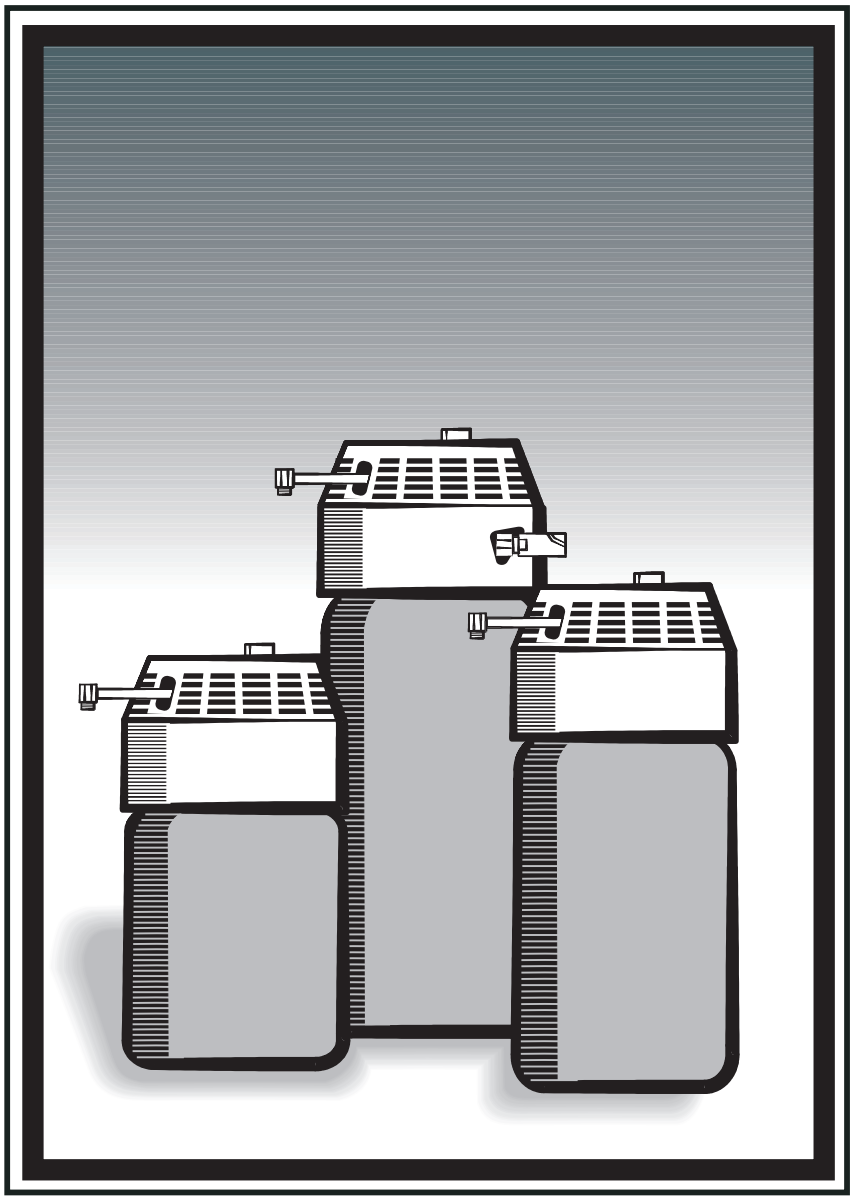
COMPANION STATIONARY

21 · 31 · 41

LIQUID

OXYGEN

SYSTEM



tyco Healthcare
Puritan Bennett

Part Number B-701162-00 Rev. B

TECHNICAL MANUAL

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Healthcare

Puritan Bennett

COMPANION STATIONARY 21, 31 & 41 LIQUID OXYGEN SYSTEM TECHNICAL MANUAL

PART NUMBER B-701162-00

REVISION B
3/2003

CAUTION: Federal Law (USA) restricts this device to sale by or on the order of a physician.

List of Effective Pages

This list of effective pages represents manual P/N B-701162-00, revision B.

Revision	Description	Date
A	Initial Release	2-97
B	Added bulletins B-702058-00, B-701276-00, B-701315-00, B-701361-00, B-701032-00. Replaced "Miscellaneous" with "Technical Bulletins" divider. Changed "Nellcor Puritan Bennett" to "Puritan Bennett". Removed references to screw head type.	3-03

Pages	Revision	Pages	Revision
i (Title Page)	B	4-1	A
ii, iii	B	4-2	B
iv, v, vi	A	4-3	A
1-1 to 1-9	A	5-1	A
1-10	B	5-2	B
1-11	A	5-3 to 5-5	A
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3-7	B	6-7	A
3-8	A	7-1, 7-2	B
3-9	B	7-3, 7-4	A
3-10, 3-11	A		

NOTE:
SI pressure values expressed in manual are referenced to atmosphere.

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PREFACE

This manual provides the information needed to service the Puritan Bennett *Companion* 21, 31 and 41 liquid oxygen Stationary units. **This information is intended for use by technicians or personnel qualified to repair and service medical liquid oxygen equipment.** Do not attempt to fill or repair these units until the information in this manual has been read and understood.

The following documents contain additional information useful in servicing the Companion 21, 31 and 41.

- *Companion* Liquid Oxygen Stationary Operating Instructions P/N B-701417-00

For product assistance contact:

Puritan-Bennett Corp.
4280 Hacienda Drive
Pleasanton, CA 94588 USA
Customer Service:
1-800-497-4968
Technical Support:
1-800-255-6774, press 2

The *Companion* Stationary unit is intended only for the delivery of medical grade oxygen as prescribed by your physician. Oxygen supplied from this equipment is for supplemental use and is not intended to be life-supporting or life-sustaining.

Information contained in this document, including the performance specifications, is subject to change without notice.

Puritan-Bennett makes no warranty of any kind with regard to the material in this manual, including but not limited to the implied warranties of salability and fitness for a particular purpose.

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DEFINITION OF STATEMENTS

Statements in this manual preceded by the following words are of special significance.

WARNING

Means there is the possibility of injury or death to yourself or others.

CAUTION

Means there is the possibility of damage to the unit or other property.

NOTE:
Indicates points of particular interest for more efficient and convenient operation.

TABLE OF CONTENTS

Section 3 (con't):

WARNING

Read section 1, and any other applicable section, thoroughly before attempting to service or fill the *Companion* Stationary liquid oxygen system. Failure to do so may result in personal injury or death.

PRODUCT DESCRIPTION

This section provides introductory information on the *Companion* 21, 31, and 41(A, AG and D) Liquid Oxygen Stationary units (Figure 1-1). This information includes a product description, serial number designation, safety precautions, performance specifications, unit operation, routine maintenance, recommended tools, test equipment and service materials.

FIGURE 1-1
***Companion* 21, 31 and 41 Stationary Units**

PRODUCT DESCRIPTION (cont.)

The *Companion* Stationary units are nearly identical in features and operational specifications. The numbers 21, 31, or 41 in the model number indicate the nominal amount of liquid oxygen capacity in liquid liters. The letter A on the end of a model number designates a contents indicator on the unit. The letters AG on the end of the model number designates a unit with both a contents indicator and system pressure indicator on the unit. The letter D on the end of a model number designates a Dual-Fill unit with the optional side-fill connector. Throughout this manual the *Companion* 21, 31, 41(A, AG, and D) are referred to as Stationary units. The letter G on the end of the model number indicates a unit with only a pressure indicator. Units referred to as Standard Series are units without contents and pressure indicators. The Standard Series and series G units are no longer available, however select replacement parts are. Information specific to any one model is noted.

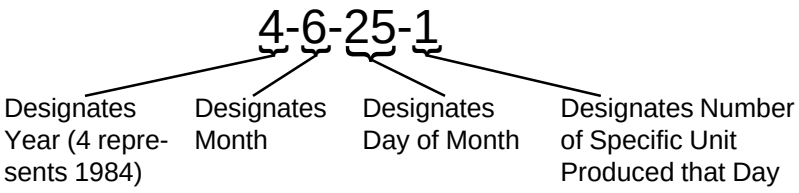
The *Companion* Stationary unit provides the user with a means of both filling portable liquid oxygen units, and breathing gaseous oxygen. In order to store liquid oxygen, the cryogenic container must be well insulated from the surrounding atmosphere. The liquid oxygen, stored in the cryogenic container at -276° F (-171° C) would readily vaporize in the presence of the heat in the atmosphere. The vacuum insulated container of the *Companion* Stationary unit however does allow a small amount of heat to be absorbed by the liquid oxygen. This causes some of the liquid oxygen to be vaporized into a gas. The pressure created from the constant vaporization process of the liquid oxygen (known as the Normal Evaporation Rate or NER gas) is controlled by the primary relief valve when there is no patient flow from the unit. This is known as the "Standby" pressure of the unit. This pressure is required in the unit for any flow to take place. When a flow demand placed on the unit that is larger than the NER, the pressure begins to decay and the primary relief valve closes. The pressure drops to a point where it is regulated by the economizer valve. This is known as the "Operating" pressure of the unit. This allows the patient to breathe the gas that would normally be vented through the primary relief valve. When the flow demand placed on the system is greater than the gas produced by the NER, and the pressure is in the "Operating" range, liquid oxygen is withdrawn from the container into a vaporizing coil to balance the flow demand. Once in the vaporizing coil, heat is absorbed by the liquid oxygen converting it into a gas. After being converted into a gas, the oxygen continues on to a warming coil where the gas is warmed to near room temperature. The gas finally passes through the flow control valve and on to the patient at a metered rate.

SERIAL NUMBER DESIGNATION

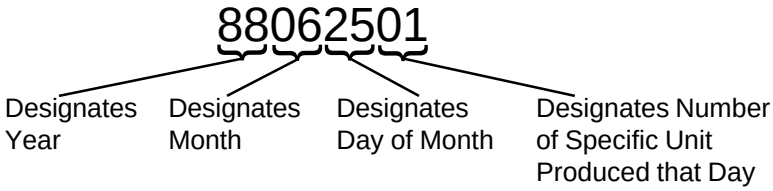
Each *Companion* Stationary unit is marked with a serial number etched on the handle of the container (See Figure 1-2). The number contains the month, day and year of manufacture, as well as the number of the unit produced that day.

NOTE:
Dates listed below are estimations of the serial number change.

- Containers manufactured **prior to** January of 1985:



- Containers manufactured **in and after** January of 1985 and **prior to** October 1994:



- Containers manufactured **in and after** October 1994:

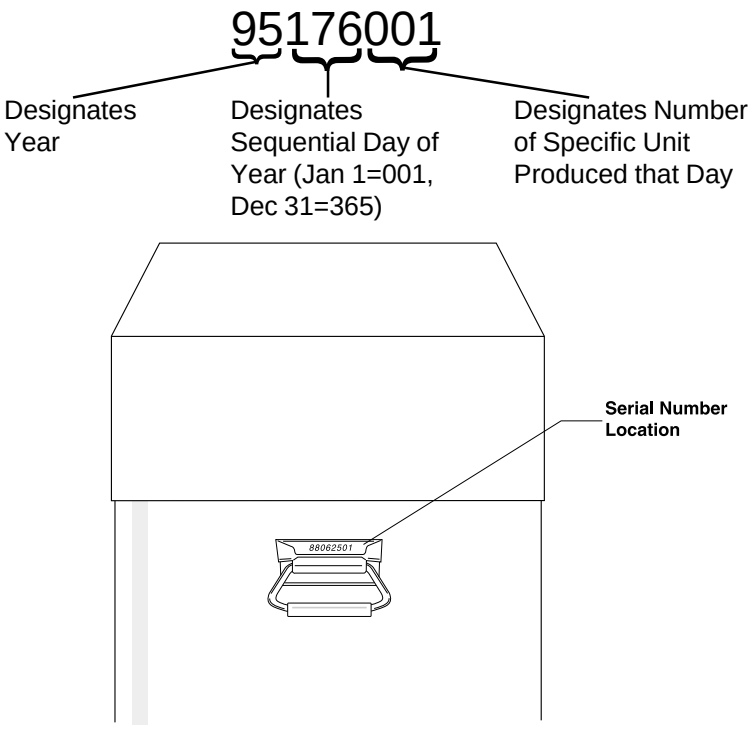


FIGURE 1-2
Serial Number Location

SAFETY PRECAUTIONS

This section covers precautions and safe practices as they apply to facilities and to personnel involved in servicing medical oxygen equipment. They are divided into three main areas: cold safety, expansion safety, and fire safety. The service techniques, work area and equipment used in the storage, service and handling of this system must be of the highest standard in order to assure reliability and safety.

Cold Safety

WARNING

Extreme cold hazard. Liquid oxygen will freeze skin on contact. (-297° F/-184° C). Never touch liquid oxygen or frosted parts.

WARNING

Extreme cold hazard. Liquid oxygen can spill when Stationary is tipped over. Keep Stationary upright at all times.

Recommended Protective Clothing:

- *Heavily Insulated Gloves* (e.g. welding gloves); Never use gloves that are contaminated with grease or oil when working with liquid oxygen.
- *Protective Face Shield*
- *Long Sleeve Shirt* - Wear natural fibers such as cotton or wool. Avoid synthetic materials such as polyester or rayon.
- *Long Pants* - Never wear pants with cuffs. Liquid oxygen may become trapped and cause serious burns to skin. Wear natural fibers such as cotton or wool. Avoid synthetic materials such as polyester or rayon.

Expansion Safety

WARNING

Explosive hazard. Extreme high pressure can rupture container or plumbing components. Be sure proper pressure relief devices are present and functioning properly.

Important Facts:

- Liquid oxygen expands at a ratio of approximately 860 : 1 (at 0 psig) when vaporizing into a gas. This can occur very rapidly when exposed to the heat in the atmosphere.

- Ensure that the proper pressure relief devices are present and functioning properly in **any device** that will contain liquid oxygen.

WARNING

Fire Hazard. Do Not Smoke.
Injury or Death May Occur.

WARNING

Concentrated Oxygen. Increased Risk of Fire.
Keep Away From:

- Sources of Ignition (Cigarettes, Open Flames, Electrical Equipment, etc.)
- Flammable Materials (Asphalt, Oil, Grease, Vaseline, Aerosols, Wood, etc.)
- Furnaces, Stoves, Dryers, Water Heaters, etc.

Important Facts:

- The possibility of fire exists when the combination of a fuel, source of ignition and oxygen is present (See Figure 1-3). The possibility of combustion is greatly enhanced in high concentrations of oxygen. (Air is approximately 21% oxygen).

- Store and service oxygen systems in well ventilated areas.

- **Obtain all replacement parts for medical oxygen equipment from the manufacturer**. Clean all tools that come into contact with the oxygen system before service.

- Any clothing or porous material that is splashed with liquid oxygen or otherwise absorbs high concentrations of oxygen should be removed and aired for at least 1 hour away from any source of ignition.

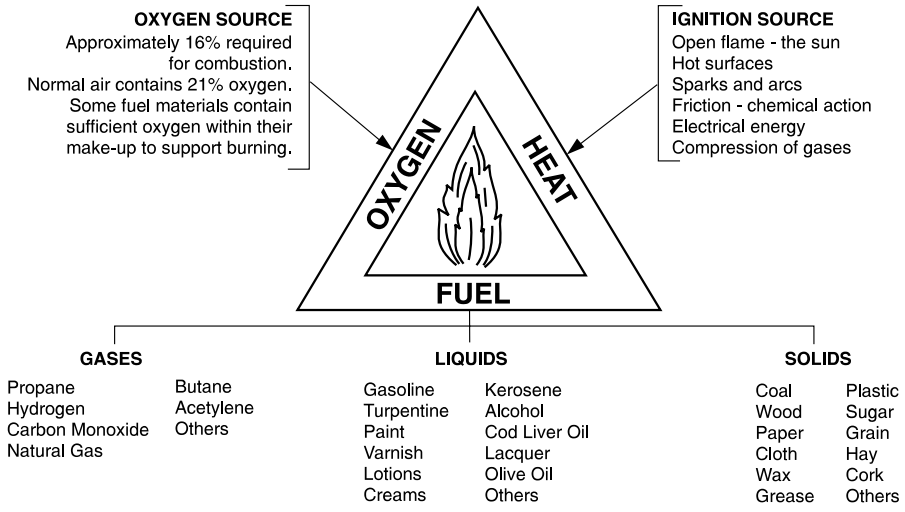


FIGURE 1-3
Combustion Triangle

PERFORMANCE SPECIFICATIONS

The *Companion* 21, 31 and 41(A, AG and D) Stationary unit performance specifications are listed below In Table 1-1.

TABLE 1-1

COMPANION STATIONARY SPECIFICATIONS*			
	C 21 (A, AG and D)	**C 31 (A, AG and D)**	**C 41 (A, AG and D)**
Volume of Liquid Oxygen (typical)	21.0 liters/.742 ft³	31.0 liters/1.095 ft³	41.0 liters/1.45 ft³
Weight of Liquid Oxygen at 22 psig (152 kPa) Saturation (typical)	49 lbs/22 kg	73 lbs/33 kg	98 lbs/44 kg
Gaseous Oxygen Equivalent at 1 atm. and 70° F	16,750 liters/591.4 ft³	24,950 liters/881.0 ft³	33,500 liters/1182 ft³
Height	27.5 in/69.9 cm	33.0 in/83.8 cm	38.5 in/97.8 cm
Diameter	14.25 in/36.20 cm	14.25 in/36.20 cm	14.25 in/36.20 cm
Empty Weight	45 lbs/20 kg (46 lbs/21 kg D models)	51 lbs/23 kg (52 lbs/24 kg D models)	60 lbs/27 kg (61 lbs/28 kg D models)
Full Weight	94 lbs/42 kg (95 lbs/43 kg D models)	124 lbs/56 kg (125 lbs/57 kg D models)	158 lbs/71 kg (159 lbs/72 kg D models)
Operating Pressure	19.5 psig/134 kPa Nominal (Acceptable Range 18.5-20.5 psig/128-141kPa)	19.5 psig/134 kPa Nominal (Acceptable Range 18.5-20.5 psig/128-141kPa)	19.5 psig/134 kPa Nominal (Acceptable Range 18.5-20.5 psig/128-141kPa)
Primary Relief Valve Pressure	22.0 psig/152 kPa Nominal (Acceptable Range 20.5-25.0 psig/141-172 kPa)	22.0 psig/152 kPa Nominal (Acceptable Range 20.5-25.0 psig/141-172 kPa)	22.0 psig/152 kPa Nominal (Acceptable Range 20.5-25.0 psig/141-172 kPa)
Secondary Relief Valve Pressure	30 psig/207 kPa Nominal (Acceptable Range 25-37 psig/170-260 kPa)	30 psig/207 kPa Nominal (Acceptable Range 25-37 psig/170-260 kPa)	30 psig/207 kPa Nominal (Acceptable Range 25-37 psig/170-260 kPa)
Normal Evaporation Rate (typical) (maximum)	1.9 lbs/.86 kg per Day 2.1 lbs/.95 kg per Day	1.9 lbs/.86 kg per Day 2.2 lbs/1 kg per Day	1.9 lbs/.86 kg per Day 2.2 lbs/1 kg per Day
Fill Time	Fill times vary with the saturation and operating pressure of the source vessel. Contact Technical Service for more information.		
Flow Ranges**	Standard Valve 0-6 l/min; Optional 0-4 and 0-10 l/min Valves Available	Standard Valve 0-6 l/min; Optional 0-4 and 0-10 l/min Valves Available	Standard Valve 0-6 l/min; Optional 0-4 and 0-10 l/min Valves Available

*Specifications subject to change without notice.

**Flow values for flow control valves are as follows - (See Page 3-11 for Tolerances):
0-6 lpm valve includes 0, .25, .5, .75, 1, 1.5, 2, 2.5, 3, 4, 5 and 6
0-4 lpm valve includes 0, .12, .25, .5, .75, 1, 1.5, 2, 2.5, 3, 3.5 and 4
0-10 lpm valve includes 0, .5, .75, 1, 1.5, 2, 3, 4, 5, 6, 8 and 10

RUN TIME SPECIFICATIONS

The *Companion* 21, 31 and 41(A, AG and D) Stationary unit run time specifications are listed below In Table 1-2. Data listed in the table is expressed in hours.

TABLE 1-2

COMPANION STATIONARY RUN TIME SPECIFICATIONS (Hours)*

Flow Settings (Liters/min.)	Companion 21	Companion 31	Companion 41
0.12	620	924	1241
0.25	620	924	1241
0.5	558	832	1117
0.75	372	554	744
1	279	416	558
1.5	186	277	372
2	140	208	279
2.5	112	166	223
3	93	139	186
3.5	80	119	160
4	70	104	140
5	56	83	112
6	47	69	93
8	35	52	70
10	28	42	56

*Specifications subject to change without notice. Data listed in table is analytical and based on continuous flow without any portable fills.

UNIT OPERATION

The following information is relevant to the operation of the Stationary unit and includes a description of the controls, indicators, connectors, filling instructions, and resaturating instructions.

Controls, Indicators and Connectors

The controls, indicators and connectors that are used on the *Companion* Stationary unit are shown in Figures 1-4 & 1-5. Their functions are described below.

Contents Indicator
The amount of liquid oxygen contained in the *Companion* Stationary unit is displayed by an integral indicator that is viewed through the top cover. The liquid contents are indicated by aligning the colored line on the piston with the graduated markings on the cylinder. **Do not** fill a portable oxygen unit if the contents indicator is at or below the empty (0) mark.

A kit is available to retrofit Stationary units without contents indicators (See Accessories List). Stationary units manufactured prior to November 1986 (Serial Number 8611XXXX) do not have the liquid level gauge sensing line required to outfit a unit with a contents indicator. Any unit manufactured after this date can be outfitted with an indicator.

Pressure Indicator (Optional)
This gauge indicates the status of the pressure inside of the *Companion* Stationary unit. Under normal conditions, the pressure indicator pointer is within the shaded area on the indicator dial. **Do not** fill a portable oxygen unit if the pressure indicator pointer is not within the shaded region.

Two separate kits are available to retrofit Stationary units without pressure indicators. One kit fits Stationary units without a contents indicator. The other fits Stationary units with a contents indicator (Series A). (See Accessories List).

Flow Control Valve
The flow control valve is an adjustable, rotary indexed 12 position valve that controls the rate of oxygen flow from the unit. The standard valve is calibrated in flows from 0-6 lpm. (0-4 lpm and 0-10 lpm valves are also available, see Parts List).

Some Stationary units have a flowlock feature on the flow control valve which consists of a flowlock plate and rivet used in conjunction with the knob and decal. Contact the Technical Support department if you have a question concerning the flowlock feature.

Some older Stationary units may have an 8 position valve. The knobs, flow plates, decals and rivets used with the 8 & 12 position valves are not compatible with one another. Eight position flow control valves are no longer available, however, select replacement parts are. (See Parts List).

Humidifier Adapter
Oxygen outlet that allows the connection of a humidifier or a tubing adapter through a DISS (Diameter Index Safety System) connection.

Vent Valve
The vent valve is a quarter turn ball valve that is accessible with a vent key through the top cover. This valve is opened to vent the inner container during the Stationary unit filling process. The valve is closed upon terminating the filling process.

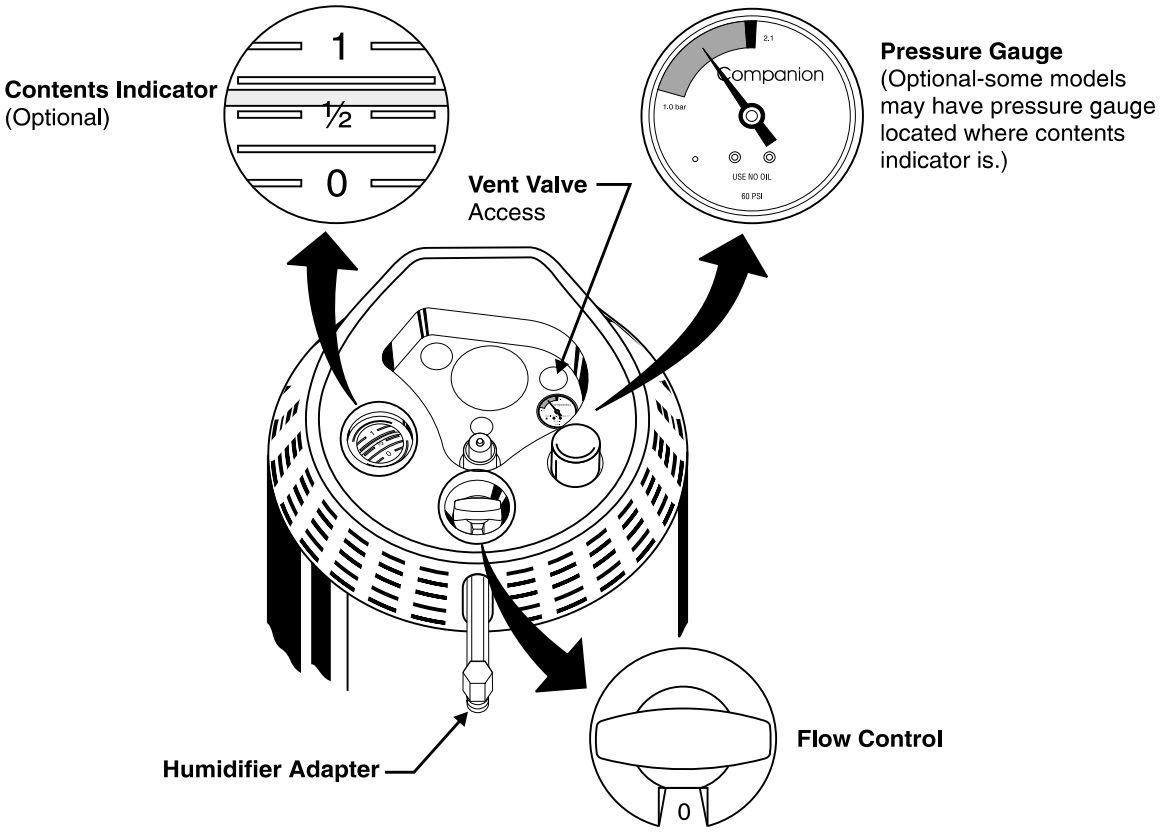


FIGURE 1-4
Controls, Indicators, and Connectors

Controls, Indicators and Connectors(cont.)

Fill Connector(s)
The Puritan Bennett (PB) fill connector used on the *Companion* Stationary unit is a quick connect coupling used to transfer liquid oxygen to and from the Stationary unit. The side-fill connector used on the Dual-Fill models, serves the same purpose, but allows the transfer of liquid oxygen through an alternate source.

Fill Connector Cover (Standard on Dual-Fill Models)
The fill connector cover is a cap that fits over the Puritan Bennett fill connector. The cover keeps the PB fill connector clean when the side-fill connector is being used.

