Operation and Maintenance Manual

ULTRA-FREEZE®
Carbon Dioxide Tunnel Freezer

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Manuf. for: _____

Model: _____

Size: _____

Serial No: _____

Date: _____

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For more specific information about the equipment and components, please refer to the manufacturer.

1. General Overview

This manual describes the installation and operation of **ULTRA-FREEZE®** tunnel freezers using liquid carbon dioxide (CO_2). The installation described herein comprises the bulk CO2 storage system, the supply piping, the application-specific installation, as well as auxiliary equipment and accessories.

The information applies to the various models such as those with 30" wide or 48" wide conveyor belts, single pass and three tier freezers, as well as those with optional variable speed fans. When necessary for clarification, special comments will be included for a specific variation.

1.1. INSPECTION

Carefully inspect for damage that may have occurred during shipping. Check the packaging list to make sure that all separately packed items (exhaust, spare parts, bolts, etc.) have been received.

If there is any damage, all claims must be made promptly to the shipping company. The local Air Liquide representative should also be notified of any claims made.

1.2. SYMBOLS & IDENTIFIERS

The following symbols are found throughout the document to bring attention to potentially dangerous situations.

	**Hazardous situation** Possible consequences: Slight to major injuries.
	**Harmful situation** Possible consequences: Damage to the equipment or environment.
	**Tips and useful information**
	**Electrical hazard** Possible consequences: Severe or fatal injuries.

2. Safety Precautions

To ensure your safety, and the safety of those around you, carefully read through the safety precautions in this section.

2.1. SAFETY CONSIDERATIONS BEFORE OPERATION

The **ULTRA-FREEZE®** freezer has been designed to operate in as safe a manner as possible with an exhaust system to assure the efficient removal of carbon dioxide (CO_2) gas.

It is emphasized that the room in which the freezer will be installed shall be large enough and have sufficient air changes, preferably with high and low level ventilation, to prevent a build-up of carbon dioxide gas in case of accidental spillage or malfunctioning of the equipment. A carbon dioxide monitor with alarm function is strongly recommended.

The freezer described in this manual should only be used for freezing of food products and should be operated according to the instructions as provided in this manual.

2.2. GENERAL GUIDELINES

Ensure the safety of operating personnel and avoid damage to your freezing equipment by considering the following guidelines:

- Ensure the freezer exhaust system is turned on and the production area is adequately ventilated during operation of the installation.
- Do not touch any cooled parts or products without suitable protective gear.
- Always check that the exhaust system is functioning properly before starting the injection of CO_2. Failure to do so could result in asphyxiation.
- Never touch liquid carbon dioxide, frozen products or freezer internals with bare hands. All are extremely cold and can cause cold burns. Personal Protective Equipment (PPE) for use with liquid CO_2 are found in the Appendix A – Carbon Dioxide MSDS.
- Avoid stopping the conveyor belt and exhaust system while the freezer is cold. This allows humid air into the freezer, and may cause the system to freeze up.
- Always make sure the side guards (entry end/load deck) and the scraper plate (discharge end) are in position before starting freezer operation.
- Never reach inside the freezer when it is running. Doing so may result in bodily injury.
- Never leave the freezer unattended when it is running.
- Avoid wearing loose clothing (e.g. open work coats, loose strings, scarves, etc.) in the vicinity of moving mechanical parts (e.g. drive unit, conveyor belt). This can result in severe bodily injury.
- Maintenance or other work on the installation should only be performed in the presence of another person, and with the freezer properly de-energized and locked out.

2.3. SAFETY DEVICES

The **ULTRA-FREEZE®** is equipped with several safety devices, designed with the operator's safety in mind. The following is a list of engineered safety controls.

CO_2 Level Interlock

The **ULTRA-FREEZE®** is equipped with an optional CO_2 interlock that is tied into the emergency stop loop. A CO_2 monitor with a beacon and an audible alarm should be purchased to monitor the CO_2 levels in the area around the **ULTRA-FREEZE®** freezer. It should be wired in to the contacts provided for this in the control panel so that the freezer will be shut down in the event that high CO_2 levels are detected. Carbon dioxide concentrations in the ambient (i.e. room) atmosphere should be lower than 0.5%, the OSHA level for an 8 hour exposure. In the event of a shut down, the belt, CO2 injection and circulating fans will stop. However, the exhaust system will continue to run if an e-stop is activated. This ensures continued removal of excess CO2 in the production area.

Exhaust Blower Interlock

Injection of CO2 can only occur if the exhaust blower motor is in operation. In addition, the **ULTRA-FREEZE®** is equipped with an optional exhaust interlock that is tied into the emergency stop loop. A switch (e.g. pressure or flow) should be installed in the exhaust ductwork, and wired in to the contacts provided for this in the control panel. If the switch detects low or no air flow, due a problem with the exhaust blower, the freezer will shut down (the belt, CO2 injection and circulating fans will stop). Before troubleshooting, the freezer should be locked out at the main disconnect switch if maintenance on the exhaust blower is required. It is also good practice to install a disconnect switch at the blower on the roof.

Emergency Stop Buttons

There are a total of three Emergency Stop (e-stop) buttons; they are located on the control panel, and at each end of the freezer. In event of an emergency, operators can shut down the freezer within seconds. Both solenoid valves (SV-103 and SV-300) will fail closed to prevent further CO2 injection, and the conveyor belt and circulating fans will stop. The exhaust will continue to run after the e-stop is activated, to ensure the proper removal of CO2 vapor. Should the solenoid valves (SV-103 and SV-300), NOT properly close, then the shut-off valve (main valve) on the CO_2 supply line at the freezer can be closed manually until the problem is resolved. In the event of a major product jam-up, belt jam-up, or other unexpected stoppage, the operator should make use of the E-stop.

Upper Freezer Door Interlock

Limit switches monitor the open/close status of the upper freezer doors. The safety-rated limit switches are wired normally open to prevent the circulating fans and CO2 injection from activating when the doors are open. When the doors close, the limit switch contacts also close, energizing the circulating fans and the CO2 injection solenoid valves. If the doors are opened during operation, the circulating fans and CO2 injection will stop.

Pressure Relief Valves

A pressure relief valve is located on the freezer between the manual shutoff valve at the freezer, and the two solenoid valves. The relief valve prevents the possibility of pipe rupture due to the trapped liquid expanding to gas. Relief valves should be piped away to an outside location, to ensure proper removal of CO2 gas if a valve failure should occur.

2.4. HAZARDS OF LIQUID CARBON DIOXIDE

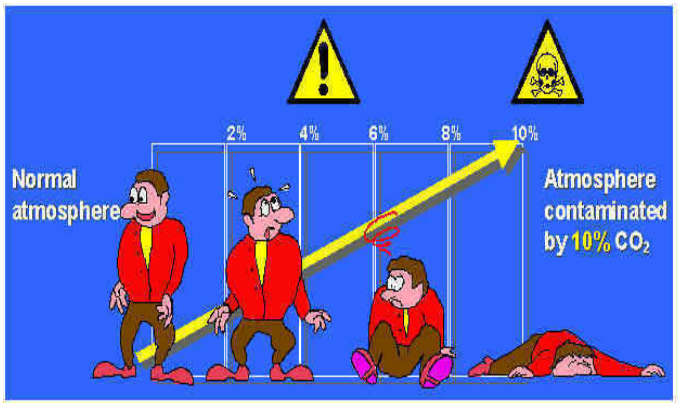
Inform all personnel about the potential hazards related to the use of liquid carbon dioxide.

> See **Appendix A – Carbon Dioxide MSDS** for more information.

COLD BURNS: The freezer operates on CO_2, which, in its solid form can reach temperatures of as low as to –78.5 °C/ –109.3 °F. Physical contact with the solid CO_2 (CO_2 snow) can cause cold burns and tissue damage. Avoid any direct contact with food or mediums/metal in direct contact with carbon dioxide by wearing suitable safety gear (safety glasses, facial shield, long-sleeved clothes, long pants, appropriate thermal insulated gloves). The surface of the food product leaving the injection points may also be at sub-zero temperature and should not be handled without sufficient protection. This also applies to the internal surfaces of the freezer when just opened. Contact with the cold gas can cause freezing of exposed tissue.

HIGH PRESSURE INJURY: As liquid carbon dioxide warms up, the liquid turns to gas and can expand up to 550 times in volume. This expansion could cause the pipe to explode. To prevent this from happening, be aware of trapping liquid carbon dioxide in the line. Ensure that the pressure can bleed back into the supply tank or out of a safety relief valve. Know where shut-off valves are in case of an emergency.

CO2 GAS: CO2 gas can displace the air in the area surrounding and cause asphyxiation. Carbon dioxide cannot be detected by the human senses and will be inhaled like air. If adequate ventilation is not provided, it may displace normal air without warning. Since carbon dioxide is more dense than air, high concentrations can persist in open pits, tanks, or low areas. **Concentrations of 10% CO2 or greater will cause unconsciousness or death, without regard to oxygen concentration.**



An **indoor** customer installation should include a CO2 area monitor.

> The **ULTRA-FREEZE®** can be interlocked with a CO2 monitoring device, to shut down the freezer if high CO2 levels are detected.

Moisture in the air could lead to the formation of carbonic acid which can be irritating to the eyes.

Oxygen concentrations in the ambient (i.e. room) atmosphere should always be higher than 19.5%, the lower limit according to OSHA. Exposure to atmospheres containing 16% or less of oxygen will lead to unconsciousness without warning! Please refer to the MSDS sheet in the attachments to see the effects of lower oxygen levels on the body.

3. About the ULTRA-FREEZE®

3.1. EQUIPMENT SPECIFICATIONS

SPECIFICATIONS	ULTRA-FREEZE TUNNELS	
Conveyor Width	30" width	48" width
Width of Freezer		
Door Closed	4'-10"	6'-2"
Doors Open	6'	7'-6"
Product Loading Height (± 1½")		
1 Tier	35"	35"
3 Tier	40 ½"	40 ½"
Product Discharge Height (± 1½")		
1 Tier	23 ½"	23 ½"
3 Tier	28 ½"	28 ½"
Product Clearances		
1 Tier	8 ¾"	8 ¾"
3 Tier	4"	4"
Shipping Crate		
Length	Up to 21'-10"	
Width	5'-7"	7'-0"
Height	6'-5"	6'-5"
Electrical	230V 60Hz Standard 25-100 amps (depending on modules)	
Hydraulic	Fused and wired to NEC and CSA standards 230/460 V 3 phase 60hz	

ULTRA-FREEZE MODULES	FREEZER LENGTH	USABLE CONVEYOR LENGTH	
		1 TIER	3 TIER
2	16'	15'-4"	35'-5"
3	21'-7"	20'-11"	52'-4"
4	27'-3"	26'-7"	69'-2"
5	32'-10"	32'-2"	86'
6	38'-6"	37'-10"	102'-11"
7	43'-11"	43'-5"	119'-10"
8	49'-9"	49'-1"	136'-8"
9	55'-4"	54'-8"	153'-6"
10	61'	60'-4"	170'-5"

3.2. THE ULTRA-FREEZE® PROCESS

The basic principles of the Ultra-Freeze® process are:

- The use of fans to circulate the cold gases at high velocity
- Accurate control of temperature to eliminate the build-up of dry ice snow.

