TW-303

Operating and Maintenance Instructions

10K and 24K

CryoStorage Systems

with AutoTend Controller

Taylor-Wharton

Do not attempt to use or maintain this unit until you read and understand these instructions. Do not permit untrained persons to use or maintain this unit. If you do not fully understand these instructions, contact your supplier for further information.

SAFETY

Liquified Gases

Extremely cold refrigerant – cover eyes and exposed skin. Accidental contact of the skin or eyes with any cryogenic liquid or cold gas may cause a freezing injury similar to frostbite. Protect your eyes and cover your skin when handling stored product, or when transferring liquid or in any instance where the possibility of contact with liquid, cold pipes and cold gas may exist. Safety goggles or face shield should be worn when transferring liquid. Long-sleeved clothing and gloves that can be easily removed are recommended for skin protection. Cryogenic liquids are extremely cold and will be at a temperature of -320° F (-196° C) under normal atmospheric pressure.

Keep equipment well ventilated. Although the liquefied gas refrigerant used in this equipment is non-toxic and non-flammable, it can cause asphyxiation in a confined area without adequate ventilation. An atmosphere that does not contain oxygen for breathing will cause dizziness, unconsciousness, or even death. These gases cannot be detected by the human senses and will be inhaled normally as if they were air. Ensure that there is adequate ventilation where this equipment is used and store liquid refrigerant supply only in a well ventilated area.

Liquid Nitrogen System - The liquid nitrogen supply pressure at the inlet to the refrigerator should be in the range of 10 psig (0.7 bar/69 kPa) to 20 psig (1.4 bar/138 kPa) for optimum performance. Higher operating pressures will increase transfer loses and create excessive turbulence of the liquid in the refrigerator which can generate false signals to the liquid level controller causing the refrigerator to underfill. In “liquid phase” storage applications, excessive turbulence can cause splashing which could result in personal injury and/or damage to the refrigerator. When installing piping or fill hose assemblies, make certain a suitable safety relief valve is installed in each section of plumbing between shutoff valves. Trapped liquified gas will expand as it warms and may burst hoses or piping causing damage or personal injury. A relief valve is installed in the refrigerator plumbing to protect the line between the customer supplied shut-off valve and the refrigerator solenoid valve.

WARNING: Inlet pressure must not exceed 22 psig (1.5 bar/152 kPa.) Higher pressures could result in damage to equipment and/or sufficient depletion of oxygen in the atmosphere to cause dizziness, unconsciousness, or death.

NOTE: For detailed information on the handling of cryogenic liquids refer to the Compressed Gas Association publication. P-12 “Safe Handling of Cryogenic Liquids” available from Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

Electrical

Electrical shock can kill. The liquid level controllers used with these refrigerators operate from 24VAC. However, the external transformer does have a 110/120VAC primary. Do not attempt any service on these units without disconnecting the electrical power cord.

NOTE: Units are supplied with Taylor-Wharton approved controllers. If other liquid level controllers are used, please contact Taylor-Wharton before putting the refrigerator into service.

Freight Damage Precautions

Any freight damage claims are your responsibility.

Cryostorage systems are delivered to your carrier from Taylor-Wharton’s dock in new condition. When you receive our product, you may expect it to be in that same condition. For your own protection, take time to visually inspect each shipment in the presence of the carrier’s agent before you accept delivery. If any damage is observed, make an appropriate notation on the freight bill. Then, ask the drive to sign the notation before you receive the equipment. You should decline to accept containers that show damage which may affect serviceability.

General Information

Taylor-Wharton CryoStorage Systems are designed for applications where extremely low temperature of biological products are required. They are also appropriate for industrial or other functions where liquid nitrogen temperatures and high capacity are needed.

The 10K and 24K refrigerators covered by this publication are designed for, but not limited to, the laboratory environment. The 10K and 24K feature square, modular cabinets that facilitate grouping several units together in a cryostorage. Both of the models will accommodate inventory control systems or provide unobstructed storage area for larger product. Models feature full access lid openings, and are supplied with casters where limited mobility for cleaning purposes is important.

These standard models are equipped with the AutoTend electronic liquid level controller that will monitor and control the supply of liquid nitrogen to the unit. The instructions for easy operation are printed on the front panel. The addition of a liquid nitrogen supply and inventory control racks for systematic retrieval of stored product completes the total cryostorage system

Maximum Refrigerator Contents

Your cryostorage system has a maximum weight capacity which is stated in the specifications. This capacity exceeds the maximum amount of liquid nitrogen the refrigerator is capable of holding. Generally, as product is added to liquid storage phase, the stored product and inventory control system are heavier than the liquid nitrogen they displace. In vapor-phase storage applications, where the liquid refrigerant is found only in the bottom portion of the refrigerator, the weight of contents is determined more by weight of the stored product.

Liquid nitrogen at atmospheric pressure weighs 1.78 lb./liter (0.8 kg/liter). To ensure you are not exceeding the capacity of the cryostorage system, calculate the weight of the quantity of liquid nitrogen in your unit and subtract the result from the Total Allowable Capacity Weight found in specifications section of this publication. All K Series CryoStorage Systems are designed to support the full weight of liquid nitrogen and a complete stainless steel or aluminum inventory control system with boxes and specimens.

		10K	24K
Dimensions			
Height(1)	mm.	11118	1118
	in.	44	44
Width	mm.	587	864
	in.	23.1	34
Depth(2)	mm.	775	965
	in	30.5	38
Usable Height, Internal	mm.	737	737
	in.	29	29
Internatl Diameter(3)	mm.	533	787
	in.	21	31
Capacity			
Space Volume	cu.m	0.16	0.36
	cu. ft	5.8	12.7
LN2 Capacity			
	L	165	365
Evaporation Rate (4)			
	L/day	5	7
Work, Empty	kg.	111	184
	lb.	245	405
Total Allowable CapacityWeight (5) (Including liquid refrigerant and stored product)	kg.	133	291
	lb.	292	641
Maximum Gross Weight (6)	kg.	245	476
	lb.	540	1050
Inventroy Control System Specifications			
No. 5x5 Racks(7)		7	17
No. Shelves/Rack		13	13
No. 3.0x3.0 Racks(8)		4	6
No. Shelves/Rack		13	13
Vial Capacity, 2 ml(9)		10,400	24.05
Blood Bag(10)		175	360

Specifications are subject to change without notice

1. Maximum required clearance (with the lid open) for the 10K is 69 in. (1753 m); 24K is 76 in.(1930 mm).
2. Depth with lid open for 10K is 34 in. (864 mm); 24K is 48.5 in. (1232 mm).
3. Temperature Gradient Suppression System reduces internal diameter by approx. 2/4 in. (6.4 mm). Does not apply to 10K
4. Evaporation rate is nominal. Actual rate may be affected by the nature of the contents, atmospheric conditions, container history, and manufacturing tolerances.
5. Does not include the weight of the refrigerator itself. Refer to Maximum Refrigerator Contents section.
6. Includes the empty weight and total allowable capacity weight.
7. 5 in. x 5 in. (127 mm x 127 mm) 100 cell box
8. 3.0 in x 3.0 in. (76 mm x 76 mm) 25 cell box
9. 3 ml vial size: 12.5 mm O.D. internal thread.

