

Liquid CO₂ and LN₂ Free-Standing Control Assemblies

Installation and Operation Manual



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1 Introduction

The CO₂ and LN₂ Free-Standing Backup Systems are designed to meter liquid cryogenics to the freezer compartment. The liquid flow is controlled by a solenoid valve, which is powered by a rechargeable battery. The battery charge is maintained by a built-in charger. The solenoid valve opens and closes in response to an electronic control system which monitors the tank temperature.

2 Safety Considerations

2.1 General Precautions



WARNING! Do not modify or change system components. Replacement parts must be O.E.M. exact replacement equipment. Modification or use of the equipment in a manner other than expressly intended may cause death or serious injury. This includes use of user-supplied components and materials not specifically designed for the unit. Reconfiguring the controller may cause death or serious injury.

The manufacturer shall not be liable for any damages, including incidental and/or consequential damages, regardless of the legal theory asserted, including negligence and/or strict liability.

Before using, user shall determine the suitability and integrity of the product for the intended use and that the unit has not been altered in any way. User assumes all risk and liability whatsoever therewith.



WARNING! For personal safety and trouble-free operation, this unit must be properly grounded before it is used. Failure to ground the equipment may cause personal injury or damage to the equipment. Always conform to the National Electrical Code and local codes. Do not connect unit to already overloaded power lines.



WARNING! Disconnect unit from main power before attempting any maintenance to equipment or controls.

2.2 CO₂ and LN₂ Precautions

The following are precautions for using liquid CO₂ and LN₂ backup systems.



CAUTION! Always purchase cylinders equipped with siphon tubes which withdraw liquid from the bottom of the cylinder.



WARNING! If a CO₂ or LN₂ cylinder falls and a valve is knocked off, the cylinder can travel like a missile. Transport the cylinders in a handtruck or cart with secure chain ties for the cylinder. After cylinders are connected to the equipment, securely attach them with chains to a solid, stationary object such as a building column.



WARNING! The gases produced by evaporation of CO₂ or LN₂ are non-poisonous but displace the oxygen in a confined space and can cause asphyxiation. **Do not store the cylinders in subsurface or enclosed areas.**



WARNING! CO₂ and LN₂ liquids are very cold and will burn unprotected skin. Always wear protective eyewear and clothing when changing cylinders or working on the piping systems attached to an active source of liquid refrigerant.



CAUTION! When closing the cylinder valve, make sure that the injection solenoid is energized to allow all the liquid to bleed off instead of being trapped in the supply tubing. Failure to do this results in activation of the pressure relief device, which could damage the freezer and requires replacing if it is activated.



CAUTION! Always install the Cabinet Vent Assembly (refer to Figure 4 on page 3) before operating the backup system. This assembly prevents excess pressure from building within the cabinet due to frost formation which can block the porthole on the back of the unit. The porthole provides pressure relief when emergency gases are being admitted directly into the cabinet interior and must always be kept open.

3 Pre-Installation

3.1 Unpacking

At delivery, examine the exterior for physical damage while the carrier's representative is present. If exterior damage is present, carefully unpack and inspect the unit and all accessories for damage.

If there is no exterior damage, unpack and inspect the equipment within five days of delivery. If you find any damage, keep the packing materials and immediately report the damage to the carrier. Do not return goods to the manufacturer without written authorization. When submitting a claim for shipping damage, request that the carrier inspect the shipping container and equipment.

Do not exceed the electrical ratings printed on the dataplate located on the back of the control assembly case.



CAUTION! Improper operation of the equipment could result in dangerous conditions. To preclude hazard and minimize risk, follow all instructions and operate within the design limits noted on the dataplate.

4 Installation

Do not exceed the electrical ratings printed on the dataplate located on the back of the control assembly case. The design operating voltages are:

- 100 – 120 VAC, 50/60 Hz
- 200/240 VAC, 50/60 Hz



CAUTION! Improper operation of the equipment could result in dangerous conditions. To preclude hazard and minimize risk, follow all instructions and operate within the design limits noted on the dataplate.



WARNING! Be extremely careful inside the tank area. Drilling holes is **not** recommended because the drill could pierce the evaporator tubing attached to the tank wall. If the evaporator tubing is pierced, refrigerant leaks into the atmosphere, causing unit failure. Refrigerant can burn the operator.

4.1 Pressure Requirements and Safeguards

Be sure that the input pressure follows the guidelines described below.

For CO₂

The recommended operating pressure for CO₂ backup systems is between 900 and 1000 psi.

When the pressure exceeds approximately 1300 psi, a rupture disk causes the system to shut down and release excess pressure. The release valve is located in back of the control panel.

In models equipped with an audible alarm feature on the main control panel, the alarm will sound when the pressure drops below 725 psi. The alarm resets at 900 psi.

For LN₂

The recommended operating pressure for LN₂ backup systems is between 15 and 25 psi.

When the pressure exceeds approximately 50 psi, a rupture disk causes the system to shut down and release excess pressure. The release valve is located in back of the control panel.

In models equipped with an audible alarm feature on the main control panel, the alarm will sound when the pressure drops below 3 psi. The alarm resets at 15 psi.

4.2 Control Assembly for Upright Models

Note: Read all of the following steps before proceeding with the installation.

To install the control assembly, complete the following steps:

1. Place the control unit on top of the cabinet. Place the CO₂ cylinder at the back of the control unit and chain the CO₂ cylinder in a secure place.

2. Select the door switch and mounting bracket required for your unit (refer to Figure 1). Refer to Figure 2 or Figure 3 on page 3 for assembly illustration.



