Control Panel settings are changed, the SAROS re-enters a 5 minute stabilization mode during which no alarms are to be expected.

### Step 6: SELECT USER DEFINABLE SETTINGS USING THE UTILITY MENU

The Utility Menu has the features that can be adjusted by the user or information for the user or Service Technician. Below are the features of the Utility Button and the Utility Menu:

- Pressing the Utility button will turn off the audio alarm for 119 seconds unless this is prevented by a malfunction.
- The Utility Menu mode can be entered whenever the unit has power (Standby or ON) or 9V Battery.
- Each time the Utility Button is pressed, the Utility menu will advance to the next option.
- The options within the Utility Menu can be changed by using the Increase and Decrease buttons.
- Pressing the Flow Mode button in the Utility Menu goes back to the previous Utility menu item.
- The Utility Menu will revert back to the previous display mode after 5 seconds.

NOTE: Pressing and holding the Utility button for at least 10 seconds will reset the SAROS. To restart, press and hold ON/OFF (Standby) button.

The following sequence of screens shall be displayed on the LCD when the Utility Menu is displayed.

|   |  |
|---|--|
| <b>Alarm Codes</b>                              | Format: AC=XXXX<br>See Alarm Code Table definitions. When more than one alarm code is present, pressing the Increase key will show the next highest priority code and pressing the Decrease key will show the next lowest priority code. |
| <b>Pulse Sensitivity</b>                        | Format: P SENS = X (where X is the value of 1 thru 3)  |
| <b>LCD Contrast</b>                             | Format: LCD CT = X (where X is the value from 1 thru 6)  |
| <b>Normal Mode Brightness</b>                   | Format N BRT = X (where X is 1 thru 6)<br>Selects the LED and LCD backlight Light intensity used in Normal Mode.   |
| <b>Tactical Mode Brightness</b>                 | Format T BRT= X (where X is 0 thru 6)<br>Selects the LED and LCD backlight Light intensity used in Tactical Mode.  |
| <b>Tactical Buzzer Volume</b>                   | Format: T VOL=X (where X is the value from 0 thru 6)   |
| <b>Tactical Mode On / Off selection</b>         | Format: TACT=ON<br>Format: TACT=OFF  |
| <b>9V Battery Status</b>                        | Format: 9V = GOOD<br>Format: 9V = RPLC   |
| <b>Hours of Operation</b>                       | Format: HR= XXXXX  |
| <b>System Software Part Number and Revision</b> | Format: SPPPP Mm<br>(where SPPPP = System Software Part Number, M = Major Version, and m = minor Version)  |
| <b>Motor Software Part Number and Revision</b>  | Format: MPPPP Mm<br>(where MPPPP = Motor Software Part Number, M = Major Version, and m = minor Version)   |

Table 5-4. Utility Menu Screens

### Step 7: Begin using the SAROS

NOTE: You will achieve longer operating time on the Battery if you operate in the Pulse Flow Mode.

### Step 8: Power off the Device

Press and hold the “ON/OFF” Standby Button for two (2) seconds to power OFF the SAROS.

## 6.0 OPERATOR MAINTENANCE & SERVICE

### 6.1 CLEANING THE SAROS

Use mild detergent solution to clean the sleeve, control panel and power supplies. Turn OFF the SAROS and disconnect from AC or DC power before any cleaning or disinfection activity. DO NOT spray the sleeve, control panel or power supplies. Use a damp (not soaking wet) cloth or sponge. Spray the cloth or sponge with mild detergent solution to clean the sleeve, control panel or power supplies. To disinfect the SAROS, use only Lysol Brand II disinfectant (or equivalent). Proceed as directed by the manufacturer.

#### Cleaning the SAROS Battery

The Battery in the SAROS requires special care to assure a longer life and the highest level of performance. The CAIRE Inc. Battery is the only approved Battery recommended for use with the SAROS.

Use a damp (not soaking wet) cloth or sponge. First spray the cloth or sponge with a mild detergent and then clean the Battery case and the latch.

#### Cannula Replacement

Replace your supply tubing and cannula on a regular basis as recommended by the cannula manufacturer's instructions.

### 6.2 ROUTINE MAINTENANCE

| Maintenance Step                         | Frequency                                       |
|--|---|
| Clean Air Inlet Filter                   | weekly (If in use, not required if in storage.) |
| Run device and fully drain SAROS battery | 3 months*                                       |
| Air Inlet Filter Replacement             | 6 months, or as needed                          |
| HEPA Filter                              | 6 months, or as needed                          |
| Performance Verification Check           | 6 months, or when a problem is suspected        |
| Replace 9-volt battery                   | as needed                                       |

Table 6-1. Routine Maintenance

\*Three month recommendation is based on a climate-controlled storage environment. For other storage conditions, contact CAIRE Technical Support at 1-800-482-2473.

#### Tools Required

The following section lists procedures that are necessary to maintain the SAROS. Service should only be performed by a qualified technician. To perform periodic maintenance, the only tools that should be necessary are:

- #1 Phillips Screwdriver
- 3/8" open end wrench
- Oxygen Analyzer that includes the capability to measure both flow rate (LPM and mL) and Oxygen concentration/purity %.
- Tubing to connect the SAROS to the Oxygen Analyzer for testing.

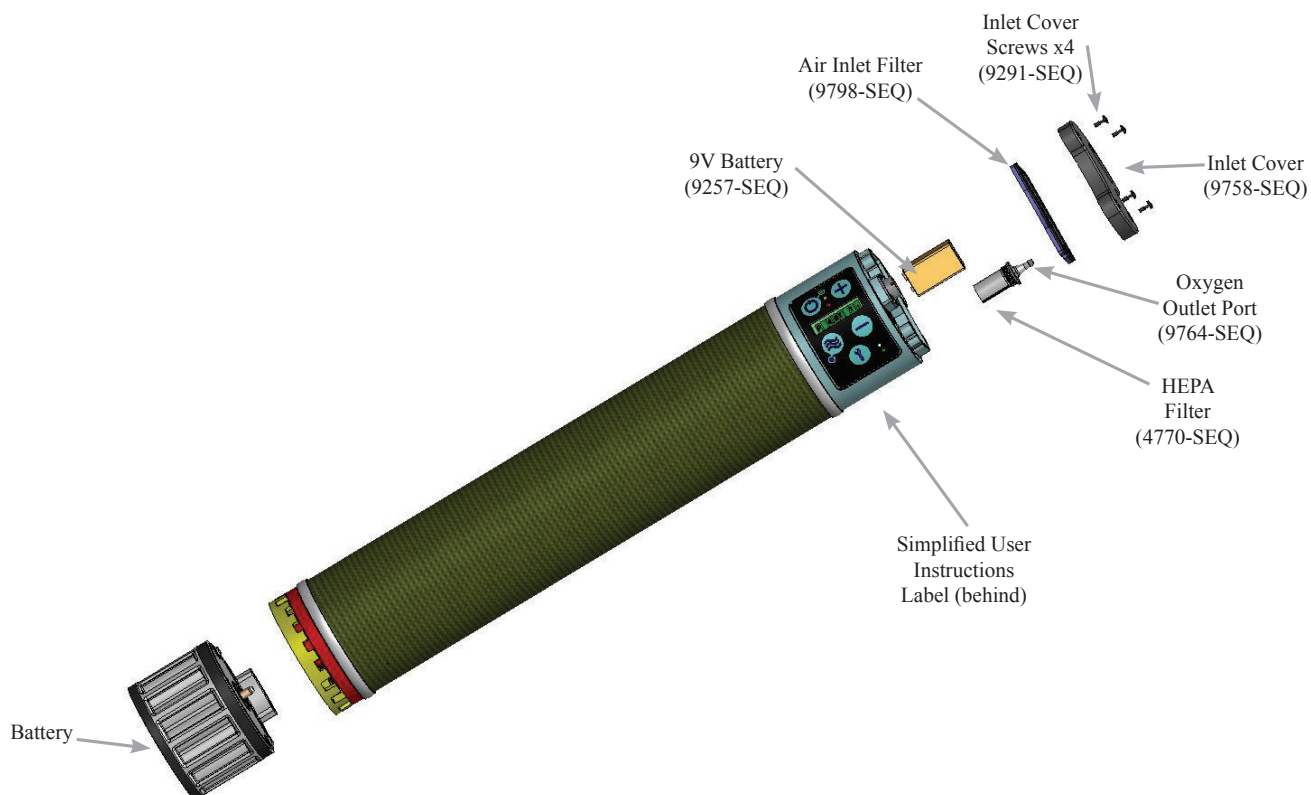


Figure 6-1. SAROS Components

### 6.3 CLEANING OR REPLACING AIR INLET FILTER

- 6.3.1 Removing the air inlet cover.
- 6.3.2 Disconnect power supplies and remove the battery if connected.
- 6.3.3 Using a Phillips #1 screwdriver, loosen the four captive screws.
- 6.3.4 Remove cover.

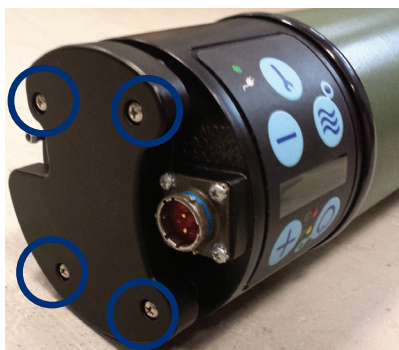


Figure 6-2. Remove Cover

#### 6.3.5 REMOVING AND CLEANING/REPLACING THE AIR INLET FILTER

- 6.3.6 Gently remove the filter shown in figure 6-3.
- 6.3.7 If the filter is damaged, replace.
- 6.3.8 For cleaning, gently wash with warm soapy water. Allow filter to completely dry before re-installing.
- 6.3.9 Re-install Air Inlet Filter.

6.3.10 Using a Phillips #1 screwdriver, re-attach the Cover with screws.

6.3.11 Initial and date the Service and Maintenance Record.



Figure 6-3. Filter



**CAUTION:** Operating the SAROS with a clogged air inlet filter may reduce performance and lead to system damage or premature failure.

## 6.4 REPLACING THE HEPA FILTER

6.4.1 Disconnect all power supplies including external Battery if connected.

6.4.2 Using a 3/8" open end wrench, remove the O2 Fitting/HEPA Filter shown in figures 6-4.

6.4.3 Unscrew the HEPA Filter from the O2 Fitting as shown in figure 6-4.

6.4.4 Replace with new HEPA Filter. Do not over tighten.

**NOTE:** Ensure that the O-Rings shown in figure 6-4 are positioned correctly before re-installation.

6.4.5 Re-install the O2 Fitting/HEPA Filter. Do not over tighten.

6.4.6 Initial and date the Service and Maintenance Record.

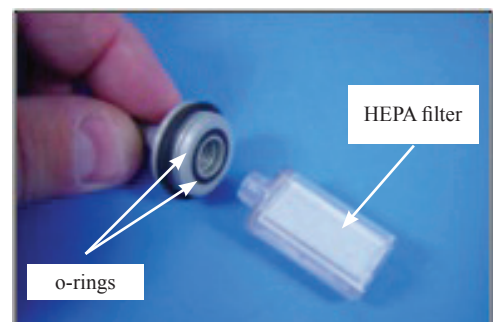


Figure 6-4. Reinstall O2 Fitting/HEPA Filter

## 6.5 RUN DEVICE AND FULLY DRAIN SAROS BATTERY

Operate the device once every 3 months by running the device on battery power until drained. This is required if the device is in storage and unused. If the device is not run regularly per this recommendation there is a risk it will not perform to specification when removed from storage.

- 1) Turn on the SAROS and run at any continuous flow setting until the battery is completely drained and the SAROS powers off.
- 2) Once the SAROS powers off, immediately connect to AC external power to begin re-charging the battery. You may either continue to run the SAROS or leave it powered off during re-charge.
- 3) Once the battery is fully charged, disconnect the battery, power off the unit if still running, and return the SAROS to proper storage conditions.

## 6.6 SAROS PERFORMANCE VERIFICATION TEST

Verify functionality of the SAROS using the following procedures. The performance verification test shall be performed upon initial receipt of the SAROS, any time a problem is suspected, and at regular 6 month intervals. It may be performed at more frequent intervals if required by the equipment provider.

### 6.6.1 General Operation Test

- 1) Install the SAROS battery.
- 2) Use an external (AC or DC) power cord to connect the SAROS to external power. Verify the power cord connects securely to the receptacle on the SAROS.

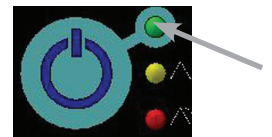
NOTE: The battery is not fully charged upon initial receipt of the SAROS. If testing a new unit, this will begin the battery charging process. Reference steps 7-8 to verify proper battery charging.

- 3) Press and hold the "ON/OFF" button for 3 seconds to power on the SAROS.



NOTE: Before powering on, ensure the SAROS is in the well-ventilated area and that the air inlet and exhaust vent are not obstructed.

- 4) Verify the audible alarm sounds upon start-up and the screen defaults to display a flow setting of C3.
- 5) Allow the unit to run for a minimum of 5 minutes to reach its performance specifications. After the warm-up period, verify that only the green light remains illuminated and there are no audible alarms.



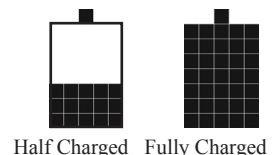
- 6) Press the utility button once and verify that there are no active alarms. The display screen will read "AC = NONE" if no alarms are active.



- 7) Verify that the battery icon is visible on the right side of the screen.



- 8) Verify that the battery is charging. The battery icon bars will move in a waterfall fashion while charging. If the battery icon is not moving, verify if the battery is already fully charged. A fully charged battery will have a completely dark icon with all bars filled.



Half Charged Fully Charged

- 9) Verify the functionality of the blocked flow alarm. Block the cannula outlet fitting with your finger, or by completely obstructing the flow through an outlet tube using a clamp, for approximately 60 to 90 seconds and verify that a visual and audible alarm is triggered. Unblock the outlet port to stop the alarm.



10) Verify the functionality of the increase and decrease flow buttons. Starting at flow setting C3, press the decrease flow button and verify the screen reads C2. Press the increase flow button and verify the screen changes back to C3.

NOTE: It is normal for the motor to speed up or slow down with each flow adjustment.



Decrease flow button



Increase flow button

11) Verify the functionality of the pulse dose mode button. Press the button and verify the device toggles between a continuous flow setting (C) and pulse dose setting (P). The C & P are displayed on the far left side of the screen.



12) Verify the functionality of the no breath alarm. Switch to a pulse dose setting and do not attach any tubing to the outlet. Within 60 seconds of no breath detected, verify the system automatically changes to continuous flow. This is a patient safety measure.

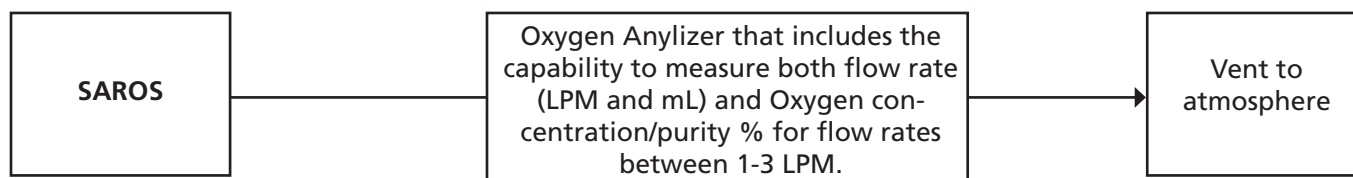
13) Verify the unit runs on battery power. Disconnect the AC power supply and allow the SAROS to run for approximately 60 seconds. Verify the unit continues to run without interruption and that the battery icon is still displayed on the screen.

14) Verify the no battery alarm. Remove the battery and verify that an audible alarm sounds and the red light is visible.

15) Within 5-10 seconds, reinstall the battery and verify the SAROS restarts automatically. Once the SAROS restarts, re-connect the external power as well to resume battery charging.

## 6.6.2 Flow and O<sub>2</sub> Concentration Test

Connect the SAROS to a testing station per the diagram shown below:



NOTE: If testing concentration or flow rate at multiple settings, allow a 5 minute stabilization period between changing the flow rate prior to taking any test readings.

NOTE: The SAROS is BTP compensated. If measuring concentration and/or flow with a device that is non-Argon compensated and non-BTP compensated, an additional 0.10 LPM should be added to the flow rate recorded by the testing equipment. The VT PLUS HF Gas Flow Analyzer manufactured by FLUKE Biomedical is not BTP or Argon compensated.

NOTE: Be sure to use standard oxygen-compatible tubing. The tubing from SAROS to the testing device should be a single continuous piece with no restrictions in line.

1) Verify continuous flow settings C3 and C2 using the following procedure:

- Turn on the SAROS and set the flow to C3 (3.0 LPM). Allow the unit to run for a minimum of 5 minutes to stabilize before testing.
- Verify the O<sub>2</sub> concentration is within 90-96% and record the reading.
- Record a 60 second running average for the flow rate. Verify the 60 second average is within 2.70 - 3.30 LPM. If using a non-Argon or Non-BTP compensated measuring device, verify the 60 second average is within 2.60 – 3.20 LPM.
- Adjust the flow setting to C2 (2.0 LPM). Allow the unit to run for a minimum of 5 minutes to stabilize before testing.
- Verify the O<sub>2</sub> concentration is within 90-96% and record the reading.

F) Record a 60 second running average for the flow rate. Verify the 60 second average is within 1.80 - 2.20 LPM. If using a non-Argon or Non-BTP compensated measuring device, verify the 60 second average is within 1.70 - 2.10 LPM.

NOTE: It is not required to test flow and concentration at 1LPM for performance verification. This is not a typical clinical use case.

