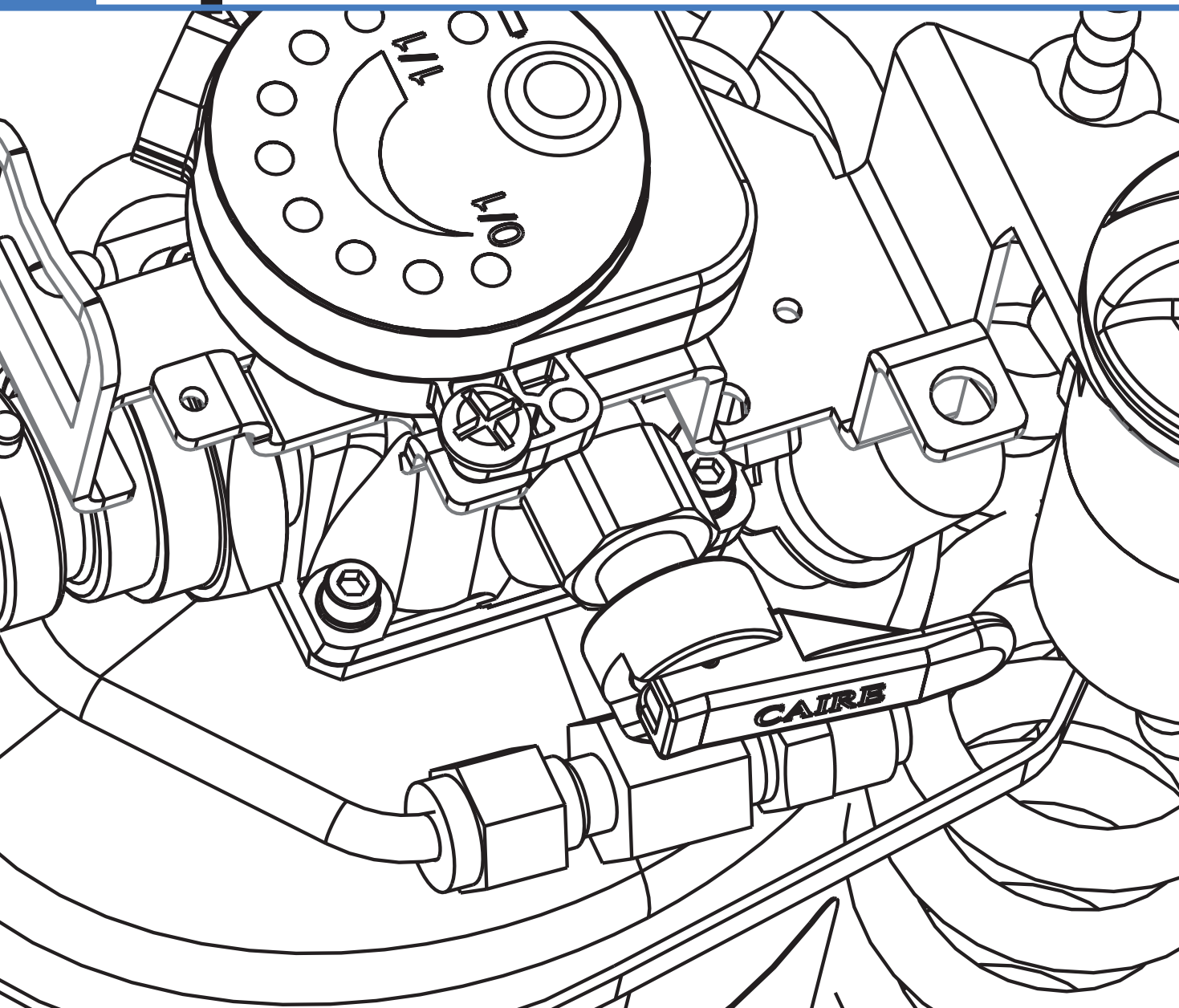




Sprint & Stroller



Technical Service Manual

I Preface

SERVICE MANUAL

SPRINT™ STROLLER®

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Abbreviations

FCV	Flow Control Valve	PRV	Primary Relief Valve
LED	Light Emitting Diode	QDV	Quick Disconnect Valve
LOX	Liquid Oxygen	RMA	Return Materials Authorization
LPM	Liters Per Minute	RP	Repair Procedure
NER	Normal Evaporation Rate	R/R	Removal and Replacement
POI	Patient Operating Instructions	SRV	Secondary Relief Valve
N2	Nitrogen Gas	O2	Oxygen Gas
TF	Top Fill	SF	Side Fill
DF	Dual Fill	PTFE	Polytetrafluoroethylene (Teflon®)

Definition of Terms

WARNING Description of a condition that can result in personal injury or death.

CAUTION Description of a condition that can result in equipment or component damage.

NOTE A statement containing information important enough to emphasize or repeat.

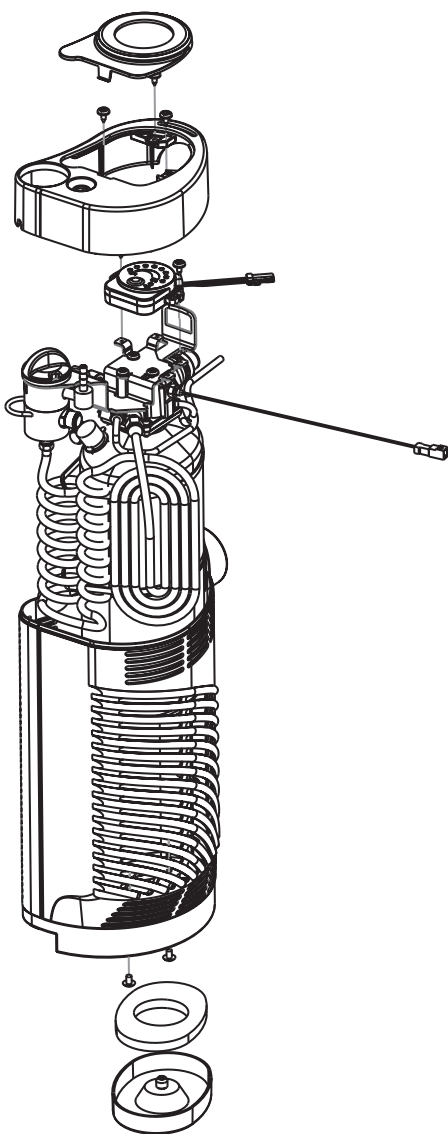
(ITEM) Item numbers used throughout this manual are shown on the illustrations beginning on page 34.

Disclaimer

This manual is intended for use by experienced personnel only. No attempt should be made to fill or maintain this equipment until both this manual and the Patient Operating Instruction booklet have been read and fully understood.

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FIGURE 1: Sprint / Stroller Components



* Gen 4 meter with hardcase shown

CAIRE Inc.'s Sprint or Stroller is the portable component of the Liberator/Portable supplementary oxygen system. Enclosed in a contoured light-weight case, the Sprint or Stroller incorporates a stainless steel cryogenic container with the valves, plumbing, and associated hardware required to deliver gaseous oxygen to the patient at near ambient temperature.

The Sprint and Stroller are comprised of five major assemblies, grouped according to function.

1. **Cryogenic Container** – This assembly is a double walled, vacuum insulated dewar for storing liquid oxygen at approximately -180°C (-300°F).
2. **Breathing Circuit** – This circuit consists of the manifold assembly, fixed orifice rotary flow control valve (FCV) and vaporizing coil. It withdraws liquid oxygen from the cryogenic container, warms it to near ambient temperature, and regulates the flow of oxygen gas to the patient. Water that condenses on the cold coils is collected and absorbed by the condensate pad.
3. **Case Assembly** – The hard case assembly consists of a top cover, side cover, and bottom cover. These cases house and protect the cryogenic container, the breathing circuit, and the liquid level meter. The Stroller soft case is a one piece assembly.
4. **Liquid Level Meter** – This system uses a capacitance probe and an electronic (LED) readout to measure and display the LOX level by pressing the onboard operate button. Alternatively, the Sprint / Stroller are also available in a Spring Scale version.
5. **Filling Circuit** – This manual covers both the side fill Sprint/Stroller with the rotary quick disconnect valve and the top fill Sprint/Stroller with the push quick disconnect valve for filling.

	STROLLER*	PEDIATRIC STROLLER*	SPRINT™	PEDIATRIC SPRINT™
Capacity				
LOX lbs. (kg)	3.0 (1,36)	3.0 (1,36)	1.5 (0,68)	1.5 (0,68)
Liquid Liters	1,25	1,25	0,63	0,63
Gaseous Liters	1026	1026	513	513
Selectable Flow Rates				
Liters Per Minute (LPM):	Off 0,25 0,50 0,75 1,0 1,5 2,0 2,5 3,0 4,0 5,0 6,0	Off 0,03 0,06 0,13 0,25 0,38 0,50 0,63 0,75 1,0 1,5 2,0	Off 0,25 0,50 0,75 1,0 1,5 2,0 2,5 3,0 4,0 5,0 6,0	Off 0,03 0,06 0,13 0,25 0,38 0,50 0,63 0,75 1,0 1,5 2,0
Flow Rate Accuracy	± 0.1 liter per minute or ±10% of flow setting, whichever is greater	Refer to Table 1 on page 9	± 0.1 liter per minute or ±10% of flow setting, whichever is greater	Refer to Table 1 on page 9
Normal Evaporation Rate lbs./day (kg/day)	1.3 (0,57)	1.3 (0,57)	1.3 (0,57)	1.3 (0,57)
Operating Pressure PSIG (Bar)	20 (1,4)	20 (1,4)	20 (1,4)	20 (1,4)
Primary Relief Valve Setting PSIG (Bar)	19.7-21.5 (1,35-1,48)	19.7-21.5 (1,35-1,48)	19.7-21.5 (1,35-1,48)	19.7-21.5 (1,35-1,48)
Secondary Relief Valve Setting PSIG (Bar)	27-33 (1,86-2,27)	27-33 (1,86-2,27)	27-33 (1,86-2,27)	27-33 (1,86-2,27)
Filling Time				
Warm minutes:seconds	2:00	2:00	1:30	1:30
Cold minutes:seconds	1:00	1:00	0:45	0:45
Height in (cm)	13.5 (34,3)	13.5 (34,3)	11.75 (29,8)	11.75 (29,8)
Hard Case				
Width in (cm)	Oval 6.5 x 5.0 (16,5 x 12,7)	Oval 6.5 x 5.0 (16,5 x 12,7)	Oval 6.5 x 4.0 (16,5 x 10,2)	Oval 6.5 x 4.0 (16,5 x 10,2)
Soft case				
Width in (cm)	Oval 7.25 x 5.0 (18,4 x 12,7)	Oval 7.25 x 5.0 (18,4 x 12,7)		
Weight				
Empty lbs. (kg)	5.0 (2,3)	5.0 (2,3)	4.5 (2,0)	4.5 (2,0)
Full lbs. (kg)	8.0 (3,6)	8.0 (3,6)	6.0 (2,7)	6.0 (2,7)
Fill Connector Types	Male side mounted rotary coupling, female bottom mounted push-on coupling, or female bottom mounted rotary coupling.			

Oxygen, as it exists at standard atmospheric pressure and temperature, is a colorless, odorless, and tasteless gas. Oxygen constitutes 21% of the atmosphere, by volume. Aside from its well-documented ability to sustain life, oxygen also supports combustion, even though it is nonflammable. Many substances which will burn in air, burn at a faster rate and at a higher temperature in an oxygen-enriched atmosphere. Other materials that do not burn in air will burn as oxygen concentration increases. Additionally, many greases and liquid solvents become extremely hazardous materials when placed in an oxygen-enriched environment. In its liquid form, oxygen is still odorless and tasteless, but is pale blue in color. At an operating pressure of 20 psig (1,4 bar), the temperature of liquid oxygen is about -173°C (-280° F). Skin exposed to such a low temperature can become severely frostbitten.

These hazards require certain safety precautions to be taken when working with or around gaseous and/or liquid oxygen:

1. Never permit combustible substances such as greases, oils, solvents, or other compounds not oxygen compatible to contact any component of the unit exposed to higher-than-atmospheric concentrations of gaseous or liquid oxygen. This especially applies to tubing, fittings, and valves.
2. Keep oxygen equipment away from open flames or electrical appliances such as heaters, stoves, toasters, and other devices with heating elements.
3. Never permit smoking in an area where oxygen equipment is repaired, filled, or used.
4. Always wear goggles, a face shield, and insulated gloves when working with or around liquid oxygen.

While CAIRE Inc. equipment is designed and built to the most rigid standards, no piece of mechanical equipment can ever be made 100% foolproof. Strict compliance with proper safety practices is necessary when using any Sprint/Stroller unit. We recommend that our distributors emphasize safety and safe handling practices to their employees and customers. While safety features have been designed into the unit and safe operations are anticipated, it is necessary that all distributor personnel carefully read and fully understand **WARNINGS**, **CAUTIONS**, and **NOTES** throughout the manual. Periodic review of this information is recommended.