CAUTION! Some upright cabinets are built with condenser coils secured to the inside of the outer cabinet shell. The bracket **must** be used as a template in drilling the mounting hole to avoid puncturing the condenser coils. If the condenser coils are pierced, refrigerant leaks into the atmosphere, causing unit failure. Refrigerant can burn the operator.

3. Mount the switch and bracket assembly:
 - a. Position the bracket on the top of the cabinet.
 - b. Use the bracket to locate the mounting screw position and use the included self drilling screw to mount the bracket.
 - c. Place the bracket slot under the screw head and tighten the screw.
 - d. Adjust the bracket position so that the door switch is actuated as the door swings open and closed.

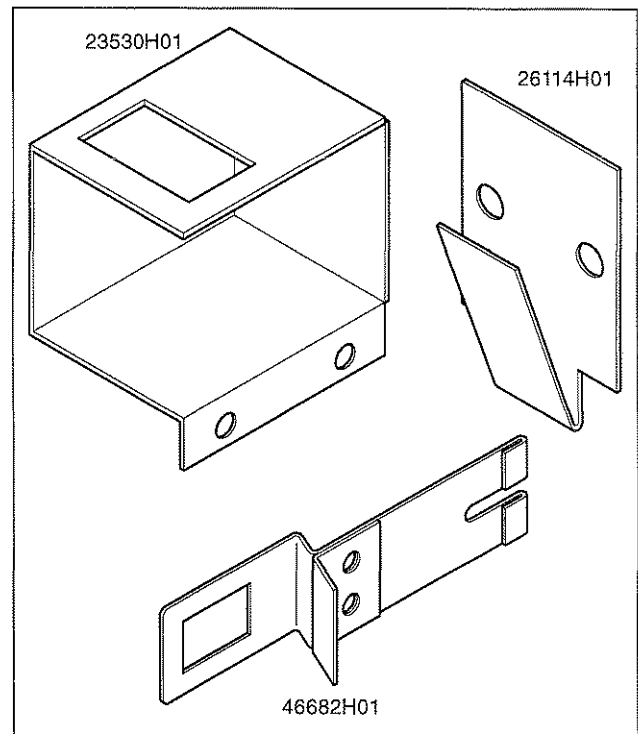


Figure 1. Door/Lid Liquid Cutoff Switch Brackets

The two top brackets (23530H01 and 26114H01) are designed for use with 3 ft³ and 5 ft³ chest freezers with bracket location holes on the back of the cabinet. The bottom bracket (46682H01) is designed for use with upright freezers and 3 ft³ and 5 ft³ chest freezers without bracket location holes on the back of the cabinet.

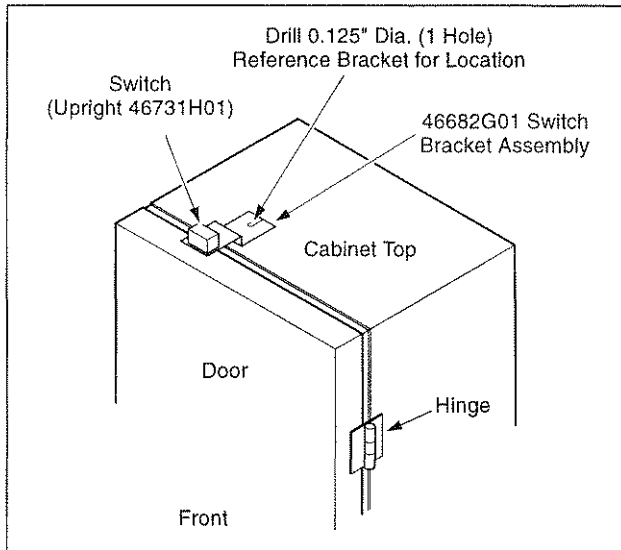


Figure 2. Positioning Switch Bracket (Upright)

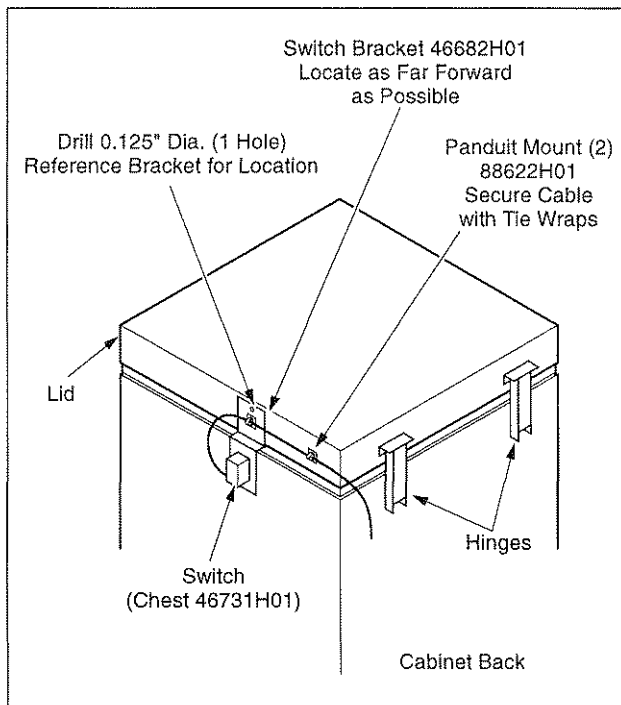


Figure 3. Positioning Switch Bracket (Chest) on 390 without Switch Bracket Location Holes on Back of Cabinet