Release Button
Pressing the release button on the *Companion* Stationary unit activates the fill connector release lever mechanism for the Puritan Bennett fill connector. This in turn disengages either a portable oxygen unit or a transfer line from the Stationary unit.

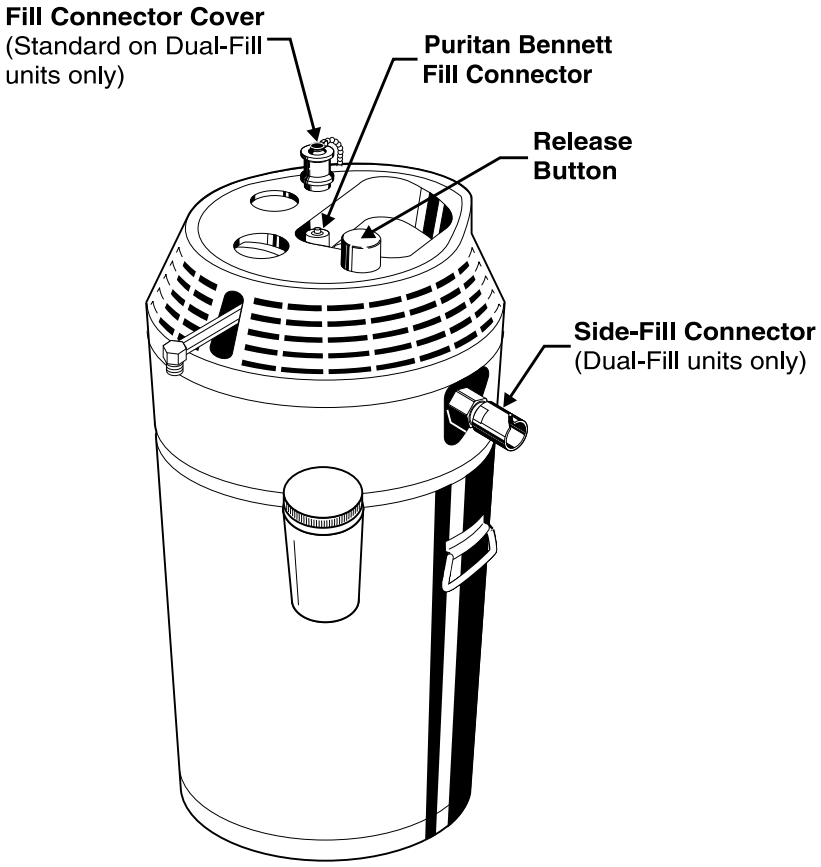


FIGURE 1-5
Controls, Indicators, and Connectors

Contents Scale (Optional)
The contents scale is a mechanical weight scale used to measure liquid contents in Stationary units without contents indicators (Series A). Stationary units without contents indicators are no longer available. There are two variations of the scale in service. The old style is round in shape and has a blue top assembly (See Figure 1-6). The current style is square in shape and has a black top assembly (See Figure 1-7). The scales come in three different models to match the three different sizes of Stationary units (See Accessories List).

NOTE:
The older style contents scales are no longer available. The only serviceable parts on the scale are the screws in the top assembly, the bottom feet and the screws in the bottom feet (See Accessories List). The round blue top assembly is no longer available.

Calibration:

1) Place an empty Companion Stationary on the appropriate contents scale. Ensure that the scale is marked with either a 21, 31, or 41.

2) Adjust the scale so that the pointer is in the middle of the "E" in the red box. Make the adjustment while standing directly in front of the pointer.

   Old Style Scale
   Zero the scale by turning the scalloped adjuster, located on the lower front portion of the scale, clockwise to move the pointer to the left, or counterclockwise to move the pointer to the right.

FIGURE 1-6
Old Style Contents Scale

   Current Style Scale
   Zero the scale by turning the star adjuster, located on the lower rear portion of the scale, clockwise to move the pointer to the left, or counterclockwise to move the pointer to the right.

FIGURE 1-7
Current Style Contents Scale

3) Verify that the scale reads full when the Stationary is full of liquid oxygen.

Filling Instructions

If a *Companion* Stationary fails a part of this procedure that is vital to the function of the unit, make the necessary repairs before placing the unit in service.

OXYGEN REQUIREMENTS

Use only U.S.P. Medical Oxygen to fill a *Companion* Stationary unit. The oxygen used for filling should have no moisture content. This requirement is the responsibility of the supplier.

TRANSFER LINE

The standard Puritan Bennett transfer line is shown in Figure 1-8. A transfer line with both a Puritan Bennett and a side fill adapter is also shown in Figure 1-8. The side fill adapter is not available from Puritan Bennett. However, a universal adapter kit that attaches most side fill adapters to the transfer line is available. (See Accessories List)

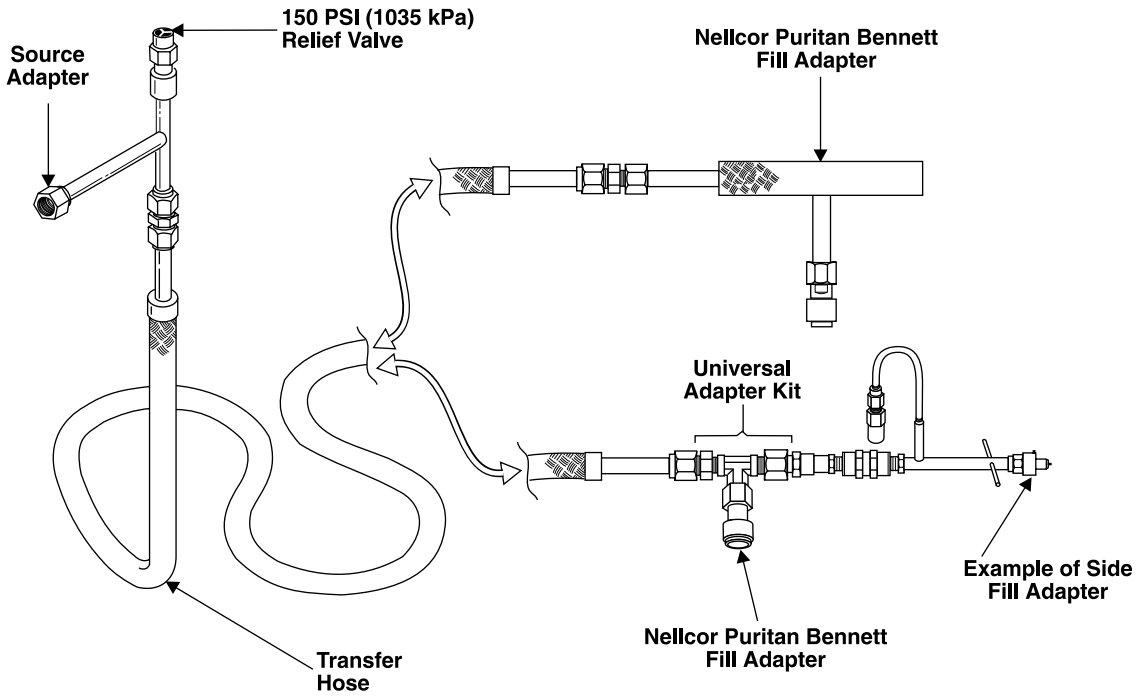


FIGURE 1-8
Standard Transfer Line and
Transfer Line w/Nellcor Puritan Bennett
and Side Fill Adapter

FILLING PRESSURE

The filling pressure is extremely important. The saturation pressure of the source vessel affects the fill time, fill losses and Stationary unit saturation pressure. The recommended source vessel saturation pressure is 40-50 psig (276-345 kPa). This requirement is the responsibility of the supplier.

FILLING LOSSES

The filling procedure results in some loss of oxygen for the following reasons:

1) Vaporization that is inherent in the process of cooling the metal parts of the source vessel, the transfer line and the *Companion* Stationary unit
2) Gaseous oxygen venting during the fill
3) Saturation losses

PRE-FILL INSPECTION PROCEDURE

1) Ask the user if there are any questions or concerns regarding the equipment since your last visit.
2) Visually inspect Stationary for overall product integrity (Cracked or damaged components).
3) Verify all labels are present and legible on the unit. (Figure 1-9)
4) Verify that there is no frost or heavy condensation on the container below the shroud and no excessive venting from the relief valve. (Some venting from relief valve is normal.)
5) Verify the LOX content level is consistent with the delivery schedule and expected patient usage.
6) Verify the fill connector/s (Top and/or Side) are not worn, leaking or damaged. Verify the release lever mechanism for the top fill works.
7) Verify the vent valve stops are not bent or broken.
8) Verify the contents indicator or contents base scale is operational and reads full at the end of the filling procedure. (If Applicable)
9) Verify the condensate drain spout is functional.

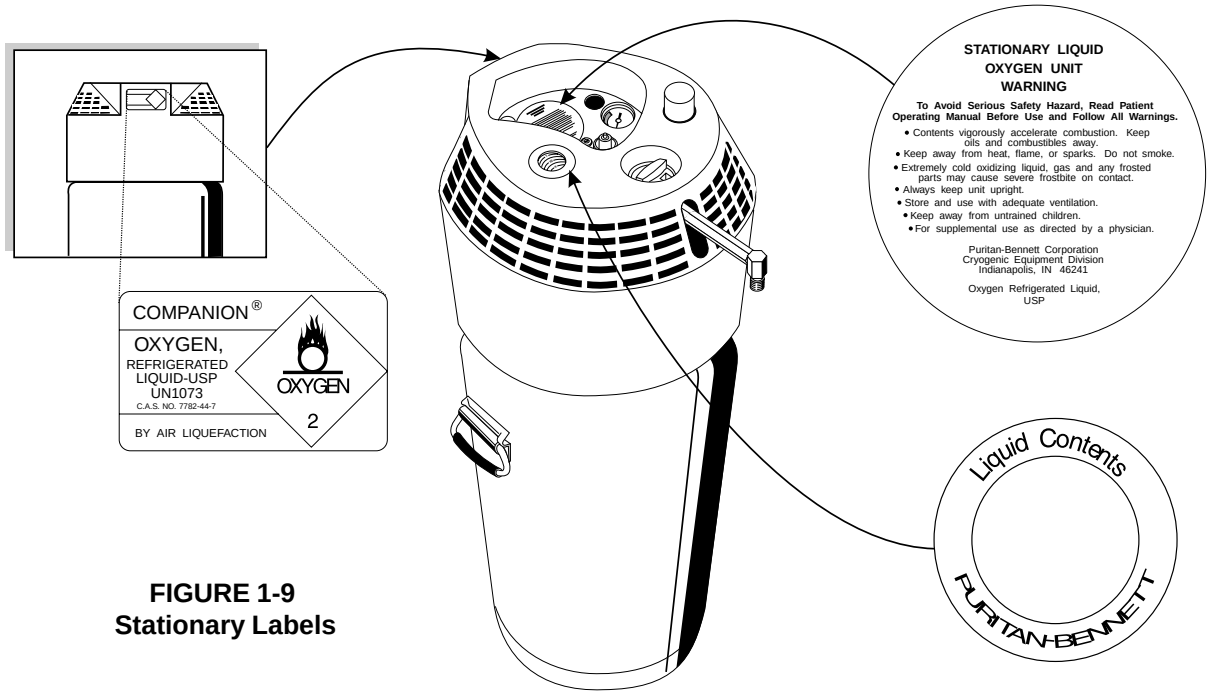


FIGURE 1-9
Stationary Labels

Filling Instructions (cont.)

FILLING PROCEDURE

Perform the following procedure to fill a *Companion* Stationary unit with liquid oxygen:

WARNING

Fire hazard. Do not spill liquid oxygen on asphalt or any other combustible surface. Always fill unit on noncombustible surface such as concrete or steel drip pan.

WARNING

Explosive hazard. Extreme high pressure can rupture transfer line. Be sure proper pressure relief valve is present and functioning properly.

WARNING

Fire hazard. Oxygen spillage can occur. Tie down Stationaries securely when transporting units containing liquid oxygen.

WARNING

Fire hazard. Oxygen can accumulate in delivery vehicle. Exhaust vent gases to outside of vehicle. (See CGA Safety Bulletin SB-9)

1. Wear the proper protective clothing as specified on page 1-4.

2. Verify that the liquid oxygen in the source vessel is saturated between 40-50 psig (276-345 kPa) before starting the fill.

   NOTE:
   If difficulty obtaining properly saturated oxygen is experienced, consult the factory for alternatives.

3. Attach the 5/8 in. female end of the transfer line source adapter to the liquid withdrawal valve of the source vessel. Position the source adapter relief valve straight up.

4. Attach the pressure gauge (Figure 1-10) to the humidifier adapter and set the flow control valve to the highest setting. Verify that the pressure is 18.5-25 psig (128-172 kPa) for units that contain liquid oxygen. If the unit is empty, continue on with step 5 without verifying the pressure at this point.

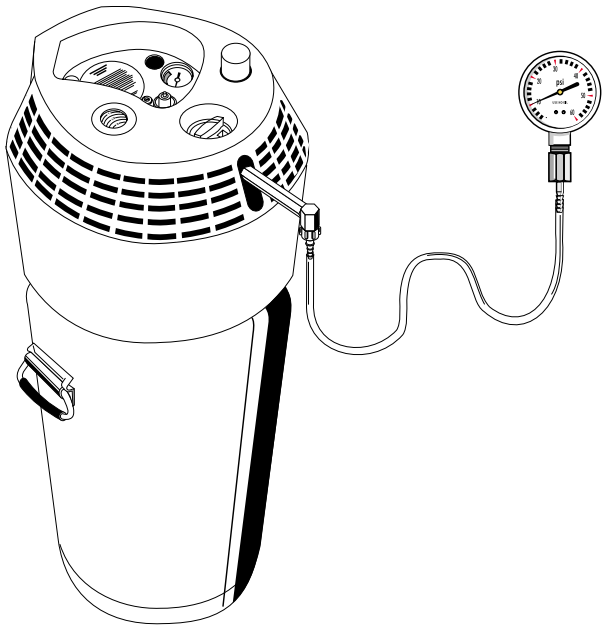


FIGURE 1-10
Attaching Test Pressure Gauge

5. Remove the fill connector cover from the fill connector if applicable. (Available as an option, see Parts List).

6. Check that the fill connectors on both the Stationary unit and the fill adapter are clean and dry. Wipe the connectors with a clean, lint-free cloth or blow dry with gaseous oxygen or nitrogen as needed.

7. Use the vent key to open the vent valve on the *Companion* Stationary unit by rotating the key 1/4 turn counterclockwise.

   NOTE:
   At this point, an audible venting noise may be noticed if the Stationary unit is pressurized.

Filling Instructions (cont.)

8. Engage the transfer line to the appropriate fill connector on the *Companion* Stationary as follows:

   Puritan Bennett fill connector -
   Align the fill adapter over the fill connector and apply approximately 20 lbs. of downward force.

CAUTION

Damage to the side-fill connector may occur. Follow instructions for using side-fill connector precisely.

   Side fill connector -
   Align the male end of the transfer line directly in front of the side-fill connector. Insert the male end of the transfer line into the side fill connector and rotate counterclockwise until the roller or pin on the fill adapter drops into the slot on the side-fill connector. Rotate clockwise until the fill adapter locks into place.

9. Slowly open the liquid valve on the source vessel. Continuously adjust the liquid valve throughout the fill to maintain the needle on the attached pressure gauge between 18-20 psig (124-138 kPa).

   NOTE:
   It may be necessary to open the liquid withdraw valve completely, and throttle the *Companion* vent valve back to maintain the proper pressure during the fill.

   NOTE:
   At this point a vigorous audible venting noise will confirm that the filling process has started.

10. Close and reopen the vent valve on the Stationary unit when 45 to 60 seconds have passed. This will minimize the possibility of the vent valve freezing in the open position.

    NOTE:
    As the level of liquid oxygen in the unit nears the top of the inner container, the sound and appearance of the escaping vapors will change. The vapor will become more dense, and as liquid oxygen reaches the vent valve, a discharge of liquid oxygen will be seen and heard.

    NOTE:
    The first discharge of liquid oxygen observed usually results from turbulence inside the container and does not necessarily indicate that the unit is full. To insure a complete fill, continue filling until a steady stream of liquid oxygen is observed.

11. When a steady stream of liquid oxygen is observed exiting the vent valve, close the vent valve immediately by rotating the vent key 1/4 turn clockwise. Simultaneously, disconnect the transfer line as follows:

    Puritan Bennett fill connector -
    Depress the release button and remove the transfer line.

    Side fill connector -
    Rotate the fill adaptor counterclockwise and remove the transfer line.

WARNING

Extreme cold hazard. Liquid oxygen discharge from fill connector can occur. Never stand directly over, or in front of, fill connector when disconnecting transfer line. Open vent valve to stop release of liquid oxygen.

NOTE:
If the vent valve freezes in the open position, terminate filling by disconnecting the fill connector and allowing the vent valve to warm until it closes easily. If the vent valve remains open for a period of time, the liquid oxygen in the unit will desaturate to a pressure lower than required. If this occurs, refer to the Resaturating Liquid Oxygen section on page 1-19.

12. Close the source vessel liquid valve and replace the fill connector cover, if applicable, on the Stationary unit.

    NOTE:
    Closing the liquid valve on the source vessel immediately following a fill may trap liquid oxygen in the transfer line. This will cause pressure to build in the transfer line and may cause the relief valve to vent.

    NOTE:
    If difficulties are encountered when filling, refer to Section 4-1, Troubleshooting

TESTING

1. Verify that the Stationary unit pressure is 18.5-25 psig (128-172 kPa).

2. Connect a test flowmeter to the oxygen outlet of the Stationary, and check the patient's prescribed flow setting(s).

    NOTE:
    If system is at relief valve pressure (20.5-25 psig/144-172 kPa) flows may be slightly high. You may vent the system to bring the pressure down to the operating pressure (18.5-20.5 psig/128-144 kPa) and then test flows.

Determining Saturation Pressure

Perform the procedure listed below to determine the saturation point of liquid oxygen in a *Companion* Stationary unit. The saturation point cannot be determined by simply taking a pressure reading on the unit.

PROCEDURE

1. Connect either the pressurizing fixture (Figure 1-13) to the fill connector or a pressure gauge to the humidifier adapter (Figure 1-10) on the *Companion* Stationary unit.
2. Momentarily open the Stationary vent valve and observe the needle of the gauge drop.

3. Note where the needle of the gauge hovers (See Figure 1-11), and shut the vent valve. This is the approximate saturation pressure of the Stationary unit. Readings between 18.5-25.0 psig (128-172 kPa) are in the acceptable operating range of the unit. Readings below 18.5 psig (128 kPa) are not usually considered normal, but may be acceptable if there is no immediate patient flow required on the unit.

4. Perform the Resaturating Liquid Oxygen procedure on an as needed basis according to the information provided.

   NOTE:
   Readings above 25.0 psig are not considered normal. This is usually a result of the liquid being oversaturated. Open the vent valve until the needle of the pressure gauge reads between 18.5-25.0 psig (128-172 kPa) and then close the vent valve.

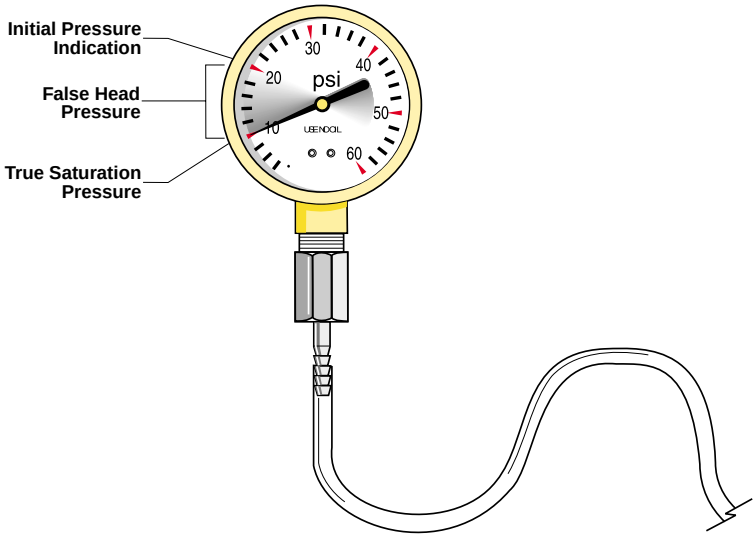


FIGURE 1-11
Gauge Needle "Hovering"

Resaturating Liquid Oxygen

If the *Companion* Stationary unit looses its saturation pressure and the cause of this condition is corrected without emptying the liquid contents, the saturation may be restored by either of the three following methods. The simplest way to restore saturation (**Method 1**) is to simply allow the unit to stand in normal room conditions for a specified amount of time. The entire volume of liquid will usually regain proper saturation within 48 hours. If however this is not a reasonable option, the liquid may be resaturated by either of the following methods.

Resaturating Liquid (Method 2)

1. Attach the source adapter of the transfer line assembly to either the gas withdrawal or vent valve on the source vessel.

2. Attach the pressure gauge (Figure 1-10) to the humidifier adapter and set the flow control valve to the highest setting.

3. Engage the transfer line fill adapter to the Stationary fill connector by aligning the fill adapter over the fill connector and applying approximately 20 lbs. of downward force.

4. Partially open the vent or gas withdraw valve on the source vessel, and slowly adjust the valve open as far as possible without blowing open the Stationary primary relief valve. Be sure to leave the Stationary vent valve closed.

   NOTE:
   If there is immediate noticeable audible venting of the Stationary primary relief valve, start to close the vent or gas withdraw valve until the relief valve on the Stationary closes.

5. When the attached pressure gauge reads 18.5-20.5 psig (128-141 kPa) and relief valve venting is heard, shut off the gaseous oxygen supply to the unit.

6. Recheck the saturation pressure as described on the previous page. Repeat the resaturation procedure until the liquid is saturated.

Resaturating Liquid - (Method 3 - Use Only U.S.P. Oxygen)

NOTE:
Check regulations for oxygen traceability requirements when using this method.

1. Attach the pressurizing fixture (Figure 1-13) to the Stationary unit by means of the hold-down strap. Attach an adjustable 0-50 psig (0-345 kPa) source of gaseous U.S.P. oxygen to the DISS (Diameter Index Safety System) oxygen inlet connection on the fixture (Figure 3-2).

Resaturating Liquid Oxygen (cont.)

2. Partially open the gaseous oxygen source tank valve, and slowly adjust the pressure regulator to as high a pressure possible without blowing open the Stationary primary relief valve. Be sure to leave the Stationary vent valve closed.

   NOTE:
   If there is immediate noticeable audible venting of the primary relief valve, reduce the regulator pressure on the gaseous oxygen supply until the relief valve closes.

3. When the gauge on the pressurizing fixture reads 18.5-20.5 psig (128-141 kPa) and relief valve venting is heard, shut off the gaseous oxygen supply to the unit.

4. Recheck the saturation pressure as described on the previous page. Repeat the resaturation procedure until the liquid is saturated.

ROUTINE MAINTENANCE

Routine Maintenance for the *Companion* Stationary is built into the filling procedure. When all steps of the filling procedure are performed properly there is no additional routine maintenance required. It is however important to remember that if a *Companion* Stationary fails a part of the filling procedure that is vital to the function of the unit, make the necessary repairs before placing the unit in service.

RECOMMENDED TOOLS, TEST EQUIPMENT & SERVICE MATERIALS

Hand tools, test equipment, and materials used to properly service the *Companion* Stationary unit and maintain it in operable condition are listed in Table 1-3. If hand tools, test equipment and materials other than those specified in Table 1-3 are used, their functional characteristics such as quality and accuracy must be equal to or better than those specified in the table.

CALIBRATION OF TEST EQUIPMENT

Perform periodic calibration checks of test equipment (pressure gauges, weight scales, flowmeters etc.) to ensure the reliable operation of your *Companion* Stationary unit. Perform these checks at intervals based on your previous experience calibrating that particular piece of test equipment. If the piece of test equipment is new you may use a default of every 6 months. However, if the test equipment sees an unusually high usage rate, you may want to consider checking it once a month. Once you have begun using the piece of test equipment you may adjust the calibration schedule. If for example you start out calibrating your filling pressure gauge every 6 months and it is repeatedly out of calibration when you check it, you may want to adjust the schedule to every 3 months. You should reach an interval where your equipment is in calibration everytime it is checked. Always perform a calibration check on a piece of test equipment that has been dropped or mishandled before using it on a *Companion* Stationary unit.

Reference ISO 1012-1 (Quality Assurance Requirements for Measuring Equipment) for additional information.

TABLE 1-3. RECOMMENDED TOOLS, TEST EQUIPMENT & SERVICE MATERIALS

TOOLS	
Description	**Manufacturer/Model No.**
• Hex Key (Allen) Wrenches - 7/64 in., 5/32 in.	Local Source
• Open End Wrenches - 1/4 in.,3/8 in., 7/16 in., 1/2 in., 9/16 in., 5/8 in., 3/4 in.	Local Source
• Adjustable Wrench - 8 in., 10 in.	Local Source
• Screwdrivers - medium flat blade, small flat blade	Local Source
• Pliers - needlenose	Local Source
• 5/16 in. Socket (1/4 in. Drive)	Local Source
• Torque Wrench (30-200 in-lb)	Snap-On No. TQR 100A
• Torque Wrench (20-100 ft-lb)	Snap-On No. QJR 117E
• Vent Valve Key (Figure 1-14)	Puritan Bennett No. B-775182-00
• NPB Fill Connector Inner Installation Tool (Figure 1-15)	Puritan Bennett No. B-775392-00
• NPB Fill Connector Male Installation Tool (Figure 1-15)	Puritan Bennett No. B-775393-00
• Hex Thread Ring Tool (Side-fill Units)	Puritan Bennett No. B-701055-00
• Flow Knob Removal Tool	Puritan Bennett No. B-701273-00
TEST EQUIPMENT	
Description	**Manufacturer/Model no.**
• Test Pressure Gauge with Tubing Adapter (0-60 psig/0-414 kPa, Figure 1-12)	Puritan Bennett No. B-775270-00
• Pressurizing Fixture (0-60 psig/0-414 kPa, Figure 1-13)	Puritan Bennett No. B-701067-00
• Adjustable 0-50 psig (0-345 kPa) Gaseous Oxygen Source	Local Source
• Calibrated Flowmeter for the appropriate range	Local Source
• Calibrated weight scale — 0-200 lbs (0-91 kg) with .02 lb (9.1 g) maximum graduation, accuracy, and repeatability	A & D Engineering FW-100-KA1
• Liquid leak detector (SNOOP®)	Puritan Bennett No. B-775272-00

Table 1-3 cont.