2) Verify functionality of the device in pulse dose mode using the following procedure:

- a) Adjust the SAROS to a setting of P48 (48mL).
- b) Trigger a simulated breath by folding and pinching the tubing\* running from the SAROS to the testing device. Verify the breath is triggered by the light blinking adjacent to the pulse flow mode button.  
\*Other acceptable procedures to trigger a breath may include connecting a tee to a breath simulator (syringe, jet venturi, nasal cannula, etc.). If you are using a tee, the tubing to the breath simulation device should not exceed 2 inches in length.
- c) Note and record the bolus size in mL of each breath. Repeat 5 times. Average the five bolus measurements and record the average reading. You may need to "ZERO" the oxygen analyzer testing device between triggering a simulated breath.
- d) Adjust the SAROS to a setting of P96 (96mL).
- e) Repeat steps B & C for the P96 testing.
- f) Average the five bolus measurements and record the average reading.

### 6.6.3 Battery Run Time Test

1) Test battery run time using the following procedure:

- a) Fully charge the battery via AC power by leaving it connected to AC power for a minimum of 1 hour. After 1 hour, verify the power cartridge status indicator is fully illuminated and no longer displays a waterfall motion.
- b) Disconnect the AC power. Power the SAROS on at C3 (3.0 LPM) and start a timer.
- c) Allow the unit to continue to run until it shuts off.
- d) Once the unit shuts off completely, stop the timer and record the battery duration.
- e) Verify that the time recorded is >24 minutes

NOTE: The nominal capacity of a new battery is 30 minutes at setting C3. A battery is considered within its useful life if its duration is 80% of the nominal capacity of a new battery (24 minutes at C3).

## 6.7 REPLACING THE 9V BATTERY

- 6.7.1 Disconnect power supplies and remove external battery if connected.
- 6.7.2 Using a Phillips #1 screwdriver, loosen the four captive screws shown in figure 6-2.
- 6.7.3 Remove cover.
- 6.7.4 Remove 9V battery from where shown in figure 6-5.
- 6.7.5 Disconnect and replace battery as shown in figure 6-5.
- 6.7.6 Using a Phillips #1 screwdriver, replace the Air Inlet Cover.
- 6.7.7 Initial and date the Service and Maintenance Record.

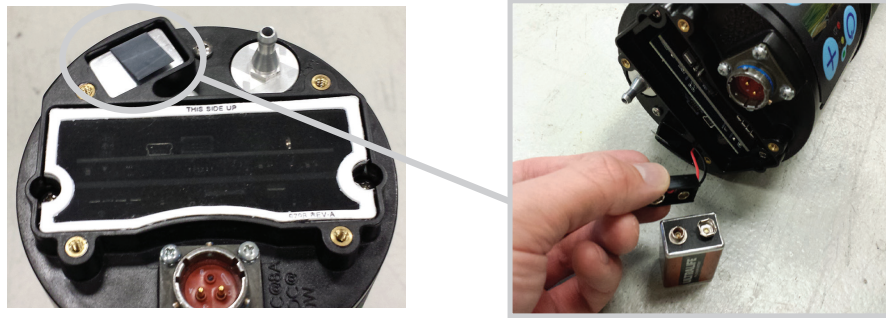


Figure 6-5. Replacing 9V battery

## 7.0 ALERTS, ALARMS, AND TROUBLESHOOTING TABLE

The tables show the possible audible and visual alerts and alarms, their conditions and suggest appropriate troubleshooting responses. If you are unsure about any alerts or alarm conditions, or responses please contact an authorized service technician or go to [www.CAIREmedical.com](http://www.CAIREmedical.com).

### Alarm levels

| Type       | Level | Green LED | Yellow LED | Red LED | Audio Alarm                                       | LCD                           | Description           |
|------------|-------|-----------|------------|---------|---|-------------------------------|-----------------------|
| High Alarm | 0     | OFF       | OFF        | ON      | ON<br>(may shutdown electronics after 10 seconds) | Flashing star replaces T or N | Malfunction           |
| Med Alarm  | 1     | OFF       | Blink      | OFF     | 2 beeps every 119 sec                             | Flashing star replaces T or N | Attention is required |
| Low Alarm  | 2     | OFF       | Blink      | OFF     | 1 beep every 119s                                 | Flashing star replaces T or N | Attention is required |
| Status     | 3     | ON        | OFF        | OFF     | OFF   | NC                            | All OK                |

NC= No Change

Table 7-1. Alarm Levels

|  |   |
|--|---|
|  | <b>WARNING: AVAILABILITY OF A BACK-UP SOURCE OF OXYGEN IS RECOMMENDED IN CASE OF POWER OUTAGE OR A DEVICE FAILURE. CONSULT YOUR PROVIDER FOR BACK-UP OXYGEN SYSTEM.</b> |
|  | <b>WARNING: DO NOT Ignore Alarms. System will attempt to produce oxygen under fault condition but may not be at purity or flow.</b>                                     |

## 7.1 SYSTEM TROUBLESHOOTING GUIDE

| SYMPTOM  | PROBABLE CAUSE  | REMEDY  |
|--|---|---|
| <b>SAROS does not power on when ON/OFF button is pressed (constant tone)</b> | No Battery installed  | Install Battery or plug into external power   |
|  | Battery is discharged or no external power is present       | Plug into external power  |
|  | Other   | Contact an authorized Service Technician  |
| <b>No Oxygen</b>   | Air Inlet or HEPA Filter Blocked                            | Clean Air Inlet Filter or replace HEPA Filter   |
|  | SAROS not ON  | Power SAROS ON  |
|  | Tubing or cannula is not properly connected or is kinked    | Check tubing, cannula and connections   |
|  | Other   | Contact an authorized Service Technician  |
| <b>Low Oxygen Concentration</b>  | Restriction in tubing                                       | Repair or replace tubing.   |
|  | Air Inlet or HEPA Filter restricted                         | Clean air inlet filter or replace HEPA Filter. Place your SAROS so there is adequate air flow.  |
|  | Inadequate Ventilation                                      | Place your SAROS so that there is adequate air flow, i.e. not covered by a blanket or a poncho. |
|  | Hot environment   | Allow SAROS to cool   |
|  | Other   | Contact an authorized Service Technician  |
| <b>Low Oxygen Flow</b>   | Restriction tubing  | Repair or replace tubing.   |
|  | Air Inlet or HEPA Filter Blocked                            | Clean Air Inlet Filter or replace HEPA Filter   |
|  | Other   | Contact an authorized Service Technician  |
| <b>No Oxygen delivered in Pulse Flow Mode</b>                                | Tubing/cannula longer than 7 feet (2.1m)                    | Attach 7 foot (2.1m) tubing/cannula   |
|  | No inspiration detected                                     | Contact an authorized Service Technician  |
| <b>Battery Status Gauge never indicates fully charged</b>                    | Battery is aging  | Contact an authorized Service Technician to replace Battery                                     |
| <b>Heat related failures, i.e. Compressor too hot</b>                        | Ambient condition is too hot                                | Place unit in cool environment or out of direct sunlight, if possible.                          |
| <b>Battery will not latch onto SAROS</b>                                     | Battery Latching Pin Release is stuck in the wrong position | Press the Latching Pin Release Button inward to free the latch mechanism and re-install Battery |
| <b>Oxygen production is limited due to power limitations</b>                 | External power source cannot supply enough power            | Check air inlet filter and check the external power source                                      |

Table 7-2. System Troubleshooting Guide

## 8.0 REPROGRAMMING/CALIBRATION

All reprogramming of the circuit boards shall be performed by CAIRE, Inc or by a factory authorized service center. No reprogramming shall be done in the field.

## 9.0 SHIPPING AND TRANSPORTING THE SAROS

When shipping the SAROS use original packaging if possible. Always remove the Battery from the SAROS before shipping.

If original packaging material is available repack the SAROS, Battery and power supplies in the designated packaging area.

If original packaging material or other CAIRE Inc. authorized shipping container is not available, contact CAIRE Inc. for replacement shipping container.

## 10.0 STORING AND DISCARDING THE SAROS



**WARNING:** Do not expose the SAROS to water. The SAROS enclosure does not provide protection against the harmful effects of liquid ingress. Electrical shock or damage to the unit may result.

### STORING THE SAROS

Heat and humidity may degrade the performance or severely damage the SAROS. Store the device in a cool, dry protected area away from high temperatures, moisture and humidity. Remove the Battery when storing the device.

| Storage Environment |                                |
|---------------------|--------------------------------|
| • Temperature       | -4° F to 140° F (-20° to 60°C) |
| • Humidity          | Up to 95% Non-condensing       |

Table 10-1. Storage Environment

Ensure that all recommended maintenance procedures in section 6.0 are performed while the device is in storage. It is especially important that the 3-month requirement to run the device and fully drain the SAROS battery be performed while the unit is in storage to ensure proper operation.

### Discarding the SAROS

**Battery Disposal:** Your Battery is rechargeable and can be recycled. Always return it to an authorized service center or CAIRE Inc. for proper disposal. You can also contact your local city or town offices for instructions on proper disposal of the Battery.

**SAROS:** Local environmental laws may prohibit disposal of electrical and/or electronic equipment such as the SAROS and AC Power Adapter. Contact the local city, town or country offices for instructions on proper disposal of electrical or electronic equipment. Alternately, CAIRE Inc. may be contacted for disposal information at 1-800-482-2473.

## 11.0 OVERHAUL & REPAIR

### 11.1 TOOLS AND TEST EQUIPMENT

- #1 Phillips Screwdriver
- #1 Flathead Screwdriver
- Needle nose pliers
- Wire cutting pliers
- 3/8" open end wrench
- Oxygen Analyzer that includes the capability to measure both flow rate (LPM and mL) and Oxygen concentration/purity %.
- Tubing to connect the SAROS to the Oxygen Analyzer for testing.
- ESD mat or approved ESD system.

### 11.2 MAINTENANCE AND SERVICE PARTS

| Maintenance Parts                      |             |
|--|-------------|
| Description                            | Part Number |
| 9V Battery                             | 9257-SEQ    |
| Air Inlet Filter                       | 9798-SEQ    |
| HEPA Filter                            | 4770-SEQ    |
| HEPA Filter O-Ring (Large)             | 9251-SEQ    |
| HEPA Filter O-Ring (Small)             | 9250-SEQ    |
| Accessories                            |             |
| Description                            | Part Number |
| AC Power Supply                        | 9726-SEQ    |
| 24VDC Cable                            | 9727-SEQ    |
| Battery Pack (packaged 9723-SEQ)       | 20952897    |
| Nasal Cannula                          | 5408-SEQ    |
| Repair & Overhaul Parts                |             |
| Description                            | Part Number |
| 9V Battery Foam                        | 9256-SEQ    |
| Air Inlet Cover                        | 9758-SEQ    |
| ATF Bulkhead                           | 9922-SEQ    |
| ATF Exhaust Filter                     | 9221-SEQ    |
| ATF Exhaust Tubing                     | 9227-SEQ    |
| ATF Module Assembly                    | SP9729-SEQ  |
| ATF Muffler To Rain Guard Tubing       | 9390-SEQ    |
| ATF Muffler Assembly                   | 9314-SEQ    |
| ATF To Product Tank Outlet Tubing      | 9797-SEQ    |
| ATF To Product Tank Pipe               | 9342-SEQ    |
| ATF To Product Tank Pre-Cut Inlet Tube | SP6981-SEQ  |
| Battery Interface Plate                | 9939-SEQ    |
| Battery Interface Plate Screws (3)     | 9914-6-SEQ  |
| Cable Ties                             | 6968-SEQ    |

|                                     |             |
|-------------------------------------|-------------|
| Compressor & Product Tank Assembly  | SP9240-SEQ  |
| Compressor Fan                      | 9767-SEQ    |
| Compressor Fan Screws (4)           | 9913-10-SEQ |
| External Power Connector            | 9766-SEQ    |
| External Power Connector Screws (4) | 9203-2-SEQ  |
| Hose Clamp                          | 9369-SEQ    |
| Inlet Cap Assembly                  | 9756-SEQ    |
| Inlet Cap Mounting Screws (3)       | 9941-6-SEQ  |
| Inlet Cover Screws (4)              | 9291-SEQ    |
| Kapton Tape (1/2 in Diameter)       | 2696-SEQ    |
| Left Strut                          | 9779-SEQ    |
| Loctite Adhesive                    | 1405-SEQ    |
| Membrane Panel                      | 9731-SEQ    |
| O2 Outlet Port                      | 9764-SEQ    |
| O-Ring For External Power Connector | 9916-3-SEQ  |
| Oxygen Outlet Tubing                | 6981-SEQ    |
| PCB Circuit Board Assembly          | 9710-SEQ    |
| Proportional Valve                  | 5293-SEQ    |
| Proportional Valve Block            | 9231-SEQ    |
| Proportional Valve Screws (2)       | 9203-7-SEQ  |
| Rain Guard                          | 9292-SEQ    |
| Rain Guard O-Rings (Large)          | 9928-SEQ    |
| Rain Guard O-Rings (Small)          | 9374-SEQ    |
| Rain Guard Screws (2)               | 9960-4-SEQ  |
| Right Strut                         | 9780-SEQ    |
| SAROS Sleeve                        | 9280-SEQ    |
| Strut Screws (13)                   | 9912-1-SEQ  |
| Top Strut                           | 9778-SEQ    |

Table 11-1. Maintenance and Service Parts



### 11.3 REPROGRAMMING AFTER OVERHAUL AND REPAIR PROCEDURES

A flow calibration procedure is required after replacing any of the following components or assemblies: ATF Module, Compressor and Product Tank, PCB Circuit Board, Proportional Valve. If any of these components are replaced, the SAROS must be returned to CAIRE or a factory-authorized service center to have the flow calibration performed before returning to use. Equipment or procedures to perform a flow calibration are not contained in this manual.

NOTE: Further damage to the SAROS or other components is possible if the flow calibration is not performed.

### 11.4 SAROS MAIN COMPONENTS

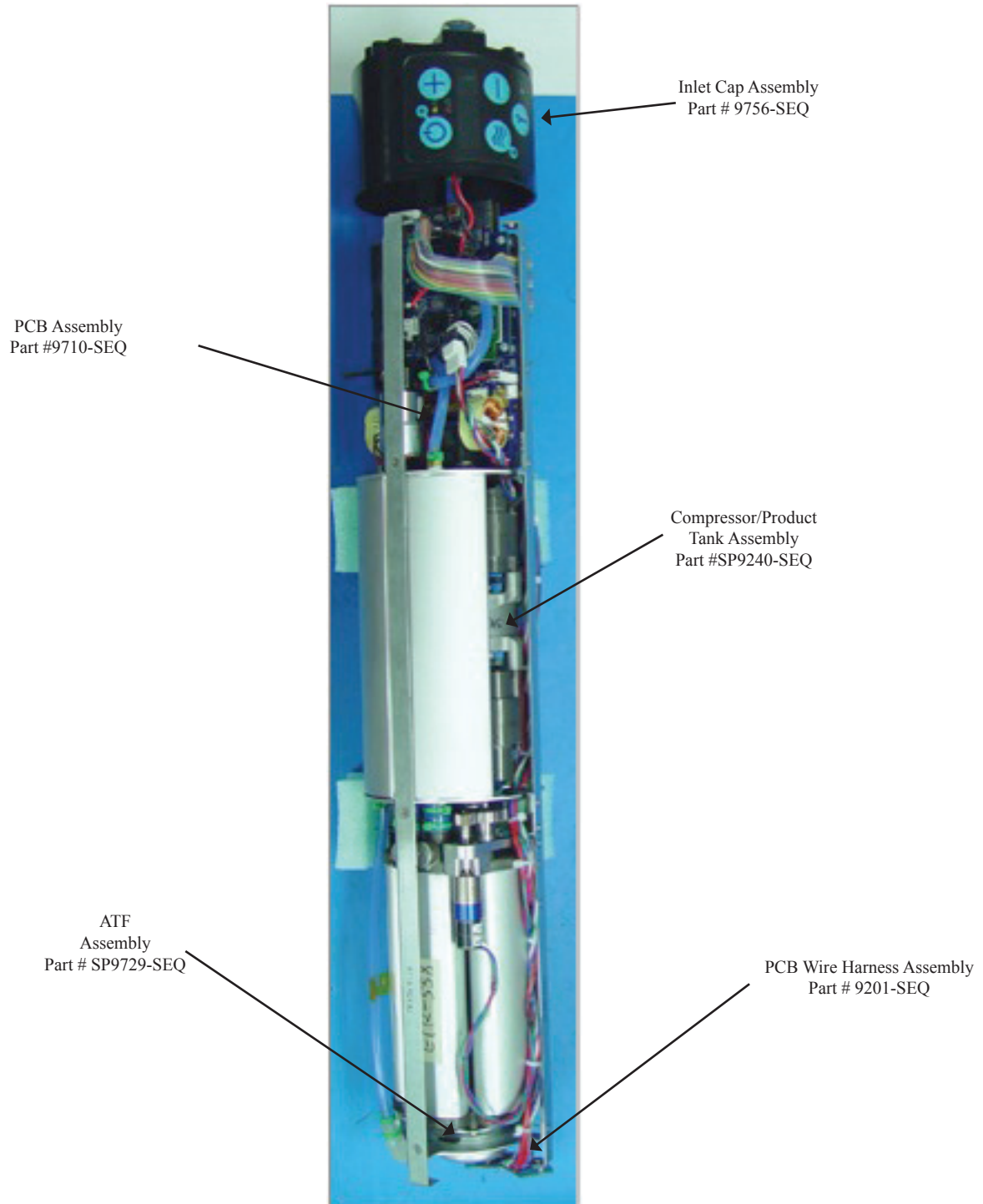


Figure 11-1. Inside SAROS

## 11.5 ALARM INDICATIONS AND CODES

| Description   | Audio Indicator            | Ext. Power LED | Battery Icon | Alarm Code | Description  |
|---|----------------------------|----------------|--------------|------------|--|
| All OK  | OFF                        | NC             | NC           | None       | This indication shall exist when no alarms are detected.   |
| Initialization                                      | OFF                        | NC             | NC           | None       | Purity alarms shall be inhibited during the initialization period. The SAROS will also enter the stabilization period where no alarms are active if a control panel setting is changed.              |
| <b>FLOW</b>   |                            |                |              |            |  |
| %O <sub>2</sub> < 70%                               | ON                         | NC             | NC           | 400        | The alarm shall activate only when concentration has been less than 70% for more than 60 seconds. It shall clear immediately if the concentration goes above 70%.The unit shall continue production. |
| %O <sub>2</sub> < 50%                               | ON                         | NC             | NC           | 410        | The alarm shall activate only when concentration has been less than 50% for at least 120 seconds after the warm up period has expired. The unit shall restart production.                            |
| 70%< O <sub>2</sub> <85%                            | 2 beeps of 0.5s every 119s | NC             | NC           | 800        | The alarm shall activate only when concentration has been less than 85% for more than 60 seconds. It shall clear immediately if the concentration goes above 85%.                                    |
| Flow Rate Error                                     | 2 beeps of 0.5s every 119s | NC             | NC           | 2000       | The alarm shall activate when the difference between the desired flow rate and the measured flow rate exceeds 10% for a minimum duration of 60 seconds.  |
| Breath Pressure Sensor Failure                      | 2 beeps of 0.5s every 119s | NC             | NC           | A210       | The alarm shall activate when a breath pressure sensor failure.  |
| Ultrasonic Sensor Failure                           | ON                         | NC             | NC           | A300       | O <sub>2</sub> production shall stop or cannot be started.   |
| Unable to Achieve or Maintain Product Tank Pressure | ON                         | NC             | NC           | A500       | O <sub>2</sub> production shall stop.  |
| Purity Calibration Data Failure                     | ON                         | NC             | NC           | A600       | The unit shall produce using default data.   |
| Flow Calibration Data Failure                       | ON                         | NC             | NC           | A700       | The unit shall produce using default data.   |
| Ambient Pressure Sensor Failure                     | ON                         | NC             | NC           | AB00       | O <sub>2</sub> production shall continue.  |
| Ambient Temperature Sensor Failure                  | ON                         | NC             | NC           | AB10       | O <sub>2</sub> production shall continue.  |

