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Operating and Maintenance Instructions

8K and 17K
Cryostorage Systems



SINCE 1742

TAYLOR-WHARTON

A Division Of Plant City Steel — HARSCO Corporation

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TAYLOR-WHARTON

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FREIGHT DAMAGE PRECAUTIONS

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 driver to sign the notation before you receive the equipment. You should decline to accept containers that show damage which may affect serviceability.

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SAFETY

Liquefied 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 and when transferring liquid, or in any instance where the possibility of contact with liquid, cold pipes, and cold gas may exist. Safety goggles or a 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° Fahrenheit (−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 enough 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 there is adequate ventilation where this equipment is used and store liquid refrigerant supply containers only in a well ventilated area.

Install Relief Valves in Cryogenic Liquid Lines — When installing piping or fill hose assemblies, make certain a suitable safety relief valve is installed in each section of plumbing between shut-off valves. Trapped liquefied gas will expand as it warms and may burst hoses or piping causing damage or personal injury.

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 the 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 120/240 Vac. These voltage levels can be very dangerous. Do not attempt any service on these units without disconnecting the electrical power to the rear panel.

Electrical Equipment Must be Properly Grounded — An improper electrical ground may result in a shock hazard. On refrigerators with electrical chassis, have a qualified electrician perform periodic "Electrical Leakage Current" tests to ensure the metal cabinet is properly grounded. Ground Fault Interrupter electrical receptacles are recommended as a safeguard against undetected grounding faults.

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GENERAL INFORMATION

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

The 8K and 17K refrigerators covered by this publication are designed for, but not limited to, the laboratory environment. They feature square, modular cabinets that facilitate grouping several units together in a cryostorage area, and circular stainless steel inner containers which accommodate inventory control systems or provide unobstructed storage area for larger product. Both models feature full access lid openings.

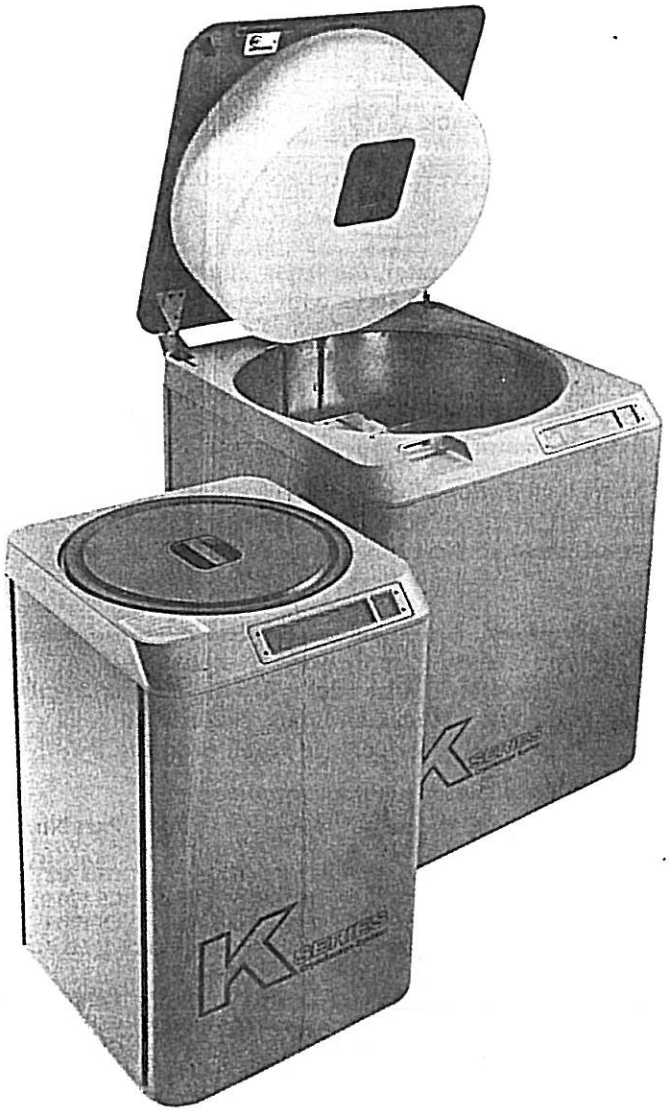


Figure 1. 8K and 17K Cryostorage Systems

The 8K and the 17K are supplied with built-in casters for those applications where mobility for cleaning purposes is important, and either model may be equipped with one of several electronic liquid level sensors/controllers. When installed, these systems become an integral part of the refrigerator and monitor or control the supply of liquid nitrogen to the unit. The addition of a liquid nitrogen supply and an inventory control rack for systematic retrieval of stored product completes the total cryostorage system.

Performance Characteristics

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 over 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. Some Cryostorage system models utilize liquid level controllers that feature temperature readouts. The temperature probes supplying data to these controllers are located at only one level (normally near the lid) and do not indicate the coldest temperature in the storage area.

Specifications

	8K	17K
Dimensions		
Width	23.1 in.(587 mm)	33.5 in.(851 mm)
Depth	25.5 in.(648 mm)	38.75 in.(984 mm)
Overall Height[1]	36.5 in.(927 mm)	40.8 in.(1036 mm)
Inner Diameter	19.0 in.(483 mm)	31.0 in.(787 mm)
Inner Usable Height	24.5 in.(622 mm)	27.2 in.(691 mm)
Evaporation Rate (Nominal)	3.5 liters/day	7 liters/day
Capacity	100 liters	336 liters
Total Allowable Net Weight (Including liquid refrigerant stored product, and inventory control system)	300 lbs.(136 kg)	620 lbs.(281 kg)
Empty Weight	185 lbs.(84 kg)	395 lbs.(179 kg)
Max. Gross weight	485 lbs.(220 kg)	1015 lbs.(460 kg)

[1]With Casters

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INSTALLATION

Your Taylor-Wharton cryostorage system is shipped with its controller packed separately to protect it from damage. Unpacking instructions for the refrigerator are attached to the exterior of the shipping carton. Follow these directions carefully to avoid damaging the unit while removing it from the shipping material.

Controller Installation Procedure

Before attempting controller installation, open the carton(s) containing the controller and confirm that you have all the components shown below.

- A Controller or Alarm Chassis Assembly
- A Wiring Harness
- A Power Cord
- An Electrical Power Panel Assembly
- A Sensor Assembly (also a Thermocouple Assembly for Controller R06K-8C16)
- A bag containing A Sensor Tube Plug, a Remote Alarm Plug, and Decals

Solenoid Installation. Once you have confirmed that you have all the items needed to install the controller in your refrigerator, remove the two electrical and plumbing access panels on the rear cabinet of the refrigerator, remove and discard the manual fill plumbing, and install the electrical solenoid and fill line filter using the illustrations shown in Figure 4 as a guide.