The **ULTRA-FREEZE®** process utilizes the "wind chill" effect to increase the freeze rate for products. The high velocity gas flow created by the circulating fans, continually removes the thin insulating envelope of static gas that normally surrounds the product to be frozen. This allows the super cold carbon dioxide gases to be in constant contact with the surface of the food product. The rapid freeze achieved by the high velocity gas flow reduces product shrinkage and moisture loss, as well as maintains final quality of the product.

The **ULTRA-FREEZE®** process does not deposit dry ice snow directly on the product or cause an accumulation of snow in the freezer. The small particles of dry ice formed at the injection orifices are rapidly sublimed (converted to cold gas) by absorbing heat from the temperature controller freezer zones. The secret to the efficient operation of the **ULTRA-FREEZE®** tunnel is accurate temperature control of the modules to eliminate the build-up of dry ice.

The **ULTRA-FREEZE®** temperature controlled injection system keeps the CO_2 consumption low by matching the injection to the product heat load. If the product flow stops, the freezer automatically reduces the liquid carbon dioxide injection rate to the minimum required to maintain the desired operating (set point) temperature.

Operating the freezer at a temperature below -95^{o}F causes snow to build-up, causing an excess of unused product at the end of the day. It takes approximately 2.5 pounds of LCO_2 to make 1 pound of dry ice, therefore demonstrating that efficient operation of the freezer requires eliminating wasted snow.

A key error made by many operators of CO2 freezers is improper management of the freezing process. Standards need to be set for various products (set point temperature and belt speed), and proper belt loading and proper belt speed (dwell time) must be maintained. There should be prompt attention to changing conditions as well.

3.3. THE FREEZER

The **ULTRA-FREEZE®** is an assembly of one or more modules joined together to form an insulated tunnel that product is conveyed through. There is an entry and an exit vestibule bolted to the respective end of the tunnel. The entry vestibule allows an area for loading the conveyor belt and has an exhaust trough for collecting the cold exhaust vapors. The exit vestibule has the conveyor drive motor(s), the exit exhaust trough and is the product discharge area.

The individual modules form natural zones that are used to efficiently control temperature of the freezing process. Each module is equipped with two propeller-type circulating fans mounted above the conveyor that rapidly circulate the cold gases over the product. Product heat load variations cause the temperature in each zone to change, which signals the CO2 injection system to cycle off and on as

required. This insures the highest product freezing capacity with the optimal utilization of the CO2 freezing capacity.

Each module has welded steel tubing frames built inside the sealed fiberglass skins. The frames are located on the warm outer surfaces of the parts to keep cooling losses to a minimum. All fasteners attached to the modules are anchored to the inner steel framework through the use of threaded rivet type fasteners.

The fiberglass parts are high strength hand lay-up molded fiberglass parts, coated with a USDA accepted food grade gel coat. All joints in the fiberglass are on the outside surfaces where they are not subject to temperature shocks or expansion and contraction. The doors are insulated with foam-in-place closed cell polyurethane foam for high insulating value and high structural strength. The module is insulated with staggered layers of preformed polyurethane foam to allow for minor expansion and contraction. There are no direct metal heat conduction paths to the outside of the freezer. The door gaskets are preformed spun polyester strips. If they are damaged, the individual gasket sections can be replaced easily.

All exposed internal metal parts are stainless steel. The fan blades are hard anodized cast aluminum. All exposed plastic parts are of materials approved by inspection agencies for use as food contact surfaces. The upper and lower doors open on each side of the freezer to fully expose the inside for ease of cleaning.

3.4. CONVEYOR(S) / BELT(S)

The conveyor belt is an all stainless steel ¾" pitch Ashworth (or equivalent) omni grid style with side drive links. The conveyor mesh overlay is selected to be suitable for the product to be cooled or frozen.

The conveyor drive gear reducer(s) is driven by a DC motor with the speed controller potentiometer mounted on the freezer control panel. The horsepower of the drive motor (3/4HP or greater) depends on the width and length of the freezer.

The standard conveyor belt speed range is 5 to 22 ft per minute. Other speed ranges are provided as required. If the conveyor needs to operate at extremely low speeds, a change in gear ratio may be required. DC motor speed should be greater than 500 rpm to prevent the motor from overheating.

3.5. CIRCULATING FANS

Apparatus boxes on top of certain modules house the starters for the circulating fan motors, and module wiring.

Fixed speed fan freezers have two fans in each module. They are driven by vertically mounted 1 HP 1200 rpm motors located on the top of each module.

Each fixed speed fan motor has an automatic fail safe brake. Once power to the motor is shut off, the brake is engaged and the fan will stop rotating almost instantly. In a freezer with fixed speed fans,

whenever an upper door on a module is raised, the safety limit switch on that door will stop the 2 fans in that module as well as CO2 injection into the freezer.

> **WARNING!** Do not manually override the brake, or injury could occur due to someone reaching inside the module before the fan stops rotating.

Variable speed fan freezers do not have brakes. The 1/2HP 1200 rpm motors also stop almost instantly by using electric dynamic braking. Whenever any upper door is raised, the safety limit switch will shut all circulating fan motors off, as well as CO2 injection into the freezer.

> **WARNING!** If electrical power is shut-off to controller, or if fan stop button is pushed while fans are rotating, there is no effective electronic braking. Therefore, the fans will coast to a stop and may still be rotating even with the doors open.

3.6. CONTROL PANEL

The freezer controls are conveniently located on the front panel of the NEMA 12 rated control cabinet. The controls are the following:

1. Main motor disconnect switch handle (230 VAC, 3 phase, 60 Hz)
2. a. Fan motor push button stations (1 per module) for fixed speed only
   b. Fan motor push button station (1 per freezer) for variable speed fans
3. Conveyor drive push button station (1 per drive)
4. Instrument power push button station
5. Exhaust blowers push button station
6. Temperature controller(s) (1 per CO2 drop)
7. Conveyor speed selector knob(s) (1 per drive)
8. Conveyor speed indicator (reads in ft/min with standard ratio gear reducers)
9. Fan speed selector knob for variable speed fan models (1 per freezer)
10. Emergency Stop Button (not shown)

SAFETY NOTE: Do not disassemble the CO_2 piping before first closing all appropriate lines. Liquid CO_2 changes to dry ice when depressurized, which can form dry ice plugs in the valves and fittings. Pockets of pressure can be held back by such ice plugs, which could cause a high pressure release.

3.7. INJECTION HEADERS

Each assembly feeds the LCO_2 through the bottom of the apparatus box down into the center of a freezer module. Each drop can control injection of LCO_2 into either 1, 2 or 3 modules through the use of extension headers. A single module drop supplies liquid to the right or left side orifice headers. There are (4) ¼" OD orifice header pipes with (3) 0.030" diameter orifices uniformly drilled along the tubing. These should be adjusted to blast down onto the product. They should be pointed to the outer edge of the conveyor belt (approximately 45^{o} angle).

The injection headers are positioned so the orifices are pointing 5 to 10° off vertical and in the direction of the fan closest to it. Sometimes, if lightweight products on the conveyor would be disturbed by the velocity of the CO2 injection, the orifices are pointed almost horizontal.

Each orifice tube has white plastic sleeves pressed on the tube to allow for capacity tuning of the injection rate. These sleeves slide along the tube to adjust the number of active orifices operating in each module.

SAFETY NOTE: The plastic sleeves need to be checked occasionally because the high pressure water hoses used during cleaning can inadvertently move the sleeves from their proper position. The last orifice (at the end of the header) should never be covered with a plastic sleeve, as it can cause LCO_2 to freeze in the header and halt production.

Those drops that require the use of extension headers have tubing run to either the preceding or following module with a duplicate header system in those modules. For optimal freezing capacity, the **ULTRA-FREEZE®** tunnel should have CO_2 injection headers in each module.

3.8. TEMPERATURE CONTROL SYSTEM

The **ULTRA-FREEZE®** tunnel freezer utilizes one or more RTD type (Resistance Temperature Device) electronic temperature controllers to operate each LCO_2 drop assembly. Stainless steel sheathed platinum type sensor(s) extend down through the apparatus box(es) above the freezer module down into the module(s) itself. The sensor should extend a minimum of 1" to 1-1/2" into the module for accurate temperature sampling of the gaseous medium.

The temperature controller(s) is mounted on the cover of the main control cabinet.

4. Installation & Assembly

4.1. SITE SELECTION REQUIREMENTS

The installation site of the **ULTRA-FREEZE®** must meet the following requirements for safe operation:

- Located in close proximity to the Liquid Carbon Dioxide (LCO_2) tank or vessel.
- Located in a large, well ventilated room
- Supply Voltage/Frequency: 460 or 230 VAC+ Ground, 3 phase, 60Hz
- The exhaust duct piping from the **ULTRA-FREEZE®** must run outside in order to ensure removal of the CO_2 gas from the processing room. Note: Avoid exhausting to outside areas where people typically congregate (e.g. break areas, smoke areas, etc)
- Rooms underneath the installation site must be adequately ventilated.
- Warning or hazard signs posted around the freezer for safety purposes are highly recommended.

CAUTION: Keep Carbon Dioxide gas out of lower lying spaces, channels and shafts.

Installation Path Requirements

To avoid possible hindrances, carefully map out the path to the installation area prior to unloading the **ULTRA-FREEZE®** from the truck. Determine the most suitable freezer orientation to pass through all "bottle necks" and to assure correct orientation at final in-plant location.

Pay particular attention to:

- the height and width of doorways on the path to the installation area;
- the height and width of the various corridors.

Be sure to account for obstructions such as light armatures, ramps, overhangs, ducting, cupboards, shelves, etc. Use the dimensions provided in Section 3.1 - Equipment Specifications.

Floor Space Requirements

Prior to installation of the **ULTRA-FREEZE®,** ensure that the space available at the installation site will accommodate the freezer dimensions.

Remember to:

- allow for sufficient space around the freezer for normal traffic;
- make sure the freezer is accessible in case of emergency;
- provide sufficient clearance for all pivoting parts (e.g. doors). Be sure to account for obstructions such as light armatures, ramps, overhangs, ducting, cupboards, shelves, etc.

Overall freezer dimensions, in-feed height, exit height, etc. can be found in Section 3.1 - Equipment Specifications. Utilize this data to make height adjustments of freezer and/or processing line equipment.

4.2. UNLOADING THE ULTRA-FREEZE®

Professional riggers are recommended when unloading the freezer. Professional riggers have the experience and equipment to unload the freezer and move it into the desired location in minimal time.

