



WORTHINGTON
INDUSTRIES

CS200 Control Systems

LABS and K Series Cryostorage Systems
Operation & Maintenance Instructions



CAUTION - SAFETY FIRST!

- REVIEW AND UNDERSTAND ALL SAFETY PROCEDURES IN THE "HANDLE WITH CARE" BOOKLET BEFORE ATTEMPTING TO INSTALL, OPERATE OR PERFORM MAINTENANCE ON THIS LN₂ CONTROLLER.
- DO NOT ATTEMPT TO USE OR MAINTAIN ANY LIQUID NITROGEN FREEZER 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.
- BEFORE ATTEMPTING TO OPERATE THIS CONTROLLER WITH ANY WORTHINGTON INDUSTRIES LABS OR K SERIES UNITS, YOU MUST READ THE SEPARATE OPERATING AND SAFETY MANUAL PROVIDED WITH THAT UNIT.

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Liquid Nitrogen

Nitrogen is an inert, colorless, odorless, and tasteless gas making up four-fifths of the air you breathe – and can be very dangerous. Air is roughly one-fifth oxygen. Liquid nitrogen is at a temperature of -196°C (-320°F) under normal atmospheric pressure. Cryogenic freezers are used in LN_2 service only.

Extreme Cold - Cautionary Statement

Accidental contact of liquid nitrogen or cold issuing gas with the skin or eyes may cause a freezing injury similar to frostbite. Handle the liquid so it won't splash or spill. Protect your eyes and cover the skin where the possibility of contact with the liquid, cold pipes and equipment, or cold gas exists. Safety goggles or a face shield should be worn when operating this equipment. Insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Trousers without cuffs should be worn outside boots or over the shoes to shed spilled liquid.

Keep Equipment Area Well Ventilated

Although nitrogen is non-toxic and non-flammable, it can cause asphyxiation in a confined area without adequate ventilation. Any atmosphere not containing enough oxygen for breathing can cause dizziness, unconsciousness, or even death. Nitrogen, a colorless, odorless, and tasteless gas that cannot be detected by the human senses, will be inhaled normally as if it were air. One (1) liter of liquid nitrogen is equivalent to 24.6 scf of nitrogen gas. Without adequate ventilation, the expanding nitrogen will displace the normal air resulting in death.

Liquid Nitrogen System

The liquid nitrogen supply pressure at the inlet to the freezer should be in the range of 10 psig (0.7 bar/69 kPa) to 22 psig (1.5 bar/152kPa) for optimum performance. Higher operating pressures will increase transfer losses and create excessive turbulence of the liquid in the freezer, which can generate false signals to the liquid level controller causing the freezer to under-fill. In "liquid phase" storage applications, excessive turbulence can cause splashing which could result in personal injury and/or damage to the freezer. When installing piping or fill hose assemblies, make certain a suitable safety relief valve is installed in each section of plumbing between any two isolation points. Trapped liquefied gas will expand greatly as it warms and may burst hoses or piping causing damage or personal injury. A relief valve is installed in the freezer plumbing to protect the line between the customer-supplied shut-off valve and the freezer solenoid valve. Relief valves can be piped to the outside of the building.

Electrical

- This product is not intended for a life support function.
- This product is intended to be used in hospitals and clinics.
- This product has no Radio Transmitter (Intentional Radiator) functions.
- This product is not intended for electromagnetic shielded rooms only.

WARNING:

The following safety precautions are for your protection. Before installing, operating, or maintaining this unit read and follow all safety precautions in this section and in reference publications. Failure to observe all safety precautions can result in property damage, personal injury, or possibly death.

WARNING:

Maintain adequate ventilation to prevent asphyxiation hazard (see Safety Precautions).

Caution:

When installing field fabricated piping, make certain a suitable safety relief valve is installed in each section of piping between any two isolation points.

WARNING:

Inlet pressure should not exceed 22 psig (1.5 bar/152 kPa). Higher pressures could result in damage to equipment.

WARNING:

Electrical shock can kill. Do not attempt any service on these units without first disconnecting the electrical power cord.

General Information

- This product does not intentionally apply RF energy for its function.
- This product does not intentionally receive RF energy for its function.

The liquid level controllers used with these freezers operate from 12 VDC. Disconnect the electrical power cord from the outlet before attempting any service.

For more detailed information concerning safety precautions and safe practices to be observed when handling cryogenic liquids consult CGA publication P-12 "Safe Handling of Cryogenic Liquids" available from the Compressed Gas Association: CGA website: www.cganet.com; CGA customer service +1.703.788.2700; or email customerservice@cganet.com.

General Information

The CS200 SERIES Control System can monitor and control both the liquid nitrogen level and the vapor temperature range in the Cryostorage unit you have selected. CS200 SERIES Control Systems are designed to work with Worthington Industries Cryostorage Systems. The features are designed to provide a safe environment for samples while at the same time tracking all relevant information associated with the freezer. This control provides a complete historical record of the environment in your unit and therefore, the environment in which your samples have been stored in this system. This controller features a vacuum fluorescent display. The addition of a liquid nitrogen supply and inventory control racks for systematic retrieval of stored product completes the total Cryostorage System.

Worthington Industries Cryostorage Systems are designed for applications where extremely low temperature storage of biological products is required. They are also appropriate for industrial or other applications where liquid nitrogen temperatures and high capacity are needed.

Before beginning installation or operation of this CS200 SERIES Control System, make sure that you read and understand this manual as well as the operating and safety instructions for the Cryostorage unit you will be using with this controller.

CS200 SERIES Control System Specifications

Specifications	
Control Type	LN ₂ Level Control & Temperature Control
Level Measurement	
Sensor Type	8-Thermistor Fixed (standard)
Range	8 inch range (8-Thermistor), 6 inch usable range
Redundancy	Multiple discrete points
Temperature Measurement Sensor Type	Type T Thermocouple
Accuracy	1° or 1.5% of reading, whichever is greater
Resolution	.1°C
Number of channels	2
Temperature Display Units	°C, F, K, R
Electrical	
Input Voltage	100-240 VAC
Input Current (max)	1.75 A
Input Current (continuous)	.5 A
Power Consumption (max)	21 W
Power Consumption (continuous)	6 W
Input Frequency	50/60 Hz
Output	12 VDC
Control Input Voltage	12 VDC
Power cord	Available for all countries
Battery	
Rating	12 Volt, 18Ah
Type	AGM Sealed Non-Spillable
Short Protection	Installed PCB with thermal fuse
Battery Cover	Vinyl
Solenoid Valve	
Input Voltage	12 VDC
Input Current	.96 amps
Communications	
Protocol	CryoWire Secure™
Number of Communication Ports	3

CS200 SERIES Control System Specifications (cont'd)

User Interface	
Display Type	Vacuum Fluorescent Display (VFD)
Buttons	11
Level, Temperature and Alarm Information	VFD
"At a Glance" status	LED status wheel
Filling	1 LED
Menu Access	1 LED
Language	English and German
Control Tests	
Power Up Self-Test	Control system check
Thermistor Status	Yes
Battery voltage	Yes
Control voltages	Yes
Temperature circuit	Yes
Alarms	
Low Level Alarm	Always enabled
High Level Alarm	Always enabled
Sensor Error Alarm	Always enabled
High Temperature Alarm (T/C #1, T/C #2)	Programmable
Low Temperature Alarm (T/C#1, T/C#2)	Programmable
Thermocouple Calibration Alarm	Always enabled
Thermocouple Open Alarm	Always enabled
Power Failure (Remote only)	Always enabled
Low LN ₂ Supply Alarm	Programmable
Battery Mode Warning	Always enabled
Lid Open Too Long Alarm	Programmable
Valve Stuck Open Alarm	Programmable
Unauthorized Access Warning	Programmable
LN ₂ Usage Warning	Programmable
Low Battery Voltage	Always enabled
Audible Alarm	Always enabled
Audible Alarm Re-trigger	Programmable
Visual Alarm Indicator	Always enabled
Remote Alarm Delay	Programmable

CS200 SERIES Control System Specifications (cont'd)

Buttons	
Power	Turns power on/off
Fill/Defog	Open Valve
Stop	Close Valve
Menu	Access Menu
Mute	Silence audible
Enter	Save a setting or select a menu choice
Back/Exit	Leave a setting unchanged or back out of menu.
Up arrow	Scroll the menu system or increase a value
Down arrow	Scroll the menu system or decrease a value
Left arrow	Scroll horizontal menu
Right arrow	Scroll horizontal menu
Data Collection	
Temperature	Yes
Level	Yes
Alarms	Yes
Memory	4 Mb
Dimensions	
Display Width	9.5" (241 mm)
Display Height	2.0" (50.8 mm)
Display Depth	1.31" (33.3 mm)
Display Weight	.625 lbs (.28 kg)
Main Control Width	8.875" (225.4 mm)
Main Control Height	6.688" (169.9 mm)
Main Control Depth	1" (25.4 mm)
Main Control Weight	1.0 lbs (.45 kg)
Battery Width	7.25" (184.2 mm)
Battery Height	6.375" (161.9 mm)
Battery Depth	3.25" (82.6 mm)
Battery Weight	12.4 lbs (5.6 kg)

NOTE: Above measurements are for LABS; CS200 controllers are integrated into all K Series models.

Delivery & Returns

Unpacking and Inspection

Inspect shipping containers for external damage. All claims for damage (apparent or concealed) or partial loss of shipment must be made in writing within ten (10) days from receipt of goods. If damage or loss is apparent, please notify the appropriate parties as indicated below:

Domestic LTL Shipments – The customer should notify and file the appropriate damage claims with the carrier. All products are shipped Ex Works.

Domestic UPS Shipments – Any damage should be noted and reported to shipper upon delivery, and Worthington Industries must also be notified. Confirm with Worthington Industries Customer Service the filing procedures for any UPS damage claims.