SERVICE MATERIALS	
• Lubricant - Krytox® 240 AC Fluorinated Grease (DuPont)	Puritan Bennett No. B-775239-00
• RTV Silicone	Puritan Bennett No. B-778885-00
• Thread Sealant - 3/16 in. Teflon® Tape	Local Source
• Isopropyl Alcohol	Local Source
• Cloth - Lint Free	Local Source
• Cotton Swabs	Local Source

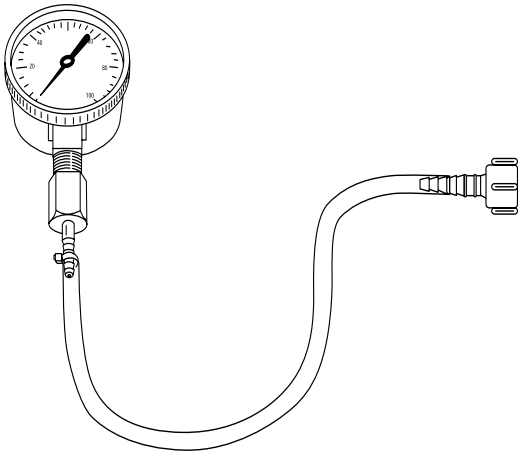


FIGURE 1-12
Test Pressure Gauge
P/N B-775270-00

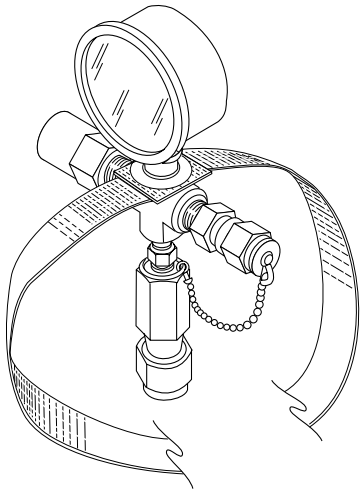


FIGURE 1-13
Pressurizing Fixture
P/N B-701067-00

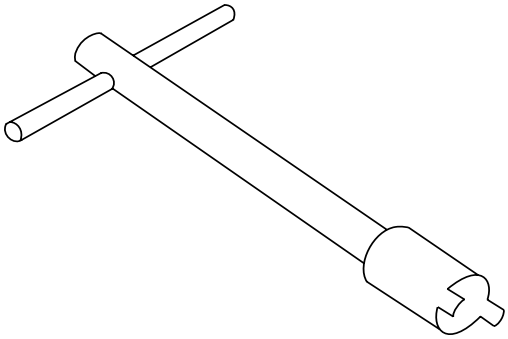


FIGURE 1-14
Vent Valve Key
P/N B-775182-00

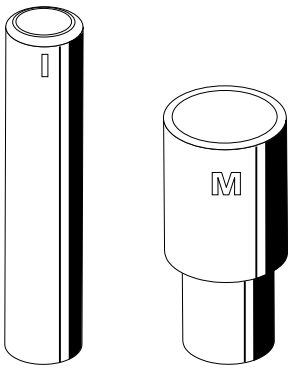


FIGURE 1-15
PB Fill Connector Installation Tools
P/N B-775392-00 & B-775393-00

THEORY OF OPERATION 2

This section describes the theory of operation for the *Companion* liquid oxygen Stationary unit. Information covered in this section includes system component descriptions, liquid oxygen saturation principles and *Companion* Stationary unit operating principles. Please note that numerical values used in this section are nominal values used for descriptive purposes only.

SYSTEM COMPONENT DESCRIPTION

The following information provides a brief description of each of the major functional components on the *Companion* Stationary unit.

Cryogenic Container

Liquid oxygen is stored in the *Companion* Stationary unit at a temperature of approximately -276˚F (-171˚C) and a pressure of 22 psig (152 kPa). The cryogenic container (Figure 2-1) is designed to minimize the transfer of ambient heat into the liquid oxygen contents. It consists of a stainless steel inner container suspended within a stainless steel outer container.

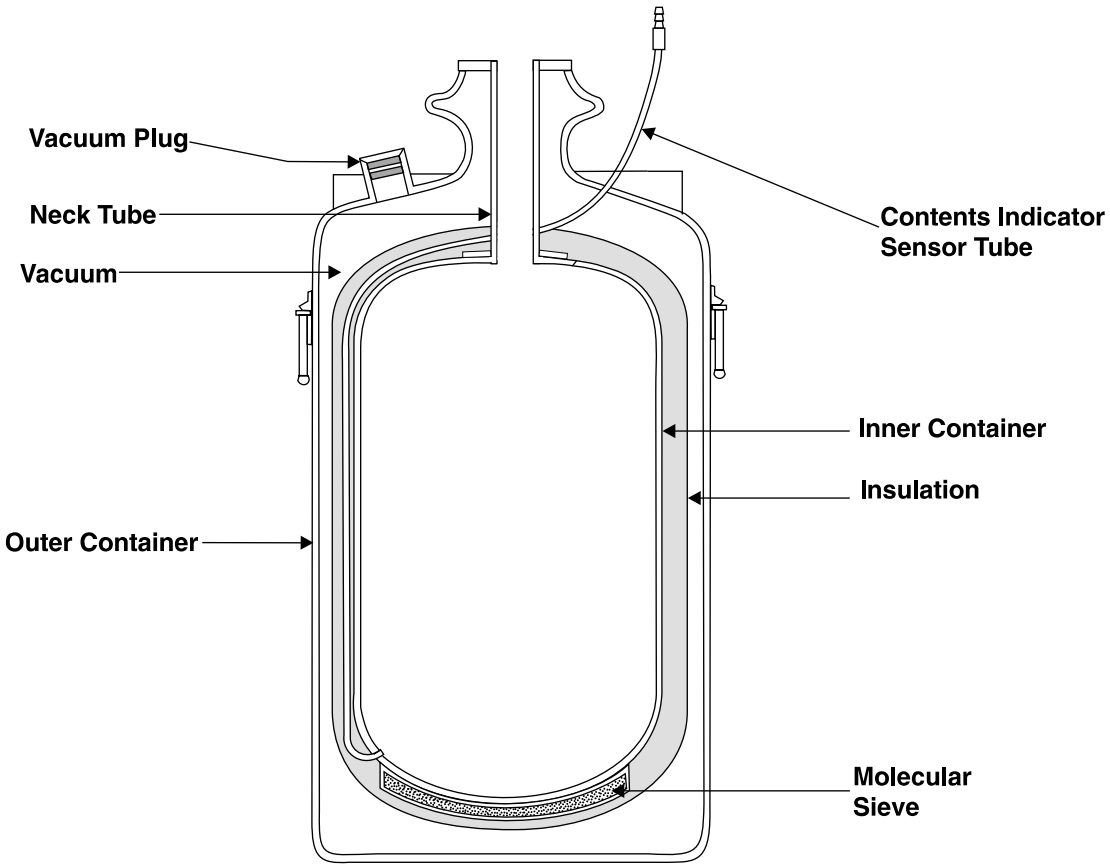


FIGURE 2-1
Cryogenic Container

Cryogenic Container (con't.)

Conductive heat transfer is kept to a minimum by limiting the number of contact points the inner container has with the outer container. In addition, the inner container is orbitally wrapped with multiple alternating layers of aluminum foil and fiberglass insulation. This insulation wrap reflects radiant heat from the outer container. Finally, to minimize the effects of convective heat transfer between the two containers, a vacuum is created in the annular space between the outer and inner containers. The vacuum, drawn through the evacuation port, removes most of the gas molecules in the annular space. Since no vacuum created on earth is perfect, a molecular sieve material is placed on the bottom of the inner container in the vacuum space. When the presence of liquid oxygen in the inner container cools the molecular sieve to cryogenic temperatures, stray gas molecules are removed from the vacuum space by adsorption into the sieve. This improves the vacuum and decreases the heat transfer between the containers.

Puritan Bennett Fill Connector

The Puritan Bennett fill connector (Figure 2-2, A) on the *Companion* Stationary unit is the male half of a fluid coupling system. It mates with the female connector found on a *Companion* portable oxygen unit and/or a transfer line fill adapter. The connector provides a means for transferring liquid oxygen to and from the Stationary unit. The male connector consists of an anodized aluminum body and a spring loaded cartridge assembly. With the connector disengaged, the spring loaded poppet is held closed and maintains a leak free seal. When a female connector engages with the male connector (Figure 2-2, B), the poppets of both connectors simultaneously push off their seats, allowing the transfer of liquid oxygen. A lip seal in the female connector prevents leakage of liquid oxygen between the female and male connectors during liquid oxygen transfer.

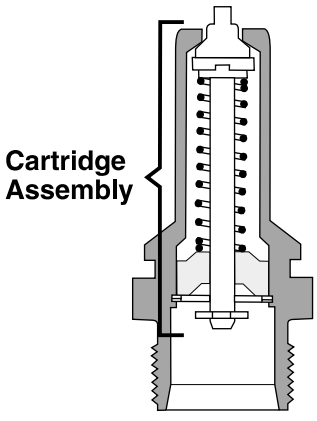


FIGURE 2-2 (A)
Male Connector

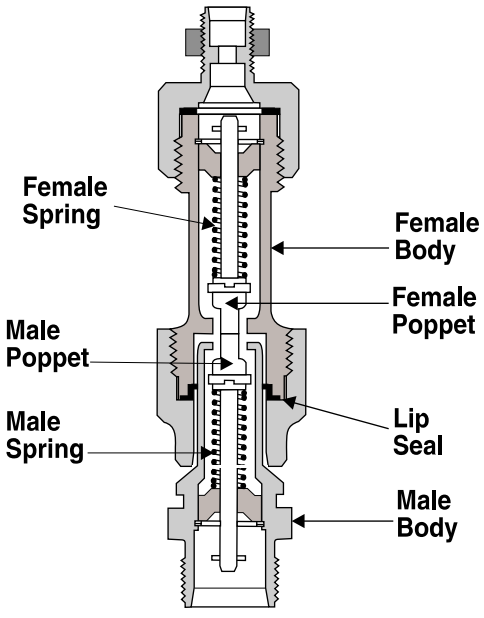


FIGURE 2-2 (B)
Male/Female Connector Fully Engaged

Puritan Bennett Fill Connectors

Side-fill Connector

The side-fill connector (Figure 2-3) on the *Companion* Dual-Fill models is the female half of a fluid coupling system. The connector provides a means for transferring liquid oxygen to and from the Stationary unit. The connector consists of a housing, valve assembly, hex coupler, hex thread ring, O-ring, and a lip seal. When a compatible male connector locks into place, the poppets in both connectors simultaneously push off their seats. This allows liquid oxygen to transfer through the connectors.

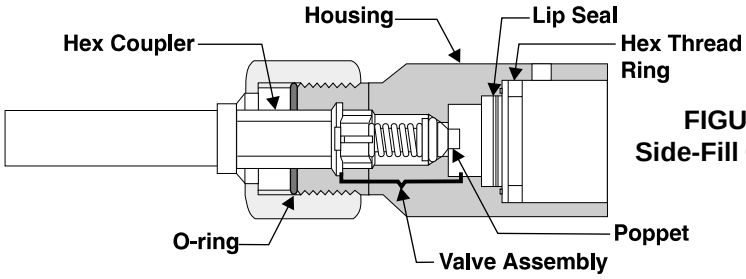


FIGURE 2-3
Side-Fill Connector

Vaporizing Coil

The vaporizing coil (Figure 2-4) on the *Companion* Stationary unit is a tightly wound coil of 1/4 in. aluminum tubing that connects between the warming coil and a tee connected to the manifold. It is a heat exchanger that transfers heat from the surrounding atmosphere to the fluid contents inside the coil. The vaporizing coil serves two purposes on the Stationary unit. The first is to assist in warming the headspace gas that passes through the economizer valve. The second is to convert the liquid oxygen from the liquid withdrawal tube into gaseous oxygen when the flow demand placed on the system is greater than the NER (Normal Evaporation Rate) of the unit.

Warming Coil

The warming coil (Figure 2-4) on the *Companion* Stationary unit is a loosely wound coil of 1/4 in. aluminum tubing that connects between the flow control valve and the vaporizing coil. The warming coil is a heat exchanger designed to transmit heat from the surrounding atmosphere to the cold gaseous oxygen. The purpose of the warming coil on the Stationary unit is to warm the cold gaseous oxygen exiting the vaporizing coil to near room temperature.

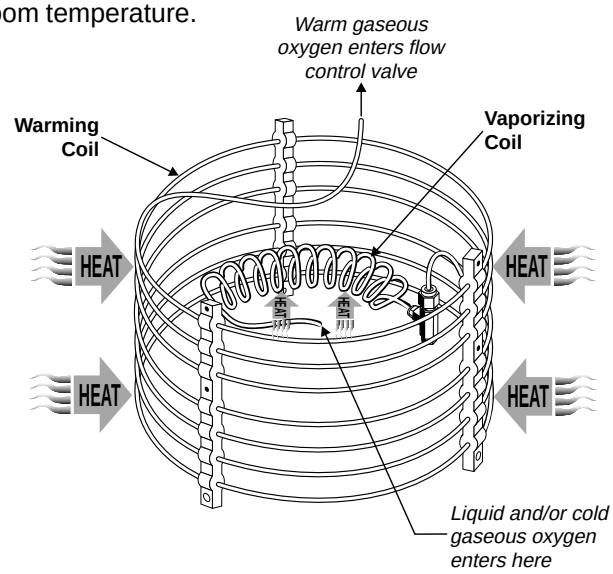


FIGURE 2-4
Vaporizing/Warming Coil

Flow Control Valve

The *Companion* Stationary flow control valve (Figure 2-5) is a rotary, fixed orifice device that consists of a moveable rotor with eleven individually sized orifices (12 position valves consist of 11 orifices + "0" or off position). When a specific flowrate is selected on the flow control valve, the corresponding orifice is aligned between the inlet and outlet ports of the valve. The orifice is calibrated to deliver the selected flow when gaseous oxygen at 19.5 psig (134 kPa) is present at the valve inlet port.

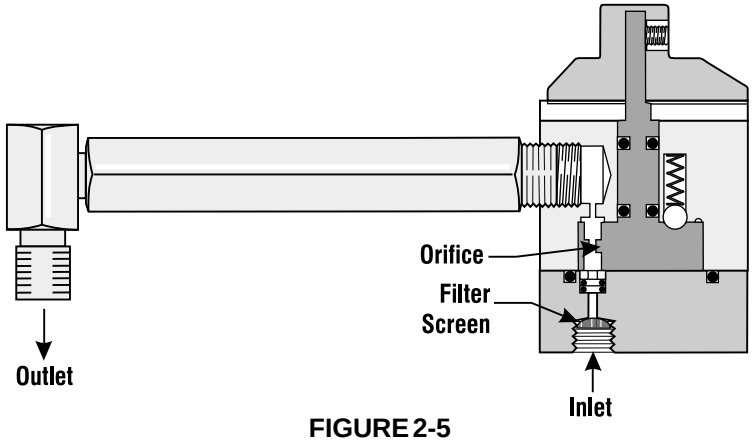
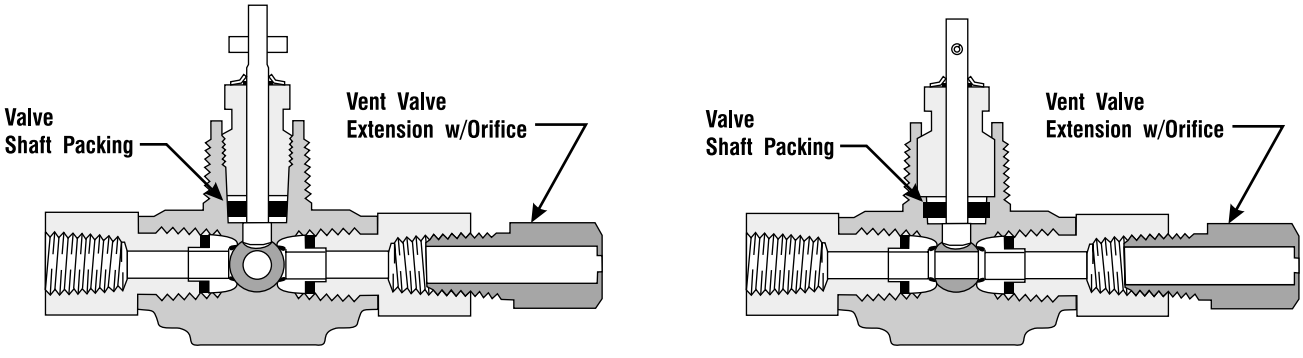


FIGURE 2-5
Flow Control Valve

Vent Valve

The vent valve (Figure 2-6) is a quarter turn ball valve that vents the *Companion* Stationary inner container to atmosphere. Venting the inner container is required to fill the *Companion* with liquid oxygen. The valve is activated by a vent valve key that engages the valve shaft. When the valve is closed, the hole through the ball is at 90˚ to the inlet and outlet ports of the valve. Flow through the valve is stopped. To open the valve, the vent key is turned 90˚. This causes the valve shaft to rotate 90˚ so that the hole in the valve ball lines up with the inlet and outlet ports.



Closed **Open**

FIGURE 2-6
Vent Valve

Primary Relief Valve

The primary relief valve (Figure 2-7) determines the system pressure of the *Companion* Stationary unit when there is no flow through the flow control valve ("Standby" condition). The relief valve consists of a poppet with an elastomer seal and a spring. In its normal state, the poppet seals a port that vents to atmosphere. When system pressure acting on one side of the poppet overcomes the force created by the spring, the poppet lifts off of the port and allows headspace gas to vent to atmosphere. The venting gas lowers the system pressure until an equilibrium is established between the opening and closing forces on the poppet. If system pressure increases rapidly, the relief valve poppet opens a greater amount and vents additional gas to maintain the force equilibrium on the poppet. The *Companion* Stationary will typically maintain a primary relief valve pressure of 22 psig nominal (152 kPa) when it contains liquid oxygen. The primary relief valve has an acceptable range of 20.5-25 psig (141-172 kPa).

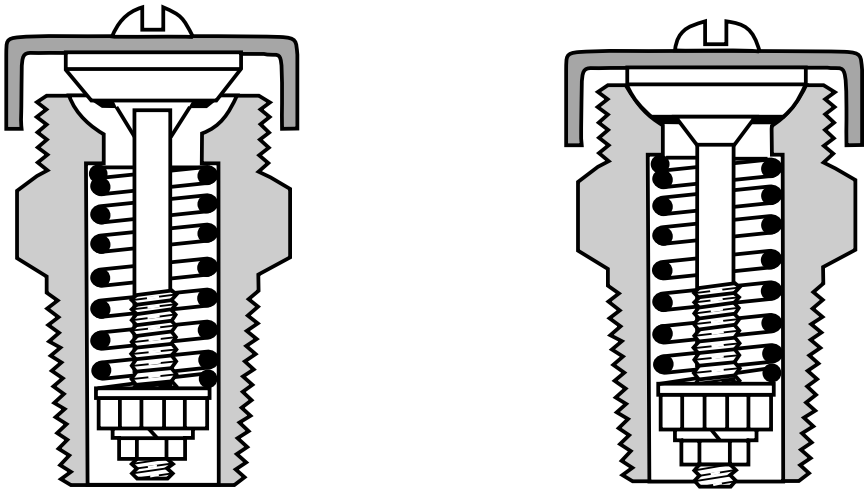


FIGURE 2-7
Primary/Secondary Relief Valve

Secondary Relief Valve

The secondary relief valve (Figure 2-7) is used as a safety backup in the event that the primary relief valve fails to limit system pressure to an acceptable range. The relief valve is identical in design and function to the primary relief. However, the secondary relief valve is set to limit the pressure to 30 psig nominal (207 kPa). The secondary relief valve has an acceptable range of 25-37 psig (172-255 kPa).

Economizer Valve

The economizer valve (Figure 2-8) on the *Companion* Stationary unit is a pressure regulating valve that allows a patient to breathe the NER (Normal Evaporation Rate) gas that would normally be vented to atmosphere. When system pressure is in excess of 19.5 psig (134 kPa), the economizer diaphragm opens a port that allows headspace gas to access the vaporizing coil. Under no flow conditions, the headspace gas will typically be at relief valve pressure (22 psig/152 kPa). When flow through the flow control valve is established, gas flows from the headspace through the open economizer valve. When this flow is greater than the NER of the system, the pressure in the headspace begins to decrease. The pressure in the headspace will eventually reach a point where the opening and closing forces acting on the economizer valve come to an equilibrium. The economizer port remains open just enough to allow a small flow of headspace gas created by the unit's NER to pass through. A constant system pressure of 19.5 psig (134 kPa) is maintained even though gas created by the NER is constantly being added to the headspace. If for any reason the system pressure falls below 19.5 psig (134 kPa) the economizer valve will close. Any flow demand in excess of the NER placed on the system is supplied by the liquid withdrawal circuit. This flow, together with the small NER flow through the economizer valve, balances the flow demand on the system. When gas withdrawal from the system ceases (flow control valve set at "0"), the NER of the system causes the pressure to increase to 22 psig (152 kPa) where it is maintained by the relief valve.

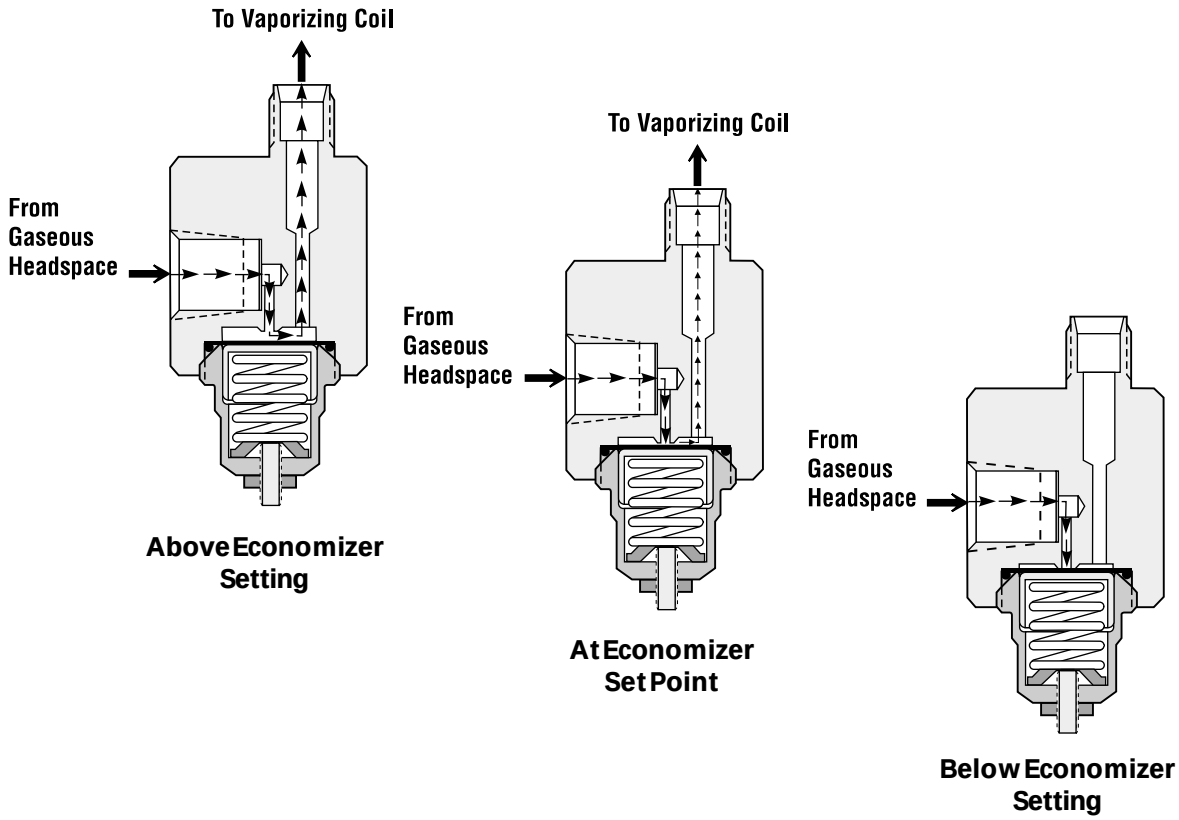
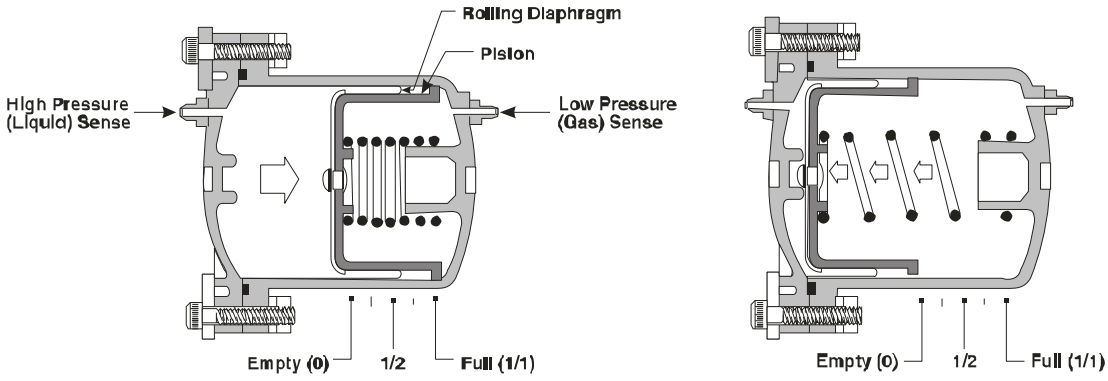


FIGURE 2-8
Economizer Valve

Contents Indicator

The contents indicator (Figure 2-9) consists of a moveable piston/rolling diaphragm assembly that is sealed within a clear plastic cylinder. A differential pressure causes the piston to move in the cylinder a distance proportional to the amount of liquid oxygen in the container. The liquid oxygen contents are indicated by aligning the colored line on the piston with the graduated markings on the cylinder.



Full **Empty**

FIGURE 2-9
Contents Indicator

Pressure Indicator

The pressure indicator (Figure 2-10) is a bourdon tube pressure gauge that indicates the status of the system pressure in the head space. The indicator is not calibrated in units of pressure. However, a dark blue shaded region on the indicator dial marks an acceptable operating pressure range of approximately 15-25 psig (103-172 kPa).

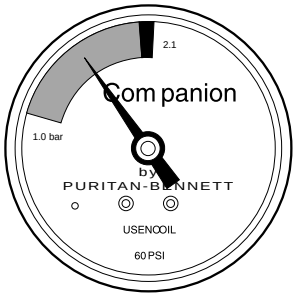


FIGURE 2-10
Pressure Indicator

Liquid Oxygen Saturation Principles

An understanding of the concept of liquid oxygen saturation is important to the understanding of the *Companion* Stationary unit operation. A saturated liquid is one that has absorbed the maximum amount of heat possible at a given pressure without boiling. As additional heat is added, the saturated liquid begins to vaporize (boil) while remaining at a constant temperature until all of the liquid is vaporized. A common example of a saturated liquid is water at its boiling point of 212°F (100°C) and 14.7 psig (101 kPa); additional heat does not cause the water to become hotter but instead causes part of the liquid to vaporize, or turn to water vapor.