4. Plug the door switch cable into the door switch connection on the back of the control assembly cabinet.
5. Install the CO₂ or LN₂ sensor:

- a. Remove the existing freezer sensor and the recorder sensing bulb, if any. Enlarge the hole through the insulation.
- b. Uncoil the control unit sensor assembly and mount the sensor to the bracket which holds the freezer sensor at the right rear corner of the tank. This sensor is routed from the control unit, down the back of the freezer to the machine compartment, and up through the access hole in the bottom of the cabinet compartment.
- c. Apply silicone over the access hole in the bottom of the cabinet after the CO₂/LN₂ sensor is installed.
- d. Insert the bulbs, cables, and recorder capillary (if used). Use three 1/4 in. plastic clamps to replace the existing clamps.
- e. Plug the sensor cable into the sensor cable connection on the back of the control assembly cabinet.
6. Install the Cabinet Vent Assembly through the 1 in. diameter port located on the back wall of the cabinet (refer to Figure 4) before operating the backup system.

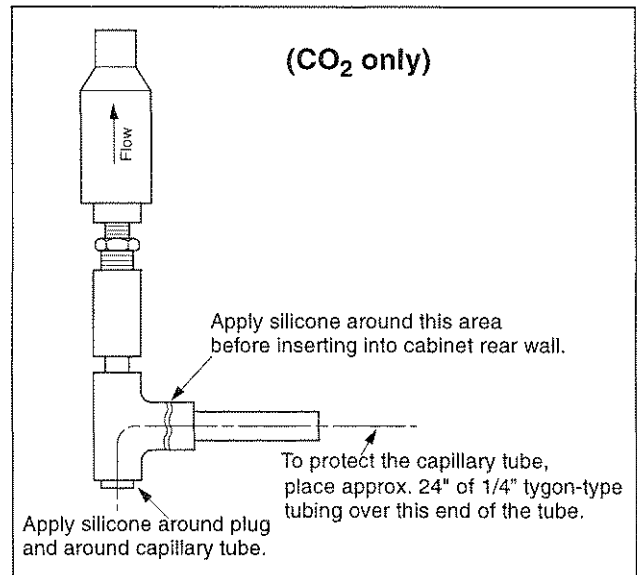


Figure 4. Cabinet Pressure Relief Check Valve



CAUTION! The Cabinet Vent Assembly prevents excess pressure from building within the cabinet due to frost formation which can block the porthole on the back of the unit. The porthole provides pressure relief when emergency gases are being admitted directly into the cabinet interior and must always be kept open.

4.3 Liquid Delivery System for Upright Models



CAUTION! The liquid delivery systems for CO₂ and LN₂ are different. Follow the installation instructions for your system.

Note: Read all of the following steps before proceeding with the installation.

4.3.1 CO₂ Systems

To install a CO₂ delivery system, complete the following steps:

1. Install the CO₂ supply tube (refer to Figure 5).

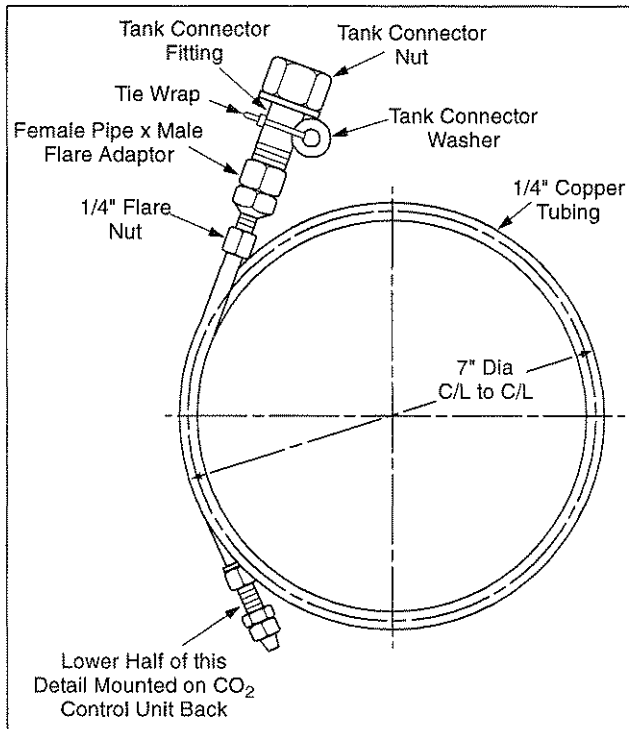


Figure 5. CO₂ Supply Tube Assembly

2. Remove the stainless steel mounting bracket.
3. Install the liquid discharge tube (refer to Figure 6 and Figure 7):
 - a. Remove the coil of capillary tubing from the control unit housing.
 - b. Insert the end of the capillary tube through the PVC cabinet vent assembly (refer to Figure 4 on page 3).

Note: It's much easier to run the capillary tube through the tee of the vent assembly before the assembly is siliconed together (refer to Figure 4 on page 3).

- c. Attach the capillary tube with the perforated, stainless steel mounting bracket supplied with the accessory kit.
- d. Bend the end of the capillary tube 105 degrees so that spray is directed away from the door. Do not create a sharp bend in the capillary tube.

- e. Hold the capillary tube end in place with a tie wrap.