International Shipments – Any damage and/or claims are to be filed with the carrier. Insurance agent(s) and Customs should also be notified.

In all cases, Worthington Industries should be notified so we can assist if needed in filing damage claims.

Open the shipping containers; a packing list is included with the system to simplify checking that all components, cables, accessories, and manuals were received. Please use the packing list to check off each item as the system is unpacked. Inspect for damage. Be sure to inventory all components supplied before discarding any shipping materials. If there is damage to the system during transit, be sure to file proper claims promptly. Please advise Worthington Industries of such filings. In case of parts or accessory shortages, advise Worthington Industries immediately. Worthington Industries cannot be responsible for any missing parts unless notified within 10 days of shipment.

Freight Damage Procedures

Any freight damage claims are your responsibility. Cryostorage Systems are delivered to your carrier from Worthington Industries' 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 might affect serviceability.

Repackaging for Shipment

If it is necessary to return any part of the system for repair or replacement, a Return Material Authorization (RMA) number must be obtained from an authorized factory representative before returning the equipment to our service department. Contact your distributor for return authorization. When returning equipment for service, the following information must be provided before obtaining an MRA:

1. System model and serial number, and controller model and serial number.
2. User's name, company, address, and phone number
3. Malfunction symptoms

If possible, the original packing material should be retained for reshipment. If not available, consult Worthington Industries for shipping and packing instructions. It is the responsibility of the customer to assure that the goods are adequately packaged for return to the factory. *All freezers returned to Worthington Industries must be clean and decontaminated before return.*

Putting Unit into Service

Your Cryostorage System comes with complete instructions for how you should remove the unit from the crate and put it into service. Read both this manual and your Cryostorage System's manual before beginning any installation. Make sure to follow any required procedures and safety guidelines when you are connecting your liquid nitrogen source.

The CS200 SERIES Control System is designed to be operated at normal room temperatures 15° C to 27° C (60° F to 80° F) at a relative humidity level below 50%. The humidity level should be maintained such that the electronics are not exposed to condensation.

The Worthington Industries Cryostorage freezer should be positioned such that the all sides of the unit are easily accessible and the user can easily connect/disconnect the power cord from the wall socket.

Proper ventilation **MUST BE** adequate to sustain life for those working with or maintaining this equipment.

Electrical

The liquid level controllers used with these freezers operate at 12 VDC. The external power supply has a 120 VAC (50/60 Hz) primary. Disconnect the electrical power cord from the wall outlet before attempting any service.

Electromagnetic Compatibility (EMC)

Although this equipment conforms to the intent of the 2004/108/EC EMC Directive, all medical equipment may produce electromagnetic interference or be susceptible to electromagnetic interference. The following are guidance and manufacturer's declarations regarding EMC for the CS200 SERIES Control System.

The CS200 SERIES Control System needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in the following pages.

Portable and Mobile RF communications equipment can affect the performance of the CS200 SERIES Control System. Please use the guidelines and recommendations specified in the EN Compliance tables found on pages 50-54.

Other equipment or systems can produce electromagnetic emissions and therefore can interfere with the functionality of the CS200 SERIES Control System. Care should be used when operating the CS200 SERIES Control System adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the CS200 SERIES Control System should initially be observed to verify normal operation in the configuration in which it will be used.

The electrical cables, external power supplies and accessories listed or referenced in this manual have been shown to comply with the test requirements listed in the EN Compliance tables found on pages 50-54. Care should be taken to use only manufacturer-recommended cables, power supplies and electrical accessories with the C200S SERIES Control System. If a third-party supplier offers cables, external

WARNING:
Electrical shock can kill. Do not attempt any service on these units without first disconnecting the electrical power cord.

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

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

WARNING:
This equipment is intended for use by healthcare professionals. As with all electrical medical equipment, this equipment may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures such as re-orienting or relocating the CS200 SERIES Control System unit or shielding the location.

power supplies and electrical accessories for use with the CS200 SERIES Control System and they are not listed or referenced in this manual, it is the responsibility of that third-party supplier to determine compliance with the standards and tests in the EN Compliance tables found on pages 50–54.

The use of electrical cables and accessories other than those specified in this manual or referenced documents may result in increased electromagnetic emissions from the CS200 SERIES Control System or decreased electromagnetic immunity of the CS200 SERIES Control System.

Power Supply Connection

Connect the power supply to your Cryostorage System and then plug the power supply into a surge-protected wall outlet.

Validation

Some organizations require that equipment be validated periodically. If information is needed on the proper techniques to validate this equipment, please contact your supplier.

These instructions are for operators experienced with cryogenic equipment. Before operating the system, become familiar with the safety precautions in this manual and in reference publications. Make certain all applicable provisions set forth in the Installation Section have been followed before placing a system in operation. Study this manual thoroughly. Know the location and function of all system components.

Initial Fill

The Cryostorage System, using the CS200 SERIES Controller, comes preset from the factory. The liquid nitrogen supply pressure at the inlet to the freezer should be in the range of 10 psig (0.7 bar/69 kPa) to 22 psig (1.5 bar/152 kPa) for optimum performance. Higher operating pressures will increase transfer losses and create excessive turbulence of the liquid in the freezer which can generate false signals to the liquid level controller causing the freezer to under fill. In “liquid phase” storage applications, excessive turbulence can cause splashing which could result in personal injury.

Control Components

CS200 Series Control System Components

The CS200 SERIES Control System for the Worthington Industries Cryostorage freezer consists of the following components:

- Main Control Module
- VFD (Vacuum Florescent Display) Module
- Shielded Display Cable
- Wiring Harness Assembly
- Power Supply
- Thermocouple Assembly (Optional Second Thermocouple)
- Sensor Assembly
- Cryogenic Solenoid Valve
- Remote Alarm Plug
- Lid Switch Assembly
- 12 Volt, 18aH battery
- Solenoid Valve Assembly with Freezeguard
- Strainer

The CS200 Series Control System is assembled onto the freezer at the factory and completely tested. Start operation of the control system by plugging the power cord into the wall outlet. Press and hold the POWER button for 2 seconds. The CS200 Series Control System will go through a short startup routine and then start operation. Refer to Figure 1.0 CS200 Controller Display for a description of the controller’s navigation buttons.

CS200 Controller Display Guide

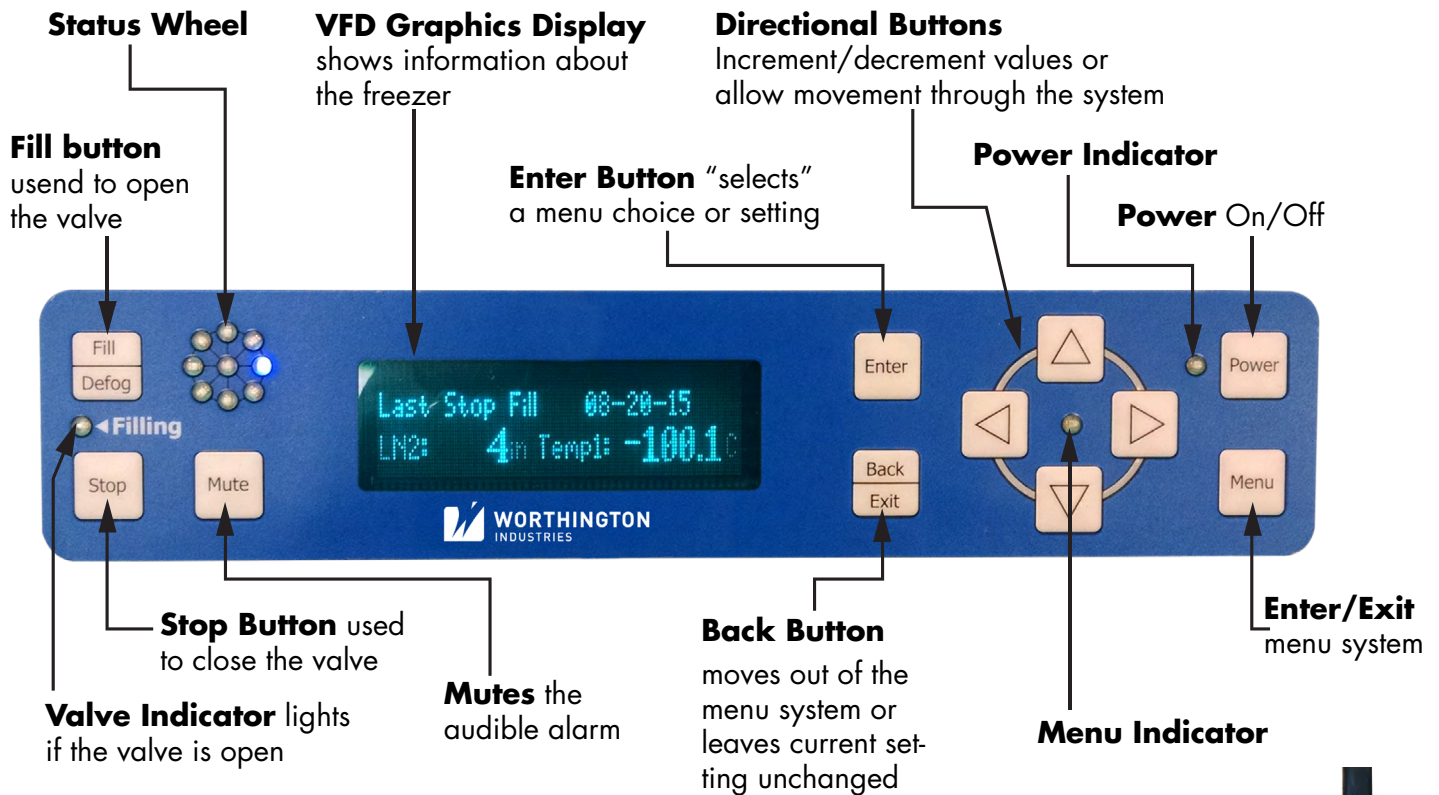


Figure 1.0 CS200 Controller Display

Operational Theory

The CS200 SERIES Control System automatically maintains the Liquid Nitrogen (LN₂) level and monitors temperature in the Cryostorage freezer. Operational conditions are monitored and any alarm is triggered if necessary. Operations data is stored in memory on the control board.