WARNING: Excess accumulation of oxygen creates an oxygen-enriched atmosphere (defined by the Compressed Gas Association as an oxygen concentration above 23%). In an oxygen-enriched atmosphere, flammable items may burn vigorously and may explode. Certain items considered non-combustible in air may burn rapidly in such an environment. Keep all organic materials and other flammable substances away from possible contact with oxygen; particularly oil, grease, kerosene, cloth, wood, paint, tar, coal dust, and dirt which may contain oil or grease. **DO NOT** permit smoking or open flame in any area where oxygen is stored, handled, or used. Failure to comply with this warning may result in serious personal injury.

WARNING: In the event a unit is dropped, tipped over, or unreasonably abused; immediately, but cautiously, raise the container to its normal vertical position. If substantial container damage has occurred, remove the liquid oxygen from the vessel in a safe manner (RP14). Purge the unit with an inert gas (nitrogen) and promptly return it to CAIRE, Inc. for inspection. The container should be prominently marked **“CONTAINER DROPPED, INSPECT FOR DAMAGE.”** Failure to comply with these procedures may result in personal injury and can seriously damage the container.

WARNING: Personnel must remove liquid oxygen and depressurize the unit before removing parts or loosening fittings from a unit. Failure to do so may result in personal injury from the extreme cold of liquid oxygen and/or the pressure in the vessel.

WARNING: During transfer of liquid oxygen, components will become extremely cold. Care should be used to avoid any contact with these components, as serious frostbite may result.

WARNING: Keep filled unit upright at all times. Tip over of filled unit may result in liquid oxygen leakage and/or an oxygen-enriched atmosphere.

CAUTION: Only use replacement equipment which is compatible with liquid oxygen and has been cleaned for oxygen use. Do not use regulators, fittings, hoses, etc. which have been previously used in non-oxygen service.

V Safety

WARNING: Medical electrical Equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in this manual.

WARNING: Portable and mobile RF communications equipment can affect Medical Electrical Equipment.

WARNING: The use of Accessories, transducers, and cables other than those specified by the manufacturer may result in increased Emissions or decreased immunity of the Sprint/Stroller.

WARNING: The Sprint/Stroller should not be used adjacent to or stacked with other equipment, and that if adjacent or stacked use is necessary, the Sprint/Stroller should be observed to verify normal operation in the configuration in which it will be used.

Table 1

Guidance and Manufacturer's declaration—electromagnetic emissions

The Sprint/Stroller is intended for use in the electromagnetic environment specified below. The customer or the user of the Sprint/Stroller should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic environment—guidance
RF emissions CISPR 11	Group 1	The Sprint/Stroller uses RF energy only for internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The Sprint/Stroller is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Not applicable	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Not applicable	

Table 2

Guidance and manufacturers declaration—electromagnetic immunity

The Sprint/Stroller is intended for use in the electromagnetic environment specified below. The customer or the user of the Sprint/Stroller should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment—guidance
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.*
Electrical fast transient/burst IEC 610004-4	±2 kV for power supply lines ±1 kV for input/output lines	Not applicable DC powered device Not applicable No data input/output lines	Not applicable
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	Not Applicable DC powered device	Not Applicable
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% UT (>95% dip in UT) for 0,5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5 sec	Not Applicable DC powered device	Not Applicable
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.


Note: UT is the a.c. mains voltage prior to application of the test level.

* This statement indicates that the required testing was performed in a controlled environment and the Sprint/Strollers are found to be compliant with regulations.

Table 4*

Guidance and manufacturers declaration—electromagnetic immunity

The Sprint/Stroller is intended for use in the electromagnetic environment specified below. The customer or the user of the Sprint/Stroller should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment—guidance
Conducted RF IEC 61000-4-6	3Vrms 150kHz to 80 MHz	Not Applicable Battery powered device	Portable and mobile RF communications equipment should be used no closer to any part of the Sprint/Stroller, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = 1.2 \sqrt{P}$ $d = 1.2 \sqrt{P}$ 80 MHz to 800 MHz $d = 2.3 \sqrt{P}$ 800 MHz to 2,5 GHz
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m	where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey ^a , should be less than the compliance level in each frequency range ^b . Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

^a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Sprint/Stroller is used exceeds the applicable RF compliance level above, the Sprint/Stroller should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Sprint/Stroller.

^b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

* This table is included as a standard requirement for equipment which has been tested to specific test levels and over specific frequency ranges and been found compliant with regulations.

Table 6*

**Recommended separation distances between portable and mobile
RF communications equipment and the Sprint/Stroller**

The Sprint/Stroller is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Sprint/Stroller can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Sprint/Stroller as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150 kHz to 80 MHz	80 MHz and 800 MHz	800 MHz to 2,5 GHz
	$d=1.2\sqrt{P}$	$d=1.2\sqrt{P}$	$d=2.3\sqrt{P}$
0,01	0.12 m	0.12 m	0.23 m
0,1	0.38 m	0.38 m	0.73 m
1	1.2 m	1.2 m	2.3 m
10	3.8 m	3.8 m	7.3 m
100	12 m	12 m	23 m

For transmitters rated at a maximum output power not listed above, the recommended separation distance (d) in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 at 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

* This table is included as a standard requirement for equipment which has been tested to specific test levels and over specific frequency ranges and been found compliant with regulations.

VI Theory of Operation

Filling

1. Method

The Sprint and Stroller are portable units designed to be filled by the patient from a Liberator, Low Loss Reservoir, or other compatible unit.

The unit is filled by coupling the quick disconnect valve of the Sprint/Stroller with the quick disconnect valve on the Reservoir and opening the vent valve on the portable. Liquid oxygen is forced up the Reservoir fill tube, through the coupled quick connectors, and into the inner vessel of the Sprint/Stroller.

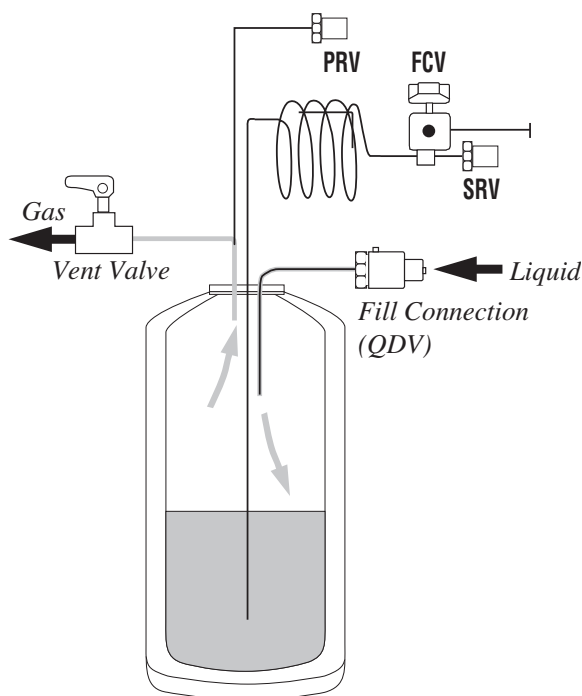
There will be some oxygen vaporized during filling. This gas is discharged through the vent valve. When the unit is full, liquid oxygen is expelled through the vent valve. Closing the vent valve and separating the units terminates the fill process.

2. Saturation Pressure

The liquid Oxygen saturation pressure can seriously affect the overall efficiency and operation of the Sprint or Stroller.

- If the saturation pressure of the liquid in the fill source is greater than 30 psig (2,1 bar), high filling losses, flow rates out of tolerance, and/or frozen open relief devices may result.
- If the saturation pressure of the liquid in the fill source is below 18 psig (1,2 bar), below tolerance flow rates may result.

FIGURE 2: Filling

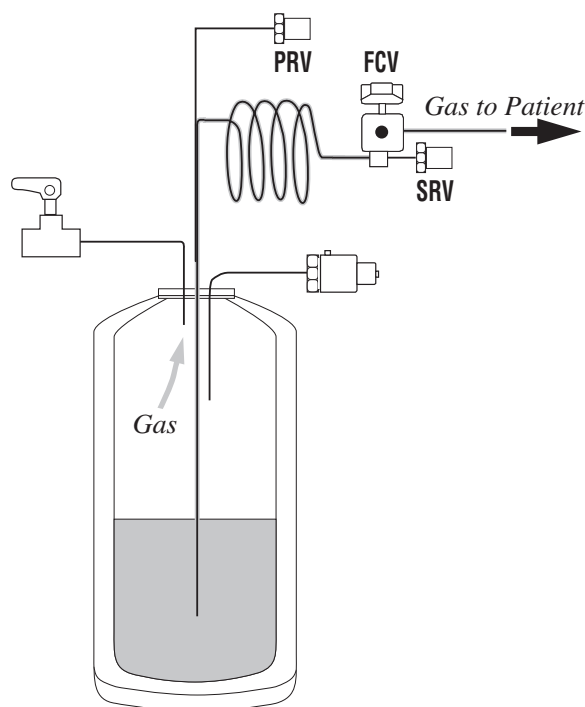


Oxygen Withdrawal

With oxygen in the unit, and the vent valve closed, the pressure in the inner vessel will remain at or near the primary relief valve pressure of 19.7 - 20.6 psig (1,35 - 1,42 bar).

At operating pressure and with the flow control valve at any setting other than Off, pressure forces liquid oxygen up the liquid withdrawal tube and into the breathing coil. In the breathing coil, liquid oxygen absorbs heat and vaporizes, warming to almost ambient temperature by the time gas is dispensed by the flow control valve to the patient.

FIGURE 3: Oxygen Withdrawal



VI Theory of Operation

Liquid Level Measurement

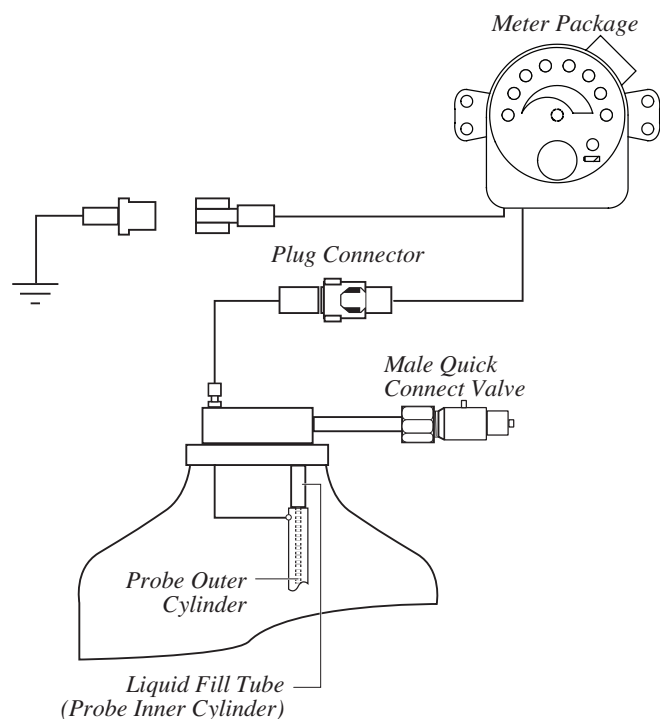
1. LED

Sprints and Strollers are equipped with a unique liquid level measurement system. This system measures the level of liquid oxygen inside the unit with a capacitance probe and displays that liquid level on the level meter's LEDs.

The liquid level probe consists of two concentric stainless steel cylinders extending inside the inner vessel. As the liquid oxygen level rises, the capacitance of this assembly goes up. The level meter then displays the liquid level in the cylinder based on a calibration relating capacitance to level. The higher the liquid level in the dewar, the more LEDs are activated, beginning at the leftmost LED.

Electrical connection between the G4 meter and the probe is made via a single conductor JST connector. The male plug is attached to its female counterpart extending from the probe, creating a watertight connection. A single ground wire is connected from the meter to a male spade terminal on the mounting bracket.

FIGURE 4: Liquid Level Meter



The meter is powered by an internal battery, offering an estimated battery life of 5 years or more at 30 actuations per day. The meter has a low battery (LOW BATT) indicator which signals the need for battery replacement. The meter battery is covered under a 2-year limited warranty. If battery failure occurs within 2 years of Sprint/Stroller shipment date, contact CAIRE Inc. customer service for a replacement meter. If the meter battery is no longer under warranty, the CR2032 coin cell battery can be replaced (RP2). The battery can be found at most hardware stores, or they can be ordered through CAIRE Inc. customer service.