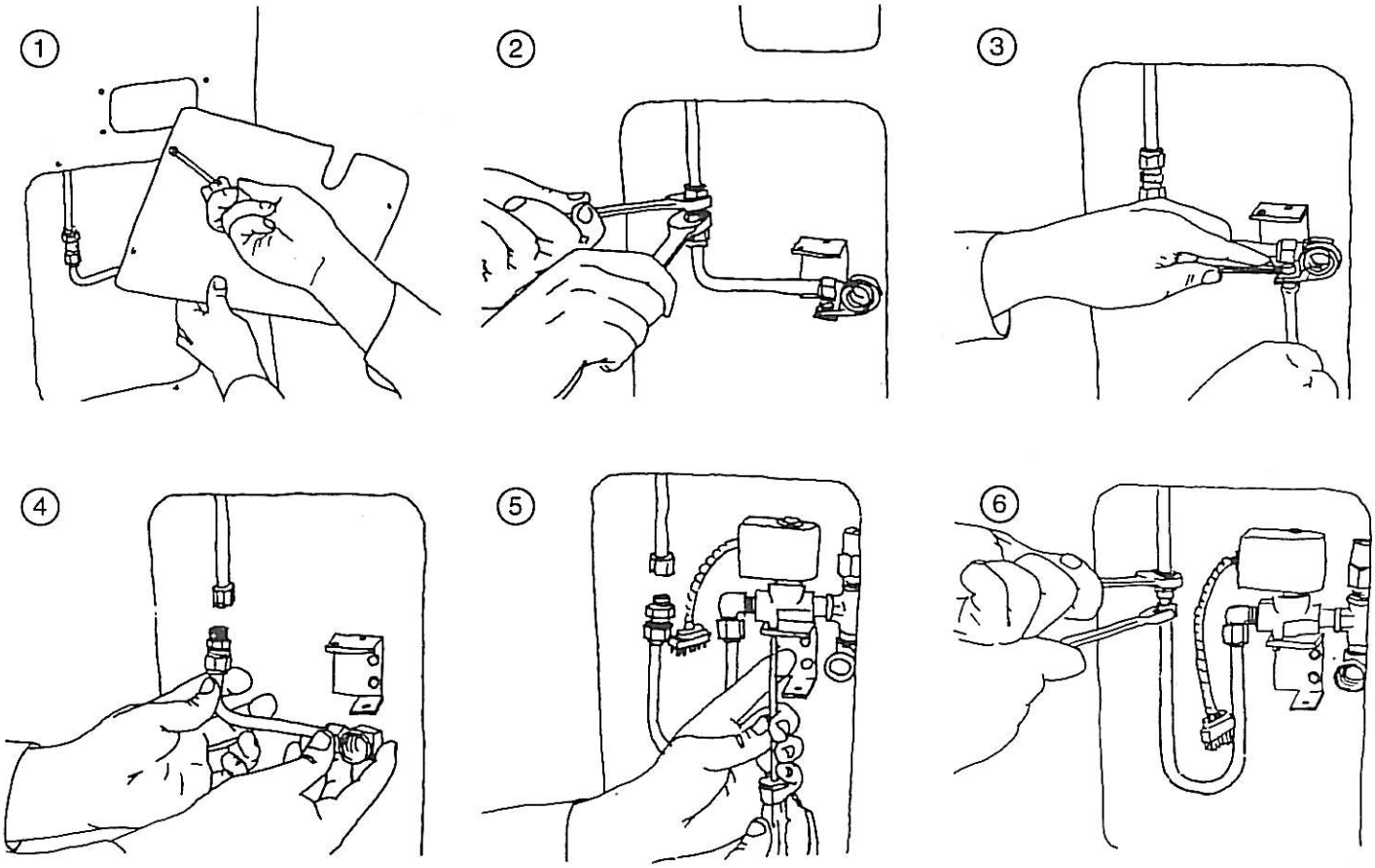


Figure 4. Solenoid Installation

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Cabinet Top Removal. Next follow the steps illustrated in Figure 5 to remove the trim around the controller mounting opening at the front of the refrigerator, and discard the blank face plate found there. 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. On the 8K the cabinet top can be lifted free of the refrigerator; on the 17K it may only be raised as shown in Figure 5 because of the lid hinges *Do not remove the hinged lid on this model.*

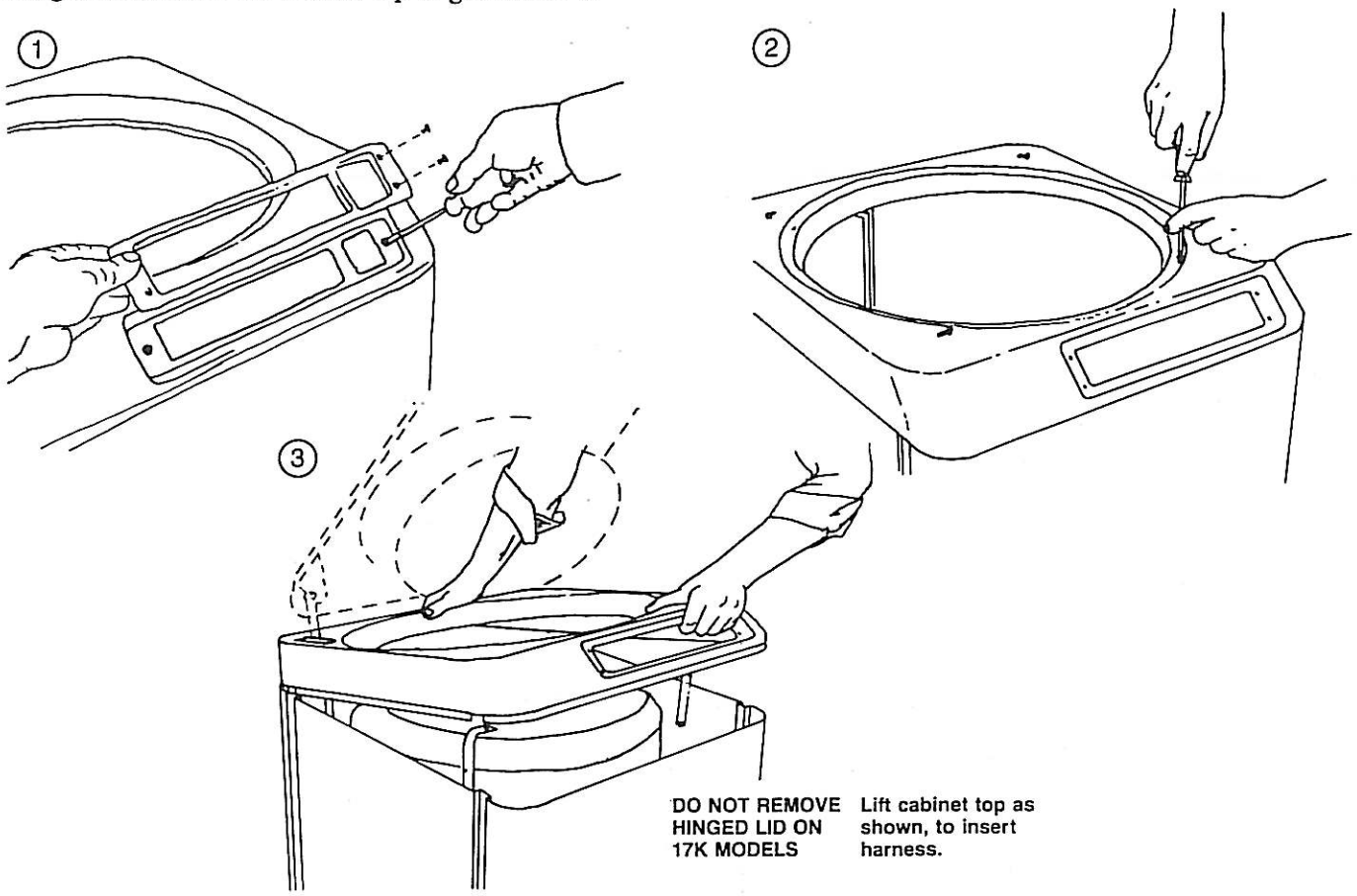


Figure 5. Removing the Cabinet Top

Cable Installation. With the cabinet top removed or raised, route the Wiring Harness through the rear access panel, along the inside of the cabinet to the area on the front of the refrigerator where the controller chassis will be installed. The cable terminations with the red and white plugs should be at the cabinet rear; the longer, orange, controller connectors at the front of the cabinet. Select the sensor assembly from the remaining parts, and feed the end with one or more plastic "pods" through the rear access panel and into the inner container area of the refrigerator.

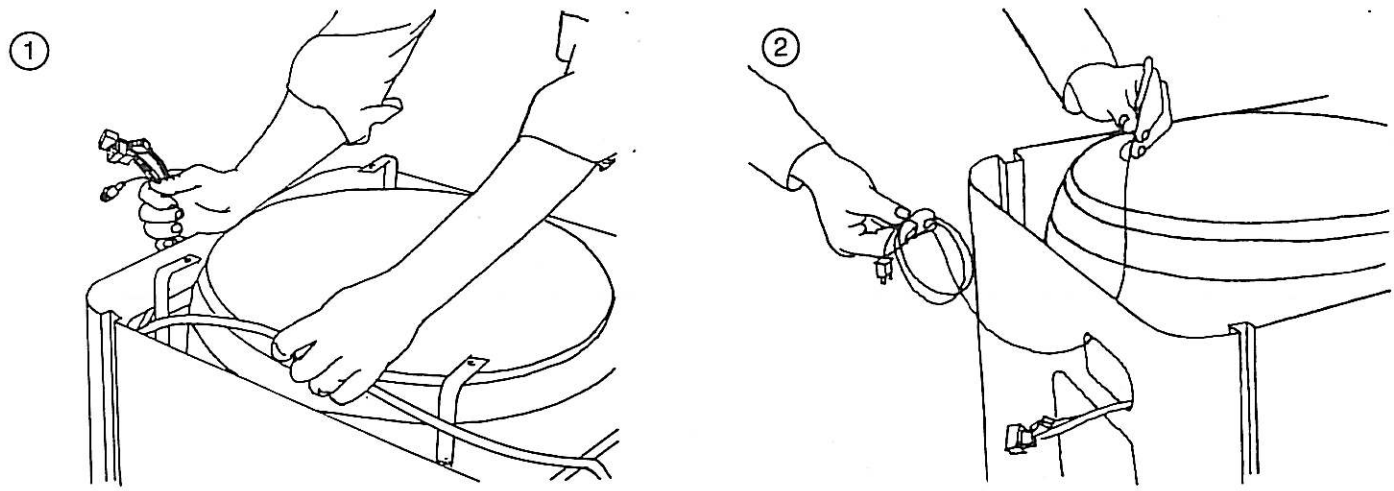


Figure 6. Install Wiring Harness

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Sensor Positioning. The level sensors are installed in a tube near the fill tube. Their position in that tube determines the level of liquid nitrogen to be maintained. Generally sensor position is determined by measuring the distance from the top of the sensor tube to the bottom of the refrigerator, then subtracting the desired liquid level. The result is used to position a split rubber plug on the sensor leads. When correctly installed, the plug will position the sensors at the correct liquid level when the sensor assembly is inserted into the tube. The plug caps the tube and functions as a sensor retainer.