The CS200 CONTROL SYSTEM uses thermistors to measure the LN₂ level within the vessel. A thermistor is a thermal resistor and its resistance changes as the temperature changes. When a thermistor is submerged in LN₂, its resistance will be significantly greater than its resistance at room temperature. The control can detect this resistance change and determine the level of the LN₂ within the freezer. The CS CONTROL SYSTEM is designed to work with an 8-thermistor assembly. There are four thermistors that can be selected to maintain the LN₂ level. These selected thermistors correspond to Low Alarm, Start Fill, Stop Fill and High Alarm. When the LN₂ level drops below the Start Fill thermistor, the control opens the solenoid valve allowing LN₂ to enter the vessel. This continues until the Stop Fill thermistor is submerged in LN₂ at which point the solenoid valve is closed, preventing the flow of additional LN₂ into the vessel. The Low Alarm, Start Fill, Stop Fill and High Alarm settings can all be changed by the user through the menu system.



Figure 2.0 Factory Default Settings Shown

The LN₂ level is indicated on the display and is determined by the number of thermistors submerged in LN₂ according to the table below:

Table 1.0 8-Thermistor Sensor (G=GAS, L=LIQUID)

8-THERMISTOR SENSOR									
#1	#2	#3	#4	#5	#6	#7	#8	OFFSET	DISPLAY
G	G	G	G	G	G	G	G	0	0
L	G	G	G	G	G	G	G	0	1
L	L	G	G	G	G	G	G	0	2
L	L	L	G	G	G	G	G	0	3
L	L	L	L	G	G	G	G	0	4
L	L	L	L	L	G	G	G	0	5
L	L	L	L	L	L	G	G	0	6
L	L	L	L	L	L	L	G	0	7
L	L	L	L	L	L	L	L	0	8

NOTE - Offset value for LABS94K only = 3.0 in (126 mm).

Alarm Conditions

The CS200 SERIES Control System monitors a number of conditions and provides an alarm if a problem is detected. The alarms are listed below:

Table 2.0 Alarm Conditions

Alarm	Problem Detected
Low Level Alarm	LN ₂ level is too low. The low level alarm thermistor on the sensor assembly is not submerged in LN ₂ .
High Level Alarm	LN ₂ level is too high. The high level alarm thermistor on the sensor assembly is submerged in LN ₂ .
Sensor Error Alarm	A problem exists with the level sensor assembly. The control detects an open sensor circuit meaning that the sensor is unplugged or the sensor assembly has been damaged. A Sensor Error will be represented by an "O" within the Thermistor Status menu.
High Temperature Alarm	The temperature detected is warmer than the high temperature alarm setting.
Low Temperature Alarm	The temperature detected is colder than the low temperature alarm setting.
Thermocouple Calibration Alarm	The calibration data is incorrect.
Thermocouple Open Alarm	A problem exists with the temperature sensor (thermocouple). The control detects an open circuit meaning that the sensor is unplugged or the sensor assembly has been damaged.
Power Failure	No Power.
Low LN ₂ Supply Alarm	A problem may exist with the LN ₂ supply connected to the freezer. This alarm occurs if the freezer does not fill within the designated amount of time as determined by the setting on the control. This may occur for a number of reasons including an empty supply cylinder, low pressure in the supply cylinder or a closed shut off valve.

NOTE: Please see description of the offset on Pg. 40 - Making Adjustments to the Level Settings. Level displayed may vary depending on the offset setting.

Alarm	Problem Detected
Lid Open Too Long Alarm	The lid has been opened for a period which is longer than the designated alarm setting.
Valve Stuck Open Alarm	The solenoid valve is stuck open.
Unauthorized Access Warning	The lid has been opened and an incorrect identification has been entered.
LN ₂ Usage Warning	The consumption of LN ₂ has increased and should be checked.
Low Battery Voltage	The voltage on the battery is low.
Audible Alarm Retrigger	The audible alarm is retriggered if error conditions still exist when the retrigger timer expires. The retrigger time can be adjusted by the user.
Remote Alarm Relay	The control provides a relay to provide an external signal that an alarm condition has occurred. The remote alarm timer can be set through the menu system. This setting determines the amount of time an error must be active before the relay is triggered.
Operating in Battery Mode Alarm Warning	The power from the power supply has been disrupted and the control system is operating on battery power.

All alarms include the following:

- The flashing status wheel flashes to signal an error condition
- An audible tone sounds
- The error detected is displayed and scrolled on the screen
- The remote alarm relay changes state to provide a dry contact output signal

Lid Switch

The Lid Switch (Figure 4.0 and 4.1) is attached to the hinge and determines whether or not the lid is open on the freezer. This also allows the control to determine whether to activate the Auto Defog, Quick Chill or Lid Alarm features.

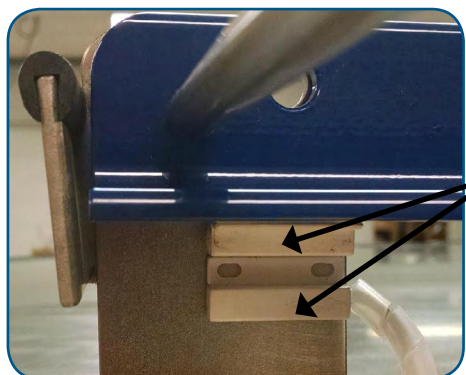


Figure 3.0 LABS Lid Switch



Figure 3.1 K Series Lid Switch

Solenoid Valve

These units are designed to work with 12 VDC solenoid valve (see Figures 17.0, 17.1, and 17.2 Plumbing Assemblies on page 42).

Thermocouples

Type T thermocouples monitor the temperature in the freezer. The user may choose to use NONE, 1 or 2 thermocouples with this control at any time. (The unit comes complete with one thermocouple)

Power Supply

A 12 VDC power supply is supplied for the CS200 SERIES Control System. This system is supplied with a universal power supply that accepts 100/240 VAC (50/60 Hz). UL approval for the system as a whole is not required since the control operates on low voltage. If your power source differs, or is subject to disruption or line surges due to other equipment on line, consult your Worthington Industries representative.

Remote Alarm

If an error condition occurs after a user defined period of time, a remote alarm can be initiated. This is accomplished by connecting a remote device to the remote alarm jack on the rear electrical panel. The 3-pin jack on the back of the unit provides continuity between pin #2 (common) and pin #3 in the normal condition. Continuity between pin #1 and pin #2 is provided in an error condition.

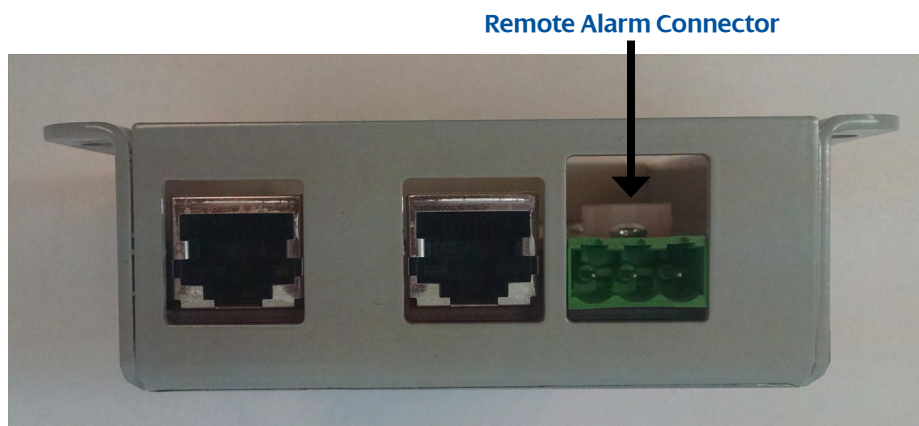


Figure 4.0 Remote Alarm Plug Connection

Operating Parameters

When materials are immersed in LN₂, they will assume the temperature of the liquid (-196°C/-320°F). When material is stored in the vapor phase above the liquid pool, the liquid nitrogen vapor is still a very cold refrigerant, but the freezer's interior temperature increases as product is stored higher above the liquid. This temperature differential is not significant for many biological storage applications, and is affected by the amount of product stored in the freezer, the type, size and material of the inventory control system, and the liquid level in the unit.

The liquid level in the freezer is determined by the position of the Thermistor Assembly in the sensor tube. These sensors are set at installation to maintain a specific liquid level. A filling cycle is initiated when the level falls below the Start Fill sensor and is completed when the Stop Fill sensor is reached. This filling cycle repeats

when the level fall below the Start Fill sensor. Level Sensor assignments may be changed on the controller keypad to define new start and stop levels, and these levels may be set independently to vary the liquid level deference between fills. Prior to the initial fill of the freezer, a determination should be made whether vapor phase or liquid phase storage will be utilized.

All units are supplied with an eight-thermistor assembly and a freeze-guard sensor unless otherwise specified. The LABS factory setting positions will maintain liquid level within a distance of 2 in. (51 mm) from the bottom of the carousel on the LABS 20K, 38K, 40K, 80K units, and 3 in. (76 mm) from the bottom of the carousel on the LABS 94K. The K Series factory setting positions will maintain liquid level settings between 3 in. (76 mm) and 6 in. (152 mm). See page 40 for example.

Temperature Monitoring

The CS200 SERIES Control System uses a Type T thermocouple to monitor the temperature in the vessel. The thermocouple is factory-installed near the top of the Worthington Industries Cryostorage freezer vapor chamber and the temperature is measured at that point.

The CS200 SERIES Control System accommodates a second thermocouple (optional) for temperature measurement at a secondary location. This requires a Type T thermocouple.