The new level meter improves upon the previous meter by integrating all components within its casing, simplifying removal and replacement (RP2). Even more importantly from a technical service point of view, there is a much improved calibration procedure requiring no additional tools and a range of error reporting codes which can be read directly from the LEDs to report calibration errors. These calibration codes can be found in the calibration procedure (RP6).

2. Spring Scale

Sprints or Strollers may also be equipped with a spring scale liquid level measurement system. This system measures the level of liquid oxygen inside the unit with a simple spring scale mechanism, which is incorporated into the strap assembly. The spring scale display is calibrated to read empty when only the weight of the portable unit is suspended from the strap. As liquid oxygen is placed into the portable, the spring scale displays the increase in weight. The only calibration is to set the scale to zero, or empty point.

VII Unpacking and Setup

Unpacking

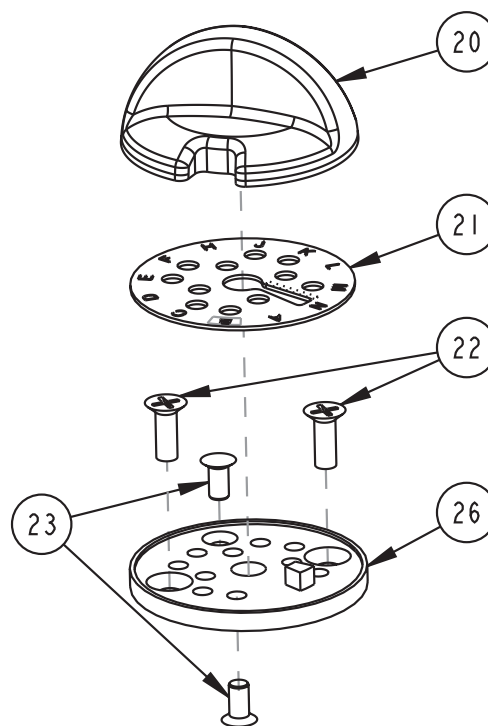
1. Inspect the carton for shipping damage. Report any damage to the freight company before signing the bill of lading.
2. Check the description on the carton against your order.
3. Unpack the unit, including the Patient Operating Instructions (POI).
4. Set aside the packing material in case the unit must be returned to the factory.

Setup

If desired, the flow control knob (Item 20) can be adjusted so it will not exceed the maximum prescribed flow rate.

1. To remove the flow control knob, firmly grip and pull straight up away from the portable.
2. Remove the flow rate decal number disc (Item 21).
3. Remove the 2 Phillips head screws (Item 22) from the flow lock plate (Item 26) and remove the plate.
4. Remove the locking pin (Item 23) from its storage position on the flow lock plate and place in the underside of the hole corresponding to the maximum allowable flow rate.
5. Replace the flow lock plate (Item 26) and tighten screws (Item 22). Replace number disk (Item 21) and push-on knob (Item 20). Verify the flow lock is at the correct position.

FIGURE 5: Flow Control Knob



VIII Operation

Refer to Patient Operating Instrucons (POI) Manual.

There are two schedules for routine maintenance which the home health care distributor may follow. These schedules allow the distributor maximum flexibility while assuring that the equipment is operating properly.

CAIRE, Inc. recommends returning the unit to a CAIRE service facility every 10 years for vacuum check and re-evacuation if necessary.

Schedule A – 30-Month

A. Introduction

Routine maintenance is a series of steps used to assure that equipment is functioning properly.

1. If a unit fails a given test, one of two things may be done:
 - a. Refer to Troubleshooting section (Section XI) of this manual.
 - b. Return the unit to CAIRE, Inc. for repair.
2. Schedule A – Maximum of 30 Months between routine maintenance testing. Unit should be tested whenever a problem is suspected.

B. Procedure

Follow the steps in order listed. If the unit fails any step, refer to the Troubleshooting section (Section XI) of this manual.

1. Visual Inspection:
 - a. Look for damaged or missing parts.
 - b. Dry condensation pad. Replace if soiled.
2. Full Unit:
 - a. Fill, vent full, of LOX.
 - b. Check for audible or visual leaks in QDV and vent valve.
 - c. Verify that the meter reads full (8 LED's or "Full" on spring scale).
3. Check Efficiency of Unit:
 - a. Allow the unit to stabilize after filling (10–15 minutes).
 - b. Inspect the bottle for cold sweaty condition, and for excessive venting from relief valve (some venting is normal).
 - c. If either condition is observed, conduct NER test (see RP29 in this manual).
4. Flow Test (Table 1):

TABLE 1: Flow Test Acceptable Ranges

Unit Type	FCV Setting	LPM
Standard	OFF	0
Standard	0,25	0.08 to 0.42
Standard	0,50	0.33 to 0.67
Standard	0,75	0.58 to 0.92
Standard	1,00	0.83 to 1.17
Standard	1,50	1.18 to 1.82
Standard	2,00	1.61 to 2.43
Standard	2,50	2.08 to 2.97
Standard	3,00	2.55 to 3.51
Standard	3,50	N/A
Standard	4,00	3.43 to 4.62
Standard	5,00	4.33 to 5.77
Standard	6,00	5.14 to 6.92
Pediatric	OFF	0
Pediatric	0.05	0.03 to 0.09
Pediatric	0.10	0.05 to 0.20
Pediatric	0.20	0.07 to 0.39
Pediatric	0.30	0.18 to 0.52
Pediatric	0.40	0.20 to 0.56
Pediatric	0.50	0.33 to 0.67
Pediatric	0.75	0.58 to 0.92
Pediatric	1.00	0.83 to 1.17
Pediatric	1.25	0.98 to 1.55
Pediatric	1.50	1.18 to 1.82
Pediatric	2,00	1.61 to 2.43

NOTE: SLPM is corrected to normal temperature and pressure (70°F & 14.7 psig or 21°C and 1.01 Bar). The above acceptable flow rates are intended for field testing only of flow control valves to account for variation in elevation and temperature. This table reflects tolerance requirements of ISO 10524. This does not affect CAIRE's factory compliance with the +/-10% tolerance requirement of ISO 18777.

- a. Set FCV to the highest flow setting, run for at least 20 minutes.
- b. Check all flow settings to chart above and check pressure to be at least 18 psig (1,2 bar).
5. Prepare for Use:
 - a. Empty contents by setting FCV at the highest flow setting and running unit until dry and warm to room temperature (approximately two hours).
 - b. Verify that meter reads empty (1 LED) and that the low battery LED is not lit. For spring scale units, verify that scale reads empty (red line).
 - c. Clean case with household glass cleaner and lint free cloth (do not get in any valves).

Schedule B – Continuous

A. Introduction

Continuous maintenance is a set of tests and inspections performed periodically to ensure the equipment is functioning properly. It can be done with equipment in service by drivers or other personnel.

1. If a unit fails a given test, it should be taken out of service. Refer to the Troubleshooting section (Section XI) or contact Technical Service.
2. Schedule B – Checks are made when the driver visits patients and when equipment is transferred between patients.

B. Procedure

These inspections are to be performed at least once per year by the driver or other personnel when the Sprint/Stroller is in use by the patient (LOX in the unit).

1. Visual Inspection:

- a. Case not damaged or dirty. Flow control knob turns easily with firm detent feel.
 - b. Condensation pad is not soaking wet or excessively dirty.
 - c. QDV pin not bent (side fill only).
2. Verify that the meter or scale reads correct liquid level.
 3. Check flow rate. Erie liter meter (± 0.25 LPM) can be used.

These inspections/tests are to be done between patients.

1. Visual Inspection:

- a. Broken case.
 - b. Condensation pad (replace if soiled).
 - c. QDV pin not bent (side fill only).
 - d. Inspect interior of unit for dirt or contaminants.
2. Verify that liquid level meter or scale reads empty.
3. Fill Unit:
 - a. Verify that liquid level gauge or scale reads full.
 - b. Check for audible/visual leaks in QDV and vent valves.

4. Flow Test (Table 1):

- a. Set flow control knob to highest flow setting, run for at least 20 minutes.
- b. Check all flow settings with chart below and check pressure to at least 18 psig (1,2 bar).

5. Prepare for Use:

- a. Empty contents by turning flow selection knob to highest flow setting and running unit until dry and warm to room temperature (approximately two hours).
- b. Verify that the meter or scale reads empty.
- c. Clean case per RP28.

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Introduction

1. These procedures are designed to be performed only by qualified personnel with proper equipment.
2. Any failure during routine maintenance checks will refer you to this section. See troubleshooting chart for appropriate procedure.

X Troubleshooting Chart

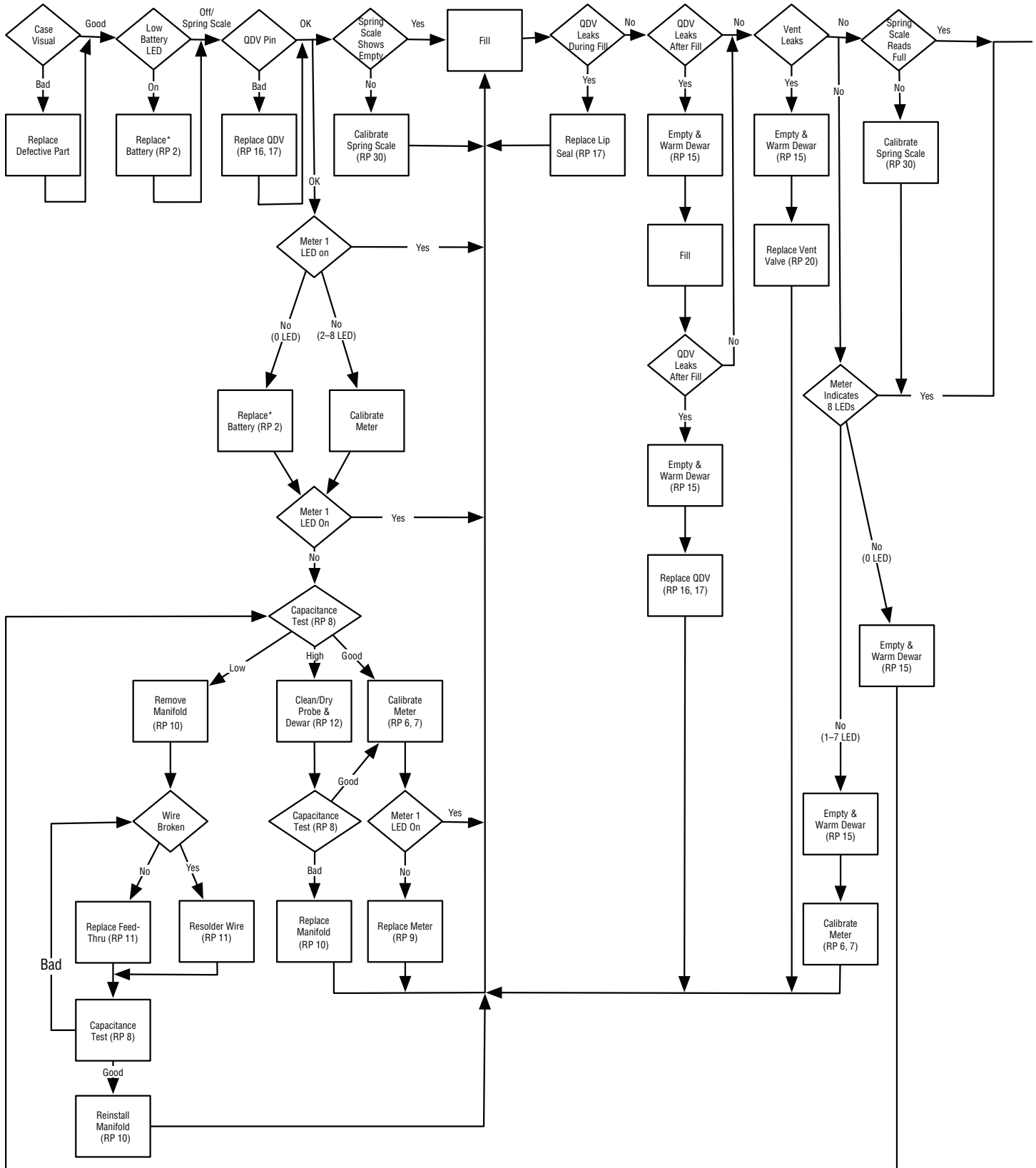
Symptom		Probable Cause		Corrective Action
1)	Unable to start fill or excessively long fill times	a)	QDV not properly engaged on the reservoir	Make sure the QDV on the portable and reservoir are properly aligned. Ensure that a downward force is being applied to the portable for top fill. Ensure the portable is completely engaged for side fill.
		b)	Reservoir is empty	Swap or re-fill the reservoir
		c)	Vent valve not open	Ensure that the vent valve lever is fully in the open position. The lever must be open to begin a fill.
		d)	FCV is open	Be sure that the FCV knob is in the off ("0") position. If the valve is open, fill times can increase.
		e)	Reservoir saturation pressure is too low	Swap reservoirs or allow the reservoir time to stabilize and build pressure
		f)	Vent valve is obstructed	Inspect the vent tubes for blockages. Clean by blowing out with compressed gas or replace parts if necessary.
		g)	Leak in the system	Check the portable for leaks (RP19) and repair if needed.
		h)	QDV damaged or faulty	Inspect the QDV and be sure the poppet opens properly and smoothly. If necessary, replace the QDV (RP16 or RP17)
		i)	Faulty vent valve	Replace the vent valve (RP20)
2)	Liquid leaks from the coupled QDVs during the fill	a)	Worn or damaged lip seal	Replace the QDV lip seal if top fill (RP17). See reservoir technical manual for replacement of side fill lip seal on reservoir.
3)	Unable to disconnect the portable from the reservoir	a)	Pop-off assembly not being utilized (Top fill only)	Ensure that the pop-off assembly on the reservoir is being used (top fill only). Do not use force to separate the QDVs on top fill or side fill.
		b)	QDVs are frozen together	Leave the units coupled with the vent valve closed and let them sit until they warm up enough to disconnect. Always ensure that male and female QDV's are cleaned and dried prior to each fill.
4)	Liquid leaks from the QDV after filling	a)	Ice crystal preventing the QDV from closing properly.	Engage and disengage the portable onto the reservoir several times to dislodge the ice crystal. Always be sure that the male and female QDVs are wiped clean and dry before filling.
		b)	Dirty or damaged QDV poppet	Replace the QDV (RP16 or RP17)
5)	Liquid leaks from the vent valve tube/outlet	a)	Vent valve is not fully closed	Ensure that the vent valve lever is fully in the closed position.
		b)	The portable has been transported or laid in an improper operating position	Return the portable to an upright or acceptable operating position and allow several minutes for stabilization.
		c)	Vent valve is frozen open	Allow the portable to warm until the vent valve can close. After the warm up, allow up to 60 minutes for the portable to stabilize and build pressure before operating.
		d)	Faulty vent valve	Replace the vent valve (RP20)