Fenwal 4R-5461 bag.

Liquid Nitrogen Supply Connection

The package included with the refrigerator includes a filter and an elbow. The liquid fill hose from a low pressure source of liquid nitrogen must be connected to the inlet through these two fittings. This liquid nitrogen source must have a shut-off valve, and may be any portable liquid cylinder or a bulk supply. The liquid nitrogen supply pressure at the inlet to the refrigerator should be in the range of 10 psig (0.7 bar/69 kPa) to 20 psig (1.4 bar/138 kPa) for optimum performance. Higher operating pressures will increase transfer losses and create excessive turbulence of the liquid in the refrigerator which can generate false signals to the liquid level controller causing refrigerator to underfill. In “liquid phase”, storage applications, excessive turbulence can cause splashing which could result in personal injury and/or damage to the refrigerator.

If the liquid nitrogen supply pressure at the inlet to the refrigerator rises above the opening pressure of the relief valve on the refrigerator, liquid nitrogen will be discharged into surrounding area which can cause rapid and very dangerous depletion of oxygen in the atmosphere. Once this pressure relief device has opened and cooled to liquid nitrogen temperature, it will not reset until it has warmed to near ambient temperature. THIS COULD PERMIT THE ENTIRE CONTENTS OF THE LIQUID NITROGEN SUPPLY SYSTEM TO BE DISCHARGED INTO THE IMMEDIATE AREA OF THE REFRIGERATOR(S).

WARNING: In order to prevent the relief device on nitrogen refrigerator(s) from opening when the system is in operation, the liquid nitrogen supply system must be protected by a pressure relief device that will open when the pressure at the inlet to the refrigerator(s) is approximately 22 psig (1.5 bar/ 152 kPa). Never install the supply system pressure relief device into a liquid service line.

W A R N I N G

INLET PRESSURE MUST NOT EXCEED 22 PSIG (1.5 BAR).
HIGHER PRESSURES COULD RESULT IN DAMAGE TO EQUIPMENT AND/OR SUFFICIENT DEPLETION OF OXYGEN IN THE ATOMOSPHERE TO CAUSE DIZZINESS, UNCONSCIOUSNESS OR EVEN DEATH

DO NOT REMOVE THIS LABEL
DECAL PART NO. R22K-9C43

Figure 1. Warning Label (R23K-9C42)

Filling the Refrigerator (Initial Fill)

The 10K and 24K units are using the AutoTend controller come preset from the factory to operate.

The liquid nitrogen supply pressure at the inlet to the refrigerator should be in the range of 10 psig (0.7 bar/69 kPa) to 20 psig (1.4 bar/138 kPa) for optimum performance. Higher operating pressures will increase transfer losses and create excessive turbulence of the liquid in the refrigerator which can generate false signals to the liquid level controller causing refrigerator to underfill. In “liquid phase” storage applications, excessive turbulence can cause splashing which could result in personal injury and/or damage to the refrigerator.

WARNING: Maintain adequate ventilation to prevent asphyxiation hazard. (See Safety Precautions)

Power Supply Connection

Connect the 24 Volt AC power supply to the rear of the cryostorage system; then plug the power supply into a 110/120 VAC outlet. (See Figure 5 for the Electrical Supply Connections.) Turn on the AutoTend by turning the key on the front panel (see Figure 5) to the “on” position. The audible alarm may sound during set-up; silence the alarm by pressing the button labeled MUTE.

WARNING: If the fill fails to stop for any reason, quickly close the liquid supply valve to prevent overfilling unti the cause of the problem can be determined.

The unit is now under automatic fill control. Liquid will be added by the controller as long as the liquid supply and electrical power are maintained.

Operating Parameters

When materials are immersed in liquid nitrogen, they will assume the temperature of the liquid -320° F (-196° C). When material is stored in the vapor phase of the liquid, the liquid nitrogen is still a very cold refrigerant, but the refrigerator’s interior temperature increases somewhat as product is stored higher above the liquid. This temperature differential is not significant in many biological storage applications, and is affected by the amount of product stored in the refrigerator, the type and size of inventory control system, and the liquid level in the unit.

The liquid level in the refrigerator is determined by

the position of the sensor probes in the tube located at the front of the refrigerator. These probes are set at installation to maintain a specific liquid level. (See Figure 4) The cycle repeats when the liquid level drops to the low level sensor over time. Sensor probes may be moved to define new high and low levels, and these levels may be set independently to vary the liquid level differential between fills. For adjusting the temperature probes see “Changing Liquid Level” section in this manual.

Vapor Phase Storage

Vapor phase storage is normally utilized when stored product is unable to withstand liquid nitrogen temperatures, or when the storage medium (vials, ampules, etc.) is not designed for liquid phase storage.

In a typical vapor phase storage system, the liquid level sensors are positioned to maintain the liquid level at or below the platform supplied to the inventory control system. This positioning allows stored product to be kept at cryogenic temperatures without being exposed to liquid nitrogen, reducing the possibility of leakage or cross-contamination. Care must be taken in the positioning of the level of refrigerant in the event of power outages, which may disable the controller for an extended period of time. Consideration must also be given to liquid nitrogen availability and delivery schedules.

Liquid Phase Storage

Liquid phase storage is normally utilized when liquid nitrogen temperatures are required to maintain stored product viability and the storage mediums are adequate for storage in liquid nitrogen.

In a typical liquid phase storage system, the liquid level sensors are positioned to maintain the liquid level at or below the top level of the inventory control system. During operation, the upper levels of the inventory control system will at times become exposed as the liquid level fluctuates.

Care must be taken to ensure that the liquid level remains below the bottom of the refrigerator lid. Exposure to liquid nitrogen may result in physical damage to the lid. Additionally, operating the refrigerator with high liquid levels characteristic of liquid phase storage may result in turbulence during fill cycles. Caution must be exercised if the refrigerator lid is opened during a fill, and appropriated safety equipment should always be worn.

Thermistor Positioning for the AutoTend Controller

The longest sensor probe contains the Low Level and Low Alarm sensors in one pod. The probe with two pods contain the High Level and the High Alarm sensors. The factory sensor positions will maintain a liquid level between 3.0 in. (7.6 cm) to 6.0 in. (15 cm.) The dimensions used for the factory sensor installation are shown in Figure 2.