The control provides a High Temperature Alarm for each thermocouple which can be selected by the user. If the temperature exceeds the temperature alarm set point, the status wheel flashes and an audible alarm is triggered.

Liquid Phase Storage

Liquid phase storage is normally utilized when (-196°C/-320°F) is required to maintain stored product viability and the storage medium is adequate for storage in LN₂. 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 freezer lid. Exposure to LN₂ may result in physical damage to the lid. Additionally, operating the freezer with high liquid levels characteristic of liquid phase storage may result in turbulence during fill cycles. Caution must be exercised if the freezer lid is opened during a fill, and appropriate safety equipment should always be worn.

The Worthington Industries Cryostorage Systems are factory set for vapor phase storage.

Maintenance

To insure proper operation and maintain excellent performance of the Worthington Industries Cryostorage freezer, an annual maintenance schedule should be followed for the CS200 SERIES Control System. This would include the following:

Table 3.0 Annual Maintenance Schedule

CS200 SERIES Control	Examine for exposure to moisture, wear and tear, connector problems, and damage to the faceplate or buttons. In addition, periodic firmware updates may be important
Harness Assembly	Examine for damage to the cable and damage to connectors,
Battery	Examine connection cable and connector for damage. Examine vinyl cover for damage. Replace every 3 years
Solenoid Valve	Examine wires and connector for damage. Replace every 2 years.
Lid Switch	Examine lid switch pickup and wires for damage. Replace if necessary
Level Sensor Assembly	Examine for damage to wires and connector. Replace every 3 years
Thermocouple Assembly	Examine for damage to wires and connector. Replace if needed

In addition, inspection and preventive maintenance should also be performed on the freezer and its mechanical parts. Refer to owner's manual for details.

If any intermittent alarm or defect with the Cryostorage System is observed or suspected, it should be investigated and remedied immediately even if this falls outside of the normal maintenance schedule.

Controller Operation

This section of the operating manual is for Worthington Industries approved equipment that uses the CS200 SERIES Control System.

Introduction

The CS200 Control System LN₂ level and temperature controller is designed for easy operation and reliable uninterrupted service. This controller will maintain the selected liquid level range of LN₂ in your freezer as well as providing audible and visual alarms for any non-conforming conditions that may occur. An Alarm is any condition outside the activated preset limits on the control, such as an open sensor circuit or temperature alarm. "System Events" are lid openings and closings, solenoid valve openings and closings, and operation of the controller's relay for remote alarm indication. System Events, Alarms and Temperature "Data" can be downloaded.

The System should require no additional attention to maintain liquid level if an adequate supply source of liquid nitrogen is available. If your protocol calls for you to "top-off" the Cryostorage System at the end of a workday or workweek, press the FILL button. The unit will fill 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.

Operation Data

The CS200 CONTROL SYSTEM stores data related to the operation of the Worthington Industries Cryostorage freezer. This data includes date, time, LN₂ level, temperature, system events and error conditions. This can be useful for audit purposes, operation analysis and preventive maintenance.

Communications

The CS200 CONTROL SYSTEM has been designed with advanced communications capabilities. This allows for the transfer of data out of the control where the data can more easily be used. Please check with your supplier for available protocols and compatible products.

Normal Fill Cycle






When the freezer is filled and the controller is operating, the *START FILL* and *LOW ALARM* sensors are immersed in LN₂. Their resistance values are interpreted by the controller as "in liquid". At the same time, the *STOP FILL* and the *HIGH ALARM* sensors are above the liquid pool, informing the control that these sensors are in vapor. As LN₂ evaporates, the liquid level in the freezer drops slowly until the *START FILL* sensor is above the liquid and sends a different signal to the controller. After a delay sufficient to ensure the signal, the controller interprets this condition as low liquid level and opens the solenoid valve, admitting more liquid nitrogen from the supply source.

The freezer will fill slowly. The fill continues until the *STOP FILL* sensor sends the controller a signal that it is now in liquid. The controller will close the solenoid valve to stop the fill. As liquid evaporates, the display will indicate the liquid is at a normal level as the cycle begins again.

Control Setting Adjustments

Level

The standard sensor assembly that is installed on a freezer consists of a circuit board with thermistors installed. The assembly has a maximum range of 6 in. (152 mm). Thermistor assignments can be changed through the menu system and the operating range can be changed by either raising or lowering the thermistor sensor assembly (offset) within the freezer.


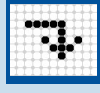
Enter and Exit the menu system by pressing:	
Move down through the menu system by pressing:	
Move up through the menu system by pressing:	
Select a menu choice or lock in a setting by pressing:	
Back out of the menu system by pressing:	

Features & Settings

Some control settings can be changed through the menu system.

When changing settings, single button presses will increment/decrement a value one step at a time. Pressing and holding a button will allow for rapid change of a setting.

The menu system incorporates icons to show the user settings which can be changed and which are locked.

Locked menu choice	
Accessible menu choice	

Also, the menu system includes a scroll bar on the right side of the display. The scroll bar will indicate the current location in the menu system and will indicate if additional menu choices are available with the display of up and down arrows on the scroll bar.

The control will continue to monitor all sensors and conditions while the user accesses the menu system. If no activity is detected for 30 seconds, the control will automatically return to the main operational screen.

View Only

The View Only menu selection allows the user to view settings but will not allow changes to any settings. This restriction is designated with a lock symbol. Refer to Figure 7.0 Menu System - View Only on page 27 to navigate the "View Only" menu.

Change Settings

The Change Settings menu selection allows the user to change operational settings for the control system. Refer to Figure 7.1 Menu System - Change Settings on page 28 to navigate through any changes you need to make.

TEMPERATURE

- **Thermocouple Select:** Allows the user to enable/disable thermocouples for temperature measurement.
- **Calibrate**
 - *Calibrate Thermocouple 1:* Allows the user to calibrate the control for use with thermocouple #1.
 - *Calibrate Thermocouple 2:* Allows the user to calibrate the control for use with thermocouple #2.
 - *Restore Calibration:* Resets the calibration to the calibration settings stored during factory calibration.
- **Test Temperature System**
 - *Check Thermocouples:* Gives status of temperature sensors.
 - *Test Temp Alarms:* Allows the user to manually test temperature alarms for the thermocouples.
- **Control by Temperature**
 - *Temp Control On/Off:* Enable/Disable temperature control.
 - *Temp Control Range:* Allows the user to set the range for temperature control.
- **Temperature Alarms**
 - *High Temperature Alarm:* Allows the user to set the high temperature alarm for both thermocouples. Settings 0°C (32°F) to -196°C (-320°F)
 - *Low Temperature Alarm:* Allows the user to set the low temperature alarm for both thermocouples. Settings 0°C (32°F) to -196°C (-320°F)
 - *Time with no Temp alarm:* Displays the time since the last high or low temperature alarm
 - *Temperature Units:* Allows the user to choose the units of measure for temperature.

LEVEL

- **Thermistor Status:** Gives the user the status for the 8-thermistors on the level sensor assembly, the freezeguard sensor and the lid switch.
- **Sensor Positions:** Allows the user to set the positions for low level alarm, start fill, stop fill, high level alarm and the sensor offset.
- **Valve Open Duration:** Allows the user to set the fixed times for valve open and valve closed durations.
- **Sensor Error Mute:** Allows the user to mute the audible alarm for a sensor error.
- **Inch/MM:** Allows the user to choose units of measurement for level.

SYSTEM

- **Date/Time:**
 - *Set Date/Time:* Allows the user to set the date and the time. Use the up/down arrows to change settings. Use the left/right arrows to move between the date and time fields.
 - *Date Format:* Allows the user to change between U.S. and International format.
 - *Date & Time Sync:* This feature can be used to automatically synchronize the date and time between the CS200 Control and the ciSmart Com Communications Hub (Optional).

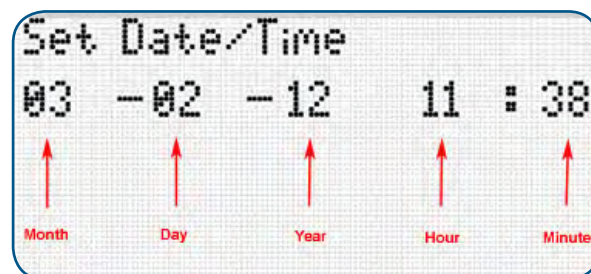


Figure 5.0 Set Date/Time Menu

- **Lid Functions**
 - *Lid Switch:* Allows the user to enable/disable the lid switch feature.
 - *Quickchill Timer:* Allows the user to set the amount of time that the solenoid valve will stay open after the lid is closed.
 - *Manual Defog Timer:* Allows the user to set the amount of time that the solenoid valve stays open when the Fill/Defog button is pressed and the LN₂ level is within normal range.
 - *Auto Defog Timer:* Allows the user to set the amount of time that the solenoid valve stays open when the lid is opened and LN₂ level is within the normal range.
 - *User Access*
 - User Access On/Off: Allows the user to enable/disable this feature.
 - User ID's: Allows the user to set user identification for freezer access.
 - User ID On/Off: Allows the user to turn off user identification.
 - Delete user ID: Allows the user to delete user ID's.