Auto-fill Controller (P/N R06K-8C11) or Alarm (P/N R06K-8C06) On these controllers the sensor consists of only one sensor pod that contains one or more temperature sensors. To install, measure the distance to the bottom of the inner container, subtract the desired liquid level, and use the result to measure from the sensor pod up the sensor wiring to determine plug location. Install the split rubber plug at this point and insert the sensor into the tube, feeding the leads in carefully until sensor position can be secured by pressing the rubber plug firmly into the top of the sensor tube. If you have no firm requirements as to liquid level, the positions shown on Figure 7 are a suggested starting level that will maintain approximately one inch (2.5 cm) of liquid.

Fully-automatic Controller (P/N R06K-8C16) When installing the sensors for this type of controller three different sensor heights are established by the position of a split rubber plug that retains the sensor leads and seals the tube. The longest lead with a single sensor pod is the lo-level sensor assembly; the lead with two pods is the hi-level sensor assembly; and the lead with no apparent end pod is the temperature thermocouple.

The low and high sensors must be separately positioned to set the liquid levels at which the controller will start or terminate each fill cycle. The temperature thermocouple is normally set to sense the temperature under the lid, but may be positioned to read any level in the refrigerator within the limits of its lead length.

Each of the above sensors is positioned by measuring the distance from the top of the sensor tube to the floor of the inner container and then subtracting the desired liquid level. The result is the distance from each sensor to the rubber plug. Figure 8 shows this relationship and suggested settings that will initiate a fill at approximately 1"(2.5 cm), and terminate at approximately 2.5" (6.4 cm).

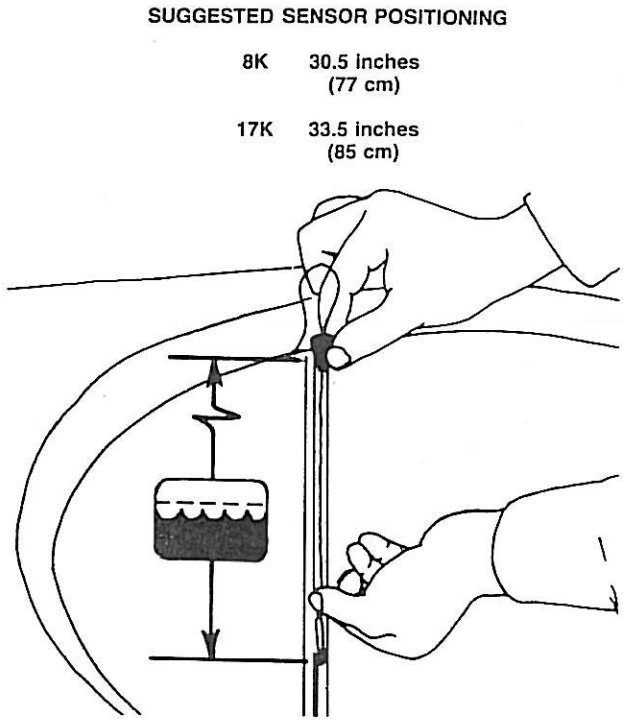


Figure 7. Sensor Positioning — R06K-8C06/8C011 Controllers

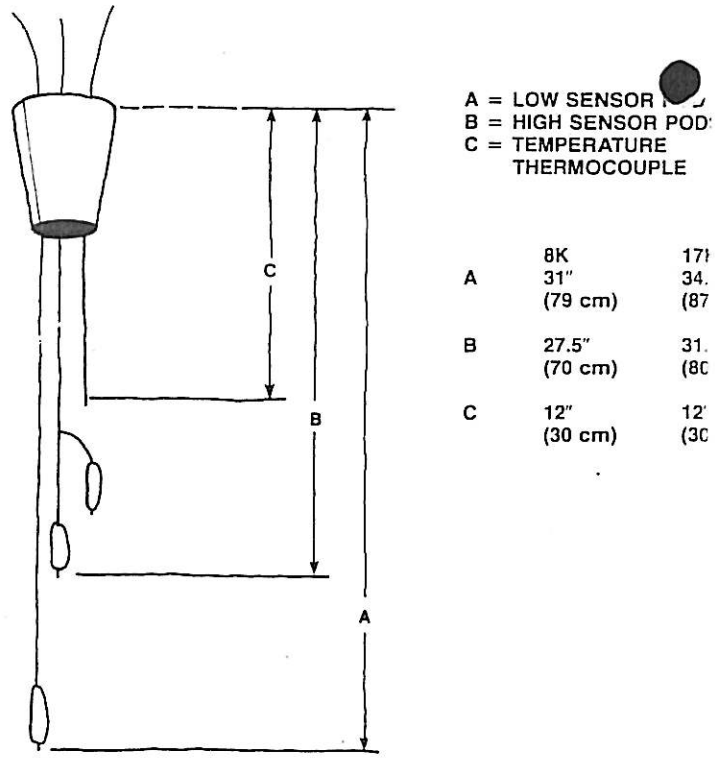


Figure 8. Sensor Positioning — P/N R06K-8C16 Controllers

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After sensor position is determined, and the rubber plug is properly located on the sensor assembly leads, the sensor(s) are inserted into the sensor tube as shown in Figure 9. Perform this operation carefully so the sensor leads are not damaged.

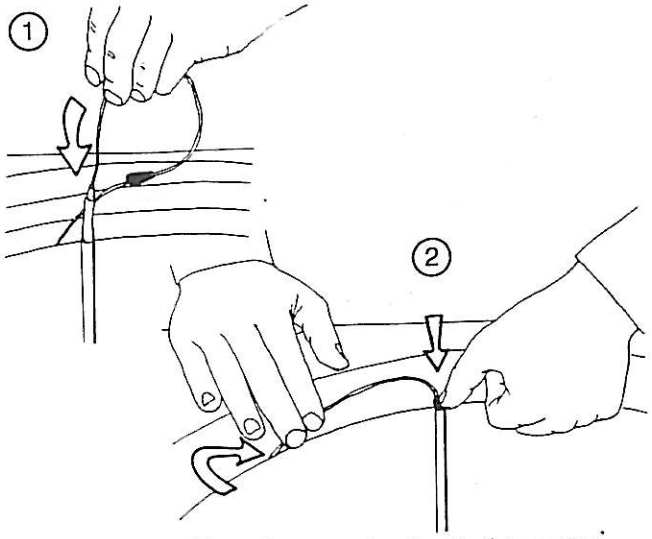


Figure 9. Installing Sensors in the Refrigerator

Now feed the controller connectors through the controller mounting opening while replacing the cabinet top as shown in Figure 10. Position the sensor cable in cabinet top gap near the fill tube. Replace the four screws removed earlier.

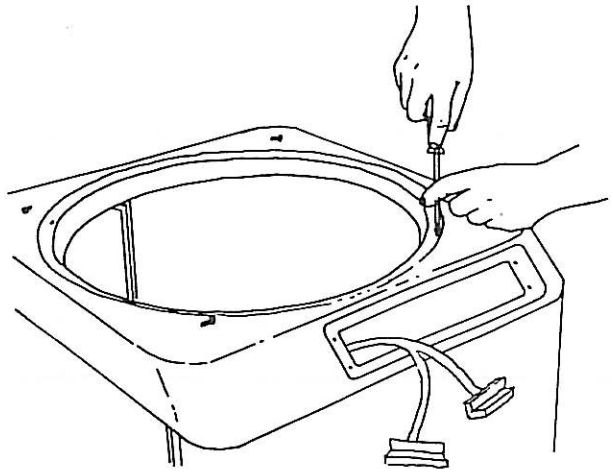


Figure 10. Installing Cabinet Top

Controller Chassis Installation. With the top secure, prepare the controller chassis for installation by selecting the appropriate supply voltage jumper on the printed circuit board near the power transformer.