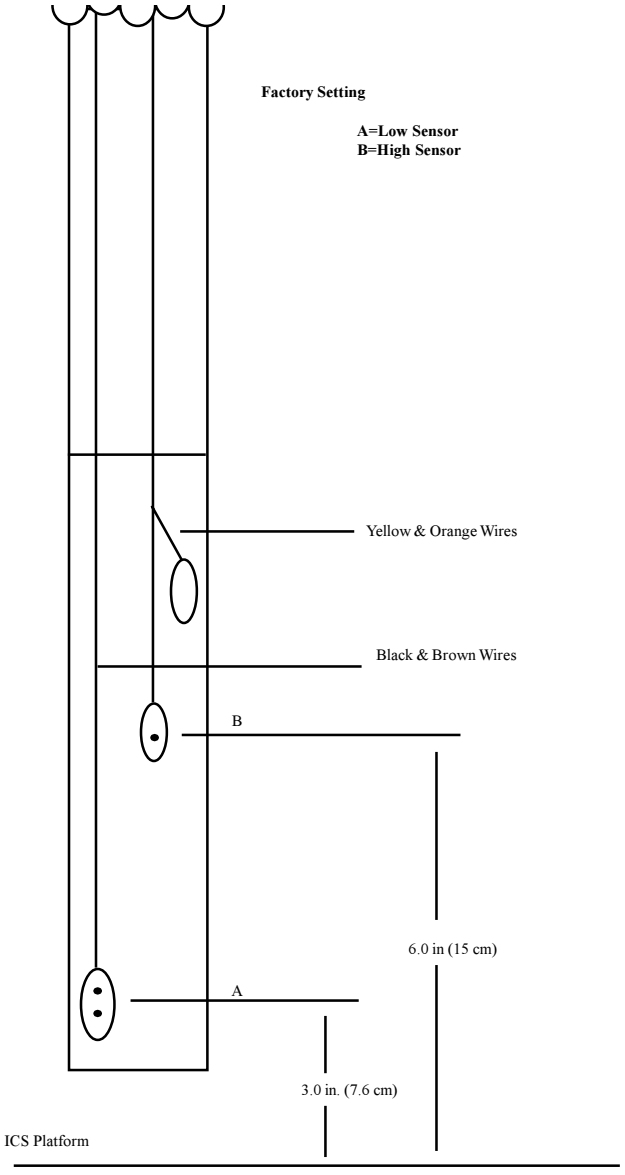


Figure 2. Sensor Positioning for the AutoTend Controller

Using Inventory Control Systems (ICS)

The purpose of the inventory control system is to bring order to the storage of many small samples and to allow direct retrieval of the particular samples you need at any time. It is important to be aware that when you lift an ICS rack from the refrigerator it is in a warmer environment. Learn to locate your sample quickly to avoid unnecessary warming of your stored product.

Keep ICS inserts (drawers of boxes) and dividers in good repair. Replacement inserts and dividers are available from your Taylor-Wharton distributor to keep your system as efficient as possible.

Always wear gloves when handling ICS racks or stored product, as they are very cold – read the precautions in the Safety section of these instructions, and in Taylor-Wharton publication TW-10, “Handle with Care”, for more detail on handling product stored in liquid nitrogen.

If an alternate platform is supplied with your inventory control system, the liquid phase platform in the bottom of your refrigerator may need to be removed to accommodate your inventory control system platform.

Temperature Gradient Suppression System

Every Taylor-Wharton CryoStorage unit includes a Temperature Gradient Suppression System. The Temperature Gradient Suppression System is a thermal conductor designed to conduct heat downward toward the nitrogen reservoir, and by doing so, will significantly reduce the temperature gradient between the top of the inventory control system and the nitrogen reservoir.

While specific temperature profiles will vary with the use of the refrigerator and the type of inventory control system used, the Temperature Gradient Suppression System is an effective way to lower the temperature underneath the refrigerator lid without noticeable increasing liquid nitrogen consumption.

NOTE: Temperature Gradient Suppression Systems are specifically designed for use in vapor phase applications and will be of little value when liquid phase storage is used.

The chart below represents typical temperature gradients within a Taylor-Wharton CryoStorage System utilizing the Temperature Gradient Suppression System.

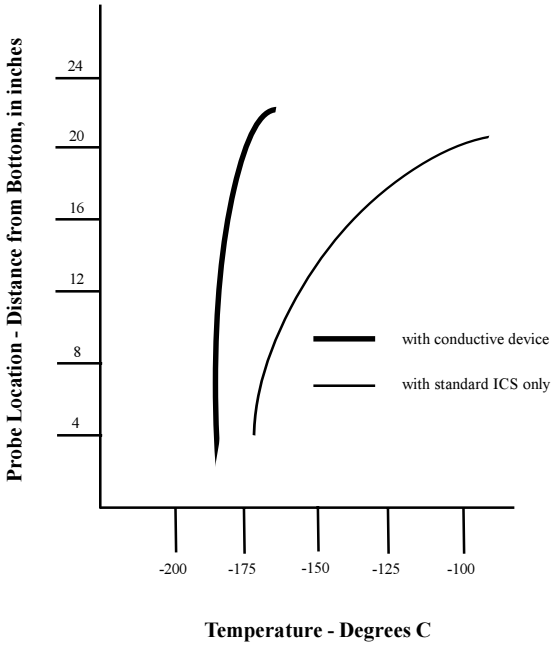


Figure 3. Temperature Gradient Suppression System

CONTROLLER OPERATION

Introduction

The **AUTO-TEND** Control System is designed to provide simple, reliable liquid level control in your LN_2 freezer. It operates on 24 Volts AC and uses a two-sensor system to open and close a solenoid valve. The liquid level, the sensor condition, the valve condition, and the LN_2 supply condition are indicated by lights on the front panel.

System Components:

AT-01	**AUTO-TEND** Control
AT-02	24 VAC Wall Transformer
AT-03	Harness Assembly
AT-04	24 VAC Solenoid Valve
AT-05	Sensor Assembly

Installation:

The **AUTO-TEND** Control System is designed to drop into your Taylor-Wharton Cryogenic refrigerator. The components plug into the back of the control panel as follows: the Harness Assembly has a 5-pin connector with a red dot. The Solenoid Valve has a 2-pin connector with a green dot. The sensor assembly has a 6-pin connector with a brown dot. These plug into the mates with the matching dots on the back of the control panel.

The sensor assembly should be installed with the yellow and orange wires at the High Level and the black and brown wires at the Low Level. These are labeled for easy reference.

The Auto-Tend controller should require not additional attention to maintain liquid level if an adequate supply of liquid nitrogen is maintained. If your protocol calls for you to “top off” the cryostorage system at the end of a work day or work week, press the Start button. The unit will full to the upper allowable liquid level and stop automatically. You may choose to manually stop the fill by pressing the STOP button at anytime during the fill.

