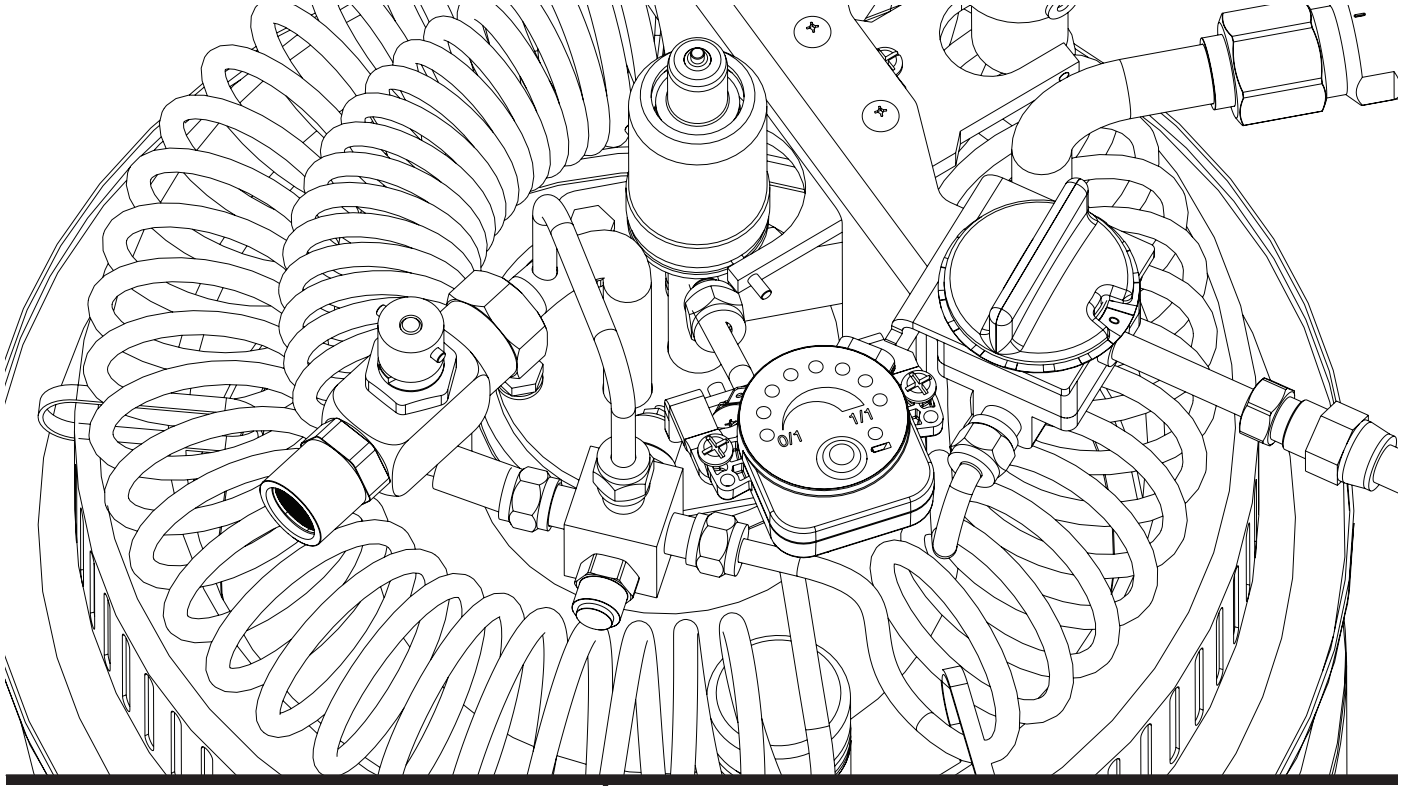
LIBERATOR 10

G4



SERVICE MANUAL

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SERVICE MANUAL

LIBERATOR 10—G4

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Abbreviations

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

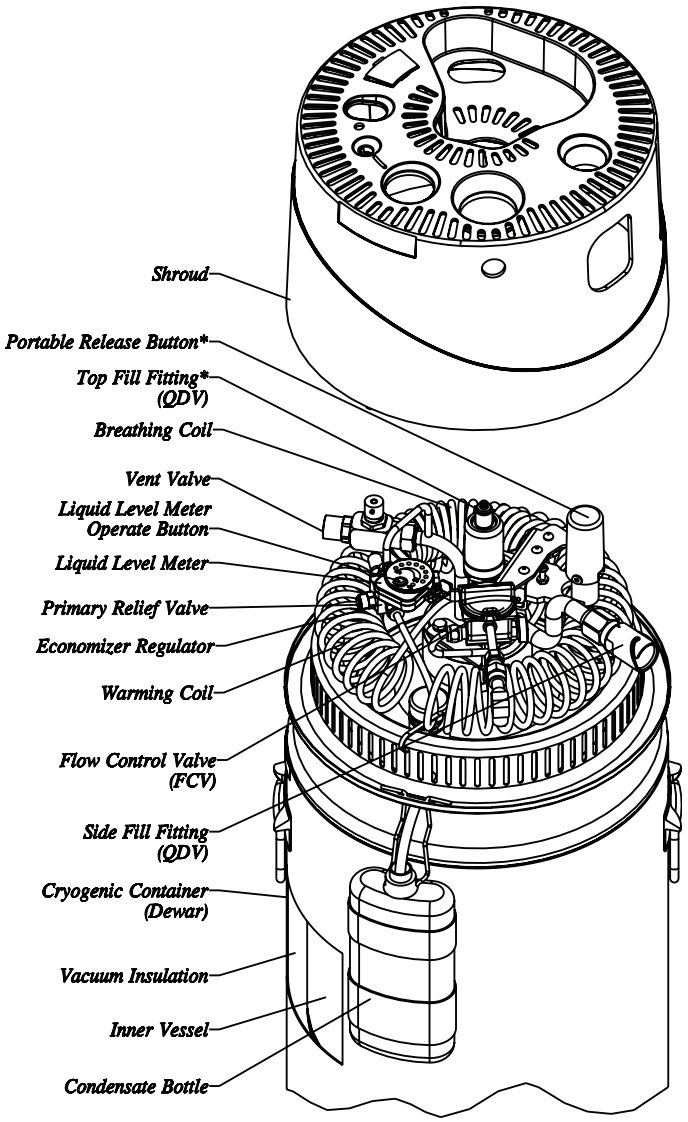
Disclaimer

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.

Table of Contents II

III Equipment Description

FIGURE 1: Liberator Components



* For Top Fill or Dual Models Only

The CAIRE Liberator® 10 is the stationary component of the Liberator/Portable supplementary oxygen system. The Liberator 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 Liberator is comprised of four major assemblies, grouped according to function.

1. **Cryogenic Container** – This assembly is a double walled, vacuum insulated dewar for storing liquid oxygen (LOX) at approximately -173°C (-280° F). The inner vessel is designed to safely hold liquid oxygen and is protected from over pressurization by the primary relief valve. Vacuum insulation between the inner and outer vessel keeps outside heat from causing the cold liquid inside to evaporate.

2. **Breathing Circuit** – This circuit consists of the manifold assembly, fixed orifice rotary flow control valve (FCV), breathing coil, and warming 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. Any water that condenses on the cold coils is routed into the condensate bottle. An economizer regulator is utilized to conserve LOX by drawing oxygen head gas into the breathing circuit.

3. **Shroud Assembly** – The shroud assembly houses and protects the breathing circuit and liquid level meter. Labels listing safety information and patient operating instructions are affixed to the side of the shroud.

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.

   An optional roller base can be provided to help move the Liberator.

LIBERATOR 10

Capacity

kg (lbs) LOX	11,8 (26)
Liquid Liters	10,7
Gaseous Liters	8881

Selectable Flow Rates

Liters Per Minute (LPM): Off, .25, .5, .75, 1, 1.5, 2, 2.5, 3, 4, 5, 6

Flow Rate Accuracy ± 0,1 liter per minute or ±10% of flow setting, whichever is greater

Hours of Operation Refer to the Liquid Oxygen Duration Time Chart located at www.cairemedical.com

Standard Fill Connections Side, Top

Operating Pressure (Economizer Regulator)

Bar (PSIG) 1,4 (20 ± 2)

Primary Relief Valve Setting

Bar (PSIG) 1,5-1,7 (21.8-24.2)

Secondary Relief Valve Setting

Bar (PSIG) 1,9-2,3 (27.0-33.0)

Normal Evaporation Rate

kg (lbs) per day 0,54 (1.2)

Height

cm (in) 495 (19.5)

Diameter

cm (in) 35,6 (12)

Weight

Empty kg (lbs)	11,8 (26)
Full kg (lbs)	23,5 (52)

Fill Connector Types Side Mounted Rotary Coupling, Top Fill Push-On

V Safety

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 1,5-1,7 bar (21.8-24.2 psig), 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 Liberator 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.

CAUTION: The Liberator should be moved by utilizing the roller base or hand truck. Do not roll units on their side or edge as insulation damage can occur. The Liberator must be used, stored, and transported in a vertical position. Do not lay, store, or ship the unit on its side.

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 (RP22). Purge the unit with an inert gas (nitrogen) and promptly return it to CAIRE 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: During transfer of liquid oxygen gas blowoff from the vent valve creates a loud horn-like noise. Ear protection is recommended.

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.

WARNING: 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.

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 Liberator.

WARNING: The Liberator should not be used adjacent to or stacked with other equipment, and that if adjacent or stacked use is necessary, the Liberator 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 Liberator is intended for use in the electromagnetic environment specified below. The customer or the user of the Liberator should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic environment—guidance
RF emissions CISPR 11	Group 1	The Liberator 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 Liberator 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 Liberator is intended for use in the electromagnetic environment specified below. The customer or the user of the Liberator 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 Liberators are found to be compliant with regulations.

Table 4*

Guidance and manufacturers declaration—electromagnetic immunity

The Liberator is intended for use in the electromagnetic environment specified below. The customer or the user of the Liberator 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 Liberator, 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 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: 
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m	

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 asses 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 Liberator is used exceeds the applicable RF compliance level above, the Liberator should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the Liberator.

[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 frquency ranges and been found compliant with regulations.

Table 6*

Recommended separation distances between portable and mobile RF communications equipment and the Liberator

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

Rated maximum output power of transmitter	**Separation distance according to frequency of transmitter** m		
W	**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.

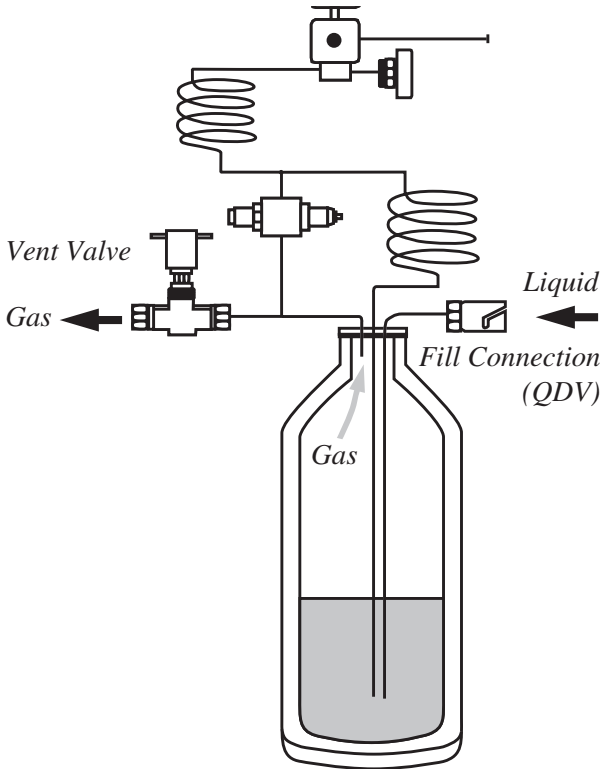
* This table is included as a standard requirement for equipment which has been tested to specific test levels and over specific frquency ranges and been found compliant with regulations.

Filling

The Liberator is filled by connecting a pre-purged transfer line with a fill adapter from a larger liquid oxygen source to the Liberator side fill or top fill QDV. The Liberator vent valve is then opened. The pressure differential between the Liberator and source tank forces liquid oxygen through the transfer line and into the Liberator inner vessel.

There will be some oxygen vaporized during filling. This gas is discharged through the vent valve. When the Liberator is full, liquid oxygen is expelled. Disconnecting the fill adapter from the Liberator QDV and closing the Liberator vent valve terminates the fill process.

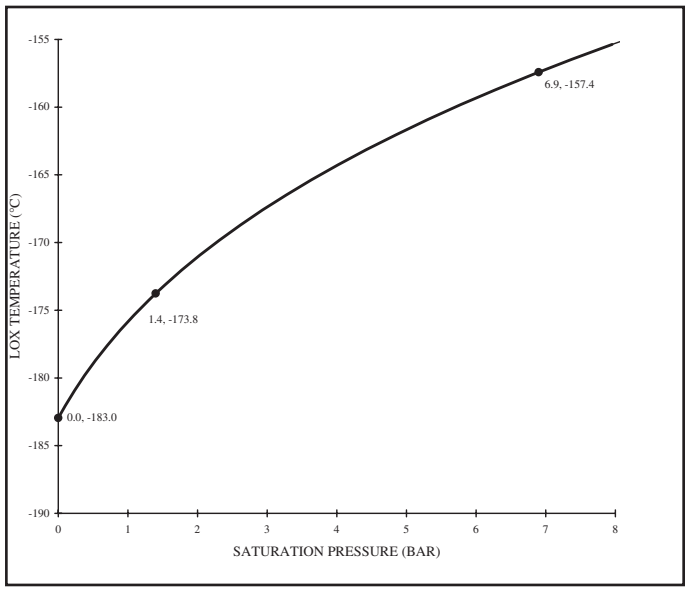
FIGURE 2: Filling



Saturation Pressure

The saturation point of a liquid is a steady-state condition where the liquid has absorbed the maximum amount of heat possible. A liquid can be at its saturation point at a number of different pressures and temperatures, but each specific saturation pressure has a corresponding saturation temperature and vice-versa (see Figure 3). This means that the final temperature of your liquid oxygen is dependent upon the pressure at which it is transferred from the storage system to the Liberator. For the purposes of this manual, we will speak in terms of saturation pressure, since it is easier to control than temperature. Treat saturation temperature as a dependent variable of saturation pressure.