NC = No Change

Table 11-2. Alarm Indications and Codes

| Description                  | Audio Indicator            | Ext. Power LED | Battery Icon | Alarm Code | Description  |
|------------------------------|----------------------------|----------------|--------------|------------|--|
| <b>Power</b>                 |                            |                |              |            |  |
| Loss of Power                | ON                         | NC             | NC           | 4000       | This alarm shall activate during production when the system determines that valid power has been lost. O2 Production and battery charging shall stop, and the electronics shall shut down after 10 seconds.                |
| Missing Power                | ON                         | NC             | NC           | 4010       | This alarm shall activate if the user attempts to start the unit while there is no usable power source connected. O2 Production and battery charging shall not begin and the electronics shall shut down after 10 seconds. |
| Low Battery                  | 2 beeps of 0.5s every 119s | NC             | (1s/1s)      | 9540       | The alarm shall activate when the time remaining on battery is $\leq 6$ minutes. The alarm shall cease when the time remaining is $\geq 12$ minutes.   |
| Cannot Charge Battery        | 2 beeps of 0.5s every 119s | NC             | (1s/1s)      | 952C       | This alarm shall activate if system is attempting to charge the battery, but can't do so.  |
| External voltage too high    | ON                         | (1s/1s)        | NC           | AC00       | This alarm shall activate when the external voltage is greater than 30V. O2 Production and battery charging shall not begin and the electronics shall shut down after 10 seconds.  |
| Low 9 volt battery           | 3 beeps after POST         | NC             | NC           | None       | The 9 volt battery measured less than 6.5V.  |
| <b>Physical / Functional</b> |                            |                |              |            |  |
| Key Stuck On                 | 2 beeps of 0.5s every 119s | NC             | NC           | 8110       | This alarm shall activate when a key is active for greater than 7 seconds.   |
| Compressor Stall             | ON                         | NC             | NC           | 9194       | O2 production shall stop or cannot be started.   |
| Compressor Driver Fault      | ON                         | NC             | NC           | 9195       | O2 production shall stop or cannot be started.   |
| Pulse Mode Disabled          | 2 beeps of 0.5s every 119s | NC             | NC           | A200       | This alarm shall activate when a breath sensor malfunction is detected. The system shall not enter pulse mode.   |
| Motor Controller Fails Post  | ON                         | NC             | NC           | FD00       | O2 production shall not be started.  |

Table 11-2. Alarm Indications and Codes (continued)

| Description                 | Audio Indicator            | Ext. Power LED | Battery Icon | Alarm Code | Description   |
|-----------------------------|----------------------------|----------------|--------------|------------|---|
| <b>COMM</b>                 |                            |                |              |            |   |
| Invalid Reset               | ON                         | NC             | NC           | 8000       | O2 production and battery charging shall not start. The electronics shall shut down within 15 seconds when on battery power. The display shall be blanked within 15 seconds when on external power.                 |
| I/O Port Failure            | ON                         | NC             | NC           | 8100       | O2 production and battery charging shall not start. The electronics shall shut down within 15 seconds when on battery power. The display shall be blanked within 15 seconds when on external power.                 |
| RAM Failure                 | ON                         | NC             | NC           | 8200       | O2 Production and battery charging shall stop. The electronics shall shut down within 15 seconds when on battery power. The display shall be blanked within 15 seconds when on external power.                      |
| Run Log Storage Failure     | 2 beeps of 0.5s every 119s | NC             | NC           | 8300       | Production shall continue. Battery charging if required shall continue.   |
| Program Memory Failure      | ON                         | NC             | NC           | 8310       | O2 Production and battery charging shall stop. The electronics shall shut down within 15 seconds on when on battery power. The display shall be blanked within 15 seconds when on external power.                   |
| Event Log Storage Failure   | 2 beeps of 0.5s every 119s | NC             | NC           | 8320       | Production shall continue. Battery charging if required shall continue.   |
| EEPROM Data Write Failure   | 2 beeps of 0.5s every 119s | NC             | NC           | 8400       | Production shall continue. Battery charging if required shall continue.   |
| Watchdog Time out           | ON                         | NC             | NC           | 9000       | O2 production and battery charging shall stop or cannot be started. The electronics shall shut down within 15 seconds when on battery power. The display shall be blanked within 15 seconds when on external power. |
| Battery Communication Error | 2 beeps of 0.5s every 119s | (1s/1s)        | (1s/1s)      | 9500       | Battery shall not be charged or discharged.   |
| IPC Failure                 | ON                         | NC             | NC           | A000       | O2 production and battery charging shall stop or cannot be started. The electronics shall shut down after 10 seconds when on battery power. The display shall be blanked after 10 seconds when on external power.   |

Table 11-2. Alarm Indications and Codes (continued)

| Description                                    | Audio Indicator            | Ext. Power LED | Battery Icon  | Alarm Code   | Description   |
|--|----------------------------|----------------|---------------|--------------|---|
| <b>Temp</b>                                    |                            |                |               |              |   |
| ATF Temperature Sensor Failure                 | ON                         | NC             | NC            | 8900         | O2 production shall continue.   |
| Compressor Too Hot                             | ON                         | NC             | NC            | 9100         | O2 production shall stop or cannot be started.  |
| Compressor Temperature Sensor Failure          | ON                         | NC             | NC            | 9110         | O2 production shall continue.   |
| Compressor and ATF Temperature Sensor Failure  | ON                         | NC             | NC            | 9110         | O2 production shall stop or not be started depending on Compressor Temperature Sensor and ATF Temperature Sensor condition.   |
| Power Board Too Hot                            | ON                         | NC             | NC            | 9200         | O2 production and battery charging shall stop or cannot be started. The electronics shall shut down after 10 seconds when on battery power. The display shall be blanked after 10 seconds when on external power. |
| Power Board Thermistor Failure                 | 2 beeps of 0.5s every 119s | NC             | NC            | 9210         | Production shall continue. Battery charging if required shall continue.   |
| Motor Driver Board Too Hot                     | ON                         | NC             | NC            | 9300         | O2 production and battery charging shall stop or cannot be started.   |
| Motor Driver Board Thermistor Failure          | 2 beeps of 0.5s every 119s | NC             | NC            | 9310         | Production shall continue. Battery charging if required shall continue.   |
| Battery Too Hot                                | ON                         | NC             | (1s/1s)       | 9510         | Battery shall not be charged or discharged.   |
| Battery Thermistor failure                     | 2 beeps of 0.5s every 119s | NC             | (1s/1s)       | 9550         | The system shall not use the battery if the independent battery thermistor determined to be open or shorted.  |
| Battery Chip Thermistor failure                | 2 beeps of 0.5s every 119s | NC             | (1s/1s)       | 9560         | The system shall not use the battery if the reported battery chip thermistor is determined to be open or shorted.   |
| Battery Too Cold to Use                        | OFF                        | NC             | No Water-fall | 95C0         | The battery shall not be charged or discharged.   |
| Battery Too Cold to Charge                     | OFF                        | NC             | No Water-fall | 95CC         | The battery shall not be charged.   |
| Product Temperature Sensor Failure             | ON                         | NC             | NC            | A410         | O2 production shall continue.   |
|  |                            |                |               | A410         | Product Temperature Sensor and Ambient Temperature Sensor condition.  |
| Battery Too Hot to Charge                      | OFF                        | NC             | No Water-fall | None         | The battery shall not be charged.   |
| Product and Ambient Temperature Sensor Failure | ON                         | NC             | NC            | A410<br>AB10 | O2 production shall stop or not be started depending on Product Temperature Sensor and Ambient Temperature Sensor condition.  |

Table 11-2. Alarm Indications and Codes (continued)

## 11.6 COMPREHENSIVE TROUBLESHOOTING GUIDE

|   | Indications   | Code | Possible Cause  | Remedy  |
|---|---|------|---|---|
|   | During start up or stabilization period when a control panel (flow) setting has been changed:           |      | 5 minutes before alert conditions will sound or code  | Alert condition will be silent until the warm up period or stabilization period is over, 5 minutes.   |
| 1 | At start up, All 3 light are on (green, yellow, & red)  | 0400 | Device warming up - >70% O <sub>2</sub>   | Normal condition  |
| 2 | At start up, 2 lights are on (green & yellow)   | 0800 | Device warming up - >85% O <sub>2</sub>   | Normal condition  |
| 3 | At start up, 1 light remains (green)  | 0000 | Device warmed up, Within spec 93 +/-3% O <sub>2</sub>   | Ready to use  |
|   | After Start Up conditions:  |      | Front panel setting change—alerts will be reset for 5 minute stabilization.   | Follow numerically until resolved.  |
| 4 | Continuous mode:<br>Low O <sub>2</sub> : between 85 to 70%<br>* (yellow light is flashing)              | 0800 | * Low Flow for extended periods of time, filters occluded.<br>* ATF gear motor slow or not turning, ATF has moisture.<br>* Compressor slow or not working<br>* PCB set not calibrated, malfunctioning | 1) Clean or replace filters;<br>2) If device has been in storage, attempt to run for 24 hours continuously to bring up the purity;<br>3) Check gear motor on ATF is turning, replace ATF if needed (PN: SP9729-SEQ);<br>4) Check Compressor is not labored, squeaking; replace if not working (PN: SP9240-SEQ);<br>5) Replace PCB set (PN: 9710-SEQ). |
| 5 | Continuous mode:<br>Low O <sub>2</sub> : between 70 and 50%<br>* (Red light is flashing, alarm beeping) | 0400 | * ATF gear motor slow or not turning, ATF has moisture.<br>* Compressor slow or not working<br>* PCB set not calibrated, malfunctioning   | 1) Check gear motor on ATF is turning, replace ATF if needed (PN: SP9729-SEQ);<br>2) Check Compressor is not labored, squeaking; replace if not working (PN: SP9240-SEQ);<br>3) Replace PCB set (PN: 9710-SEQ).   |
| 6 | Loss of Power   | 4000 | Power has been lost to the SAROS (unit beeps for 2 sec, and switches to attached battery - if present)  | 1) Check if the front panel power verification LED is lit;<br>2) Check the power source for proper voltage, review spec chart to details;<br>3) Check/replace External power supply for functionality (PN: 9726-SEQ or PN: 9727-SEQ);<br>4) replace External power connector (PN: 9766-SEQ)<br>5) Replace PCB set (PN: 9710-SEQ).                     |
| 7 | Flow Rate error<br>Yellow LED will be flashing  | 2000 | A block to flow greater than 10% is detected for more than 60 sec, unit beeps and yellow light is on.<br><br>Unit will establish normal use after 30 seconds of unblocked patient circuit.            | 1) Find tubing blockage and remove;<br>2) if blockage is within SAROS device - remove tubing and investigate filters.   |
| 8 | Compressor too hot (>115°F)   | 9100 | Environment too hot, Compressor too hot   | 1) Allow device to cool;<br>2) Check the cooling fan, replace Compressor cooling fan if not rotating smoothly or at all (PN: 9767-SEQ)<br>3) If after cooling, the Compressor is damaged or squeaking, replace Compressor (PN: SP9240-SEQ).   |

Table 11-3. Troubleshooting Guide



|    | Indications                               | Code | Possible Cause   | Remedy   |
|----|---|------|--|--|
| 9  | Breath rate malfunction (Pulse Mode only) | A200 | While in Pulse mode, the breath rate was not sensed for more than 60 sec.  | 1) Press Mode button to re-establish Pulse Mode, if SAROS switched to Continuous;<br>2) Ensure patient is breathing through their nose, not their mouth;<br>3) Adjust Pulse Sensitivity to a more sensitive setting. See menu options for adjustment;<br>4) Ensure the SAROS does not have a humidifier attached. Acts as a water block to neg inspiration;<br>5) Ensure tubing length does not exceed 7 ft. |
| 10 | Battery communication error               | 9500 | Battery is not communicating with the SAROS.<br><br>Battery indicator is flashing, or not there when battery is connected. | 1) Re-connect the battery;<br>2) Test the Battery on another unit to ensure the same code, replace battery;<br>3) Check the bridge pcb connector for damage, replace BBB wiring harness if needed (PN: 9201-SEQ);<br>4) Replace the PCB set (PN: 9710-SEQ).  |
| 11 | Battery too HOT (>105°F)                  | 9510 | Battery indicator not scrolling - water-falling (scroll bottom to top)   | 1) Remove battery and allow to cool;<br>2) Replace with cool Battery.  |
| 12 | Battery too Hot to Charge                 | XXXX | Battery will not waterfall (scroll bottom to top)- indicates not charging (no code expected)                               | 1) Check battery connection is proper;<br>2) Reset battery connection locking pin brass barrel;<br>3) check condition of Battery wiring harness, replace if damaged (PN: 9201-SEQ);<br>4) Replace PCB set (PN: 9710-SEQ).  |
| 13 | Power Board too Hot (>115° F)             | 9200 | Charging has stopped, Device shut down, the alarm is on, and the ambient temp is above temp limits.                        | 1) Allow PCB set / Device to cool in the shade or A/C environment<br>2) Once cooled, check functionality to spec.  |
| 14 | Motor Driver Board too Hot (>115° F)      | 9300 | Charging has stopped, Device Shut down, the alarm is on, and the ambient temp is above temp limits.                        | 1) Allow PCB set / Device to cool in the shade or A/C environment;<br>2) Once cooled check functionality to spec;<br>3) Replaced Failed PCB set (PN: SP9710).  |
| 15 | Battery is too Cold (<40° F)              | 95C0 | No waterfall effect (scroll bottom to top) on display.   | 1) Remove Battery from device. Position battery in an environment above 40 degrees (F);<br>2) Allow to warm to in-spec temperature internal to the battery. Re-insert Battery;<br>3) Replace with warmer battery.  |
| 16 | Low Battery Condition                     | 9540 | Battery Icon is blinking, Yellow light is on, Device is beeping (2 beeps at 119 sec), <= 6 minutes remaining.              | 1) Plug into External power;<br>2) Replace with fully charged Battery.   |
| 17 | Front Panel Key Stuck                     | 8110 | A key is stuck for more than 7 seconds. (NOTE: Utility or tool button/key will not activate this alarm.)                   | 1) Remove and replace front membrane panel (PN: 9731).   |

Table 11-3. Troubleshooting Guide (continued)



**WARNING: DO NOT Ignore Alarms. System will attempt to produce oxygen under fault condition but may not be at purity or flow.**