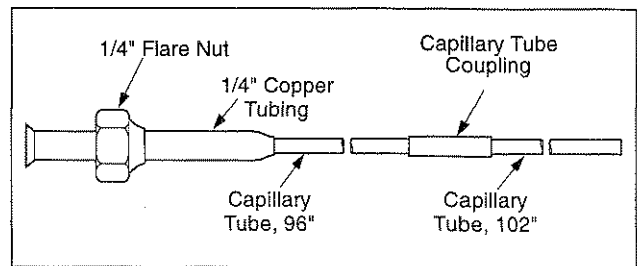


Figure 6. CO₂ Discharge Tube Assembly

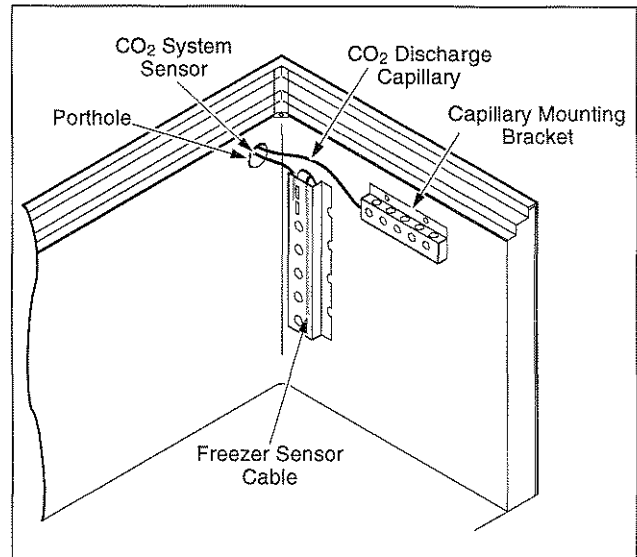


Figure 7. CO₂ System Component Placement

4.3.2 LN₂ Systems

To install an LN₂ delivery system, complete the following steps:

1. Connect one end of the LN₂ supply tube (insulated coil of 1/4 in. OD tubing, refer to Figure 8) to the liquid source and the other end to the inlet fitting on the back of the control unit.

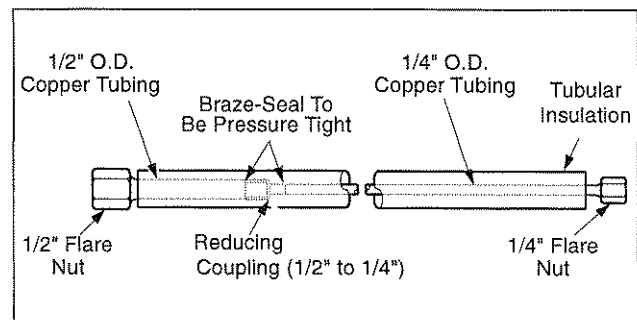


Figure 8. LN₂ Supply Tube Assembly

2. Connect one end of the LN₂ extension tube (insulated coil of 3/16 in. OD soft copper tubing, refer to Figure 9) to the LN₂ supply tube and connect the other end to the discharge tube. These connections are on the outside of the freezer cabinet.

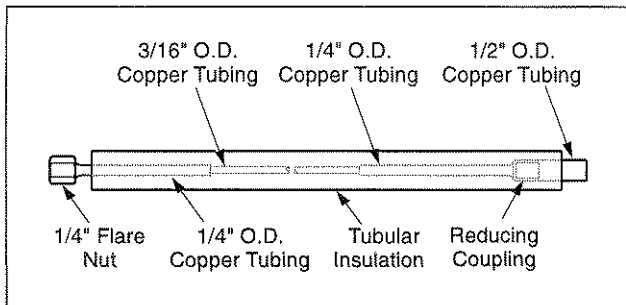


Figure 9. LN₂ Extension Tube Assembly

3. Connect the LN₂ discharge tube (preformed length of 1/2 in. OD perforated stainless steel tubing, refer to Figure 10) to the LN₂ extension tube:
 - a. Locate the brass elbow assembled with ferrules and nuts in place. **Do not** remove the nuts from this elbow.
 - b. Insert the LN₂ discharge tube into one end of the elbow until the tube bottoms out. Tighten the elbow nuts 3/4 turn only. Do not tighten more than 3/4 turn.
 - c. Insert the LN₂ extension tube into the other end of the elbow until the tube bottoms out. Tighten the elbow nuts 3/4 turn only. Do not tighten more than 3/4 turn.

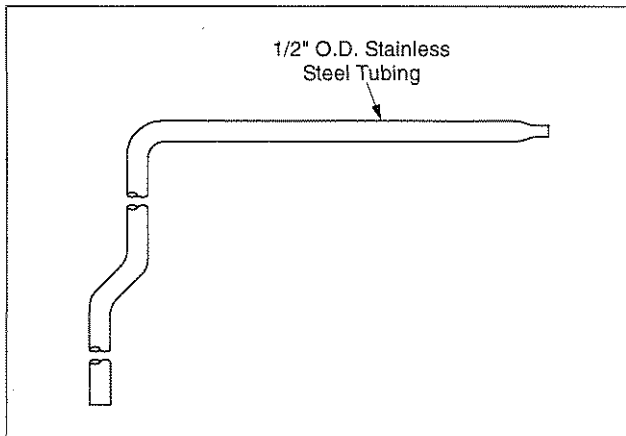


Figure 10. LN₂ Discharge Tube Assembly

Note: There are three different lengths of LN₂ discharge tubes, depending on the size of the freezer cabinet. In upright models, install the tube on the left front of the tank wall. The LN₂ extension and discharge tube assembly serves the same function as the CO₂ discharge capillary tube.