- *Lid Safety Interlock*: Allows the user to disable the solenoid valve if the lid is open.
- **System Alarms**
 - *Test Alarms*: Allows the user to manually check the audible, visual and remote alarm.
 - *LN₂ Supply Alarm Delay*: Allows the user to set the delay before an error condition occurs if the freezer does not fill in a timely manner. If this alarm occurs the supply should be checked to insure that the supply valve is turned on, a sufficient supply of LN₂ is available in the supply cylinder and the LN₂ source pressure is adequate. Settings [30, 45, 60, 75, 90 min] or [2, 3, 4 hours].
 - *Remote Alarm Delay*: Allows the user to set the time before the remote alarm relay is triggered after an error condition occurs. Settings [Immediate, 30, 60, 90 min] or [2, 3, 4, 6 hours]
 - *Lid Open Alarm Delay*: Allow the user to set the time before an alarm condition occurs if the lid is opened too long.
 - *Valve Stuck Alarm*: Allow the user to enable/disable this feature.
 - *Audible Repeat Delay*: Allows the user to set the time before the audible alarm is repeated after an alarm has been acknowledged but an error condition has not been corrected. Settings [15, 30, 60, 120, 240, 480 min] or [1 day] [Never].
 - *Usage Alarm*: Estimates LN₂ use in the freezer. This is calculated by dividing the level decrement by time and converting to a daily rate, and requires a minimum of two complete fill cycles.
- **Display**
 - *Display Brightness*: Allows the user to adjust brightness for the display. Settings [1 to 15]
- **Freezer ID**: Allows the user to provide a nickname for the freezer.
- **Fill Sequence Number**: Provides the capability to enable local warm gas bypass on the freezer. Also provides the capability to enable freezer filling management to optimize LN₂ use.

SCHEDULED EVENTS

- **Scheduled Fills**
 - *Set Time*: Allows the user to set the day and time for the next filling operation.
 - *Next Fill*: Displays the next scheduled fill.
- **Maintenance Reminder**: Allows the user or service company to acknowledge a reminder that preventive maintenance should be performed on the freezer.
- *Acknowledge Reminder*: Acknowledges the maintenance reminder and resets it 12 months into the future.
- The Maintenance Reminder can be acknowledged through the MENU System.

MENU > CHANGE SETTINGS > SCHEDULED EVENTS > MAINTENANCE REMINDER > ACKNOWLEDGE REMINDER > YES

- *Next Reminder:* Displays the next scheduled maintenance reminder.
- **LN₂ Supply Reminder:** Allows the CS200 to provide a reminder that the LN₂ supply should be checked.
 - *Set Reminder:* Allows the user to set the day which the control will display a reminder to check the supply of LN₂. [Off, Sun, Mon, Tues, Wed, Thurs, Fri, Sat, Daily]
 - *Acknowledge Reminder:* Allows the user to acknowledge that the LN₂ supply has been checked.
 - *Next Reminder:* Displays the next scheduled reminder.
- **Check Level Reminder:** Provides a reminder that the LN₂ level inside the freezer should be manually checked with a dipstick.
 - *Set Reminder:* Allows the user to set the day which the control will display a reminder to check the supply of LN₂. [Off, Sun, Mon, Tues, Wed, Thurs, Fri, Sat, Daily]
 - *Acknowledge Reminder:* Allows the user to acknowledge that the LN₂ supply has been checked.
 - *Next Reminder:* Displays the next scheduled reminder.

Below are the Menu Settings that are available only in the “Change Settings” mode.

SECURITY

- **Settings Password:** Allows the user to set a password to allow setting changes.
- **Power Password:** Allows the user to set the password which secures power button operation
- **Change Remote Password:** Allows the user to change the remote password.
The remote password will be used in the future with new features.

CONTACT SUPPORT

- **LN₂ Supplier:** User-defined.
- **Distributor:** User-defined.
- **Worthington Industries:** customerservice@worthingtonindustries.com / +1 614-438-7968
- **Pacer Digital:** info@pacerdigital.com / +1 317-849-7887

SELECT LANGUAGE: Allows the user to select the desired language.

SYSTEM INFORMATION: Displays the control serial number, the firmware version, the freezer ID and any options that are enabled.

DATA MANAGEMENT: Allows the user the capability to download operational data. (Optional equipment required)

USAGE: Provides easy access to view the usage data.

Controller Operation

Temperature

The temperature in the Cryostorage freezer is measured at the location of the thermocouple. The installation location is different depending on the model of the freezer but usually the thermocouple is positioned level with the top storage box. This may mean that temperatures displayed may be slightly warmer than the temperature experienced by the samples or product stored in the freezer.

Temperature Control

The CS200 SERIES Control System has the capability to control the vapor temperature at the top of the freezer. The temperature is controlled at the location of thermocouple 1.

To maintain temperature, the CS200 SERIES Control System bubbles nitrogen gas through the pool of LN₂ in the bottom of the freezer. The nitrogen gas evaporates some of the LN₂ causing a cooling effect and reducing the temperature in the freezer. Since a pool of LN₂ is important in the process of temperature control, an adequate level is always maintained by the control systems and the level control always takes precedence over temperature control. Temperature control will not work if the LN₂ level is above the High Level Alarm.

Enabling the temperature control feature will **always** increase the use of LN₂. The increased consumption will depend on a number of factors including the temperature to be maintained, the range of the controlled temperature, the ambient temperature, the length of supply hose connected to the freezer and the frequency which users open the lid or otherwise introduce heat.

Battery Operation

The CS200 SERIES Control System is designed to operate with or without an optional battery backup system if required. Simply plug the battery into the appropriate connector. The control will recognize that the battery has been connected and will activate the battery backup mode.

LED Status Wheel

The CS200 SERIES Control System offers an innovative concept called a status wheel. In normal operation, the LED's on the status wheel light to show a slow rotation of the wheel. If an error condition occurs, the control will alert the user with an additional visual alarm from the status wheel. The rotation can be accelerated, flashed or even illuminated in the opposite direction.

Condition	LED Flash Property
Normal	Clockwise pattern, 1 LED per second
General Error	Clockwise pattern, rapid rotation, flash

Table 4.0 LED Status Wheel Flash Patterns

Lid Switch

The lid switch consists of a magnet and a pickup installed on the lid. The control can determine when the lid is opened because the magnet moves out of range of the pickup and the circuit becomes open. A number of features are associated with the lid switch such as Auto Defog, Quickchill and the Lid Open Too Long Alarm. If the lid switch is deactivated, these features are also disabled.