NOTE:

All controllers are shipped wired for 230 Vac to protect the unit against damage that may be caused by inadvertent connection to an incorrect power source. If your application utilizes 110 Vac, you must move the jumpers as marked on the printed circuit board (See Figure 11-1).

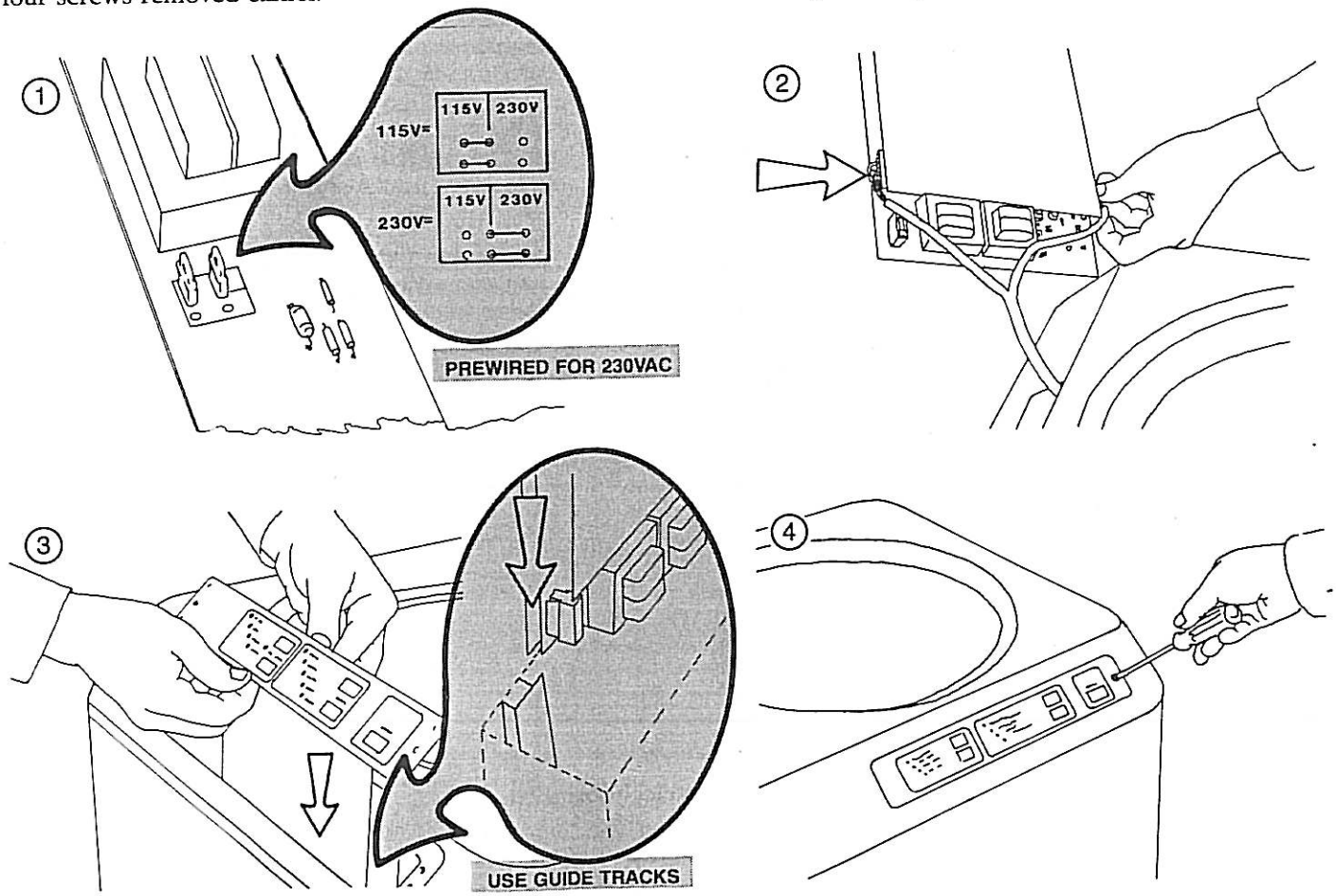


Figure 11. Controller Installation

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After selecting the proper supply voltage, attach the two orange wiring harness plugs to the controller chassis. These connectors are keyed to prevent misconnection. *Do not force.* If the plugs do not connect easily, check to ensure the plug socket pattern matches the pin pattern of the circuit board connector.

Now insert the controller chassis into the opening in the cabinet top. Be careful to engage the guide tracks inside the cabinet (see Figure 11-3). Secure the controller (two screws) and remount the trim (four screws)

Cable Connections (Figure 12). The following connections are made through the electrical access panel at the rear of the refrigerator. All connectors are keyed to prevent misconnections, so if a connector doesn't fit easily, don't force it. First connect the solenoid to the wiring harness. This is a five pin in-line connector, and although there is only one connector on the solenoid, you will have two connectors to choose from on the wiring harness. The Red connector is for 230 Vac operation; the *White* is for 120 Vac. Select the appropriate plug, mate it with the solenoid connector, and, if necessary, move the blank-off insert to the unused connector.

Now connect the sensor plug (six-pin rectangular connector) to the matching connector on the wiring harness. With controller R06K-8C16 connect the two-pin temperature sensor plug; with other controllers this is an unused, extra connector on the wiring harness.

Locate the electrical panel in the remaining parts with the installation kit, and connect its six-pin rectangular plug to the wiring harness. Install this panel to the cabinet in place of the access panel you originally removed (four screws), and leave the plumbing access panel open for attaching the fill line and its filter later.

Power Cord. To complete controller installation, attach the female end of the power cord to the receptacle on the electrical panel, make sure the power switch is turned off, and attach the appropriate operating voltage label near the power cord.

NOTE:

If you are using 230 Vac, the plug on the male end of the power cord must be adapted to a plug that is compatible with local power connections.