4. Mount the LN₂ discharge tube to the tank wall with the lower of the two screw grommets on the left front of the tank wall. Insert the tube through the rear porthole and across the left side of the tank. Then bend the tube 90 degrees so it runs downward along the inner door stop (refer to Figure 11).

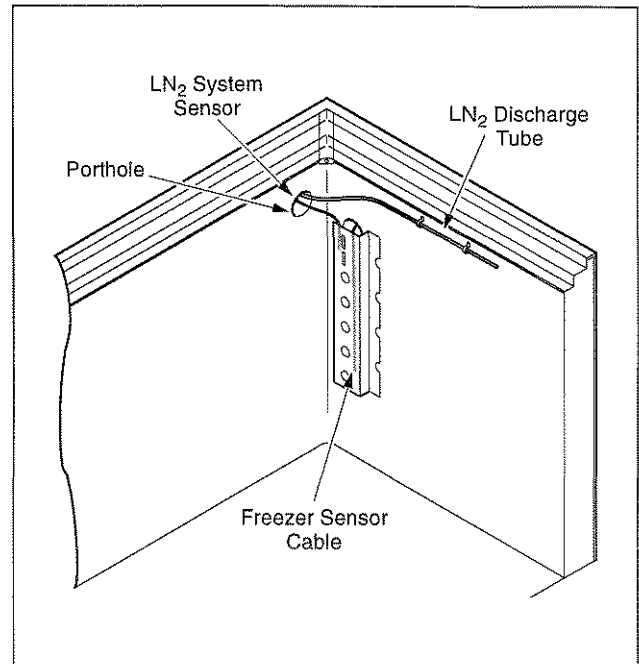


Figure 11. LN₂ System Component Placement

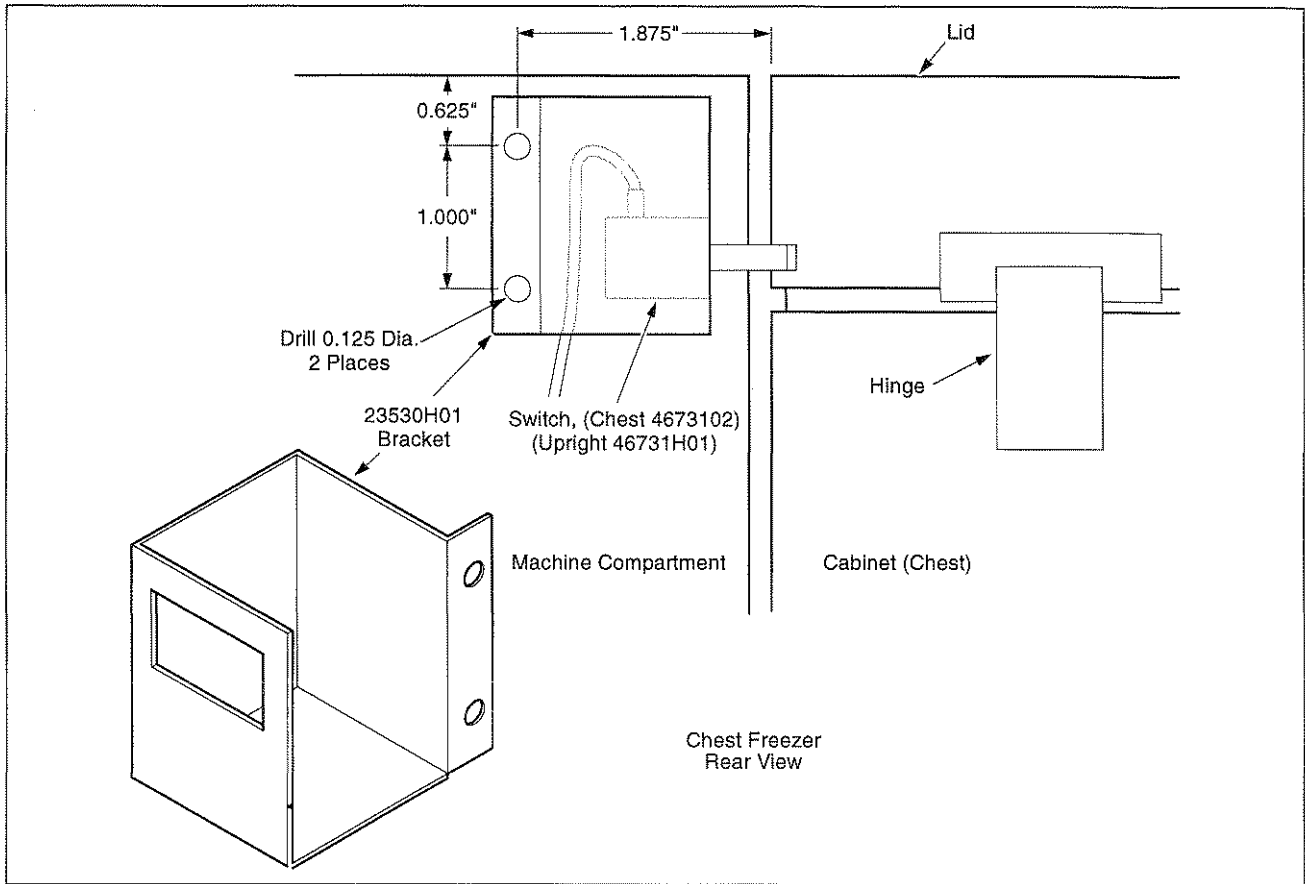


Figure 12. Positioning Switch Bracket

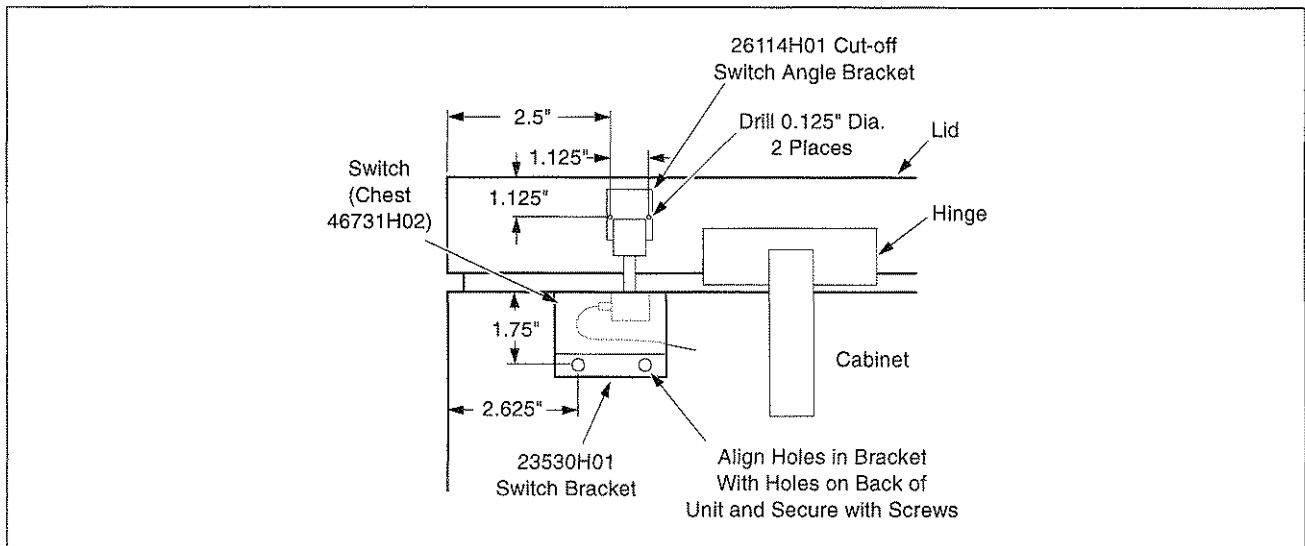


Figure 13. Positioning Switch Brackets on 390 and 590 with Bracket Location Holes on Back of Cabinet

4.4 Control Assembly for Chest Models

Note: Read all of the following steps before proceeding with the installation.

To install the control assembly, complete the following steps:

1. Place the control unit on the top of the machine compartment. For 3 ft³ and 5 ft³ chest models, either set the control on the floor beside the unit or mount it on a shelf next to the cabinet.
2. Select the door switch and mounting bracket required for your unit (refer to Figure 1 on page 2). Refer to Figure 12 or Figure 13 on page 6 for assembly illustration.



CAUTION! Do not drill into any part of the cabinet on a 3 ft³ or 5 ft³ freezer. Any drilling can puncture the refrigeration tubing or insulation.

3. Mount the switch and bracket assembly:
 - a. Position the bracket on the top of the cabinet.
 - b. Use the bracket to locate the mounting screw position and use the inclosed self drilling screw to mount the bracket.
 - c. Place the slot in the bracket under the screw head and tighten the screw.
 - d. Adjust the bracket position so that the door switch is actuated as the door swings open and closed.
4. Plug the door switch cable into the door switch connection on the back of the control assembly cabinet.
5. Install the CO₂ or LN₂ sensor:
 - a. Remove the existing freezer sensor and the recorder sensing bulb, if any. Enlarge the hole through the insulation.