Each freezer is shipped in a specially designed crate to protect the modules and allow for easy unloading. Crates can be as long as 21.8 feet. Thirty inch freezer creates are 5.6 feet wide and 48 inch freezer crates are 7.0 feet wide. Overall height is 6.4 feet.

The layout and sizes of doors within the production plant sometimes dictate that the freezer be crated in smaller sections. If the production plant doors are too small, then a contractor will have to be called in to make the door large enough to get a crated freezer section through. The freezer can be broken down into individual modules to allow for movement on freight elevators, etc., if required. This should be avoided to reduce on-site wiring and assembly time.

For safety reasons the freezer must be unloaded by means of a crane or forklift. The recommended means of transport is on industrial rollers, if a crane or forklift can not be used. Ensure that the total weight of the freezer does not exceed the maximum allowed load of the crane, lifting straps or forklift. Check the stability of the configuration during the lifting operation.

4.3. SHIPPING/CRATING

The freezer will be shipped in a specially designed crate to protect the modules and allow for easy unloading. The layout and sizes of doors within the production plant sometimes dictates that the freezer be crated in smaller sections. If the production plant doors are too small, then a contractor will have to be called in to make the door large enough to get a crated freezer section through. The freezer can be broken down into individual modules to allow for movement on freight elevators, etc if required. This should be avoided to reduce on-site wiring and assembly time.

4.4. POSITIONING THE FREEZER

The location of the freezer in a crowded area sometimes dictates which end of the freezer has to be put into position first. The freezer can be loaded on the truck with the crates in the correct order to allow proper orientation. If the plant area is large enough to turn a section around, then the sections of the freezer may be loaded in any combination.

Each freezer is shipped anywhere from one to four crated sections of up to three modules each which can include both vestibules. Other crates include:

- Conveyors – Precut to the appropriate lengths, with splice rods. (Loose pedestals are usually strapped to these crates.)

- Control Cabinet – Wiring diagrams and manuals are inside the enclosure. The shielded cables for the temperature sensors are also included.
- Exhaust Troughs – Two stainless steel vapor collection troughs to be attached, one each to the entry and exit vestibules. They are available both right hand and left hand, but usually are matched sets.
- Insulated Drop Assemblies, Miscellaneous Metal Covers, Baffles & Other Loose Parts
- Hydraulic Power Unit – (Optional) Hydraulic units only.

4.5. CONNECTING FREEZER SECTIONS AND SEALING

A) Move the freezer sections into their proper relative positions on the floor (the exit vestibule has the drive motors mounted on its sides). The module crates are designed to be moved by fork lift or pallet trucks and can be rolled or skidded. Lifting should be done only along the 2x10's that form the perimeter of the crate. DO NOT lift the upper 2x4's on the trusses.

B) Check with the wiring diagrams to determine proper placement of each crate before assembly (for 2 and 3 module tunnels proceed to step J).

C) Uncrate the first section to be assembled. Each module end needs to be fully supported before completely removing the lower 2x10 support braces. Screw down the adjustable plastic pedestal legs to meet the floor and raise the modules off the crating slightly before removal.

D) Attach the end pedestal to the module just uncrated, unless it was shipped that way.

E) Push the second group of modules up to the end of the first and uncrate the end only. The first module of the second crate should be positioned to extend about 2" onto the exposed pedestal half mounting surface.

F) Uncrate the modules.

G) Coat to inner mating surface of modules with the silicone sealants shipped with the freezer. Make sure the whole edge of same module is covered.

H) Quickly push the two sections together before the sealant sets. Bolt the modules together with the four bolts and acorn nuts provided. Guide the electrical conduit into the apparatus box hole.

I) Clean away the excess sealant from the module joint.

J) Continue until all sections are assembled.

K) To position freezer (sideways or lengthwise) place 2x4's underneath pedestal legs and pinch it along. One person per leg is required to prevent damage.

L) When the freezer is positioned, adjust plastic pedestal legs until freezer is leveled. Floor clearance should be about three inches. Clean the outer module joints with acetone so the vinyl

tape will adhere properly. Do not stretch, just lay over the joint and press down so the heat of the hand will cause the tape to stick. Make sure the tape is at least 70°F or it will not adhere properly.

4.6. INSTALLATION OF THE CONVEYOR BELTS

Set the box containing the conveyor about 18" from the exit end of the freezer and line up the conveyor belt with the sprockets on the bottom conveyor shaft. If the belt is rolled, it will be necessary to unroll the belt and restack it as folded pile for easier installation.

NOTE: Three tier freezers have three precut conveyors, each of a different length. The longest is the top belt; the shortest is the middle belt. Make sure the proper one is selected for each conveyor. Carefully check the orientation of the belt being fed into the machine. The drive sprocket teeth should be pushing against the rods and not against the links.

Cover the bottom section of the exit vestibule with a piece of cardboard to protect the surface from damage by the conveyor being dragged over the edge. The belt should be oriented so that the looped end of the link is facing the front of the freezer. All plastic wear strips should be positioned before the conveyor is installed.

Start by installing the bottom or return section first. Thread the belt under the sprockets and drive shaft, then over the two 2" diameter idler and rollers between the exit vestibule and the last module.

If this is a 48" wide 3-tier freezer, it is necessary to install each conveyor support system as you go. Pull the conveyor through the return track, install the lattice supports, fold the conveyor over, pull the conveyor together, and install the splice rod. The 30" wide 3-tier freezers do not have an internal conveyor support system.

Pull the belt through the return track leaving the final 6 to 8 feet still in the pile. This is enough belt to fold over the drive sprockets and splice the conveyor in the middle of the last module. The conveyor is free to move until the drive sprockets teeth are engaged.

After the belt has been joined together with the splice rod, the threads protruding from the nut should be peened over. This prevents the nut from loosening during operation and damaging the conveyor.

The tension of the first and second conveyor on the 3-tier freezer needs to be adjusted prior to operation. Do not apply too much tension because the conveyor can contract as much as ½ inch per 100 ft. Belt tension should be checked cold before running production and again after the first few days of operation.

Install scraper belt at exit end of top belt and adjust it just short of touching the bet. Do the same for exit chute on bottom belt.

4.7. LEVELING THE FREEZER

The freezer should be re-leveled and readjusted after the conveyors are installed. The two threaded plastic legs on the bottom of each pedestal should be adjusted out so that they will clear the floor by about 3-1/2" for ease of cleaning. The customer's infeed equipment may actually determine the final clearance height. Check the clearance between door and the module frame as well as gasket fits. The module can be twisted slightly if the leveling screws are not properly adjusted causing the doors to bind.

4.8. EXHAUST TROUGH AND BLOWER

The exhaust troughs should be installed as soon as the machine is leveled so that the sheet metal contractor can install the exhaust piping and blowers. If a trough ends up supporting the weight of the exhaust pipe above it, then a brace should be fixed so that trough end and extend down to the floor for support.

Based upon preliminary feedback information, the customer is provided with advice on how to install his blowers, depending on proximity of location and climatic conditions. It is the customer's responsibility to supply and install the blowers. If the exhaust is through the roof, the blowers can be mounted under the roof, or outside on the roof-top. In certain cases, blowers may be mounted outside a nearby wall. The horizontal run of the exhaust should pitch downwards towards the blower to allow water to drain outwards.

Prior to freezer shipment, the appropriate installation drawing for each blower mounting is forwarded to the customer to pass on to his installation contractor who is normally responsible for mounting and connecting the exhaust to the trough outlet and the blower inlet.

For more information on exhaust system installation, see Section 5.3 – Exhaust System Installation.

4.9. FINAL ADJUSTMENTS

The door latches are adjustable to allow proper positioning of the doors. Underneath the upper latch is a lock nut that can be loosened to allow the black plastic handle to rotate. Turning the handle causes the latch point to move up or down.

All nuts and bolts should be checked to be sure they are tightened properly. They should be rechecked after the first few days. The expansion and contraction caused by temperature changes can cause threaded fasteners to work loose.

5. Auxiliary Connections

To ensure proper supply connections, take into account any restrictions as provided in Appendix B – Reference Drawings when designing the supply connections. To allow for proper installation once the freezer is in place, make sure the following is made available at the in-plant freezer location:

- provisions for electrical power supply and connection;
- provisions for CO2 supply and connection;
- provisions for proper installation and connection of exhaust duct;
- floor drains and corresponding floor pitch as required for drainage of cleaning water.

The CO2 piping and electrical conduits should be well protected against accidental damage. To minimize CO2 consumption, avoid elbows where possible and ensure piping runs are as short and direct as possible.

5.1. ELECTRICAL WIRING CONNECTIONS

As soon as the electric control cabinet is unloaded from the truck, the electric contractor should start installing it on a wall or post close to where the freezer entry end is visible.

Typically, a single 2" conduit will be required to connect the cabinet to the designated apparatus box on the freezer. Consult the wiring diagrams inside the control box for proper sizing and location. For trouble-fee operation of the temperature control system, the shielded cable for the RTD sensors should be run in a separate conduit away from control and power wiring. Unless special voltage requirements are requested, the incoming power is 230 volts – 3 phase – 60 Hertz.

CAUTION: Conduit and wiring should only be installed by a qualified electrician and in accordance to the local codes and regulations. Follow LOTO procedures where applicable.

In order to minimize or eliminate control problems with the **ULTRA-FREEZE®** tunnels, we require that good wiring practice be adhered to when running wiring in the control box and in conduit between the control box and the apparatus boxes mounted on the top of each module.

In Control Box and Apparatus Boxes

A. Mixed voltages (AC or DC) from 110V up to 600 volts can be bundled and run together without any appreciable problems.

B. Signal wires (usually shielded cable) must be run separately from the higher voltage wires as far away as possible, and no closer than 6 inches. If the wires must cross each other, they should do so at 90°. Terminal lead lengths should be as short as possible with shielding grounded at one end only, preferably at the controller end. The location

of the controller and shielded wire should be as remote as possible relative to any AFC generating unit controller to prevent pick-up of RF noise. Six inches is too close.

1. Earth Ground – Earth ground must be attached to the unit's chassis to make it noise free

2. Neutral – It is necessary to assure that neutral is at, or near, ground potential. A voltmeter check between neutral and ground should show no more than 50 millivolts.

In Conduit, Pipe or EMT

A. Control wires (115V) and power wires up to 600 volts (including DC) can be contained in the same conduit unless specified otherwise by local code regulation! This conduit terminates on a designated apparatus box, usually the number 1 module.

B. Signal wires for the RTD temperature probes (very low voltage and amperage). In our case, this is the 3-wire shielded cable which must be run in its own conduit. Each conduit should originate from each apparatus box that contains a probe, and rise vertically to normal ceiling height where these conduits may junction for the main signal run to the control cabinet. Keep at least 6 inches from other conduits.

C. Conduit into the control box, if at all possible, should make its entry at the left-hand or right-hand side and not at the top. This will minimize external water leakage which can create problems.