## 11.7 REMOVAL PROCEDURES

### 11.7.1 BATTERY INTERFACE PLATE, RAIN GUARD, AND SLEEVE

11.7.1.1 Remove the three screws (Part# 9914-6-SEQ) and remove the Battery Interface Plate (Part# 9939-SEQ).

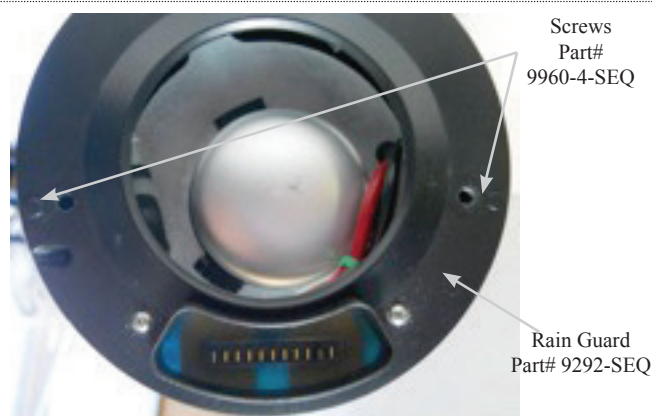
Screws  
Part# 9914-6-SEQ



Figure 11-2. Removal of the three BIP screws

11.7.1.2 Removing the two screws (Part# 9960-4-SEQ) from the Rain Guard (Part# 9292-SEQ)

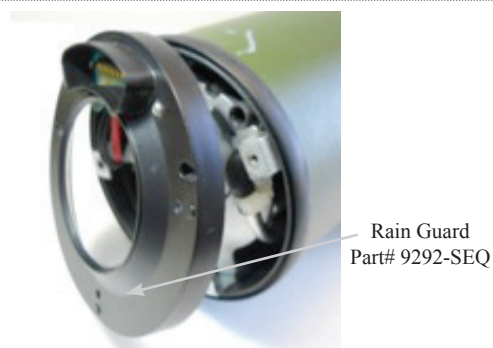
Screws  
Part# 9960-4-SEQ



Rain Guard  
Part# 9292-SEQ

Figure 11-3. Removal of the three Rain Guard Screws

11.7.1.3 Detach the Rain Guard (Part# 9292-SEQ) from the Alignment Ring



Rain Guard  
Part# 9292-SEQ

Figure 11-4. Removal of the Rain Guard

11.7.1.4 Remove the Ring SLEEVE (Part# 9928-SEQ) to expose wiring.

**NOTE:** Ensure both O-Rings (Part # 9374-SEQ) remains with the Ring Sleeve.



9374-SEQ

9928-SEQ

Figure 11-5. Removal of Sleeve Alignment Ring

### 11.7.1.5 Remove Fiberglass Sleeve (Part# 9280-SEQ) from the rails



Figure 11-6. Fiberglass Sleeve

## 11.7.2 INLET CAP REMOVAL

**NOTE:** Use ESD Controls when removing the Inlet Cap.

### 11.7.2.1 Loosen the four CAPTIVE screws (Part# 9291-SEQ) and remove the Air Inlet Cover (Part# 9758).

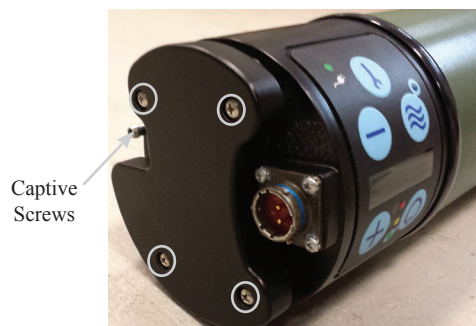


Figure 11-7. Air Inlet Cover Removal

### 11.7.2.2 Remove and disconnect the 9V Battery (Part# 9257-SEQ) and the Air Inlet Filter (Part# 9798-SEQ).

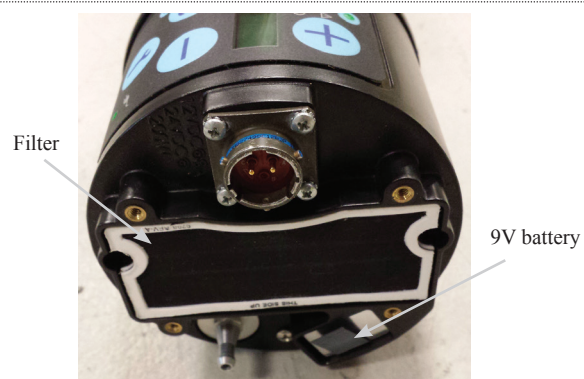


Figure 11-8. Filter Screen & 9V Removal

### 11.7.2.3 Remove three Inlet Cap Mounting screws (Part# 9914-6-SEQ).

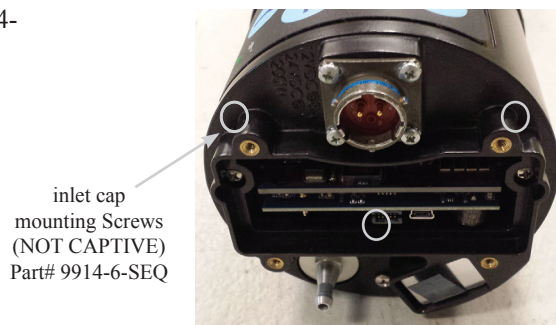


Figure 11-9. Inlet Cap Screw Removal

11.7.2.4 Cut green cable tie and disconnect the Oxygen Outlet Tube from the Flow Valve.

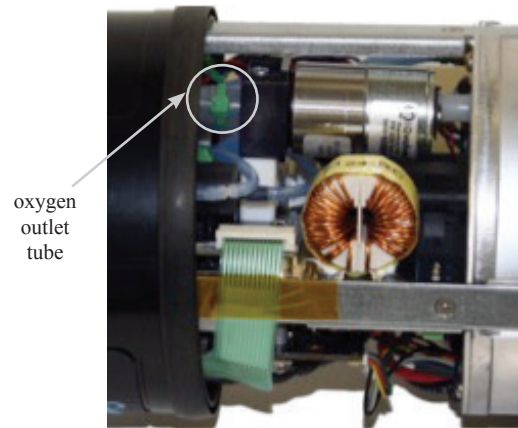


Figure 11-10. Oxygen Outlet Tube Disconnect.

11.7.2.5 Remove tape (Part# 2696-SEQ) from Front Panel Flex Cable and Top Mounting Struts (Part# 9778-SEQ). Lift up locking connector and disconnect the Front Panel Flex cable.

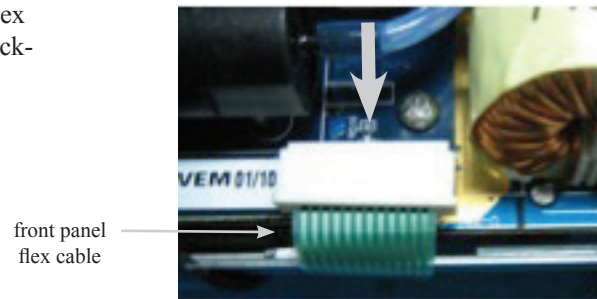


Figure 11-11. Front Panel Flex Cable Disconnect

11.7.2.6 Disconnect the Ambient Air Thermistor Connector and 9V Battery Connector.

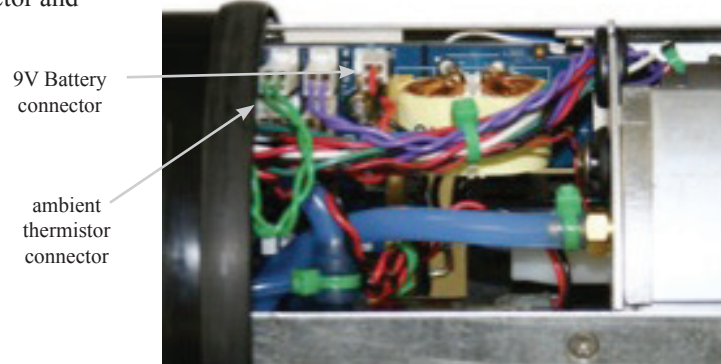


Figure 11-12. Thermistor Connector and 9V Battery Connector

11.7.2.7 Loosen the screws for the AC Power Connector and remove the wires.

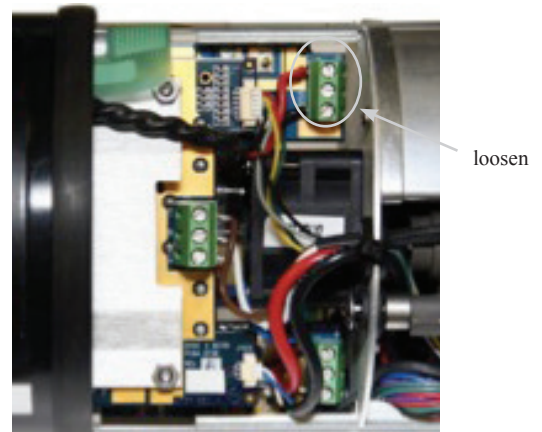


Figure 11-13. Inlet Cap Power



11.7.2.8 Disconnect the Breath Detect Tube.

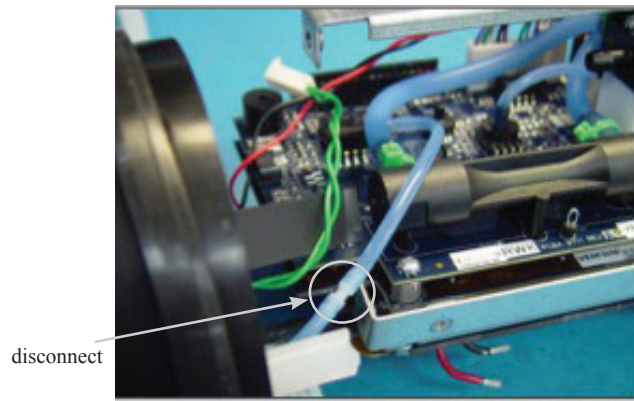


Figure 11-14. Tube Disconnect

11.7.2.9 Remove the Inlet Cap (Part# 9756-SEQ) and guide AC Power Cable under the frame of the PCB Assembly.

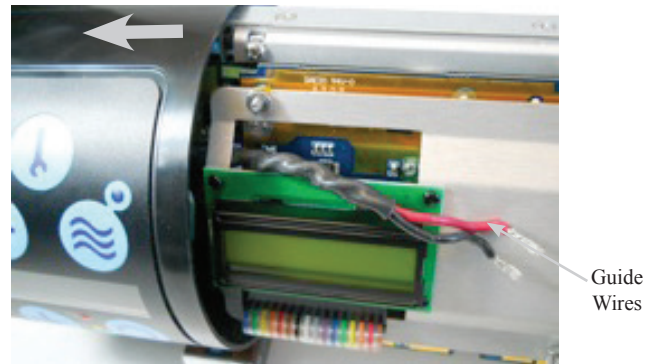


Figure 11-15. Inlet Cap Removal

11.7.2.10 Remove the 3 screws (9912-1) to detach the Top Strut (9778-SEQ).

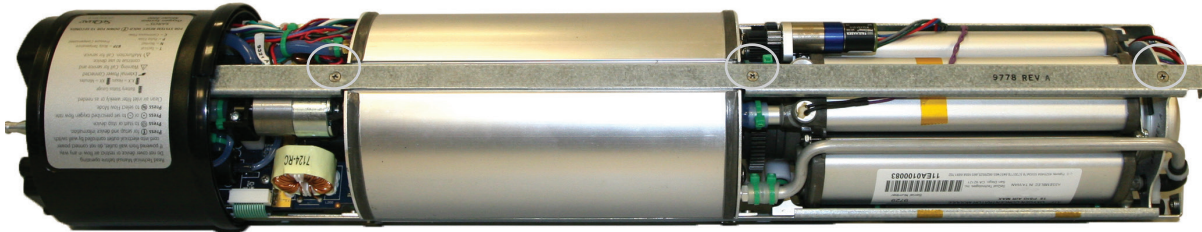


Figure 11-16. Detach Top Strut

### 11.7.3 REMOVE PCB ASSEMBLY

**NOTE:** Always use ESD Controls when handling the PCB Assembly.

11.7.3.1 Loosen the Battery Power Wire screws and remove wires.

11.7.3.2 Disconnect the Compressor Thermistor wires.

11.7.3.3 Disconnect the Halls Effect wire.

11.7.3.4 Loosen the Compressor Power screws and remove the wires.

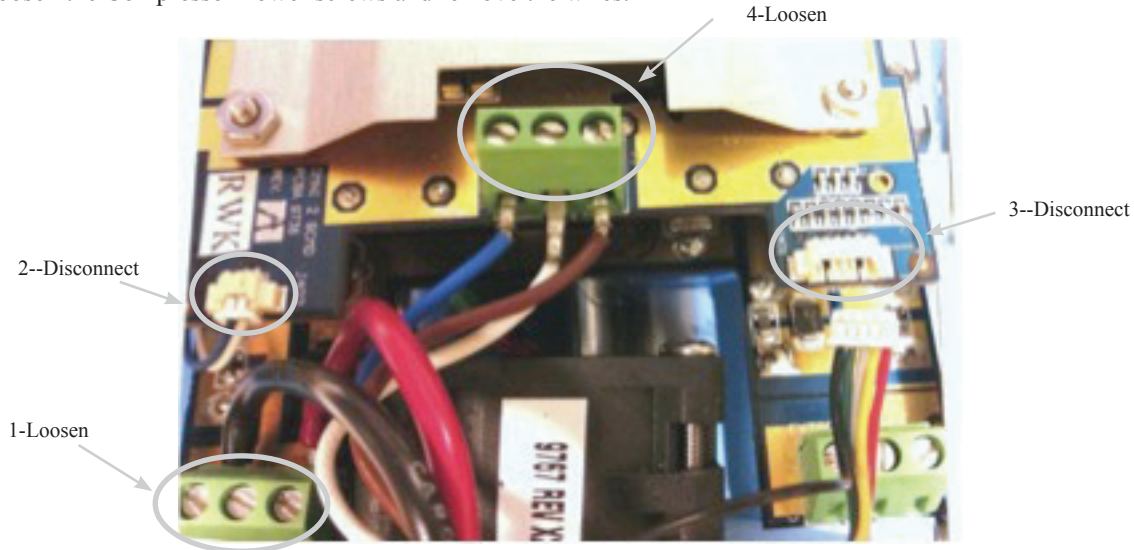


Figure 11-17. Battery Power Wires for Battery Interface

11.7.3.5 Disconnect Battery Communication Connector.

11.7.3.6 Disconnect the ATF Stepper Motor Connector from the PCB.

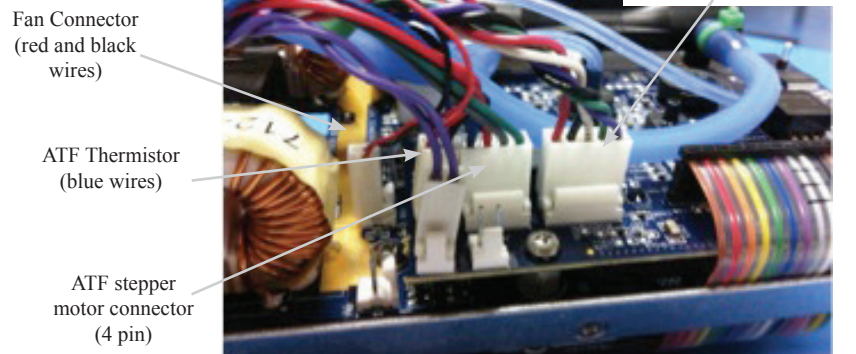


Figure 11-18. Communication Connector for Battery Interface  
ATF Stepper Motor Power, Fan Disconnect, ATF Thermistor

11.7.3.9 Cut the cable tie and remove the Flow Tube from the Product Tank.

**NOTE:** It is recommended to cap this outlet using a piece of tape during the repair process. Do not leave the plug open to atmosphere longer than it takes to preform the repair process. If this port is exposed longer than 24 hours, it must be completely sealed to prevent damage to the ATF. If just exposed during repair, tape is sufficient to prevent any damage.

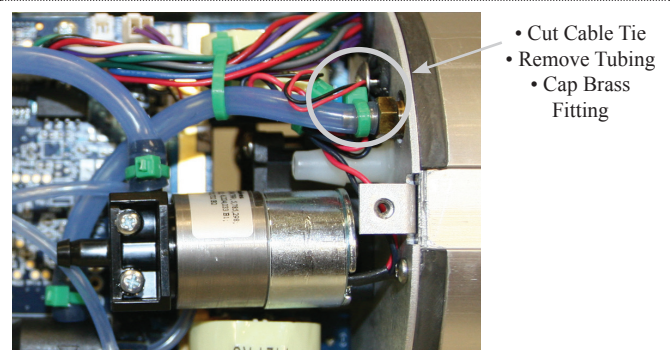


Figure 11-19. ATF Thermistor Disconnect

11.7.3.10 Remove 2 screws on the Left STRUT (9779-SEQ).

11.7.3.11 Remove 2 screws on the Right STRUT (9780-SEQ).



11.7.3.12 Slide the PCB Assembly away from the struts. (Place in ESD bag.)

NOTE: Always use ESD Control when handling the PCB Assembly.

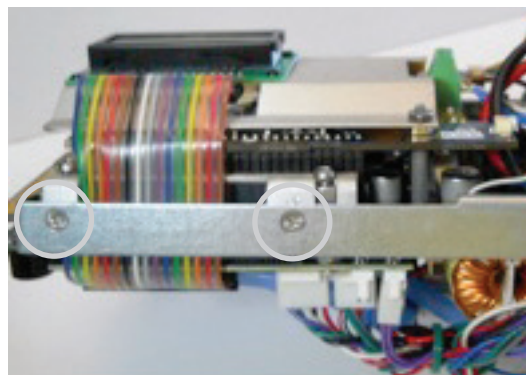


Figure 11-20. PCB Assembly

11.7.3.13 Place PCB Set in ESD Protective Bag.

#### 11.7.4 PROPORTIONAL VALVE REMOVAL (5293-SEQ)

11.7.4.1 Remove Proportional Valve wire from PCB Assembly (if not done so already).

proportional  
valve connector



Figure 11-21. Proportional Valve Wire

11.7.4.2 Remove the two screws from the Proportional valve.

NOTE: If Removing the Compressor Fan go to Step 12.9

11.7.4.3 Cut and remove Cable Tie from Proportional valve and remove tubing.

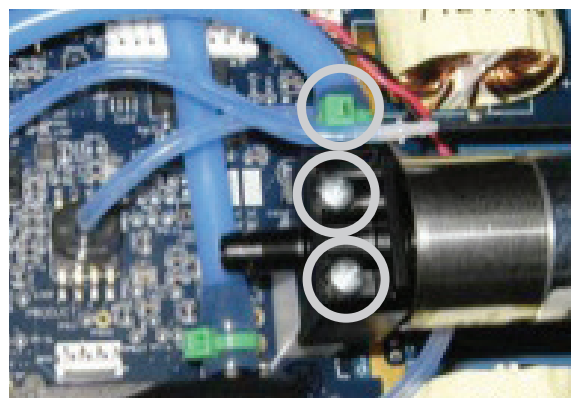


Figure 11-22. Proportional Valve Tube

11.7.4.4 Remove the Proportional Valve (5293-SEQ) from the Proportional Valve Block and replace.

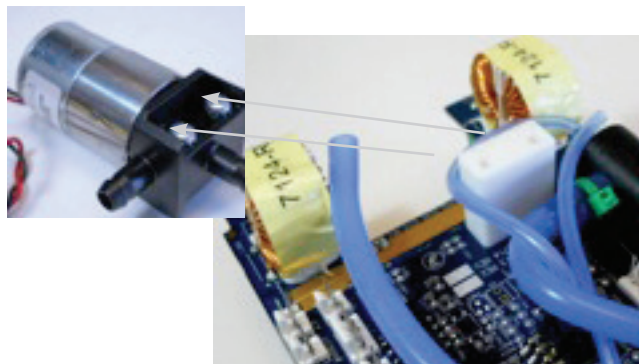


Figure 11-23. Replace Proportional Valve

### 11.7.5 COMPRESSOR FAN REMOVAL (9767-SEQ)

Remove Compressor Fan wire from PCB Assembly (if not done so already).