FIGURE 3: Temperature vs. Saturation Pressure



There are two conditions which can seriously affect the overall efficiency and operation of the system:

1. Saturation pressure of the liquid oxygen in the fill source is substantially higher than the Liberator operating pressure (oversaturated).

2. Saturation pressure of the liquid oxygen in the fill source is substantially lower than the Liberator operating pressure (undersaturated).

For example, when a Liberator is filled from a liquid source saturated at 6,9 bar (100 psig), larger transfer losses will occur. This is because the Liberator is designed to operate at 1,4 bar (20 psig), and the liquid it is filled with is saturated at a much higher pressure and at its correspondingly higher temperature. It is necessary for this liquid to reach equilibrium at a lower pressure and temperature before the relief valve will close and the Liberator will operate properly.

In order to become saturated at 1,4 bar (20 psig), the liquid oxygen must release enough heat for its temperature to be lowered to the temperature corresponding to a pressure of 1,4 bar (20 psig), as shown in the graph. The temperature is lowered through boiling. All of the gas generated by this boiling is vented through the relief valve and/or primary relief valve and is lost.

If the saturation pressure of the liquid oxygen in the filling vessel is lower than the normal operating pressure of the Liberator, oxygen vaporization within the dewar works to raise the system pressure to the required 1,4 bar (20 psig). This may require as long as a day. The time required for saturation to 1,4 bar (20 psig) depends on the initial liquid saturation pressure.

VI Theory of Operation

WARNING: Low oxygen flow rates to the patient may result if the Liberator is filled with under-saturated liquid oxygen.

WARNING: The vent valve orifice does not guarantee properly saturated LOX. The filling source tank must have a minimum 1,6 bar (23 psi) to transfill into the Liberator or low saturation will occur in the Liberator.

To minimize the effect of undersaturated liquid in the Liberator, a fixed orifice has been installed in the outlet of the vent valve. This orifice regulates the back pressure in the unit during the fill process, resulting in improved saturation pressures in the Liberator.

Operation

If the flow control valve and vent valve are closed with LOX in the unit, then the pressure in the inner vessel will remain near the primary relief valve setting of 1,5-1,7 bar (21.8-24.2 psig).

In the Liberator, as in all vacuum-insulated cryogenic containers, some liquid (oxygen in this case) is always evaporating into a gas. The rate of generation of this gas, with the flow control valve closed, is called the normal evaporation rate (NER). This gas is lost through the primary relief valve.

When the flow control valve is at any setting other than off, and the economizer valve is open (presure over 1,4 bar (20 psig), see Figure 4), gaseous oxygen is forced from the head space in the inner vessel, through the economizer valve, to the breathing coil. This process conserves or "economizes" liquid oxygen by withdrawing the head gas first, instead of allowing it to escape through the relief valve.

While flowing through the breathing coil, the cold gaseous oxygen is warmed to near-ambient temperature before being metered and dispensed by the flow control valve.

Whenever gas is removed from the space above the liquid oxygen (head space), the inner vessel internal pressure begins to drop slightly. When the pressure drops to 1,4 bar (20 psig), the economizer valve closes,(see Figure 5) forcing liquid oxygen up the withdrawal tube and through the warming coil where it becomes gas.

The gas then flows through the bypass tee to the breathing coil, the flow control valve, and then the patient.

As the pressure in the container increases over 1,4 bar (20 psig), the economizer valve opens, and the cycle repeats, maintaining constant oxygen flow, at the selected flow rate, to the patient.

FIGURE 4: Operation Above 1,4 Bar (20PSI)

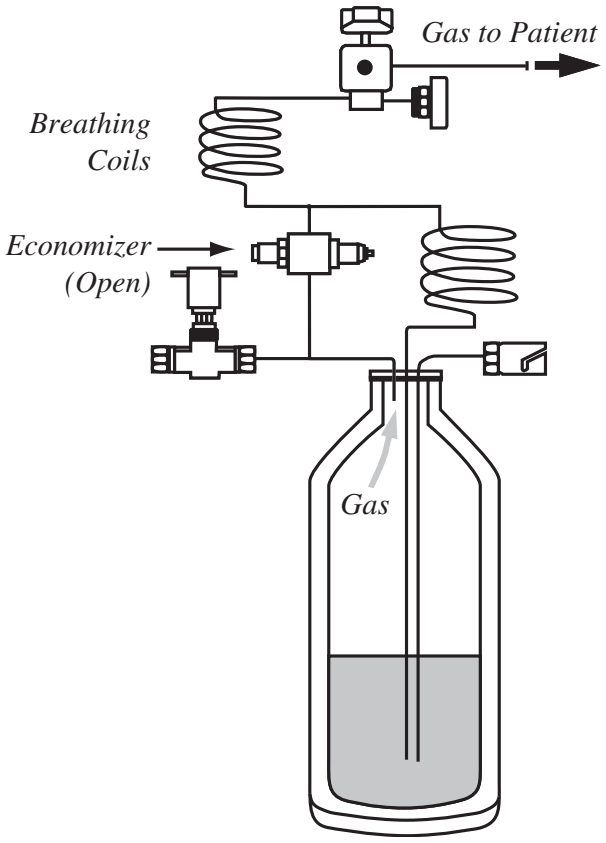
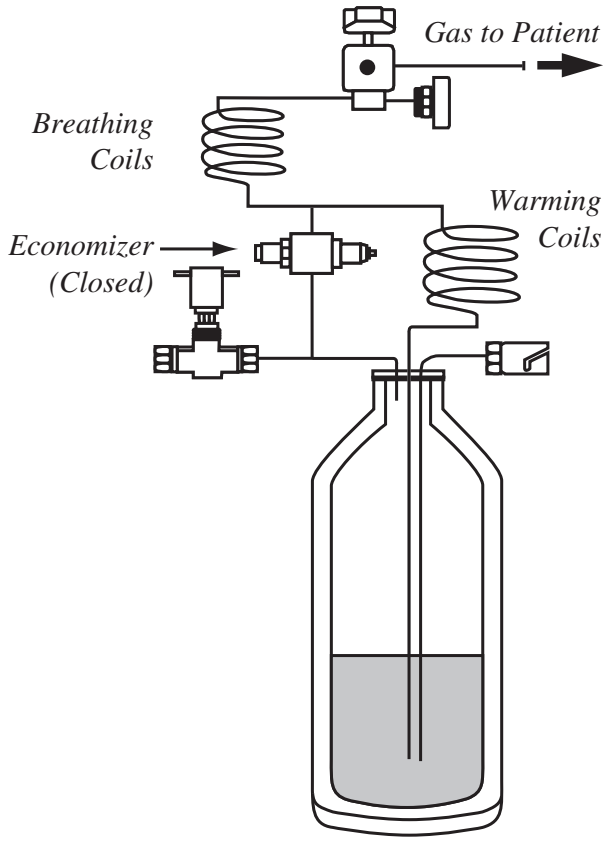


FIGURE 5: Operation Below 1,4 Bar (20PSI)



Liquid Level Measurement

Liberators 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 fill level. The higher the liquid level in the dewar, the more LEDs are activated, beginning at the leftmost LED.

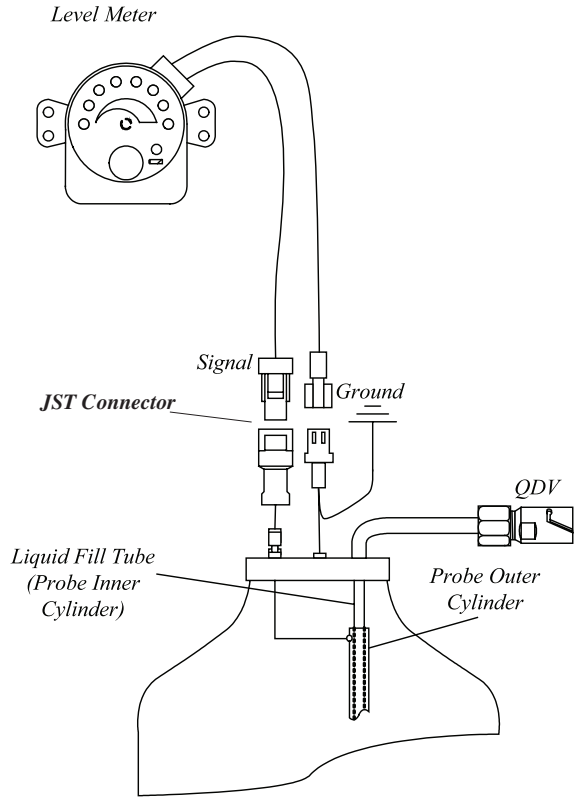
Electrical connection between the level meter and the probe is made via a single conductor JST connector. This male plug is attached to its female counterpart extending from the probe, creating a watertight connection. A single ground wire is connected from the meter to a male spade terminal on the mounting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

The meter is powered by an internal battery offering battery life of 5 years or more at 30 cycles 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 the Liberator 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 (RP5). Replacement batteries can be found at most hardware stores or they can be ordered through CAIRE customer service.

The new level meter improves upon the previous meter by integrating all components within its casing, simplifying removal and replacement (RP4). Even more importantly, there is a much improved calibration procedure that requires no additional tools and a range of error reporting codes which can be read directly from the LEDs to report calibration errors. These can be found in the calibration procedure (RP7).

NOTE: Tampering with meter battery housing will void the battery's 2-year warranty.

FIGURE 6: Liquid Level Meter Circuit



VII Unpacking and Setup

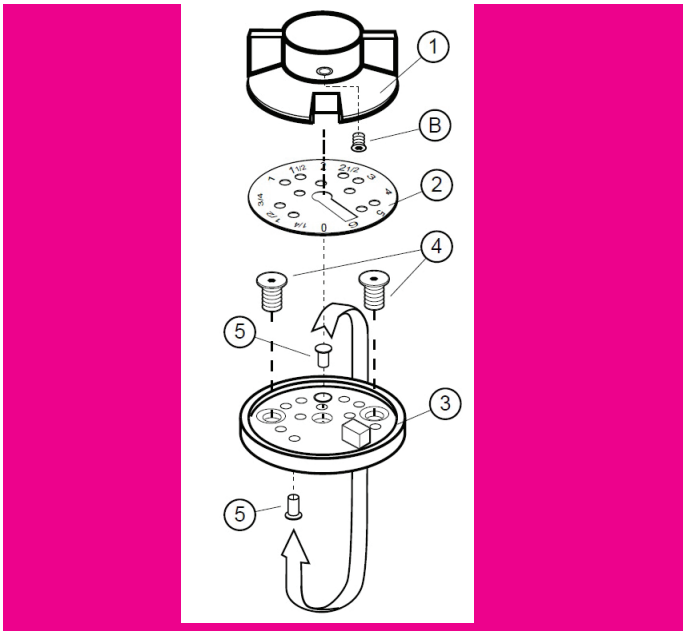
Unpacking

1. Inspect carton for shipping damage. Report any damage to freight company before signing bill of lading.
2. Check description on carton against your order.
3. Unpack unit, including condensation bottle and bracket, POI, FCV extension, and humidifier elbow kit.
4. Set aside packing materials in case unit must be returned to the factory.

Setup

1. Install condensation bottle bracket by squeezing bracket ends together and inserting into slot in handling ring directly below FCV outlet.
2. Install condensation bottle on bracket located below shroud. Remove cap from bottle. Put condensation hose inside bottle.
3. Install FCV extension by screwing it into the side of the FCV to 45 N-cm (4 in-lb).
4. Install humidifier elbow (if applicable) by screwing it into the side of the FCV extension.
5. Visually inspect the Liberator for damage from improper handling. Note any dents in the container, cracks in the shroud, missing or loose hardware, and bent quick disconnect valves or humidifier adapters.
6. Check for smooth operation of the flow control selector, making sure that a positive detent is felt at all settings. The flow control knob should be secure and properly aligned.
7. Check the vent valve for smooth operation.
8. If possible, connect a portable unit to the Liberator to check for smooth coupling, and to make sure the portable unit is in proper alignment with the Liberator when mated.
9. Verify operation of the level meter by depressing the operate button. LEDs will light, displaying the level of liquid oxygen. If the unit is empty, only the leftmost LED should light. If it does not, or if other erroneous indications are given, refer to the Troubleshooting Section (Section X).
10. Check all labels for damage and wipe away any dust on unit with a clean, dry, lint-free cloth.
11. If desired, the flow control knob (Item 1) can be adjusted so it will not exceed maximum prescribed flow rate.
    a. Remove FCV knob by firmly grasping the knob and pulling away from the base unit.
    b. Remove two phillips head screws (Item 4) from flow lock plate (Item 3) and remove plate.