X Troubleshooting Chart

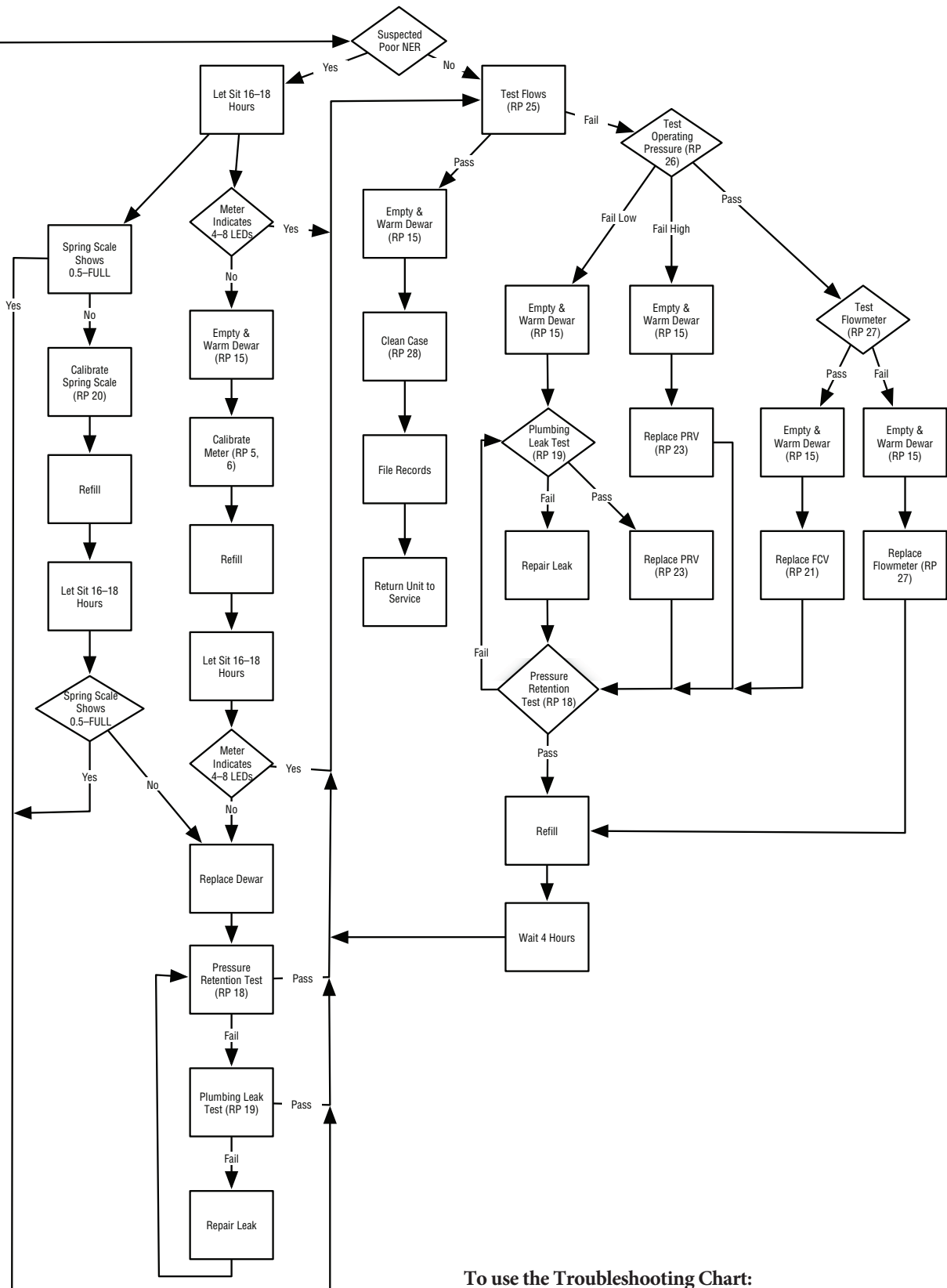
Symptom		Probable Cause		Corrective Action
6)	Excessive venting from relief valves (hissing sound)	a)	The portable has been transported or laid in an improper operating position	Return the portable to an upright or acceptable operating position and allow several minutes for stabilization.
		b)	Saturation pressure too high.	Inspect the saturation pressure of the reservoir used for filling. Allow at least 30 minutes at no flow for the portable to saturate properly.
		c)	Relief valve frozen open	Allow the portable to warm and thaw. Attempt to re-fill the portable.
		d)	Faulty relief valve	Test the operating pressure (RP26) and replace the relief valve if necessary (RP23)
		e)	Partial or complete loss of vacuum	Conduct the NER test (RP29) and return the unit to CAIRE, Inc. if necessary.
7)	No Flow	a)	Portable is empty	Check the contents indicator/level gauge and fill the portable if needed.
		b)	Flow control valve turned off	Ensure the flow control knob is not in the off ("0") position.
		c)	Nasal cannula kinked or disconnected	Ensure proper nasal cannula functionality and positioning
		d)	Saturation pressure is too low	Inspect the saturation pressure of the reservoir used for filling. Allow at least 30 minutes at no flow for the portable to saturate properly.
		e)	Leak in the system	Perform a leak check on the plumbing (RP19). Repair leaks as necessary.
		f)	Relief valve is open	Ensure that there is no venting from the relief valves. If there is refer to the corrective actions for "Excessive venting from relief valves (hissing sound)"
		g)	Vent valve is open	Ensure that there is no venting from the vent valve outlet/tube. If there is refer to the corrective actions for "Liquid leaks from the vent valve tube/outlet"
		h)	Blockage in the liquid withdrawal circuit	Check the warming coils and withdrawal tubes for blockages. Replace if necessary.
8)	Low flow at all LPM settings	i)	FCV Faulty	Replace the FCV (RP21)
		a)	Nasal cannula kinked or leaking	Inspect the functionality of the nasal cannula.
		b)	Saturation pressure is too low	Inspect the saturation pressure of the reservoir used for filling. Allow at least 30 minutes at no flow for the portable to saturate properly.
		c)	Leak in the system	Perform a leak check on the plumbing (RP19). Repair leaks as necessary.
		d)	PRV faulty	Test the operating pressure (RP26) and replace the relief valve if necessary (RP23).
		e)	Blockage in the liquid withdrawal circuit	Check the warming coils and withdrawal tubes for blockages. Replace if necessary.
		f)	FCV faulty	Replace the FCV (RP21)

X Troubleshooting Chart

Symptom		Probable Cause		Corrective Action
9)	Increased NER	a)	Saturation Pressure is too high	Inspect the saturation pressure of the reservoir used for filling. Allow at least 30 minutes at no flow for the portable to saturate properly.
		b)	Leak in the system	Perform a leak check on the plumbing (RP19). Repair leaks as necessary.
		c)	Relief valve open	Ensure that there is no venting from the relief valves. If there is refer to the corrective actions for "Excessive venting from relief valves (hissing sound)"
		d)	Partial or complete loss of vacuum	Conduct the NER test (RP29) and return the unit to CAIRE, Inc. if necessary.
10)	Excessive Frost <i>NOTE: Minimal frost on the case and on the plumbing is normal, especially at higher flow rates. This symptom applies to frost that is much greater than what is normally observed.</i>	a)	Frost is acceptable	Some frost on the outer case and on the plumbing is acceptable, especially at high flow rates. This is due to the evaporation of LOX to gas and the temperature difference between the LOX and room temperature.
		b)	High humidity level	High humidity levels can increase frost accumulation.
		c)	Saturation pressure is too high	Inspect the saturation pressure of the reservoir used for filling. Allow at least 30 minutes at no flow for the portable to saturate properly.
		d)	Leak in the system	Perform a leak check on the plumbing (RP19). Repair leaks as necessary.
		e)	Relief valve open	Ensure that there is no venting from the relief valves. If there is refer to the corrective actions for "Excessive venting from relief valves (hissing sound)"
		f)	Partial or complete loss of vacuum	Conduct the NER test (RP29) and return the unit to CAIRE, Inc. if necessary.
11)	Unit will not maintain acceptable pressure when in use	a)	Saturation pressure is unacceptable	Inspect the saturation pressure of the reservoir used for filling. Allow at least 30 minutes at no flow for the portable to saturate properly.
		b)	Leak in the system	Perform a leak check on the plumbing (RP19). Repair leaks as necessary.
		c)	PRV faulty	Test the operating pressure (RP26) and replace the relief valve if necessary (RP23).



*see NOTE in RP 2



To use the Troubleshooting Chart:

- Start at the upper left corner.
- Unless otherwise noted by the arrows, the flow through the chart is down or to the right.

RP1 – General

The following procedures have been carefully prepared to allow proper removal and replacement of defective components and should be used in conjunction with the Troubleshooting Chart and the tests listed in this section.

WARNING: Make sure the unit is empty and vent valve is open before replacing any component, except shroud assembly components or lip seals.

WARNING: The technician's hands, tools, and clothing should be free of all oils and greases.

WARNING: Parts that are welded in place must not be replaced in the field. Should these parts fail, return complete assembly or sub-assembly to factory for repair. DO NOT use solder or silver solder to repair broken welds.

WARNING: The manufacturer of fluorolubricant warns users not to allow fluorolubricant to contaminate tobacco products. Wash fluorolubricant from hands before smoking.

WARNING: Do not use glue type thread locking compounds or unapproved sealants on any repairs.

CAUTION: When replacing components, make sure the new part is oriented exactly the same as the original part prior to installation.

CAUTION: Some components require a specific amount of torque when assembling. Follow torque requirements where specified.

NOTE: All replacement parts must be factory approved, cleaned for oxygen service, and stored in sealed plastic bags. The repair area must be clean and separate from other areas. Room air should be filtered, and free from dust, soot, and other contaminants.

NOTE: When replacing components with pipe threads, use PTFE tape thread sealant. Apply two rounds of PTFE tape to threads near end of component, avoiding first thread.

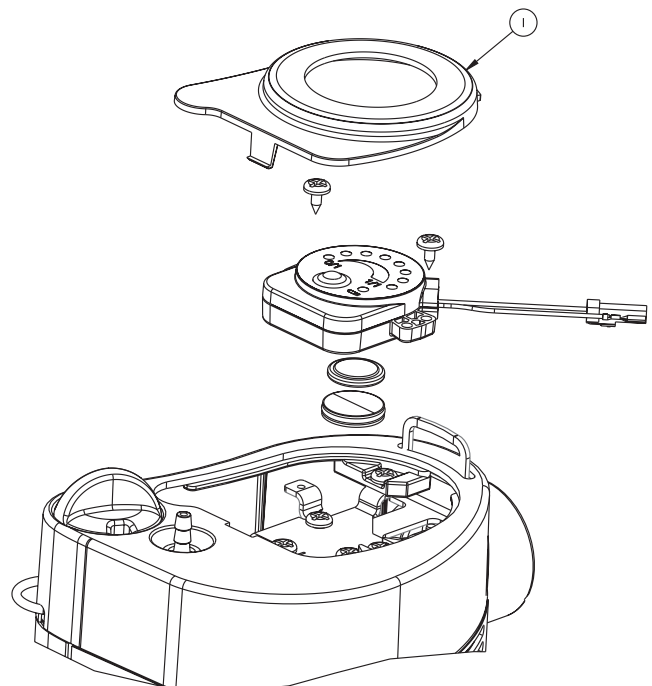
NOTE: When assembling new compression fittings, tighten 1/8", 1/4" and 1/2" nuts eight flats past finger tight and 3/16" nuts five flats past finger tight. When reassembling previously used compression fittings, tighten nuts one to two flats past finger tight.