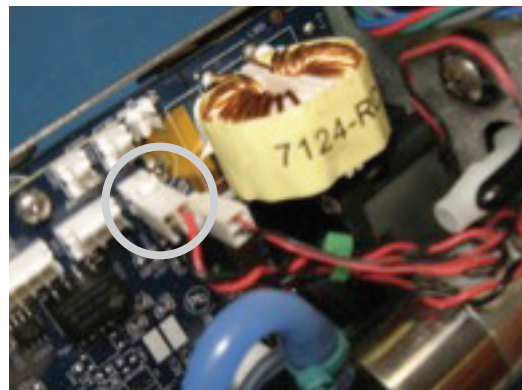


Figure 11-24. Remove Compressor Fan wire

11.7.5.1 Lift the Proportional Valve out of the way (See Proportional Valve Removal Step 3.4)

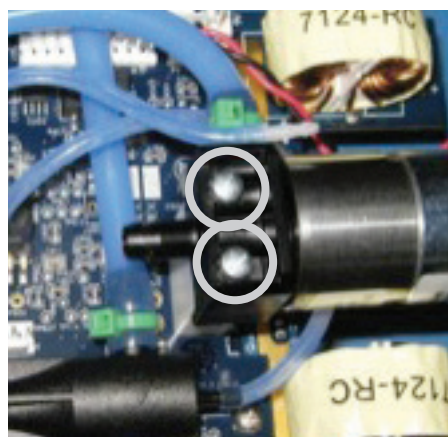


Figure 11-25. Lift the Proportional Valve

11.7.5.2 Loosen Compressor Fan screws (9913-10-SEQ) Remove the Fan subassembly (9767-SEQ) from the Compressor Bulkhead.

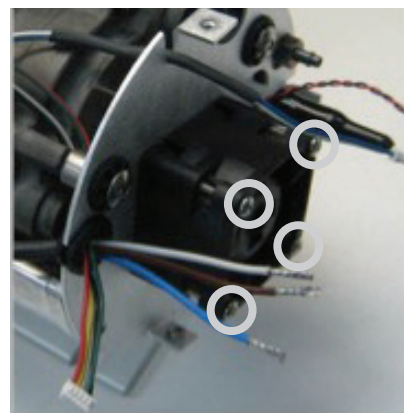


Figure 11-26. Compressor Fan

## 11.7.6 BATTERY CABLE REMOVAL (9201-SEQ)

11.7.6.1 Pull out the wires from the grommets on the bulkhead of the Compressor as shown in figure below.

Hall Effect  
Sensor

Hall Effect  
Sensor

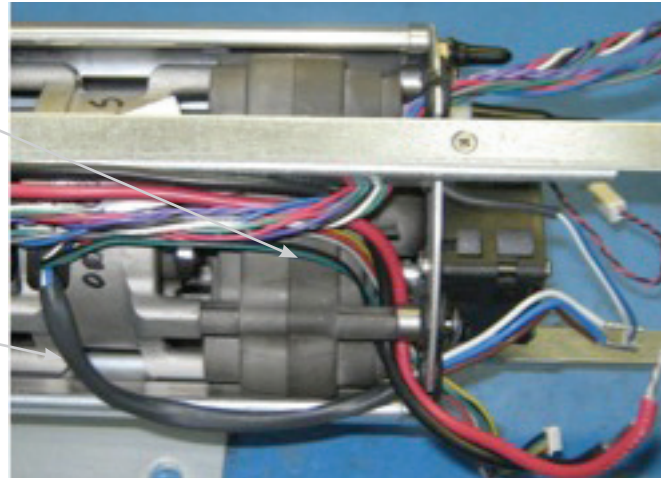


Figure 11-27. Hall Effect Sensor

11.7.6.2 Remove the two large wires (Battery Connector Cable) thru the middle Bulkhead as shown in figure below.

11.7.6.3 Remove the Wire Sleeve with the wires thru the Bulkhead.

ATF power & ATF  
thermistor wire  
connector cable

Battery Connector  
Cable (9201-SEQ)

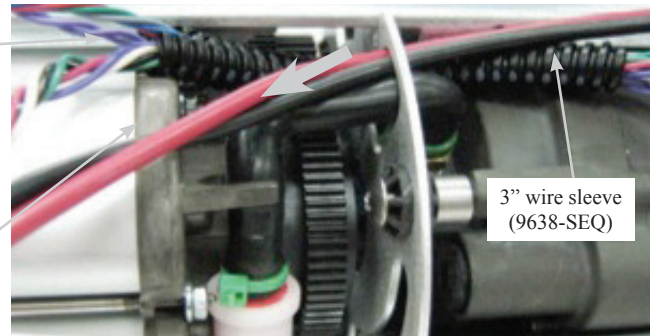


Figure 11-28. Remove Wire Sleeve

11.7.6.4 Cut and remove the 6 Cable Ties (part# 6968-SEQ) on the Side Rail & Cable Ties that group the Cable bundle together.



**CAUTION: Do not cut wires.**

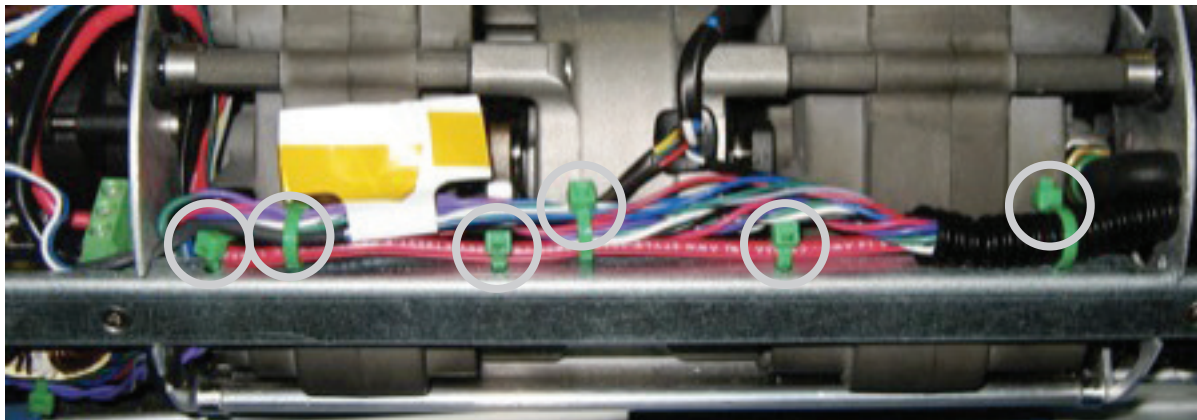


Figure 11-29. Cable Ties and Rails



11.7.6.5 Cut and remove all four Cable Ties between the STRUT (9779-SEQ) and the ATF Assembly.



**CAUTION:** Do not cut wires or damage insulation.

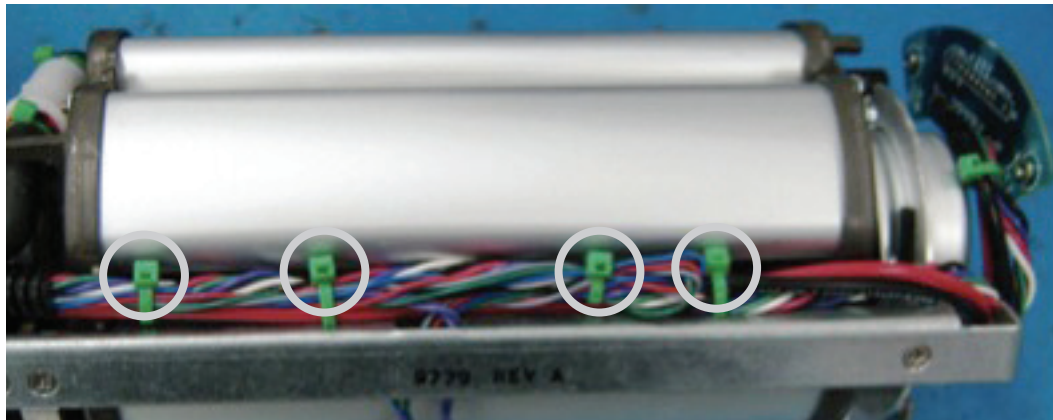


Figure 11-30. Cable Ties and Struts

### 11.7.7 RAIL REMOVAL

11.7.7.1 Remove five screws (part# 9912-1-SEQ) from left strut (9779-SEQ).



Figure 11-31. Left Strut

11.7.7.2 Remove five screws (part# 9912-1-SEQ) from right strut (9780-SEQ).

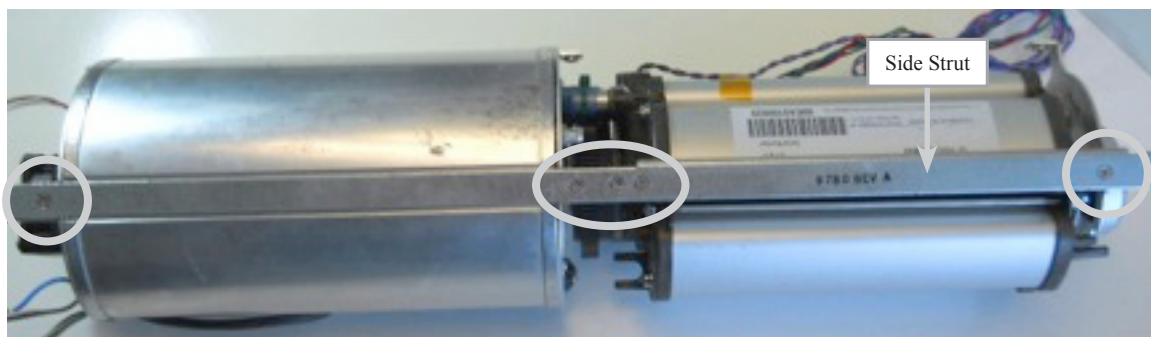


Figure 11-32. Right Strut

### 11.7.8 ATF & COMPRESSOR / TANK ASSEMBLY REMOVAL

11.7.8.1 Remove Kapton Tape (2696) from the Muffler Assembly and left strut (9779-SEQ), as shown in figure.

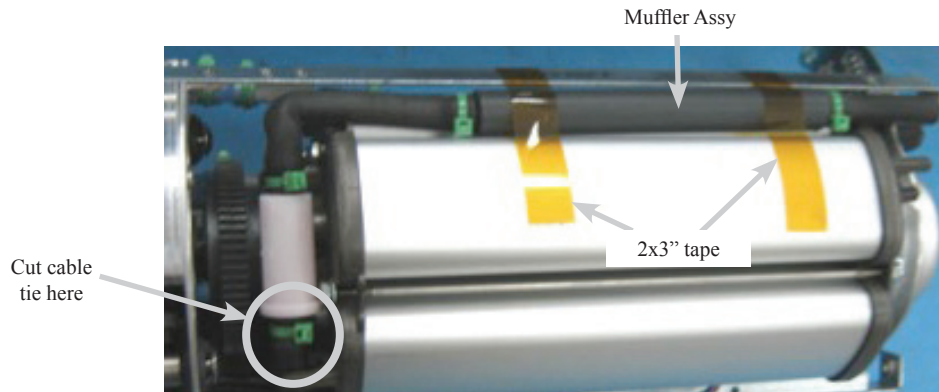


Figure 11-33. Kapton Tape

11.7.8.2 Remove exhaust tube and ATF to product tank tubing. Cap the connection port on the ATF that is exposed when the tubing is removed.



Figure 11-34. Exhaust tube

11.7.8.3 Cut and remove 2 Cable Ties (6968-SEQ) as shown on figure below.

NOTE: Leave the cable tie closest to the Compressor/Product Tank Assembly Intact.

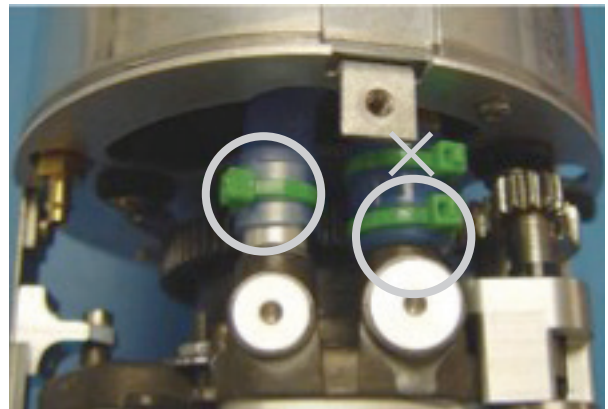


Figure 11-35. Cable Ties

11.7.8.4 Remove the silicone tubing from the ATF, leaving the tubing attached to the Compressor Assembly.

NOTE: May need to carefully pry tubing from ATF ports with a tool.

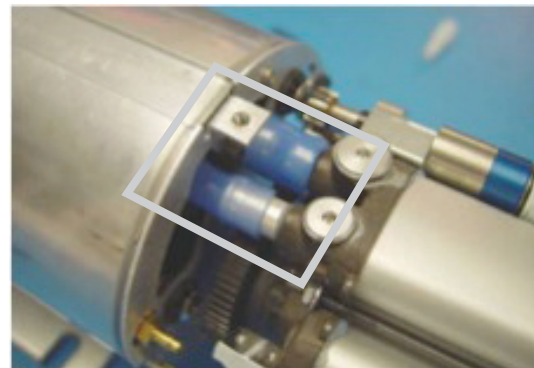


Figure 11-36. Silicone tubing

11.7.8.5 Cap both ATF ports (Feed and Vacuum ports).

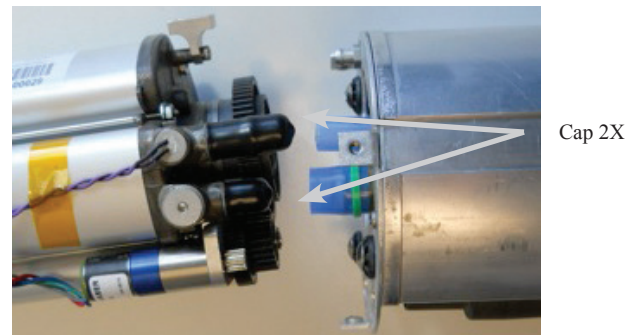


Figure 11-37. ATF ports

11.7.8.6 Remove the ATF Bulkhead FROM the bottom of the ATF Module Assembly as shown in figure below.

NOTE: Mark the position for installation.

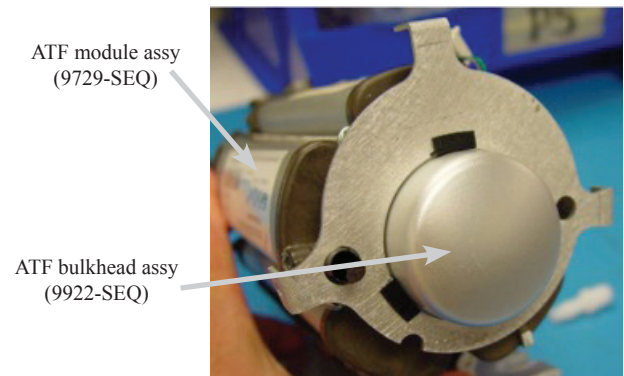


Figure 11-38. ATF bulkhead

## 11.8 INSTALLATION PROCEDURES

### 11.8.1 GENERAL PROCEDURE

11.8.1.1 Thread Locking Procedure: When applying thread locker to screws, apply 1 drop of the appropriate thread locking fluid to the first four threads of the screw/standoffs as show in the figure below. The Loctite 222MS will be used unless specified otherwise.

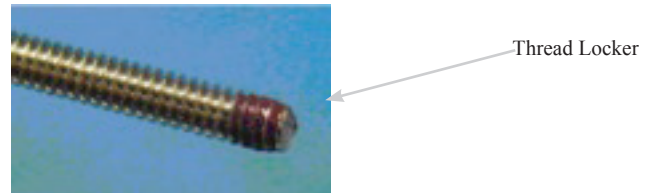


Figure 11-39. Thread Locking Procedure

11.8.1.2 CABLE TIE INSTALLATION PROCEDURE: All cable ties will be installed using cable tie gun unless specified otherwise.



Figure 11-40. Cable tie installation



## 11.8.2 ATF & COMPRESSOR/PRODUCT TANK INSTALLATION

**NOTE:** A flow calibration procedure is required after replacing the ATF or Compressor, the PCB Circuit Board, the Proportional Valve. If any of these components are replaced, the SAROS must be returned to CAIRE or a factory-authorized service center to have the flow calibration performed before returning to use.