D. Advise the customer to maintain the disconnect switch in the energized position during shut-down. This will keep the box heater "on" to maintain warmth and prevent internal condensation. The DC conveyor motors will also stay hot to prevent moisture collection within, and help extend their useful life.

5.2. CO2 SUPPLY CONNECTION

For operation, the freezer requires a source of CO2 from a storage tank. The CO2 supply piping connects the storage tank with the CO2 injection system of the freezer. Insulate all CO2 piping up to the connection at the freezer to ensure an efficient and economical operation.

IMPORTANT: Do not install any additional manual shut-off valves between the valve at the storage tank and the connection to the freezer. Additional valves will render the safety system ineffective without a safety relief valve in place.

It is recommended that the CO2-supply line is purged before final hook-up to the freezer by opening the main supply valve at the tank slowly. Purge the CO2-line for approximately 30 seconds, and then close the main supply valve.

5.3. EXHAUST SYSTEM INSTALLATION

The freezer exhaust system, if properly installed and tuned, will ensure an efficient removal of all superfluous CO2 gas.

IMPORTANT: Air Liquide highly recommends the use of CO2 monitoring systems in any room that utilizes CO2.

Note the following prior to installation of the exhaust system. It is recommended that the exhaust system is designed and installed by qualified personnel only.

- Design the exhaust ducting to facilitate cleaning and inspection. Stainless steel ducting is recommended, though PVC ducting is commonly used.
- Provide adequate make-up air in the production area. This will allow for proper exhaust system performance and reduce negative pressure in the production area.
- Protect the exit of the exhaust system against bad weather conditions and/or birds.
- Minimize the length of the exhaust ducting and the number of turns.
- Avoid installing flow regulation systems directly in the main exhaust duct (these will cause ice build-up).

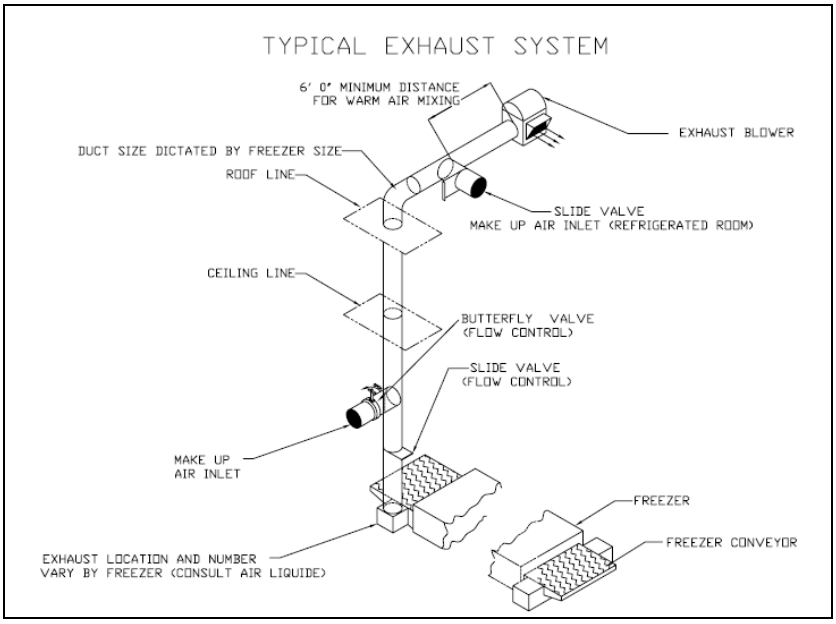
IMPORTANT: The exhaust system must be sized for the typical ambient and operating conditions of the freezer.

5.4. TUNING OF AMBIENT AIR INTAKE

Ambient air is required to prevent the exhaust duct and fan from falling below 32°F and causing ice build-up due to the humidity in the air.

The amount of ambient air required will depend on the ambient air temperature. In case of a non-refrigerated room (70°F, 70% relative humidity), normally two to three volumes of air is diluted with one volume of CO2 gas generated in the freezer.

If the freezer is located in a humid, refrigerated room (40°F, 50% relative humidity) the air dilution must be increased to four up to six volumes of air per volume of CO2 generated in the freezer.



Importance of Vapor Balance

A correct vapor balance is related to the amount of gas flowing out of the freezer. If properly adjusted, only a small amount of CO_2 gas will arrive in the production area.

This slight spill of gas ensures that no room air is drawn into the **ULTRA-FREEZE®** freezer. Room air can bring moisture into the freezer, therefore affecting the efficiency and economical operation of the freezer.

6. Initial Start-up and Tuning

The **ULTRA-FREEZE®** was factory tested before delivery. All efforts have been made to simulate the operating conditions when testing and calibrating the freezer. However, operating conditions may vary once the **ULTRA-FREEZE®** freezer is installed, therefore requiring fine-tuning of the equipment. The guidelines presented here should help during initial start-up/tuning of the freezer.

6.1. PRE-STARTUP CHECKLIST

1. Verify that all packaging material and tools have been removed from the freezer (inside and outside).
2. Verify that all electrical, CO2 and exhaust connections have been made according to the guidelines provided in Section 5 - Auxiliary Connections.
3. Verify that the CO2 throttling valve (HV-301) is open about halfway.
4. Ensure all of the apparatus box covers are closed and screws are tightened.
5. Clear conveyor belt of all loose tools and parts and check for proper tension and potential jams.
6. Close and latch the module doors and exhaust trough doors.
7. Ensure the vestibule covers and curtains are in place.
8. Ensure all of the buttons on the main control panel are OFF.
9. With the main disconnect in the OFF position, use a multi meter to check that the proper voltages and amperage is supplied to the control panel. Low voltage to the DC motor controllers will cause premature failures.
10. Open the main shut-off valve on the CO2-supply line or at the storage tank.
11. Purge all supply lines to remove loose debris.
12. If necessary, close the main shut-off valve on the CO2-supply line or at the storage tank to clean the strainers. Follow maintenance procedures as applicable.

6.2. INITIAL START-UP

1. Clean the **ULTRA-FREEZE®** thoroughly, prior to the initial start-up. Refer to Section 8: Cleaning for detailed information. Normally, the **ULTRA-FREEZE®** doors are left in the open position after cleaning, to continue drying overnight.

2. Turn the main disconnect switch into the ON position.

3. Start the exhaust blowers. Check for proper blower motor rotation. Radial blade blowers have a small suction even when rotating backwards. Motor should rotate so the blower blades move towards exhaust spiral outlet.

4. Start the conveyor drive(s). Check for proper tracking of the individual conveyor belts on the sprockets. If there is a brush, adjust the brush in the entry vestibule to lightly tough the conveyor belt. Adjust the belt tension or change the belt lengths if required. Adjust the scraper bar(s) as required to just touch the conveyor belt.

5. Start the circulating fans. Check for proper rotation (all in counterclockwise direction viewed from above). Check for proper release of the fan brakes when the motors are on (fixed speed electric). Check for motor overheating due to binding in the bearings or excessive vibration.

6. Check that all of the door limit switches are working properly. Limit switches are wired normally open (NO) so fans should only energize if the doors are closed.

Alternately open each upper module door and check for proper operation of safety fan shut-off switches. Adjust as required. Do not operate the freezer unless all safety door switches operate properly.

7. Turn on the fan motors and the instrument power after opening all CO2 valves.

8. Shut off all module fan motors before opening the module doors to check for proper operations of the injection headers. All active orifices should have a uniform discharge plume. All orifices should be aligned to blast down on the conveyor at approximately a 45° angle. On 48 inch wide freezers, the two injector arms on each side should be staggered to blast down onto the outer 10” width of conveyor not under the fan blades. They should be angled so that one covers the outer 5” band, and the other covers the inner 5” band on each side but not spray into the door cavity.

9. Check the temperature controllers for proper operation and tune the injection system (see Section 6.3 CO2 injection – tuning and adjustment).

6.3. CO2 INJECTION – TUNING AND ADJUSTMENT

System Description

The CO2 injection system in a freezer module has 4 injection header tubes, 2 on each side. Each injector has 3 small orifices approximately 0.030 inch diameter for a maximum of 12 orifices per module.

A typical freezer requires no more than 6 to 9 active orifices per module to properly freeze the product. Hot or cooked product may require all 12 orifices in the first few modules in order to be able to maintain the desired set point temperature. Because of these variable parameters, the **ULTRA-FREEZE®** has a system to "tune" or adjust the CO2 flow rate to match that required for each product.

Tuning of the CO2 injection system is generally required only during the initial installation and any time a major change in production techniques occurs. Each temperature control zone needs to be adjusted separately (a zone includes one or two or three modules depending upon the freezer length and set-up).

The system that the **ULTRA-FREEZE®** uses is a 2 step (high, low) flow adjustment that is temperature controlled. Two liquid CO2 (LCO2) solenoid valves (SV-103 and SV-300) are used per zone to inject the CO2 at the restricted or low rate (AMBER) or the full or high rate (RED).

At temperatures above (warmer than) the controller set point, both the high and low valves are open giving maximum CO2 flow (RED & AMBER). When the zone cools down to the set point, the RED or high system shuts off, leaving the AMBER or low system on. If the temperature continues to decrease below the set point, the low or AMBER system will turn off stopping all liquid CO2 flow. At this time, the CO2 vapor purge solenoid (SV-202) will open to flush the liquid CO2 headers with CO2 vapor to prevent plugging of the headers and orifices with dry ice (solid CO2/SCO2).

Proper system operation while freezing calls for the low or AMBER system to be on 100% of the time; it needs to be tuned to primarily handle the fixed heat load of an idling freezer with no product being frozen. The high flow RED system should be on 50% to 70% of the time when the freezer is operating with full product heat loading.

The tuning is done two ways: (1) Adjusting the pressure drop across the needle valve (HV-301) in the apparatus box, which relates to the AMBER solenoid valve; done via throttling (2) Closing off some of the active orifices in the zone, by sliding the sleeves over, or opening orifices by sliding the sleeves off.

1. Adjusting the Pressure Drop (Low Flow Only)

The needle valve following the low flow solenoid (SV-300) does not require periodic adjustment and is generally set to achieve a 25 to 50 psi pressure differential, based on a CO2 tank pressure of 290 psi. **It should never be set to have an absolute supply pressure below 200 psig,** otherwise there is a risk of plugging the orifice and headers with dry ice.

2. Closing off Orifices (High and Low Flows)

The number of active injection orifices in a zone can be reduced by sliding white plastic sleeves over selective orifices to close them off. This allows a freezer to be very rapidly adjusted to efficiently handle both high and low heat load products.

The **end** orifice in each injector header should **always** be open and never closed off. This prevents "dead" pockets of LCO2 that could freeze to dry ice. (Stagnant LCO2 will freeze at temperatures below -70°F). An orifice is de-activated by centering a plastic sleeve over the first or middle orifice as required. Unused sleeves are left on the injector but should be moved at least 1-2 inches away from the nearest orifice.