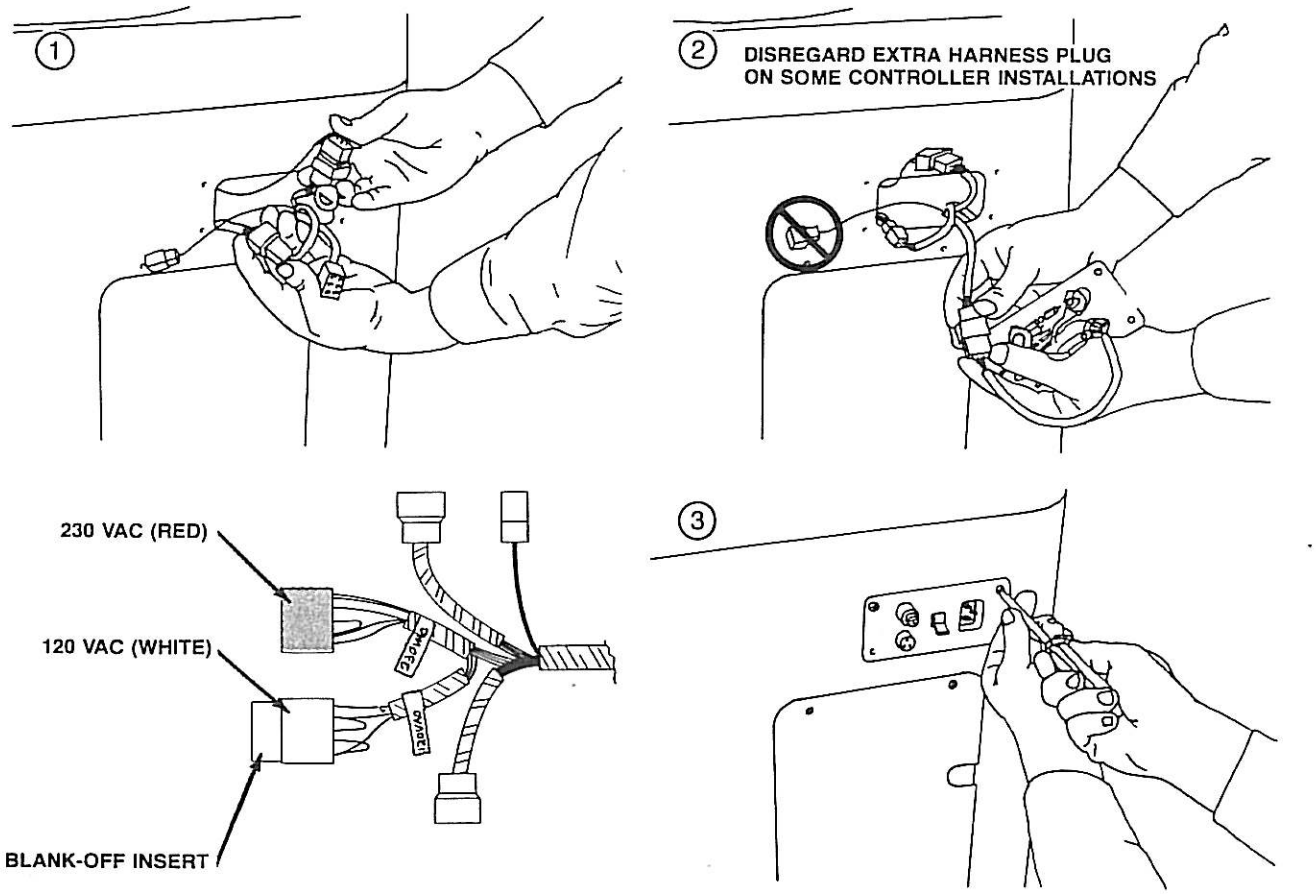


Figure 12. Electrical Connections

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Remote Alarm Installation

Relay connections are provided on the rear of the controller for user installation of a remote alarm circuit. Internal normally open and normally closed contacts will make or break a 2 amp. (max.) circuit 30 minutes after the controller has gone into a local alarm condition. A plug for the remote alarm (Switchcraft no. 05CL3M) is supplied with the controller. External wiring and alarm devices must be supplied by the user. During an alarm condition, contacts 1 & 2 are open and contacts 2 & 3 are closed. During normal operation, contacts 1 & 2 close while 2 & 3 are open.

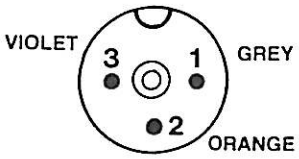


Figure 13. Remote Alarm Connector

Fill Connection

On units that have a level controller, the controller installation package includes a bag that contains a filter/dryer and several fittings. This device is very important. It prevents moisture that may cause the solenoid to freeze from entering the refrigerator. Install the fittings and the supply line filter/dryer to the liquid inlet line on the refrigerator using Teflon tape to seal the threads. Then replace the plumbing access panel and install the support clamp provided as shown in Figure 14. Be sure to orient the filter/dryer in the direction indicated arrow on its body (arrowhead pointing toward the refrigerator supply fitting).

The liquid fill hose from a low pressure source of liquid nitrogen may now be attached to the inlet fitting to the filter/dryer. This source must have a shut-off valve, and may be any portable liquid cylinder or a bulk supply that is capable of providing an adequate amount of cryogenic liquid for your requirements at an output pressure of less than 40 psig (2.8 bar/276 kPa).

NOTE:

The filter/dryer (R08K-8C16) must be replaced at least once a year to prevent moisture accumulation and solenoid operation problems.

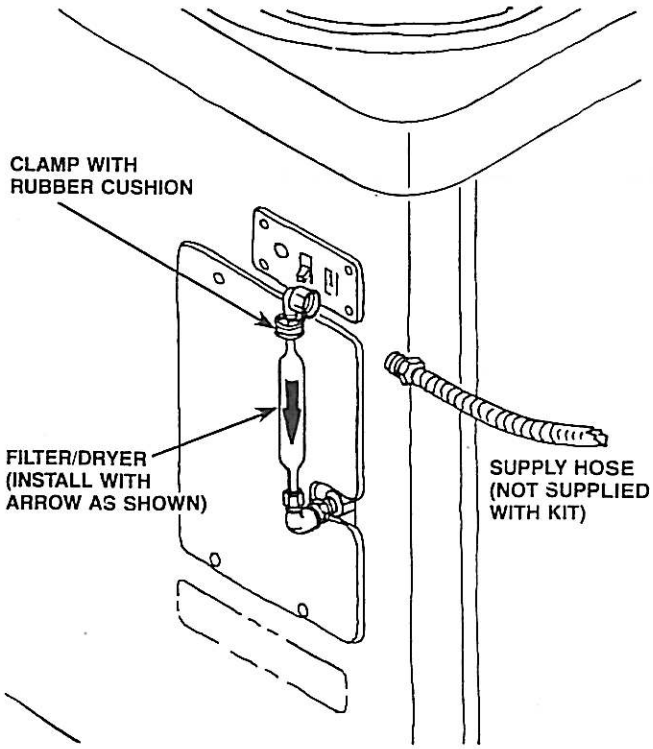


Figure 14. Filter/Dryer Plumbing Installation.

Remote Temperature Recorder (Controller R06K-8C16 Only)

The Full-Auto Controller features external connections for a remote temperature recorder. The recorder must have a linear, 0-1 mA movement with a maximum input impedance of 250 ohms, and a floating input (isolated from ground). The recorder must be wired to pins 21(+) and 22(−) on the controller chassis. A Connector is provided at that location for ease of wiring. A Recorder Span Adjustment is also provided to allow alignment of the controller's digital readout to the recorder indication (See Figure 20 for the location of the connector and the Recorder Span adjustment).

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Filling The Refrigerator (Initial Fill)

To fill the refrigerator, first turn on the liquid nitrogen to confirm that there is no flow into the refrigerator. *If the unit is not equipped with a controller the fill will begin with this action and must be terminated manually. The remainder of these filling instructions do not apply to manual fill units.* Open the lid, during the initial fill, to allow venting gas to escape and observe the fill.

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

Turn on the power switch on the rear electrical panel to activate the controller. The POWER indicator should come on, as well as the FILL/DEFOG indicator. *The EX LOW indicator will also light, if your controller is so equipped, and an audible alarm will sound until the alarm sensor is immersed in liquid. The alarm may be silenced by pressing the MUTE switch.*

When the liquid reaches the level of the high liquid sensor, the fill valve will close, the FILL/DEFOG indicator will go off, and the HIGH indicator will come on.

CAUTION:
If the fill fails to stop for any reason, quickly close the liquid supply valve to prevent overfilling until 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.

OPERATION — Controller R06K-8C16

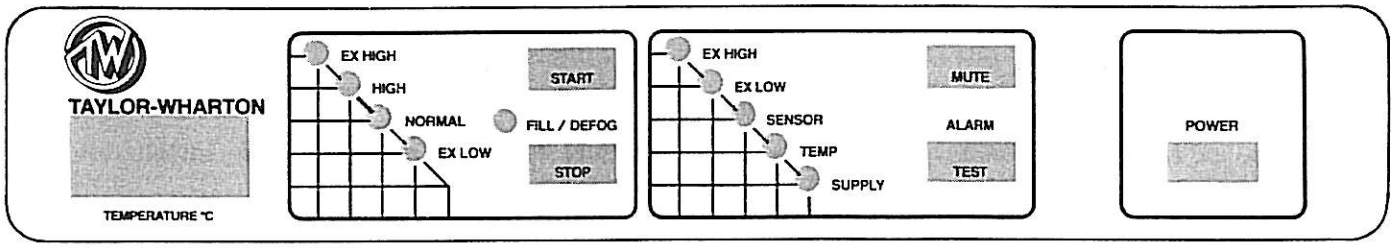


Figure 15. Controller R06K-8C16

General Information

One of two different controllers or an alarm may be installed in 8K or 17K cryostorage systems. The following operating instructions apply to the Full-Automatic level controller R06K-8C16. If your cryostorage system is equipped with either the R06K-8C11 Auto-Fill controller, or the R06K-8C06 Alarm, you will find operating instructions for your controller in the APPENDIX of this publication.

Normal Fill Cycle Operation

When the refrigerator is filled and the controller is operating, the Normal and Ex-low sensors are immersed in liquid nitrogen and their resistance value can be interpreted by the controller as "in liquid". At the same time, the Ex-high and the High sensors are above the liquid pool and sending the controller an "above liquid" signal. In this condition only the EX LOW and NORMAL indicators will be on. As liquid nitrogen evaporates, the liquid level in the refrigerator drops slowly until eventually the Normal sensor is above the liquid and sends an "above liquid" 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 admitting more refrigerant.

The refrigerator fills slowly, the NORMAL indicator, which had gone off briefly while its sensor was above the liquid, now comes back on, but the fill continues until the High sensor sends the controller a signal that it is now in liquid. The HIGH indicator will light briefly while its sensor is immersed, and the controller will close the liquid supply solenoid to stop the fill. As liquid evaporates, the HIGH indicator will go out and the display will indicate the liquid is at a normal level as the cycle begins again. Figure 16 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.