Normal Fill Cycle

When the refrigerator is filled and the controller is operating, the low level and low alarm sensors are immersed in liquid nitrogen (see Figure 4.) Their resistance values are interpreted by the controller as “in liquid.” A the same time, the high level and the high alarm sensors are above the liquid pool sending the controller a “high” signal. In this condition, the control panel will read “Normal.” As liquid nitrogen evaporates, the liquid level in the refrigerator drops slowly until the low level sensor is above the liquid and send a different signal to the controller. After a delay sufficient to ensure the signal is not false, the controller interprets this condition as low liquid and opens the fill solenoid valve admitting more refrigerant. The refrigerator fills slowly, the control panel will read “LOW” when the liquid level is above the low level sensor. It will continue to display the green filling light until the high level sensor is immersed in liquid. Once the level of the liquid

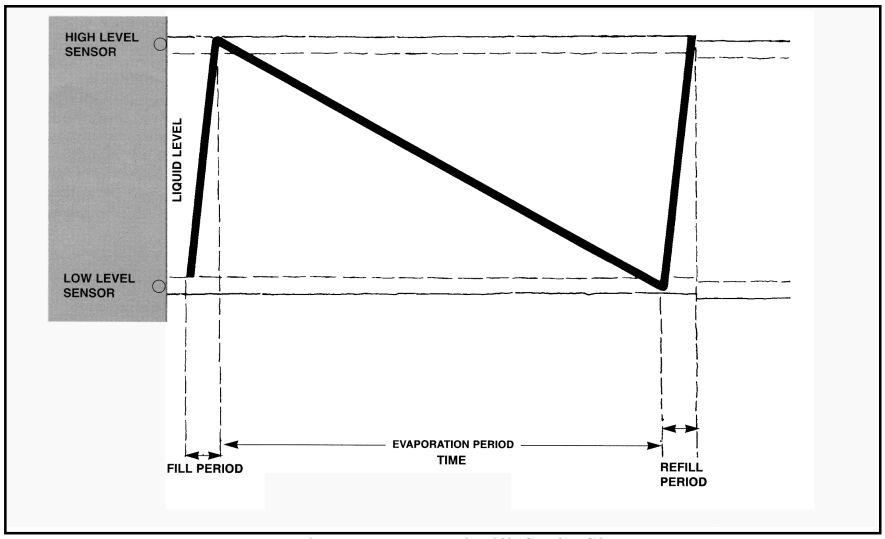


Figure 4. Normal Fill Cycle Chart

reaches the point of the high level sensor, the control panel will indicate “Normal” and will indicate the start of a new fill cycle. Figure 4 illustrates this cycle in graph form where liquid level is plotted against time, and display graphics are shown as they appear at key points in the cycle.

Controller Features
Level LN_2 Controllers

The controller is designed to maintain the LN_2 level in the refrigerator within a user-defined range. The LN_2 level will be maintained between the low level sensor and the high level sensor. When the liquid level reaches the low level sensor, LN_2 will be added to the refrigerator until it reaches the high level sensor. There are also two additional sensors located in the sensor assembly. The high alarm sensor is located 1 in. (2.54 cm) above the high level sensor. The high alarm sensor is used to shut off the LN_2 if the liquid level were to go past the high level sensor. The low level alarm sensor is located 1 in. (2.54 cm) below the low level sensor. The low alarm sensor is used to provide a warning that a LN_2 fill has not occurred as required to maintain the preset liquid.

Basic Operation

1.) **Automatic Fill:** The control will open the solenoid valve automatically when the liquid level falls below the Low Level Sensor. It will continue filling until the High Level Sensor is covered by liquid.

Manual Fill: The Start Fill button can be pressed at any time and the solenoid valve will open. If the liquid level is between High Level Sensor and the Low Level Sensor, the solenoid will stay open until the Stop Fill button is pressed or until the liquid level covers the High Level Sensor. If the liquid level is above the High Level Sensor, the solenoid valve will stay open while the user presses the Start Fill Button but will close when the user releases the button.

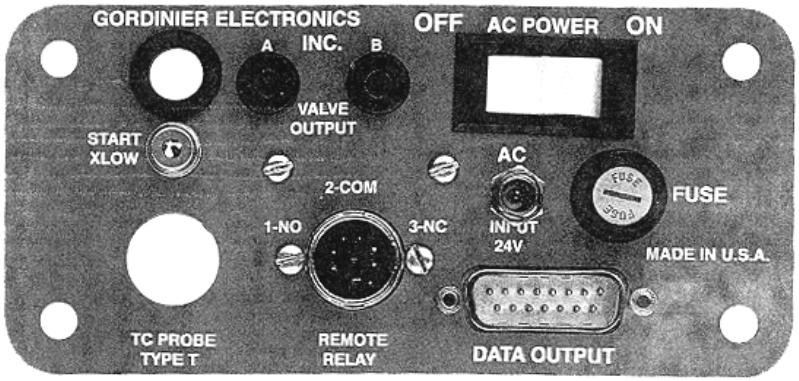
Please Note: The maximum time that the valve will stay open when the liquid level is above the High Level sensor is one minute. The user can open the valve again by simply releasing and then pressing the Start Fill button again.

Alarm Conditions: An alarm condition occurs when a sensor problem develops or the supply tank runs low on LN_2. When an alarm condition does occur, the appropriate light on the front panel flashes and an audible alarm is activated.

Testing the front panel lights: To test all the lights on the control except the Filling LED, press the Stop Fill & Mute button and hold for 8 seconds.

Testing the Remote Alarm: To test the remote alarm, press the Stop Fill & Mute button and hold for 13 seconds (5 additional seconds after testing the lights.)

Remote Alarm: The remote alarm relay has a set of “dry contacts” capable of carrying 5 amperes current at 30 volts D.C. The relay is “normal” during any alarm condition. The remote alarm is triggered 30 minutes after an error condition occurs. The remote alarm will be reset when the error condition is corrected. Pins 1 and 2 are closed in normal operating condition while pins 2 and 3 are closed in a remote alarm condition.