High pressure water hoses used by cleaning crews can at times move the sleeves along the injector tube. This can open or close more orifices than required, changing the freezer efficiency and effectiveness. A master orifice tuning chart should be kept handy to quickly check the proper settings.

6.4. INJECTION SYSTEM TUNING PROCEDURE

Preliminary Settings

1. Set the needle valve in the apparatus box for each CO2 drop to maintain a 175-200 psig pressure on the gauge (AMBER light on only).
2. Block off at least 1 orifice per injector (5-6 open orifices/module). For hot, cooked product, use 8-9 in the 1st and or 2nd module.

Final Settings

1. Cool down the freezer. It should reach operating temperature in 15 - 30 minutes. (Add 5 minutes without an LCO2 circulating pump?).
2. Set the temperature controllers on the control cabinet to -90°F or the required set point freezer temperature.
3. Load the freezer at the expected production capacity. Monitor the lights on the temperature controllers. The RED light should be on at least 50-70% of the time. If the RED rarely or never goes on, some orifices in those zone(s)/ module(s) need to be closed. If the RED never shuts off or the zone cannot maintain temperature, additional open orifices are needed.
4. Allow the freezer to idle by emptying it or eliminating the product heat load. Check the AMBER lights to see that they stay on 90-100% of the time. If the AMBER shuts off too often, further close the zone needle valve (HV-301) in the apparatus box to reduce the supply pressure and liquid flow (but never below 200 psig). If the RED comes on at all, open this valve slightly, increasing the pressure and CO2 flow rate.

A properly adjusted freezer will cool down initially in about 15 to 30 minutes and idle with the AMBER lights on most of the time. The RED light will cycle off and on 50 to 70% of the time to handle the product heat load during production. It may be necessary to do some fine tuning after following the above procedure to meet specific production conditions. A properly tuned freezer will not leave a dry ice build-up due to excessive injection or have an excessive vapor purge (both lights off). Problems with exhaust vapor control and entrainment of room are are reduced when a tunnel is properly tuned since the liquid CO2 flow is better matched to the actual demand.

The quality assurance or line supervisor should have a chart or table showing the proper settings for the "tuned" freezer as well as conveyor belt speeds, operating temperatures, belt loadings, etc., for each product. This acts as a quick check list if product results deviate from standard.

6.5. OPERATING TEMPERATURE

The normal operating temperature of the **ULTRA-FREEZE®** tunnel can be adjusted from 0° to -95°F. A temperature of -90° is recommended for most products for optimum product quality, maximum freezing capacity, and best operating efficiency. Operation below -95°F causes a build-up of dry ice "snow" (SCO2) in the modules with no effective increase in freezing capacity.

CO2 is used as an expendable refrigerant, unlike ammonia or Freon which is recycled in a closed loop system. The liquid CO2 is stored in an insulated pressure vessel at typical conditions of 300 psi and 0°F. The low temperature, high capacity freezing available with CO2 is obtained by expanding the liquid through the injection orifices to atmospheric pressure.

The liquid CO2 is converted by expansion cooling to 45% solid dry particles (CO2 snow) and 55% cold CO2 vapor at -110°F. Over 90% of the available cooling from the CO2 is achieved by subliming (conversion of solid directly to gas) the solid dry ice "snow". The remainder of the cooling is gained by warming the resulting cold gases from -110°F to the exhaust gas discharge temperature. The cloud or fog seen exiting an orifice is this mixture of fine dry ice "snow" particles and cold flash gases.

The operating set point temperature of the freezer must be at least 15 to 20 degrees warmer than the sublimation temperature of the snow, otherwise dry ice will build-up in the module. The high velocity circulating fans promote the rapid sublimation of the dry ice snow for rapid cooling and the best efficiency. Setting the temperature controller below -95°F causes snow to exit with the product or to build-up inside the freezer, wasting CO2. Wasting small amounts of CO2 snow can dramatically increase the total amount of CO2 required to freeze the food product – and thus overall freezing cost - with no increase in freezing capacity.

All the circulating fans must be operating for best performance.

6.6. FREEZER CONTROL VARIABLES

The variables the operator controls to obtain the most efficient freezer performance are:

a. Conveyor speed
b. Temperature
c. Fan speed (optimal)

For each product, there is an optimum setting for each of these variables for a given set of circumstances (production rate, input temperature, output temperature, etc.). Once determined, these settings should be established as standard for that product.

Generally, it is recommended that the conveyor be run at the slowest speed that will handle the required production, and then increase the freezer operating temperature to the warmest temperature that will produce the desired results. This is the most economical method of operation.

Quite often, the speed of the conveyor is established by production from an automatic feeder of a meat patty machine, etc., and then the only variable left to control is the temperature. This should still be set as warm as possible to obtain the desired degree of freezing.

The freezer conveyor belt should be loaded with the product full across its width and to the greatest density practical.

Here too, the product loading on the freezer conveyor may be determined by upstream production equipment. The product may be produced in rows that just fit across the freezer conveyor. Then the conveyor speed should be adjusted for minimum practical spacing between the rows. A shuttle conveyor may be required to change product coming to the freezer in single file, to rows across the freezer conveyor belt. Product random loaded on the freezer conveyor may require infeed equipment such as vibrating conveyor, etc.

Variable speed fans – This option provides another control for the freezer operator. A standard fan speed setting can be established for light weight or heavy items to take advantage of the heat transfer improvement contributed by velocity of the cold CO2 vapor circulating over the product.

If the product being frozen is very flat and very light, the circulating fans may cause the product to lift off the belt. This can cause product damage and production interruptions. Do not stop the circulating fans, as this will significantly affect the efficiency of the Ultrafreeze. Rather, run the variable speed fans at a lesser speed, or, if this is not possible (fixed speed fans) or not enough, the blades of the circulating fans can be changed to a shallower pitch that should not cause lifting of the product off the belt.

Setting the fan speed too high can cause products to move off of the belt, potentially jamming the belt in place.

Three tier freezers – These freezers have two separate controlled conveyor drives. One varies the speed of the top conveyor. The second drive varies the speed of the second conveyor belt. The third conveyor is driven from the second conveyor by a chain and sprocket which is usually a 1:1 ratio, but can be another ration, to vary the speed of the third conveyor from the second conveyor. When freezing items such as meat patties, the top conveyor speed must be set to provide adequate dwell-time to crust freeze and stiffen the item so it can transfer to the second conveyor without damage to the product. When IQF freezing items in particle form (such as shrimp or diced chicken), the items must be kept separate from each other on the top conveyor. The conveyor speed must be adjusted to sufficiently crust freeze each particle so the individual particles can be transferred to the second conveyor and piled to provide for extended dwell time on the second (and third) conveyor belt

7. Operating Instructions

7.1. IMPORTANT OPERATING AND MAINTENANCE POINTERS

The following synopsis is intended to be a handy reference of specific, important, Operation, Cleaning, and Maintenance Factors, requiring most frequent attention. However, familiarity and understanding of the detailed explanations and descriptions in the manual is essential.

Operation

1. Temperature setting must not be lower than -95°F
2. Develop a procedure for temporary shutdown of freezer

Cleaning

1. Cover motors, control cabinet and apparatus boxes to protect them from splash water. Uncover motors to run fans or conveyor.
2. Do not abuse door gaskets
3. Dry out freezer as well as possible after clean-up. Leave all freezer doors open between shifts.

Maintenance

1. Check if all fan motors are running daily
2. Check adjustable baffles for free action daily
3. Check solenoid valve operation at least weekly
4. Check conveyor belt slack frequently
5. Change conveyor drive gear box oil as specified

7.2. DAILY START-UP AND OPERATION

The freezer should be visually inspected before start-up to make sure all covers are in place. Ensure that the **ULTRA-FREEZE®** is free of tools or any other objects. A check should be made for loose bolts, damaged gaskets, etc., which should be repaired. Verify that there is still enough CO2 in the storage tank and that the pressure is adequate (35-40psi is recommended).

The freezer should be dry from the previous night clean-up. Check that the freezer is completely clean and dry prior to cool down. Water remaining in the freezer may affect its proper operation, as the CO2 will immediately freeze the water into ice. If not, the upper doors should be closed and the fans and conveyors turned on for a few minutes to air dry the internal hardware before cooling down the freezer with CO2.

Freezer Start-Up Procedure:

1. Follow the Pre-Startup Checklist in Section 6.1 prior to start-up every day.

2. Open the main manual shut-off valve on the the CO_2 supply line or at the storage tank if not open.
3. Close and latch all module doors. Check for loose tools or parts on conveyors.
4. Close all exhaust trough cleanout doors and replace cleanout caps on exhaust ducts.
5. Close and install all entry and exit covers and curtains.
6. Turn the main disconnect to the ON position. It is recommended to leave the disconnect switch on constantly. This keeps the field windings of the DC conveyor drive motors warm to prevent burnouts and moisture damage.
7. START the exhaust blowers. Check for proper operation. Adjust the exhaust flow if required.
8. Before starting the freezer, make sure the outfeed conveyor belt is running so there is not a pile-up at the exit end.
9. START the conveyor drives. Adjust to proper speeds.
10. START the Fan Motor(s). Check to see that all are operating.
11. Turn on the instrument power, set temperature controller.

IMPORTANT: Make sure the exhaust (gas removal) system is properly working, prior to initial CO_2-injection into the freezer. The CO_2-control valve has been interlocked electrically with the exhaust fans to prevent injection of CO_2 in case the exhaust fan is not operating.

12. Check that the conveyor belt(s) of the **ULTRA-FREEZE®** is running. Check if the conveyor belt is running at the desired speed, by checking the residence time. The speed of the in-feed and discharge conveyors should be matched to assure a smooth product transfer.
13. Check that the CO_2 is injecting into the freezer. This starts the freezer cool-down process.
14. Check for leaks in the CO_2 piping and fittings.
15. Adjust the flow rate of the exhaust fan to make sure the spillage of CO_2 vapor from both ends of the freezer is kept to the required minimum. Note: A correct vapor balance is essential for safe freezer operation.
16. If large amounts of CO_2 vapor are blown out of the freezer, stop the unit immediately by pressing any E-stop button on the machine. Investigate the problem and start the procedure from the very beginning or call for assistance before proceeding.

17. Start loading food product. Adjust the flow rate of the exhaust system to ensure only the required minimum of CO2 vapor is coming out of freezer (correct vapor balance).

18. Check the temperature and condition of the food coming out of the freezer. Make one or more of the following adjustments if required:
    a. belt speed
    b. production rate
    c. operating temperature setpoint
    d. CO2 throttling valve (HV-301)

7.3. PRODUCTION INTERRUPTIONS

Shutdown of the freezer for relatively short production interruptions such as breaks, lunch period or production breakdown, a procedure that fits the processing line operation method should be established and adhered to.