11.8.2.1 Install the ATF Bulkhead Assembly onto the bottom of ATF Module Assembly as shown in figures below.

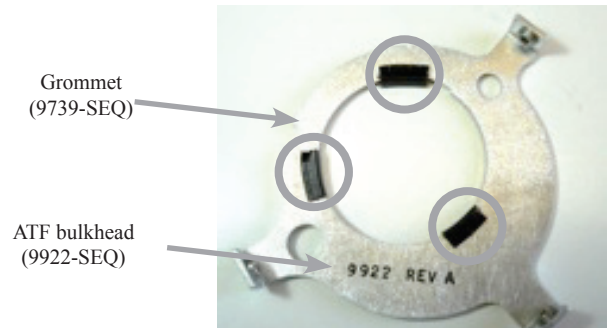


Figure 11-41. ATF Bulkhead

11.8.2.2 Place the ATF Assembly and Compressor Assembly next to each other and align as shown in figure below.

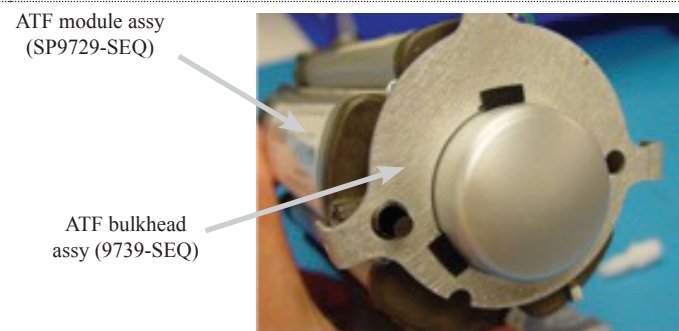


Figure 11-42. Align

11.8.2.3 Remove Caps (3575-SEQ) from the ATF. Insert the Ports from the ATF into the tubes on the Compressor /Tank Assembly. Press the ATF & Compressor together and ensure that the hoses are positioned properly.

**NOTE:** Pre-wet inner tubing on compressor with alcohol. Also, wet metal barbs on the ATF.

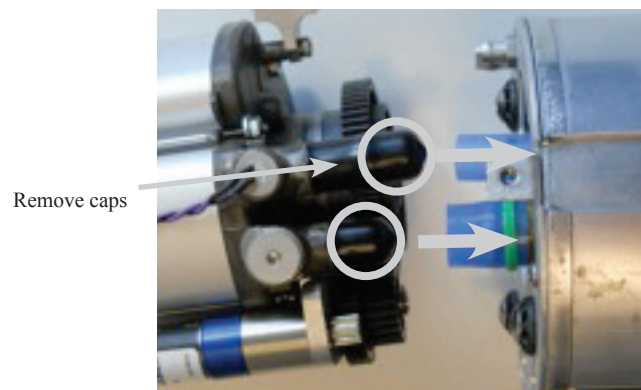


Figure 11-43. ATF caps

**NOTE:** Use Isopropyl Alcohol to lubricate the Tube and the Barb and use a Mechanics Grabber Pliers to attach the down pipe hose from the Compressor Assembly to the fitting on the ATF Module Assembly.

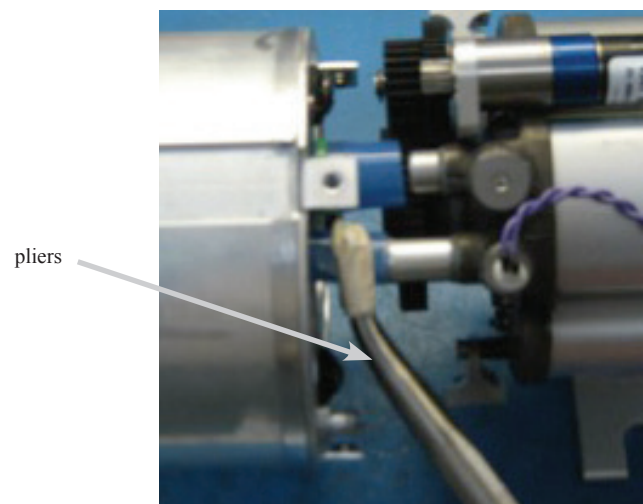


Figure 11-44. Down pipe Hose



11.8.2.4 Apply cap (1137-SEQ) to Product Tank outlet fitting to prevent ATF desaturation!

cap off  
fitting

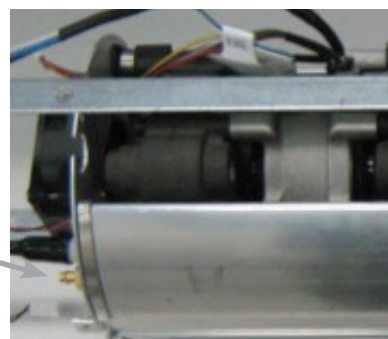


Figure 11-45. Cap

11.8.2.5 Apply 2 Cable Ties as shown on figure.

NOTE: Pre Loop Zip Ties.

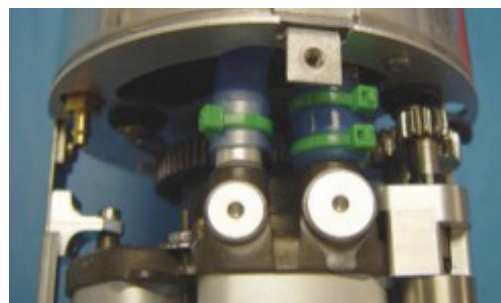


Figure 11-46. Cable Ties

11.8.2.6 Attach the Exhaust Filter, Tube, Muffler Assembly and Tube, Muffler as shown in figure below.

NOTE: Ensure Arrow on Filter points in the correct direction. Install Cable Ties (6968-SEQ) as shown in figure below. Ensure the compressor exhaust elbow tubing is through the bulkhead before/during assembly.

While applying Kapton tape, pull muffler tube to establish clearance. Make sure that tube, muffler, and muffler tube are laying down on ATF surface.

NOTE: Pulling too hard on the Exhaust Tube may cause the tube to tear.

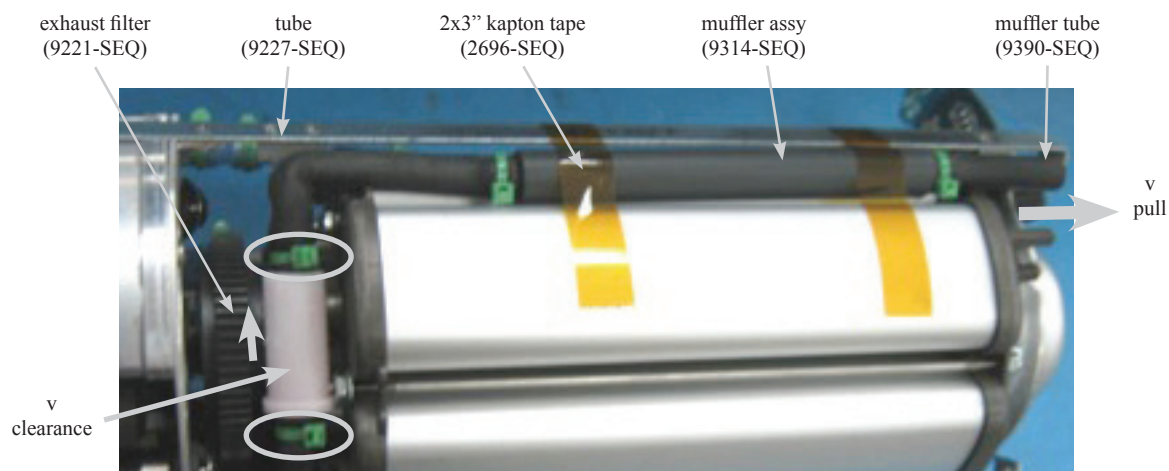


Figure 11-47. Open SAROS

11.8.2.7 Install the ATF Product Pipe onto the Product Tank with Silicone tubing and secure with Cable ties. Install the other end onto the ATF with the Product Tube and Clamp as shown in figure below.

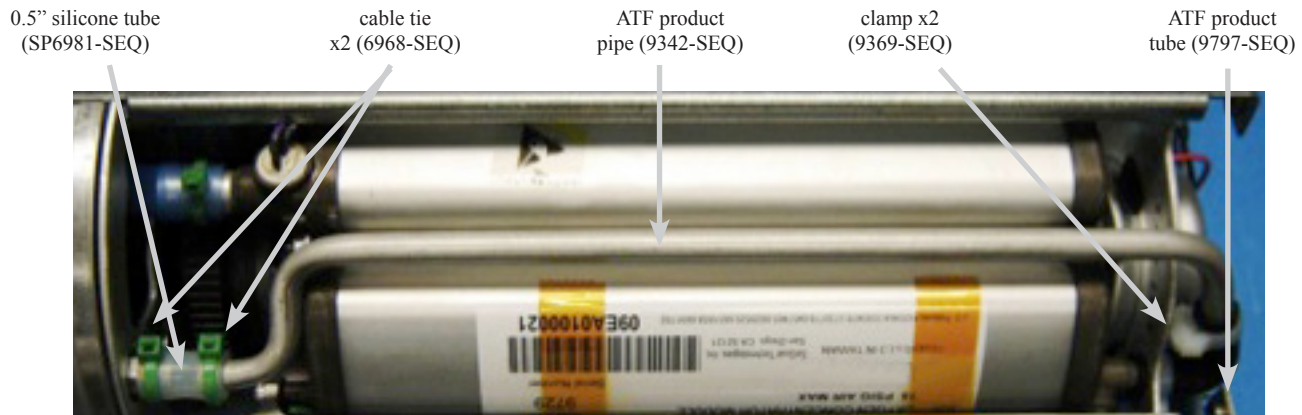


Figure 11-48. Open SAROS

### 11.8.3 RAIL INSTALLATION

11.8.3.1 Attach RIGHT STRUT (9780-SEQ) with five screws (9912-1-SEQ) with and torque to 6.0 in-lbs.

NOTE: Top bulkhead screw not shown.

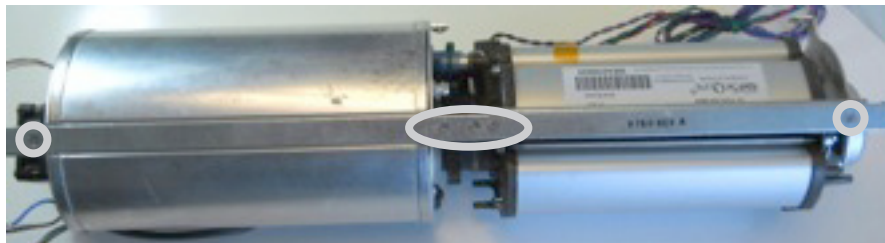


Figure 11-49. Right Strut

11.8.3.2 Rotate assembly, route the ATF wires (stepper motor and ATF thermistor wires) under the slot of the LEFT STRUT (9779-SEQ).

NOTE: Pre-install cable ties in rail holes prior to installation.

Slot in rail



Figure 11-50. Route ATF wires

11.8.3.3 Secure the STRUT (9779-SEQ) with five screws and torque the screws to 6.0 in-lb.

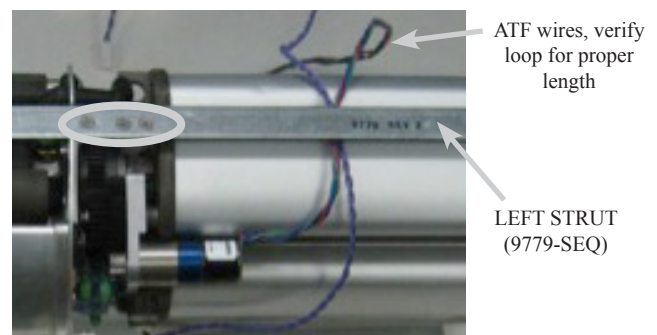


Figure 11-51. Secure

### 11.8.4 BATTERY CABLE INSTALLATION

11.8.4.1 Secure two Cable Ties through the holes in LEFT STRUT (9779-SEQ) and round all wires. Secure two Cable Ties around all wires (battery cables & ATF Bundle). Apply one Cable Tie around all battery cables, close to the battery board, as in Figure below.

NOTE: Leave the Cable Ties loose in case slack is needed at the PCBA assembly.

NOTE: Ensure slack to wires where indicated.

Orient the Cable Tie knots towards the Compressor.

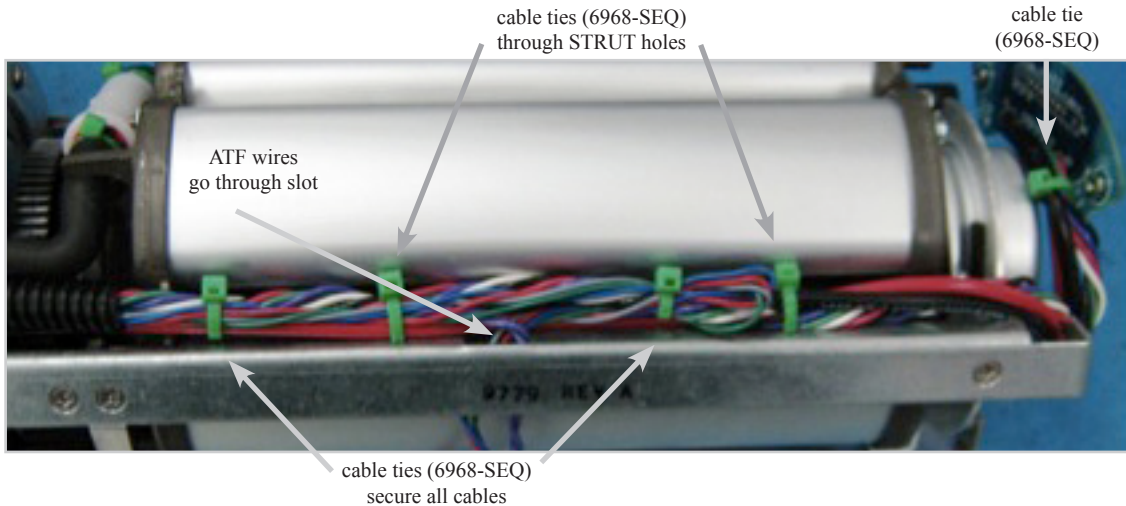


Figure 11-52. Cable Tie Knots

11.8.4.2 Wrap the Wire Sleeve around the ATF wires and pass thru the Bulkhead. Pass the two Battery wires from the Battery Connector thru the Bulkhead as shown in figure below.



Figure 11-53. Wire Sleeve



#### 11.8.4.3 Secure the Battery Power wires on the LEFT STRUT (9779-SEQ) with Cable Tie.

NOTE: Leave the Cable Ties loose in case slack is needed at the PCBA assembly.

NOTE: Ensure slack to wires where indicated.

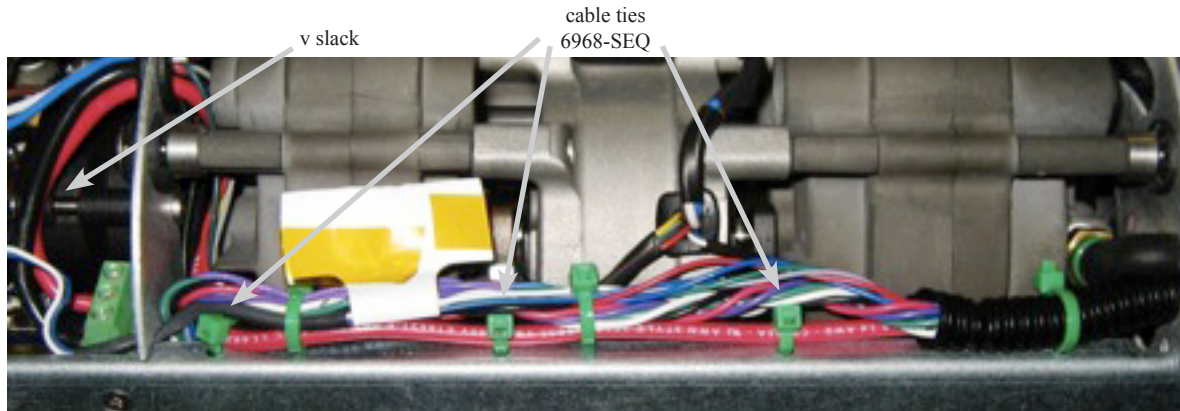


Figure 11-54. Secure Battery Wires

Orient the Cable Tie knots towards the Compressor.

#### 11.8.4.4 Secure the ATF Bundled wires to the Battery Power Cables with cable ties.

NOTE: Leave the Cable Ties loose in case slack is needed at the PCBA assembly.

#### 11.8.4.5 Ensure that there is slack on the wires on the areas indicated.

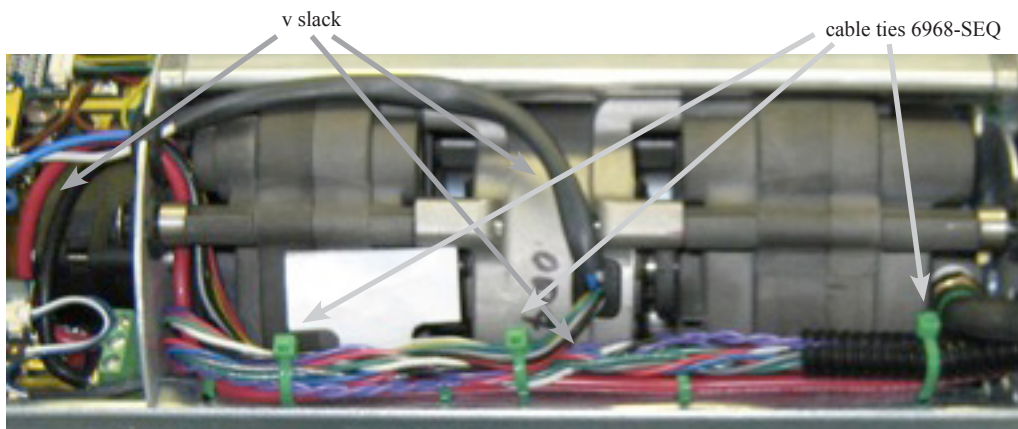


Figure 11-55. Slack

#### 11.8.4.6 Install the Grommet onto the Bulkhead to secure the ATF and Battery wires.

Route the Battery Power wires and Hall Effect wire under the mounting Compressor screw and through the Bulkhead grommet as shown in figure below.

Route the ATF wire bundle under the STRUTS prior to rail installation and through the Bulkhead grommet as shown in figure below.

NOTE: Do not pinch Thermistor Cable in bulk head.