The saturation point of a liquid depends not only on temperature, but also on pressure (Figure 2-11). If the **pressure** in a container of saturated liquid **increases,** the **temperature** required for saturation will also **increase,** leaving the liquid unsaturated, that is, capable of accepting more heat before it will boil. If the **pressure** in a container of saturated liquid **decreases,** the **temperature** required for saturation will **decrease,** leaving the liquid "super saturated" or too warm. When this occurs, rapid boiling and vaporizing of part of the liquid occurs. This process continues until the remaining liquid cools down to the new saturation temperature associated with the new pressure.

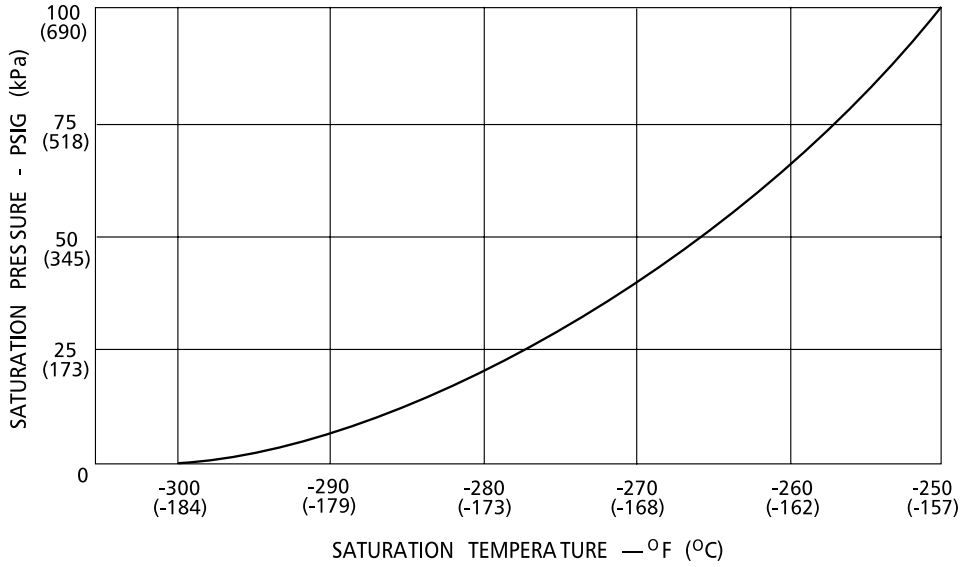


FIGURE 2-11
Liquid Oxygen Saturation Curve

Maintaining liquid oxygen saturation at approximately 22 psig (152 kPa) is important. When a portable oxygen unit is filled from the *Companion* Stationary unit, the liquid oxygen that is transferred into the portable must be saturated at approximately 22 psig (152 kPa) to insure proper oxygen flow delivery to the user. Also, as liquid oxygen is withdrawn from the *Companion* Stationary unit, a slight pressure drop occurs. This drop in pressure allows a small amount of saturated liquid oxygen in the container to readily vaporize and replenish the lost pressure.

COMPANION STATIONARY OPERATION

Filling

The following information provides a brief description of the *Companion* Stationary unit system operation.

The *Companion* Stationary unit is filled from a liquid oxygen source saturated at 40-50 psig (276-345 kPa). To begin the fill sequence, (Figure 2-12), the liquid oxygen transfer line assembly must first be engaged to the Puritan Bennett fill connector or the side-fill connector (if applicable). The *Companion* Stationary vent valve is opened to permit gas within the container to escape to atmosphere. This creates the pressure drop necessary for the liquid oxygen to flow from the source vessel into the *Companion* Stationary unit. At first, the liquid oxygen that leaves the source vessel vaporizes into gas in the transfer line and is vented to atmosphere through the *Companion* Stationary vent valve. This "flash off" is due to the relatively warm temperature of the transfer line and Stationary container and to the supersaturated condition created by the pressure drop. The vaporization process cools the transfer line and Stationary inner container within a short time to a temperature that enables liquid oxygen to be retained in the container. An orifice in the vent extension restricts gas flow through the vent valve to help maintain desired liquid oxygen saturation.

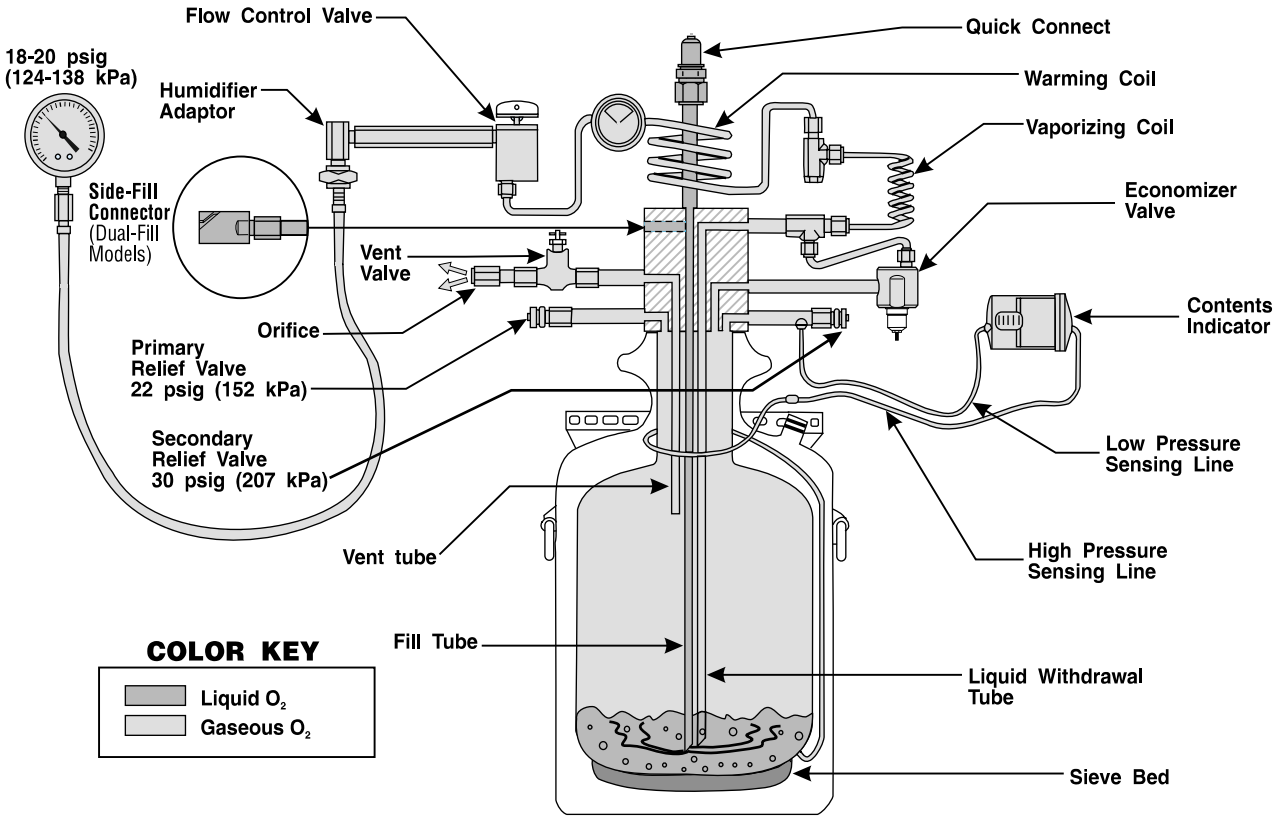


FIGURE 2-12
Filling

Fill Termination

When the liquid oxygen level in the *Companion* Stationary inner container reaches the end of the vent tube (Figure 2-13), liquid oxygen travels up the vent tube, through the vent circuit and is expelled out through the open vent valve. When this occurs, the filling operation is terminated by closing the vent valve and disengaging the transfer line from the Stationary unit.

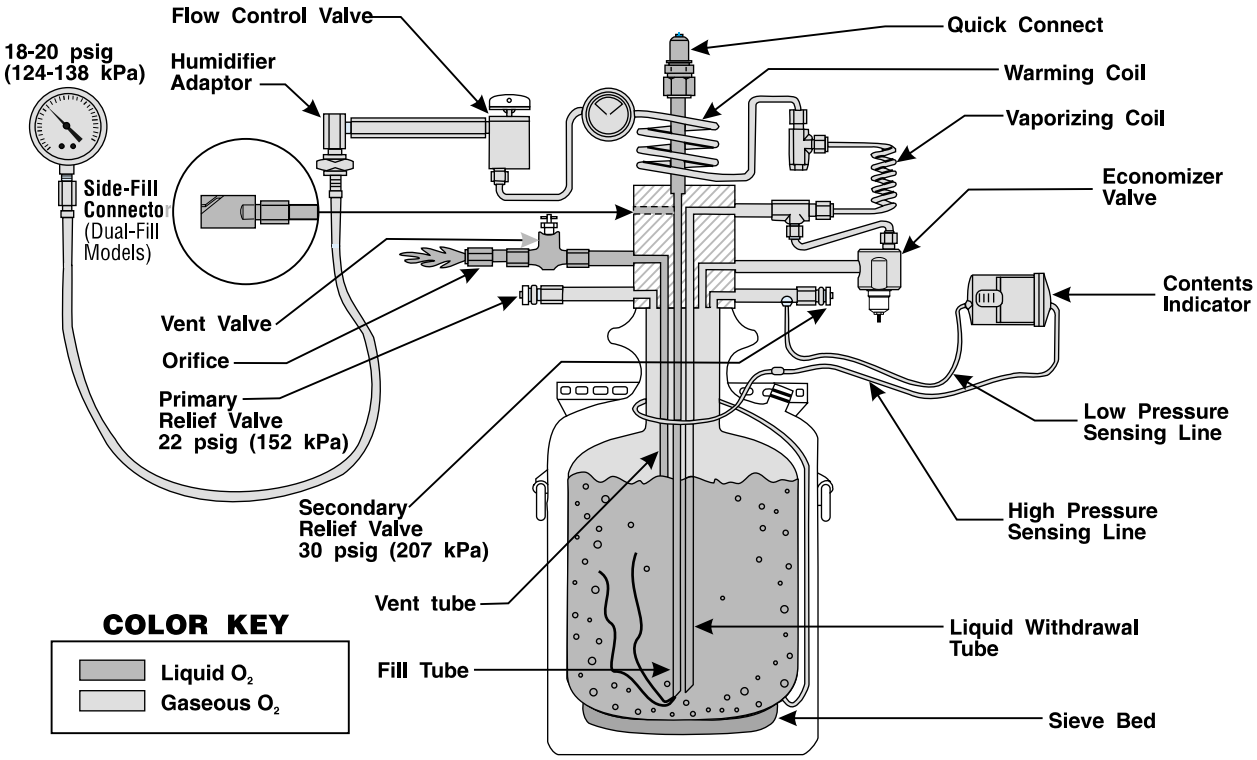


FIGURE 2-13
Fill Termination

Standby

When the *Companion* Stationary unit contains liquid oxygen, the saturation pressure in the inner container stabilizes at the primary relief valve set point, approximately 22 psig (152 kPa) (Figure 2-14). The liquid oxygen maintains saturation at this pressure due to the normal evaporation rate (NER) of the system. The NER is a function of the rate at which heat from the surrounding atmosphere "leaks" into and warms the liquid oxygen in the inner container. Once the liquid oxygen is at the corresponding saturation temperature, continued heat transfer vaporizes some of the liquid oxygen into gas. Continuous creation of gaseous oxygen builds pressure in the headspace above the liquid oxygen until the primary relief valve opens. Once open, the primary relief valve continuously vents the gaseous oxygen at the rate at which it is created to maintain the system pressure. The vented gas represents the system's NER loss.

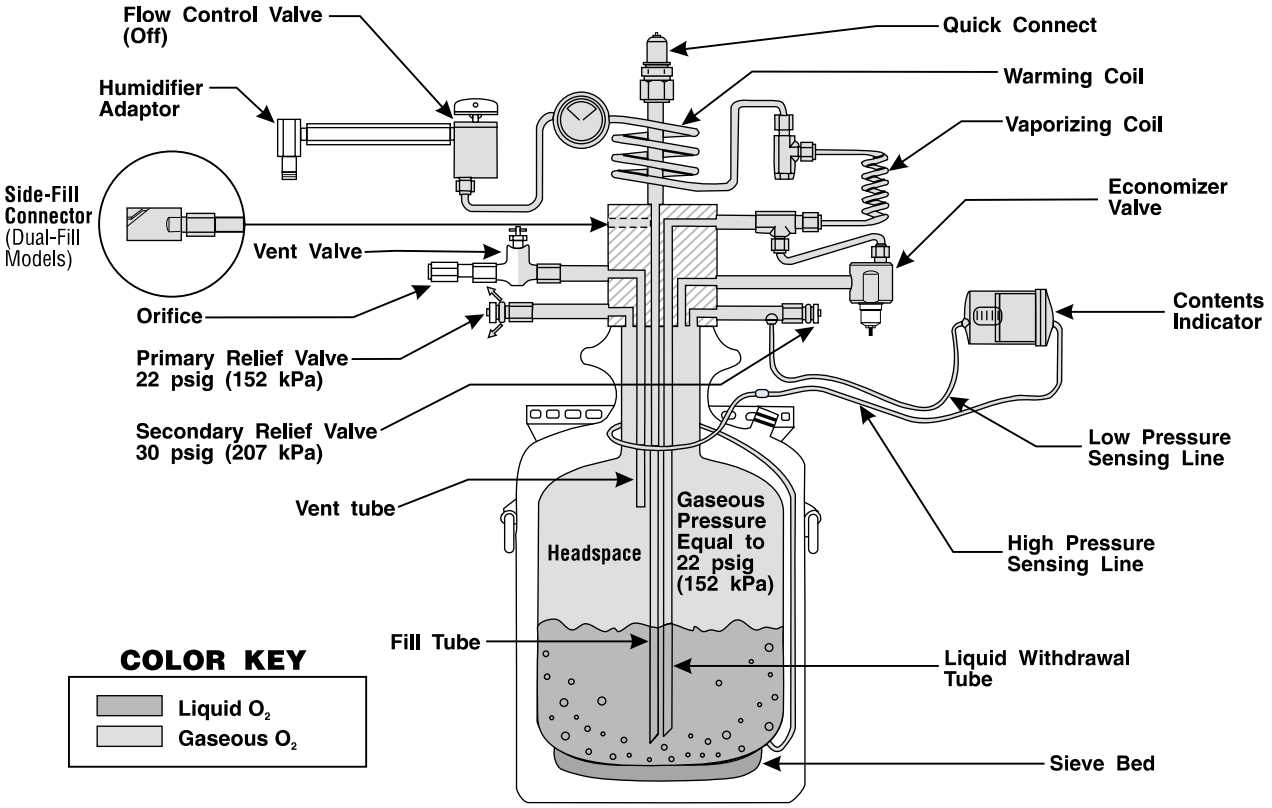


FIGURE 2-14
Standby

Oxygen Flow (Open Economizer)

When the pressure inside the *Companion* Stationary is greater than 19.5 psig (134 kPa), the economizer valve is open (Figure 2-15). When the flow control valve is set to a position other than "0", a pressure differential is created between the outlet port of the flow control valve and the inner container. This is the driving force that pushes the gaseous oxygen from the headspace through the open economizer valve and into the vaporizing and warming coils. Once at the inlet of the flow control valve, the gaseous oxygen is delivered at a metered rate by a selected orifice. When this flow is greater than the NER of the system, the pressure in the headspace begins to decrease. The pressure in the headspace will eventually reach a point where the opening and closing forces acting on the economizer valve come to an equilibrium. The economizer port remains open just enough to allow a small flow of headspace gas created by the unit's NER to pass through. A constant system pressure of 19.5 psig (134 kPa) is maintained even though gas created by the NER is constantly being added to the headspace.

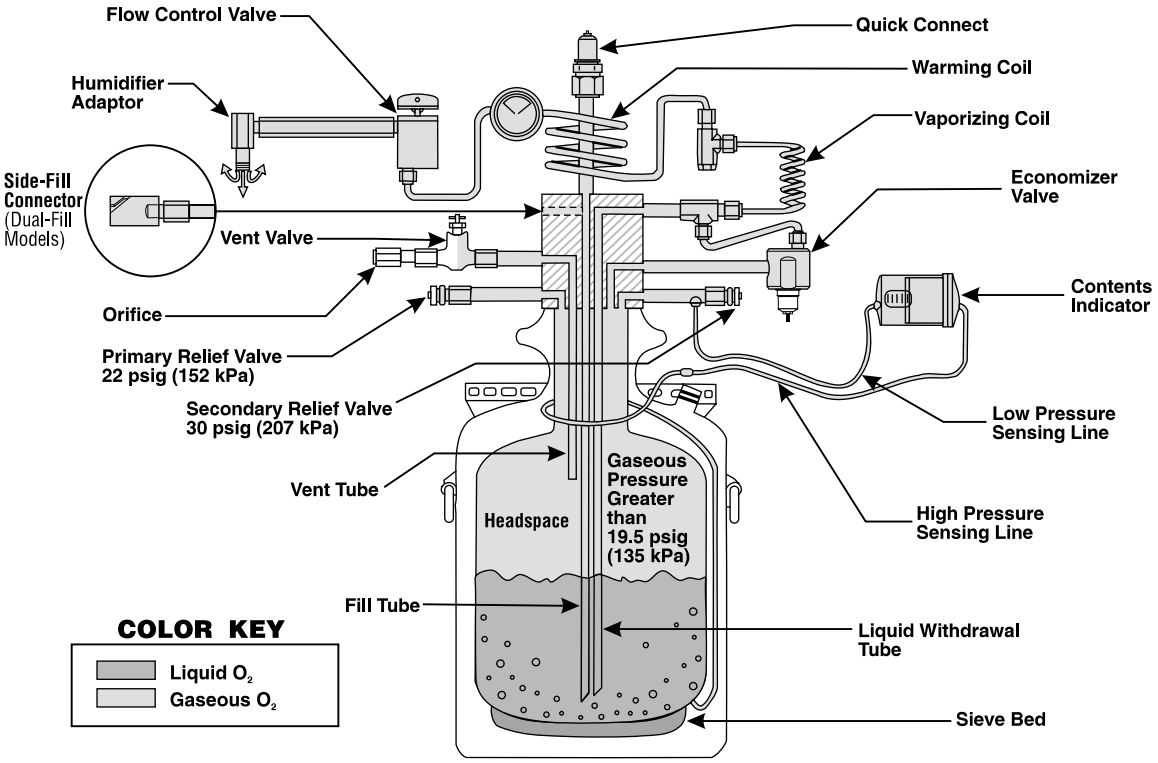


FIGURE 2-15
Oxygen Flow - Economizer Circuit

Oxygen Flow (Partially Closed Economizer / Liquid Withdrawal)

When the pressure inside the *Companion* Stationary is at the economizer valve setpoint of 19.5 psig (134 kPa), the economizer valve is not completely closed (Figure 2-16). The valve remains open just enough to allow the small flow of gas created by the unit's NER to pass through. Under normal operating conditions, this NER flow is approximately .5 lpm. This action prevents the system pressure from building greater than 19.5 psig (134 kPa). If the flow demand established by the setting of the flow control valve is greater than .5 lpm, more flow is needed than can be supplied through the partially open economizer valve. This creates a slight pressure drop in the liquid withdrawal circuit. System pressure forces liquid oxygen up the liquid withdrawal tube into the vaporizing coil. There it is vaporized into gaseous oxygen to complement the small NER flow from the economizer. The combined flow passes through the warming coil and exits the flow control valve at the desired rate.

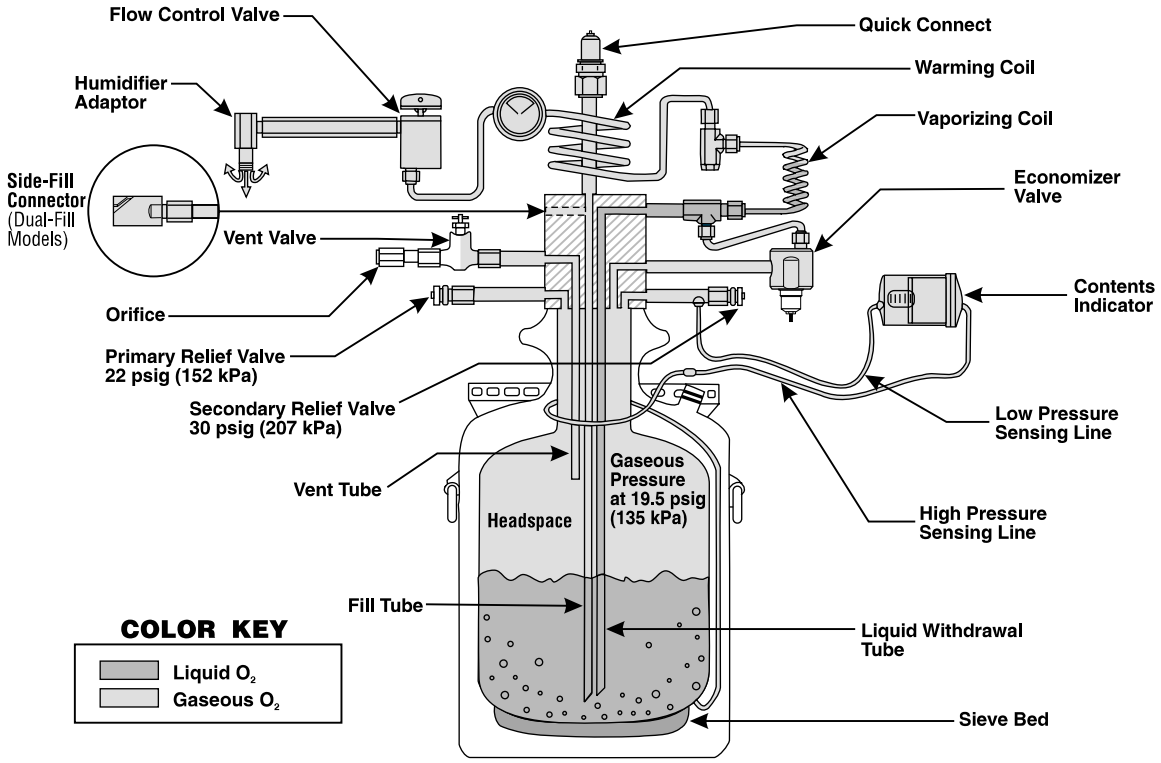


FIGURE 2-16
Oxygen Flow - Liquid Withdrawal Circuit

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PERFORMANCE VERIFICATION TESTING 3

This section provides testing information required for any of the following reasons:

- To determine the cause of operational failure.
- To check the unit's overall system operation after the repair or replacement of a component.
- To verify that the unit is operating within specifications.

Perform verification after any service work is completed.

NOTE:
In order to perform the following tests, remove the cover assembly per Cover Body removal steps 1 and 2, page 5-6.

EQUIPMENT REQUIRED

The following equipment is required to complete the performance verification tests in this section:

1) Medium flat blade screwdriver
2) Vent valve key (P/N B-775182-00)
3) Source of liquid oxygen saturated at 40-50 psig (276-345 kPa)
4) Pressurizing fixture (P/N B-701067-00)
5) Adjustable 0-50 psig (0-345 kPa) gaseous oxygen source
6) Tubing adapter (P/N-B-776945-00)
7) 3/16 in. Vinyl Tubing (P/N-B-778214-00)
8) Calibrated flowmeter/s for the appropriate ranges
9) Calibrated 0-200 lb. (0-91 kg) weight scale
10) Liquid leak detector - SNOOP® (P/N B-775272-00)

NOTE:
It is important that the test equipment used for testing the *Companion* Stationary units be on a calibration schedule. Follow Calibration of Test Equipment on page 1-20 to ensure accurate test results.

NOTE:
Do not use pressure gauges or the flowmeter(s) if they have been dropped or mishandled. They must be calibrated before placing them back into service.

LEAK TESTS

Liquid oxygen leakage from the *Companion* Stationary unit in any amount is unacceptable and calls for the immediate removal from service of any such leaking unit. Minor gas leaks in connections and fittings will not affect system operation provided that they do not exceed the normal evaporation rate (NER) of the unit. Two leak test procedures are listed below. Perform the liquid leak test portion first to determine if there are any substantial leaks. If after performing the first procedure you feel there is an unacceptable amount of leakage, perform the pressure hold section of the procedure to certify the leak.

Liquid Leak Detector Test

PROCEDURE

The liquid leak detector test may be performed on Stationary units that contain liquid and/or gaseous oxygen.

WARNING

Extreme cold hazard. Rapid discharge of liquid oxygen and/or system malfunction can occur. Use only SNOOP® liquid leak detector on the Stationary unit fill connector and blow dry completely with gaseous oxygen or nitrogen.

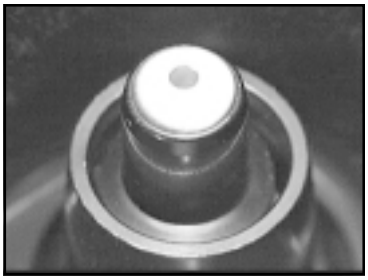
NOTE:
When using liquid leak detector on the fill connector, or the stem of the vent valve, be sure to blow dry with gaseous oxygen or nitrogen, or wipe dry with a clean lint free cloth.

1. Connect either the pressurizing fixture (Figure 1-13) to the NPB fill connector or the test pressure gauge (Figure 1-12) to the humidifier adapter (Figure 1-10) on the *Companion* Stationary unit. If the unit contains liquid, verify that the unit is pressurized between 18.5-25.0 psig (128-172 kPa). If the pressure is out of range, refer to Section 4, Troubleshooting. If the unit does not contain liquid oxygen, attach an adjustable 0-50 psig (0-345 kpa) source of gaseous oxygen to the DISS (Diameter Index Safety System) oxygen inlet on the fixture (Figure 3-2) and pressurize the unit between 20.5-25.0 psig (141-172 kPa). Leave the pressurizing fixture or test pressure gauge connected to verify that the Stationary is pressurized throughout the test.

2. Use liquid leak detector to test all fittings and connections.

   NOTE:
   A small amount of leaking around the poppet of the fill connector is acceptable. Acceptable leaks appear as a white foam in the liquid leak detector. If the bubbles created by the leak detector are considerably larger than those illustrated by Figure 3-1 after a period of 30 seconds, make necessary repairs to the fill connector according to section 5, Service and Repair.

PB Fill connector before applying liquid leak detector.



PB Fill connector 30 seconds after applying liquid leak detector.