A. If the production crew at the discharge end of the freezer remains to run out and pack off the product, the temporary shutdown procedure would be to turn off the instrument power when the freezer is emptied of product. **Let the conveyor belt and fans run for production interruptions of 30 minutes or less.**

B. If, for some reason, the packing crew at the discharge end of the freezer leave the line at the same time as the crew at the infeed end of the freezer, this would usually mean that there will be product running through the freezer on the conveyor. In this case, the temporary shutdown procedure would be to turn off instrument power, the fans, and the conveyor.

C. Three or four minutes before restarting production, start the fan motors and conveyors, checking to make sure everything is working, then push the instrument power to cool the freezer to desired temperature. The product left in the freezer over the shut down may be over-frozen by being left in the cold atmosphere.

7.4. VAPOR FLOW CONTROL

The flow of CO2 vapor from freezer should be to both the entry and the exit end of the tunnel freezer to establish a slight positive pressure at each end to minimize sucking room air into the freezer.

The directional flow of the vapor is controlled by adjustable baffles, the number of which varies with the length of the freezer. The adjustable baffles are moved to establish the desired vapor flow by means of a lever arm on the front panel of a module apparatus box. The legend plate on the control arm indicates the direction of adjustment to regulate the vapor flow. Be patient because the change is not immediate. It takes a few minutes lag time to establish a new vapor flow pattern.

7.5. VAPOR EXHAUST COLLECTION AND DISCHARGE

There is a vapor collection trough at each end of the freezer. The vapor exhaust blowers suck the vapors to the outside of the building.

Blast Gate Damper – A blast gate damper installed in the ductwork near the duct connection to the freezer controls the suction draw from the exhaust blower. For best efficiency, this should be to the point where the vapor flow almost spills over into the room. Adjustments should be made throughout the day. There should be flow of CO2 vapor to both the entry and exist end of the freezer to establish a slight positive pressure at each end to minimize sucking room air into the freezer.

7.6. PRODUCT TEMPERATURE EQUILIBRATION

Equilibration is the process of equalizing the temperature of the center and outside of the product. This occurs with time; the amount of time depending on the thickness of the product.

When a product is frozen in a CO2 freezer, a frozen crust will quickly form on the outside surface, and this will become thicker and colder with time. The center of the product will freeze last, and there will be an appreciable difference in the temperature of the outer shell and the center of the product.

If a product is to be frozen to X° at the core, it is evident that the product need not reach X° at the core in the freezer. There will be a point that can be determined by trial, at which the frozen outside shell will be thick enough and cold enough to absorb the remaining heat in the core so the entire mass equilibrates to the required X°.

When the frozen product is quickly packed together after discharge from the freezer, there is little loss of the refrigeration in the frozen shell. Equilibration occurs in the package where the refrigeration of all pieces complements each other.

7.7. SHUTDOWN

At the end of a production shift, the freezer should be shut down in the following sequence:

1. Stop loading food products.
2. Wait until all food products have exited the **ULTRA-FREEZE®**.
3. Turn OFF the Instrument power.
4. To defrost, run all fans and the conveyor for a while until the bottom doors open easily. Open the bottom doors and let the freezer defrost for 10 to 15 minutes.

IMPORTANT: Open doors cautiously to prevent damage to the door gaskets. If it is evident that the door gaskets are frozen to the module, the freezer should be defrosted before the module doors are opened.

5. Turn OFF the Circulating Fans.
6. Turn OFF the Conveyor drive(s).
7. After about 5 minutes – turn OFF exhaust blower
8. Main power switch should remain ON to keep panel and motors warm
9. **For extended shutdown:** Close the manual shut-off valve (main valve) on the CO2-supply line at the freezer or at the storage tank. For shift shutdowns, it is not necessary to close the liquid valves at the tank or above the module apparatus boxes. The valve at the tank only needs to be turned off when working on the infeed lines.

7.8. EMERGENCY SHUT DOWN

Emergency stop, or e-stop, buttons are located on the control panel, as well as the entrance and exit ends of the freezer. If an emergency occurs, hit any one of the e-stops and the freezer will shut down. The solenoid valves (SV-103 and SV-300) will close and the conveyor will stop, but the exhaust will continue to exhaust to ensure the proper removal of CO2. A disconnect switch near the blower is recommended for isolation of the blower.

RECOMMENDED: CO2 Monitoring systems can be interlocked electrically with the **ULTRA-FREEZE®** to shut down the freezer, should CO2 levels in the room increase to above 0.5%, the 8 hour exposure limit according to OSHA.

8. Cleaning

8.1. PRE-CLEANING CHECKLIST

Safety Precautions

Before cleaning the **ULTRA-FREEZE®**, the following safety precautions should be considered to prevent personal injury or damage.

- Close and properly secure all electrical enclosures and conduit covers on the freezer and those in the cleaning area.
- Protect electrical components from water/moisture damage with plastic bags, if possible.
- Wear gloves and safety glasses to avoid personal injury from high-pressure hot water or steam jets.
- Remove or secure loose fitting clothing to prevent them from being caught in moving freezer components during clean up.

Equipment and Products Required

To properly clean the **ULTRA-FREEZE®,** provide the following equipment and cleaning products:

- Water hose for high pressure cleaning;
- food-safe detergents compatible with stainless steel, Teflon, fiberglass and polyester

8.2. CLEANING PROCEDURE

Do not spray the control cabinet, fan motors or conveyor drive motor. These should only be wiped clean.

1. The fan motors and apparatus boxes should be covered with plastic bags. The control cabinet should be protected by a plastic sheet or other suitable means. The conveyor drive motor(s) should be covered with a plastic bag when hosing around the exit end of the freezer, but the plastic bags must be removed before running the conveyor(s).

2. Remove the stainless steel panels at the entry and exit ends. Open all upper and lower doors.

3. The freezer may be washed and cleaned with any of cleaning agents normally used in a food processing plant, except live steam. Live steam should not be used since polyurethane insulation, which is just inside the freezer walls, should not be subjected to this temperature.

4. Do not use scouring powder or any other abrasive cleaner that would dull the finish of the fiberglass inner and out walls of the freezer.

5. Hose down the interior of the freezer with the conveyor running. Plastic bags must be removed from conveyor motor(s). Give particular attention to the sills under the conveyor belt where the modules join and along the door gasket strips.

6. The moving conveyor belt can be scrubbed and hosed down at the exit or entry end.

7. The design of the freezer allows wash water to drain out of the freezer freely.

8. To assist in drying out the inside of the freezer and to blow clinging water from the conveyor belt, close all upper doors, open all lower doors, and run the conveyor and all fans for about 1/4 hour. The plastic bags must be removed from the fan and conveyor drive motors at any time during operation.

9. It is best to start a production shift with the freezer as dry as possible. It is recommended that with all power off, both the upper and lower doors be left open until the next production shift.

10. Any removable parts that were taken off the freezer for clean-up should be replaced; such as stainless steel panels at the ends of the freezer, exhaust duct cleanout cap, exit and entry curtain, etc.

11. The fiberglass walls of the freezer can be polished periodically with DuPont Auto Body Cleaner and Polish (a white paste).

CAUTION: The door gaskets are designed to provide an effective seal and will not require frequent replacement if normal care is taken not to damage them. If it is not evident that a module door is frozen shut, do not force it open because this may tear the door gaskets. The clean-up crew must take care not to drag the hose over the gaskets or otherwise abuse them.

9. Maintenance

This section provides information for corrective and preventive maintenance of the various subsystems of the **ULTRA-FREEZE®**. For maintenance of specific more specific information, the appendices and other sections should be consulted. For more specific information about the equipment components, please refer to the manufacturers' literature in Appendix C – Component Manuals.

Care should be taken when performing maintenance on the freezer. The following safety considerations are listed to protect you from injury:

- Maintenance should only be performed by qualified personnel.
- Always de-energize the control panel before opening and working on any components inside. Follow Lock Out Tag Out (LOTO) procedures where applicable.
- Isolate the LCO_2 by closing the shutoff valve at the tank and the shutoff valve at the freezer (HV-100). Bleed any excess LCO2 trapped between the valves with a bleed valve. It is not good practice to use the safety relief valve as a bleed valve.
- Remember to replace all guards after performing maintenance.

9.1. PREVENTATIVE MAINTENANCE

REPLACE	EVERY
Solenoid Valves	2-3 years
Doors	5 years
Entrance / Exit Vestibules	5 Years
Door Plungers/Hinges	2 years
Safety Relief Valves	5 years
Module Joint Tape	As necessary
Silicone	As necessary
Scraper brush *	As necessary
Curtains *	As necessary

* Optional accessory, not included with all units

9.2. ENTRY / EXIT VESTIBULES

Replace phenolic material as needed if new coating is not possible, or every 5 years..

9.3. CONVEYOR AND CONVEYOR DRIVE

Conveyor Belt

Inspect the belt daily for the first several days of operations and semi-monthly afterwards. If local wear is apparent, determine the cause and correct the problem.

A tensioning device is in place for the conveyor belt of a single pass freezer, and the top and mid-conveyor belt of the three tier design. The slack in the bottom (of 3 tier) conveyor belt at the exit end is the required catenary to compensate for expansion and contraction and needs to take-up.

The conveyor belt will wear in and stretch with use. Therefore, if this slack becomes excessive, it will be necessary to shorten the conveyor belt by removing drive links and cross rods. Too much slack is readily determined by the conveyor almost dragging on the floor of the ext end section when warm, and often by a jerking or hesitation of the travel of the conveyor under power.

The 3-tier freezer has a conveyor belt tensioning mechanism for the top belt and another for the second belt. The slack should be minimized by tensioning with the tensioning devices.

To remove slack in the conveyor belt:

a. Run the conveyor to locate a splice rod at a convenient location to work on the belt
   - This is the entry end of a single pass conveyor, or the top of a 3-tier freezer
   - And the first module for the second and third tier conveyor for 3-tier freezers. It will, of course, be necessary to part the upper conveyor belts to provide access to the lower belts

b. Back-off the nut on the splice rod and remove the rod.

c. Adjust the tensioning devices to center position

d. Pull the conveyor belt tight through the freezer and determine which drive links cut to shorten the belt. See Figure 1 in Appendix A.

e. After cutting out the links, pull the belt ends together and join together with the splice rod; being sure to thread all mesh properly. The threaded end should be on the side that would cause the nut to rotate clockwise should the bottom of the nut ride up the top of the belt supports which would prevent the nut from unscrewing itself.

f. Run the nut on the splice rod and peen it on securely.

g. Adjust the tensioning devices. Remember the conveyor belt will shrink and become shorter when cooled to an operating temperature in the minus degrees, so check operation of belt under cold operating conditions.

Conveyor Drive Gear Reducer

Change oil after the first 80 hours, 250 hours, and then after every 1,000 hours of operation. Use Mobil 600W cylinder oil or equivalent.

Conveyor Drive Chain

Grease this chain every three months after installation. Use food compatible lightweight grease. The tension arm must be adjusted to control slack in the drive chain. Check periodically to be sure tension arm is correctly positioned and bolt is tight.