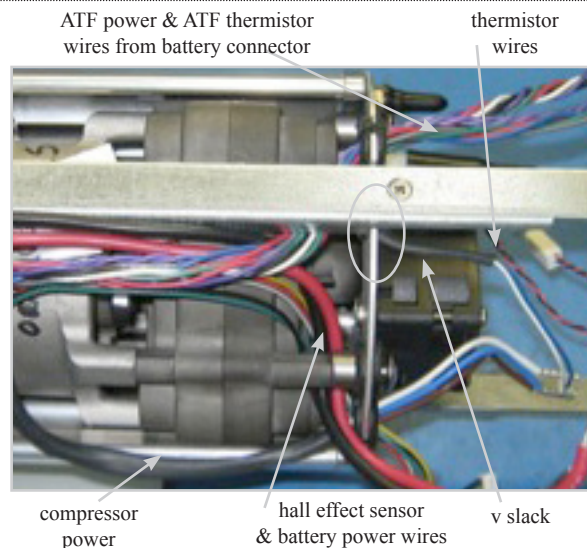


Figure 11-56. Secure ATF

### 11.8.5 COMPRESSOR FAN REPLACEMENT

11.8.5.1 Attach the Fan subassembly (9767-SEQ) with the flow arrows towards the Bulkhead as shown on figure. Apply Loctite 222MS (1405-SEQ) on the screws and torque to 2.0 in-lbs.

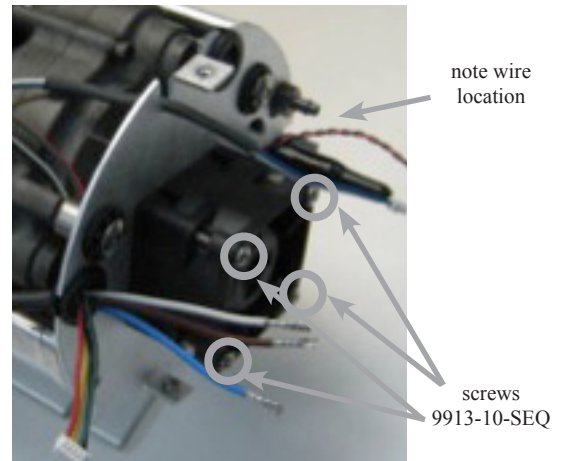


Figure 11-57. Fan

11.8.5.2 Connect the Compressor Fan wire to the PCB Assembly (If PCBA Assembly is connected)

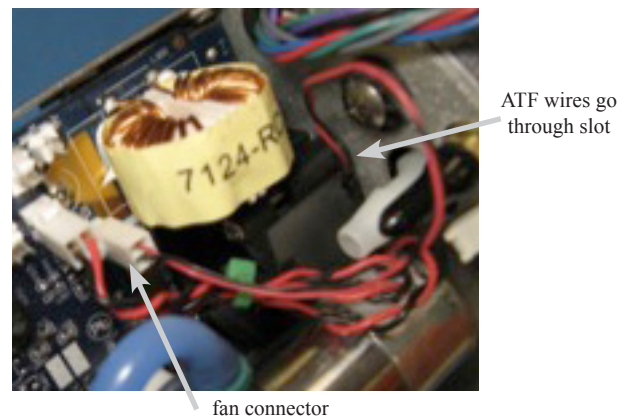


Figure 11-58. Compressor Fan Wire

### 11.8.6 PROPORTIONAL VALVE REPLACEMENT (5293-SEQ)

**NOTE:** A flow calibration procedure is required after replacing <the ATF or Compressor, the PCB Circuit Board, the Proportional Valve> If this components is replaced, the SAROS must be returned to CAIRE or a factory-authorized service center to have the flow calibration performed before returning to use.

11.8.6.1 Attach the two screws from the Proportional valve in to the Proportional Block (White) below it and Torque to 3.8 in-lbs.

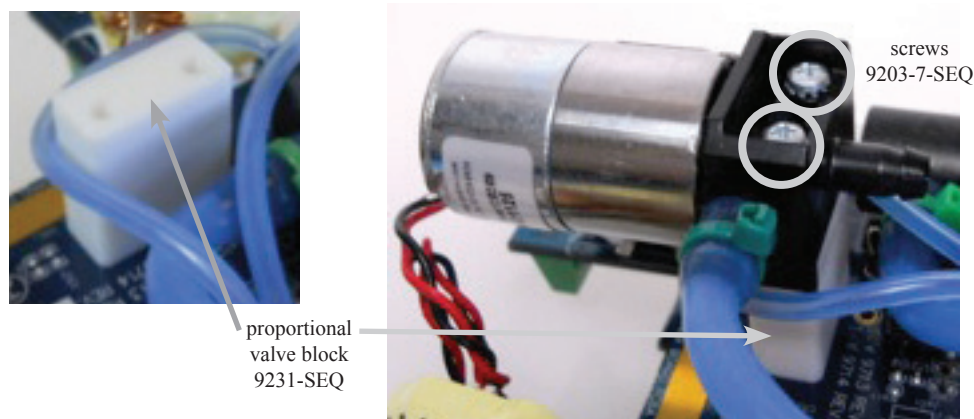


Figure 11-59. Proportional Valve

11.8.6.2 Secure the Flow Tube with a Cable Tie to the Proportional valve.

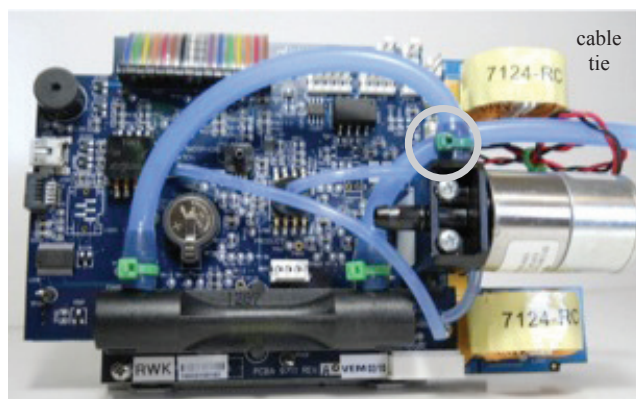


Figure 11-60. Secure

11.8.6.3 Connect Proportional Valve wire to the PCB Assembly

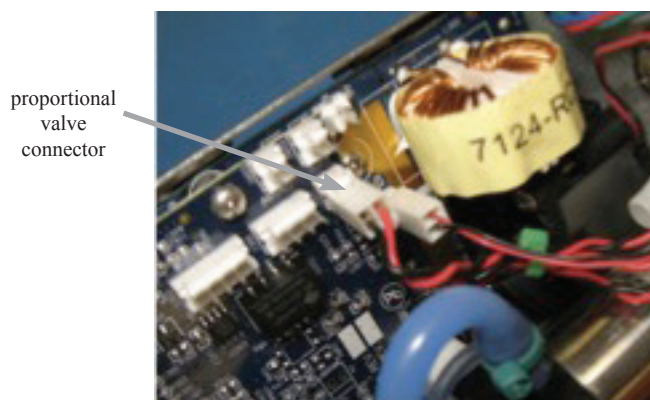


Figure 11-61. Connect

### 11.8.7 INSTALLATION OF PCB ASSEMBLY

**NOTE:** A flow calibration procedure is required after replacing <the ATF or Compressor, the PCB Circuit Board, the Proportional Valve> If this components is replaced, the SAROS must be returned to CAIRE or a factory-authorized service center to have the flow calibration performed before returning to use.

11.8.7.1 Position the PCB Assembly between the 2 STRUTS (9779-SEQ & 9780-SEQ). Install 2 Screws on each side and torque the Screws to 6.0 in-lbs.



Figure 11-62. Screws



11.8.7.2 Insert and secure the Battery Power and Compressor Power Wires where shown. Use a flat blade screwdriver to tighten and torque the screws to 4.4 in-lbs.

NOTE: Battery wire polarity indicated on the PCBA. Red is (+) and Black is (-).

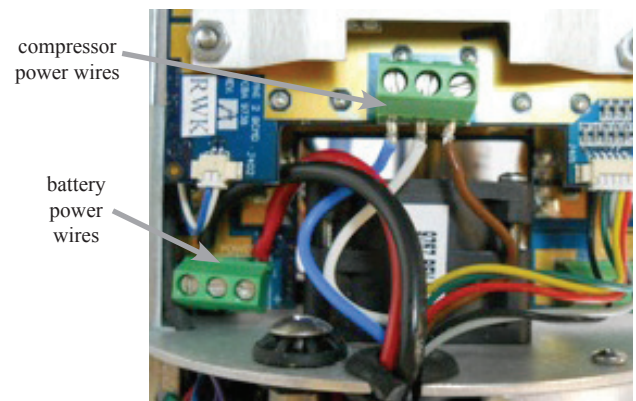


Figure 11-63. Secure

11.8.7.3 Connect the Thermistor Connector to the PCBA

11.8.7.4 Connect the Hall Effect Connector to the PCBA

NOTE: Ensure there is enough slack to the Hall Effect Wire

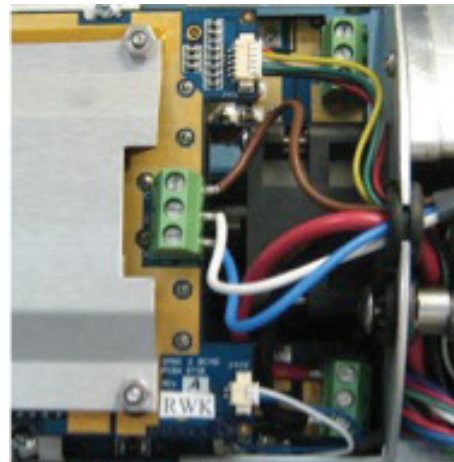


Figure 11-64. Connect

11.8.7.5 Connect the Fan Connector to the PCB and connect flow tubing.

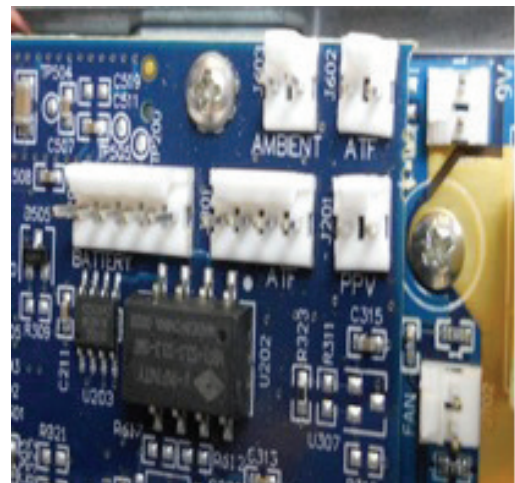


Figure 11-65. Fan Connector



11.8.7.6 Attach the Flow Tube into the Product Tank. Secure the Flow Tube with Cable tie.

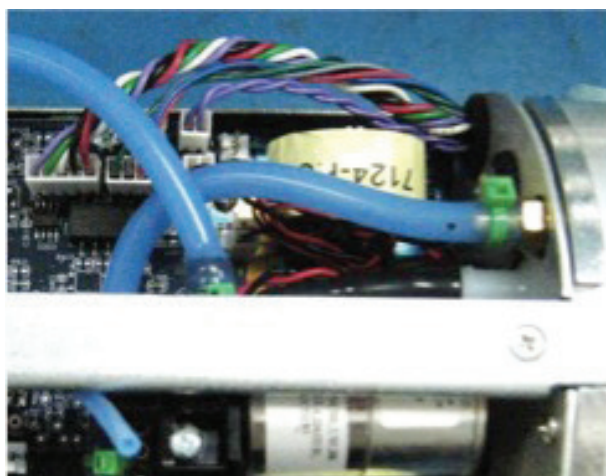


Figure 11-66. Flow Tube

11.8.7.7 Tighten and secure all wires with Cable Ties.

NOTE: Orient ALL Cable Tie knots towards the Compressor.

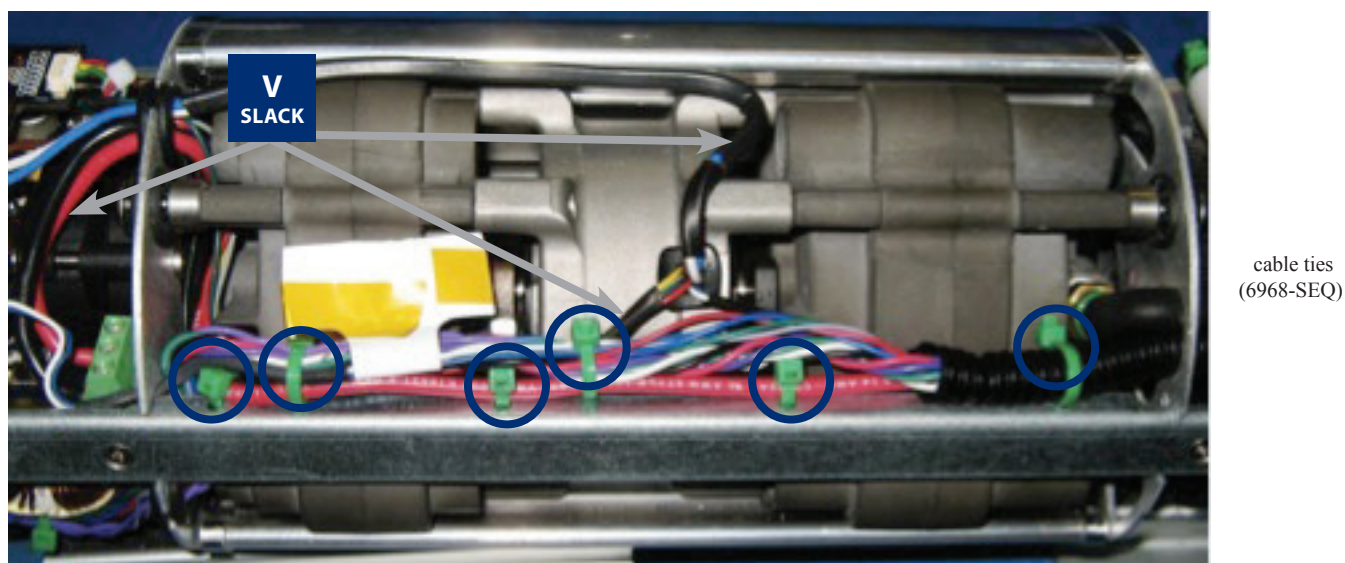


Figure 11-67. Tighten

11.8.7.8 Tighten and secure all wires with Cable Ties.

NOTE: Orient ALL Cable Tie knots towards the Compressor.

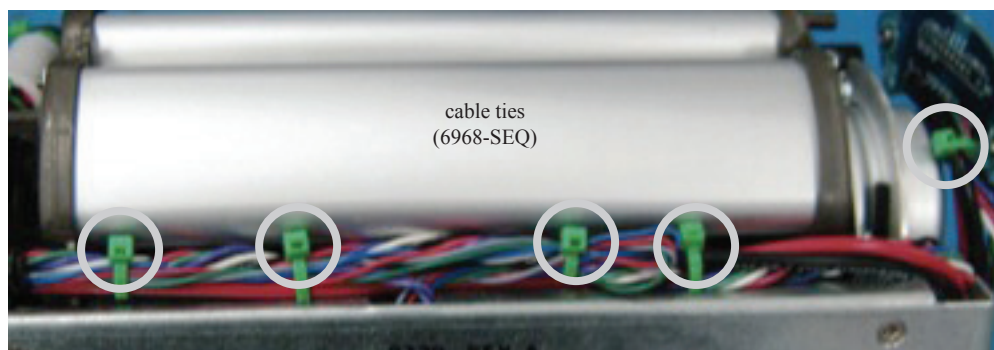


Figure 11-68. Tighten

11.8.7.9 Add Cable Tie to hold wires away from the coil. Hand-tighten loose as in Figure below.

cable tie  
(6968-SEQ)

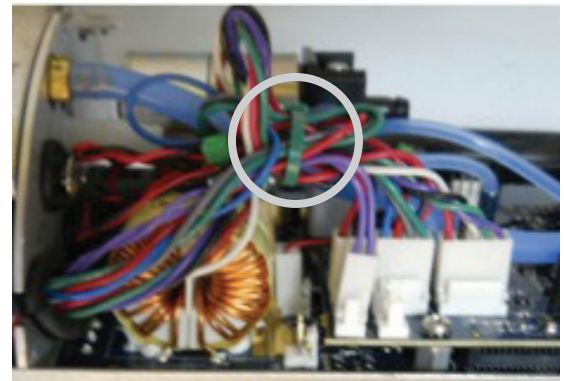


Figure 11-69. Cable Ties

11.8.7.10 Attach Top STRUT (9778-SEQ) with 5 screws as shown on figure below. Torque the screws to 6.0 in-lbs.

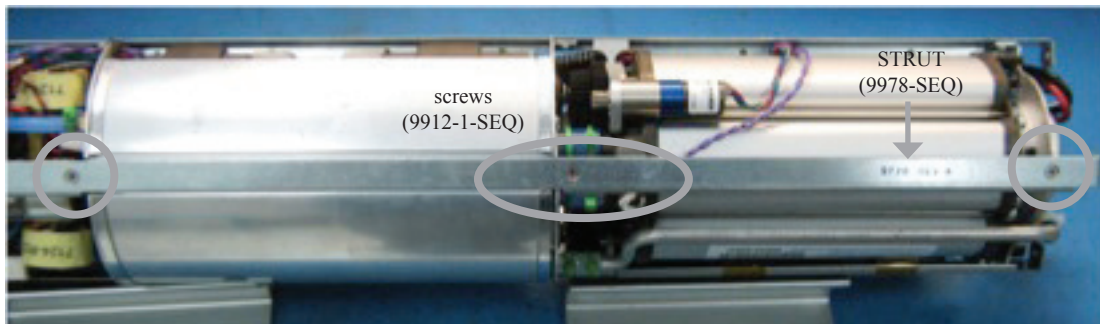


Figure 11-70. Top strut

### 11.8.8 POWER CONNECTOR REPLACEMENT (9766-SEQ)

11.8.8.1 After performing steps 11.7.1.1 thru 11.7.1.8 from “INLET CAP REMOVAL”

11.8.8.2 Remove the four screws (9203-2-SEQ) and remove the Power Connector (9766-SEQ).

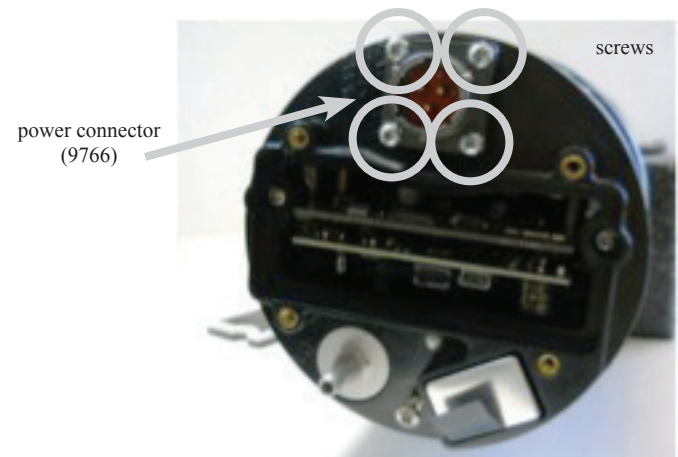


Figure 11-71. Remove screws

11.8.8.3 Install new Power Connector (9766-SEQ). Use Loctite 222 on the four mounting screws. Replace O-Ring (9916-3-SEQ) if necessary.