Menu System

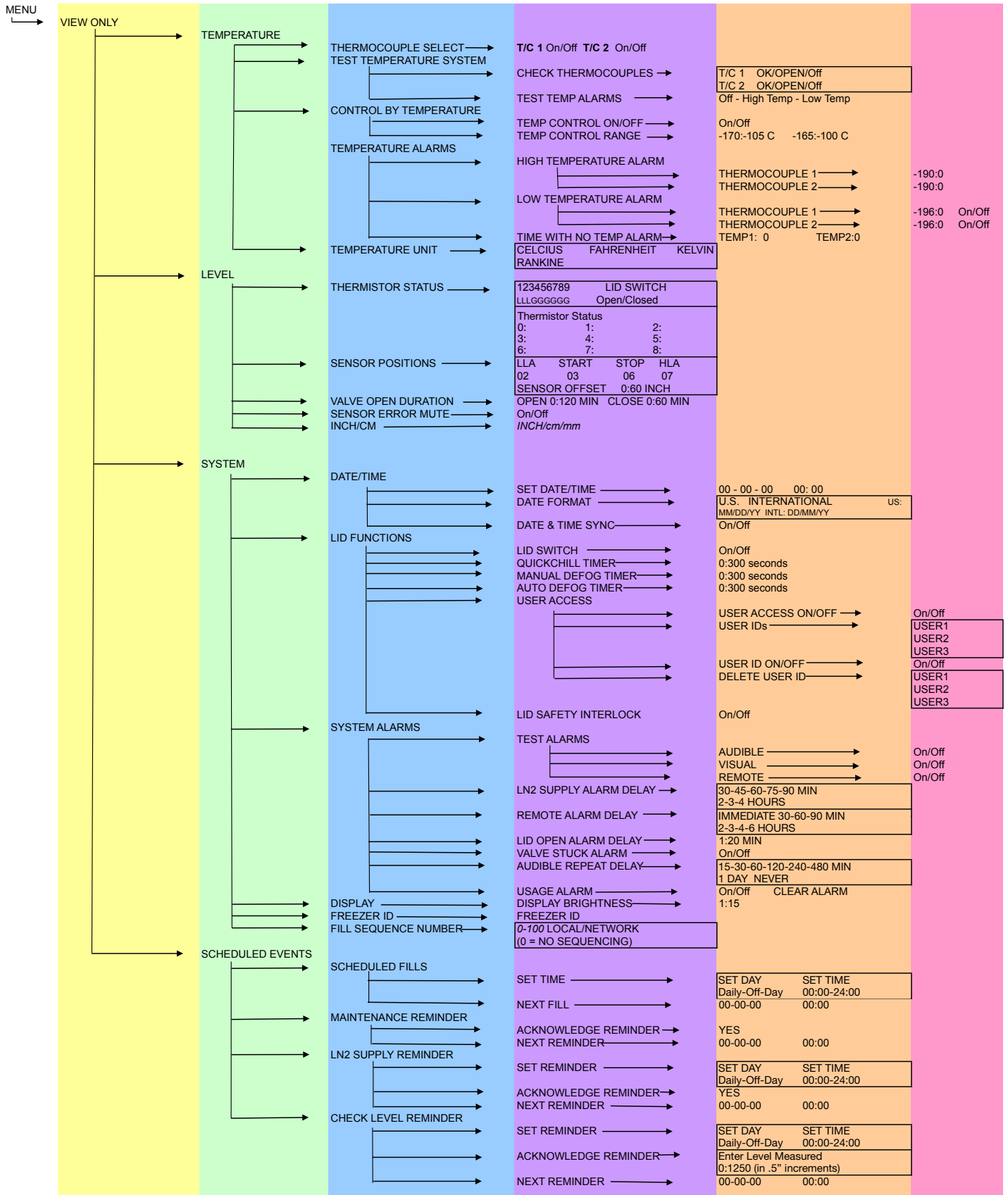


Figure 6.0 Menu System - View Only

Controller Operation

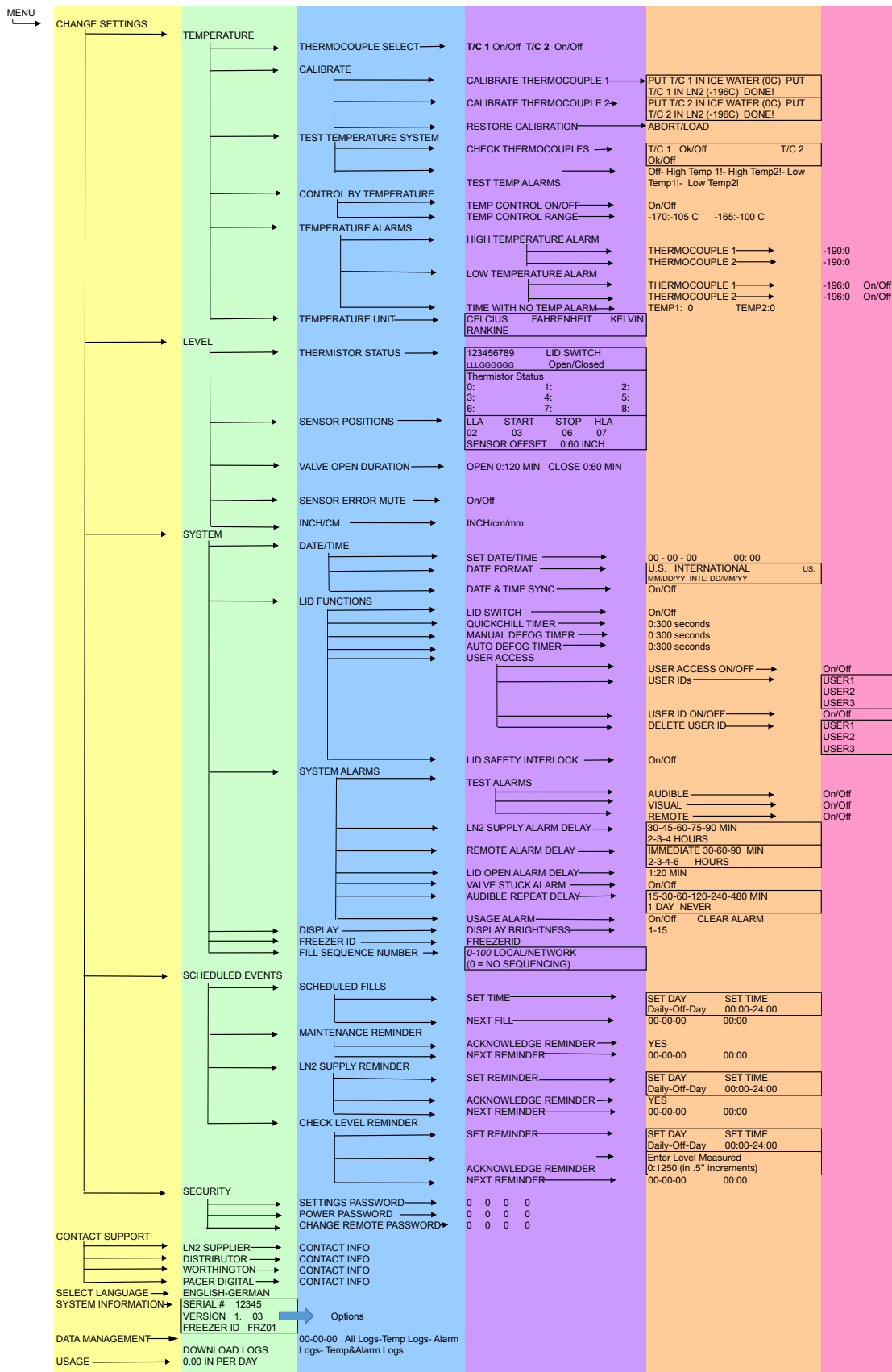


Figure 6.1 Menu System - Change Settings

Factory Defaults

Thermocouple #1	On
Thermocouple #2	Off
Control by Temperature	Off
High Temperature Alarm #1	-100°C
High Temperature Alarm #2	-100°C
Low Temperature Alarm #1	Off
Low Temperature Alarm #2	Off
Temperature Units	Celsius
Sensor Position	Freezer dependant
Valve Open Duration	Off
Sensor Type	8-thermistor sensor (standard)
Freezeguard feature	On
Sensor Error Mute	Off
Freezeguard Error Mute	Off
Level Units of Measure	inch
Date/Time	Factory Set for Central Standard Time
Lid Switch	On
Quickchill Timer	30 seconds
Manual Defog Timer	30 seconds
Auto Defog Timer	30 seconds
User Access	Off
Lid Open-Valve Off	Off
LN₂ Supply Alarm Delay	30 minutes
Remote Alarm Delay	30 minutes
Lid Open Alarm Delay	10 minutes
Valve Stuck Alarm	On
Audible Retrigger	30 minutes
Display Brightness	10
Screen Saver Time	30 minutes
Freezer ID	Not set
Scheduled Fills	Off
LN₂ Supply Reminder	Off
Settings Password	Off
Power Password	Off

Table 5.0 Factory Defaults

Controller Operation

Troubleshooting

If the Worthington Industries Cryostorage freezer with the CS200 SERIES Control System installed experiences problems or appears that it is not operating at optimum efficiency, please contact your distributor for assistance. The CS200 SERIES Control System has incorporated state of the art diagnostic tools to assist in the identification and correction of any issues that may arise.