 - b. Uncoil the control unit sensor assembly and mount the sensor to the bracket which holds the freezer sensor at the right rear corner of the tank. This sensor is routed from the control unit, down the back of the freezer to the machine compartment, and up through the access hole in the bottom of the cabinet compartment.
 - c. Insert the bulbs, cables, and recorder capillary (if used). Use three 1/4 in. plastic clamps to replace the existing clamps.
 - d. Plug the sensor cable into the sensor cable connection on the back of the control assembly cabinet.
6. Install the Cabinet Vent Assembly through the 1 in. diameter port located on the back wall of the cabinet (refer to Figure 4 on page 3) before operating the backup system.



CAUTION! The Cabinet Vent Assembly prevents excess pressure from building within the cabinet due to frost formation which can block the porthole on the back of the unit. The porthole provides pressure relief when emergency gases are being admitted directly into the cabinet interior and must always be kept open.

4.5 Liquid Delivery System for Chest Models



CAUTION! The liquid delivery systems for CO₂ and LN₂ are different. Follow the installation instructions for your system.

Note: Read all of the following steps before proceeding with the installation.

4.5.1 CO₂ Systems

To install a CO₂ delivery system, complete the following steps:

1. Install the CO₂ supply tube (refer to Figure 5 on page 4).
2. Remove the liquid discharge tube from the perforated stainless steel shield.
3. Insert the liquid discharge tube through the rear porthole and along the right side of the tank.
4. Reassemble the tube inside the shield and mount the assembly to the existing screw grommets with nylon standoffs and Phillips head self-tapping screws.



CAUTION! Make sure the end of the liquid discharge tube points down or liquid could be sprayed at the door and possibly injure the operator.