FIGURE 7: Flow Control Knob



    c. Remove flow rate decal number disc (Item 2).
    d. Remove locking pin (Item 65) from its storage position on flow lock plate (Item 3) and place in underside of hole corresponding to maximum allowable flow rate.
    e. Replace flow lock plate (Item 3), number disc (Item 2) and knob. Tighten screws (Item 4) to 45–65 N-cm (4–6 in-lbs). Verify flow lock is at correct position.

Transport

Specifically designed roller bases are available for moving Liberators short distances on smooth surfaces. Hand trucks can also be utilized for Liberator transport.

CAUTION: Always ship, store, or transport a Liberator, empty or full, in an upright position, properly secured to prevent damage. DO NOT ROLL UNITS TO TRANSPORT

Liberator 10 units may be moved about or transported in a vehicle while full without damage; however, they should not be dropped or handled roughly in order to prevent necktube damage.

Filling

NOTE: The fill source should have the correct fitting (5/8" x 45° male flare) to connect to transfer line.

1. Fill Source Preparation

   a. Ensure the source contains a sufficient amount of liquid oxygen to completely fill the Liberator (approximately 120% of Liberator volume).

   b. Ensure the liquid oxygen in the fill source is saturated at 2,4-4,1 bar (35-60 psig). 3,4 bar (50 psig) is optimal.

WARNING: Fill source must be in a well-ventilated area to prevent developement of an oxygen-enriched atmosphere.

WARNING: Wear insulated gloves and eye protection whenever working with liquid oxygen.

2. Fill Procedure

   a. Required Equipment:

      ❏ Fill source as outlined above
      ❏ Liquid oxygen transfer line
      ❏ Male transfer line adapter for side fill Liberators
      ❏ Female transfer line adapter for top fill Liberators
      ❏ Liberator vent valve wrench
      ❏ Eye protection
      ❏ Pressure gauge
      ❏ Insulated gloves

   b. If refilling a partially filled Liberator, verify flow rates are within tolerance specifications before filling.

   c. Verify that liquid level meter is operating properly. The LED display should indicate approximate level in unit. The low battery LED should not be lit.

NOTE: If flow rates are out of specifications or liquid level meter operates improperly, refer to Troubleshooting section (Section X).

   d. Connect transfer line to fill source. Connect proper transfer line adapter to transfer line.

   e. Fully open liquid valve on fill source.

   f. Purge transfer line for a minimum of 5 seconds ensuring gas is safely piped away from operator:

      i. Connect transfer hose fill adapter to a securely mounted mating QDV.

      -OR-

      ii. Push adapter poppet against the side of a Liberator unit or other unpainted stainless steel surface.

   g. Wipe reservoir fill connector with lint free rag if moist.

NOTE: Purge the transfer line any time fill source valve has been closed.

   h. Weigh unit as required by local and federal standards.

   i. Fully open Liberator vent valve.

   j. Connect transfer line to Liberator to begin fill.

   k. Connect a pressure gauge to oxygen outlet and open the flow control valve to 2 LPM or greater.

   l. While filling, throttle the vent valve with the vent valve wrench as needed to keep pressure at approximately 1,4 bar (20 psi).

      An alternate method is to attach a flow meter to the oxygen outlet, set the flow control valve to 2 LPM, and then throttle the vent valve to maintain a flow of 2 LPM. This is equivalent to using a pressure gauge.

   m. When liquid spurts from vent outlet, terminate the fill by disconnecting transfer line.

   n. Close Liberator vent valve immediately after removing transfer line.

   p. Disconnect pressure gauge (or flow meter) from oxygen outlet and turn off FCV.

CAUTION: Do not allow excessive venting of liquid oxygen through the vent valve. Prolonged exposure may freeze the valve in the open position.

   q. Replace protective cover on QDV adapter and hang adapter and transfer line using hook provided.

   r. Verify that all flow rates are within tolerance specification and that the liquid level meter indicates full.

NOTE: The liquid level indicating system is accurate only after the vent valve is closed, and the oxygen has stabilized for five minutes.

VIII Operation

Liquid Level Measurement

As noted in the Theory of Operation (Section 6), Generation 4 Liberators are equipped with new liquid level meters. In order to obtain a liquid level reading, the technician or end-user should depress the green operate button on the face of the meter (note that the button has been moved onto the meter from its previous position). This will cause the LEDs to quickly flash from right to left around the meter's perimeter to indicate button activation. The LEDs will then light from the left to the right, signifying the liquid level in the cylinder (1 LED for empty, 8 for full). If you feel the meter is giving incorrect measurements, reference RP7 to calibrate the meter.

Cleaning and Disinfection

To insure proper functioning and end-user safety, all Liberator units should be cleaned whenever dirt or grime is visually apparant. The unit should be disenfected according to any applicable local regulations or the home healthcare distributor's own decontamination schedule.

Preparation

Prior to cleaning or disinfection, the unit should be completely purged of LOX. The technician should wear appropriate safety gear and prepare mild solutions of glass cleaner or Simple Green (available at www.simplegreen.com) and disinfectant respectively. If at any time either solution becomes visibly dirty or cloudy, it should be switched out for fresh solution.

Cleaning

1. Inspect through air holes in shroud to see if any debris has accumulated beneath shroud. If it has, remove debris using long tongs or tweezers.
2. Wipe off the exterior of the unit with the cleaning solution using a lint-free cloth. The cloth should be damp but not dripping. Be as thorough as possible.
3. Discard the cleaning cloth.
4. Wipe off excess cleaning solution and dry thoroughly with a lint-free cloth. Discard the cloth.

Disinfection

Disinfection should be performed in accordance with the home healthcare provider's own validated procedures and/or in accordance with local regulations.

Table 1 shows disinfectants which have proven to be compatible with materials used in the construction of the Liberator base unit.

Table 2 shows actual material content of the Liberator base unit to assist the home healthcare distributor in establishing its own disinfection protocol.

Table 3 lists a selection of common disinfectant chemicals and their compatibility with Liberator base units.

TABLE 1: Recommended Disinfectant Solutions

Name	Producer	Website
Microbac Forte	Bodie Chemie Hamburg	www.bode-chemie.com
Wex-Cide	Wexford Labs, Inc.	www.wexfordlabs.com
Vesphene IIse	Steris Corp.	www.steris.com
Note: The above solutions are recommendations only and there may be a number of other effective solutions.		

TABLE 2: Liberator Material Content

Part	Material
Shroud	Polycarbonate
Breathing Coil	T3003 Aluminum
Vaporizer Coil	T3003 Aluminum
Dewar	Stainless Steel
Valves	T6061 Aluminum

TABLE 3: Common Disinfectant Chemicals

Disinfectant Agent	Compatible with Generation 4 Liberators
Aldehyde	Yes
Quanternary Ammonium Compound	Yes
Sauerstoffabspalter	No
Alcohol	*Yes - Ethanol based cleaner (only when all O2 has been purged)
Amine Derivatives	Yes
Phenol	Yes
pH: Basic (alkaline) Cleaners	Yes
Ether/Ester based products	No

End of Life

At the end of the unit's service life, all Liberator units must be returned to a recycling facility in compliance with the Waste Electrical and Electronic Equipment Directive (WEEE), or other applicable codes and regulations.

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 equipment is operating properly.The healthcare distributor may follow either Schedule A or Schedule B, or a combination of the two schedules.

Schedule A – Biennial

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 X) of this manual.

   -or-

   b. Return the unit to CAIRE, Inc. for repair.

2. Schedule – Maximum of two years 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 Troubleshooting section (Section X) of this manual.

1. Visual Inspection:

   a. Remove any LOX prior to maintenance (RP22).
   b. Look for damaged or missing parts.
   c. Verify the meter reads empty (one LED), the low battery LED is not lit, and no error codes appear on the meter.

2. Component Test:

   a. Remove shroud (RP2).
   b. Pressurize the unit between 1,5 bar (21.8 psig) and 1,7 bar (24.2 psig) and check that PRV opens.
   c. While sealing off the PRV, pressurize the unit to between 1,9 bar (27.0 psig) and 2,3 bar (33.0 psig), pressurize the unit to between 27.0-33.0 (RP13) and check that SRV opens.
   d. Recalibrate meter (RP7).
   e. Test pressure retention (RP15).
   f. Replace shroud (RP2).

TABLE 4: Flow Test Acceptable Ranges

FCV Setting	LPM
OFF	0
0,25	0,15 to 0,35
0,50	0,40 to 0,60
0,75	0,65 to 0,85
1,00	0,90 to 1,10
1,50	1,35 to 1,65
2,00	1,80 to 2,20
2,50	2,25 to 2,75
3,00	2,70 to 3,30
3,50	3,15 to 3,85
4,00	3,60 to 4,40
5,00	4,50 to 5,50
6,00	5,40 to 6,60

3. Flow Test:

   a. Fill with approximately 7kg (15 lbs) of properly saturated LOX.
   b. Set FCV to maximum setting and run for one hour minimum.
   c. Check all flow settings according to Table 4 and verify pressure stays above 1,24 bar (18 psig).

4. Check Efficiency of Unit:

   a. Set FCV to zero and allow unit to warm up (10-15 min).
   b. Inspect unit for cold or sweaty condition and for excessive venting from relief valve (some venting is normal).
   c. If either condition is observed, conduct NER test (RP31).

5. Prepare for Use:

   a. Empty contents (RP22).
   b. Allow unit to sit until warm (2-4 hours).
   c. Clean and/or disinfect outside of unit following instruction set forth in the Operation section (Section VIII).

IX Maintenance (Schedule B, Continuous)

Schedule B – Continuous

A. Introduction

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

1. If a unit fails a given test, it should be taken out of service and sent to the Repair Center / Department for further inspection.

2. Schedule – Checks should be made when the driver sees the patient and when moving equipment between patients.

B. Procedure

These inspections/tests should be done by the driver as part of the Standard Fill Procedure every time the reservoir is filled.

1. Visually inspect for:

   a. Broken shrouds
   b. Cold sweaty bottles (vacuum problem)
   c. QDV deformation

2. Check prescription flow rate(s) using an Erie liter meter (± 0,25 LPM).

3. Check the liquid level meter. Push operate button before fill and verify that the battery is not low, there are no error codes, and the meter reading is within one LED of the values shown in Table 5. After filling, verify that the meter reads full.

TABLE 5: Unit Weight (kg) vs. Meter Reading

Model	10	
LED	**Min**	**Max**
1	11,8	13,3
2	13,3	14,7
3	14,7	16,2
4	16,2	17,7
5	17,7	19,2
6	19,2	20,6
7	20,6	22,1
8	22,1	23,6

These inspections / tests should be done between patients:

1. Visually inspect for:

   a. Broken shrouds/ flow control knobs

   b. Cold sweaty bottle or excessive venting from relief valve (vacuum problem). Some venting from relief valve is normal.

   c. QDV deformation

   d. Inspect under shroud (without removal) for any visible dirt or contaminants.

   e. Inspect drain tube for visible dirt. Clean with a 6" cotton swab to remove dirt.

2. Verify that the meter battery is not low, there are no error codes, and the meter is within one LED of the table. If the unit is empty, verify the meter reads empty, then fill with approximately 7kg (15 lbs) of liquid oxygen and verify using the chart.

3. Set FCV to maximum flow rate for one hour. Check all flow settings according to Table 4 and verify pressure remains above 1,24 bar (18 psig).

TABLE 6: Flow Test Ranges

FCV Setting	LPM
OFF	0
0,25	0,15 to 0,35
0,50	0,40 to 0,60
0,75	0,65 to 0,85
1,00	0,90 to 1,10
1,50	1,35 to 1,65
2,00	1,80 to 2,20
2,50	2,25 to 2,75
3,00	2,70 to 3,30
3,50	3,15 to 3,85
4,00	3,60 to 4,40
5,00	4,50 to 5,50
6,00	5,40 to 6,60

4. If the unit fails one of the above tests, return it to the Repair Center or CAIRE Inc. If unit passes all tests, clean outside of the unit with household glass cleaner and lint-free cloth, being careful not to get cleaner inside valves as this could lead to malfunction.