10K/24K

Figure 5. Electrical Supply Connections for 10K/24K

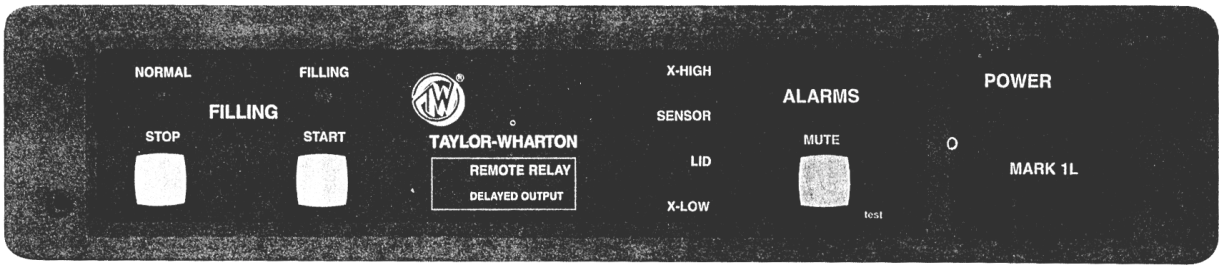


Figure 6. Front Panel Cover

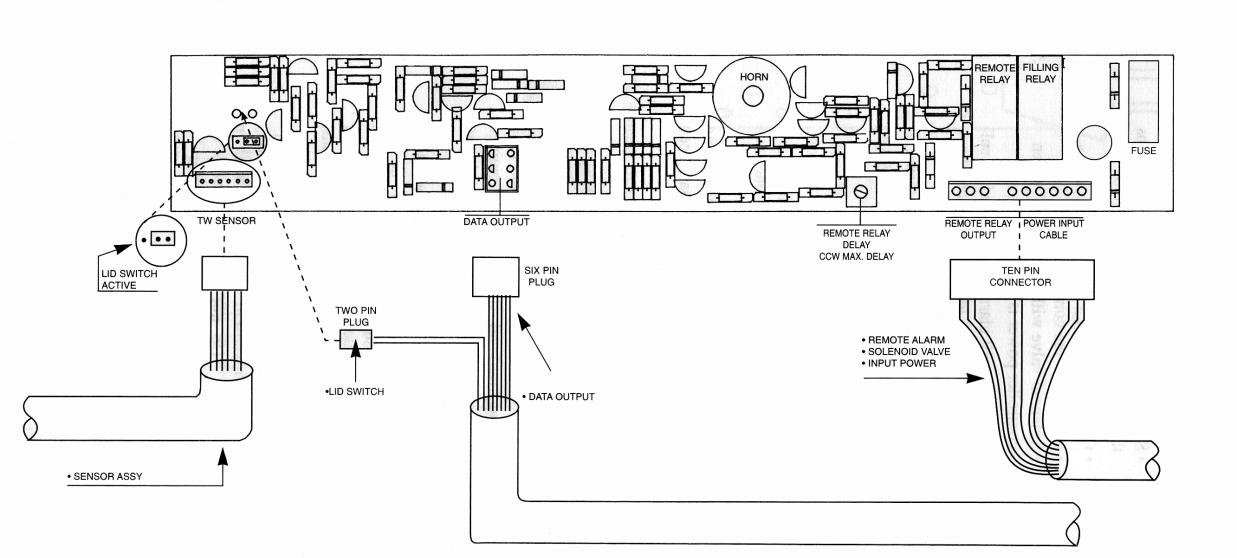


Figure 7. Internal View of Back of Controller Panel

DESCRIPTION OF FRONT PANEL

Key Lock: This turns the control On/Off. Turning the Key to the 3 o'clock position provides power to the control while rotating the key 12 o'clock position turns the control off.

Start Fill: This button opens the solenoid valve and allows LN_2 to flow into the freezer.

Stop Fill & Mute: This button closes the solenoid valve and stops the flow of LN_2 into the freezer. This button also silences the audible alarm.

Filling LED: Lights green to indicate that the solenoid valve is open.

LN_2 Level LED: Lights red to indicate that the liquid level is above the high level sensor. Lights green to indicate that the liquid level is between the low level sensor and the high level sensor. Lights yellow to indicate that the liquid level is below the low level sensor.

> **Please note:** The LED will not light if the high level sensor is submerged in LN_2 while the low level sensor is located in gas. The only time that this can occur is if the sensors are installed backwards.

Sensor Fault LED: Lights red to indicate that a sensor fault has occurred. A sensor fault can be either an open circuit or a short circuit in the sensor assembly.

Low LN_2 Supply LED: Lights red to indicate that the LN_2 supply is low. This is triggered when the liquid level does not reach the high level sensor within 1 hour of opening the valve.

Changing Liquid Level

The liquid level in the refrigerator is determined by the position of the sensor probes in a tube near the front of the refrigerator. These probes have been set at installation to maintain a specific liquid level. The controller operates a fill cycle that adds liquid at low level, fills to a predetermined high level, then stops the fill. The cycle repeats when liquid drops to the low level over time.

Sensor probe positions may be changed to define new high and low liquid levels, and these levels may be set independently to vary the liquid level differential between fills. If a higher liquid level is desired, withdraw the sensor tube; for a low level, the sensors must be moved further into (down) the sensor tube.

CAUTION: Ice or frost in the sensor tube may restrict movement of sensor probes in the tube. Do not pull excessively on sensor wiring while attempting to change sensor position. It may be necessary to remove the sensor from the container and allow it to thaw before the sensor can be repositioned.

Increasing the distance between low and high sensor probes allows greater liquid level fluctuation, less frequent filling and reduced fill loses; decreasing the distance has the opposite effect.

To set the liquid level to a different point, or to change the level differential, the sensors must be repositioned. Their position within the sensor tube is held in place by the sensor tube plug, which is split to allow the sensor leads to pass through. The sensor tube plug holds the sensors at the position necessary to maintain a specific liquid levels.

Two different sensor heights are specified by their position within the sensor tube. The low and high sensor pods are separately positioned to set the liquid levels at which the controller will start or terminate each fill cycle. Insert the high and low level sensor leads into the perforated sensor tube to the desired height. Mark the sensor leads at the top of the sensor tube. Pull the leads out just enough to install the sensor tube plug around the marks on the sensor leads. Insert sensor plug securely into the mouth of the tube. Perform this operation carefully, so the sensor leads are not damaged.

NOTE: *The high level sensors must be at least 2.0 in. (5.1 cm) above the low level sensor pod.*

CAUTION: **The high level sensor pod must be at least 8 in. (20 cm) below the top of the sensor tube container to prevent the lid from floating on liquid.**

After repositioning sensors, check to be sure the sensor tube is secure and turn the controller on. The controller should fill the refrigerator to the new liquid level. After sensors are repositioned, the controller should maintain the liquid pool at the new operating level.

Remote Alarm Connection

Relay connections are provided on an external for user installation of a remote alarm circuit (see Figure

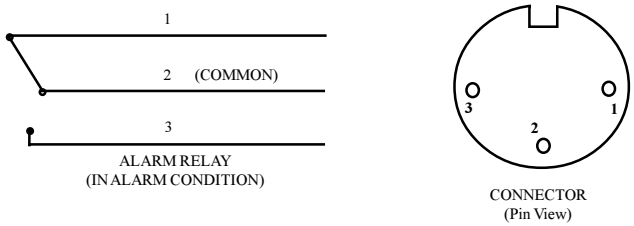
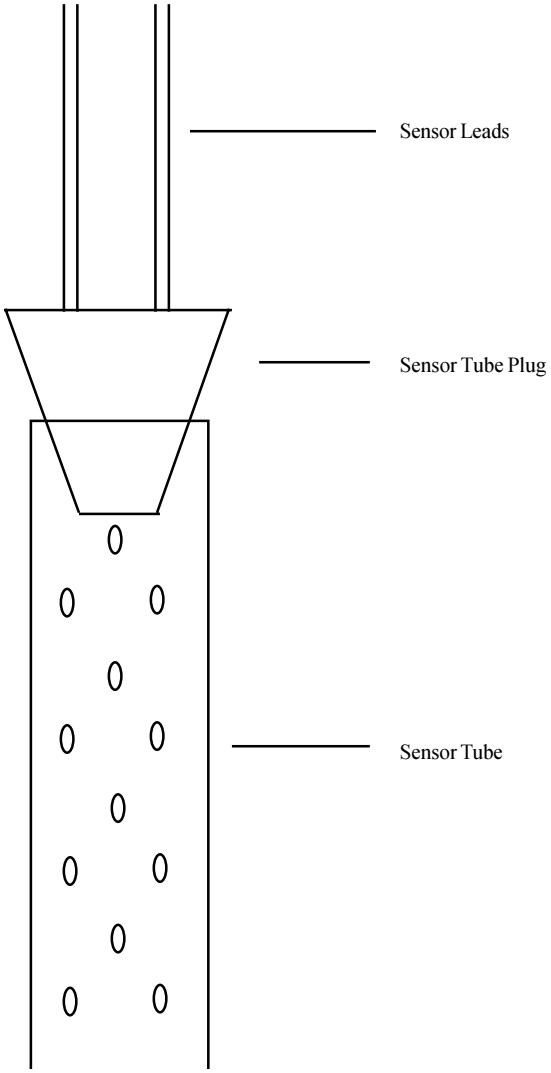