Figure 11-72. Power Connector

11.8.8.4 Perform steps 11.8.10.4 – 11.8.10.11 from section “Inlet Cap Installation”.

### 11.8.9 MEMBRANE PANEL REPLACEMENT (9731-SEQ)

11.8.9.1 After performing steps 11.7.1.1 thru 11.7.1.8 from “INLET CAP REMOVAL”.

11.8.9.2 Peel off the User Panel (9731-SEQ) as shown in the figure below.



Figure 11-73. Peel

11.8.9.3. Clean the surface shown in the figure below with Iso-propyl Alcohol before re-applying the new User Panel.



Figure 11-74. Clean

11.8.9.4 Remove the PSA protective cover from the new User Panel (9731-SEQ). Insert the Flex Cable as shown in the figure below.

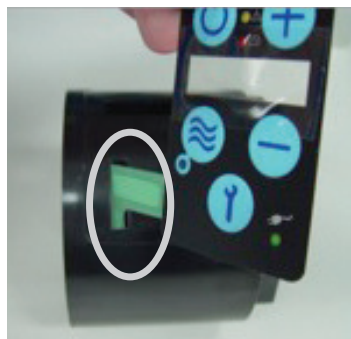


Figure 11-75. Remove PSA cover

11.8.9.5 Position and apply the new User Panel as shown in the figures below. Press firmly on the entire surface of the new User Panel to insure that it is bonded correctly.



Figure 11-76. Apply new User Panel

11.8.9.6 Reconnect the small tube (4056-SEQ [2.3’’]).

11.8.9.7 Perform steps 11.8.10.4 - 11.8.10.11 from section “INLET CAP INSTALLATION”.



### 11.8.10 INLET CAP INSTALLATION (9756-SEQ)

11.8.10.1 Place O-Ring in the Ring Sleeve.

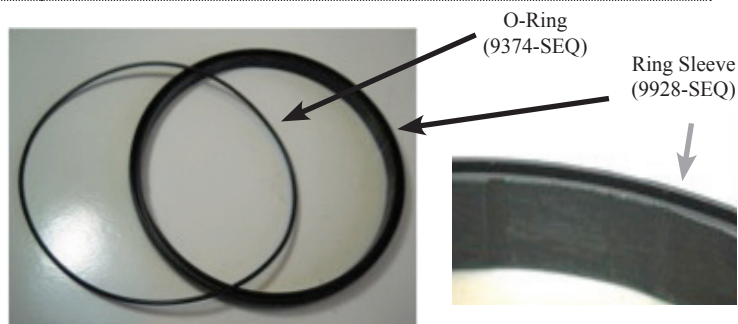


Figure 11-77. O-ring attached

11.8.10.2 Align & slide the 3 O-RINGS in the Ring SLEEVE over the 3 STRUTS.

11.8.10.3 Place the Inlet Cap (9756-SEQ) over the STRUTS so that the LCD Display is lined up with the Membrane Panel Window.



Figure 11-78. Inlet Caps

11.8.10.4 Connect the Breath Detect Tube.

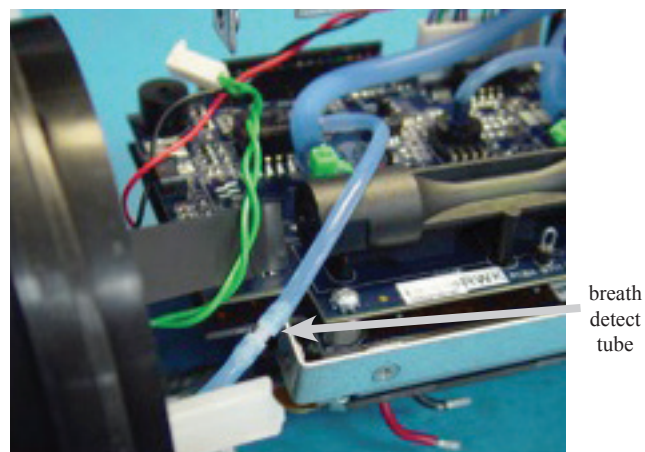


Figure 11-79. Breach Tube

11.8.10.5 Insert Power Harness wires from the Inlet Cap and tighten the screws to 4.4 in-lbs.

NOTE: Battery wire polarity indicated on the PCBA. Red is (+) and Black is (-).



Figure 11-80. Power Harness Wires

11.8.10.6 Insert Front Panel Flex cable flush with locking connector. Apply 2" of Kapton Tape (2696-SEQ) on the Mounting STRUT.

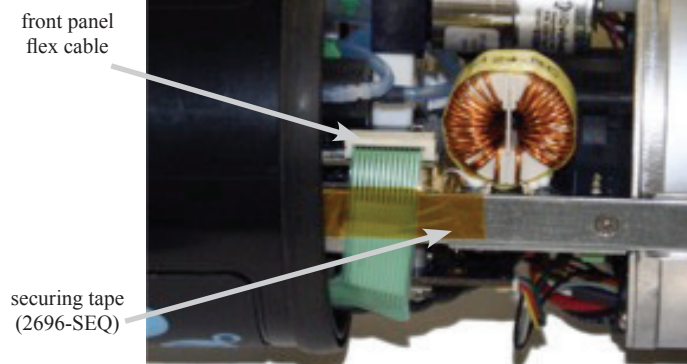


Figure 11-81. Flex cable

11.8.10.7 Connect the Ambient Air Thermistor and connect 9V Battery Connector as shown.

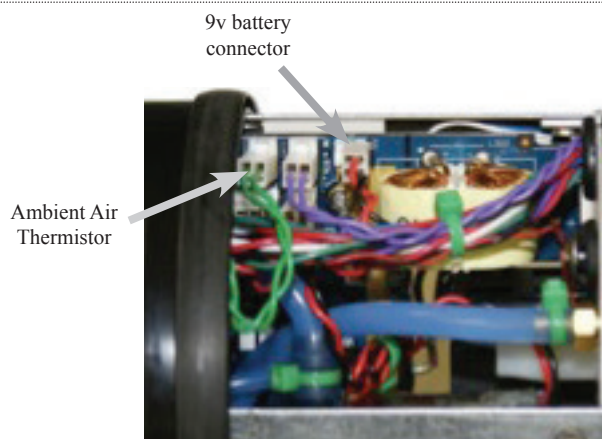


Figure 11-82. Ambient Air Thermistor

11.8.10.8 Attach the Oxygen Outlet Tube (6981-SEQ) to the Flow Valve outlet port and secure with a cable tie.

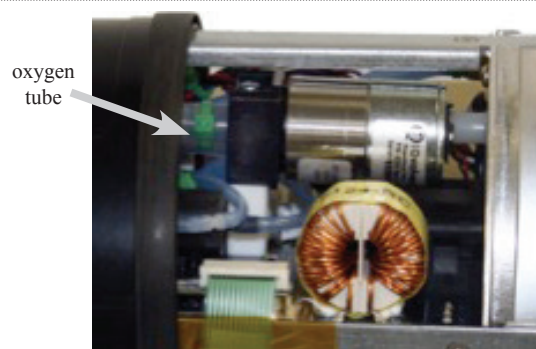


Figure 11-83. Oxygen Outlet Tube

11.8.10.9 Secure the three Inlet Cap Mounting screws (9914-6-SEQ) to each STRUT.



Figure 11-84. Inlet Cap mounting screws

11.8.10.10 Insert and connect the 9V Battery (9257-SEQ) and the Filter (9798-SEQ).

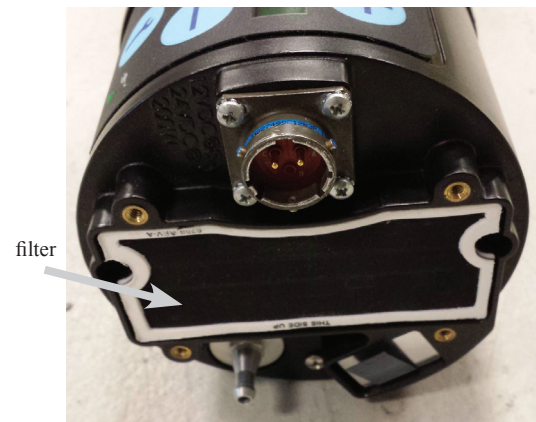


Figure 11-85. 9V battery

11.8.10.11. Align the Air Inlet Cover (9758-SEQ) to the top of the SAROS and tighten the four screws (P9291-SEQ).



Figure 11-86. Align covers and tighten

### 11.8.11 INSTALLATION OF THE SLEEVE & BATTERY INTERFACE PLATE

11.8.11.1 Slide Sleeve (9280-SEQ) and Ring sleeve with O-Rings (9928-SEQ) over struts, and insert it into Aligning Ring that is attached to the Inlet Cap.

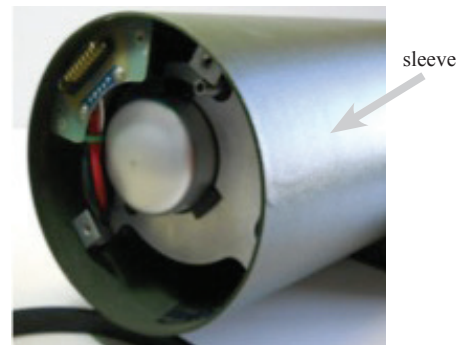


Figure 11-87. Slide Sleeves

11.8.11.2 Align second Sleeve (9928-SEQ) AND O-RING (9928-SEQ) over the STRUTS, to the Sleeve leaving the Battery board exposed.

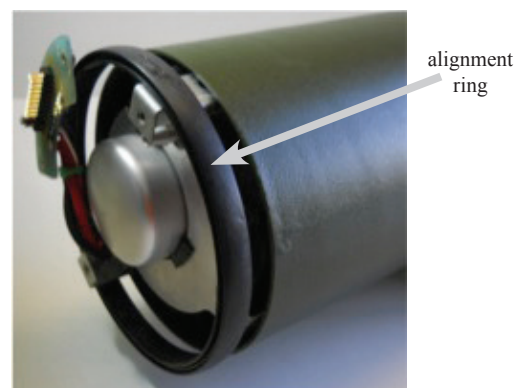


Figure 11-88. Second sleeve

11.8.11.3 Attach the Battery Interface Assembly (9292-SEQ) to the Rain Guard by attaching the two screws (9960-4-SEQ).

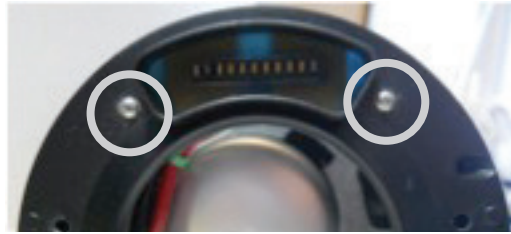


Figure 11-89. Battery Interface Assembly

11.8.11.4 Align and attach the Exhaust tube to the Exhaust port on the Rain Guard.



Figure 11-90. Attach

11.8.11.5 Align the three screws (9914-6-SEQ) of the Battery Interface Plate (9939-SEQ) to the Rain Guard.



Figure 11-91. Align



12.0 SERVICE RECORDS & RETENTION

12.1 RECORD HOURS OF OPERATION AND SOFTWARE VERSION

To help maintain the SAROS, you may obtain the Total Hours of Operation and software version numbers for the Control Board.

To obtain system information, follow these steps:  
Press the “Utility” Button on the control panel and advance to the following display mode for each time the icon is depressed:

- Tactical Mode
  - Alarm Code
- Pulse Sensitivity
  - LCD Contrast
  - Tactical Volume
- Tactical Brightness
  - Normal Brightness
  - 9-volt Battery Status
- Hour of Operation
  - System Software Version
  - Motor Software Version

| Total Hours of Operation |  |
|--------------------------|--|
| Alarm Code               |  |
| Pulse Sensitivity        |  |
| LCD Contrast             |  |
| Tactical Volume          |  |
| Tactical Brightness      |  |
| Normal Brightness        |  |
| 9-Volt Battery Status    |  |
| Hour Meter               |  |
| System Software Version  |  |
| Motor Software Version   |  |

Table 12-1. Log the Results

## 12.2 SERVICE AND MAINTENANCE RECORD

Whenever maintenance or service is performed on an SAROS unit, an entry should be made in the service log for that concentrator or recorded in accordance with your company's standard procedure. Whenever the sleeve of the SAROS is removed, the flow rate, purity, and alarm status should be verified per the Test Procedures in this manual.

[illegible]

Table 12-2. Sample SAROS Maintenance Record

## APPENDIX A

## A.1 SAROS PERFORMANCE VERIFICATION CHECKLIST

|   |   |   |  |                         |    |    |    |    |      |
|---|---|---|--|-------------------------|----|----|----|----|------|
| <b>SAROS Serial Number:</b>                                   |   |   |  |                         |    |    |    |    |      |
| Hours of Operation:   |   |   |  | Date of Testing:        |    |    |    |    |      |
| <b>A. General Operation Test</b>                              | <b>Pass</b>                                       |   |  | <b>Fail</b>             |    |    |    |    |      |
| 1) Battery installs properly                                  |   |   |  |                         |    |    |    |    |      |
| 2) External power cord (AC or DC) connects securely           |   |   |  |                         |    |    |    |    |      |
| 3) Unit powers on after holding ON/OFF button for 3 seconds   |   |   |  |                         |    |    |    |    |      |
| 4) Audible alarm sounds upon start-up                         |   |   |  |                         |    |    |    |    |      |
| 5) 5-minute warm up period complete with no audible alarm     |   |   |  |                         |    |    |    |    |      |
| 6) Utility Mode shows no active alarms after 5-minute warm up |   |   |  |                         |    |    |    |    |      |
| 7) Battery icon visible on screen                             |   |   |  |                         |    |    |    |    |      |
| 8) Battery is charging or already fully charged               |   |   |  |                         |    |    |    |    |      |
| 9) Blocked Flow Alarm is functional                           |   |   |  |                         |    |    |    |    |      |
| 10) Increase and decrease flow buttons are functional         |   |   |  |                         |    |    |    |    |      |
| 11) Pulse flow mode button is functional                      |   |   |  |                         |    |    |    |    |      |
| 12) No breath alarm is functional                             |   |   |  |                         |    |    |    |    |      |
| 13) Unit runs on battery power                                |   |   |  |                         |    |    |    |    |      |
| 14) No battery alarm is functional                            |   |   |  |                         |    |    |    |    |      |
| 15) Automatic re-start when power is reconnected              |   |   |  |                         |    |    |    |    |      |
| <b>B. Flow and O<sub>2</sub> Concentration Test</b>           | <b>Acceptable Range</b>                           |   |  | <b>Recorded Reading</b> |    |    |    |    |      |
| <b>1) Continuous Flow Setting Verification</b>                |   |   |  |                         |    |    |    |    |      |
| C3 (3.0 LPM) ) O <sub>2</sub> Concentration                   | 90 - 96 %   |   |  |                         |    |    |    |    |      |
| C3 (3.0 LPM) flow -- 60 second average reading <sup>1</sup>   | Argon-Compensated Testing Device: 2.70 - 3.30 LPM | Non Argon-Compensated Testing Device: 2.60 - 3.20 LPM |  |                         |    |    |    |    |      |
| C2 (2.0 LPM) ) O <sub>2</sub> Concentration                   | 90 - 96 %   |   |  |                         |    |    |    |    |      |
| C2 (2.0 LPM) flow -- 60 second average reading <sup>1</sup>   | Argon-Compensated Testing Device: 1.80 - 2.20 LPM | Non Argon-Compensated Testing Device: 1.70 - 2.10 LPM |  |                         |    |    |    |    |      |
| <b>2) Pulse Flow Mode Verification</b>                        |   |   |  |                         |    |    |    |    |      |
| P48 (48 mL) -- 5 bolus average reading                        | 40.8 - 55.2 mL                                    |   |  | 1:                      | 2: | 3: | 4: | 5: | Ave: |
| P96 (96 mL) -- 5 bolus average reading                        | 81.6 - 110.4 mL                                   |   |  | 1:                      | 2: | 3: | 4: | 5: | Ave: |
| <b>C. Battery Run Time Test</b>                               | <b>Acceptable Range</b>                           |   |  | <b>Recorded Reading</b> |    |    |    |    |      |
| C3 (3.0 LPM)  | > 24 min  |   |  |                         |    |    |    |    |      |

Table A-1. SAROS Performance Verification Checklist

Footnotes: (1) The SAROS is BTP compensated. If measuring concentration and/or flow with a device that is non-Argon compensated and non-BTP compensated, the acceptable range of the device readings will be reduced by 0.1 LPM.

Technician Name (print): \_\_\_\_\_

Technician Signature: \_\_\_\_\_

Date: \_\_\_\_\_



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Salter Labs® is a registered mark of Salter Labs, Arvin, CA 92303.  
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