Interconnection Block Diagram

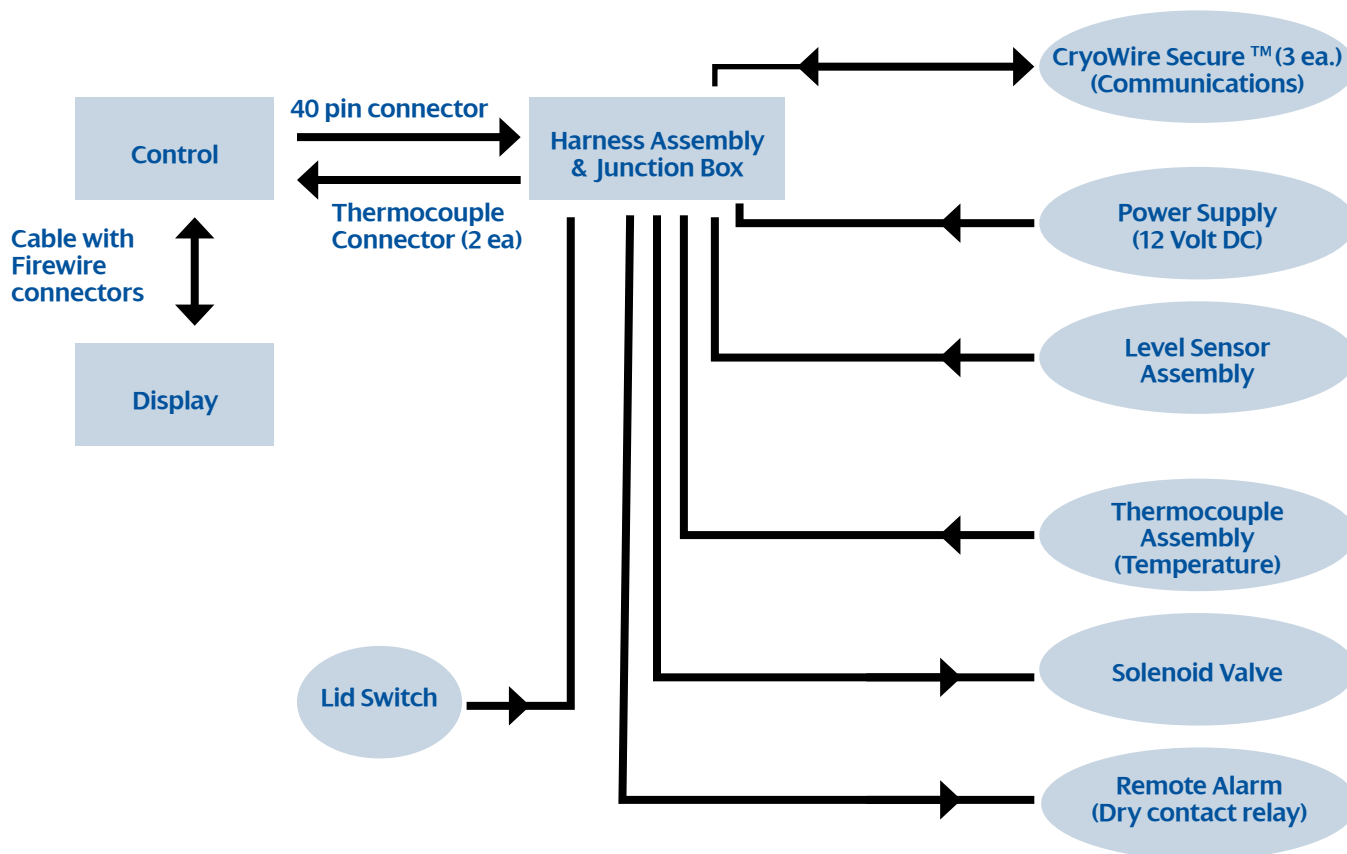


Figure 7.0 Interconnection Block Diagram

Wiring Diagram

CS200 Harness Wiring Diagram

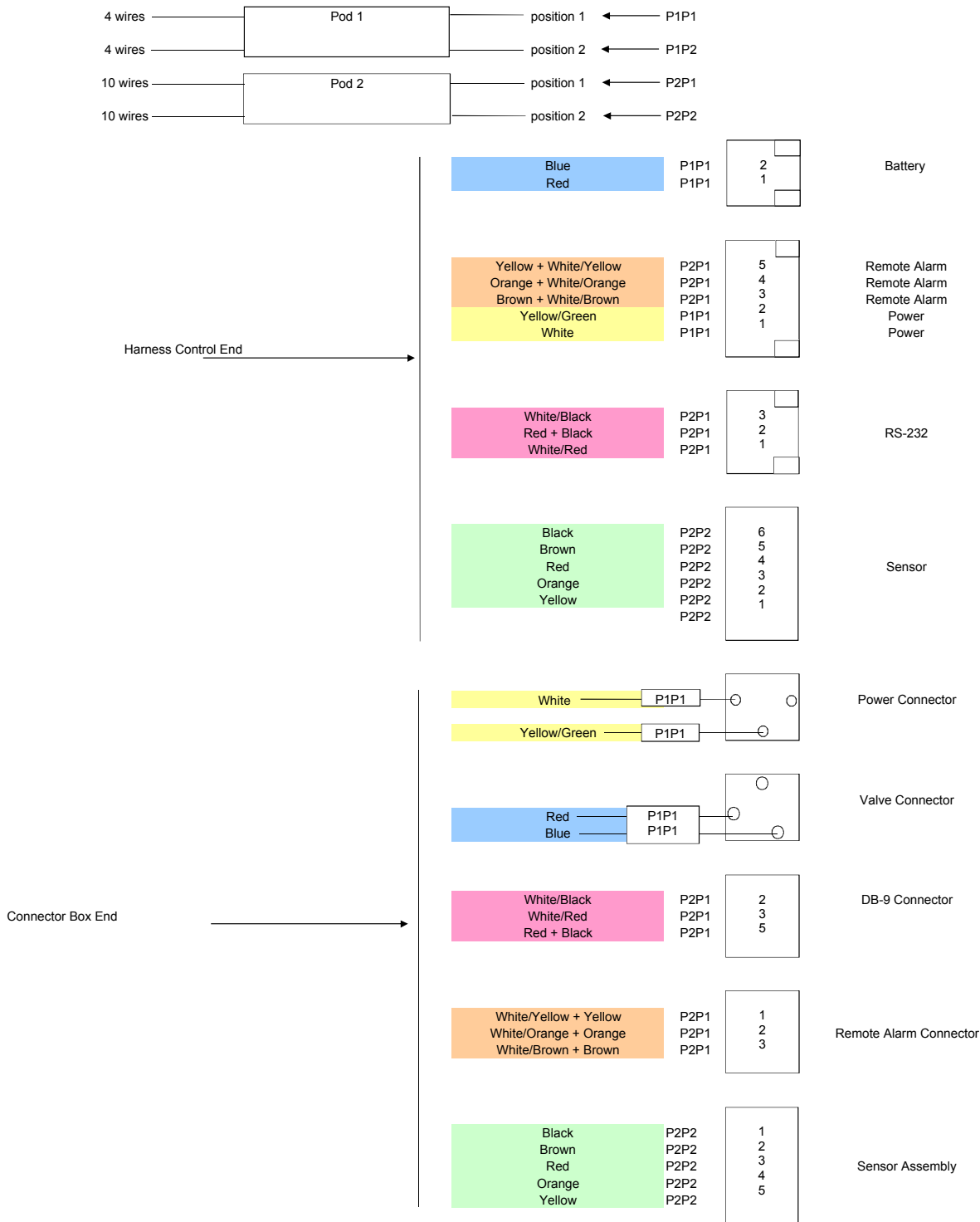


Figure 8.0 CS200 Series Control System Harness Wiring Diagram

Controller Operation

Intallation & Set-up

The CS200 CONTROL SYSTEM consists of the following components:

- Main Control
- VFD Display Module
- Wiring Harness Assembly
- Power Supply
- Thermocouple Assembly
- Lid Switch Assembly
- Sensor Assembly
- Cryogenic Solenoid Valve
- Remote Alarm Plug

Connect the wiring harness assembly to the main control. The connector is keyed and can only be plugged in one way.

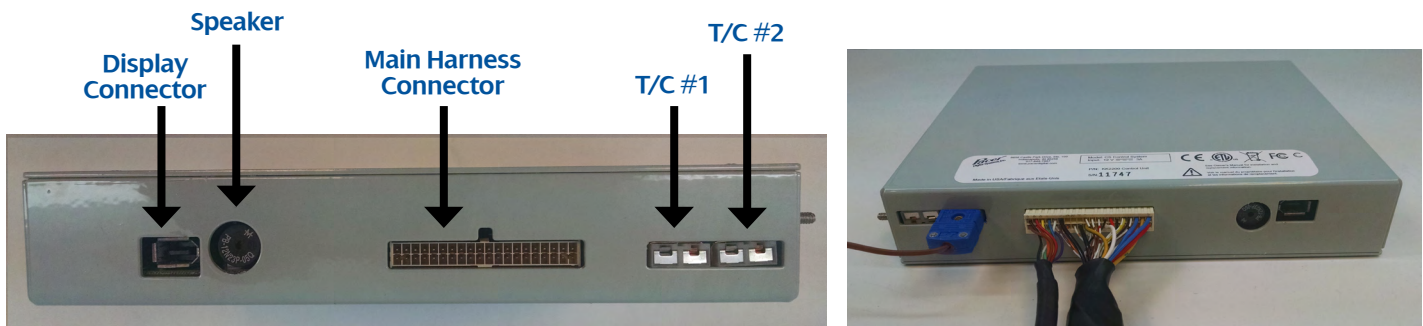


Figure 9.0 Main Control Back Panel

Connect the thermocouple plug of the harness assembly into the control at the thermocouple plug labeled T/C #1. One of the blades on the plug is slightly wider insuring that it is plugged in correctly. The copper blade should plug into copper-colored plug. Finally, connect the display cable into the main control and the display.



Figure 10.0 Connection to Main Control

Connect the level sensor assembly into the pigtail with the round connector terminating at the control end of the harness assembly. The connector is a round locking connector that is keyed so it can only be plugged in one way.

Connector to Main Control Connector for Level Sensor

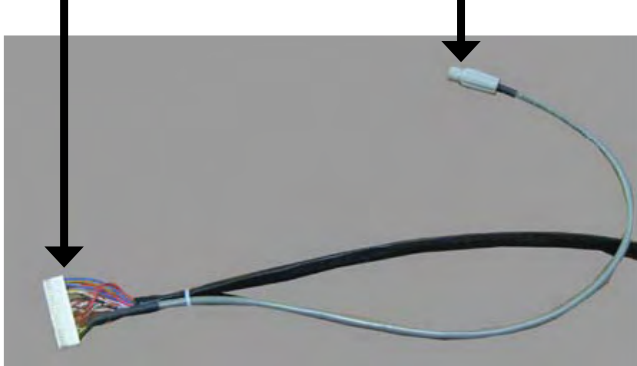
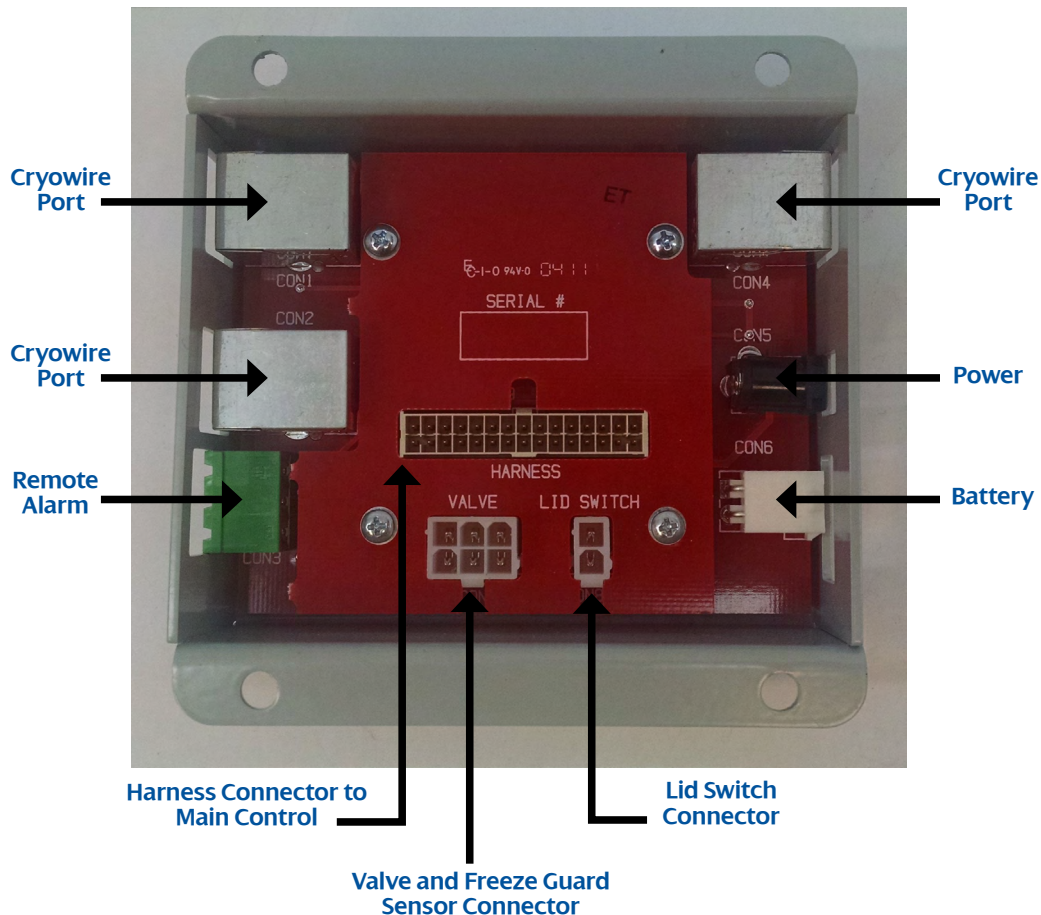


Figure 11.0 Harness Assembly



Figure 11.1 Sensor Assembly Connector



Connect the solenoid valve and the lid switch into the appropriate connectors on the connector box. These are located on the circuit board inside the box and are labeled. The solenoid connector is a 6-pin locking connector and the lid switch is a 2-pin locking connector. Each is keyed so they can only be plugged in one way.