FIGURE 3-1

3. Make repairs to leaking fittings or connections according to the appropriate item in section 5, Service and Repair.

4. If the Stationary unit continues to function improperly, continue with the pressure hold section of the test.

Pressure Hold Test

Conduct the pressure hold test on warm, empty Stationary units only. Performing this test on containers that contain liquid oxygen yields inaccurate results.

1. Empty the liquid oxygen contents from the Stationary unit according to page 5-1, before servicing the unit.

2. Use the vent key to open the vent valve on the Stationary unit.

3. Connect the pressurizing fixture (Figure 1-13) to the NPB fill connector on the Stationary unit. Attach an adjustable 0-50 psig (0-345 kpa) source of gaseous oxygen to the DISS (Diameter Index Safety System) oxygen inlet on the fixture (Figure 3-2).

4. Adjust the regulator until the gauge on the pressurizing fixture reads approximately 15 psig (103 kPa). Allow the system to purge for approximately 15 minutes with the vent valve open.

5. Close the vent valve and pressurize the unit to 22 psig (152 kPa). Remove the test fixture.

6. Let the unit stand for 1 hour. This allows the temperature and pressure inside the container to stabilize.

7. Reconnect the pressurizing fixture (minus the gaseous oxygen source) and record the initial time and pressure. Lightly tap the pressure gauge with your finger to assure that the needle is reading properly. Verify that the pressure is 20.5-25 psig (141-172 kPa) before continuing. If the pressure is not within the tolerance go back to step 3. Remove the pressurizing fixture.

8. After a period of 14-15 hours, reconnect the pressurizing fixture (minus the gaseous oxygen source) and record the final pressure. If the pressure is less than 15 psig, make repairs to suspected leaks from liquid leak test section.

GASEOUS OXYGEN TESTS

Conduct the following tests on an empty unit that has warmed to room temperature.

Primary Relief Valve Test

The primary relief valve maintains system pressure at a preset value when the *Companion* Stationary unit contains liquid oxygen. This test uses only gaseous oxygen to determine if the primary relief valve opens within its acceptable range. Perform a primary relief valve **functional** test when the Stationary unit contains liquid oxygen.

Refer to Figure 6-2 for identification of parts with **bold number** references.

PROCEDURE

1. Connect the pressurizing fixture (Figure 1-13) to the PB fill connector **52** on the *Companion* Stationary unit. Attach an adjustable 0-50 psig (0-345 kPa) source of gaseous oxygen to the DISS (Diameter Index Safety System) oxygen inlet on the fixture (Figure 3-2).

2. Slowly pressurize the unit with gaseous oxygen by adjusting the oxygen regulator.

3. Verify that the primary relief valve **60** opens (audible hiss) at 20.5 to 25.0 psig (141-172 kPa). If the primary does not open within this range, replace as specified in section 5, Service and Repair.

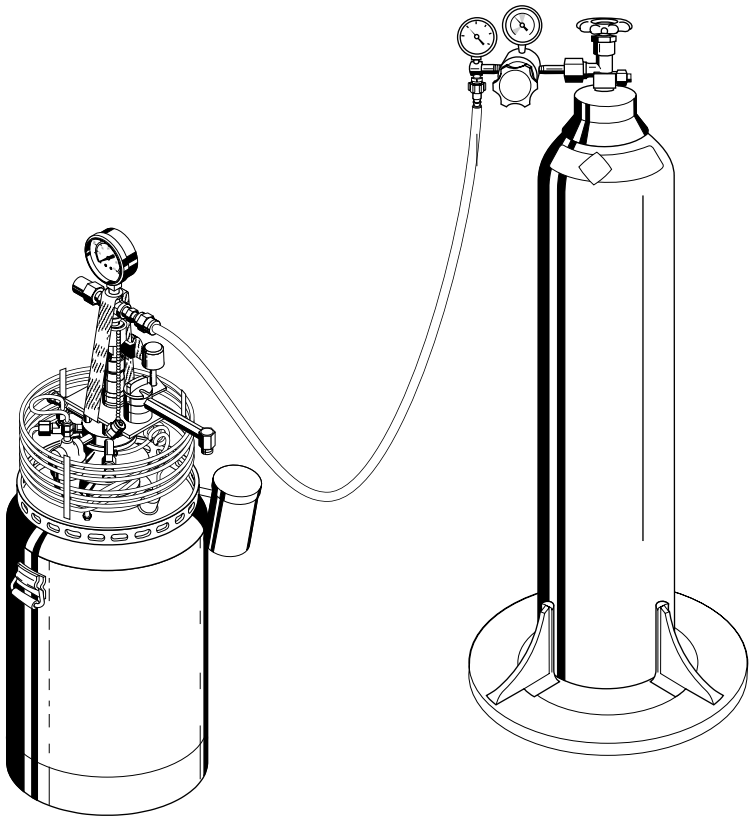


FIGURE 3-2
Pressurizing the *Companion* Stationary

Secondary Relief Valve Test

The secondary relief valve serves as a safety or backup to the primary relief valve. Under normal operating conditions the secondary relief valve remains closed. The relief valve opens if system pressure reaches 25-37 psig (172-255 kPa). This test uses gaseous oxygen to determine if the secondary opens within its acceptable range.

Refer to Figure 6-2 for identification of parts with **bold number** references.

PROCEDURE

1. Connect the pressurizing fixture (Figure 1-13) to the NPB fill connector **52** on the *Companion* Stationary unit. Attach an adjustable 0-50 psig (0-345 kpa) source of gaseous oxygen to the DISS (Diameter Index Safety System) oxygen inlet on the fixture (Figure 3-2).

2. Hold your finger over the end of the primary relief valve to prevent gas from escaping.

3. Slowly pressurize the Stationary unit while continuing to hold your finger over the end of the primary relief valve. Verify the secondary relief valve **62** opens (audible hiss) between 25 and 37 psig (172-255 kPa). If the secondary relief valve does not open within this range the first time, repeat a second time. If it fails to open within the acceptable range the second time, replace as specified in section 5, Service and Repair.

CAUTION

Damage to the primary relief valve can occur. Do not release primary relief valve until internal pressure is below 20.5 psig (141 kPa). Open vent valve to reduce internal pressure.

Pressure Indicator Test

The *Companion* Stationary pressure indicator is a bourdon tube pressure gauge that indicates the status of the system pressure.

Refer to Figures 6-1 and 6-2 for identification of parts with **bold number** references.

PROCEDURE

1. Connect the pressurizing fixture (Figure 1-13) to the PB fill connector **52** on the *Companion* Stationary unit. Attach an adjustable 0-50 psig (0-345 kpa) source of gaseous oxygen to the DISS (Diameter Index Safety System) oxygen inlet on the fixture (Figure 3-2).

2. Slowly pressurize the unit until the needle of the pressure indicator **74** or **80** lines up with the lower edge of the dark blue shaded area. (It may be necessary to tap on top of the gauge with your finger to assure that the gauge is reading properly.)

3. Verify that the reading on the pressurizing fixture is 13-17 psig (90-117 kPa). If the reading is not within the indicated range, replace as specified in section 5, Service and Repair.

Vent Valve Test

The vent valve, when open, creates a vent path to atmosphere for the *Companion* Stationary unit. This is required for filling to begin. The vent valve must be leak free when closed and allow unrestricted gas flow when fully open.

Refer to Figure 6-2 for identification of parts with **bold number** references.

PROCEDURE

1. Connect the pressurizing fixture (Figure 1-13) to the NPB fill connector **52** on the *Companion* Stationary unit. Attach an adjustable 0-50 psig (0-345 kpa) source of gaseous oxygen to the DISS (Diameter Index Safety System) oxygen inlet on the fixture (Figure 3-2).

2. Pressurize the *Companion* Stationary unit to primary relief valve **60** pressure, 20.5-25.0 psig (141-172 kPa), with gaseous oxygen.

3. Use liquid leak detector (SNOOP®) to check for leaks around the vent valve **55** stem and packing nut. If bubbling occurs, refer to Vent Valve Service in section 5-10, Service and Repair.

4. Wet a finger with liquid leak detector and lightly place it against the open end of the vent extension **56**. If bubbling occurs, and the vent valve is fully closed (full clockwise), replace the valve as specified in section 5, Service and Repair.

5. Fully open the vent valve (full counterclockwise) and verify a rapid exhaust of gaseous oxygen from the valve outlet. If no exhausting occurs, repair or replace as specified in section 5, Service and Repair.

LIQUID OXYGEN TESTS

Conduct the following tests on units that contain liquid oxygen.

Contents Indicator Test

The contents indicator is a differential pressure device that provides an approximation of the level of liquid oxygen in the *Companion* Stationary inner container.

Refer to Figure 6-1 for identification of parts with **bold number** references.

PROCEDURE

1. Fill the empty *Companion* Stationary unit with 20 to 25 lbs. (9 to 11 kg) of liquid oxygen.

2. Verify that within five minutes, the center of the colored line on the contents indicator **68** piston is within the proper range indicated by the shaded bar in Figure 3-3. If it is out of the indicated range, refer to section 4, Troubleshooting.

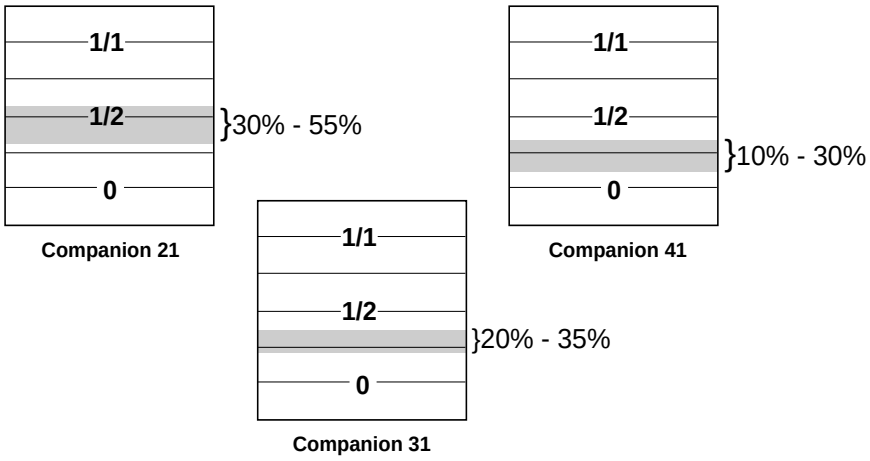


FIGURE 3-3
Contents Indicator Test

Primary Relief Valve Functional Test

The primary relief valve maintains system pressure at a preset value when the *Companion* Stationary unit contains liquid oxygen. This test determines the operating pressure of the primary relief valve.

Refer to Figure 6-2 for identification of parts with **bold number** references.

PROCEDURE

1. Fill the *Companion* Stationary unit with 20 to 25 lbs. (9 to 11 kg) of liquid oxygen. Verify that the liquid is saturated between 20.5 and 25.0 psig (141-172 kPa) by referring to the Determining Saturation Pressure section on page 1-18. Allow approximately one hour for the system pressure to stabilize.

2. Connect the pressurizing fixture (Figure 1-13) to the PB fill connector **52**. The primary relief valve **60** should be open (audible hiss) when the pressurizing fixture gauge reads 20.5 to 25.0 psig (141 to 172 kPa).

NOTE:
If the pressure gauge reading is less than 20.5 psig (141 kPa) and the relief valve is closed, check the unit for leaks. If the pressure reading is less than 20.5 psig (141 kPa) and the relief valve is open, replace the relief valve. If the pressure reading is above 25.0 psig (172 kPa) and the relief valve is closed, replace the relief valve. If the pressure reading is above 25.0 psig (172 kPa) and the relief valve is open, conduct the NER test.

Normal Evaporation Rate (NER) Test

The NER test measures the insulation efficiency of the *Companion* Stationary liquid oxygen container. The test results express, in pounds (kilograms), the amount of liquid oxygen lost (converted into gaseous oxygen and vented through the relief valve) in a 24 hour period. Perform this test when one or more of the following symptoms exist:

a) Rapid loss of liquid oxygen contents from the container.
b) Heavy condensation or frosting on the container.
c) Excessive venting of gaseous oxygen through the relief valve.

NOTE:
Some venting of gaseous oxygen through the relief valve is normal.

PROCEDURE

1. Perform a leakage test (page 3-1) on the *Companion* Stationary unit and verify that the results are acceptable.

2. Fill the *Companion* Stationary unit with 20 to 25 lbs (9 to 11 kg) of liquid oxygen saturated at 22 psig (152 kPa). Allow a 5-24 hour stabilization period before continuing.

   NOTE:
   The stabilization period is critical to the NER test. Failure to allow for the "cool down" period will yield inaccurate test results.

3. After the stabilization period, record the initial weight, pressure and time.

   NOTE:
   The primary relief valve must be venting within the acceptable range of 20.5 to 25.0 psig (141 to 172 kPa) before continuing with the NER test.

4. After an additional time of 24 hours, record the final weight, pressure and time.

5. Calculate the Normal Evaporation Rate using the following formula:

$$\text{NER (lbs/day)} = \frac{\text{Initial weight - Final weight (lbs)}}{\text{Elapsed time (hours)}} \times \frac{\text{24 hours}}{\text{1 Day}}$$

NOTE:
Verify that the NER is less than or equal to 2.1 lbs/day for the *Companion* 21 or less than or equal to 2.2 lbs/day for the *Companion* 31 and 41. If the NER is marginally out of specification, continue the NER test for an additional 24 hours.

Economizer Valve Test

The economizer valve on the *Companion* Stationary unit is a pressure regulating valve that allows a patient to breathe the NER (Normal Evaporation Rate) gas that would normally be vented to atmosphere. This test determines the operating pressure of the valve.

Refer to Figures 6-1 and 6-2 for identification of parts with **bold number** references.

PROCEDURE

1. Fill the *Companion* Stationary unit with 20 to 25 lbs. (9 to 11 kg) of liquid oxygen. Verify that the liquid is saturated between 20.5 and 25.0 psig (141-172 kPa) by referring to the Determining Saturation Pressure section on page 1-18. Allow approximately one hour for the system pressure to stabilize.

2. Connect the pressurizing fixture (Figure 1-13) to the PB fill connector **52** on the *Companion* Stationary unit.

3. Turn the flow control valve **23** to 4 lpm and record the time.

4. With the unit running, record the pressure readings on the pressurizing fixture every 30-60 minutes. A stabilization is reached when two consecutive readings are taken that are within .2 psig (1 kPa) of one another. The acceptable operating range for the economizer valve is 18.5 - 20.5 psig (128-141 kPa). If the economizer valve is out of the operating range refer to page 5-13 of Service and Repair.

Flow Control Valve Test

The Flow control valve on the *Companion* Stationary unit is an adjustable rotary indexed valve that controls the delivery rate of gaseous oxygen from the Stationary unit to the patient. The flows on the valve are calibrated at an inlet pressure of 19.5 psig (134 kPa). This test determines the acceptable flow ranges for the flow control valve.

Refer to Figure 6-1 for identification of parts with **bold number** references.

PROCEDURE

1. Fill the *Companion* Stationary unit with 20 to 25 lbs. (9 to 11 kg) of liquid oxygen. Verify that the liquid is saturated between 20.5 and 25.0 psig (141-172 kPa) by referring to the Determining Saturation Pressure section on page 1-18. Set the flow control valve to 4 lpm and allow approximately one hour for the system pressure to stabilize.

2. Connect the pressurizing fixture (Figure 1-13) to the PB fill connector **52** on the *Companion* Stationary unit. Verify that the Stationary unit is within the acceptable operating range of 18.5-20.5 psig (128-141 kPa) and remove the fixture. If it is out of this range, refer to Section 5 Service and Repair.

Flow Control Valve Test (Con't.)

3. Attach tubing adapter (P/N-B-776945-00) to the humidifier adapter **22** on the Stationary unit (Figure 3-4). Attach the 3/16 in. vinyl tubing (P/N-B-778269-00) between the tubing adapter and the appropriate specified flowmeter.

4. Check the flow control valve **23** at each appropriate flow setting with the appropriate flowmeter. (See Table 3-1)

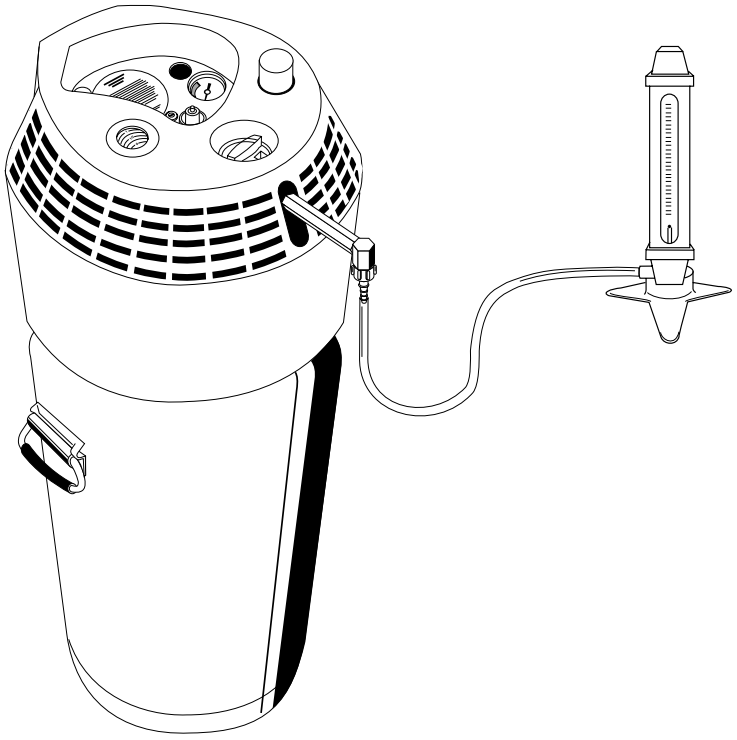


FIGURE 3-4
Attaching Flowmeter to Stationary

Table 3-1

FLOW CONTROL VALVE DATA

Nominal Flow Setting (lpm)	Allowable Range (lpm)
0.12	.02-.22
0.25	.08-.42
0.50	.33-.67
0.75	.58-.92
1.00	.83-1.17
1.50	1.18-1.82
2.00	1.61-2.43
2.50	2.08-2.97
3.00	2.55-3.51
3.50	2.92-4.04
4.00	3.43-4.62
5.00	4.33-5.77
6.00	5.23-6.92
8.00	6.72-9.28
10.00	8.47-11.53

NOTE:
Flow values listed in table 3-1 were produced in ambient conditions of 70° F (21°C) and 29.4 in Hg (747 mm Hg). Any deviation from these conditions will affect the flow results.

NOTE:
Data listed in table 3-1 is based on flowmeters with full scale accuracy of 1% for flow ranges of .10-1.20 lpm, .70-7.08 lpm and 1.0-21.0 lpm. Use of flowmeters with specifications other than those listed above may yield different results.

NOTE:
Data listed in table 3-1 is based on an operating pressure range of 18.5-20.5 psig. If your flow measurements are out of specification, check the pressure in the unit. A combination of the pressure in the unit being high or low and the tolerance of the particular flowmeter you are using can add up to inaccurate readings.

TROUBLESHOOTING 4

Table 4-1 provides troubleshooting procedures. This guide is not all-inclusive but is intended to serve as a general outline for solving operational problems. The table describes symptoms, identifies probable causes and suggests corrective actions.

When more than one probable cause is identified, the causes are listed in order of most likely to least likely reasons for failure.

Table 4-1

SYMPTOM	PROBABLE CAUSE	ACTION
Excessive venting from the primary relief valve after fill termination.	Source vessel pressure is too high resulting in excessive pressure in Stationary unit.	Open *Companion* vent valve to bleed off excessive pressure and allow relief valve to close. Reduce saturation pressure in source vessel to 40-50 psig by opening source vessel vent valve. Repair source vessel when empty.
	Primary relief valve setting is too low.	Conduct Primary Relief Valve test, page 3-7, and replace if necessary.
	Vacuum failure.	Conduct NER test, page 3-8, and contact Nellcor Puritan Bennett if test fails.
Liquid oxygen leaks from fill connector.	Ice is present on poppet or poppet seat.	Blow dry all mating parts with dry nitrogen or oxygen gas before recoupling.
	Poppet valve/cartridge assembly is damaged.	Examine poppet. Replace if damaged according to the appropriate item in section 5, Service and Repair.
Unable to disconnect transfer line or portable from Stationary unit after fill.	Fill connectors frozen together due to the presence of moisture.	Close liquid valve on source vessel and allow unit to sit until connector is warm enough to disconnect.
High product loss rate.	Container vacuum has deteriorated.	Conduct NER test, page 3-8, and contact Nellcor Puritan Bennett if test fails.
	Gas leak in tubing, connections and/or joints.	Follow Leak Test procedure, page 3-1, on all related tubing and connections. Repair as required.

SYMPTOM	PROBABLE CAUSE	ACTION
High Stationary unit pressure.	Primary relief valve setting is too high.	Conduct Primary Relief Valve test, page 3-7, and replace if necessary.
	Vacuum failure.	Conduct NER test, page 3-8, and contact Puritan Bennett if NER test fails.
	Damaged pressure indicator.	Conduct Pressure Indicator test, page 3-5, and replace if test fails.
Low Stationary unit pressure.	Vent valve is not completely closed or is leaking.	Close vent valve. Leak test the outlet and stem. Replace or repair per section 5, Service and Repair.
	Liquid oxygen in source vessel is not properly saturated.	Follow Resaturating Liquid Oxygen procedure, page 1-19.
	Primary relief valve setting is too low.	Conduct Primary Relief Valve test, page 3-7, and replace if necessary.
	Gas leak in tubing, connections and/or joints.	Follow Leak Test procedure, page 3-1, on all related tubing and connections. Repair as required.
	Cracked manifold or leak at joint between manifold and container.	Examine manifold carefully and leak test connection. Repair as required.
	Damaged pressure indicator.	Conduct Pressure Indicator test, page 3-5, and replace if necessary.
Excessively long fill time.	Vent valve is not fully open.	Rotate vent key counterclockwise until it stops.
	Liquid oxygen in source vessel is not properly saturated.	Allow source vessel to sit until liquid oxygen is saturated.
	Fill connector is not opening properly.	Check for damage to valve or cartridge assembly; Make sure fill connectors are engaged properly.
	Transfer line filter is restricted.	Clean filter.
Contents indicator reads incorrectly.	Ice blockage in contents indicator high pressure (liquid) sense line.	Follow the High Pressure Sensing Line Purge procedure, page 5-28.
	Leak in sensing lines or fittings.	Follow Leak Test procedure, page 3-1, on all related tubing and connections. Repair as required.
	Ruptured rolling diaphragm.	Replace contents indicator, page 5-21.

SYMPTOM	PROBABLE CAUSE	ACTION
Low flow at all flow control valve settings.	Gas leak.	Locate leak and repair as needed.
	Unsaturated liquid.	Allow liquid to saturate to 22 psig (May require up to 48 hours), or perform Resaturating Liquid Oxygen procedure on page 1-19.
	Economizer valve.	Conduct Economizer valve test and replace as needed.
	Flow control valve inlet filter dirty.	Remove and replace flow control valve inlet filter.
	Obstruction or leak in liquid withdrawal circuit.	Check liquid withdrawal heat exchanger tubing for blockage.
No Flow.	System is empty.	Fill unit with liquid oxygen saturated @ 22 psig (152 kPa).
	Zero head pressure caused by major gas leak (Vent valve open, relief valve malfunction, etc.).	Locate leak and repair as needed.
	Flow control valve turned off.	Set flow control valve at prescribed rate.
	Flow control valve inlet filter obstructed.	Replace flow control valve inlet filter.
	Obstruction in liquid withdrawal circuit.	Check liquid withdrawal heat exchanger tubing for blockage.

Read section 1, and any other applicable section, thoroughly before attempting to service or fill the *Companion* Stationary liquid oxygen system.

This section provides procedures for servicing the individual components of the *Companion* Stationary unit. Included are instructions, where applicable, for removal, disassembly, operational check, cleaning, inspection, adjustment, reassembly, and installation.

WARNING

Personal injury can occur. Empty liquid contents and vent system pressure before servicing.

After removing a component, visually inspect for damage or any other indication that the part should be replaced. Unless otherwise specified, replace as needed with a new part. Refer to the exploded view illustrations and the *Companion* Stationary parts list in Section 6.

NOTE:
After making repairs, always verify proper system operation by performing the functional tests in Section 3.

EMPTYING A STATIONARY

The *Companion* Stationary is emptied by attaching an extra fill adapter to the source adapter of the transfer line assembly (Figure 5-1). With the extra fill adapter attached, it is possible to transfer liquid oxygen from one *Companion* Stationary to another *Companion* Stationary. Connect one fill adapter to the Stationary to be emptied, and connect the second fill adapter to an empty receiving Stationary. Some pressure must exist in the unit to be emptied to start the transfer process. Open the vent valve on the receiving unit to begin the transfer process. When the unit to be repaired is empty, detach the transfer line assembly and open the empty unit vent valve to prevent pressure from building up. There will be some liquid oxygen remaining in the inner container since the liquid withdraw tube does not go all the way to the bottom.

WARNING

Explosive hazard. Extreme high pressure can rupture transfer line. Be sure proper pressure relief valve is present and functioning properly.

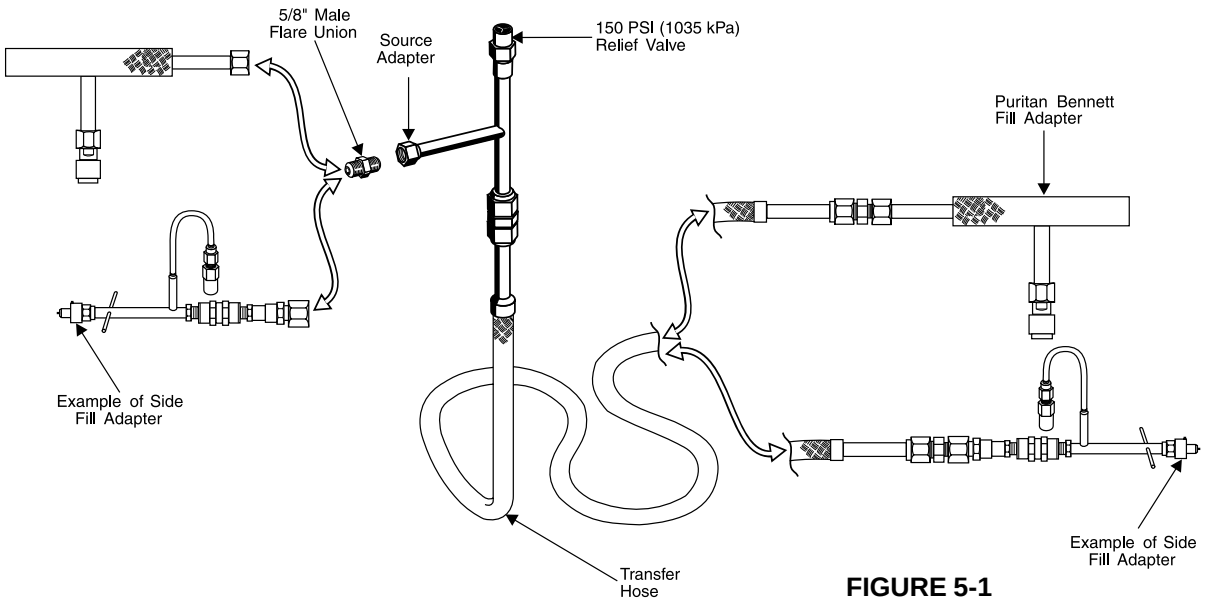


FIGURE 5-1
Transfer Line Configuration for Emptying a Companion Stationary

PRESSURE FITTINGS AND CONNECTIONS

The *Companion* Stationary uses compression fittings, tapered pipe thread (NPT) fittings and flexible tube barbed fittings. Proper make up of these pressure fittings is essential to leak-free operation of the unit.