Table of Contents

Introduction

1. These procedures are designed to be performed only by qualified personnel with proper equipment.

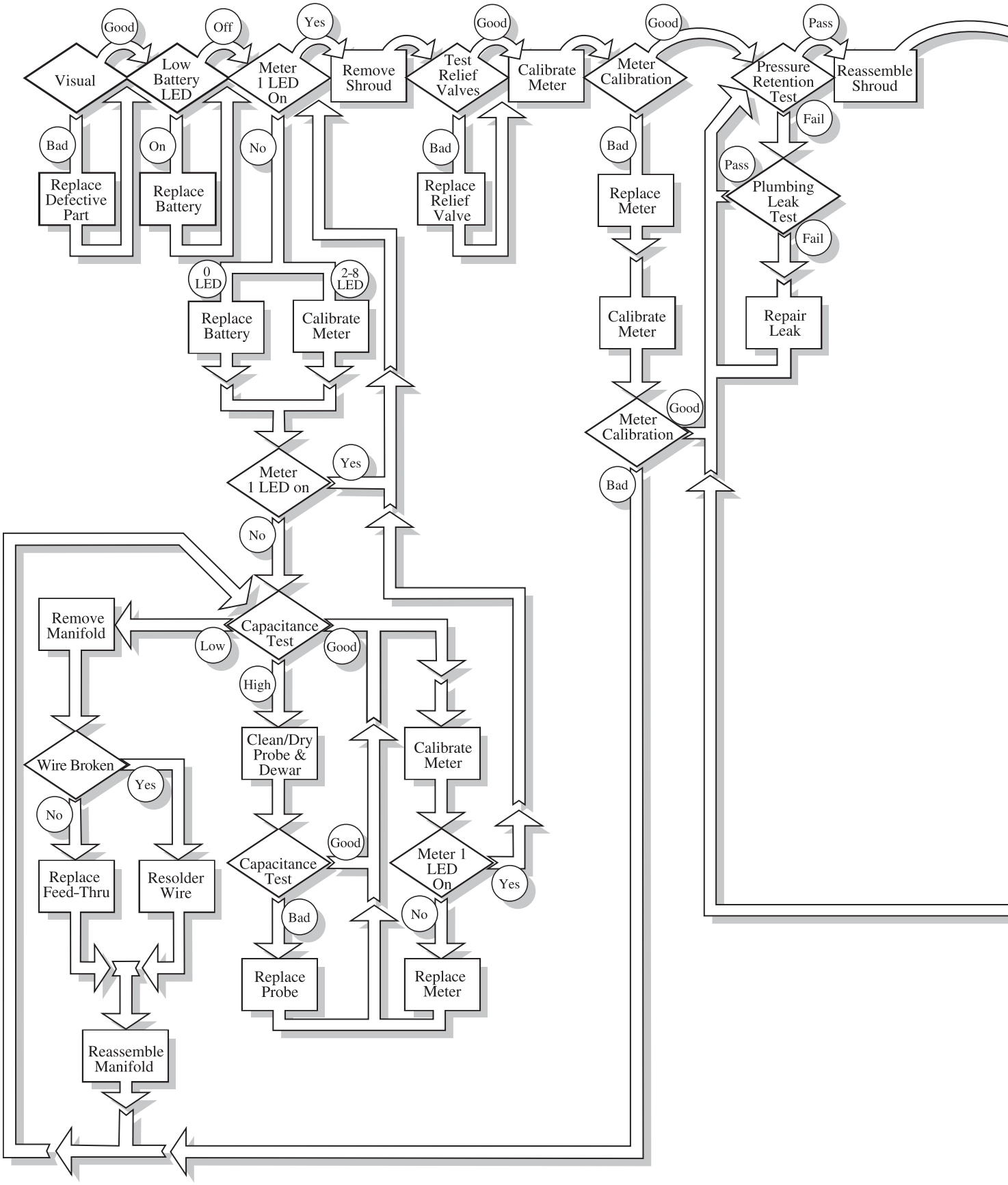
2. Any failure during routine maintenance checks will refer you to this section. See troubleshooting chart for appropriate procedure.

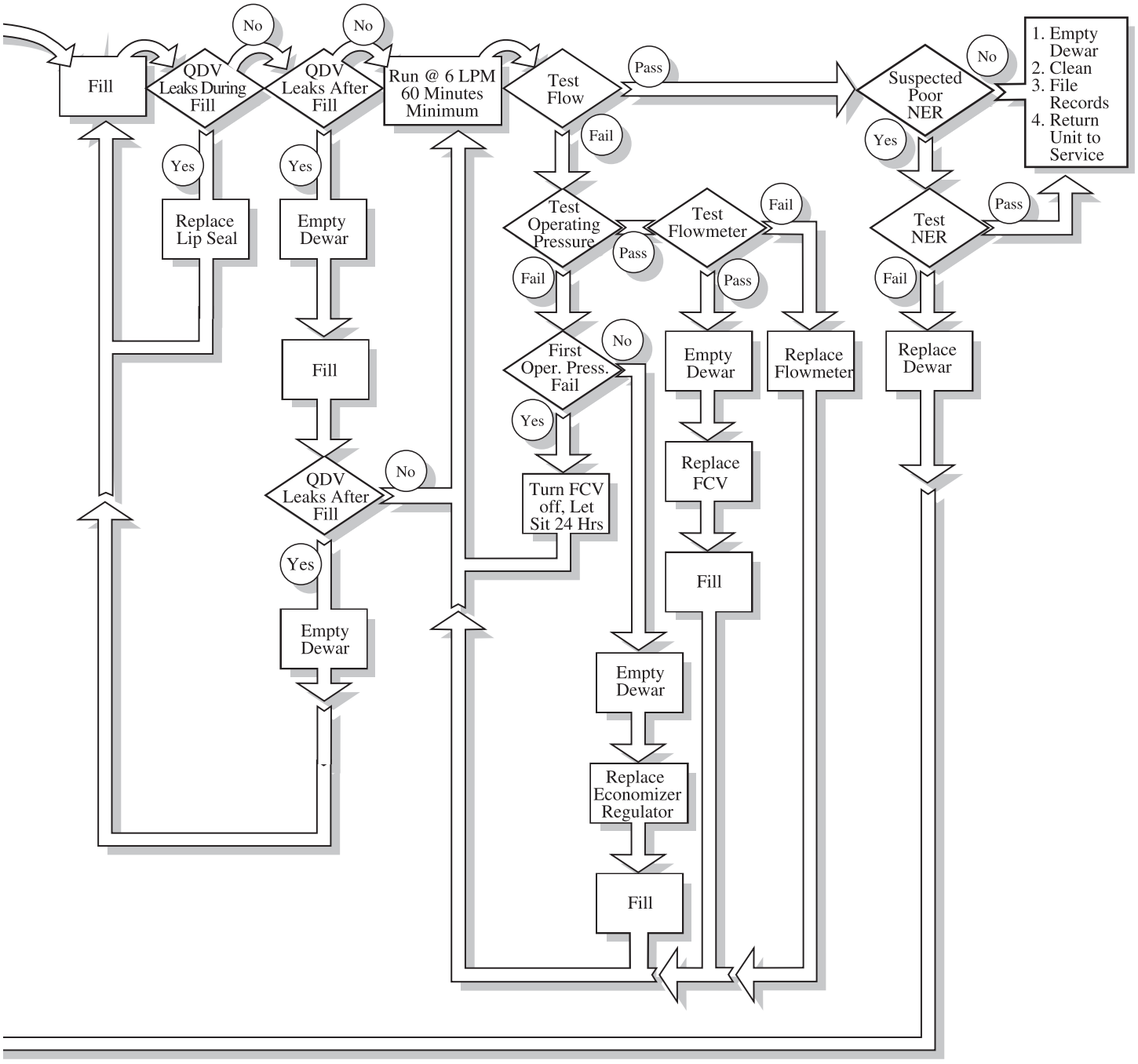
XI Troubleshooting Charts

Symptom		Probable Cause		Corrective Action
1)	Unable to start fill or excessively long fill times	a)	Transfer line not engaged fully on Reservoir QDV	Make sure the QDV on the transfer line and reservoir are properly aligned and ensure that a downward force is being applied to the transfer line assembly.
		b)	Low source pressure	Verify that pressure from the source is within the 35-50 psi range to fill the reservoir.
		c)	Vent valve not open or is blocked	Ensure that the vent valve is able to be turned to the fully open position.
		d)	Source tank is either under or oversaturated	Allow LOX to saturate to proper pressure.
		e)	Fill connector not opening properly	Check fill connector and cartridge assembly for damage; make sure fill connectors fully engage.
		f)	Vent valve is obstructed	Inspect the valve for blockages and verify that flow passes through during a fill. Clean by blowing out with compressed gas or replace parts if necessary.
		g)	Leak in the system	Check the reservoir for leaks (RP16) and repair if needed.
2)	Liquid leaks from the coupled QDVs during the fill	a)	Worn or damaged lip seal	Replace the QDV lip seal (RP19)
3)	Unable to disconnect the transfer line from the reservoir after a fill	a)	Pop-off assembly not being utilized (Does not apply to Liberator 10)	Ensure that the pop-off assembly on the reservoir is being used. Do not use force to separate the QDVs.
		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 poppet after filling	a)	Ice crystal preventing the QDV from closing properly.	Engage and disengage the transfer line 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 cartridge (RP20) or the entire QDV assembly (RP21)
5)	Excessive venting from relief valves (hissing sound)	a)	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.
		b)	Relief valve frozen open	Allow the portable to warm and thaw. Attempt to re-fill the portable.
		c)	Faulty relief valve	Test the relief valve (RP13) and replace if necessary (RP14)
		d)	Partial or complete loss of vacuum	Conduct the NER test (RP32) and return the unit to CAIRE, Inc. if necessary.
6)	No flow at oxygen outlet	a)	Reservoir is empty	Check the contents indicator/level gauge and fill the reservoir 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
		f)	Leak in the system	Perform a leak check on the plumbing (RP16). Repair leaks as necessary.
		g)	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)"
		h)	Vent valve is open	Ensure that thevent valve is fully closed.
		i)	FCV inlet filter is obstructed	Clean or replace (RP30) the filter screen.
		j)	Blockage in the liquid withdrawal circuit	Check the warming coils and withdrawal tubes for blockages. Replace if necessary.
		k)	FCV Faulty	Replace the FCV (RP30)
7)	Low flow at oxygen outlet on all LPM settings	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. Allow at least 30 minutes at no flow for the reservoir to saturate properly.
		c)	Leak in the system	Perform a leak check on the plumbing (RP16). Repair leaks as necessary.

Symptom		Probable Cause		Corrective Action
7) (Cont.)	Low flow at oxygen outlet on all LMP settings (cont.)	d)	Flow control valve inlet filter screen dirty	Clean or replace (RPxx) the filter screen.
		e)	Economizer valve faulty	Test the economizer (RP28) and replace (RP29) if necessary.
		f)	Blockage in the liquid withdrawal circuit or the flow restrictor	Check the warming coils and withdrawal tubes as well as the flow restrictor for blockages. Replace if necessary.
		g)	FCV faulty	Replace the FCV (RP30)
8)	Increased NER	a)	Saturation Pressure is too high	Inspect the saturation pressure of the reservoir. Allow at least 30 minutes at no flow for the reservoir to saturate properly.
		b)	Leak in the system	Perform a leak check on the plumbing (RP16). 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 (RP32) and return the unit to CAIRE, Inc. if necessary.
9)	Excessive Frost NOTE: Minimal frost on the shroud and on the plubming is normal. This symptom applies to frost that is much greater than what is normally observed.	a)	Frost is acceptable	Some frost on the shroud and on the plumbing is acceptable, especially at high flow rates during continuous use. 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. Allow at least 30 minutes at no flow for the reservoir to saturate properly.
		d)	Leak in the system	Perform a leak check on the plumbing (RP16). 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 (RP32) and return the unit to CAIRE, Inc. if necessary.
10)	Unit will not maintain acceptable system pressure	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)	Vent valve not completely closed	Close vent valve. Leak check vent valve outlet and stem. Replace or repair as needed.
		c)	Leak in the system	Perform a leak check on the plumbing (RP16). Repair leaks as necessary.
		d)	Economizer valve faulty	Test the economizer (RP28) and replace (RP29) if necessary.
		e)	Primary releif valve faulty	Test the primary relief valve (RP13) and replace (RP14) if necessary
11)	High Pressure at Reservoir oxygen outlet	a)	Saturation pressure is too high	Inspect the saturation pressure of the reservoir. Allow at least 30 minutes at no flow for the reservoir to saturate properly.
		b)	Primary releif valve set too high or relief valve operating improperly.	Perform relief valve test. Replace as needed.
		c)	Economizer valve stuck in closed state	Perform Economizer test. Replace as needed.
		d)	Partial or complete loss of vacuum	Conduct the NER test (RP32) and return the unit to CAIRE, Inc. if necessary.
12)	Contents indicator reads incorrectly	a)	Battery voltage too low to operate contents indicator	Replace battery as needed (RP5) then calibrate the meter following (RP6)
		b)	Sensor wires not connected properly, pinched or otherwise damaged.	Visually inspect the meter harness assembly from the meter to the point where the sensor wire enters the reservoir manifold. Replace as necessary
		c)	Contents indicator not calibrated properly	Calibrate the meter as needed following (RP6).
		d)	Ice crystal in reservoir causing incorrect or empty level reading	Empty and warm the reservoir following (RP23, RP24) to melt and evaporate moisture from inside the reservoir.
		e)	Meter malfunctioning/damaged	Inspect for physical damage. Replace meter as necessary then recalibrate the meter following (RP6)

XI Troubleshooting Charts





To use the Troubleshooting Chart:

- Start at the upper left corner.
- The top line shows the steps of routine maintenance.
- Unless otherwise noted by the arrows, the flow through the chart is down or to the right.

XII Repair Procedures

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 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 – Shroud Assembly RR (Figure 9)

a. Remove humidifier adapter (Item 26) from FCV (Item 24).

b. Loosen set screw(s) in FCV knob (Item 1). Remove knob.

c. Remove number disc (Item 2).

d. Remove two screws (Item 4), retaining locking plate (Item 3), then remove plate.

e. Remove three shroud mounting screws (Item 39).

f1. For side fill units:

a. Remove shroud (Item 7) by pressing on shroud at 90° each side of QDV (Item 11) and rotating shroud (Item 7) up and off QDV.

—OR—

f2. For top fill units:

a. Lift shroud straight up.

g. Disconnect manifold harness assembly (Item 22) located under shroud (Item 7).

h. To replace shroud assembly, reverse above procedure. Torque humidifier adapter (Item 25) to 60-80 in.-lbs. on FCV (Item 24).

RP3 – Condensation Bottle Bracket RR

a. Remove three shroud mounting screws (Item 39).

b. Remove condensate drain tube (Item 58) from bottle and remove bottle (Item 56) from bracket (Item 57).

c. Lift shroud (Item 7) approximately 1/2". DO NOT force shroud.

d. Squeeze ends of wireform bracket together. Lift bottom of bracket up and away from the tank sidewall. Twist the bracket to the side and remove hooks from under condensation ring.

e. To replace bracket, reverse above procedure.