4.5.2 LN₂ Systems

To install an LN₂ delivery system, complete the following steps:

1. Connect one end of the LN₂ supply tube (insulated coil of 1/4 in. OD tubing, refer to Figure 8 on page 4) to the liquid source and the other end to the inlet fitting on the back of the control unit.
2. Connect one end of the LN₂ extension tube (insulated coil of 3/16 in. OD soft copper tubing, refer to Figure 9 on page 5) to the LN₂ supply tube and the other end to the discharge tube. These connections are on the outside of the freezer cabinet.
3. Connect the LN₂ discharge tube (preformed length of 1/2 in. OD perforated stainless steel tubing, refer to Figure 10 on page 5) to the LN₂ extension tube:
 - a. Locate the brass elbow assembled with ferrules and nuts in place. **Do not** remove the nuts from this elbow.
 - b. Insert the LN₂ discharge tube into one end of the elbow until the tube bottoms out. Tighten the elbow nuts 3/4 turn only. Do not tighten more than 3/4 turn.
 - c. Insert the LN₂ extension tube into the other end of the elbow until the tube bottoms out. Tighten the elbow nuts 3/4 turn only. Do not tighten more than 3/4 turn.

Note: *There are three different lengths of LN₂ discharge tubes, depending on the size of the freezer cabinet. The LN₂ extension and discharge tube assembly serves the same function as the CO₂ discharge capillary tube.*

4. Mount the LN₂ discharge tube with nylon standoffs, PVC tubing clamps, and Phillips self-tapping screws (refer to Figure 14 on page 8).

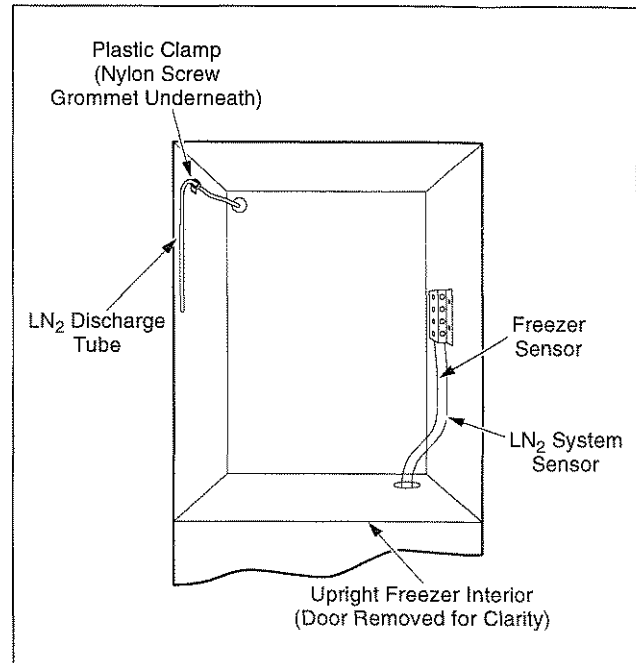


Figure 14. LN₂ System Component Placement

5 Operation

The operation procedure is the same for both upright and chest freezers.

Note: Please read the safety information in Section 2.2 on page 1 before operating the backup system.

5.1 Control Operation

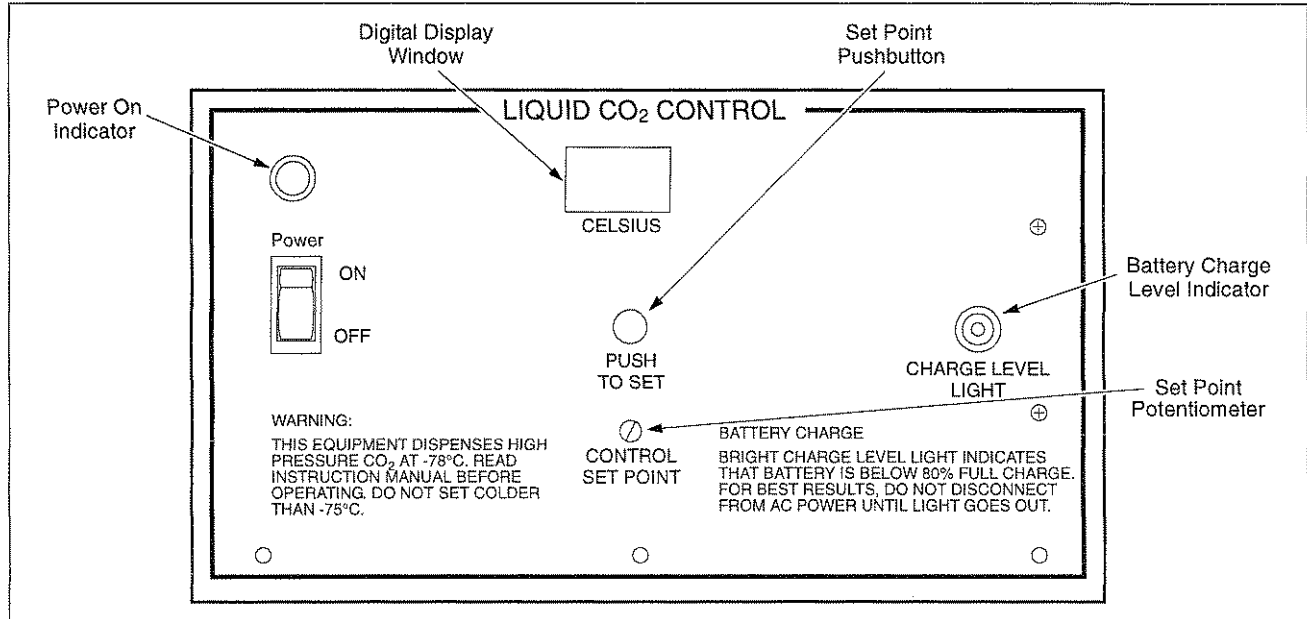


Figure 15. CO₂ Control Panel

To operate the CO₂ or LN₂ Backup System, complete the following steps:

1. Turn on the supply valve.
2. Press and hold the set point pushbutton and use a small screwdriver to rotate the set point potentiometer until the desired temperature shows in the digital display window.