Compression Fitting Make Up

The compression fittings on the *Companion* Stationary consist of a fitting body, tube, ferrule, and nut, Figure 5-2, A. These fittings typically connect the aluminum tubing to other components in the system. Sealing occurs at two points in a properly made up compression fitting. It occurs between the ferrule and the fitting body and between the ferrule and the tube.

Perform the following steps to make up a **new** compression fitting:

1. INSPECT THE TUBE END.
   The tube end should be cut square and the outside surface of the tube should be free of scratches or other marks at least one inch (25 mm) back from the tube end. Use Scotchbrite® or fine emery paper to remove light surface marks from the tube end.

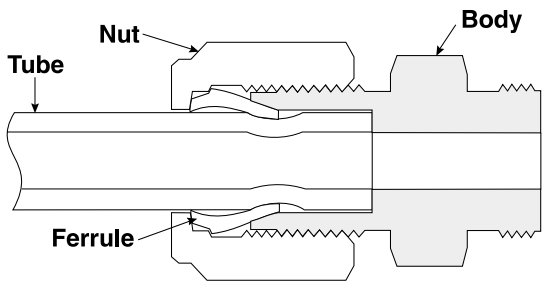


FIGURE 5-2 (A)
Compression Fitting

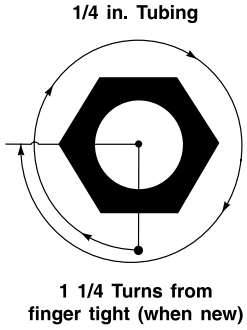


FIGURE 5-2 (B)
Compression Fitting Make-Up

2. INSTALL THE NUT AND FERRULE ON THE TUBE.

3. INSERT THE TUBE AND MAKE SURE THAT IT IS ALIGNED SQUARELY IN THE FITTING BODY.

4. MAKE SURE THE TUBE END IS BOTTOMED AGAINST THE TUBE STOP IN THE FITTING BODY.
   This is necessary to prevent movement of the tube while the nut forces the ferrule to grip the tube and create a seal.

5. NEVER PERMIT THE FITTING BODY TO ROTATE DURING MAKE UP. USE TWO WRENCHES.
   Always hold the fitting body with a wrench while tightening the tube nut.

6. ALWAYS TURN THE TUBE NUT THE PRESCRIBED AMOUNT, Figure 5-2, B.
   With the tube against the tube stop in the fitting body, tighten the tube nut finger tight. For 1/4 in. diameter tubing, tighten the nut an additional 1-1/4 turns from finger tight with a wrench.

Compression Fitting Remake

When disassembly of a compression fitting is required, mark the tube nut and the fitting body before disassembly. To remake the connection, tighten the tube nut until the marks line up again. A slight torque increase indicates the ferrule re-springing into sealing position. After several remakes it may become necessary to advance the tube nut slightly past the original position. This advance need only be 15° - 20° (1/4 to 1/3 of a hex flat). In situations where the existing tube with seated ferrule is used with a replacement fitting body, tighten the tube nut until a slight torque increase is felt indicating the ferrule re-springing into sealing position. Advance the nut an additional 15° - 20°.

Compression Fitting Troubleshooting

Most leaks in compression fittings are the result of improper make up procedures. Typically the tube is either not aligned squarely in the fitting body before make up or the tube is not held in against the stop during make up. Also overtightening can result in a cracked fitting body that will cause a leak.

To check for leaks, pressurize the system and use an oxygen compatible liquid leak detector, such as SNOOP®, on the fittings. If bubbles form at the back of the nut between the nut and the tube, you probably did not get a seal between the ferrule and the tube. Misalignment may be the cause. However, check the tube itself. There can be a scratch or seam running along the tube, allowing a leak to occur.

If the leak detector forms bubbles at the front of the nut, between it and the fitting body, then the leak is probably between the ferrule and the fitting's tapered seat. Check this area for imbedded dirt or cracks.

Tapered Pipe Thread (NPT) Make Up

Some components used on the *Companion* Stationary have tapered pipe threads (NPT) (Figure 5-3). NPT threads create leak tight connections provided that a thread sealant (Teflon® tape) is used on the threads.

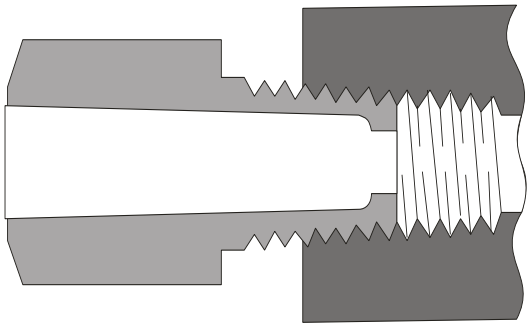


FIGURE 5-3
NPT Fittings (National Pipe Taper)

Perform the following steps when making up a new NPT fitting:

1. REMOVE OLD THREAD SEALANT.
   Use a wire brush to remove sealant or dirt from male and female threads of NPT fittings. Make sure contaminants do not drop into the fittings during the cleaning process.

2. APPLY THREAD SEALANT TO THE MALE THREADS.
   Apply two to three layers of Teflon® tape to the male threads starting **two threads back from the end** (Figure 5-4). Wrap the Teflon® tape in a clockwise direction (as viewed from thread end of fitting) to prevent unraveling when the fitting is installed.

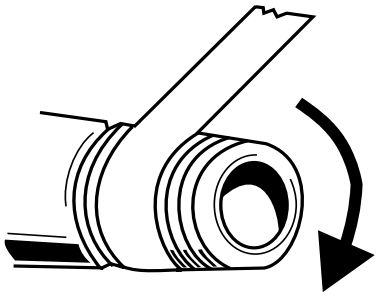


FIGURE 5-4
Applying Teflon® Tape

NOTE:
Some NPT connections require that one of the fittings be aligned in a certain orientation. Do not back out the fitting if you are unable to achieve the proper orientation as you tighten the fitting. This will typically result in a leak. Disassemble and remake the fittings.

3. ASSEMBLE THE FITTINGS AND TIGHTEN UNTIL SNUG.
   Since NPT fittings utilize tapered threads, torque requirements increase as the fittings are tightened. Tighten NPT fittings until a good seal is achieved (usually a minimum of three turns). **Do not overtighten NPT fittings.** Overtightening may result in cracked fittings, or improper component operation.

Tapered Pipe Thread (NPT) Troubleshooting

Leaks at NPT fittings are usually the result of improper application of thread sealant or loosening of the fittings.

To check for leaks, pressurize the system and use an oxygen compatible leak detector, such as SNOOP®, on the threads of the fittings. If bubbles appear, disassemble the fittings and remake per the steps in "Tapered Pipe Thread (NPT) Makeup".

Flexible Tube Barbed Fittings

Flexible tube barbed fittings are used on the *Companion* Stationary to create leak tight pressure connections where flexible tubes connect the contents and pressure indicators. The outside diameter of the barb is slightly larger than the inside diameter of the flexible tubing. This creates an interference fit sufficient to seal the connection. Brass collars secure the tube ends to the barbed fittings.

Tube Installation on Barbed Fitting

Perform the following steps to install a flexible tube on a barbed fitting.

1. INSPECT THE TUBE END.
   The tube end should be cut square and should be free of cuts or tears. If there is an impression of the barb in the tube, cut the end of the tube off (if the tube length is sufficient) or replace the tube.

2. INSTALL A BRASS COLLAR ON THE TUBE SO THAT THE LARGE END IS TOWARD THE BARBED FITTING.

3. PUSH THE TUBE SQUARELY ONTO THE BARB AS FAR AS POSSIBLE.

4. PUSH THE BRASS COLLAR ONTO THE TUBE END CONNECTED TO THE BARBED FITTING.

Tube Removal from Barbed Fitting

Perform the following steps to remove the flexible tube from a barbed fitting:

1. USE A SMALL FLAT BLADE SCREWDRIVER TO CAREFULLY BACK THE BRASS COLLAR OFF OF THE BARBED FITTING.
2. WORK THE SCREWDRIVER BETWEEN THE END OF THE TUBE AND THE FITTING BODY.
3. SIMULTANEOUSLY PULL ON THE TUBE AND PRY THE END OF THE TUBE BACK OFF OF THE BARB. USE CARE NOT TO DAMAGE THE PLASTIC BARBED FITTINGS ON THE CONTENTS INDICATOR.

COVER BODY

The *Companion* Stationary cover body is a molded polycarbonate component. It serves to protect the plumbing on the top of the unit and also to provide a means for mounting the top cover.

Refer to figure 6-1 for identification of parts with **bold number** references.

Removal

1. Unscrew the cover screw **1** in the top center of the top cover **8**.
2. **Dual-fill Units Only.** Use a 9/16 in. open end wrench to remove the humidifier adapter **22**.
3. Carefully remove the cover assembly **7**.
4. To remove the cover body **9** from the top cover, unscrew the five small screws **10** on the underneath side of the top cover.

Service

Service to the cover body consists of replacing the oxidizer contents label **12.**

Installation

Install the cover body by reversing the removal procedure.

NOTE:
Be sure to align the cover assembly so that the holes in the top cover are positioned over the proper items on top of the unit. Also be sure that the standoffs molded into the cover body are in the notches of the mounting ring.

TOP COVER

The top cover is a molded polycarbonate component that is mounted in the cover body by five small screws.

Refer to figure 6-1 for identification of parts with **bold number** references.

Removal

Remove the top cover per COVER BODY removal procedure.

Service

Service to the top cover consists of replacing the warning label **11** and the liquid contents window label **13**.

Installation

Install the top cover by reversing the removal procedure.

PURITAN BENNETT FILL CONNECTOR

The Puritan Bennett fill connector on the *Companion* Stationary is the male half of a fluid coupling system. When engaged with a female connector, the connector provides a means of transferring liquid oxygen to and from the Stationary unit. The male connector consists of an anodized aluminum body, poppet cartridge assembly, and retainer ring. The connector can either be replaced as a means of repair or it can be serviced by replacing the cartridge assembly when applicable.

Refer to Figures 6-1, 6-3, and 6-4 for identification of parts with **bold number** references.

CAUTION

Use care to prevent contaminants from entering container when removing fill connector. Do not nick or scratch sealing surfaces of fill connector.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.
2. Remove the two screws **34** which retain the fill connector release lever assembly **36.** Lift the fill connector release lever assembly and the fill connector release lever actuator **44** over the fill connector **52**. (Be sure not to lose the return spring **45**.)
3. Hold the body of the fill connector stationary with an 8 in. adjustable wrench. Use a 10 in. adjustable wrench to loosen the nut on the fill connector. Remove the fill connector.

Disassembly

1. Use a small screwdriver or an awl to remove the spiral retainer ring **54** by first carefully lifting the beveled edge of the retainer over the lip of the retaining ring groove (Figure 5-5).

FIGURE 5-5 Removing the Retainer Ring

Disassembly (cont.)

2. Carefully pry the rest of the ring over the lip until the entire ring pops out.

3. Remove the cartridge assembly **53** (Figure 5-6**)**.

FIGURE 5-6
Removing Cartridge Assembly and Retainer Ring

Inspection

1. Inspect the KEL-F® poppet on the cartridge assembly for wear, damage, or embedded contaminants.

2. Inspect the poppet seating surface of the fill connector body for any wear, damage, or embedded contaminants.

Service

Service to the fill connector consists of replacement of the cartridge assembly.

Reassembly

1. Insert the cartridge assembly into the fill connector body.

2. Insert the smaller end of the male installation sleeve (Marked "M" P/N-775393-00) into the threaded end of the fill connector body.

3. Place the spiral retainer ring in the open end of the male installation sleeve (Figure 5-7).

FIGURE 5-7
Inserting Retainer Ring into Male Installation Sleeve

4. Hold the male installation sleeve firmly against the body of the fill connector. Insert the rounded end of the inner installation tool (Marked "I" P/N-775392-00) into the male and push the retainer ring down until you feel it "click" into place (Figure 5-8).

FIGURE 5-8
Reinstalling the Retainer Ring

Installation

Install the fill connector on the liquid fill tube by reversing the removal procedure. Be sure to hold the fill connector stationary while turning the nut. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1, in Performance Verification.

NOTE:
A small amount of Krytox® on the threads of the fill connector can be used to ease the installation procedure. This helps to lubricate the threads so the fitting can be tightened more easily.

PRIMARY RELIEF VALVE

The primary relief valve is a poppet-type pressure regulating valve that controls the *Companion* Stationary system pressure. The primary relief valve is not field serviceable and should be replaced if it is not operating properly.

Refer to Figures and 6-2 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

   NOTE:
   Verify that the primary relief valve **60** is located between the vent valve **55** and the economizer valve **63**. The primary relief valve will be stamped with "22". If the primary and secondary relief valves are transposed, relocate them to the proper position.

Removal (cont.)

2. Use an 8 in. adjustable wrench to hold the hex flats of the relief valve adaptor stationary. Use a 5/8 in. open end wrench to remove the primary relief valve (Figure 5-9).

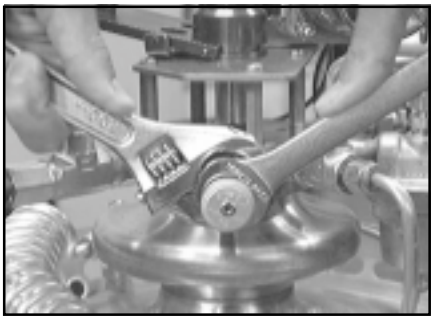


FIGURE 5-9
Removing the Primary/Secondary Relief Valve

CAUTION

High pressure hazard. Over tightening primary relief valve can cause Stationary unit to operate improperly. Do not over tighten valve.

CAUTION

Relief valve with incorrect pressure rating can seriously affect operation of Stationary unit. Be sure replacement primary relief valve is stamped with "22" before installing.

NOTE:
Wrap the relief valve threads with Teflon® tape starting two threads back from the end before installing the relief valve.

Installation

Install the primary relief valve by reversing the removal procedure. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

SECONDARY RELIEF VALVE

The secondary relief valve is a poppet-type pressure control valve that acts as a safety back up in the event that the primary relief valve fails to limit system pressure to an acceptable range. Under normal operating conditions the secondary relief valve remains closed. The secondary relief valve is not field serviceable.

Refer to Figures 6-1 and 6-2 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

   NOTE:
   Verify that the secondary relief valve **62** is located between the flow control valve **23** and the economizer valve **63**. The secondary relief valve will be stamped with "30". If the secondary and primary relief valves are transposed, relocate them to the proper position.

2. Use an 8 in. adjustable wrench to hold the hex flats of the relief valve adaptor stationary while using a 5/8 in. open end wrench to remove the secondary relief valve (See Figure 5-9).

CAUTION

High pressure hazard. Over tightening secondary relief valve can cause Stationary unit to operate improperly. Do not over tighten valve.

CAUTION

Relief valve with incorrect pressure rating can seriously affect operation of Stationary unit. Be sure replacement secondary relief valve is stamped with "30" before installing.

Installation

NOTE:
Wrap the relief valve threads with Teflon® tape starting two threads back from the end before installing the relief valve.

Install the secondary relief valve by reversing the removal procedure. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

VENT VALVE

The vent valve is a quarter turn ball valve that is opened to begin a *Companion* Stationary fill and is closed to terminate the fill.

Refer to Figure 6-2 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

2. Use an 8 in. adjustable wrench to hold the outer hex flats of the vent valve **55** stationary while using a 9/16 in. open end wrench to remove the vent valve extension **56**.

Removal (cont.)

3. Use a 3/4 in. open end wrench to remove the vent valve. Place the wrench on the hex flats closest to the manifold to prevent disassembly of the valve.

Disassembly

1. Lightly clamp the vent valve in a vise.
2. Use a pin punch and a hammer to drive the spring pin **59** out of the valve stem.
3. Use a small screwdriver to carefully pry the retainer ring **57** off the valve stem. (Figure 5-10)

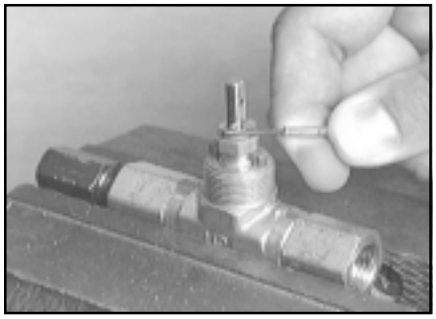


FIGURE 5-10
Removing the Retainer Ring from the Vent Valve

4. Use a dental pick or similar object to lift the O-ring **58** off the valve stem. (Figure 5-11)

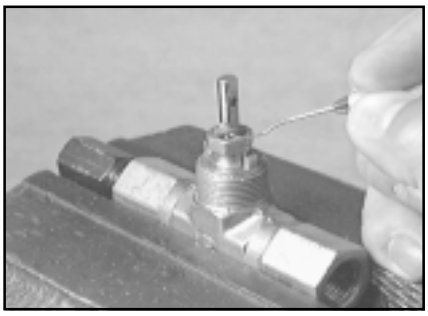


FIGURE 5-11
Removing O-ring from Vent Valve

Inspection

Inspect the O-ring and the seating surface of the valve for any noticeable wear or damage.

Service

Service to the *Companion* Stationary vent valve consists of replacement of the valve spring pin, retainer ring, and/or O-ring. Leaks that occur around the valve stem can usually be corrected by a slight tightening of the valve stem packing nut.

Reassembly

Reverse the disassembly procedure.

Installation

Install the vent valve by reversing the removal procedure. Verify that the arrow on the valve body points away from the manifold. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

NOTE:
Wrap the threaded extension on the manifold with Teflon® tape starting two threads back from the end before installing the vent valve.

ECONOMIZER VALVE

The economizer valve on the *Companion* Stationary unit is a pressure regulating valve that allows a patient to breathe the NER (Normal Evaporation Rate) gas that would normally be vented to atmosphere. The economizer valve is not field serviceable, however, the pressure setting of the valve may be reset if it is out of range. (See page 5-14).

Refer to Figure 6-1 and 6-2 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.
2. Use a 9/16 in. open end wrench to loosen both ends of the economizer circuit tube **61** and remove the tube.
3. Remove the contents indicator **68** (If equipped) per removal procedure on page 5-21.
4. Remove the warming coil **14** per removal procedure on page 5-19.
5. Use a 10 in. adjustable wrench to remove the economizer valve **63**.

Installation

Install the economizer valve by reversing the removal procedure. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

NOTE:
Wrap the threaded extension on the manifold with Teflon® tape starting two threads back from the end before installing the economizer valve.

Adjusting the Economizer Valve

If the economizer valve is operating at a pressure out of range, it may be possible to adjust the setting of the valve. There are two possible economizer valves on *Companion* Stationary units. The current is an aluminum body valve, gray in color, and the previous is a brass body valve, yellow in color. The pressure is adjusted by turning a screw in the bottom of either valve. Carefully follow the appropriate procedure listed below to reset the economizer valve.

PROCEDURE

1. Fill the *Companion* Stationary unit with 20 to 25 lbs. (9 to 11 kg) of liquid oxygen. Verify that the liquid is saturated between 20.0 and 25.0 psig (138-172 kPa) by referring to the Determining Saturation Pressure section on page 1-14. Allow approximately one hour for the system pressure to stabilize.

2. Connect the pressurizing fixture (Figure 1-13) to the NPB fill connector on the *Companion* Stationary unit.

3. Turn the flow control valve **23** to 4 lpm and record the time.

4. With the unit running, record the pressure reading on the pressurizing fixture every 30-60 minutes. A stabilization is reached when two consecutive readings are taken that are within .2 psig (1 kPa) of one another. The acceptable operating range for the economizer valve is 18.5 - 20.5 psig (128-141 kPa). If the readings taken after stabilization is reached are within the acceptable operating range listed above, discontinue the test. If the readings are not within this range, continue on with step 5.

5. **Aluminum Body Valve** - Use a 1/16 in. allen wrench to hold the adjusting screw stationary, while loosening the locknut with a 5/16 in. open end wrench.

   Brass Body Valve - Using two 7/16 in. open end wrenches, hold the economizer adjusting screw stationary and loosen the locknut on the screw.

6. With the unit still running at 4 lpm adjust the economizer screw. (Turning the screw in will increase the economizer setting, turning the screw out will decrease the economizer setting).

   Aluminum Body Valve - Use a 1/16 in. allen wrench.

   Brass Body Valve - Use a 7/16 in. open end wrench.

   NOTE:
   A fraction of a turn of the economizer adjusting screw will result in a large change in the economizer setting. After making the adjustment, it is critical that adequate time is given for the Stationary to come to the new economizer setting.

7. After adjusting the economizer screw, repeat step 4 above.

8. After the unit has stabilized and the economizer is working within the tolerance, the adjusting screw must be "locked" into place.

   Aluminum Body Valve - Hold the end of the adjusting screw stationary with a 1/16 in. allen wrench, while tightening the nut on the adjusting screw against the body of the valve with a 5/16 in. open end wrench.

   Brass Body Valve - Hold the end of the adjusting screw stationary with an 8 in. adjustable wrench, while tightening the nut on the adjusting screw against the body of the valve with a 7/16 in. open end wrench.

FLOW CONTROL VALVE

The Flow control valve on the *Companion* Stationary unit is an adjustable rotary indexed valve that controls the delivery rate of gaseous oxygen from the Stationary unit to the patient. The flows on the valve are calibrated at an inlet pressure of 19.5 psig (134 kPa).

WARNING

Extreme cold hazard. Never use flow control valves with flows beyond those authorized by the factory. Obtain all replacement valves from Nellcor Puritan Bennett.

Refer to Figure 6-1 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

2. Use a 1/2 in. open end wrench to remove the humidifier adapter **22**.

3. Use a 9/16 in. open end wrench to remove the warming coil **14** from either the male connector **24** (See Figure 5-14, A) or the male run tee **25** (See Figure 5-14, B) that connects to the flow control valve. (Male run tee used on models with pressure indicator). Use a 1/2 in. open end wrench to hold the male connector stationary or a 7/16 in. open end wrench to hold the male run tee stationary while removing the warming coil.

   NOTE:
   Perform steps 4a & 4b only for models with a pressure indicator.
   Perform step 4c only for models without a pressure indicator.

Removal (cont.)

4. a) Use a 7/16 in. open end wrench to remove the male run tee from the flow control valve **23**.

   b) Use a 9/16 in. open end wrench to remove the adapter **26** from the flow control valve.

   c) Use a 1/2 in. open end wrench to remove the male connector from the flow control valve

FIGURE 5-14A
Removing Warming Coil from Male Connector

FIGURE 5-14B
Removing Warming Coil from Tee

5. Use a 7/64 in. allen wrench (on some units) or a screwdriver to remove the two screws **49** and the lockwashers **48** from the bottom of the flow control valve and remove the flow control valve.

6. Insert a 1/16 in. allen wrench into the hole on the flow control knob **28**. Push the allen wrench in toward the knob while simultaneously pulling up on the knob.

NOTE:
Some knobs contain a set screw **29** which requires a 1/16 in. allen wrench to remove.

7. Remove the decal **30** from the flow control valve.

8. Use a medium flat blade screwdriver to remove the two screws **31** from the flow lock plate **33** and remove the plate and rivet **32**. (Rivet not available on all models)

NOTE:
Inspect the flow control knob, the decal, and the flow lock plate for any signs of wear or damage. Replace as necessary.

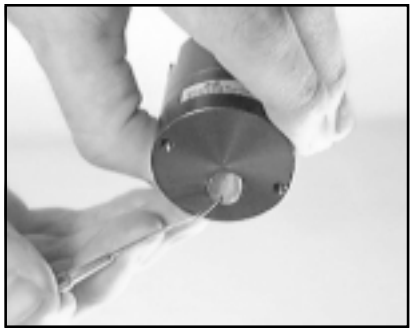


FIGURE 5-15
Removing Filter Screen
from Flow Control Valve

Inspect the flow control valve screen for any signs of damage and replace if necessary.

Inspection

NOTE:
Remove any remaining Teflon® tape from the inlet of the flow control valve before removing the filter screen.

Service

Service to the *Companion* Stationary flow control valve consists of replacing the filter screen in the inlet. Use a dental pick or a similar object to remove the flow control valve screen **27** from the flow control valve inlet. (Figure 5-15)

NOTE:
Some flow control valves contain two filter screens. Do not attempt to take the second filter screen out. It is an internal part of the valve.

Installation

Install the flow control valve by reversing the removal procedure. Verify that the flow control valve has the appropriate range and that it is calibrated at an inlet pressure of 19.5 psig (134 kPa). Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

NOTE:
Wrap the NPT threads of the humidifier adapter, the flow control valve adapter, the male connector, and/or the male run tee where applicable with Teflon® tape.

Backflushing the Flow Control Valve

The backflushing procedure will cure most low flow conditions when the cause of this condition is a clogged orifice. Gaseous oxygen is used to reverse the flow path through the flow control valve and dislodge any obstruction in the orifices. Low flow readings on all of the flow settings are usually a result of a clogged filter screen. It may, however, also be a result of low Stationary pressure (See Troubleshooting). A low flow on selected flow settings is indicative of that particular orifice being clogged.

PROCEDURE

Backflushing the Flow Control Valve

1. Perform steps 1, 3 & 5 of the flow control valve Removal procedure. (Pages 5-15 & 16)

Backflushing the Flow Control Valve (cont.)

2. Remove the filter screen per Service instructions. (Page 5-17)

3. Soak the inlet filter screen in 70% isopropyl alcohol for ten minutes. Allow the filter screen to dry for at least 15 additional minutes.