RP4 – Liquid Level Meter RR

a. Remove shroud (See RP2).

b. Remove two screws attaching liquid level meter to the bracket, being careful not to pull on the meter wires.

c. Detach JST connector (red signal wire) and spade connector (black ground wire).

d. To replace meter, screw new meter into place using the top set of holes on the meter and reattach wires.

e. Calibrate meter per RP6.

RP5 – Liquid Level Meter Battery RR

NOTE: Tampering with meter battery housing will void the battery's 2-year warranty.

If meter battery failure occures while the battery is under warranty, contact customer service to obtain a replacement meter.

If meter battery is no longer under warranty, the CR2032 coin cell battery may be replaced following the steps below.

a. Remove liquid level meter (See RP4).

b. Using a pair of pliers, grasp the battery cover on the back of the meter. Twist counter-clockwise and pull the cover away from the meter, removing the battery cover.

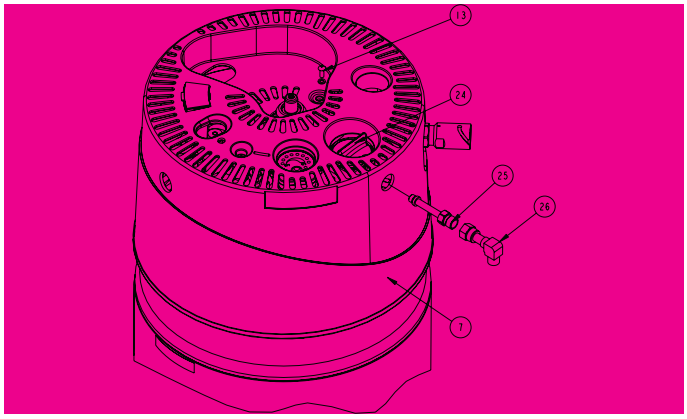
c. Slide the tip of a flathead jeweler's screwdriver beside the battery and carefully pry out the battery.

d. Insert new battery with the positive terminal facing up.

e. Apply a thin coating of fluorolubricant to the o-ring.

f. Replace battery cover by pushing it into the back of the level meter's case, ensuring the o-ring seals evenly and without kinks to restore the air-tight seal.

FIGURE 9: Shroud Assembly



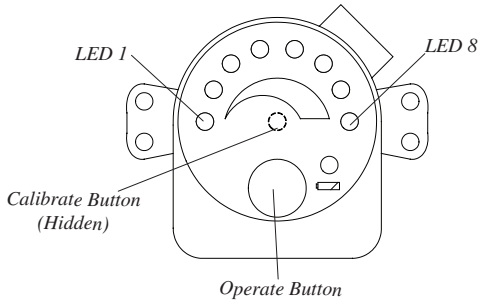
RP6 – Liquid Level Meter Calibration (Figure 10)

WARNING: You must first calibrate the empty side, and then calibrate the full side.

Calibration is required to ensure accurate meter readings and should be done whenever an error in level readings is suspected or when the meter has been replaced. If a calibration procedure is unsuccessful, the calibration value will not be saved and an error code will be displayed on the LEDs (See Table 7). To calibrate, first enter calibration mode before performing either full or empty calibration.

NOTE: In order to obtain an accurate calibration, you must calibrate both empty and full capacitance. For the full capacitance part of the calibration, you can choose either of the two procedures.

FIGURE 10: Liquid Level Meter



Enter Calibration Mode

a. Press and hold the hidden calibrate button. While still holding, continue to step B.

b. Within 3 sec, press and hold the operate button. LED 1 and LED 8 will begin alternately flashing to signify that calibration mode has been entered. If an error occurs, the calibration value will not be saved.

c. Proceed to next step within 45 seconds.

Calibrate Empty Capacitance

a. Press and hold calibrate button for 3 sec to record empty capacitance reading (LED 1 will flash for 3 sec).

b. LED 1 will flash to signify successful calibration. If an error occurs, certain LEDs will flash, signifying a specific error code and the calibration value will not be saved. (See Table 8 for a list of error codes.)

Calibrate Full Capacitance

There are two full capacitance procedures available. Procedure 1 is quite accurate and quicker to perform since it does not require you to fill the dewar. Procedure 2 is even more accurate, but requires the dewar be vent-full with LOX. To start either procedure, calibration mode must first be entered. There is no need to perform both procedures for any given calibration.

Procedure 1: Capacitance Simulated Full Method

NOTE: Please use only one of the following calibration methods.

TABLE 7: Capacitance Span LED Settings

Model	LED Setting
Liberator 10	LED 1

a. Press the operate button 3 times within a 5 sec period of entering calibration mode. One of the LEDs will light continuously.

b. Press the calibrate button until the correct LED is continuously lit (See Table 7).

c. Press the operate button to save the calibration. If an error occurs, the calibration value will not be saved.

Procedure 2: Fill Method

a. Enter calibration mode on a vent full unit with properly saturated LOX. If unit has just been filled, allow it to stabilize before continuing.

b. Press and hold operate button for 3 sec. LED 8 will flash as the meter stores calibration value. If successful LED 8 will flash again and calibration mode will exit. If an error occurs, the calibration value will not be saved.

RP 7 – G4 Meter Error Codes (Figure 11)

The table below identifies the error codes that one is likely to come across.

FIGURE 11: Calibration Errors

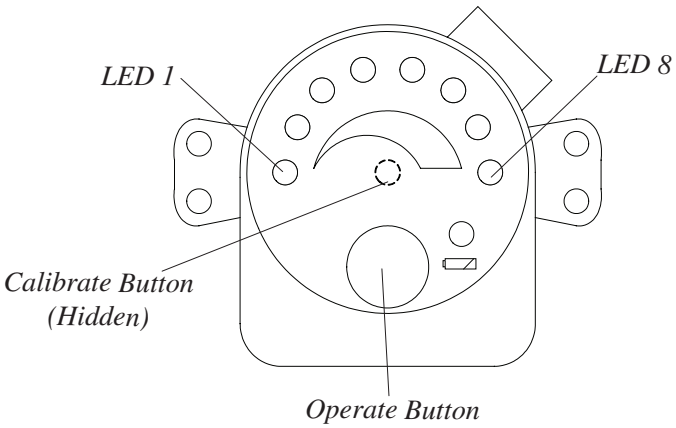


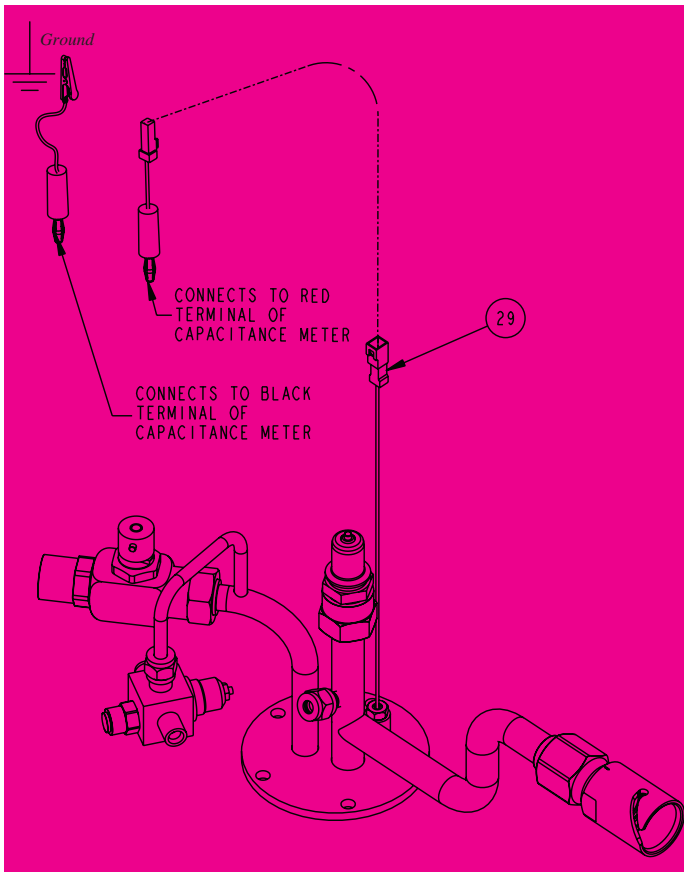
TABLE 8: Calibration Errors

LEDs	Name	Reason	Notes	Solution
2,3	Low Cap	Empty capacitance less than 100 PF	When calibrating empty	Check for loose connectinos and recalibrate
6,7	High Cap	Empty capacitance greater than 300 PF	When calibrating empty	Remove moisture and debris from probe
1,4	Low Span	Span less than 30 PF	When calibrating full	Empty unit and recalibrate
5,8	High Span	Span greater than 80 PF	When calibrating full	Empty unit and recalibrate
1,3,5,7	Range	The new full cap value is less than empty cap value	When calibrating full	Empty unit and recalibrate

TABLE 9: Operation Errors

LEDs	Name	Reason	Notes	Solution
2,4,6	High Cap	Reading is 120 PF above calibrated full value	Moisture/ Debris on probe	Remove moisture and debris from probe and recalibrate
Low Batt, 2,4,6	Bad Cal	Allow span cal setting to time out w/o pressing green button	New meter revision fixed	Recalibrate
1,3,5,7	Low Cap	Cap reading is 5 PF or greater less than calibrated empty value	Moisture in harness; added with new meter rev (on all telemetry meters)	Completely dry harness assembly and recalibrate

FIGURE 12: Manifold Capacitance Test Setup



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

WARNING: Before removing manifold assembly, Liberator must be empty, warm and vent valve open.

RP8 – Manifold Capacitance Test (Figure 12)

a. Capacitance Meter Set-Up:

1. Connect capacitance meter adapter to capacitance meter according to Figure 12.
2. Turn on capacitance meter and select 200 pF range.
3. Move zero adjustment on the front of the meter until the display reads zero.

b. Capacitance Test:

1. Remove shroud assembly (See RP2).
2. Disconnect the wires leading from the manifold harness assembly to the level meter by disconnecting the JST connector, which is zip-tied to the bracket.
3. Connect JST connector on capacitance meter adapter to manifold harness assembly (Item 29).
4. Connect alligator clip to manifold bracket.
5. Read manifold capacitance and compare to the acceptable ranges found in Table 10. If it does not meet specifications, call Technical Support.

TABLE 10: Manifold Capacitance Specifications

Model	Low Limit (pF)	High Limit (pF)
Liberator 10	105	135

RP9 – Manifold Assembly RR (Figure 13)

a. a. Remove shroud assembly (See RP 2).

b1. If removing with coils:

1. Remove three screws (Item 48) retaining breathing and warming coils.

—OR—

b2. If removing manifold without coils:

1. Disconnect compression fittings (Item 34) from economizer valve tee (Item 35).

2. Disconnect compression fitting from liquid withdrawal port (Item D). When disconnecting tube, be careful not to kink vaporizer tube or internal teflon tube.

c. Remove five manifold mounting screws (Item 31).

d. Lift manifold assembly straight up to remove.

e. Place cover on top of dewar.

f. To replace manifold assembly, reverse above procedure.

Apply small amount of Krytox to O-ring (Item 50)

before assembly. Torque manifold mounting screws

(Item 31) to 90-100 in.-lbs.

RP10 – Resolder Feed-thru Wire (Figure 14)

a Remove manifold assembly (See RP9).

b. Strip approximately 1/8" of insulation from feed-thru wire (Item A) if necessary.

c. Remove strain relief material holding the signal wire against the capacitance probe.

d. Apply small amount of Stay-Clean flux to tinned area of probe (Item B) using a cotton swab.

e. Resolder feed-thru wire (Item A) to tinned area of probe (Item B). Add small amount of lead-free solid wire solder if necessary.

f. Clean flux residue with distilled water and cotton swab. Dry thoroughly.

g. Replace manifold following listed procedure (RP9).

RP11 – Manifold Harness Assembly RR (Figure 13)

a. Remove manifold assembly (See RP9).

b. Remove strain relief material holding signal wire against the capacitance probe.

c. Unsolder feed-thru wire (Item A) from probe (Item B).

d. Loosen feed-thru nut (Item C) and remove harness.

e. To replace manifold harness, reverse above procedure. Tighten feed-thru nut (Item C) 1 to 2 flats past finger tight.

f. Solder feed-thru wire (Item A) following resolder procedure (See RP10). Replace manifold assembly (See RP9).

RP12 – Clean/Dry Probe and Dewar

Procedure 1:

a. Empty dewar per RP22.

b. Warm dewar per RP23.

c. If all moisture is not removed, continue with Procedure 2.

Procedure 2:

a. Remove manifold assembly (See RP9).

b. Blow off probe assembly with clean, dry nitrogen gas.

c. Blow out inside of dewar with clean, dry nitrogen gas until inside is clean and dry.

d. Replace manifold assembly (See RP9).