The following steps comprise a test procedure which must be performed at initial start-up and should be repeated occasionally as a preventive maintenance procedure to test the system.

Note: Set the control temperature set point at least 10° colder than the current cabinet temperature.

Liquid begins discharging into the cabinet.

3. Open and close the door or lid to verify that the liquid supply discharges into the cabinet when the door or lid is closed and stops discharging when the door or lid is opened.

If the door switch does not function, check that the wires are tight and that the switch rocker arm depresses as the door or lid closes.

4. When the freezer is at operating temperature, set the control system 10° warmer than the freezer set point.



CAUTION! When CO₂ is the liquid source, setting the temperature control colder than -75°C results in continuous liquid discharge.

5.2 Battery Operation

The Charge Level Light illuminates when the battery charge falls below 80%. This light may also illuminate when the solenoid is energized.

Leave the control assembly plugged in at all times to maintain a fully charged battery. If the battery is left in a discharged state for an extended period of time, it may not accept a full charge. If you want to turn the freezer off, unplug the door switch cable from the back of the control unit. This action prevents operation of the injection solenoid and allows the built-in battery charger to maintain a fully charged battery.

Table 1. Backup System Flow Rates

Center Air Temperature		Lbs/hr @ 75°F Ambient Temperature (Flow Rate)		
		-50°C	-60°C	-70°C
Liquid CO₂				
Chest Freezers				
3 ft ³	Empty	2.8	3.2	3.7
	1/2 Full	2.4	2.7	3.1
	Full	1.8	2.1	2.4
7 ft ³	Empty	4.1	4.7	5.5
	1/2 Full	3.5	4.0	4.6
	Full	2.6	3.0	3.5
10 ft ³	Empty	4.9	5.6	6.6
	1/2 Full	4.2	4.8	5.5
	Full	3.1	3.6	4.1
14 ft ³	Empty	5.6	6.5	7.5
	1/2 Full	4.8	5.5	6.3
	Full	3.5	4.2	4.8
17 ft ³	Empty	6.5	7.5	8.7
	1/2 Full	5.5	6.3	7.3
	Full	4.1	4.8	5.5
20 ft ³	Empty	7.3	8.4	9.8
	1/2 Full	6.2	7.1	8.2
	Full	4.6	5.4	6.2
Upright Freezers				
13 ft ³	Empty	7.4	8.5	9.7
	1/2 Full	6.5	7.4	8.3
	Full	5.1	5.9	6.7
17 ft ³	Empty	8.3	9.5	10.9
	1/2 Full	7.3	8.3	9.3
	Full	5.8	6.6	7.5
21 ft ³	Empty	8.9	10.2	11.7
	1/2 Full	7.8	8.9	10.0
	Full	6.2	7.1	8.1
25 ft ³	Empty	9.5	11.1	12.8
	1/2 Full	8.5	9.7	10.9
	Full	6.8	7.7	8.8

Center Air Temperature		Lbs/hr @ 75°F Ambient Temperature (Flow Rate)		
		-60°C	-70°C	-80°C
Liquid LN₂				
Chest Freezers				
3 ft ³	Empty	2.7	3.1	3.5
	1/2 Full	2.2	2.6	2.9
	Full	1.7	1.9	2.2
7 ft ³	Empty	3.9	4.5	4.1
	1/2 Full	3.3	3.8	4.3
	Full	2.5	2.8	3.2
10 ft ³	Empty	4.7	5.4	6.1
	1/2 Full	4.0	4.5	5.1
	Full	3.0	3.4	3.8
14 ft ³	Empty	5.4	6.2	7.0
	1/2 Full	4.5	5.2	5.9
	Full	3.4	3.9	4.4
17 ft ³	Empty	6.2	7.1	8.1
	1/2 Full	5.3	6.0	6.8
	Full	3.9	4.4	5.1
20 ft ³	Empty	7.0	8.0	9.1
	1/2 Full	5.9	6.7	7.6
	Full	4.4	5.0	5.7
Upright Freezers				
13 ft ³	Empty	7.0	7.9	8.9
	1/2 Full	6.1	6.8	7.6
	Full	4.8	5.4	6.1
17 ft ³	Empty	7.7	8.7	9.8
	1/2 Full	6.7	7.5	8.4
	Full	5.3	6.0	6.7
21 ft ³	Empty	8.4	9.5	10.7
	1/2 Full	7.3	8.2	9.2
	Full	5.8	6.5	7.3
25 ft ³	Empty	9.1	10.3	11.6
	1/2 Full	7.9	8.9	10.0
	Full	6.3	7.1	7.9

Important

For your future reference and when contacting the factory, please have the following information readily available:

Model Number: _____

Serial Number: _____

The above information can be found on the silver dataplate attached to the equipment. If available, please provide the date purchased, the source of purchase (specific agent/rep organization), and purchase order number.

IF YOU NEED ASSISTANCE:

LABORATORY PARTS and SERVICE

Phone: 800/438-4851

FAX: 828/658-2576

TECHNICAL SUPPORT

Phone: 800/438-4851

Toll Free (U.S.): 828/658-2576