4. Connect a 0-50 psig (0-350 kPa) source of gaseous oxygen to the humidifier adapter as shown in Figure 5-16.

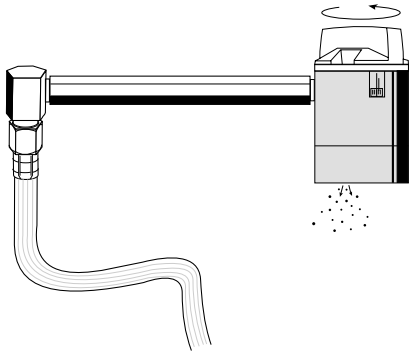


FIGURE 5-16 Backflushing the flow Control Valve

5. Rotate through each flow setting pausing approximately 15 seconds at each flow value.

6. Install the flow control valve by reversing the removal procedure. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1. Check the flow rates according to the Flow Control Valve Test (Page 3-9) in Performance Verification.

VAPORIZING COIL

The vaporizing coil on the *Companion* Stationary unit is a tightly wound coil of 1/4 in. aluminum tubing that connects between the warming coil and a tee connected to the manifold. It is a heat exchanger that transmits heat from the surrounding atmosphere to the fluid contents inside the coil. The vaporizing coil has no serviceable parts.

Refer to Figure 6-1 for identification of parts with **bold number** references.

NOTE:
Do not attempt to repair the vaporizing coil. If the ferrules or the tubing are damaged, replace the entire coil and ferrules on each end of the coil.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

2. Use a 9/16 in. open end wrench to remove the compression nut **17** from the dropout tee **19** while holding the dropout tee stationary with an 8 in. adjustable wrench.

3. Use a 9/16 in. open end wrench to remove the compression nut from the tee that connects to the manifold while holding the tee stationary with an 8 in. adjustable wrench. Remove the coil **21**.

Installation

Install the vaporizing coil by reversing the removal procedure. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

WARMING COIL

The warming coil on the *Companion* Stationary unit is a loosely wound coil of 1/4 in. aluminum tubing that connects between the flow control valve and the vaporizing coil. The purpose of the warming coil on the Stationary unit is to warm the cold gaseous oxygen exiting the vaporizing coil to near room temperature. The warming coil is a heat exchanger that transmits the heat from the surrounding atmosphere to the cold gaseous oxygen.

Refer to Figure 6-1 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.
2. Use a small screwdriver to remove the three screws **67** from the warming coil mounting brackets **15**.
3. **Dual-Fill Units Only.** Use a 5/32 in. allen wrench to remove the button head socket cap screw **92** from the side-fill connector bracket.
4. Use a 9/16 in. open end wrench to remove the warming coil from either the male connector **24** or the male run tee **25** that connects to the flow control valve **23**. (Male run tee used on models with pressure indicator.) Use a 1/2 in. open end wrench to hold the male connector stationary or a 7/16 in. open end wrench to hold the male run tee stationary while removing the warming coil.
5. Use a 9/16 in. open end wrench to remove the compression nut **17** from the dropout tee **19** while holding the dropout tee stationary with an 8 in. adjustable wrench. Remove the coil.

NOTE:
The ferrules may be replaced on the warming coil as long as there is enough tubing length available without removing any tubing from the mounting brackets.

Service

Service to the warming coil consists of replacing the ferrules on the tubing.

1. Straighten the tubing using a 7/64 in. ball driver or similar object as shown in Figure 5-17.

FIGURE 5-17
Straightening the Tubing

Service (cont.)

2. Use a tubing cutter to cut the old ferrule off the tubing as close to the end as possible. (Figure 5-18)

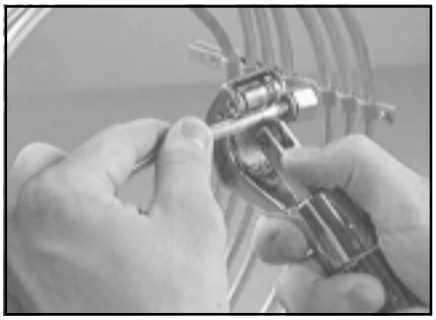


FIGURE 5-18
Cutting the Tubing

3. Use a deburring tool to clean the newly cut end of the tube. (Figure 5-19)

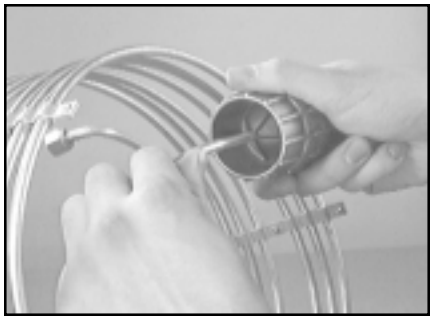


FIGURE 5-19
Deburring the Tube

4. Use a 1/4 in. tubing bender to bend the tube to 90° so that it will fit properly into the appropriate fitting. (Figure 5-20)

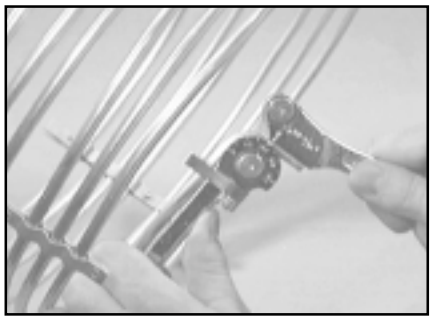


FIGURE 5-20
Bending the Tubing

Installation

Reverse the removal procedure. Install the tube and new ferrules according to Compression Fitting Make Up, page 5-2. (Tighten compression nut 1-1/4 turns from finger tight when new). Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

CONTENTS INDICATOR

The contents indicator measures the amount of liquid oxygen in the *Companion* Stationary inner container. A differential pressure established by the amount of liquid oxygen in the container moves an indicating piston a distance proportional to the liquid oxygen level.

Refer to Figures 6-1 for identification of parts with **bold number** references.

WARNING

Extreme cold hazard. Liquid oxygen discharge from contents indicator lines can occur. Remove all liquid contents (Page 5-1) and system pressure before servicing.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

CAUTION

Damage to barbed fitting can occur. Use care when removing sensor lines from the plastic barbed fittings.

2. Locate where the flexible liquid (high) pressure sensor line **71** connects to the plastic barbed fitting **69** on the contents indicator end cap. Carefully slide the brass collar **70** away from the barbed fitting and then disconnect the sensor line. Mark the sensor line to prevent cross-connection during installation.

3. Locate where the flexible gas (low) pressure sensor line **71** connects to the plastic barbed fitting on the end of the contents indicator cylinder. Carefully slide the brass collar away from the barbed fitting and then disconnect the sensor line.

4. Use a medium screwdriver to remove the two screws **46** that fasten the contents indicator to the mounting plate **47**. Remove the contents indicator **68**.

Service

The contents indicator is not field serviceable except for replacement of the plastic barbed fittings. To replace a plastic barbed fitting, apply a light coating of RTV Silicone (P/N B-778885-00) to the threads of the fitting and tighten the fitting until fully seated. Allow 24 hours for RTV to dry before pressurizing. Replace the contents indicator if evidence of cracks, crazing or contamination with chemical agents is present.

CAUTION

Contents indicator can read incorrectly. Do not pinch or kink sensor lines when installing contents indicator. Do not cross connect sensor lines. Liquid (high) pressure sensor line connects barbed fitting on contents indicator end cap to barbed fitting on stainless steel sensor tube. Gas (low) pressure sensor line connects barbed fitting on end of contents indicator cylinder to barbed fitting on secondary relief valve adaptor.

Installation

Install the contents indicator by reversing the removal procedure. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

PRESSURE INDICATOR

The pressure indicator on the *Companion* Stationary unit is a bourdon tube pressure gauge that indicates the status of the system pressure. Pressure readings in the dark blue shaded region on the indicator dial are considered acceptable. The pressure indicator is not field serviceable

Refer to Figure 6-1 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

2. Carefully remove the pressure indicator **74** or **80** using a 1/2 in. or 9/16 in. (respective) open end wrench on the square flats of the indicator while holding the female bulkhead connector **76** or **82** stationary with a 5/8 in. or 3/4 in. (respective) open end wrench.

Installation

Locate the pressure indicator dial as if viewing from the square end of the mounting plate (Figure 5-21). Install the pressure indicator by reversing the removal procedure. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

NOTE:
Wrap the pressure indicator threads with Teflon® tape starting two threads back from the end before installing the pressure indicator.

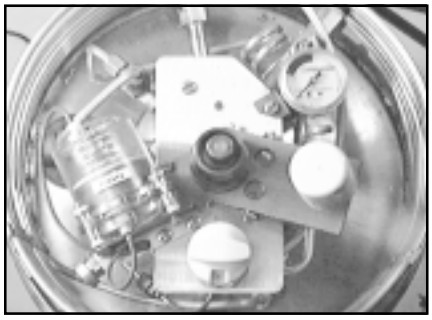


FIGURE 5-21
Positioning the Pressure Indicator

FILL CONNECTOR RELEASE LEVER ASSEMBLY

The fill connector release lever assembly is a device used to disengage the female connector from the male connector on the *Companion* Stationary unit.

Refer to Figures 6-1, 6-2 and 6-4 for identification of parts with **bold number** references.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.
2. Unscrew the release button **35** from the assembly by turning it counter clockwise.
3. Remove the two screws **34** which retain the fill connector release lever assembly **36.** Lift the fill connector release lever assembly and the fill connector release lever actuator **44** over the fill connector **52**. (Be sure not to lose the return spring **45**.)

Disassembly

Disassemble the connecting rod **37**, release lever **41**, or the pivot bracket **42** by using a roll pin punch to drive out the appropriate pins **40, 43**.

Inspection

Inspect parts for any visible wear or damage.

Service

Service to the fill connector release lever assembly consists of replacement of the release button, connecting rod, release lever, pivot bracket, roll pins, and/or O-rings **39**.

Reassembly

Reassemble by reversing the disassembly procedure.

Installation

Install the fill connector release lever assembly by reversing removal procedure.

MANIFOLD

The *Companion* Stationary manifold seals the cryogenic container from the atmosphere. Most of the major functional components of the Stationary are directly or indirectly mounted to the manifold. All of the liquid or gaseous oxygen withdrawal from the unit originates from the manifold. The welded manifold contains no serviceable parts.

Refer to Figures 6-1, 6-2, 6-3 and 6-4 for identification of parts with **bold number** references.

NOTE:
Steps 2 & 3 refer to models with a contents indicator. Skip these steps if the unit does not have a contents indicator.

Removal

1. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

2. Locate where the flexible liquid (high) pressure sensor line **71** connects to the stainless steel sensor tube barbed fitting. Carefully slide the brass collar **70** away from the fitting and disconnect the tube.

3. Locate where the flexible gas (low) pressure sensor line **71** connects to the relief valve adaptor. Carefully slide the brass collar away from the fitting and disconnect the tube.

4. Remove the two screws **34** which retain the fill connector release lever assembly **36.** Lift the fill connector release lever assembly and the fill connector release lever actuator **44** over the fill connector **52**. (Be sure not to lose the return spring **45**.)

5. Use a 9/16 in. open end wrench to remove the warming coil **14** from either the male connector **24** (Figure 5-14, A) or the male run tee **25** (Figure 5-14, B) that connects to the flow control valve **23**. (Male run tee used on models with pressure indicator). Use a 1/2 in. open end wrench to hold the male connector stationary or a 7/16 in. open end wrench to hold the male run tee stationary while removing the warming coil.

6. Remove the four screws **34,46** that hold the mounting plate **47** to the standoffs **50**.

7. Remove the mounting plate with indicator/s still attached.

8. Use a 9/16 in. open end wrench to remove the vaporizing coil **21** from the tee **19** that connects to the manifold. Hold the tee stationary with an 8 in. adjustable wrench while removing the vaporizing coil.

9. Use a 9/16 in. open end wrench to remove the vent valve extension **56**, while holding the outer hex flats of the vent valve stationary with a 3/4 in. open end wrench.

10. **Dual-Fill Units Only.** Use a 5/32 in. allen wrench to remove the button head socket cap screw **92** from the side-fill connector bracket.

11. Use a 5/16 in. open end wrench to remove the standoffs from the manifold. Carefully lift the manifold **51** from the container.

12. Follow the appropriate procedures in this section for removing and reinstalling the vent valve, the primary and secondary relief valves, and the economizer valve onto the new manifold.

Installation

NOTE:
Wrap the NPT threads of both pressure relief valves and the two nipples on the manifold with Teflon® tape before installing the components onto the new manifold.

NOTE:
Verify that the O-ring seal **64** between the manifold and the container does not have any nicks scratches or tears. Also check to see that the O-ring is not flat spotted. Replace as necessary.

NOTE:
When installing the manifold, position the secondary relief valve over the high pressure sensing line that comes through the top of the container.

Install the manifold by reversing the removal procedure.

NOTE:
It is very important that the standoffs in the manifold assembly be torqued down properly.

1. Use the specified "in-lb" torque wrench to torque the standoffs to 20 lb.-in. (230 N-cm) in an alternating sequence. (Figure 5-22)

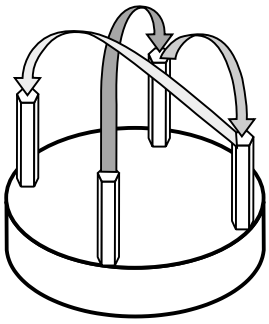


FIGURE 5-22
Torquing the Standoffs

2. Follow up by torquing the standoffs to 50 in-lb (560 N-cm) in an alternating sequence.

NOTE:
Before installing the cover assembly, pressurize the system with gaseous oxygen and test for leaks according to the Leak Test section, page 3-1.

CRYOGENIC CONTAINER

The *Companion* Stationary cryogenic container is a stainless steel, double walled, vacuum insulated container that holds liquid oxygen. The containers main function is to limit the amount of heat that leaks into the container from the surrounding atmosphere. The container is not field serviceable.

Refer to Figure 6-1 for identification of parts with **bold number** references.

Removal

1. Perform steps 1-10 of the manifold removal procedure.
2. Use a small screwdriver to remove the three screws **67** from the warming coil brackets **15**. Remove the warming coil with the vaporizing coil still attached.

Installation

Reverse the removal procedure and follow the installation procedure for the manifold.

SIDE-FILL CONNECTOR

The side-fill connector on the side of the *Companion* Dual-Fill models serves two purposes. The first is the capability to fill the Stationary unit by means of a side-fill adapter. The second is the capability to fill portable oxygen units with side-fill connectors.

Refer to Figures 6-5 for identification of parts with **bold number** references.

Removal

1. Hold the connector housing **86** stationary with an 8 in. adjustable wrench, while using a 10 in. adjustable wrench to loosen the hex nut.
2. Carefully remove the connector housing from the manifold. Remove the hex coupler **89**, valve assembly **87**, and O-ring **88** at this time.

Disassembly

1. Place the flats of the connector housing in a vise, and tighten down.
2. Remove the hex thread ring **91** from the connector housing by inserting the hex thread ring tool (P/N B-701055-00) into the housing and turning it **clockwise** (as viewed from the female end of the connector) with an adjustable wrench.
3. Use a small screwdriver to remove the lip seal **90** from the connector housing by carefully prying the edge of the seal up until it pops out.

Inspection

Inspect all components for any sign of visible wear or damage. Pay special attention to the O-ring and lip seal.

Service

Service to the side-fill connector consists of replacement of any of the following components: connector housing, hex coupler, valve assembly, hex thread ring, O-ring, and/or lip seal.

Reassembly

1. Use your fingers to insert the lip seal into the end of the connector housing and snap it into place. (Be sure the side of the seal with the O-ring is inserted into the housing first.)

2. Apply a thin film of Krytox® fluorinated grease (P/N B-775239-00) to the threads of the hex thread thread ring before installing.

3. Use your fingers to insert the hex thread ring into the end of connector and rotate **counterclockwise** until the threads engage and stop.

4. Use the hex thread ring tool, the 5/8 in. crows foot, and the specified "in-lb" torque wrench to torque the hex thread ring to 120-160 in-lb (14-18 N-m). Be sure to turn it **counterclockwise**.

Installation

Install the side-fill connector by reversing the removal procedure. Use the specified "ft-lb" torque wrench and 1 1/16 in. crows foot to tighten the connector nut to 45-55 ft-lb (61-75 N-m). Hold the connector housing stationary with a 10 in. adjustable wrench while torquing the nut. Before installing the cover assembly, pressurize the system with gaseous oxygen and check for leaks according to the Leak Test section, page 3-1.

NOTE:
Verify that the flats on the connector housing are vertical, straight up and down. If the flats are turned slightly clockwise or counterclockwise to where they are not vertical, you have the wrong connector housing. Consult the Technical Support Department for further assistance at 1-800-255-6774 (Press 2).

PURGING THE CONTENTS INDICATOR SENSING LINE

If the contents indicator is reading empty or low when the Stationary unit is full, and there are no leaking fittings or connections, there may be an obstruction in the contents indicator sensing line. The most common is the formation of ice crystals. Over a period of time water may enter the system during the Stationary filling process. Once in the system, the water may become trapped in the contents indicator sensing line. When the inner container cools to cryogenic temperatures, the water freezes and blocks the line, thus causing the contents indicator to read improperly. When this happens follow the purging procedure listed below.

PROCEDURE

Purging the Contents Indicator Sensing Line

1. Empty the liquid oxygen contents from the Stationary unit according to page 5-1, before servicing the unit.

2. Remove the cover assembly per COVER BODY removal steps 1, 2 and 3 (if applicable) on page 5-6.

3. Use the vent key to open the vent valve on the Stationary unit.

4. Connect the pressurizing fixture (Figure 1-13) to the fill connector on the *Companion* Stationary. Attach an adjustable 0-50 psig (0-345 kpa) source of gaseous oxygen to the DISS (Diameter Index Safety System) oxygen inlet on the fixture (Figure 3-2).

5. Adjust the regulator until the gauge on the pressurizing fixture reads approximately 15 psig (103 kPa). Allow the system to purge for approximately 15 minutes with only the vent valve open.

6. Disconnect the pressurizing fixture and close the vent valve.

7. With no pressure in the unit, disconnect both sensor tubes **71** at the contents indicator **68** according to the Tube Removal procedure, page 5-6. Remove the brass collars **70** from both sensor tubes, and secure the tubes to the relief valve adapter using a wire tie.

8. Reconnect the pressurizing fixture, and adjust the regulator until the pressurizing fixture reads approximately 15 psig (103 kPa). Allow an additional 15 minutes for the contents indicator lines to purge.

9. Reconnect both sensor tubes according to Tube Installation, page 5-5. Perform the contents indicator test on page 3-6 in Performance Verification.

RETURNING UNIT TO PURITAN BENNETT FOR SERVICE

WARNING

Fire hazard. Do not ship units that contain liquid or gaseous oxygen. Empty oxygen contents before shipping.

WARNING

Extreme cold hazard. Do not ship units that contain liquid oxygen. Empty liquid contents before shipping. (Page 5-1)

To return a product, contact Puritan-Bennett Cryogenic Equipment Division at 1-800-255-6774 (Press 2) and ask to speak with a Technical Support Representative. A RGA (Return Goods Authorization) number will be issued to track the return of the product. Return the unit in its original packing if at all possible. If the original packaging is not available, new packaging may be purchased (See Accessories, page 7-2).

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NOTE:
See Product Description on page 1-2 for and explanation of different model/series designations.

REF. NO.	PART NO.	DESCRIPTION	QTY. REQ'D.
1	B-701002-00	Screw - 1/4"-28 x 1 1/4" SS (Used in Conjunction with Washer after 8/95)	1
1	B-775105-00	Screw - 1/4"- 28 x 1/2" SS (Used without Washer prior to 8/95)	1
2*A	B-777095-00	Fill Connector Cover	1
3*A	B-776096-00	Snap Button	1
4*A	B-776097-00	Ball Chain Assembly	1
5*A	B-776095-00	Detachable Sleeve	1
6	B-778979-00	Top cover Washer	1
7	B-775100-00	Cover Assembly - (Standard)	1
7	B-776173-00	Cover Assembly - (Series A)	1
7	B-776170-00	Cover Assembly - (Series G)	1
7	B-776081-00	Cover Assembly - (Series AG)	1
8	B-775102-00	Top Cover - (Standard & Series A)	1
8	B-776080-00	Top Cover - (Series AG)	1
8	B-775370-00	Top Cover - (Series G)	1
8	B-701053-00	Top Cover - (Series D)	1
9	B-775101-00	Cover Body - (All Series)	1
9	B-701270-00	Cover Body - (Series D)	1
10	B-775284-00	Screw - 6-32 x 3/8" SS	5
11	B-775104-00	Warning Label (All Series)	1
12	B-776252-00	Oxidizer Contents Label (All Series)	1
13	B-778436-00	Liquid Contents Window Label (Series A, AG & D)	1
13	B-775833-00	Liquid Contents Label (Series A & Series AG)	1
13	B-775103-00	Logo Label (Standard Series)	1
14	B-775282-00	Warming Coil Assembly	1
15	B-775144-00	Mounting Bracket	6
16	B-775145-00	Pop Rivet - 1/8" Dia.	6
17	B-775265-00	Nut - 1/4" Tube (Brass)	8
18	B-775063-00	Ferrule - 1/4" (Brass)	8
19	B-775141-00	Tee - Warming Coil	2
20	B-775255-00	Plug - 1/4" NPT (Brass)	1
21	B-775251-00	Vaporizer Coil	1
22	B-775314-00	Humidifier Adapter	1
*B	B-776115-00	Flow Control Assembly (.25-6 lpm)	1
*B	B-776135-00	Flow Control Assembly (Optional .12-4 lpm)	1
*B	B-776140-00	Flow Control Assembly (Optional .5-10 lpm)	1

*A - Standard on Dual-Fill units

*B - Assemblies include flow control valve, decal, knob, screws and flowplate.
Flows for flow control valves above are as follows:
.25-6 lpm valve includes 0, .25, .5, .75, 1, 1.5, 2, 2.5, 3, 4, 5 and 6
.12-4 lpm valve includes 0, .12, .25, .5, .75, 1, 1.5, 2, 2.5, 3, 3.5 and 4
.5-10 lpm valve includes 0, .5, .75, 1, 1.5, 2, 3, 4, 5, 6, 8 and 10

REF. NO.	PART NO.	DESCRIPTION	QTY. REQ'D.
23*C	B-775855-00	Flow Control Valve (.25-6 lpm)(12 position)	1
23*C	B-701171-00	Flow Control Valve (.25-6 lpm)(12 position)	1
23	B-776134-00	Flow Control Valve (.12-4 lpm)(12 position)	1
23*C	B-776139-00	Flow Control Valve (.5-10 lpm) (12 position)	1
23*C	B-701190-00	Flow Control Valve (.5-10 lpm) (12 position)	1
24	B-775143-00	Male Connector - 1/8" NPT x 1/4" Tube	1
25	B-775448-00	Male Run Tee	1
26	B-775447-00	Adapter - 1/8" x 1/8" NPT	1
27	B-775250-00	Filter Screen - FCV	1
28	B-776168-00	Knob w/775888 - FCV (12 position)	1
28*D	B-775070-00	Knob w/775888 - FCV (8 position)	1
29	B-775888-00	Set Screw - FCV Knob	1
30	B-775834-00	FCV Decal - .25-6 lpm (12 position)	1
30	B-776070-00	FCV Decal - .12-4 lpm (12 position)	1
30	B-775835-00	FCV Decal - .5-10 lpm (12 position)	1
30*D	B-775175-00	FCV Decal - 1-6 lpm (8 position)	1
30*D	B-775223-00	FCV Decal - .5-4 lpm (8 position)	1
30*D	B-775404-00	FCV Decal - .25-3 lpm (8 position)	1
30*D	B-775407-00	FCV Decal - 1-10 lpm (8 position)	1
31	B-775074-00	Screw - 6-32 x 1/4" SS	2
32	B-775838-00	Flowlock Rivet (12 position)	1
32*D	B-775073-00	Flowlock Rivet (8 position)	1
33	B-775877-00	Flow Plate (12 position)	1
33*D	B-775071-00	Flow Plate (8 position)	1
34	B-775116-00	Screw - 10-24 x 3/8" SS	3
35	B-775113-00	Release Button	1
36	B-775106-00	Fill Connector Release lever Assembly	1
37	B-775112-00	Connecting Rod	1
38	B-775192-00	Stud - Special 6-32 x 1/2" SS	1
39	B-775119-00	O-ring	2
40	B-775114-00	Spring Pin 1/8" x 1/2" SS	4
41	B-775111-00	Release Lever	1
42	B-775109-00	Pivot Bracket	1
43	B-775115-00	Spring Pin 1/8" x 1" SS	1
44	B-775107-00	Fill Connector Release Actuator	1
45	B-775118-00	Return Spring	1
46	B-775117-00	Screw - 10-24 x 3/8" SS	5
47	B-775110-00	Mounting Plate	1
48	B-775318-00	#6 Internal Tooth Lockwasher SS	2
49	B-702147-00	Screw - 6-32 x 3/8" SS	2
50	B-775108-00	Stand Off	4
51	Consult Factory	Welded Manifold 21(All except D)	1
51	Consult Factory	Welded Manifold 31(All except D)	1
51	Consult Factory	Welded Manifold 41(All except D)	1
51	Consult Factory	Welded Manifold 41D	1
51	Consult Factory	Welded Manifold 31D	1
51	Consult Factory	Welded Manifold 21D	1

*C - P/N B-775855-00 and B-701171-00 are interchangeable. P/N B-776139-00 and B-701190 are also interchangeable.