Figure 8. Remote Alarm Connection

Figure 9. AutoTend Sensor Installation



8.) Wiring external power supply and alarm devices must be supplied by the user. During an alarm condition, contacts 1 & 2 are open and contacts 2 & 3 are open.

MAITENANCE

K Series CryoStorage Maintenance

Filter Cleaning Instructions

The container might not fill properly if the filter is clogged with ice or dirt. To clean the filter, first close the supply valve to the refrigerator. Vent the fill line of all pressure. Remove and warm the filter to ambient temperature. Purge the filter from both directions with dry nitrogen gas or dry oil-free air. Rinse the filter with alcohol and purge it again with dry nitrogen gas or dry oil-free air to clear contaminants. If cleaning process doesn't clear the blockage, replace with a new filter (P/N 7631-1075.)

Defrosting your K Series CryoStorage System

All liquid nitrogen storage systems are subject to ice and frost buildup over time. Regular preventive maintenance programs should be instituted to remove ice and frost from the sensor and fill tubes and from the refrigerator lid.

Ice and frost build up in the sensor tube may result in false readings being relayed to the controller from the sensors. Ice can form a thermal barrier around a level sensor, rendering it insensitive to the temperature differences between vapor and liquid. Sensors and thermocouple should be removed regularly and inspected for ice and frost build up.

NOTE: *Ice or frost in the sensor tube may restrict the movement of sensor probes in the tube. Do not pull excessively on the sensor wiring while attempting to change sensor position. It may be necessary to remove the sensor tube from the container and allow it to thaw before the sensors can be repositioned.*

Ice and frost buildup in the fill tube may block the flow of liquid nitrogen into the refrigerator during fill. This blockage can result in the liquid level dropping to dangerously low levels, and may result in the Low Alarm sensor being activated. In addition, a fill line blockage may cause the low LN_2 Supply Alarm to be activated. If the fill line becomes blocked, it must be removed from the refrigerator, allowed to thaw to room temperature, and purged with dry nitrogen or oil-free dry air to remove all traces of moisture before being re-installed.

Excessive ice and frost buildup may occur on the refrigerator lid if the lid id left open or the liquid is too close to the underside of the lid. To defrost the lid, open the lid to the fully open position. Clean the ice and frost from the underside of the lid by allowing it to thaw slightly and wiping with a clean, lint-fee cloth. Care must be taken to insulate the inventory control system from high temperatures, which may affect the viability of the stored product.

Excessive ice and frost buildup on the lid may occur if the lid is miisaligned or the insulative gasket material is damaged. Should this occur, please contact your Taylor-Wharton distributor for assistance.

Cleaning your K Series CryoStorage System

The Cryogenic vessel of all K Series CryoStorage Systems may need to be cleaned and sterilized if the type of stored product is changed or the unit is taken out of service. The vessel must be cleaned and sterilized, regardless of the type of stored product, prior to return to Taylor-Wharton for repair of maintenance.[2]

To clean and sterilize your K Series CryoStorage system, first turn the unit off. Disconnect the power source and the liquid nitrogen source. Remove all stored product and inventory control system components. Allow the residual liquid nitrogen to evaporate and the cryogenic vessel to warm to ambient temperature.

Spray the entire inner vessel surface with ample amounts of an approved disinfectant.[3] Allow surface contact to be maintained for a minimum of five minutes. Rinse the inner vessel with water, remove all water and debris, and towel dry the surface. Spray the inner vessel surface with a 70% alcohol to water solution and maintain surface contact for fifteen minutes. Rinse the inner vessel surface with water and towel dry.

WARNING: Never use hollow rods or tubes as dipsticks. When a warm tube is inserted into liquid nitrogen, liquid will spout from the top of the tube and may cause personal injury.

Normal Evaporation Rate (NER) Test

If the nitrogen consumption of your K Series CryoStorage System seems excessive, it may be appropriate to perform an estimated Normal Evaporation Rate (NER) test on the unit. To perform an NER Test:

1. Fill the CryoStorage unit to the “High Level” sensor.
2. Allow a 24-hour cool down.
3. Measure the liquid nitrogen level with a plastic or wooden rule.

WARNING: Never use hollow rods or tubes as dipsticks. When a warm tube is inserted into liquid nitrogen, liquid will spout from the top of the tube and may cause personal injury.

4. Close and lock the lid of the CryoStorage System for forty-eight (48) hours.
5. Open the CryoStorage System and measure the liquid nitrogen level. Typically, liquid nitrogen levels will drop approximately 1 in. (25.4 mm) per day. If your measurement indicates a drop in excess of 2.0 in. (51 mm) per day, please contact your Taylor-Wharton distibutor or Taylor-Wharton Customer Service at (334)443-8680 for further information.

Auto-Tend Controller Maintenance

WARNING: Unplug the transformer from the wall before proceeding with any repairs.

The Auto-Tend has been designed for easy setup and maintenance. All connectors on the controller are uniquely identified snap-on plugs. The sensor, assembly, solenoid valve, power, remote alarm and data lines can be connected or disconnected in seconds. The controller is connected to the back electrical panel with a 10 wire cable with the appropriate snap-on connectors.

Installing the Controller

Remove the cabinets top, follow the steps in Figure 10 to remove the four (4) screws holding the trim (escutcheon) where the controller will be mounted. Remove four (4) screws from the top of the refrigerant and life the cabinet top to gain access to the area between the cabinet and the insulated inner vessel. The cabinet top may only be raises as shown in Figure 10 because of the lid hinges. Do not remove the hinged lid. After the cabinet top is loosened and propped up, this will allow access to the location where the electrical supply connections will be mounted.

Install the electrical supply connections panel to the back of the refrigerator. (See Figure 5.) Feed the wiring harness from the electrical supply connections panel to the front of the refrigerator and through the opening to where the controller will be

mounted. Attach the electrical supply connections to the controller board. Be sure to follow all of the installation procedures for the sensor probes and solenoid valve before you reattach the cabinet top. Attach the controller to the cabinet top with the two (2) supplied screws. Place the trim (escutcheon) over the controller and screw in the four (4) screws. Be sure that all of the necessary installation procedures have been completed before you start to fill the refrigerator. To start filling, refer to **Filling the Refrigerator (Initial Fill)** section of this manual.