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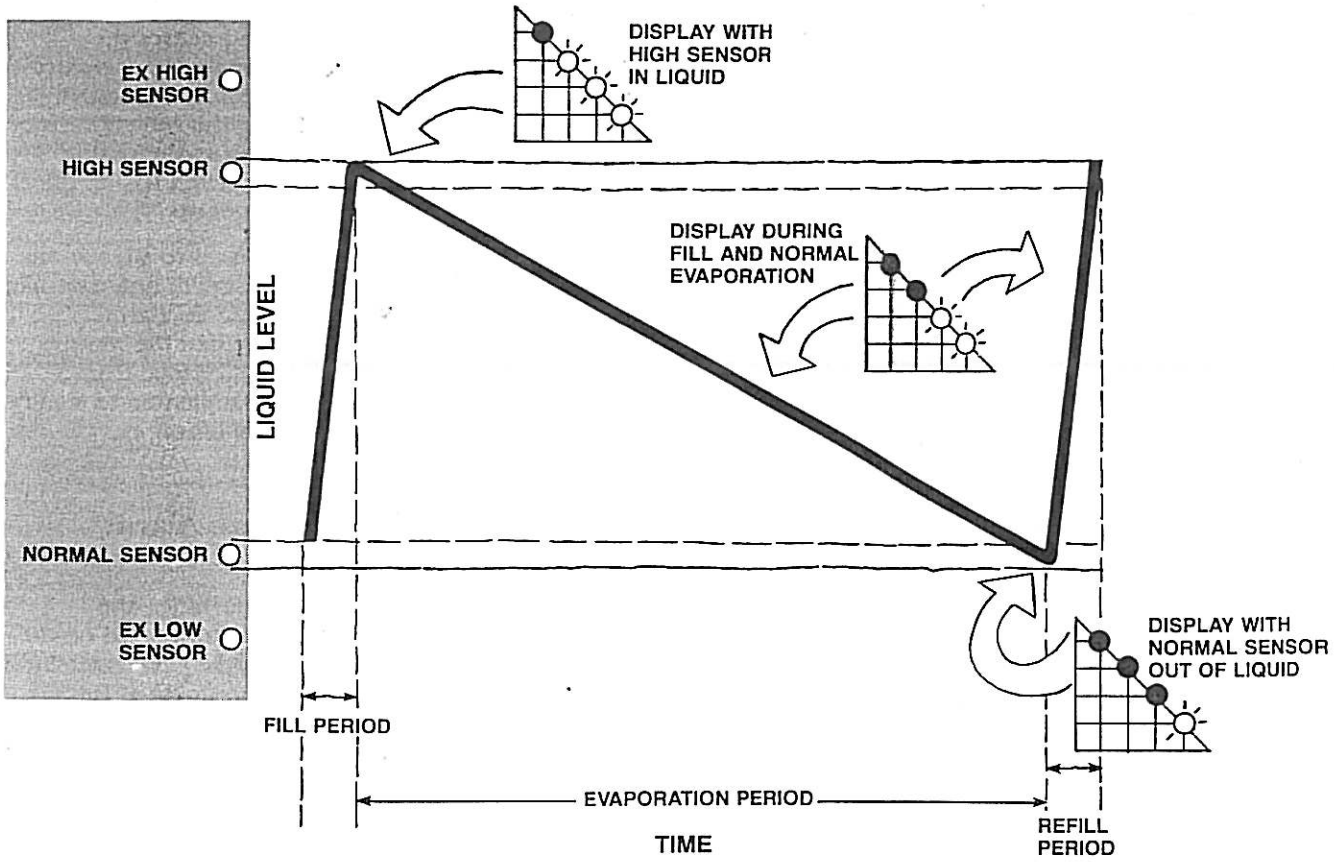


Figure 16. Normal Fill Cycle

Control Descriptions

POWER Indicator — The power switch is located on the rear of the cabinet. When the POWER indicator on the control panel is illuminated, it verifies that power is being applied to the controller.

TEMPERATURE Readout (Degrees C) — This digital display continuously presents the temperature in the cryogenic storage area of the refrigerator. The range of this display is −199° C to +50° C. The readout is also used to display the alarm temperature setpoint. This setting may be displayed by pressing the TEST switch. (See Performance Characteristics in the General Information section of this manual.)

EX HIGH Indicator — This amber lamp lights when the liquid level in the refrigerator rises above the highest level sensor. This sensor is located approximately one inch (2.5 cm) above the sensor that normally stops the automatic full cycle. An alarm condition is initiated when the EX HIGH is in liquid.

HIGH Indicator — This amber lamp will light when the liquid level is either at or above the level where automatic filling is terminated.

NORMAL Indicator — The amber NORMAL indicator will remain on as long as the liquid level is above the lower limit set for the automatic fill cycle.

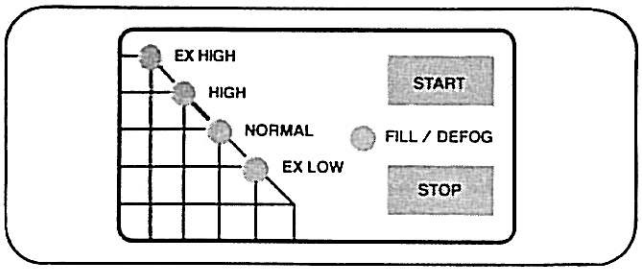


Figure 17. Level Indicators

EX LOW Indicator — This indicator will light when liquid is at or above the lowest liquid level sensor. Its amber lamp is on at all times in normal operation. The sensor that activates this lamp is approximately 3/4" (1.9 cm) below the low point in the fill cycle and an EX LOW alarm is initiated if this sensor is above the liquid level.

FILL/DEFOG Indicator — This green indicator will light when the fill valve is open. It indicates the status of this valve during automatic filling, or when the START switch is pressed for a manual fill.

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START Switch — This push switch opens the liquid fill valve. The valve will remain open until the fill is automatically terminated at the High level sensor, or until the STOP switch is pressed. This function is used to manually add liquid, or to add liquid for the purpose of dispersing fog on the surface of the cryogenic liquid.

STOP Switch — This switch will close the fill valve to stop a fill. It is effective during an automatic fill cycle, or after a manual fill initiated by the START button.

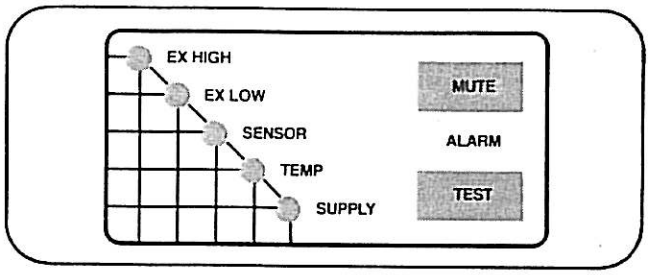


Figure 18. Alarm Indicators

EX HIGH Indicator — This red alarm indicator will light if the liquid level goes above the highest level sensor in the refrigerator. This condition overrides the fill valve control signal and closes the fill valve.

EX LOW Indicator — This alarm indicator will light if the liquid level goes below the lowest level sensor in the refrigerator. The fill valve will remain open during this alarm condition.

SENSOR Indicator — This red indicator will come on if the controller detects a malfunction in one of the four level sensors.

TEMP Indicator — This indicator will light if the temperature in the storage compartment rises above the alarm setpoint.

SUPPLY Indicator — This lamp will light if the fill valve does not close within 30 minutes of opening. Failure to complete a fill cycle in this period of time is assumed to be an insufficient supply of liquid nitrogen.

NOTE:

All of the above alarm conditions activate an indicator lamp in a flashing mode and sound an audible alarm. A timer is started that will activate a remote alarm if the condition is not cleared within 30 minutes. Pressing the MUTE switch silences the audible alarm, and changes the blinking indicator to a steady display to signify the alarm is muted.

TEST Switch — This switch activates the EX LOW, EX HIGH, and SENSOR indicators, and causes the TEMPERATURE readout to display the temperature alarm setpoint. It allows you to confirm all alarm indicators are functional. Holding the switch for more than 15 seconds will initiate a test of the remote alarm circuit. Pressing the TEST switch has no effect when an alarm condition already exists.

MUTE Switch — This switch is used to silence the audible alarm. The mute condition will only continue for 30 minutes, however, to ensure no alarm condition remains uncorrected. When the mute is activated, the alarm indicator will change from a blinking mode to a steady red illumination to signify that the alarm is in the muted condition.

Adjusting the Temperature Alarm Setpoint

When power is applied to the controller, the temperature alarm setpoint can be displayed on the temperature readout by pressing the TEST switch. The factory setting for this alarm is normally −100°C. This value can be changed by making an adjustment on the controller printed circuit board.