*D - 8 Position items used on older units (Prior to approximately 8/85)

REF. NO.	PART NO.	DESCRIPTION	QTY. REQ'D.
52	B-775322-00	Nellcor Puritan Bennett Fill Connector	1
53	B-775259-00	Cartridge Assembly w/Retainer	1
54	B-775267-00	Retainer Ring	1
55	B-775479-00	Vent Valve Assembly	1
56	B-775329-00	Vent Extension	1
57	B-775241-00	Retaining Ring	1
58	B-775285-00	O-ring	1
59	B-775136-00	Spring Pin - 3/32" x 1/2" SS	1
60	B-775138-00	Primary Relief Valve (22 psi)	1
61	B-775147-00	Economizer Tube	1
62	B-775139-00	Secondary Relief Valve (30 psi)	1
63	B-701298-00	Economizer Valve	1
64	B-775132-00	Manifold O-Ring	1
65	Consult Factory	Cryogenic Container - 21(All Series)	1
65	Consult Factory	Cryogenic Container - 31(All Series)	1
65	Consult Factory	Cryogenic Container - 41(All Series)	1
66	B-775252-00	Evacuation Port Capplug	1
67	B-775237-00	Screw - 6-32 x 1/4" SS	3
68	B-775845-00	Contents Indicator - Companion 21	1
68	B-775846-00	Contents Indicator - Companion 31	1
68	B-775847-00	Contents Indicator - Companion 41	1
69	B-775803-00	Plastic Barbed Fitting (1/16")	2
70	B-775794-00	Press on Hose Clamp	4
71	B-775856-00	Flexible Contents Indicator Sensor Line	2
72	B-775854-00	High Pressure Sensor Line Barbed Fitting (1/16")	1
72	B-777180-00	High Pressure Sensor Line Barbed Fitting (3/16")	1
73	B-775853-00	High Pressure Sensor Line Plug (1/16")	1
73	B-777178-00	High Pressure Sensor Line Plug (3/16")	1
74	B-776078-00	Pressure Indicator (Series AG)	1
75	B-778807-00	Indicator Lens	1
76	B-776079-00	Bulkhead Connector	1
77	B-775481-00	#10 Lockwasher	2
78	B-776077-00	Indicator Mounting Bracket	1
79	B-776076-00	Pressure Indicator Tube	1
80	B-775335-00	Pressure Indicator (Series G)	1
81	B-778808-00	Indicator Lens (Series G)	1
82	B-775336-00	Bulkhead Connector	1
83	B-775348-00	Indicator Mounting Bracket	1
84	B-775450-00	Pressure Indicator Tube	1
85	B-775181-00	Drain Bottle	1
86	B-701060-00	Connector Housing	1
87	B-701037-00	Valve Assembly	1
88	B-701056-00	Connector Assembly O-Ring	1
89	B-701013-00	Hex Coupler	1
90	B-701011-00	Lip Seal	1
91	B-701057-00	Hex Thread Ring	1
92	B-701279-00	Button Head Socket Cap Screw	1
93	B-775148-00	Male Connector - 1/4" NPT x 1/4" Tube	1

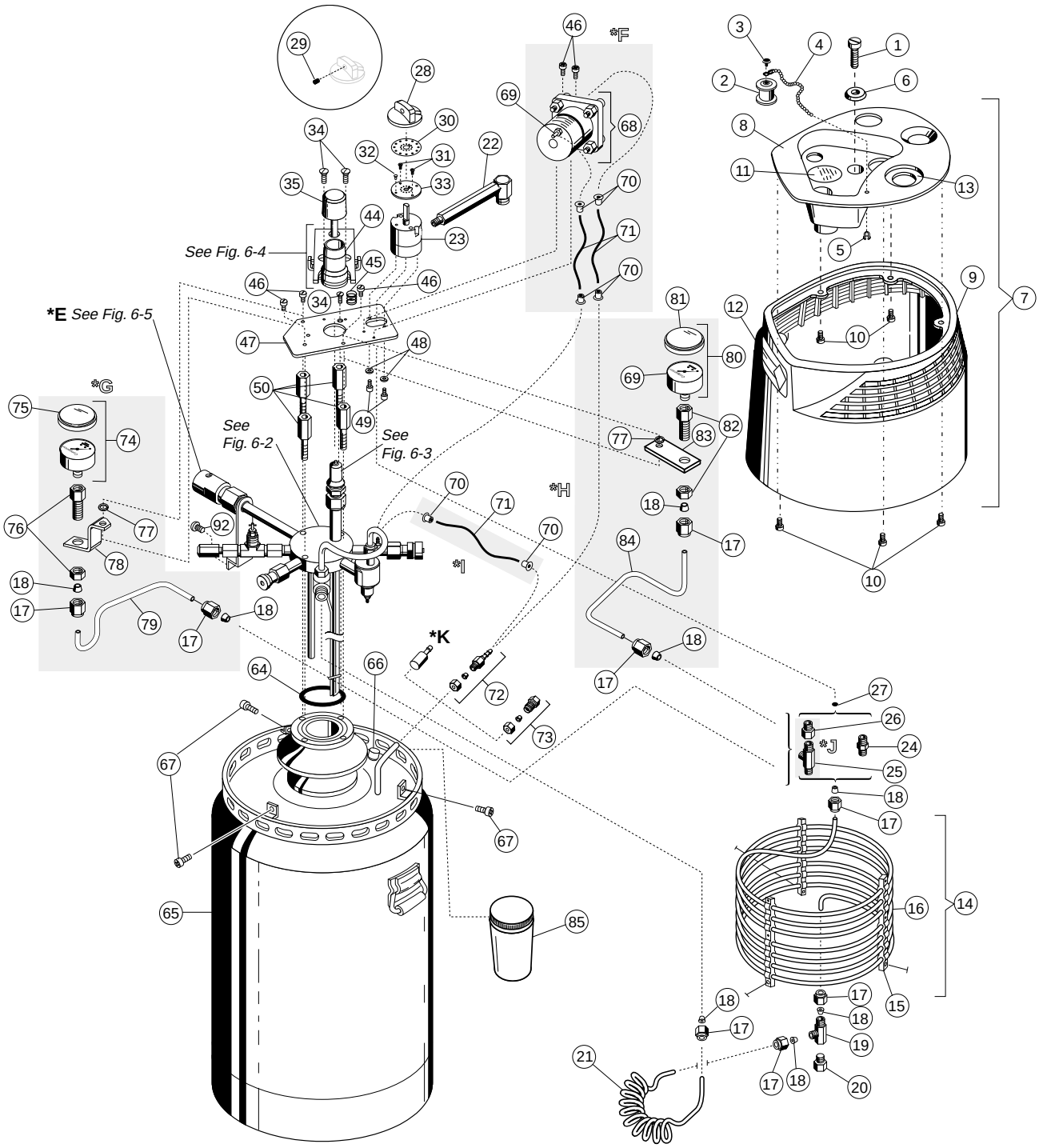

FIGURE 6-1
***Companion* Stationary**

- ***E** Side-fill connector found on Series D (Dual-Fill) units only.
- ***F** Contents indicator found on Series A, AG & D units, (i.e. Companion 31A, Companion 31AG or Companion 31D)
- ***G** Pressure gauge found on Series AG units, (i.e. Companion 31AG)
- ***H** Pressure gauge found on Series G units, (i.e. Companion 31G)
- ***I** Jumper tube found on Standard Series units (after 11/86) without contents indicators
- ***J** Included with both Series G and Series AG units (***F**, ***G**)
- ***K** Brazed on barbed fitting (After 6/95)

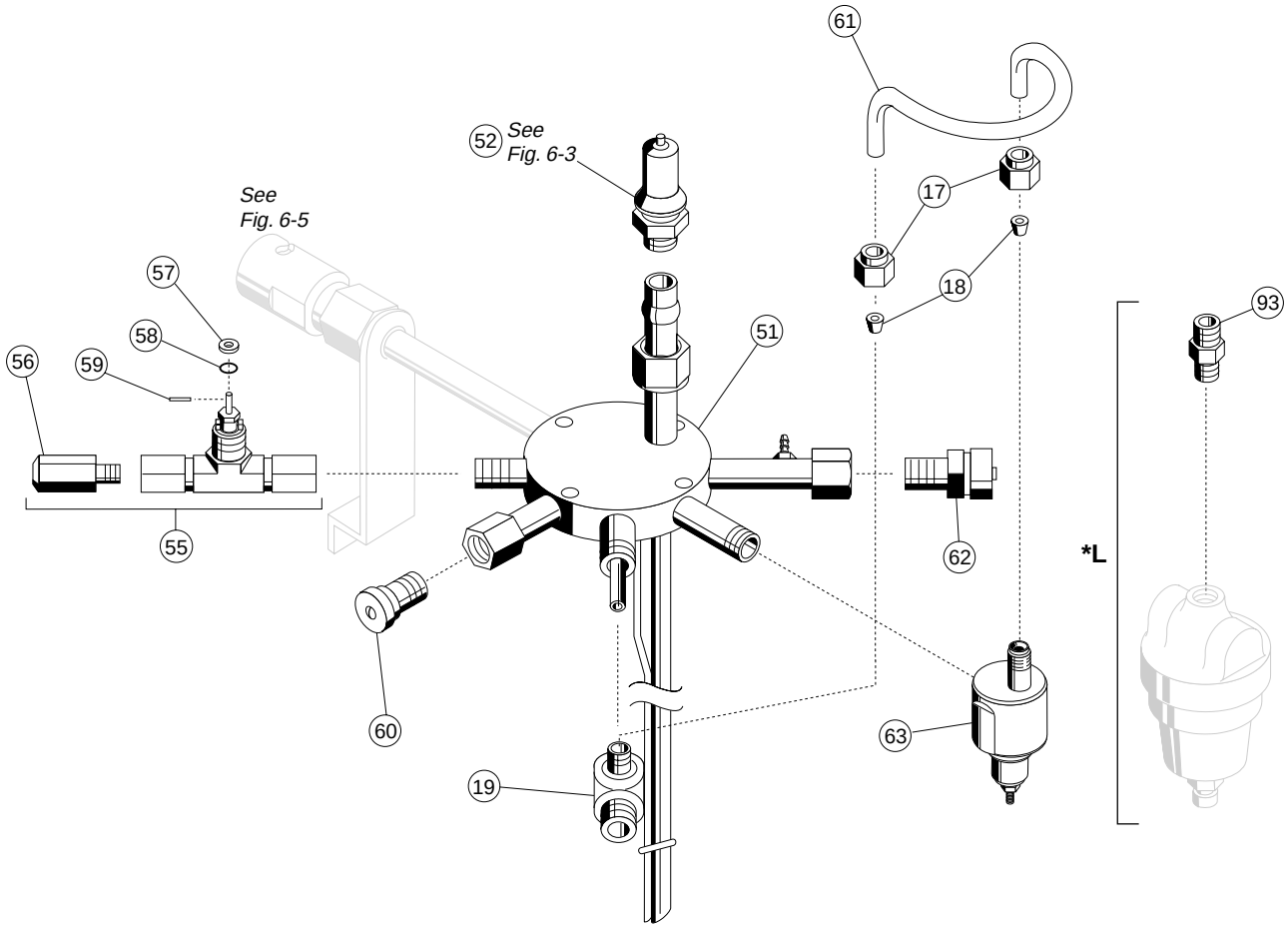

FIGURE 6-2
***Companion* Manifold**

***L** Old style economizer is no longer available. However, male connector item **93** is.

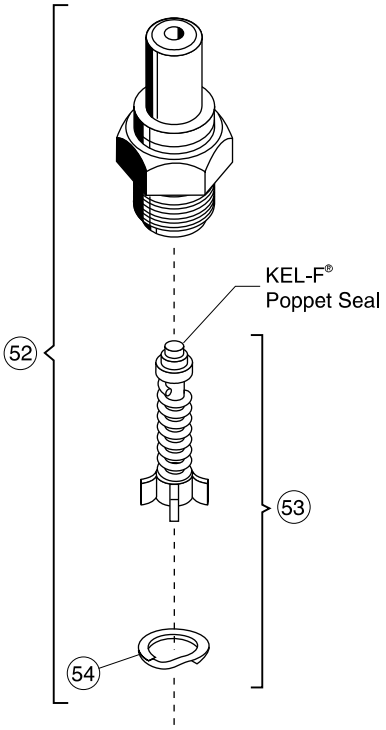

FIGURE 6-3
Puritan Bennett
Fill Connector

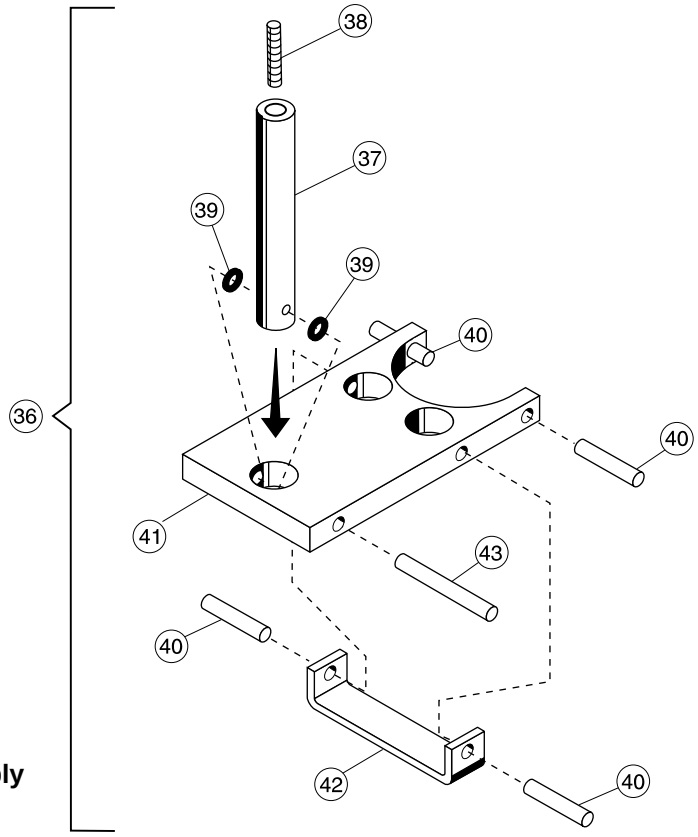

FIGURE 6-4
Fill Connector
Release Lever Assembly

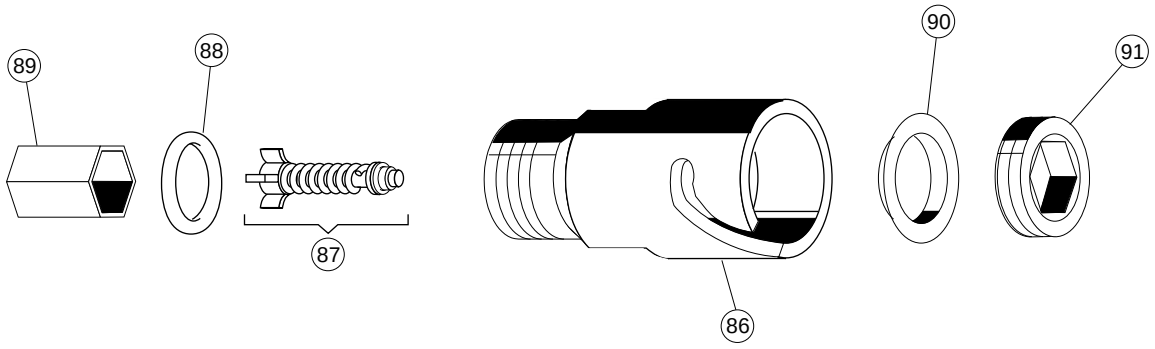

FIGURE 6-5
Side-Fill Connector

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DESCRIPTION	PART NUMBER	LOCATION
• Van *Companion* Assembly (Delivery Cart)	B-775462-00	Figure 7-1
-Strap and Buckle Assembly	B-775477-00	Figure 7-1 #1
-Faspin	B-775478-00	Figure 7-1 #2
-Pads (2 Required)	B-775476-00	Figure 7-1 #3
-Wear Strips (2 Required)	B-776169-00	Figure 7-1 #4
• Roller Base Assembly	B-776090-00	Figure 7-2
-Casters (5 Required)	B-775871-00	Figure 7-2 #1
• Transfer Line Assembly (6 ft.)	B-775288-00	Figure 7-3
• Transfer Line Assembly (10 ft.)	B-775289-00	Figure 7-3
-Transfer Line (6 ft.)	B-775280-00	Figure 7-3 #1
-Transfer Line (10 ft.)	B-775281-00	Figure 7-3 #1
-Source Adapter Assembly	B-775279-00	Figure 7-3 #2
-Relief Valve (150 psi)	B-775273-00	Figure 7-3 #3
-Source Adapter	B-775313-00	Figure 7-3 #4
-Fill Adapter Assembly	B-775278-00	Figure 7-3 #5
-Fill Adapter	B-775312-00	Figure 7-3 #6
-Fill Adapter Seal	B-775262-00	Figure 7-3 #7
-Female Fill Connector	B-775264-00	Figure 7-3 #8
-5/8 in. Union Flare (2 required per transfer line)	B-775277-00	Figure 7-3 #9
• Universal Adapter Kit	B-775461-00	Figure 7-4
-Male Flare Adapter	B-775342-00	Figure 7-4 #1
-Female Flare Adapter	B-775418-00	Figure 7-4 #2
-PB Fill Connector/Tee Assembly	B-775276-00	Figure 7-4 #3
• Scale Assembly with Roller Base 21	B-775368-00	Figure 7-5 #1
-Casters (21, 31 & 41)	B-775871-00	Figure 7-5 #4
-Scale Assembly 21	B-775341-00	Figure 7-5 #2
-Top Assembly Not Available	----------	----------
• Scale Assembly with Roller Base 31	B-775366-00	Figure 7-5 #1
-Scale Assembly 31	B-775183-00	Figure 7-5 #2
-Scale Top Assembly 31	B-777862-00	Figure 7-5 #3
• Scale Assembly with Roller Base 41	B-775422-00	Figure 7-5 #1
-Scale Assembly 41	B-778525-00	Figure 7-5 #2
-Scale Top Assembly 41	B-777861-00	Figure 7-5 #3

NOTE:
Contents Indicator kits are intended for converting a Standard Series unit to a series A unit (Units manufatured prior to 11/86 can not be converted). If a series G unit is being converted to a series AG unit both contents indicator and pressure gauge kits will need to be purchased. (i.e. Converting a *Companion* 31G to a *Companion* 31AG, purchase B-776210-00 and B-776088-00)

NOTE:
Contents Indicator kits for the *Companion* 21 are not available, however the parts may be purchased separately. Purchase items # **8**, **11**, **13**, **46**, **68**, **70**, **71** from Figure 6-1.

DESCRIPTION	PART NUMBER	LOCATION
• Contents Indicator Kit Companion 31	B-776210-00	Figure 6-1 items # **8**, **11**, **13, 46**, **68**, **70**, **71**
• Contents Indicator Kit Companion 41	B-776215-00	Figure 6-1 items # **8**, **11**, **13, 46**, **68**, **70**, **71**
• Pressure Gauge Kit ..... (All Sizes, conversion of Standard Series units)	B-775451-00	Figure 6-1 items # **8**, **17**, **18**, **25**, **26**, **74**, **76**, **77**, **78**, **79** (Purchase items **11** & **13** seperately)
• Pressure Gauge Kit ..... (All Sizes, conversion of Series A units)	B-776088-00	Figure 6-1 items # **8**, **11**, **13**, **17**, **18**, **25**, **26**, **80**, **82**, **83**, **84**
• Vent Extension Without Orifice ..... (Used when filling from a source pressure of 90-100 psig)	B-775137-00	Not Shown
• *Companion* 21 Shipping Carton	B-701174-00	Not Shown
-Insert (2 per unit)	B-701219-00	Not Shown
• *Companion* 31 Shipping Carton	B-701175-00	Not Shown
-Insert (2 per unit)	B-701218-00	Not Shown
• *Companion* 41 Shipping Carton	B-778378-00	Not Shown
-Insert (2 per unit)	B-701217-00	Not Shown
• *Companion* Liquid Oxygen Stationary Operating Instructions	B-701299-00	Not Shown

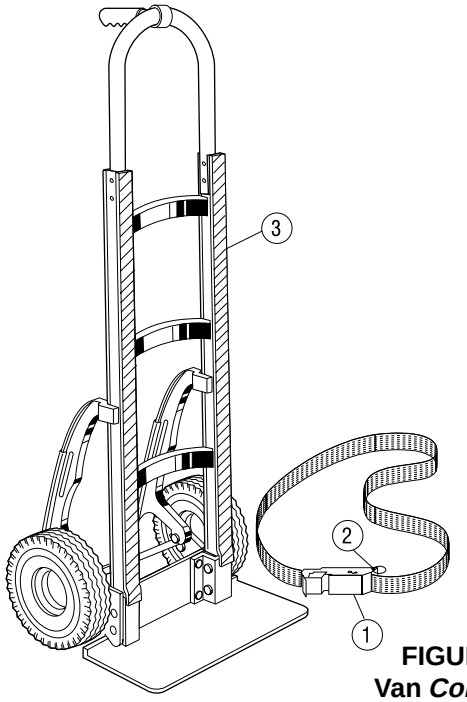


FIGURE 7-1
Van *Companion*

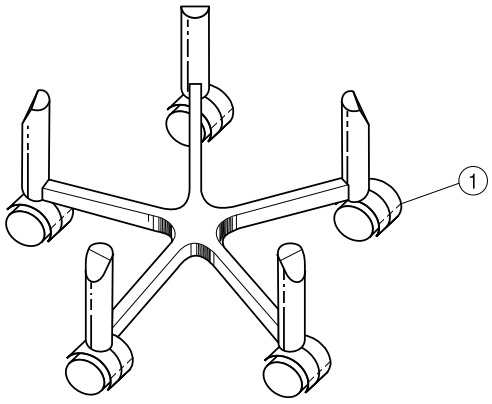


FIGURE 7-2
Roller Base

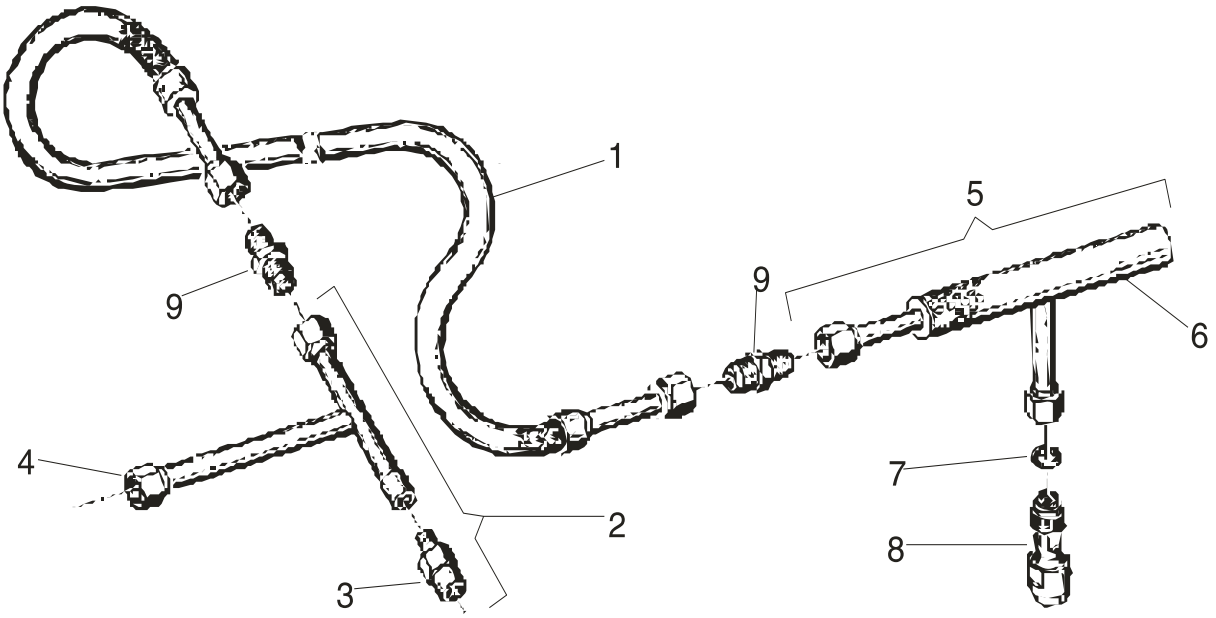
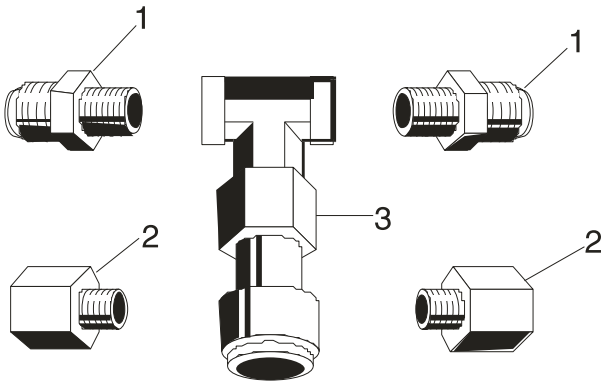


FIGURE 7-3
Transfer Line



NOTE:
Install the universal adapter kit on the transfer line assembly to allow the filling of both Puritan Bennett and liquid oxygen units with side-fill connectors with the same transfer line. (Installs between the side-fill adapter and the transfer hose).

FIGURE 7-4
Universal Adapter Kit

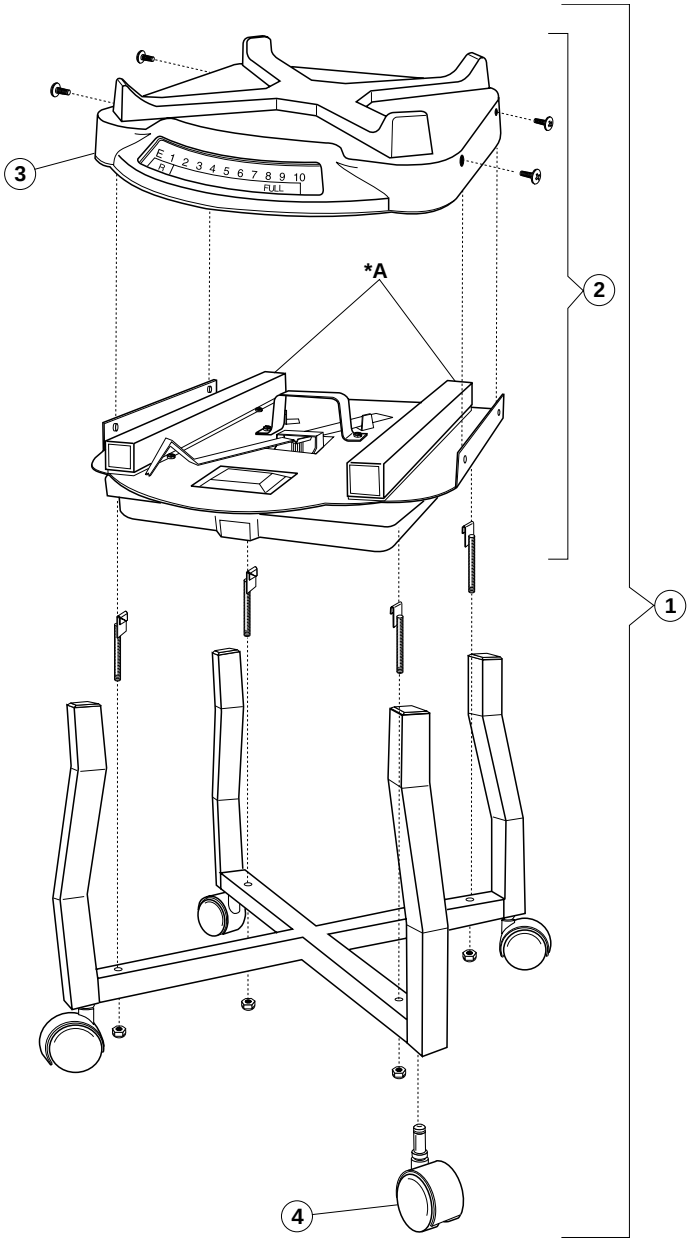


FIGURE 7-5
Base Scale
with Roller Base

*A-Support tubes for C41 scale assembly only.