Removing the Controller

To remove the control panel, follow the steps illustrated in Figure 10 to remove the four (4) screws holding the trim (escutcheon) around the controller mounting opening at the front of the refrigerator. Remove the two (2) screws from the controller and lift it from the refrigerator far enough to detach its electrical wiring. Remove four (4) screws from the top of the refrigerator and lift the cabinet top to gain access to the area between the cabinet and the insulated inner vessel. The cabinet top may only be raised as shown in Figure 10 because of the lid hinges. Do not remove the hinged lid. After the cabinet top is loosened and propped up, the electrical connection wiring may be detached to allow the back panel connection. At the completion of maintenance and repairs, reattach the electrical connection wiring to the controller. Install the controller using the procedure outlined for your refrigerator in **Installing the Controller** section.

Installing the Sensor Probes

For procedures for installing the sensor probes refer to the section titled **Changing Liquid Level** in this section of the manual.

Removing the Sensor Probes

Remove the controller using the procedures outlined in the **Removing the Controller** section. Disconnect the sensor probe lead connection from the controller board. Carefully remove the sensor tube plug from the sensor tube and remove the sensor leads from the plug.

NOTE: *Ice or frost in the sensor tube may restrict the movement of the sensor probes in the tube. Do not pull excessively on the sensor wiring while attempting to remove sensors. It may be necessary to remove the sensor tube from the container and allot it to thaw before the sensors can be removed.*

To install the new sensor probes, refer to the procedudure **Changing Liquid Level.** Installing the Solenoid Valve

To install a new solenoid valve, attach the connecting plumbing to the inlet and outlet connections of the valve using Teflon tape. Refer to Figure 11 for plumbing arrangement. Attach the compression fitting to the fill tube first and then connect to the outlet side of the solenoid valve. Position the solenoid valve onto the solenoid valve bracket and tighten the two (2) mounting screws. Attach the solenoid valve lead connection to the controller board. At the completion of maintenance or repairs, install the controller using the procedure outlined for your refrigerator model in the **Installing the Controller** section.

Removing the Solenoid Valve

Remove the controller using the procedure outlined for your particular refrigerator model in the **Removing the Controller** section. Disconnect only the solenoid valve lead connection from the controller board. Remove the back plumbing cover of the refrigerator to gain access to the plumbing and solenoid valve. (See Figure 11)

NOTE: *After disconnecting the solenoid valve leads, do not pull on wires. The wires are tied and spiral wrapped together.*

To remove the solenoid valve, loosen the compression fitting that connects the plumbing tubing in the fill tube. Unscrew the two (2) mounting screws that hold the solenoid valve to the solenoid bracket. Then remove the solenoid valve and its associated plumbing. Disconnect the plumbing from the inlet and outlet side of the solenoid valve. To install a new solenoid valve, refer to the procedure **Installing the Solenoid Valve** section.

[2] All K Series Cryostorage Systems must be cleaned and sterilized prior to return to Taylor-Wharton for repair or maintenance and must be accompanied by a written statement to this effect. Any K Series CryoStorage System received without this statement will be returned to the sender, freight collect. Contact Customer Service at (334) 443-8680 for further information.

[3] For cleaning and sterilizing of the K Series CryoStorage Systems, Taylor-Wharton recommends EXSPOR ä Cold Sterilant, manufactured by Alcide Corp., 8561 154th Ave., NE, Redmond, WA 98052 or equal. Write or call Alcide Corp. at (800)543-2133 for complete information, pricing and availability.