To reset the temperature alarm point, *turn off the power.* Remove the trim around the controller (four screws) and two screws securing the controller chassis (See Figure 19). Slide the controller up out of the cabinet high enough to locate an opening in the plastic cover marked: ALARM TEMP. This adjustment is located on the side of the controller chassis that is toward the rear of the refrigerator.

WARNING:

Electrical shock hazard. Power must be reapplied to the controller during this adjustment and there may be exposed electrical power connections on the rear of the controller chassis when it is out of the cabinet. Lift the controller chassis from the cabinet only far enough to gain access to the ALARM TEMP adjustment.

Turn on the power to the controller, hold the TEST switch, and with a small screwdriver turn the ALARM TEMP control clockwise to raise the alarm temperature setting; counterclockwise to lower it.

When you have attained the desired alarm temperature, turn the power off, reinstall the controller, and restore power when you have finished.

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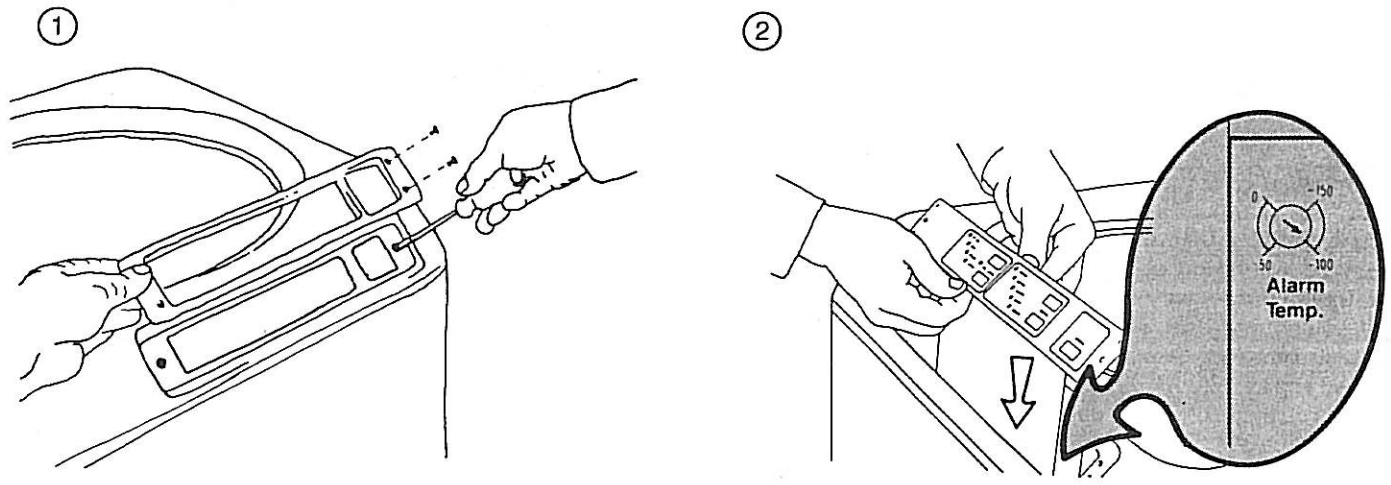


Figure 19. Temperature Alarm Point Adjustment

Adjusting Liquid Level

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

Sensor probe position 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 probes from the sensor tube; for a lower level, the sensors must be moved further into (down) the sensor tube.

NOTE:

Ice or frost on 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 time to thaw before the sensors can be repositioned.

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

The longest sensor probe contains the Normal Level and Ex Low Level sensors in one pod. The probe with two pods contains the High Level and the Ex High Level sensors. The separate sensor without a pod is the temperature thermocouple. The thermocouple is normally located above the Ex High sensor to measure the warmest condition in the storage chamber. Adjust these probes to the desired heights and reinsert into the sensor tube (See the Installation Section for more detail on sensor probe positioning).

NOTE:

The High Level sensor must be at least eight inches (20 cm) below the top of the inner container to prevent the cabinet lid from floating on liquid.

After repositioning sensors, check to be sure the rubber plug in the top of 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.

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MAINTENANCE

Controller Electrical Tests

If a controller is removed from the refrigerator for service, the liquid refrigerant level must be maintained manually to protect stored product. The fill solenoid will be inoperative with the controller chassis removed. A flexible fill line terminated with a phase separator may be used periodically through the open refrigerator lid to conduct manual fill operations until automatic operation is restored.

Sensor Probes. The sensor probes used to detect liquid level by Taylor-Wharton controllers are temperature-sensitive resistors called "thermistors." Their resistance to electrical current flow changes greatly with their temperature. The resistance of a typical thermistor used in these controllers varies with its temperature as follows:

- At Room Temperature..... 2 ohms to 10 ohms
- In Cold Nitrogen Gas ..... 8K ohms to 12K ohms
- In Liquid Nitrogen..... 25K ohms to 35K ohms

Controller Logic. The liquid level controllers read the values of the sensors as indications of liquid level. The function of a sensor, and its value, are interpreted by solid-state logic circuitry to set normal operating, fill, fill termination, and alarm conditions. In addition, on one controller model, the refrigerator temperature is monitored and an alarm is triggered if the temperature raises above a pre-determined point.

The following values will be interpreted by a controller as cause for a logic change — either an alarm, or in some cases, a fill or fill termination action.

High Sensor.....Resistance greater than 17K ohms
Low Sensor ..... Resistance less than 13K ohms
Any Sensor..... Resistance greater than 40K ohms, or less than 50 ohms

In addition to the above, an alarm condition may be triggered by a fill mode that lasts for more than 30 minutes. On controllers with a temperature readout, a thermocouple open, or a temperature warmer than the setpoint will also activate an alarm.

Wiring Harness Tests

When attempting to solve controller malfunctions, first check all connectors to ensure they are properly inserted and check cables for broken leads. In order to confirm that the controller is receiving the correct inputs from its sensors in the refrigerator, conduct the following tests using an ohmmeter. Consult the wiring diagram (Figure 20) for pin and connector locations.

1. Disconnect all power from the cryostorage system.
2. Remove the fastener holding the sensor tube to the top of the refrigerator, and carefully withdraw the tube and sensors from the liquid nitrogen.
3. With the wiring still connected, lay the sensor tube on the top of the refrigerator to thaw. The tube must be at room temperature for at least 15 minutes before proceeding.
4. Remove the controller trim, and mounting screws, then lift the controller chassis from the cabinet far enough to the orange plug from the left side of the controller as you face the refrigerator (pins 11 through 20, see Figure 20).
5. Temporarily return the controller to its mounting position, but keep the disconnected orange plug and its attached cable outside the cabinet so you can make resistance measurements from pin-to-pin.
6. Connect an ohmmeter (0-50 ohm scale or lower) between pins 11 and 13 on the open end of the orange connector to test the Low Level sensor.
7. You should read between 3 and 10 ohms under these conditions (thermistor at room temperature). If the reading is less than 3 ohms there is a short in the wiring and further isolation is needed; if the resistance is greater than 1000 ohms, the low thermistor is open and must be replaced; if the reading is between 10 and 1000 ohms, allow an additional 15 minutes of time at room temperature before concluding there is a definite indication of a problem.

Test all the sensors on your controller by following the above procedure and using the pin connection table below.

Type Controller	Sensor	Pin Numbers	Typical Resistance (at room temperature)
Alarm (R06K-8C06)	Low Level	13-14	3 -10 ohms
Auto-Fill	Low	11-13	3 -10 ohms
(R06K-8C11)	High	11-16	3 -10 ohms
Full-Auto	Ex Low	11-12	3 -10 ohms
(R06K-8C16)	Low	11-13	3 -10 ohms
	High	16-14	3 -10 ohms
	EX High	16-15	3 -10 ohms
	Thermocouple	19-20	0 ohms

If an incorrect reading is obtained at the orange plug, the controller is not receiving the correct data from the sensor. By disconnecting the sensor plug at the rear of the refrigerator and making the same continuity tests, you can determine if the problem is in the wiring or the sensor probe.