FIGURE 13: Manifold Assembly

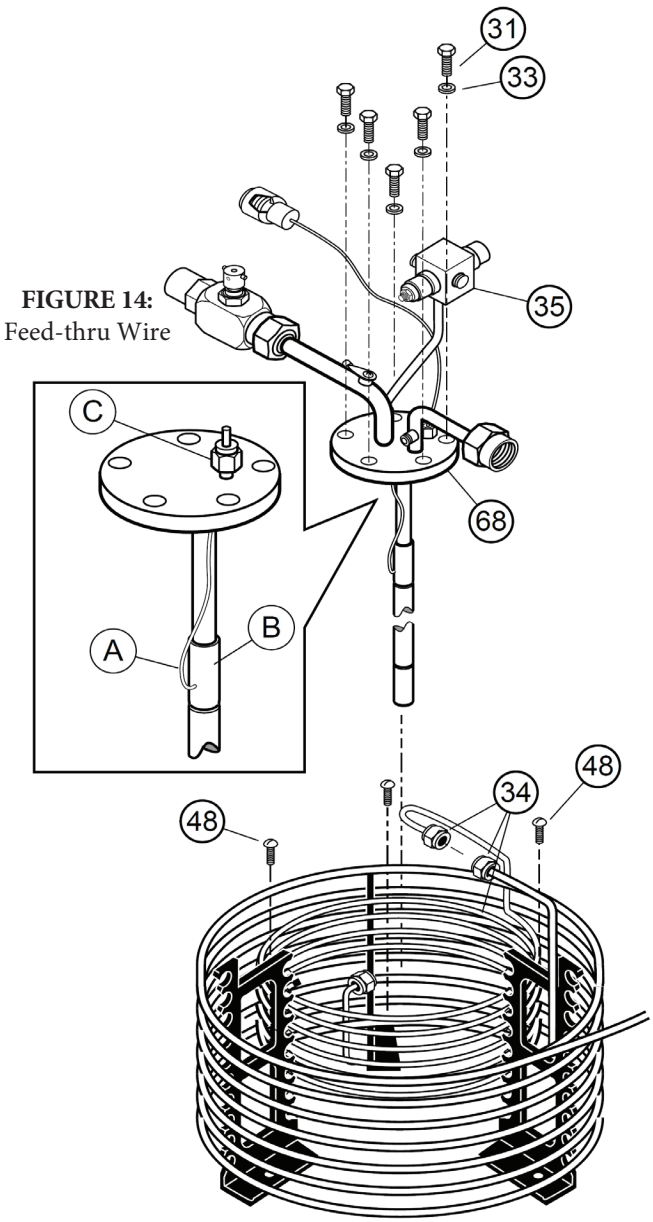


FIGURE 14: Feed-thru Wire

CAUTION: Be careful not to bend or damage manifold assembly or dewar neck tube.

FIGURE 15: Relief Valve Test Set-up

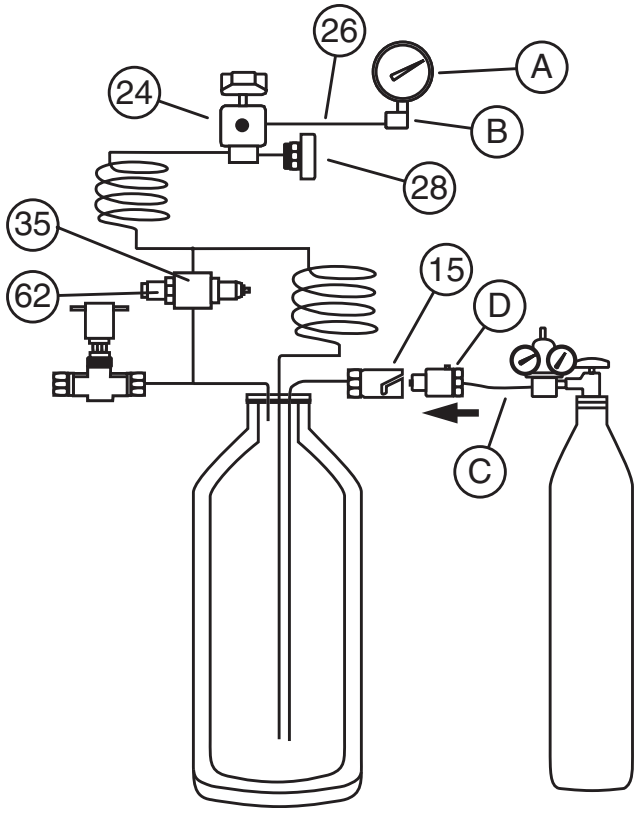


FIGURE 16: Primary Relief Valve

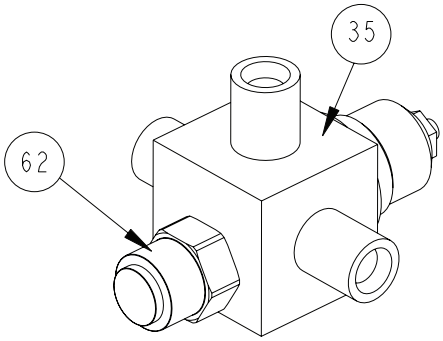
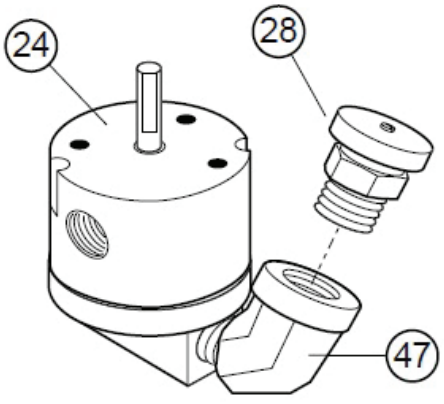


FIGURE 17: Secondary Relief Valve



RP13 – Relief Valve Test (Figure 15)

NOTE: Liberator should be empty and warm before testing.

a. Remove shroud (See RP2).

b. Assemble pressure gauge (Item A) and adapter (Item B) (use PTFE tape).

c. Connect gauge assembly to humidifier adapter (Item 26) on FCV outlet. Open FCV (Item 24) to 6 LPM setting.

d. Assemble oxygen regulator and pneumatic hose (Item C) with DISS fittings and male pneumatic test adapter (Item D). Connect assembly to oxygen gas source.

e. Connect male pneumatic test adapter (Item D) to Liberator QDV (Item 15).

f. Slowly begin increasing pressure to between 1,5-1,7 bar/21.8-24.2 psig. PRV (Item 62) should begin venting (audible noise will be heard or bubbling will be seen if leak testing).

g. Slowly begin decreasing the pressure until the PRV (Item 62) closes, meaning the audible noise is no longer heard or the bubbling is no longer seen if leak testing. The pressure at which the PRV closes should be greater than 1,4 bar/20.5 psig.

h. Hold PRV (Item 62) closed and increase pressure to 1,9-2,3 bar (27-33 psig). SRV (Item 28) should open (audible venting and/or bubbling of leak test solution).

i. Decrease pressure to 1,3 bar (19 psig). Test relief valve with leak test solution. A minimal amount of leakage (bubbling) is acceptable. If leakage is questionable, run pressure retention test before changing relief valve (RP15).

RP14 –Relief Valve RR

WARNING: Liberator must be empty and vented before starting procedure.

Primary (Figure 16)

a. Remove shroud (See RP2).

b. Unscrew PRV (Item 62) from the economizer regulator (Item 35).

c. To replace PRV (Item 62), reverse above procedure. Tighten the PRV approximately 10–20 degrees clockwise after the PRV body contacts the economizer regulator (minimum of 230-350 N-cm [20-30 in-lbs]).

Secondary (Figure 17)

a. Remove shroud (See RP2).

b. Remove SRV (Item 28) from elbow (Item 47) on FCV (Item 24). Hold elbow (Item 47) to eliminate stress on coil tubing.

c. To replace SRV (Item 28), apply Teflon® tape to the threads, staying back one thread from the end of the RV.

d. Tighten SRV to be leak free, approximately one turn from finger tight.

RP15 – Pressure Retention Test (Figure 18)

WARNING: Liberator must be empty and vented before starting procedure.

a. Assemble pressure gauge (Item A) and adapter assembly (Item B) (use PTFE tape).

b. Connect gauge assembly to humidifier adapter (Item 26) on FCV outlet. Open FCV (Item 24) to 6 LPM setting.

c. Assemble oxygen regulator, pneumatic hose (Item C) with DISS fittings and male pneumatic test adapter (Item D). Connect assembly to oxygen gas source.

d. Connect male pneumatic test adapter (Item D) to Liberator QDV (Item 15).

e. Increase pressure to 1,4 bar (20 psig).

f. Disconnect male pneumatic test adapter (Item D) from QDV (Item 15).

g. Turn FCV valve (Item 24) to Off setting.

h. Allow unit to sit undisturbed for 60 minutes.

i. Turn FCV valve (Item 24) to 6 LPM setting.

j. If pressure gauge (Item A) indicates less than 1,24 bar (18 psig), unit fails test.

RP16 – Plumbing Leak Test (Figure 18)

NOTE: Liberator should be empty and warm before testing.

a. Remove shroud (See RP2).

b. Assemble pressure gauge (Item A) and adapter assembly (Item B) (use PTFE tape).

c. Connect gauge assembly to humidifier adapter (Item 26) on FCV outlet. Open FCV (Item 24) to 6 LPM setting.

d. Assemble oxygen regulator, pneumatic hose (Item C) with DISS fittings and male pneumatic test adapter (Item D). Connect assembly to oxygen gas source.

e. Connect male pneumatic test adapter (Item D) to Liberator QDV (Item 15).

f. Increase pressure to 1,3 bar (19 psig).

g. Leak test all connections, joints, and valves with leak test solution.

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

h. Close FCV (Item 24) by turning to Off position. Remove pressure gauge assembly from humidifier adapter (Item 26).

i. Disconnect pneumatic adapter (Item D) from QDV (Item 15).

j. Leak test QDV poppet and FCV outlet.

k. Repair all leaks by following appropriate repair procedures.

FIGURE 18: Plumbing Tests Set-up

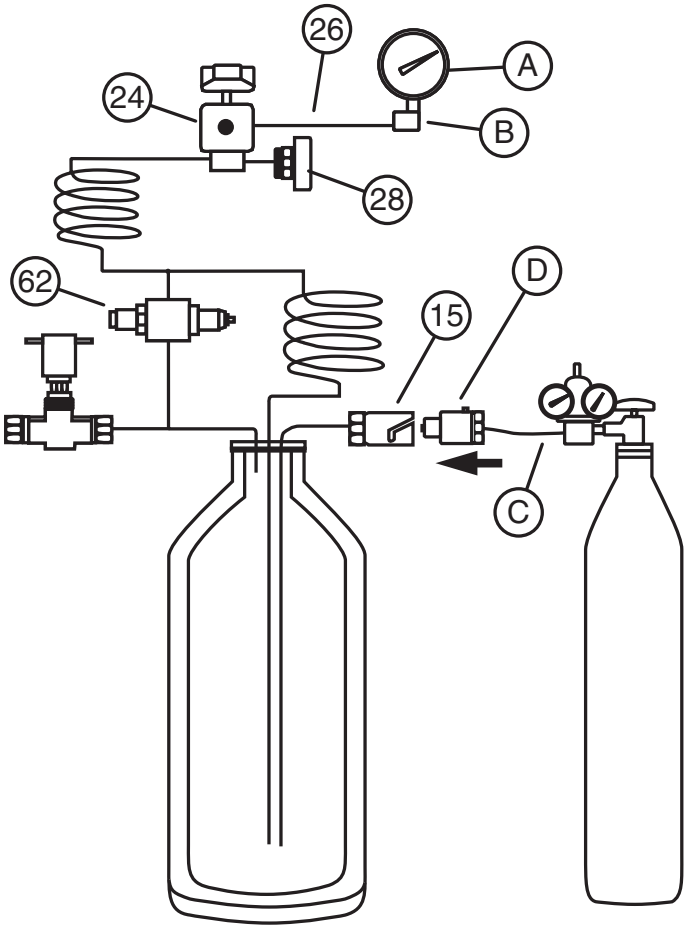
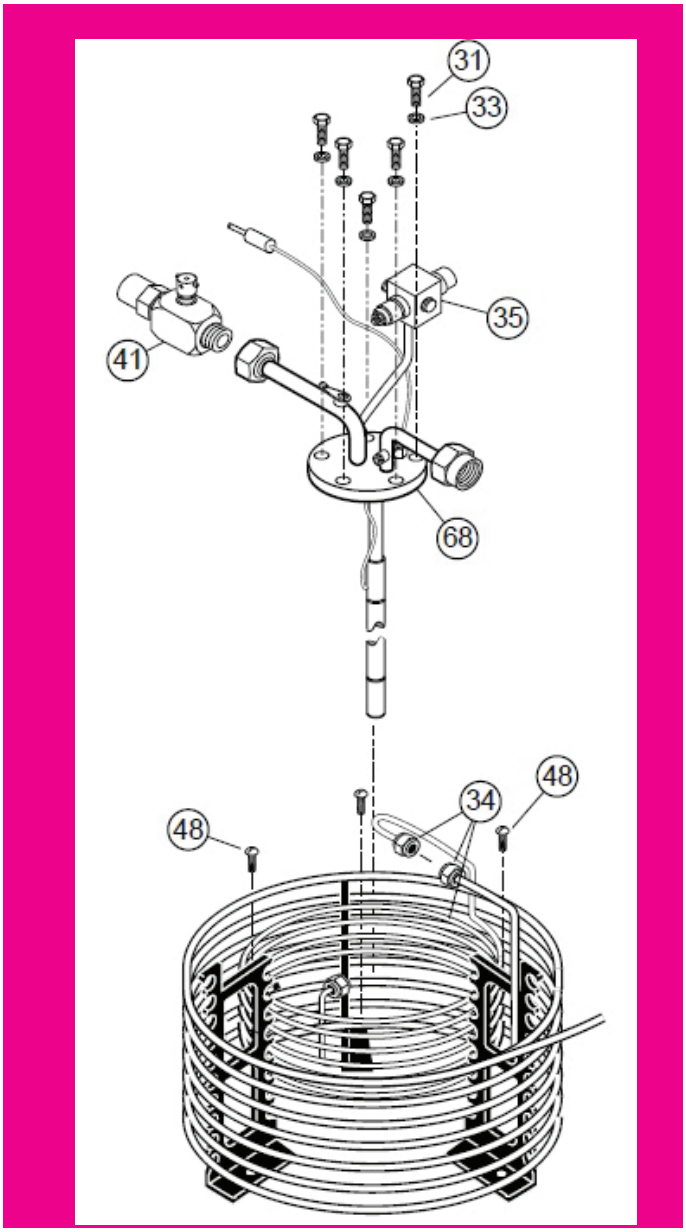


FIGURE 19: Coil and Vent Assemblies



RP17 – Warming and Breathing Coil Assembly RR (Figure 19)

WARNING: Liberator must be empty and vented before starting procedure.

a. Remove shroud (See RP2).

b. Remove manifold assembly without coils (RP9).

c. Remove three screws (Item 48) retaining coil brackets.

d. Remove warming and breathing coil assemblies.

e. To replace coil assembly, reverse above procedure.