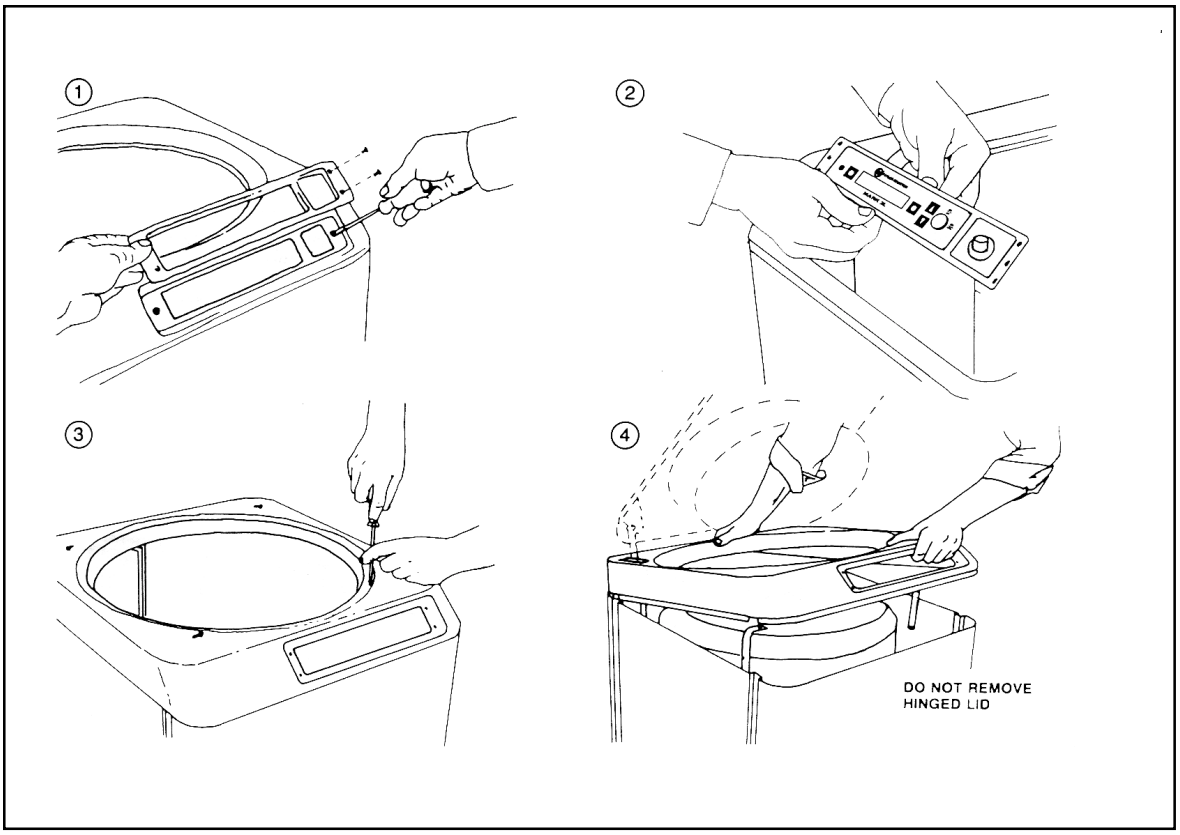


Figure 10. Removing the cabinet top of the 10K and 24K

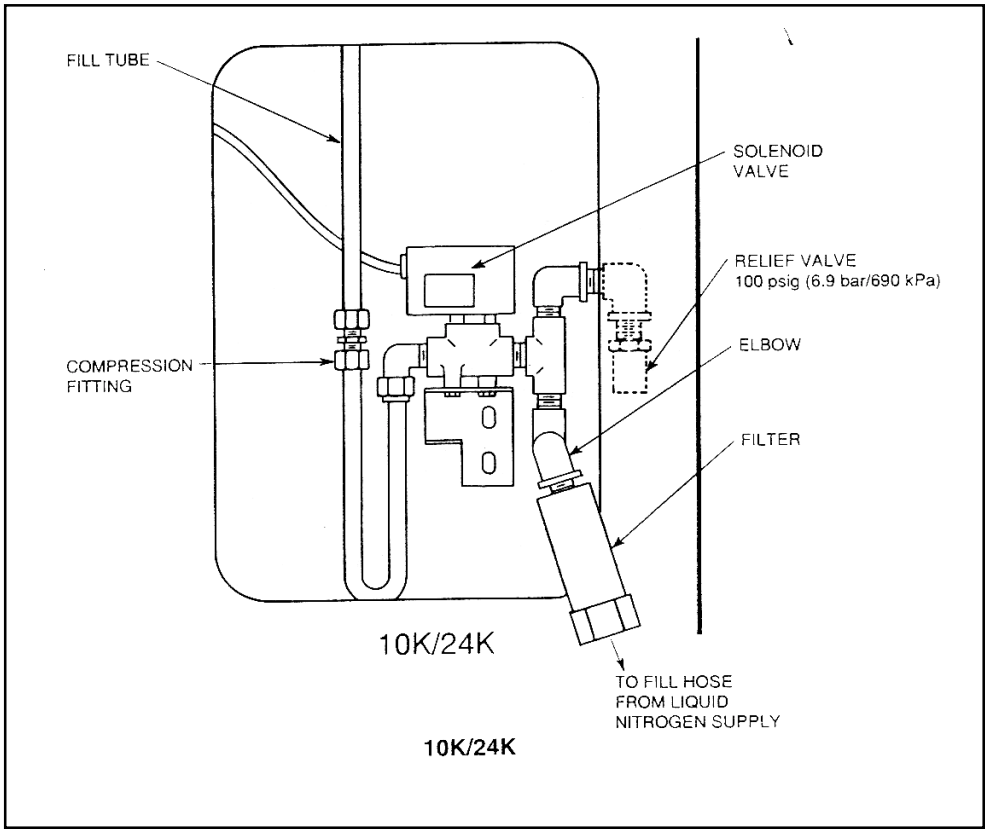


Figure 11. Rear Panel/Plumbing for 10K and 24K

TROUBLESHOOTING

Symptom	Probable Cause	Corrective Action
No response from controller.	a. No Power	a. Check plugs and power source. Check POWER key switch.
High Nitrogen consumption	a. High NER on supply container. b. Liquid Level too high c. Container has lost vacuum. d. Excessive nitrogen evaporation between source and refrigerator.	a. Contact your nitrogen supplier. b. Lower high level sensor. c. Check evaporation rate against minimal values in Specifications. d. Shorten inlet plumbing if possible – insulate piping to refrigerator.
Excessive frost or frozen lid	a. liquid level too close to underside of lid.	a. lower high level sensor.
LOW ALARM indication	a. liquid level below low sensor	a. Press "START FILL". If refrigerator still won't fill, see "Fill will not Start."
Fill will not start (no refrigerant entering unit.)	a. Refrigerant source empty. b. Open wiring to solenoid valve. c. Faulty solenoid valve. d. Filter plugged or saturated with moisture. e. Refrigerant boils away before reaching unit due to excessive fill line length.	a. replenish supply. b. check all connections. c. Replace solenoid valve d. Clean or replace part No. 7631-1075. For cleaning procedures, see section titled **Filter Cleaning Instructions.** e. Insulate and/or shorten fill line plumbing from LN_2 supply.
HIGH ALARM indication	a. liquid level above the highest sensor.	a. close liquid source valve and see "Fill Will Not Stop"
Fill Will Not Stop	a. solenoid valve frozen open. b. Faulty solenoid valve.	a. close supply valve and thaw solenoid valve. b. Replace solenoid valve.
Electrical shock from contact with metal housing	a. internal short circuit	a. discontinue use. Service controller
SENSOR FAULT indication	a. sensor probe connections b. defective sensor probe	a. remove controller and check thermistor probe connections. b. Replace probe.

REPLACEMENT PARTS

Refrigerator Parts (10K/24k)	10K	24K
Cabinet, Back, Panel	R10K-9C35	R23K-9C33
Cabinet, Front, Panel	R10K-9C33	R23K-9C33
Cabinet, Side, Panel	R10K-9C34	R23K-9C34
Cabinet, Top, Panel	R10K-9C10	R17K-9C10
Gasket Kit	R10K-9C60	R10K-9C60
Lid Assembly	R10K-9C86	R23K-9C85
Lid Boot	R10K-9C82	R23K-9C82
Lid	R10K-9C83	R23K-9C83
Escutcheon, Control Panel Trim	R10K-9C21	R06K-9C21
Back Cover, Plumbing	R10K-9C32	R06K-9C32
Caster (Four required)	7300-9020	7300-9020
Fill Tube Assembly	R10K-9C66	R23K-9C66
Sensor Tube	R23K-9C96	R23K-9C66
Pneumatic Spring, 7 in. (178 mm) Stroke 20# Force	8958-0130	8958-0130
Hinge, Top Section	R17K-9C52	R17K-9C52
Hinge, Bottom Section	R17K-9C53	R17K-9C53
Decal, Lid Warning	R17K-9C42	R17K-9C42
Decal, Warranty	R033-9C27	R033-9C27
Decal, Warning	R23K-9C42	R23K-9C52
Temperature Gradient Suppression Systems	N/A	R20K-8C71
Temperature Gradient Suppressor Straps	N/A	R20K-8C72
Inventory Control System (ICS) Platform	R10K-9C05	R17K-9C05
Inventory Rack 25 vials [13 shelves tall for 2 in. (51 mm) boxes]	R10K-9C44	R10K-9C44
Inventory Rack 100 vials [13 shelves tall for 2 in. (51 mm) boxes]	R23K-8C35	R23K-8C35

Level Controller Electrical/Mechanical Parts	10K/24K
Control Panel Auto-Tend	5140-1186
Sensor Tube Plug	R10K-9C69
Sensor Assembly Auto-Tend	5140-1188
Remote Alarm Plug	R06K-8C20
Transformer (24 AC)	5140-1146
Electrical Panel Assembly (Auto-Tend)	5140-1148
Lid Switch	5160-1042
Plumbing Assembly Auto-Tend	R10K-8C66
Solenoid Valve Assembly 24VAC	6999-9021
Relief Valve 100 psig (6.9 bar/690 kPa) ¼ in. NPT	6913-9077
Filter Assembly	7631-1075