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-196 Thermister Calibration

RV2 Potentiometer

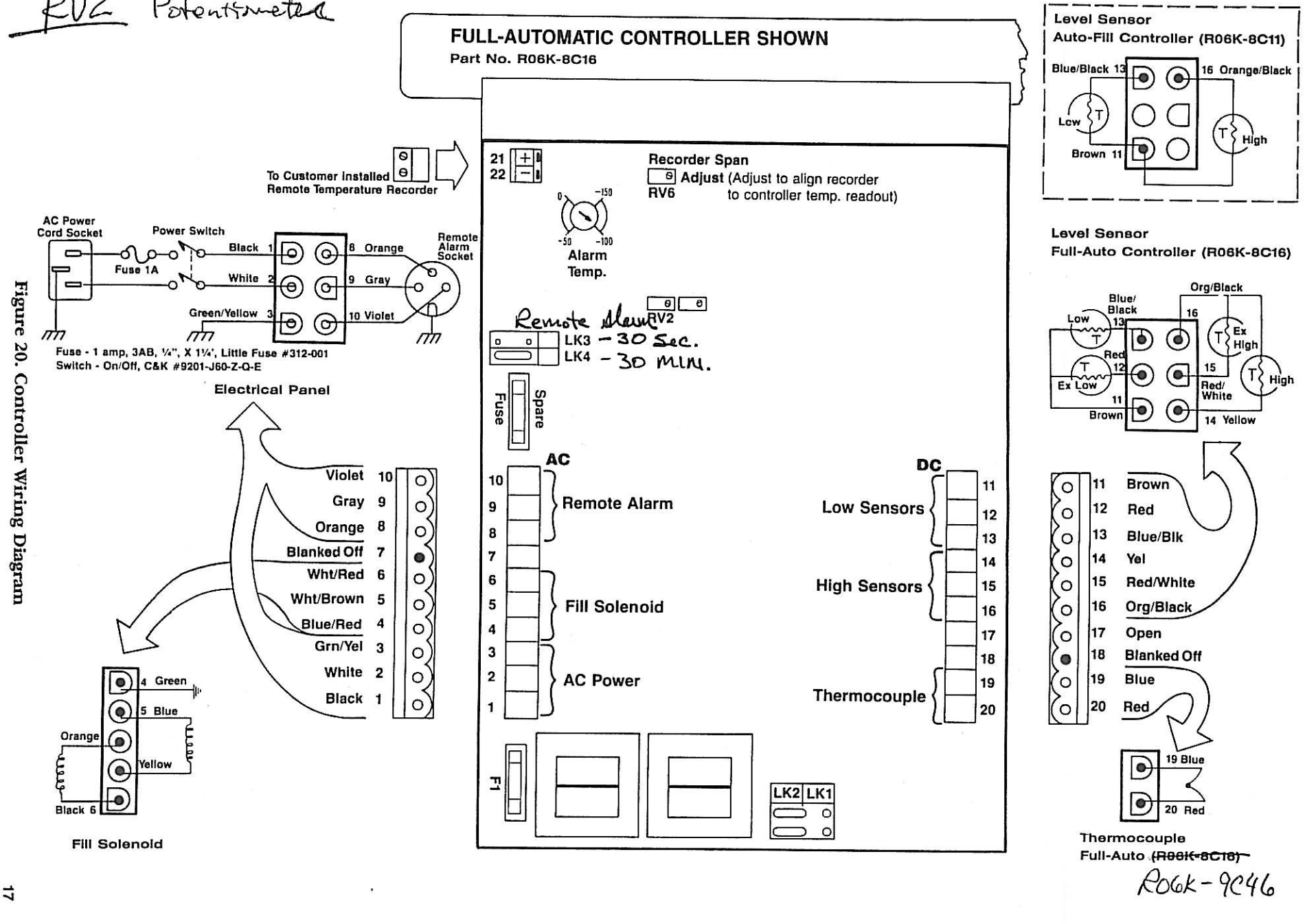


Figure 20. Controller Wiring Diagram

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TROUBLESHOOTING

Symptom	Probable Cause	Corrective Action
No response from the controller.	No power.	Check plugs and power source. Check power switch on the rear of the refrigerator.
	Open fuse.	Check ac supply fuse on the rear of the refrigerator.
		Check controller fuse (F1) on the controller board.
All controller lights on.	Sensor assy. unplugged.	Check connections.
	Faulty controller.	Replace controller.
	Thermistor failure.	Conduct "Wiring Harness Tests" in Electrical Maintenance section
High nitrogen consumption	Liquid level too high	Lower HIGH level sensor.
	Losses due to frequent fills.	Adjust sensor separation for greater level variation; fewer fill cycles.
	Excessive nitrogen evaporation between source and refrigerator.	Shorten inlet plumbing if possible — insulate piping to refrigerator.
Excessive frost or frozen lid.	Liquid level too close to underside of lid.	Lower HIGH sensor.

LEVEL CONTROLS ONLY

Fill will not start	Solenoid valve unplugged from electrical harness	Remove rear access panel and check all connections.
	Faulty solenoid valve	Replace valve.
	No voltage to solenoid	Check controller pins 5 & 6 for 120/230Vac
	Filter/dryer saturated with moisture.	Replace. Part no. R08K-8C16
Fill will not stop	Solenoid valve frozen open	Close supply valve and thaw solenoid valve.
	Faulty solenoid valve	Replace valve.
Electrical shock from contact with metal cabinet	Poor electrical ground.	Have a qualified electrician confirm proper grounding by checking "leakage current" between cabinet and earth ground to ensure compliance with local codes.
	Internal short circuit.	Discontinue use. Service controller.

CONTROLLER R06K-8C16 Only

Temp. display reads +1—	Open sensor probe	Replace sensor
Temp display indicates +1— and high temp alarm activated	Sensor probe unplugged	Remove rear access panel and check thermocouple probe connections.
	Faulty thermocouple	Replace thermocouple probe.

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REPLACEMENT PARTS

The replacement parts list includes the descriptions and part numbers necessary to allow you to identify and order parts to keep your cryostorage systems in service. When placing orders, please use the nomenclature and part numbers in this section. Send written orders to:

Taylor-Wharton USA
1505 North Main Street
Indianapolis, Indiana 46224
FAX: 1-317-243-4901,
Call: 1-317-243-4900
or 1-800-428-3304.

For International Customers:

Taylor-Wharton International
P.O. Box 568, 4075 Hamilton Ave.
Theodore, AL 36590-0568 USA
Tel: 205-653-8680
Telex: 505421
Fax: 205-653-2250



Figure 21. 17K Refrigerator

Refrigerator Parts (17K)

Cabinet, Back Panel	R17K-9C35
Cabinet, Front Panel	R17K-9C34
Cabinet, Side Panel	R17K-9C33
Cabinet, Top (requires gasket kit)	R17K-9C10
Gasket Kit, Cabinet Top	R17K-8C24
Lid assy	R17K-9C86
Escutcheon, Control Panel Trim	R06K-9C21
Caster, (Four Required)	7300-8076
Decal, Warning	R06K-9C42
Decal, Warranty	R033-9C27
Fill Tube	R17K-9C40
Sensor Tube	R17K-9C90
Gas Cylinder for Lid	8958-0130
Gas Cylinder Mounting Hardware	R17K-8C21
Hinge, Assy	R17K-8C20
Filter/dryer replacement kit	R08K-8C16

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Figure 22. 8K Refrigerator

Refrigerator Parts (8K)

Cabinet, Back Panel	R06K-9C35
Cabinet, Front Panel	R08K-9C33
Cabinet, Side Panel	R06K-9C34
Cabinet, Top (requires gasket kit)	R06K-9C10
Gasket Kit, Cabinet Top	R06K-8C24
Lid assy	R08K-9C86
Escutcheon, Control Panel Trim	R06K-9C21
Caster, (Four Required)	7300-8074
Decal, Warning	R17K-9C42
Decal, Warranty	R033-9C27
Fill Tube	R08K-9C30
Sensor Tube	R08K-9C92

Level Controller Electrical/Mechanical Parts

Controller Chassis, Auto-Fill, (for kit R06K-8C11)	5140-1127
Controller Chassis, Full-Auto, (for kit R06K-8C16	5140-1128
Controller Chassis, Alarm, (for kit R06K-8C06)	5140-1126
Wiring harness, all three controllers	R06K-9C73
Electrical Panel, AC power/Remote alarm	R06K-9C25
Power Cord	5120-3188
Plug, Remote alarm, w/leads	R06K-8C20
Sensor Assy., Alarm controller R06K-8C06	R06K-9C48
Sensor Assy., Auto-Fill controller R06K-8C11	R06K-9C47
Sensor Assy., Full-Auto controller R06K-8C16	R06K-9C44
Stopper, Sensor tube, Full-Auto	R06K-9C69
Stopper, Sensor tube, Auto-Fill/Alarm	R06K-9C68
Thermocouple, Full-Automatic R06K-8C16	R06K-9C46
Solenoid Valve Assy	R06K-9C61
Tube, U-shaped, Fill connection	R08K-9C42
Relief Valve, 35 psig (2.4 bar/241 kPa)	6913-6076
Input Filter/Dryer	7470-0003
Plumbing Hardware kit, complete, includes: solenoid valve, relief valve, input filter, and fittings	R06K-9C60

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