RP2 – Liquid Level Meter Battery RR

NOTE: Tampering with meter battery housing will void the meter's 2-year warranty. If meter battery failure occurs while under warranty, contact customer service to obtain a replacement meter. If the meter battery is no longer under warranty, the CR2032 coin cell battery may be replaced following the steps below.

- Remove Gen 4 meter cover assembly (Item 1) by inserting a flat head screwdriver into the slot and lightly pushing over and up. For soft case Stroller, unzip and peel back top cover to expose meter.
- Remove 2 Phillips head screws and turn meter over.
- Disconnect gauge plug and remove gauge cover.
- Using a pair of pliers, grasp the battery cover on the back of the meter. Twist and pull the cover away from the meter.
- Slide the tip of a flat head jeweler's screwdriver beside the battery and carefully pry out the battery.
- Insert new battery with the positive terminal facing up.
- Apply a thin coating of fluorolubricant to the o-ring.
- Replace battery cover by pushing it into the back of the meter's case, ensuring the o-ring seals evenly to restore the air-tight seal.

FIGURE 6: Liquid Level Meter Battery



RP3 – Top Cover Assembly (Hard case) RR

- Remove Gen 4 gauge cover assembly as described in RP2.
- Unscrew 3 screws (Item 8), unstrap and remove strap, and lift top cover up.
- Remove the QDV alignment sleeve (Item 11) on side fill units by lifting up and out to disengage vent line; or the plug on bottom fill units, by lifting it straight up.
- Lift top cover (Item 10) straight up to remove.
- To replace, reverse above procedure.

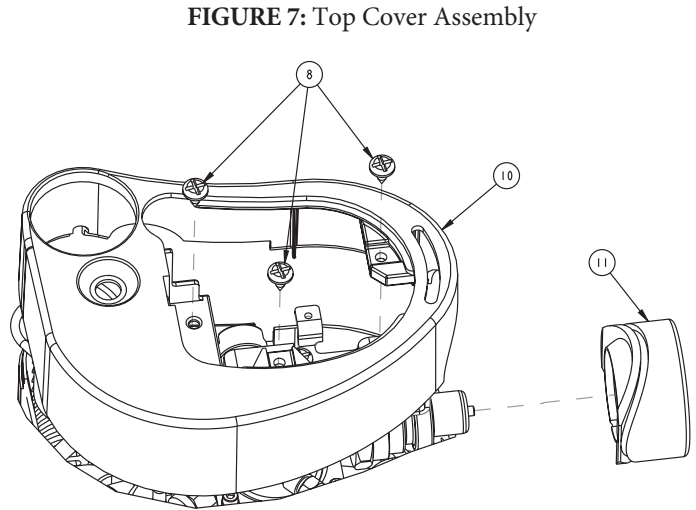


FIGURE 7: Top Cover Assembly

RP4 – Bottom and Side Cover (Hard case) RR

- If removing the entire unit case, remove the top cover (RP3) first.
- Invert Stroller. Remove condensation cup (Item 18) and condensate pad (Item 17).
- Remove the 2 screws (Item 15) retaining the bottom cover to Stroller dewar.
- Remove bottom/side cover (Item 13) by pulling straight down.
- To replace, reverse above procedure. Be sure vaporizer coil is centered in case.

CAUTION: Be careful not to pinch wires!

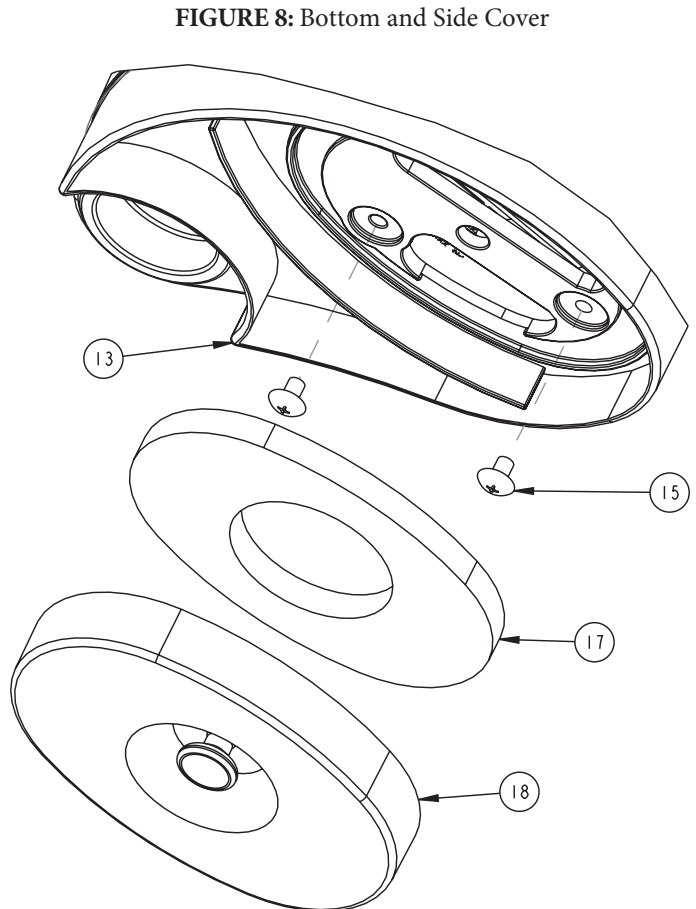


FIGURE 8: Bottom and Side Cover

RP5 – Soft Case RR

- Unzip front and back zippers.
- Carefully lift up and peel back top cover.
- Open unzipped case and carefully lift Stroller up and out of case. Do not bend or force coils, as they are easily damaged.
- To replace, carefully lower Stroller into open case and secure both front and back zippers.

RP6 – G4 Meter Empty Capacitance Calibration (Figure 9)

- a. Completely empty dewar.

NOTE: The meter must first be calibrated empty and then the span must be set for your particular model. The unit must be empty and dry for empty calibration, but does not have to be for the span setting adjustment.

- b. Allow dewar to warm to room temperature.

- c. Enter Calibration Mode

1. Press and hold the hidden calibrate button located on the center of the meter face.
2. While holding the calibrate button, press and hold the green operate button.
3. Continue holding both buttons until LED 1 and LED 8 alternately flash. The meter is now in calibration mode.
4. Release both buttons.

- d. Press and hold the hidden calibrate button for 3 seconds. LED

NOTE: Step d must be performed within 45 seconds or calibration mode will exit.

1 will flash for 3 seconds followed by a short pause.

- e. If successful, LED 1 will flash again for 3 seconds and exit calibration mode storing the new empty value.
- f. If calibration is unsuccessful, multiple LEDs will flash. The LEDs indicate what error has occurred (see Table 2).

FIGURE 9: G4 Meter

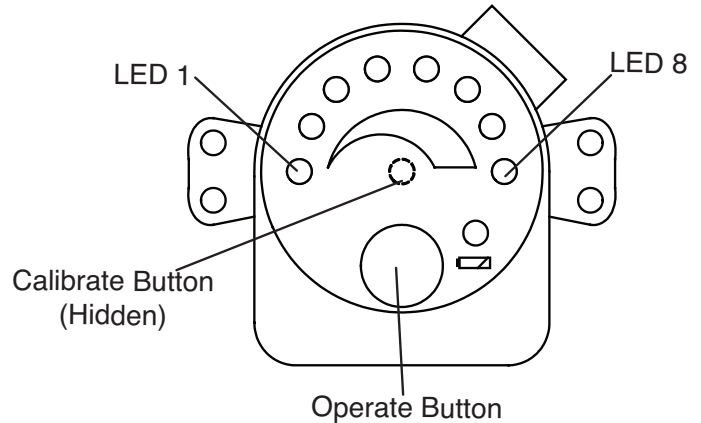


TABLE 2: Calibration Error Codes

Error Code	Reason for Fault	Solution
LED 1 & LED 4	Empty to full span is too low.	Ensure tank is empty. Recalibrate.
LED 2 & LED 3	Open Circuit	Check meter connections and wire integrity.
LED 6 & LED 7	Empty capacitance is too high.	Remove moisture from inner vessel. Decontaminate probe.
LED 5 & LED 8	Empty to full span is too high.	Ensure tank is empty. Recalibrate.
LED 2, LED 4 & LED 6	High Capacitance	Remove moisture from inner vessel. Decontaminate probe.
LED 1, LED 3, LED 5 & LED 7	Calibrated full value higher than empty value.	Dry harness assy. Decontaminate.

RP7– G4 Meter Span Setting Adjustment (Figure 9)

a. Enter Calibration Mode

1. Press and hold the hidden calibrate button located on the center of the meter face.
2. While holding the calibrate button, press and hold the green operate button.
3. Continue holding both buttons until LED 1 and LED 8 alternately flash. The meter is now in calibration mode.
4. Release both buttons.

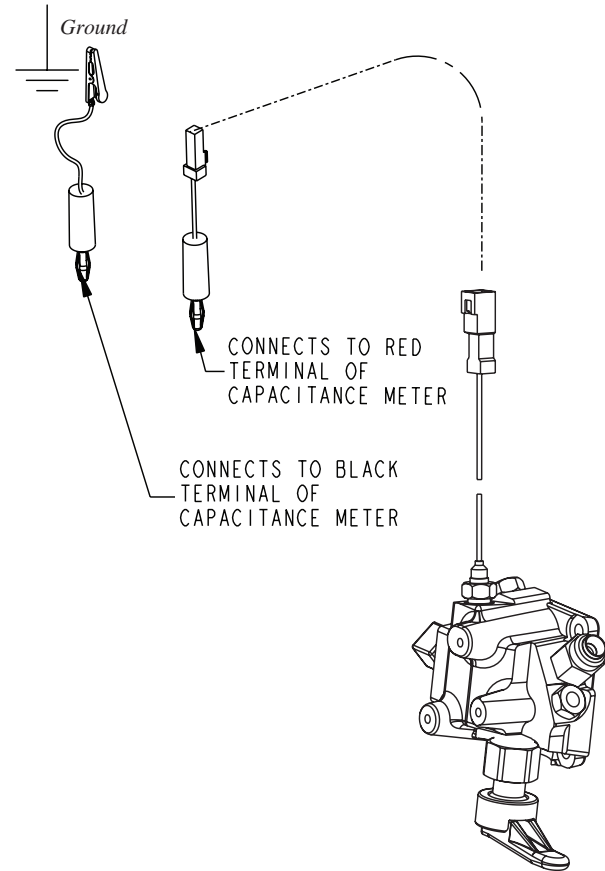
NOTE: Step d must be performed within 45 seconds or calibration mode will exit and the meter will NOT be calibrated properly. The calibration procedure will then need to be repeated from the beginning.

- b. Press the green operate button 3 times within a 5 second period.
- c. One of the meter LED's will light continuously, signifying one of the Stroller/Sprint models per Table 3 below.
- d. Press the hidden calibrate button to scroll through the LED until the LED which matches the Stroller/Sprint being calibrated is continuously lit. See Table 4 below for the correct LED setting for your unit.
- e. Once the correct LED for your unit is lit, press the green operate button to store the setting and exit calibration mode.

TABLE 3: Preset Capacitance Span LED Settings

Model	LED Setting
Stroller / High Flow	LED 8
Sprint	LED 3

FIGURE 9: Manifold Capacitance Test Setup



RP8 – Manifold Capacitance Test (Figure 10)

a. Capacitance Meter Setup:

1. Connect wire adapter with jumper wire to capacitance meter, following color code.
2. Turn on capacitance meter and select 200 pF range.
3. Move zero adjustment on front of meter until display reads zero.

b. Capacitance Test:

WARNING: Make sure the unit is empty and at room temperature before testing.

1. Remove top cover (RP 3).
2. Connect wire adapter to manifold harness connection.
3. Connect alligator clip to bracket or any other properly grounded surface.
4. Read manifold capacitance and compare to these acceptable ranges. If it does not meet specifications, call Technical Support.