9.4. SAFETY RELIEF VALVES

Safety Relief Valves should be located between any two shutoff valves, and changed every 5 years or upon any signs of leakage for preventative maintenance.

9.5. MODULE JOINTS

Remove and replace silicone as needed, or when a sanitation issue becomes present. Replace module joint tape when cracked or peeling.

9.6. SOLENOID VALVES

Turn off the LCO2 infeed line valve to check for vapor solenoid valves (SV-202). Turn on the instrument power and the power to all fans. Adjust the temperature controller so that the AMBER and RED lights are OFF. Vapor should be injecting. Adjust the temperature so the AMBER and RED lights are ON; the vapor should stop injecting (the liquid will not inject because the infeed valve is off).

Turn the LCO2 infeed valve to the open (on) position; liquid should inject. Turn off liquid injection by means of the temperature controller so that the vapor will purge the line before turning the instrument power to off.

When the malfunctioning solenoid valve is located and confirmed, check wiring connections and solenoid coil and correct as necessary. Solenoid valves should be replaced every 2-3 years as part of preventative maintenance.

9.7. STRAINER

Check and clean out the strainers for debris on a regular basis, to prevent excess blockage in the piping.

9.8. DOORS

Maintain water-tight integrity and replace doors as needed, to prevent loss of freezer efficiency. As a general rule of thumb, each door weighs 37 lbs brand new, but can get up to 55 lbs due to the ingress of water. Change doors every 5 years, or as necessary.

Door Seals

The door seals or gaskets are precut, spun polyester strips. They are attached with stainless steel hold-down strips and screws. Should a gasket become excessively warped, cut, or cracked, allowing vapor leakage, it should be replaced.

See Section 11 - Spare Parts List for the specific gasket required. To replace it, remove screws hold-down strips and screws. After making sure the gasket guide is clean, install new gasket in its place, with existing hold-down strip and screws. Do not force the screws tight!

Door Latch Adjustment

The knob on the door latch is screwed in to latch the side doors more firmly, or screwed out to loosen them. To turn this knob, back off the locking nut on the inside of the latch. Reset this locking nut after desired adjustment is made.

Door Safety Switch

The adjustment of the door safety switch actuation is done in the following sequence:

1. Make sure power is turned OFF
2. Loosen the set screw that fastens the microswitch arm to the microswitch shaft. Be sure the shaft does not turn when the door is raised and lowered.
3. Raise the upper door almost half open and retighten the set screw on the microswitch shaft. Correct adjustment is when microswitch clicks when door (latch area) rotates out about 10 inches and again when closing door to about 5" from fully closed position. Readjust switch until this adjustment is attained. Use silicone grease to lubricate microswitch shaft every three (3) months.

Door Hinges and Plungers

To replace plungers, remove the back hinge pin and let plunger hang down. Then remove the two hitch pin clips and remove plunger pivot pin. Replace with new plunger assembly every 2 years.

Rivnuts

To remove rivnut, very gently cut the head off with a small chisel. Then take a flat punch and push remaining part of rivnut into the hole. Do not try and remove it because it will not bother anything and you will damage the area for the new rivnut. Install rivnut with rivnut too.

9.9. HEADERS AND ORIFICES

The injection headers are positioned so the orifices are pointing 5 to 10° off vertical and in the direction of the fan closest to it. Sometimes, if lightweight products on the conveyor would be disturbed by the velocity of the CO2 injection, the orifices are pointed almost horizontal.

A small mirror is handy to use to easily determine if an orifice is open and the direction in which it points.

When a freezer is installed, the CO2 lines are blown out to clear out debris. There is a strainer (ST-101) on each CO2 drop that needs to be cleaned about one time per year.

During the first month or two after start-up, there is a possibility of foreign matter in the lines clogging one or more orifices.

To clean the orifices, remove the header. Probe the orifices with a fine pin and tap the header lightly to remove the foreign material from inside. Replace the header and make sure to point the orifices the same as they were.

Sometimes an orifice can be cleared without removing the header. With the fans and injection switches off, probe the clogged orifice with a pin. With the top door open, activate the fan and injection switches (fans will not run) and actuate the controller to open the solenoid to check if the orifice has been cleared.

9.10. TEMPERATURE CONTROLLER

FDC-4300 Fuzzy Logic plus PID microprocessor-based controller, incorporates a bright, easy to read 4-digit LED display, indicating process value. The Fuzzy Logic technology enables a process to reach a predetermined set point in the shortest time, with the minimum of overshoot during power-up or external load disturbance. The units feature three touch keys to select the various control and input parameters. Our unit is powered by 11-28 or 90-264 VDC/AC supply, incorporating a 2 amp. control relay output and dual 2 amp. alarm relays output as standard. The unit is set up to digitally display temperature in degrees F. There are LED status indicators to show activation of Outputs 1 and alarm 1 and the set point and ambient is displayed. The outputs are on/Off signals. Alarm 1 signal controls the constant (throttled) low flow injection, and Out 1 signals the make-up (full flow) injection. The lower limit set point is programmed to not go below -95F, but can be reprogrammed for warmer or colder limits if the situation warrants it

Control functions, alarm settings, and other parameters are easily entered through the front keypad. Programmed data is protected from unauthorized changes with its “ENABLE MOD” security system. Battery back-up protects against data loss during AC power outages.

The instrument is removable from its housing. External wiring for the controller is connected to the panel board at the back of the housing.

To remove the instrument from its housing, loosen the screw lock centered on the lower part of the face of the instrument. Pull the instrument straight out.

When reinstalling, be sure that the vertically mounted circuit boards are inserted in the correct grooves in the top and bottom of the housing and make certain the lock screw is sufficiently tight.

The controller has a default circuit and is checked out at the time of freezer assembly. Should a temperature control problem develop, first check for loose connections to the controller and the temperature sensor and the sensor connection in the module apparatus box.

To check for defective temperature sensor, connect a new sensor to input terminals of controller inside a control cabinet with the freezer sensor disconnected. Immerse a sensor in the ice water and cycle

controller around 32°F to see if the red light comes "on." Also, immerse the sensor in CO2 snow and cycle the set point around -110°F to see if the red light comes "on". If the red light does not operate at the set points, replace the temperature sensor in the freezer. If the red light does not operate, the controller instrument is at fault and must be replaced and the sensor can be assumed to be operative.

Or…

Unplug the relay for the injection system being checked. With the upper doors open, turn fans and instrument power "on." Immerse the temperature sensor in ice water as explained above and observe temperature reading on controller.

9.11. TEMPERATURE SENSOR (RTD TYPE)

To replace the temperature sensor, disconnect leads inside the apparatus box, loosen compression nut, fittings and remove fitting and sensor from within the apparatus box. Install new sensor by sliding it through the same opening in the apparatus box; the sensor should protrude 1" to 1-1/2" down from the ceiling of the module and be free from being hit by the fan blade. Connect new leads to proper wires of shielded cable. A fitting is part of the new sensor.

To Replace Fan Shaft Bearing Only

1. Remove fan blade by first loosening the two cross bolts on it. Remove hex cap screw and thrust washer and slide fan blade and key off shaft.

2. Remove the clamping collar.

3. Force flat point of a screwdriver or similar tool in one of the slits in the bearing housing to pry slightly apart. Remove bearing sleeve and bearing. A short bent wire may be helpful to reach up in bearing housing and catch the top of the bearing to pull it out.

4. To reassemble with new bearing, install clamping collar loosely on bearing housing. Insert bearing on the fan shaft and push up in to bearing housing.

5. Grease* the fan shaft holes in the fan blade. Install fan blade with curve "hump" up. Cross bolts and nuts are to be just tight, not forced tight; snug, no not tighten set screw in clamping collar after fan blade is mounted. (*refer to Fan Assembly sketch located at the end of Section 4)

To Repair Motor Brake or Fan Shaft (Fixed Speed)

Remove the motor and fan assembly:

1. Disconnect power and then disconnect motor electrical cable from inside the apparatus box and free the cable.

2. Remove fan blade by first loosening the two cross bolts on it. Remove hex cap screw and thrust washer and slide fan blade and key off the shaft.

3. Remove the clamping collar.

4. On top of module, remove the cap screws that secure motor mounting plate to module.

5. Pull entire assembly up and examine it at work bench.

6. Replace faulty part.

7. The Fan Assembly sketch located at the end of the Section, clearly shows how this assembly goes together. There are, however, certain requirements to observe as follows:

    a. Assembling square coupling to motor shaft. Lay a 5/16" rod across face of motor to locate position of coupling on motor shaft.
    b. Grease* face of motor when assembling motor to brake
    c. Wiring motor to brake. Refer to Fan Assembly sketch at end of Section.
    d. Fan shaft to break shaft with coupling. Both shafts to be properly seated in coupling. Insert space in the cross slot in coupling and set both shafts against spacer to each shaft is fully into its half of coupling. Remove spacer. Grease* threads of all four coupling cap screws and tighten screws evenly.
    e. Assembly of bearing housing to motor/brake assembly. Grease* the four ¾" machine screws and attach bearing housing to bottom of break housing.
    f. Check the alignment of the fan shaft in the bearing housing. It must be concentric.
    g. Insert assembly into body of freezer. Insert bearing sleeve and then bearing on fan shaft and push up into bearing housing.
    h. Install clamping collar. Grease* the fan shaft hole in the fan blade. Install fan blade with curved "hump" up. Cross bolts and nuts are to be just tight, not forced tight; snug, do not tighten set screws in clamping collar after fan blade is mounted.
    i. Fan Motor Wiring – be sure it is connecter for 230V. When attaching motor wires to motor starter, the color is red, white and black, from left to right; i.e. T1, T2, T3. Check fan rotation. Must be counterclockwise as viewed from the top of freezer.

*GREASE – Use silicone or compound GE-G661 or Vaseline.

To Repair Variable Speed Motor or Fan Shaft

(Refer to Fan Assembly sketch located at end of the Section)

1. Disconnect power and then disconnect motor electrical cable from inside the apparatus box and free the cable.

2. Remove fan blade by first loosening the two cross bolts on it. Remove hex cap screw and thrust washer and slide fan blade and key off the shaft.

3. Remove the clamping collar.

4. Force flat point of screwdriver or similar tool in one of the slits in bearing housing to pry slightly apart. Remove bearing sleeve and bearing. A short bent wire may be helpful to reach up in bearing housing and catch the top of the bearing to pull it out.