RP18 – Vent Valve RR (Figure 19)

a Remove shroud (See RP2).

NOTE: Valve must be properly aligned to allow access to handle through hole in shroud.

b. Remove vent valve (Item 41) by unthreading valve nut while supporting the valve to prevent it from turning.

NOTE: Ensure static seal (Item 67) is not damaged and is in its proper place.

c. Replace vent valve (Item 41). Tighten vent valve nut to 60–67 N-m (45–50 ft-lbs). Support the valve to prevent it from turning when tightening valve.

d. Replace shroud (See RP2).

RP19 – Twist Lock QDV Lip Seal RR (Figure 20)

NOTE: Lip seal may be changed on a full Liberator (Side Fill Only).

a. Insert lip seal tool into Liberator female QDV (Item 15). Engage tabs on tool with slots in retaining ring (Item 87).

b. Use wrench on hex end of tool. Push in on tool while turning to engage tabs on tool with slots in retaining ring (Item 87). Turn tool clockwise to loosen retaining ring (Item 87). Remove the ring.

c. Remove lip seal (Item 88) from QDV (Item 15). Jeweler's screwdriver may be used if necessary, but seating surfaces must not be damaged.

d. Apply thin film of fluorolubricant to new lip seal (Item 88).

e. Place retaining ring (Item 87) and new lip seal (Item 88) on tool.

f. Install retaining ring (Item 87) in QDV body (Item15) by turning tool counter-clockwise while pushing in on tool. Torque retaining ring (Item 87) to 225–280 N-cm (20-25 in-lbs).

RP20 – Twist-Lock QDV RR (Figure 20)

WARNING: Liberator must be empty and vented before starting procedure.

a. Remove shroud (See RP2).

b. Loosen nut (Item C) by holding QDV body (Item 15) with a wrench and turning nut (Item C) clockwise.

c. Remove QDV by pulling QDV body (Item 15) off and then pulling the hex coupler (Item 89) and O-ring (Item 16) out of the fill tube.

NOTE: All Internal Components of the QDV Must Remain Assembled During this Process.

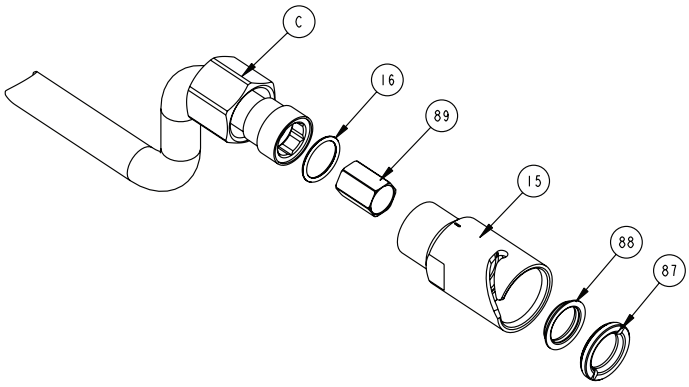
d. Apply thin film of fluorolubricant to O-ring (Item 16).

e. Reattach QDV by matching alignment marks on valve body and fill tube.

f. Torque nut (Item C) to 60–67 N-m (45-50 ft-lbs) while holding valve body (Item 15).

g. Replace shroud (See RP2).

FIGURE 20: Side Fill (Twist Lock) QDV Assembly



RP21 – Push-on QDV Assembly RR (Figure 21)

WARNING: Liberator must be empty and vented before starting this procedure.

a. Remove shroud (See RP2).

b. Remove the top fill QDV by turning the QDV nut (Item D) clockwise while holding the QDV (Item 11) with a wrench.

c. Pull the QDV straight up and off of the fill tube (Item D). Use rubber mallet to lightly knock upward if required. If replacing entire QDV (recommended) skip to step h.

d. Remove and replace the static seal (Item 67) if needed.

e. Push QDV back on to fill tube (Item D) and torque nut to 60–67 N-m (45-50 ft-lbs) while holding valve body to fasten QDV in place.

f. Replace shroud (See RP2).

FIGURE 22: Emptying Unit

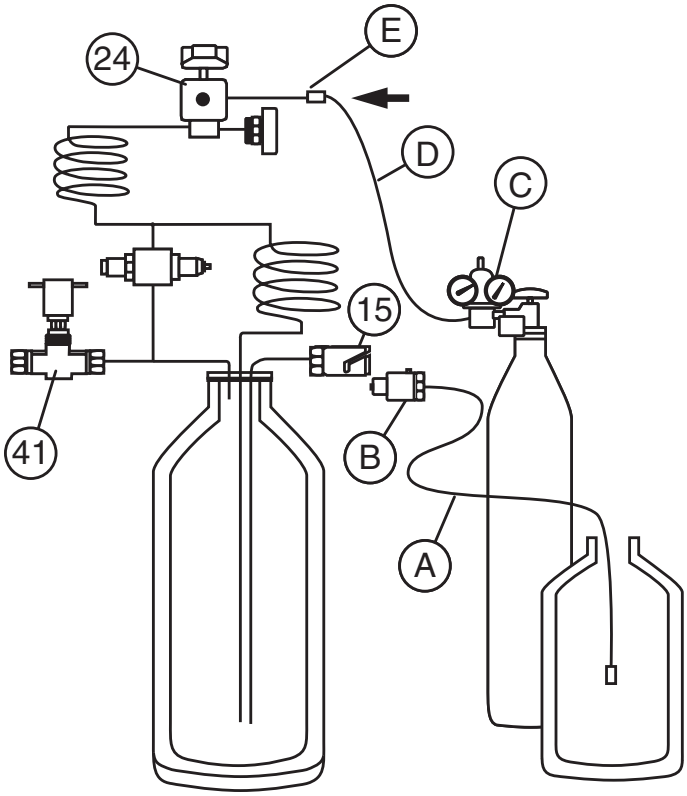
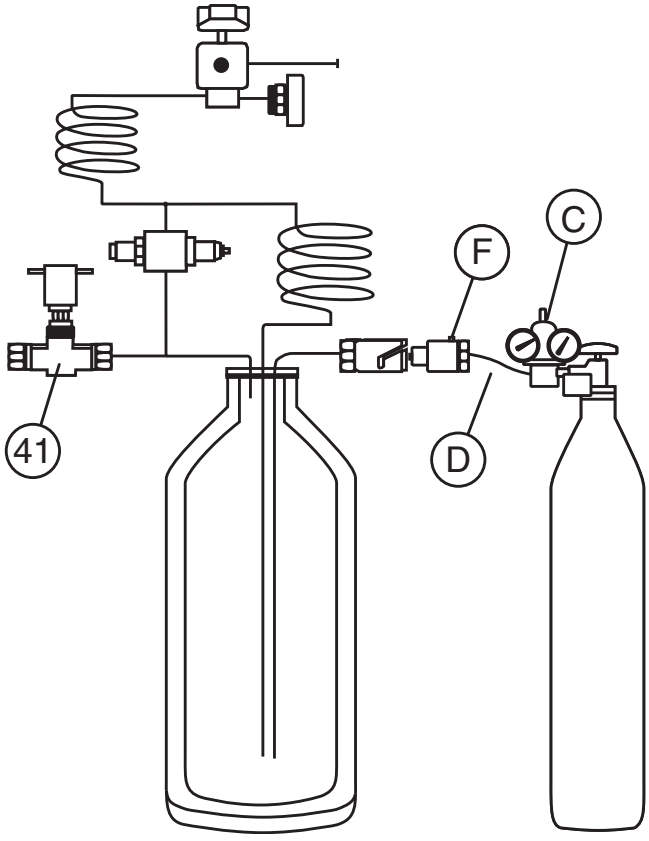


FIGURE 23: Warming Unit



RP22 – Empty Unit (Figure 22)

WARNING: Make sure open end of transfer line remains inside cryogenic container. Wear insulated gloves and eye protection when using this procedure. DO NOT reuse liquid oxygen.

a. Place one end of the transfer line (Item A) into a suitable cryogenic container such as an empty, clean Liberator dewar. Connect a male transfer line adapter (Item B) to the other end of the line.

NOTE: Female transfer line adapter should be substituted for item B in top fill version.

b. Connect the adapter to the Liberator QDV (Item 15), keeping the vent valve (Item 41) closed.

c. Liquid oxygen will be discharged from the open end of the transfer line into the empty container. Continue process until Liberator is empty.

d. If Liberator has no pressure, pressurize with the following procedure.

1. Connect regulator (Item C) to oxygen gas source.
2. Connect pneumatic hose (Item D) to regulator and Liberator DISS Fitting (Item E).
3. Adjust regulator (Item C) to supply up to 1,4 bar (20 psig).
4. Set Liberator FCV (Item 24) to 6 LPM setting.
5. Continue until Liberator is empty.

RP23 – Warm Unit (Figure 23)

a. Liberator may be allowed to sit (FCV off, vent closed) a minimum of 48 hours after emptying.

b. To warm a Liberator more quickly:

1. Connect regulator (Item C) to oxygen or nitrogen gas source.
2. Connect pneumatic hose (Item D) to regulator (Item C) and male pneumatic adapter (Item F).
3. Adjust regulator to 1,4 bar (20 psig). Open vent valve (Item 41) to allow slow venting.
4. Allow Liberator to vent for 1-1/2 hours minimum after vent valve (Item 41) defrosts.

RP24 – Flow Rate Test (Figure 24)

NOTE: For flow rate test Liberator needs to be at least 1/4 to 1/2 full of properly saturated liquid oxygen.

NOTE: Be careful to allow for accuracy tolerances of flow meter. Table 11 does not account for these tolerances.

a. Conneztz FCV (Item 24) outlet to flow meter (Item G) inlet with respiratory tubing. Make sure flow meter outlet is open and unobstructed and flow meter (Item G) is properly positioned.

b. Unit should operate for 1-1/2 hours minimum (overnight is optimum). Test flow rate at each FCV (Item 24) position. Record all flow rates.

c. Flow rates must be nominal values within tolerances listed in Table 11 or unit fails flow rate test.

RP25 – Operating Pressure Test (Figure 24)

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

a. Assemble pressure gauge (Item H) and adapter (Item J) (use PTFE tape).

b. Connect gauge assembly to DISS fitting on FCV outlet. Open FCV (Item 24) to 6 LPM setting.

c. Read operating pressure on pressure gauge (Item H).

d. Operating pressure must be 1,2 - 1,7 bar (18 - 24.2 psig) or unit fails test.

RP26 – Flow Meter Verification

a. 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).

b. 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.

FIGURE 24: Flow and Pressure Tests

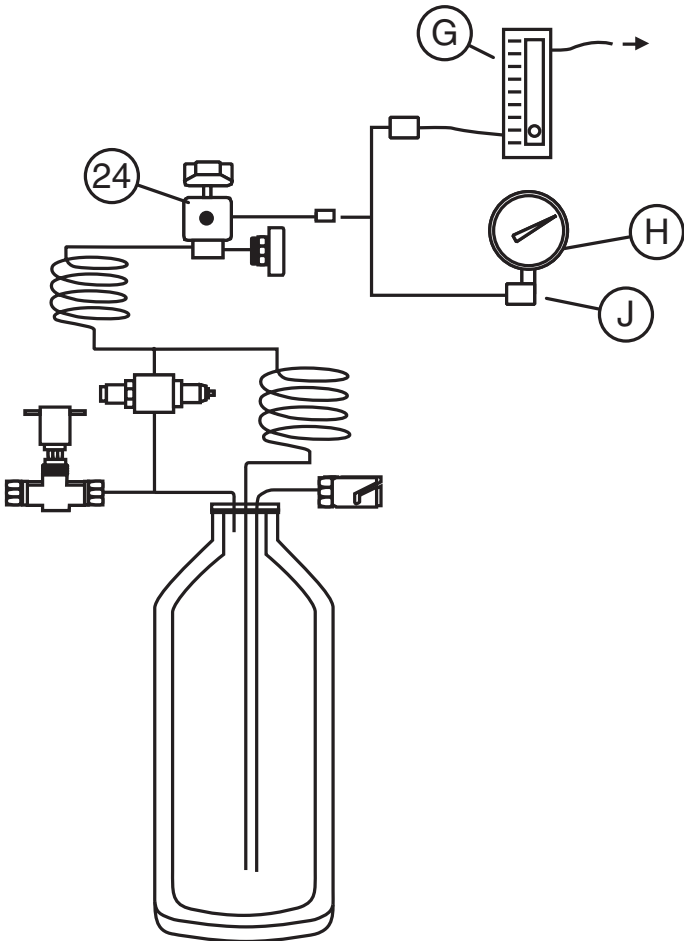


TABLE 11: Flow Test Acceptable Ranges

FCV Setting	LPM
OFF	0
0,25	0,15 to 0,35
0,50	0,40 to 0,60
0,75	0,65 to 0,85
1,00	0,90 to 1,10
1,50	1,35 to 1,65
2,00	1,80 to 2,20
2,50	2,25 to 2,75
3,00	2,70 to 3,30
3,50	3,15 to 3,85
4,00	3,60 to 4,40
5,00	4,50 to 5,50
6,00	5,40 to 6,60
8,00	7,20 to 8,80
10,0	9,00 to 11,0
12,0	10,8 to 13,2
15,0	13,5 to 16,5