Stroller: 145–180 pF
Sprint™: 125–155 pF

X Repair Procedures

RP9 – Gen 4 Meter RR

- Remove the G4 meter cover assembly (RP 2).
- Remove 2 meter mounting screws.
- Remove meter assembly from top cover.
- Unplug the wiring connection.
- Disconnect ground wire spade terminals.
- To replace G4 meter, reverse above procedures.

CAUTION: Be careful not to pinch wires!

RP10 – Manifold Assembly RR (Figure 11)

WARNING: The unit must be empty, warm and vented before starting procedure.

- Remove meter, top cover, and bottom.side cover (RP 2, 3, 4, or 5).
- Disengage FCV (Item 24) from bracket.
- Remove (3) bracket screws (Item 29) and lift bracket (Item 28) from manifold.
- Loosen and disconnect breathing coil nut (Item 38) from withdrawal fitting (Item 41) and FCV (Item 24). Be careful not to bend or kink Teflon® tubing.
- Loosen and disconnect primary relief valve from manifold fitting. For pediatric units, also loosen and disconnect secondary relief valve from manifold fitting.
- For top fill units, loosen and remove QDV from manifold fitting.
- Use a hex wrench to loosen and remove the (4) manifold retaining screws (Item 31).
- Remove manifold assembly by lifting straight up.

NOTE: If substantial force is required, closely examine wire and probe for damage.

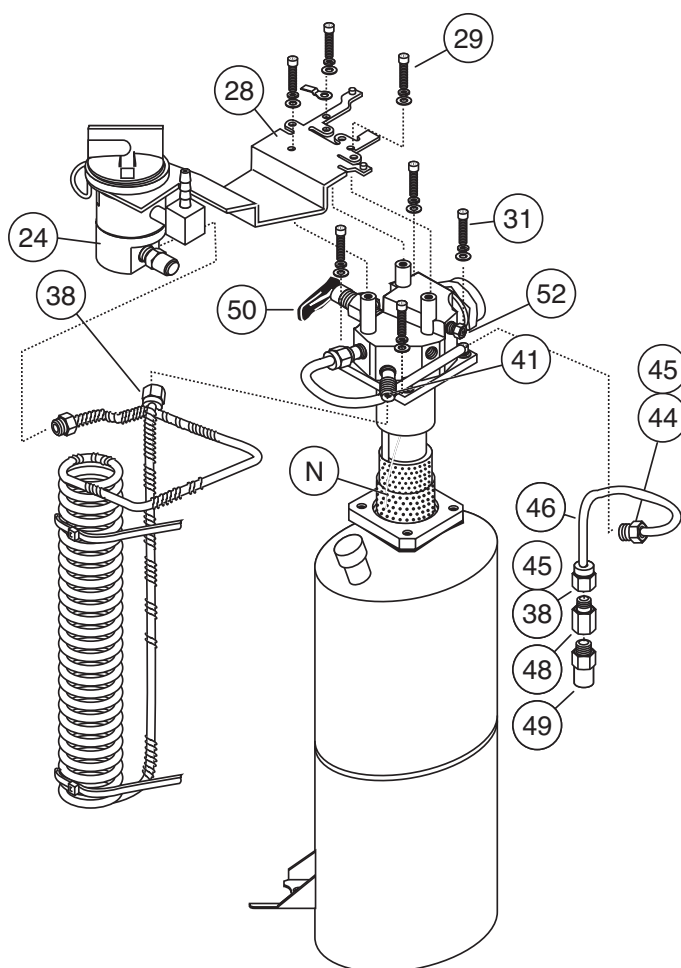
- To replace manifold, reverse above procedure.

NOTE: Ensure proper seating of O-ring in dewar. Apply small amount of fluorolubricant to O-ring before assembly. Torque manifold mounting screws (Item 31) to 21–23 in-lbs (237–260 N-cm) using cross-tightening method.

RP11 – Resolder Feed-thru Wire (Figure 11)

- Remove manifold assembly (See RP 10).
- Strip approximately 1/8" (0,3 cm) of insulation from feed-thru wire if necessary.
- Apply small amount of Stay-Clean flux to tinned area of probe using a cotton swab.
- Resolder feed-thru wire to tinned area of probe. Add small amount of lead-free solid wire solder if necessary.
- Clean flux residue with distilled water and cotton swab. Dry thoroughly.
- Replace manifold following listed procedure (RP10).

FIGURE 11: Feed-thru Wire



RP12 – Clean/Dry Probe and Dewar (Figure 11)

Procedure 1:

- Follow steps A through E (RP 18).
- Open vent valve (Item 50) and supply valves.
- Loosen feed-thru nut (Item 52) and remove harness.
- After vent valve (Item 50) is thawed, if all moisture is not removed, continue with procedure #2.

Procedure 2:

- Remove manifold assembly (See RP 10).
- Blow off probe assembly with clean, dry nitrogen gas.
- Blow out inside of dewar with clean, dry nitrogen gas until inside is clean and dry.
- Replace manifold assembly (See RP 10).

RP13 – LOX Fill

Refer to POI for proper fill procedure.

NOTE: Filling source must contain a minimum of 5 liters of properly saturated LOX.

RP14 – Liberator Lip Seal RR (Side Fill)

Refer to Liberator Service Manual.

RP15 – Empty and Warm

- Turn FCV knob to highest flow setting.
- Allow unit to sit for 24 hours before proceeding.

RP16 – QDV RR (Side Fill) (Figure 12)

WARNING: The unit must be empty and vented before starting procedure.

- Remove top cover (RP 3, or 5).
- Loosen retaining nut and remove QDV from manifold (Item A).
- To replace QDV, reverse above procedure, aligning pin in the upright position. Apply thin film of fluorolubricant to O-ring (Item 36). Torque retaining nut to 140–150 inch-lbs (1550–1700 N-cm).
- Replace top covers.

RP17 – QDV and Lip Seal RR (Top Fill)

WARNING: The unit must be empty and vented before starting procedure.

- Remove bottom/side covers (RP 4, or 5).
- Remove two retaining nuts (Item 54) and lift bottom fill tube out of coil.
- Replace QDV by substituting old QDV (Item 62) with the new one, tightening Item 57 to 140–150 inch-lbs (1550–1700 N-cm) and Item 58 to 300 inch-lbs (3000 N-cm).
- Replace lipseal by removing Item 65 and Item 64. Apply a thin film of fluorolubricant to new Item 64 and insert into QDV. Tighten Item 65 to 140–150 inch-lbs (1550–1700 N-cm).

FIGURE 12: Relief Valve Test Set-up

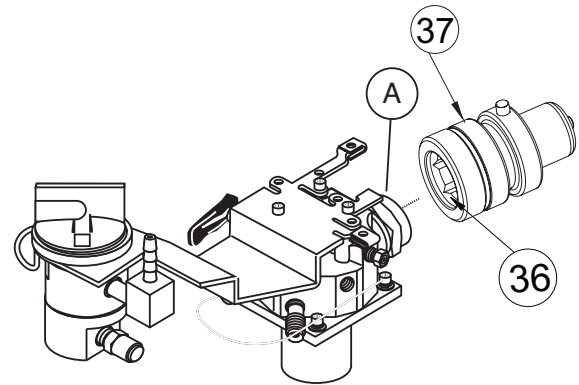
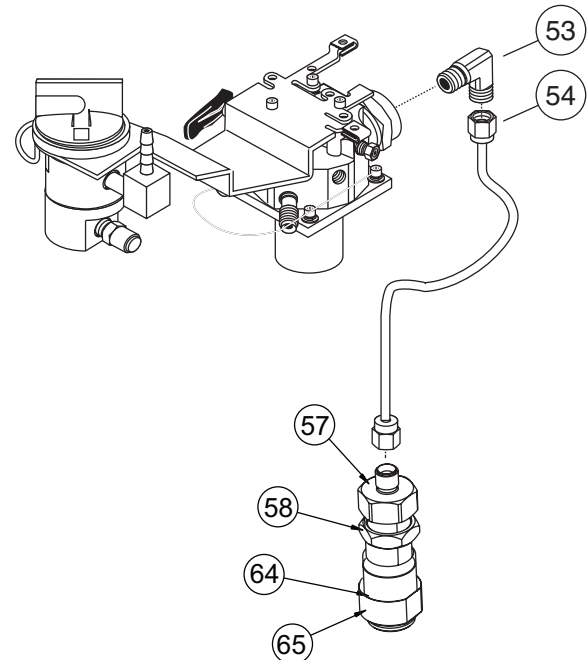


FIGURE 13: Primary Relief Valve



X Repair Procedures

RP18 – Pressure Retention Test

- Assemble oxygen regulator, pneumatic adapter and hose. Connect assembly to oxygen gas source.
- Assemble pressure gauge (Item J) and adapter assembly. Thread hose barb onto pressure gauge (use Teflon® tape). Push tubing onto hose bard and attach with clamp.
- Connect gauge assembly (Item J) to hose barb on FCV outlet. Open FCV (Item 24) to highest flow setting.
- Connect the proper pneumatic adapter to QDV (Item 37) for side fill units or (Item 62) for top fill.
- Increase pressure to 19 psig (1,3 bar).
- Turn FCV valve (Item 24) to Off setting.
- Allow unit to sit undisturbed for 60 minutes.
- Turn FCV valve (Item 24) to highest flow setting.
- If pressure gauge (Item J) is at or above 10 psig (0,7 bar), unit passes test.

RP19 – Plumbing Leak Test (Figure 14)

WARNING: The unit must be empty and vented before starting procedure.

- Remove bottom, side and top covers (RP 2, 3, 4, or 5)
- Assemble oxygen regulator, pneumatic adapter and hose. Connect assembly to oxygen gas source.
- Assemble pressure gauge (Item J) and adapter assembly. Thread hose barb onto pressure gauge (use Teflon® tape). Push tubing onto hose bard and attach with clamp.
- Connect gauge assembly (Item J) to hose barb on FCV outlet. Open FCV (Item 24) to highest flow setting.
- Connect the proper pneumatic adapter to QDV (Item 37) for side fill units or (Item 62) for top fill.
- Increase pressure to 19 psig (1,3 bar).
- Leak test all connections, joints, and valves with leak test solution.

NOTE: PRV (Item 49) and SRV (Item 43) may leak slowly. Repair all other leaks first and retest for pressure retention before changing relief valves.

- Close FCV (Item 24) by turning to Off position. Remove pressure gauge assembly from humidifier adapter (Item 26).
- Disconnect pneumatic adapter from QDV (Item 37).
- Leak test QDV poppet and FCV outlet.
- Repair all leaks by following appropriate repair procedures.

FIGURE 14: Plumbing Tests Set-up

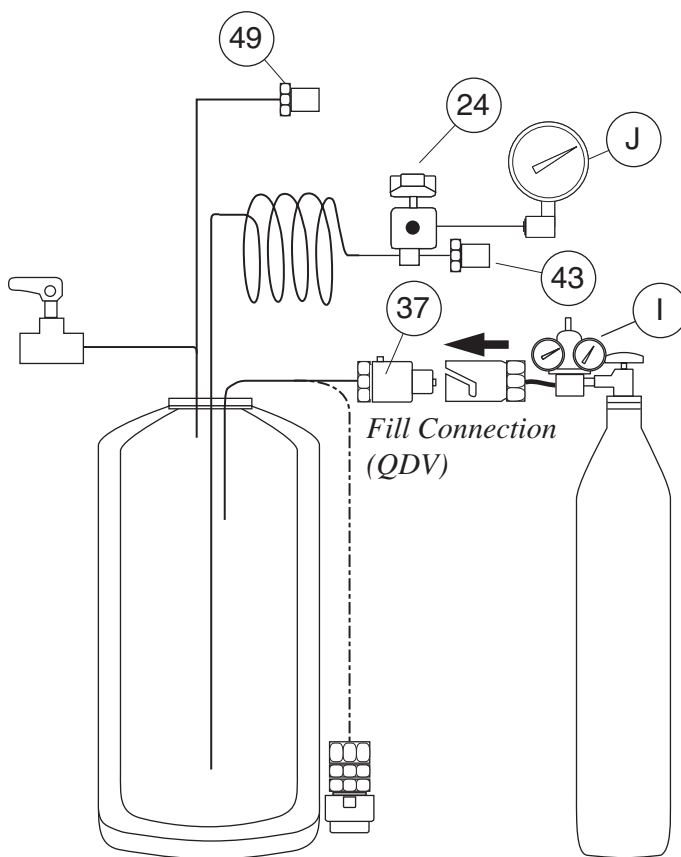
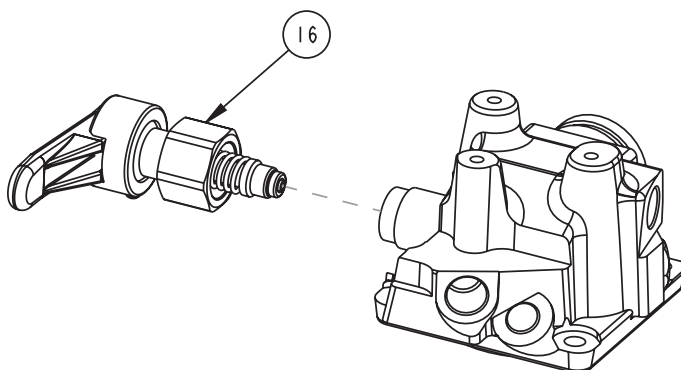