5. On top of module, remove the cap screws that secure motor mounting plate to module.

6. Pull entire assembly up and examine it at work bench.

7. Replace faulty part and reassemble as follows.

8. The attached assembly drawing clearly shows how this assembly goes together. There are, however, certain requirements to observe as follows:

    a. Fan shaft to motor shaft with coupling. Both shafts to be properly seated in coupling. Insert spacer in the cross slot in coupling and seat both shafts against spacer so each shaft is fully into its half of coupling. Remove spacer. Grease* threads of all four coupling cap screws and tighten screws evenly.
    b. Assembly of bearing housing to motor. Grease* the four machine screws.
    c. Check the alignment of the fan shaft in the bearing housing. It must be concentric. Connect electronically and run motor-fan shaft must not wobble.
    d. Assembly of bearings, bearing sleeve and clamping collar. Install clamping collar loosely on bearing housing. Insert bearing sleeve and then bearing on the fan shaft and push up into bearing housing.
    e. Assembly of fan blade. Grease* the fan shaft hole in the fan blade. Install fan blade with curved “hump” up. Cross bolts and nuts are to be just tight; not forced tight. Snug, do not tighten set screw in clamping collar after fan blade is mounted.
    f. Fan motor wiring – be sure it is connected for 230V. When attaching motor wires to motor starter, the color code is red, white, and black, from left to right; i.e. T1, T2, T3. Check fan rotation. Must be counter-clockwise as viewed from top of freezer.

*GREASE – Use silicone or compound GE-G661 or Vaseline.

10. Trouble Shooting

This section helps the maintenance or reliability team troubleshoot the freezer and take the appropriate actions. Additional information on the various components can be found in the appendices. Troubleshooting should only be carried out by qualified personnel.

10.1. ELECTRICAL POWER SUPPLY

The **ULTRA-FREEZE®** has been designed to operate from a 3-phase, 60 Hz electrical power supply. Use the electrical schematic in Appendix B – Reference Drawings for more information with respect to the voltage requirements and other specifications. The variation in supply voltage to the freezer should not exceed +10 % to -5 % of the nominal value. In case of any operating problems, first check the voltage at the main disconnect switch on the side of the electrical enclosure.

10.2. CO2 SUPPLY

Check if the amount of CO2 in the storage tank is adequate for the intended operating period. If the product exiting the freezer is not completely frozen, check the position of the CO2-control valve. If the CO2-control valve is full open, check the storage tank pressure is sufficient.

Occasionally, the orifices may become blocked by food or other debris. In the case of severe blockage, the temperature in the freezer will rise and the product will not be sufficiently frozen. Clear the blockage of the orifices as described above.

10.3. CONVEYOR SYSTEM

3-phase induction motors power the belt drive system of the **ULTRA-FREEZE®** freezer. If the drive system fails to operate, check the following in order:

- Check if the emergency stops have been activated. Reset if necessary.
- Check if the main fuses of the drive motor (belt) are intact.
- If the conveyor belt does not run at a smooth, uniform speed, check the belt tension.
- Check the belt tension pressure for proper operation. Excessive slack in the belt tension may cause an irregular belt speed.

10.4. TROUBLSHOOTING TABLE

TROUBLE	PROBABLE CAUSE	REMEDY
CO2 vapor flowing over exhaust troughs	Exhaust blower not operating or wrong rotation	Check blower and correct cause
	Clogged exhaust duct or closed blast gate in piping	Check and correct cause
	Too much air drawn in from opposite end of freezer	Check curtain. Check directional baffle.
	Negative pressure of room	Room needs positive pressure (bring in make-up air)
	Exhaust (entrance) opening is blocked at top (conveyor, etc.)	Loosen thumb screw to lower opening by dropping slide plate adjust
	Uneven draw across belt (entrance & exit)	Adjust slope baffle at bottom, by reversing of changing open draw area
	Exhaust system failure	Check the exhaust system (motor, blades, shaft, etc.) and replace if necessary.
Both AMBER and RED lights shut-off (during production runs)	Over-injection of CO2	Reduce number of open orifices in the zone
		Valve may need throttling
	Injection too close to sensor	Change location of open orifice
Both AMBER and RED lights stay on continuously, but freezer cannot maintain temperature	Not enough open orifices	open orifices
	Valve throttled too much	Re-adjust valve
Insufficient cooling in freezer or freezer will not maintain set point temperature	Lack of CO2 Tank empty of liquid Solenoid valve(s) turned off or malfunctioning Strainer plugged	Check tank, piping, valves, strainer. Correct cause. Check solenoid valves for proper functioning. Correct cause or replace parts if necessary. Refer to Maintenance Section.
	Header orifices plugged	Clean headers. See Maintenance Section
	Temperature controller or sensing element	Refer to Manual on controller. Check settings, sensing element, its wiring and controller. Correct cause or replace sensing element to controller, if necessary
	Suction of room air into freezer	Reset adjustable baffle(s). Repair curtains
	Relay or solenoid valve	Check relay or solenoid valve. Correct cause or replace item(s)

TROUBLE	PROBABLE CAUSE	REMEDY
Temperature indicator overshooting	Liquid solenoid valve stuck open	Check for foreign material on valve seat. Correct cause or replace parts, if necessary
	Temperature controller or sensing element	Refer to Manual on controller. Check settings, sensing element and its wiring and controller. Correct cause or replace sensing element or controller if necessary
	Sensor projection too short	Extend projection
Accumulation of CO2 snow in freezer	Liquid solenoid stuck open	Check for foreign material on valve eat. Correct cause or replace.
	Temperature controller or sensing element	Refer to Manual on controller. Check settings, sensing element and its wiring and controller. Correct cause or replace sensing element or controller if necessary
	Orifice shooting snow near edge of conveyor	Adjust orifice direction
	Sensor project too short	Extend project of sensor further into freezer tunnel
Conveyor will not operate	Power supply	Check and restore power
	Electrical short in motor or drive controller or fuse blown in drive controller	Check motor and drive controller. Correct cause or replace each, if necessary
	Jammed conveyor belt (motor hums)	Immediately turn “OFF” power to conveyor drive (OR USE E-STOP), check for jam, and correct cause
	Belt drive not activated.	Activate belt drive.
	Emergency stop is activated.	Pull to reset the e-stop button.
	Thermo-magnetic or circuit breaker of motor (belt) tripped out.	Check thermo-magnetic or breaker. Reset. Measure current to motor in case of repeated trip-out.
	Insufficient start power.	Investigate cause and solve.
Circulating fan motor(s) not running	Starter control dropped out for some cause	Manually spin fan blade to see if it spins freely or there are evident bad bearings if spins freely reset starter. If motor does not start, check electrical connections or perhaps motor burned out. Find cause and correct.

TROUBLE	PROBABLE CAUSE	REMEDY
	Fan motor pushbutton is not on.	Press the START button for the Fan Motor on the control panel.
	One of the upper doors is open, or the limit switch is not engaged	Check each of the upper doors and limit switches.
Banks of fan motors not running (for variable speed motors) or behaving erratically	Check display for error message	Refer to Section 16.0 of the Leeson Manual to interpret messages and suggested remedies
	Check display – no error message	Refer to Table for Check Points and Suggested Remedies
Product exits freezer too warm at start-up of production.	Freezer not sufficiently cooled down.	Wait a few more minutes before correcting.
	Steady state not reached.	
	Product residence time too short.	Reduce belt speed.
	No CO2-injection.	Check if all valves are open and working properly.
No power at control panel or components.	Main disconnect not switched on.	Turn main disconnect into ON position.
	Main fuses failed.	Identify cause and replace if required.
	Power supply of plant failed.	Check power supply up-stream of machine.
Product exits freezer too cold.	Product residence time too long.	Increase the belt speed.
Exhaust fan not running	Exhaust system not switched on.	Activate exhaust system.
	Circuit breaker of motor failed.	Reset breaker.
No CO2-injection.	CO2-injection not activated.	Start CO2-injection.
	Tank is empty.	Re-order CO2.
	Main shut-off valve on supply line or at storage tank closed.	Open main shut-off valve.
	Emergency stop pushed.	Pull the e-stop button.
	Exhaust fan not activated.	Activate exhaust fan.
	Upper doors not closed. Limit switch not activated.	Close doors.
		Replace limit switch.
	Various drive units (belt, fans) not activated.	Make sure all drive units have been activated and are properly working.
	header orifices are blocked.	clean orifices

11. Spare Parts List

The following list of spare parts apply to **ULTRA-FREEZE®** Freezers with 30" or 48" wide belts, and 1 or 3 tiers. To obtain spare parts for items not listed below, please contact RS CRYO at (866) 305-1300.

11.1. MOTOR AND FAN ASSEMBLY PARTS

Part Number	Part Description
30-570212	Motor, Fan, 1 HP, 1140 RPM, 230V, 3 PH, 60 Hz (Fixed Speed Only)
30-570009-M	Motor, Fan, 1 HP, 1140 RPM, 230V, 3 PH, 60 Hz (Variable Speed Only)
30-570210 Obsolete 30-570582	Brake, Fan Motor (Fixed Fan Speed Models Only) [pre 3/93] Brake, Fan Motor (Dodge) NEW STYLE as of 3/93
30-551385	Shaft, Fan
30-570263	Coupling, Fan Shaft Split (5/8" I.D.)
30-570354	Bearing, Fan Shaft
30-550561	Sleeve, Bearing
30-570303	Fan, Blade P1171 (High Pitch)
30-570207	Fan, Blade P1179 (Low Pitch)

11.2. CONTROL CABINET PARTS

Part Number	Part Description
30-570004-M	Controller, DC Conveyor Drive, ¾ and 1 HP
30-570375	Controller, DC Conveyor Drive, 1-1/2 HP
30-130512	Fuse, Conveyor Drive Controller, 3/4 – 1-1/2 HP, 2 amp, Ceramic
30-130516	Fuse, Conveyor Drive Controller, ¾ - 1 HP, 10 amp, Ceramic
30-130514	Fuse, Conveyor Drive Controller, 1-1/2 HP, 15 amp, Ceramic
30-570587-M	Inverter, AC Speed Control, 5 HP, 3 PH, 230V
30-570331	Relay (Potter & Brumfield KRP11A)
30-570566	Controller, Temperature (RTD Sensor) Kit Reprogram for --95°F
30-570347	Lamp, Push Button (#120 PSB Lamp Push-In Type 120V)
30-570037	Potentiometer, Control Speed (DC Controllers)
30-570532	Switch, Door Safety
30-570074	Potentiometer, Fan Speed

11.3. OTHER PARTS

Part Number	Part Description
30-570461	CO2 Injection Solenoid Valve (without coil)
30-570360	Sensor, Temperature (RTD type)
30-570005	Motor, Conveyor Drive, ¾ HP (DC)
30-570004	Motor, Conveyor Drive, 1 HP (DC)
30-550491	Gasket, Door Curved, Spun Polyester
30-550490	Gasket, Door Straight, Spun Polyester
30-550489	Guide Strip, Door Gasket, Stainless Steel
30-550087	Latch Assembly, Door with Striker Plate (550082)
30-550082	Striker Plate, Door Latch
30-550003	Shim Plate, Door Latch
30-570085	Knob, Door Latch
30-550056	Plunger Assembly, Lower Door
30-550032	Plunger Assembly, Upper Door

12.Appendices

Appendix A

CO2 MSDS

Appendix B

Reference Drawings

Appendix C

Component Manuals