FIGURE 25: Economizer Regulator

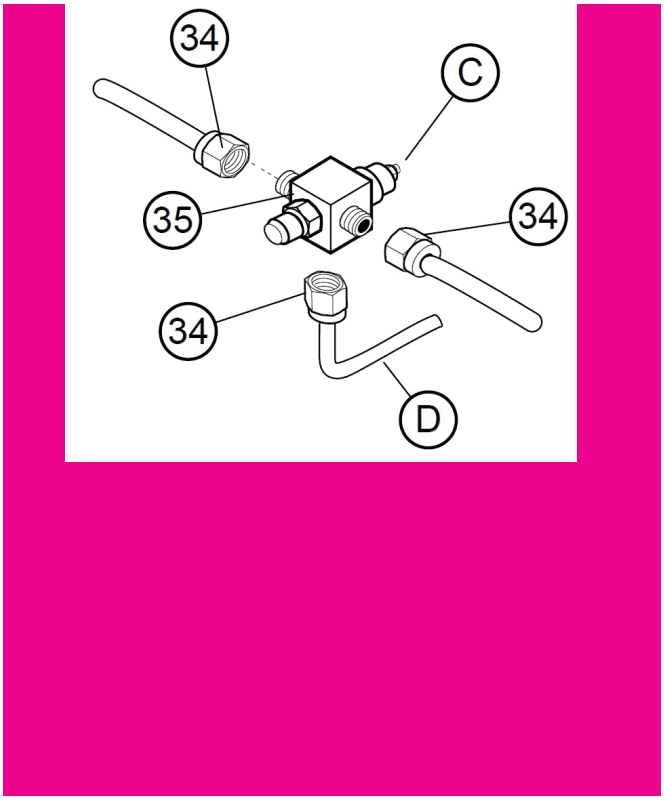
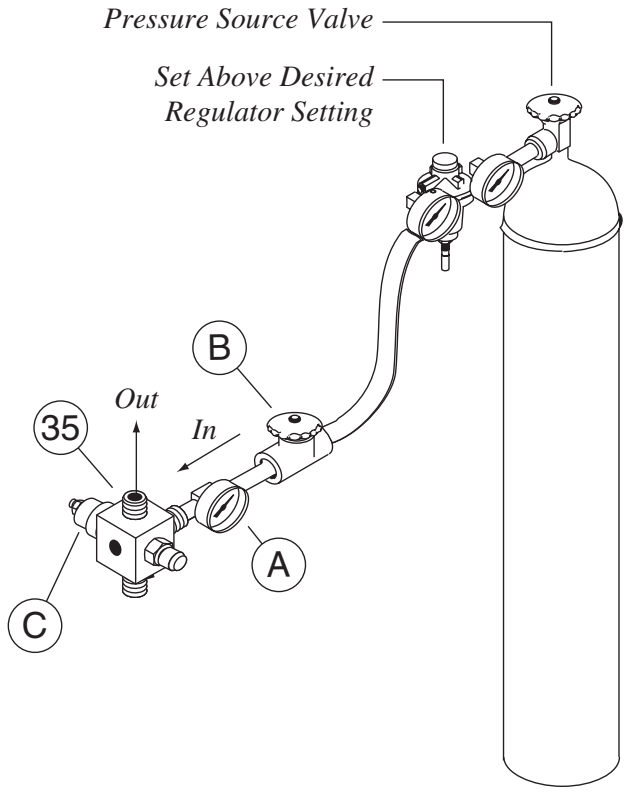


FIGURE 26: Economizer Test Setup



RP27 – Economizer Regulator RR (Figure 25)

WARNING: Liberator must be empty and vented before starting this procedure.

a. Remove shroud (See RP2).

b. Loosen the three compression fitting nuts (Item 34) at the economizer regulator (Item 35). Move coils (on the sides) and economizer tube (Item D) away from the economizer regulator (Item 35).

c. Follow RP28 to ensure proper settings on the replacement regulator.

d. Reverse remainder of procedure to install new properly adjusted regulator.

RP28 – Economizer Regulator Test (Figure 26)

a. Follow steps a and b of RP27 to remove economizer regulator.

WARNING: Liberator must be empty and vented before starting this procedure.

b. Connect the oxygen pressure source to the inlet of the economizer regulator (Item 35) as shown in Figure 25. The inlet is the side attached to the economizer tube (Item D, Figure 25).

c. Open the pressure source valve. Adjust the pressure source regulator to 1,6 bar (23 psig). The economizer regulator should be set to open at 1,47 bar (21.3 psig) and close at 1,34 bar (19.5 psig).

d. Slowly open valve (Item B) just enough to allow some gas to escape.

e. Pressure gauge (Item A) will indicate the setting of the economizer regulator.

f. Reverse steps a and b of RP27 to reinstall regulator.

Note: If the economizer is suspected to be malfunctioning, please contact Technical Service.

RP29 – Flow Control Valve RR (Figure 27)

WARNING: Liberator must be empty and vented before starting this procedure.

NOTE: Special care should be taken in aligning the FCV in order to ensure that it lines up properly with the shroud.

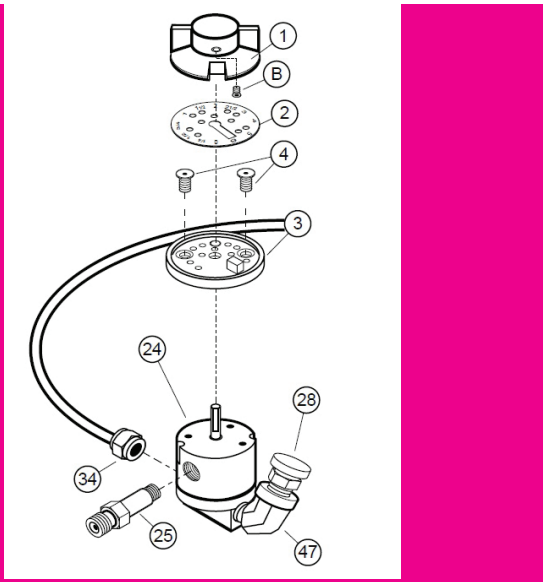
a. Remove shroud (See RP2).

b. Loosen compression fitting nut (Item 34) at connection of breathing coil (Item 49) and FCV assembly. Disconnect FCV assembly (Item 24) from coil.

c. Remove elbow (Item 47) and SRV (Item 28) from FCV (Item 24).

d. Replace the FCV (Item 24), by reversing the above procedure.

FIGURE 27: Flow Control Valve



RP30 – Dewar RR

a. Remove shroud (See RP2).

b. Remove manifold assembly and coils (See RP9).

WARNING: Liberator must be empty and vented before starting this procedure.

c. Remove condensate bottle (Item 56), drain tube (Item 55) and bracket (Item 54) following RP3.

d. Remove dewar cap from the new dewar and place the cap on old dewar.

e. Clean/dry both the probe and dewar following procedure in section VIII.

f. Connect the manifold assembly with coils to the new dewar; be sure to follow the manifold assembly replacement procedure (See RP9). Do not replace shroud.

g. Replace condensate bottle (Item 56), bracket (Item 57) and drain tube (Item 58).

h. Scribe part number and serial number on new dewar handle. Make part number and serial number on old dewar illegible.

i. Calibrate meter by following RP7.

RP31 – Normal Evaporation Rate Test

a. Fill the unit with correct amount of properly saturated liquid oxygen shown in Table 12. Values are approximate.

TABLE 12: NER Filling Key

Model	Empty kg (lb)	Lox kg (1b)	Total kg (lb)
Lib 10	11,8 (26)	5,4 (12)	17,2 (38)

b. Allow unit to sit undisturbed for a minimum of 12 hours with the FCV in Off position and the vent closed.

NOTE: Scale must be accurate to ± 0.02 kg (0.05 lbs).

c. Weigh unit. Record weight and time.

d. Allow unit to sit undisturbed for a minimum of 24 hours.

e. Weigh unit. Record weight and time.

f. Calculate liquid loss rate (NER) using the following formula:

$$NER = \frac{\text{Weight lost (kg or lbs)}}{\text{Elapsed time in hrs.}} \times 24 \text{ hours/day}$$

Example

$$NER = \frac{0.63 \text{ kg}}{25.5 \text{ hrs.}} \times 24 \text{ hours/day}$$

NER = 0,59 kg/day

g. If NER is more than 0,9 kg/day (2 lbs/day) for a Liberator, the dealer may want to send the unit to CAIRE, Inc. for re-evacuation. If NER is more than 2,3 kg/day (5 lbs/day) the dealer should remove the unit from service and have the unit re-vacuumed.

Service Tools/Equipment/Supplies XIII

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. Pliers
7. 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)
8. Jeweler's Screwdriver

Required Fixtures/Equipment

1. Capacitance Meter
2. Soldering Iron
3. Oxygen Regulator
4. Pressure Gauge
5. Pressure Gauge Adapter
6. Flowmeter
7. 02 Gas Source (High Pressure bottle)
8. 02 Liquid Source
9. N2 Gas or Clean, Dry Compressed Air Source
10. Tubing (02 compatible)
11. Lip Seal Service Tool
12. Male Pneumatic Test Adapter
13. LO2 Transfer Line
14. Transfer Line Adapter with Filter
15. Dewar Cap
16. Vent Valve Wrench
17. Scale 0-70 kg (0-150 lbs), 0.02 kg (0.05 lb) increments

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. PTFE Tape
8. Fluorolubricant
9. Leak Detection Fluid

Cleaner

1. Simple Green available at www.simplegreen.com

Tools and Accessories available from Caire

Part No	Description
10679862	Female Top Fill Pneumatic Test Adapter
10678157	Female Top Fill Transfer Line Adapter
CA200071	240 AC Fluorolubricant
CA200072	Leak Detection Fluid (gallon)
97200076	Erie "Liter Meter"
97212021	Male Side Fill Pneumatic Test Adapter
97212023	Male Side Fill Transfer Line Adapter w/Filter
15075347S	Transfer Line Adapter Cover
97217007	Pressure Gauge Adapter
CA400004	Replacement Filter/Male Transfer Line Adapter
97403016	Jeweler's Screwdriver
97202005	Vent Valve Wrench
3910486	Dewar Cap
97403577	0-4.1 bar (0-60 psig) Pressure Gauge
97404564	Transfer Line Swivel Connector
97405147	0-3.1 bar (0-45 psig) Oxygen Regulator
97405279	Pneumatic Hose with DISS Fittings
97405431	Liquid Oxygen Transfer Line – 2 m (6 ft)
97405590	Lip Seal Service Tool
CA406308	10.3 bar (150 psi) Relief Valve Assembly
CA406310	TEFLON Tape
CA406398	10.3 bar (150 psi) Relief Valve Only
97406471	Tandem Tee Kit
97406555	Super Flex Liquid Oxygen Transfer Line – 6'
97406630	Dual Fill Head Tee
13350704	Service Manual
10661515	Conversion Kit TF to SF
10660361	Conversion Kit SF to Dual
10660344	Conversion Kit TF to Dual
10661523	Conversion Kit SF to TF
13329091	G4 Capacitance Meter Adaptor Kit

XIV Parts Price List

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

Ordering Information

The following steps should be used when ordering a new Liberator or replacement parts for an existing unit:

1. **Compile a list of all equipment and replacement parts to be ordered.**

NOTE: Use the following numbers to order a complete unit.

Model (0–15 LPM)	Side Fill	Top Fill
L10	11631086	11654114

For European Part Numbers, please call +44(0) 1344 40310. For Asia 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: 770 257 1299
Fax: 770 257 1300

Asia, Australia, Pacific Rim
Phone: +61 297 494333
Fax: 888 932 2473

Europe
Phone: +44(0) 1344 403100
Fax: +44(0) 1344 429224

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

CAIRE Inc.
2200 Airport Industrial Dr., Ste. 500
Ball Ground, GA 30115 USA

Unit 2, Maxdata Cantre
Downmill Rd.
Bracknell, Berkshire RG12 1Qs
United Kingdom

All new equipment will be shipped either "prepaid", F.O.B. Canton, Georgia, 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. If a particular carrier or method of shipment is desired, specify when placing order.

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

XVI Return & Restocking Policy

When a Liberator 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 the Troubleshooting Chart in Section X, page 12-13. 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 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 Inc.
   Unit 2, Maxdata Centre
   Downmill Rd.
   Bracknell, Berkshire RG12 1QS
   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. A 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:

   CAIRE Inc.
   2000 Airport Drive
   Ball Ground, GA 30107

   CAIRE Inc.
   Unit 2, Maxdata Centre
   Downmill Rd.
   Bracknell, Berkshire RG12 1QS
   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. An 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®

A Chart Industries Company

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Caire Inc., BioMedical Group
2200 Airport Industrial Dr., Ste. 500
Ball Ground, GA 30107
Ph 770-721-7700 • Toll Free 1-800-482-2473
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