FIGURE 15: Coil and Vent Assemblies



X Repair Procedures

FIGURE 16: G4 Meter Top Fill (Push-on) QDV Assembly

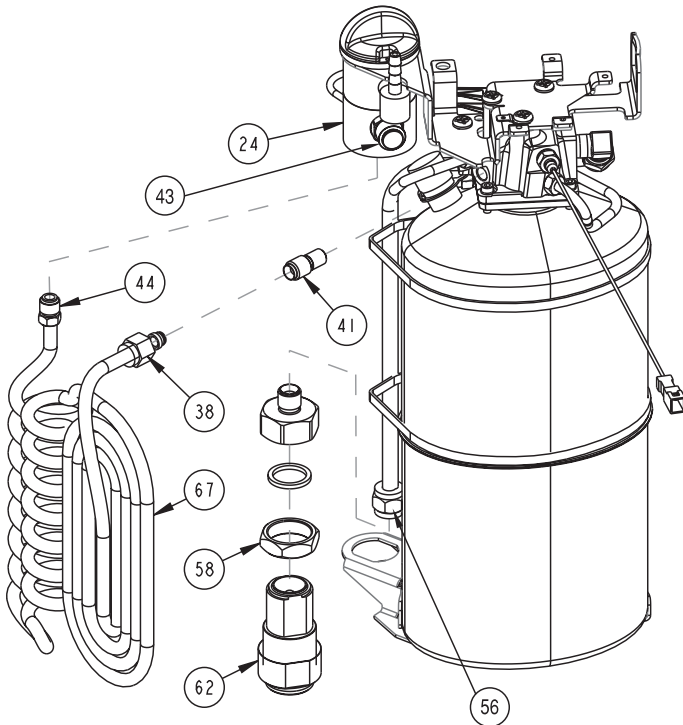
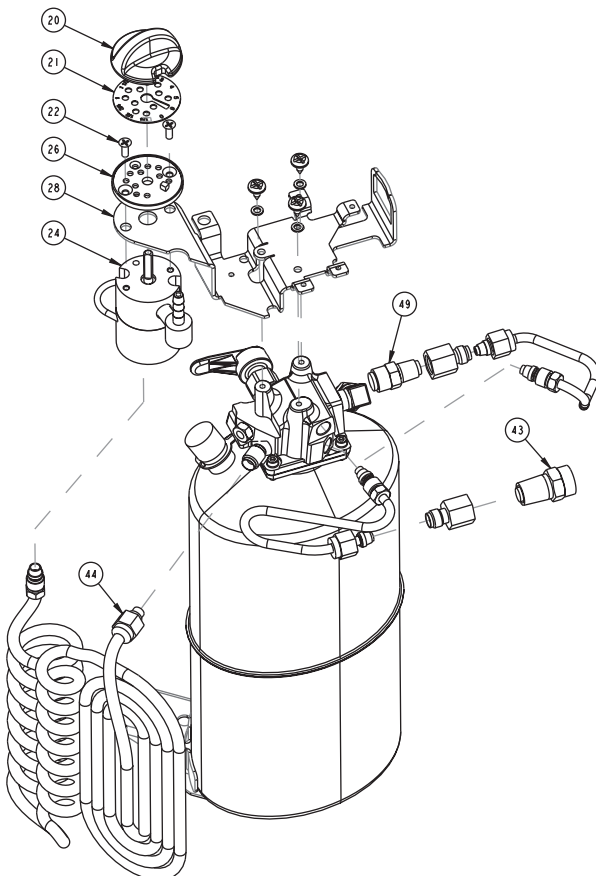


FIGURE 17: Spring Scale Top Fill (Push-on) QDV Assembly



RP20 – Vent Valve RR (Figure 15)

WARNING: The unit must be empty and vented before starting procedure.

- Remove bottom, side and top cover (RP 2, 3, 4 or 5).
- Open the vent valve.
- Remove vent valve (Item 16) by turning counterclockwise.
- To replace vent valve, reverse above procedure. Torque nut to 90-100 inch-lbs (1000-1100 N-cm).

RP21 – FCV RR (Figure 16, 17)

WARNING: The unit must be empty and vented before starting procedure.

- Remove bottom, side and top cover (RP 2, 3, 4 or 5).
- Disconnect coils from FCV inlet by loosening compression fitting (Item 44), and removing coils.
- Remove FCV knob (Item 20) and flow decal (Item 21).
- Disconnect and remove the FCV from bracket (Item 28) by removing two screws (Item 22).
- Remove SRV (Item 43) from FCV.
- To replace FCV, reverse above procedure. Tighten screws (Item 22) to 4-6 inch-lbs. (45-70 N-cm). Record FCV serial number.

RP22 – SRV RR

G4 meter units (Figure 16)

- Remove bottom, side and top cover (RP 2, 3, 4 or 5).
- Disconnect SRV (Item 43) from FCV (Item 24).
- Replace SRV in reverse order. When reassembling SRV, tighten approximately 10 to 20 degrees after the SRV contacts the FCV body (20-30 inch-lbs, 225-350 N-cm minimum).

Spring scale units (Figure 17)

- Remove bottom, side and top cover (RP 2, 3, 4 or 5).
- Disconnect 30 psig (2,1 bar) SRV (Item 43) from tube adapter.
- Reassemble in the reverse order using Teflon® tape on the SRV threads.

RP23 – PRV RR (Figure 18)

- Remove bottom, side and top cover (RP 2, 3, 4 or 5).
- Remove PRV (Item 49) while holding adapter (Item 48).
- Replace the PRV using two rounds of Teflon® tape on the threads.
- Reassemble in the reverse order.

RP24A – Breathing Coil RR (Side Fill) (Figure 18)

WARNING: The unit must be empty and vented before starting procedure.

- Remove bottom, side and top covers (RP 2, 3, 4 or 5).
- Loosen the two compression fitting nuts (Items 38 and 44) from liquid withdrawl fitting (Item 41) and FCV (Item 24). Disconnect breathing coil (Item 67), being careful not to kink breathing coil or internal Teflon tube.
- Carefully remove breathing coil outlet from around top of dewar.
- To replace breathing coil, reverse above procedure.

CAUTION: The vaporizer coil is fragile. Do not drop coil. Do not hit or mar coil with wrenches.

RP24B – Breathing Coil RR (Top Fill) (Figure 19)

WARNING: The unit must be empty and vented before starting procedure.

- Remove bottom, side and top covers (RP 2, 3, 4 or 5).
- Loosen the two compression fitting nuts (Items 38 and 44) from liquid withdrawl fitting (Item 41) and FCV (Item 24). Disconnect breathing coil (Item 67), being careful not to kink breathing coil or internal Teflon tube.
- Loosen QDV tube (Item 56) nut.
- Loosen QDV jam nut (Item 58). Remove QDV (Item 62) from fill tube.
- Cut two cable ties holding coil in place. Remove breathing coil by sliding straight down from fill line. Be careful to properly remove breathing coil outlet from around top of dewar.
- To replace coil, reverse above procedure. Tighten QDV jam nuts to 140–150 inch-lbs. (1550–1700 N-cm).

FIGURE 18: Side Fill (Push-On) QDV Assembly

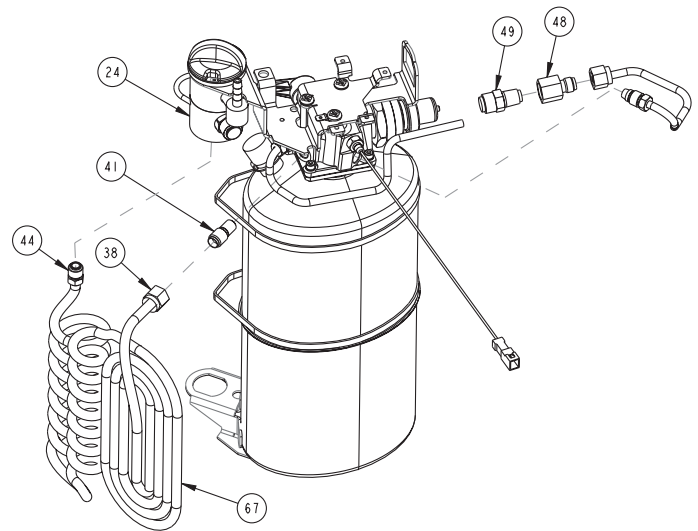
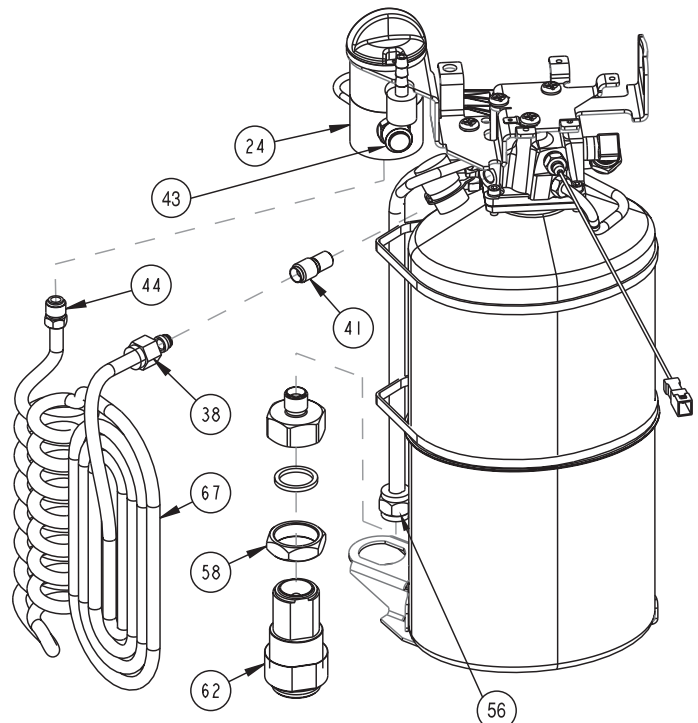
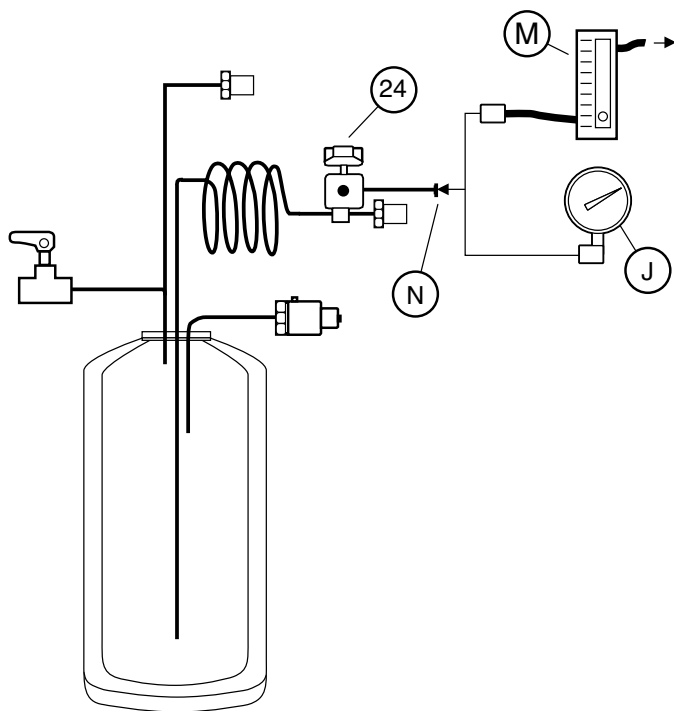


FIGURE 19: Top Fill (Push-On) QDV Assembly



X Repair Procedures

FIGURE 20: Top Fill (Push-On) QDV Assembly



RP25– Flow Rate Testing (Figure 20)

- Unit must be at least 1/2 full with correctly saturated LOX.
- Set FCV to 2 LPM setting and allow unit to operate for 20–60 minutes.
- Connect FCV outlet (Item N) to flowmeter inlet (Item M) with respiratory tubing. Make sure flowmeter outlet is open, unobstructed, and properly positioned.
- Test flow rate at each FCV position. Record all flow rates.
- Flow rates must be nominal value within tolerances listed in specification section of this manual or unit fails flow rate test.

NOTE: Be careful to allow for accuracy tolerances of flowmeter.

RP26 – Operating Pressure Test (Figure 20)

- Assemble pressure gauge and adapter assembly (Item J). Thread hose barb onto pressure gauge (use Teflon[®] tape). Push tubing onto hose barb and attach with clamp.
- Connect gauge assembly (Item J) to hose barb on FCV outlet. Open FCV (Item 24) to highest flow setting.
- Read operating pressure on pressure gauge (Item J).

NOTE: If testing operating pressure because of improper flow rates, test immediately after flow rate test.

- Operating pressure must be 18-22 psig (1.2-1.5 bar) or unit fails test.

RP27 – Flow Meter Verification

- Flow meter accuracy is best verified by a calibration laboratory. Equipment should indicate liter per minute oxygen gas at atmospheric pressure and 21°C (70° F).
- Flow meter accuracy may also be tested by comparison to one or more new, unused, calibrated flow meters. This method will increase confidence in accuracy of readings, but not necessarily verify accuracy.

X Repair Procedures

RP28 – Case Cleaning

NOTE: Clean case only after unit is empty and warm. Do not clean in oxygen enriched atmosphere.

- Clean using household glass cleaner and lint-free cloth. Do not get glass cleaner inside case or onto any valves.
- Allow unit to dry thoroughly before filling.

Note: Only use disinfectants or cleaning agents approved for use with this equipment by CAIRE such as Sporidicin®, HydroPure®, Hydroklean®, or others as specified by CAIRE.

RP29 – Normal Evaporation Rate Test

- Fill unit following procedure found in the Patient Operating Instructions (POI).
- Push button and check that all 8 LEDs are on, or verify that the spring scale reads full.
- Check for leaks in QDV and vent valve.
- Let unit sit 16–18 hours.
- Make sure FCV and vent valves are closed.
- Do not move unit during this time.
- If the Stroller is at least half full (4 LEDs or 0.5 on spring scale), or any liquid remains in the unit, the unit passes. Maximum loss rate prior to dewar servicing is 1.75 lbs./day (0,8 kg/day).

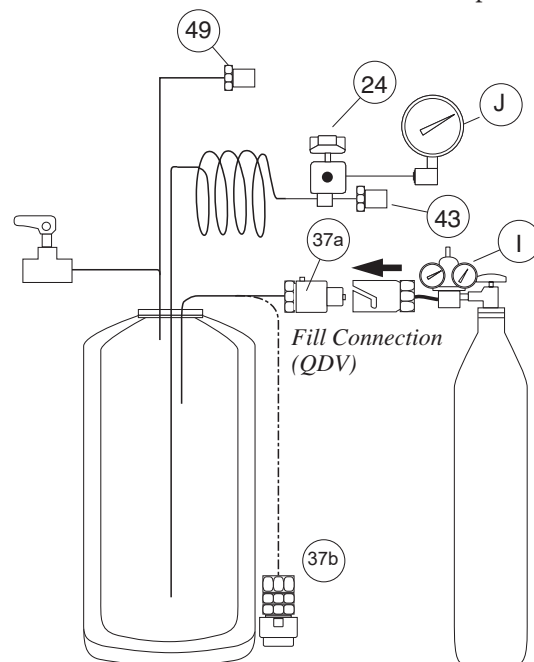
RP30 – Spring Scale Liquid Level Calibration

NOTE: Spring scale adjustments will only set the placement of the indicator and not the span (empty to full movement). The span adjustment is fixed by the design.

- Empty and warm portable unit (RP 15).
- Lift the portable by the strap (directly above the spring scale) and note the amount of misadjustment in the indicator.
- Use a Phillips head screwdriver to adjust the internal spring scale calibration screw, which can be accessed at the base of the spring scale.
- Adjust the spring scale calibration screw until the empty red stripe indication is shown.
- Fill unit with liquid oxygen. Verify FULL green stripe indication is shown.

RP31 – Relief Valve Test

FIGURE 21: Relief Valve Tests Set-up



WARNING: The unit must be empty, warm and vented before starting procedure.

- Remove case (RP3 and RP4).
- Assemble pressure gauge (Item J) and adapter assembly. Thread hose barb onto pressure gauge. Push tubing onto hose barb and attach with clamp.
- Assemble oxygen regulator, hose and pneumatic adapter. Connect assembly to oxygen gas source. Connect pneumatic adapter to unit QDV (Item 37a or 37b).
- Slowly begin increasing pressure to between 1,35-1,48 bar/19,7-21,5 psig. PRV (Item 49) should begin venting (audible noise will be heard or bubbling will be seen if leak testing).
- Slowly begin decreasing the pressure until the PRV (Item 49) closes, meaning the audible noise is no longer heard or the bubbling is no longer seen if leak testing. The pressure at which the audible noise or bubbling is no longer seen should be greater than 1.24 bar/18psig.
- Hold PRV (Item 49) closed (with finger) and increase pressure to 1,9-2,3 bar (27-33 psig). SRV (Item 43) must begin open (audible venting and/or bubbling of leak test solution).
- Slowly begin decreasing the pressure until the SRV (Item 43) closes, meaning the audible noise is no longer heard or the bubbling is no longer seen if leak testing. The pressure at which the audible noise or bubbling is no longer seen should be greater than 1,68 bar/24,3 psig.
- Slowly begin decreasing the pressure in order to release the finger from the PRV.

Required Tools

1. Hex Wrenches (various sizes)
2. Flat Blade Screwdriver
3. 5/16" Nut Driver
4. Open End Wrenches (1/2" to 1-1/8")
5. Side Cutters
6. Phillips Screwdriver
7. Pliers
8. Torque Driver/Wrenches:
 - 12-17 N-cm (10-15 in-lbs)
 - 23-29 N-cm (20-25 in-lbs)
 - 69-92 N-cm (60-80 in-lbs)
 - 104-115 N-cm (90-100 in-lbs)
 - 6.2-6.9 N-m (45-50 ft-lbs)
9. Jeweler's Screwdriver

Required Fixtures/Equipment

1. Capacitance Meter
2. Soldering Iron
3. Oxygen Regulator/Hose Kit
4. Pressure Gauge
5. Pressure Gauge Adapter
6. Flowmeter
7. O2 Gas Source (High Pressure bottle)
8. O2 Liquid Source
9. N2 Gas or Clean, Dry Compressed Air Source
10. Tubing (O2 compatible)

Required Supplies

1. Stay-Clean Flux
2. Cotton Swabs
3. Lead-free Solder
4. Distilled Water
5. Household Glass Cleaner
6. Lint-Free Cloth
7. Teflon[®] Tape
8. Fluorolubricant
9. Leak Detection Fluid

Tools and Accessories available from CAIRE Inc.

Part No	Description
CA200071	240 AC Fluorolubricant
CA200072	"Snoop" Leak Detection Fluid
CA400004	Replacement Filter/Male Transfer Line Adapter
CA406308	10.3 bar (150 psi) Relief Valve Assembly
CA406310	Teflon [®] Tape
CA406398	10.3 bar (150 psi) Relief Valve only
10662631	Service Manual
13214825	Airlift Backpack
10018138	C1000 Backpack
97112026	Female Side Fill Pneumatic Test Adapter
97200076	Erie "Liter Meter"
97217007	Pressure Gauge Adapter
97212021	Male Side Fill Pneumatic Test Adapter
97403015	Capacitance Meter
97403016	Jeweler's Screwdriver
97405279	Pneumatic Hose with DISS Fittings
97403574	Dewar Cap
97403577	0-4.1 bar (0-60 psig) Pressure Gauge
12917730	Stroller Cart
97405147	0-45 psig Oxygen Regulator
97405177	Portable Carrying Handle
97405431	Liquid Oxygen Transfer Line – 2 m (6 ft)
97404564	Transfer Line Swivel Connector
97405590	Lip Seal Service Tool
97406471	Tandem Tee Kit
97406555	Super Flex Liquid Oxygen Transfer Line – 6'
97406630	Dual Fill Head Tee
13329091	G4 Capacitance Meter Adaptor Kit

XI **Parts Price List**

Contact Customer Service or visit
www.caireinc.com
to obtain your parts list.

XI Ordering Information

Ordering Information

The following steps should be used when ordering a new Sprint/Stroller, or replacement parts for an existing unit:

1. **Compile a list of all equipment and replacement parts to be ordered.** An exploded view of assemblies for easy parts identification, along with parts/price lists can be found on www.caire-medical.com.

For US/Canada Part Numbers, please call 770 721 7759.

For European Part Numbers, please call +44 (0) 1189 367060 . For Asian, Australia, New Zealand Part Numbers, please call +61 297 494333.

2. **Fill out a purchase order containing the following information:**
 - a. Purchase order number.
 - b. Name and address of billing location.
 - c. Name and address of shipping location.
 - d. Quantity, part number, description, and unit cost for each item ordered.

3. **Telephone or fax CAIRE Inc. at one of the numbers listed below to begin immediate processing of the order:**

USA

Toll Free Phone: 800 48 CAIRE
(800 482 2473)

Toll Free Fax: 888 WE CAIRE
(To place an order): (888 932 2473)

Phone: 770 721 7759
Fax: 770 721 7758

Asia, Australia, Pacific Rim

Phone: +61 297 494333
Fax: 888-932-2473

Europe

Phone: +44 (0) 1189 367060
Fax: +44(0) 118 979 9245

4. **Mail or fax the completed purchase order for confirmation to:**

CAIRE Inc.
2200 Airport Industrial Drive
Suite 500
Ball Ground, GA 30107

CAIRE Medical Ltd.
Unit 6, Ashville Way
Wokingham, Berkshire, RG41 2PL
United Kingdom

All new equipment will be shipped either "prepaid", F.O.B. Canton, Georgia, F.O.B. Bracknell, UK, or collect via your specified carrier. All replacement parts will be sent by UPS "prepaid", and the shipping charges for equipment and parts will be added to the final invoice. Payment for replacement parts are located on CAIRE, Inc.'s invoice with payment date indicated. All shipments will originate from Canton, Georgia or Bracknell, UK. If a particular carrier or method of shipment is desired, specify when placing order.

For additional ordering and contact information, visit www.caireinc.com

When a Sprint/Stroller is received, it should be inspected immediately, as outlined in Section VII, Unpacking and Setup Instructions.

If a problem with the unit should be encountered, reference should be made to Troubleshooting Charts on pages 17-21. If these procedures do not provide a solution for the problem, the following steps should be taken:

1. Call CAIRE Inc. Customer Service. State the problem with the unit. If it is determined that the problem cannot be solved by the distributor, a Return Material Authorization (RMA) number will be assigned to the unit or part(s). If a Purchase Order Number is to be referenced, please give this number to the Customer Service Representative at that time.
2. Carefully package the parts, or repack the unit in its original shipping container, precisely as shipped.
3. Write the Return Material Authorization Number on the top of the shipping container.
4. Return the unit or parts by professional carrier to:

CAIRE Inc.
2000 Airport Drive
Ball Ground, GA 30107

CAIRE Medical Ltd.
Unit 6, Ashville Way
Wokingham, Berkshire, RG41 2PL
United Kingdom

All equipment returned to CAIRE Inc. must be shipped "prepaid".

When the defective item(s) is received at CAIRE Inc. it will be serviced and returned to the distributor as soon as possible. A copy of the "Repair Cost Sheet" will be enclosed giving a detailed listing of any maintenance performed.

Restocking Policy

If it becomes necessary to cancel an order with CAIRE Inc. after the shipment has been received, use the following "Restock Policy" procedure:

1. Notify the Customer Service Department at CAIRE Inc. using the toll-free number. When contacting Customer Service personnel, it will be necessary to relay the following information:
 - a. State the quantity and description of equipment to be returned.
 - b. Give the Serial Number of each unit to be returned.
 - c. State the equipment purchase date.
2. An RMA number will be issued in the name of the distributor by CAIRE Inc. for the equipment to be returned. When the equipment is shipped to the factory, the RMA number must appear on the packing slip.
3. All equipment must be returned "prepaid" to the original shipping location:

CAIRE Inc.
2000 Airport Drive
Ball Ground, GA 30107

CAIRE Medical Ltd.
Unit 6, Ashville Way
Wokingham, Berkshire, RG41 2PL
United Kingdom

4. Finally, a "Credit Memo", minus a 15% restocking fee, will be issued to the distributor when all equipment has been received, inspected, and restocked by CAIRE Inc.

Return of Unused Non-Defective Merchandise

CAIRE Inc., at its discretion, charges a 15% restocking fee for unused non-defective merchandise that is returned. A RMA number must be obtained from CAIRE Inc. Customer Service prior to return of any goods. Merchandise cannot be returned for credit after sixty (60) days. Customer to pay all freight charges. Tracking capability and insurance on all returned goods is advised. CAIRE Inc. will not be responsible for misdirected shipments.



CAIRE Inc.
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U.S.A.

CAIRE Medical Ltd
Unit 6 Ashville Way
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