Figure 12.0 Harness Assembly & Back Panel

Controller Operation

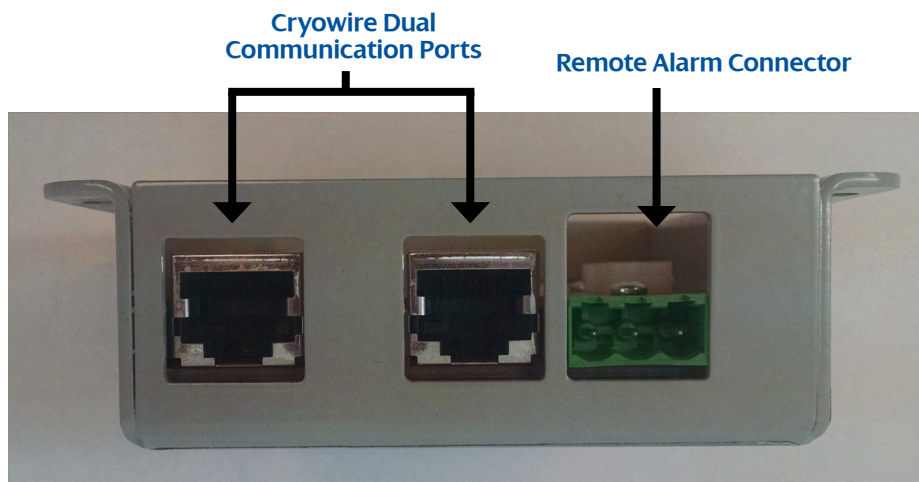


Figure 13.0

Connect the Remote Alarm plug into the panel at the end of the wiring harness assembly. It is keyed so that it can only be plugged in one way.

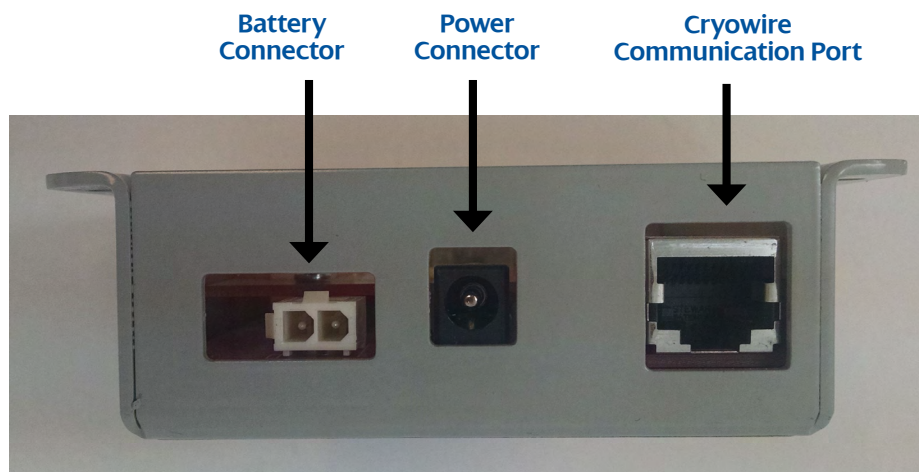


Figure 14.0

Finally, connect the barrel plug of the power supply and the battery into the appropriate receptacles in the connector box.

External Connector Ratings

Designated Use	Max rated voltage/current ratings	Connector type
Power	36 VDC	2.5mm barrel connector
CryoWire Secure™	N/A	Modular shielded jack
Remote Alarm	300 volts	5mm terminal block
Solenoid Valve	600 volts	4.2mm header
Thermocouple	N/A	2-pin thermocouple
Level Sensor	5 amps / contact	Sealed circular connector

Table 6.0 External Connector Ratings

LED Status Wheel Flash Patterns

Condition	LED Flash Property
Normal	Clockwise pattern, 1 LED per second
General Error	Clockwise pattern, rapid rotation, flash

Table 7.0 LED Status Wheel Flash Patterns

Temperature Thermocouple Select

The chamber temperature is monitored with 1 or 2 Type T thermocouples. The thermocouple is placed in the chamber to monitor temperature level at the top of the inventory system. Factory installation includes one thermocouple inside the thermocouple tube at an elevation to match the height of standard racks. A second Type T thermocouple may be added to monitor another location inside the chamber. Both thermocouples can be activated/deactivated through the menu system.

Temperature Calibration

The CS200 CONTROL SYSTEM uses a Type T thermocouple to measure temperature within the Cryostorage freezer. The temperature curve for a thermocouple is nonlinear so it is important that the CS200 CONTROL SYSTEM have a good calibration to provide accurate temperature readings. The temperature is traceable to the National Institute of Standards and Technology (NIST) ITS-90 Thermocouple Database.

There are three important reference points needed for calibration:

- Ambient Temperature: Room Temperature
- Ice Water: 0°C
- Liquid Nitrogen (LN₂): -196°C (-320°F)

The ambient temperature is the temperature measured inside the control box and is used to provide temperature compensation adjustment. This is calibrated at the factory and should not be adjusted in the field.

Ice water and LN₂ provide the reference points on the temperature curve. If these two points are calibrated correctly then all other points (temperatures) on the curve are correct.

The accuracy of a thermocouple is +/- 1°C or +/- 1.5% of the reading, whichever is greater.

To check a calibration, dip the thermocouple in ice water, dry thoroughly and then dip in LN₂. If readings are within accuracy specifications noted above, the temperature circuit on the control is properly calibrated. If not, follow the steps below to calibrate the temperature.

Controller Operation








Access the menu by pressing	
Highlight CHANGE SETTINGS and press	
Highlight TEMPERATURE and press	
Highlight CALIBRATE and press	
Highlight CALIBRATE THERMOCOUPLE 1.	
The display will read Dip the thermocouple into ice water.	
Submerge the thermocouple into an ice water bath. The bar graph will fluctuate. When a good stable reading is obtained, the bar graph will decrease to 1 or 2 bars. At this point, press to lock in the value. Dry the thermocouple thoroughly.	
The display will read Dip the thermocouple into LN ₂ .	
Submerge the thermocouple into LN ₂ . The bar graph will fluctuate. When a good stable reading is obtained, the bar graph will decrease to 1 or 2 bars. At this point, press to lock in the value	
If the calibration values fall within the expected range, "DONE!" Will be displayed on the screen.	

Table 8.0 Temperature Calibration Instruction

Test Temperature System

The temperature circuitry can be checked at any time through the menu system. This check will tell if the thermocouples are working or if they are "open" (broken or unplugged). If a thermocouple is not connected to the control it will check as "open." If a thermocouple is "Disabled" through the menu system, it will not show up on the check.

Test Level Sensors

The sensor assembly can be tested through the menu system. The sensor diagnostics indicates the sensor number and the status (whether in liquid or gas). If the control is set for an eight-thermistor it will indicate 9 sensors (8 level sensors & 1 Freeze Guard sensor) in the diagnostics. The status is indicated with either an "O" for open, a "G" for gas or an "L" for liquid. This is an easy means to tell if sensors are in or out of liquid or if a new sensor assembly is needed (open or defective sensors).

If the sensor assembly is unplugged and the main control is still on, the display will indicate that a sensor error

has occurred. This occurs because the control cannot differentiate between a very high resistance (when a thermistor is in LN₂) and an infinite resistance (when an open circuit appears in the level sensing circuitry).

Alarms and Error Conditions

The CS200 SERIES Control System control monitors many different conditions in the freezer and has a full complement of alarms associated with these different conditions. As alarms occur, they trigger an audible tone as well as a flashing red light on the status wheel. A remote alarm relay is also triggered following a user-designated period of time, after the error condition occurs, if it is not corrected. In addition, the error condition is displayed on the top line of display until the error condition is corrected. When an error occurs, the audible alarm may be muted by pressing the designated button. The audible alarm will then be silent until activated by a new error condition or the alarm condition is not corrected by the time the retrigger timer expires. A red light will continue to flash until all errors are corrected. The remote alarm will be activated if the power is interrupted.

The High Temperature Alarm for Thermocouple #1 can be set through the menu system. This alarm is activated if the temperature rises above the designated temperature. The alarm temperature can range from 0°C (32°F) to -196°C (-320°F). It can also be disabled.

High Temperature Alarm for Thermocouple #2 can be set through the menu system. This alarm is activated if the temperature rises above the designated temperature. The alarm temperature can range from 0°C (32°F) to -196°C (-320°F). It can also be disabled.

System Alarms

A Low LN₂ Supply Alarm can be set through the menu system. This alarm is activated if the solenoid valve is not closed within a designated time period after a fill starts. The solenoid valve can be closed either automatically (the LN₂ level reaches the *STOP FILL* sensor) or manually (the Stop Fill button is pressed). To change the timer which activates this alarm, the menu options for this alarm are None, 15, 30, 45, 60 minutes, 2 or 3 hours. This alarm does not correct itself until the fill is stopped (the solenoid closes).

The Sensor Error Alarm can be set through the menu system. This alarm is activated if the control detects a sensor error. The possible choices are ENABLE or DISABLE. An open sensor can be confirmed through the *TEST LEVEL SENSORS* option in the menu system.

A Remote Alarm Timer can be set through the menu system. This is the amount of time before the remote alarm relay is triggered if an error condition is not corrected. The possible choices are None, Immediate, 30 minutes, 60 minutes or 2 hours.

Lid Open Too Long Alarm can be set through the menu system. This is the amount of time the lid can be open before it triggers an alarm condition. The possible choices are None, 1, 2, 5 or 10 minutes.

Thermocouple Alarm can be set through the menu system. This alarm is activated if either thermocouple experiences an open circuit. Your choices are ENABLE or DISABLE.

Test Alarms

Audible, visual and remote alarms can be tested at any time through the menu system. Follow the instructions on the display to hear the audible indicator of an alarm, to see the red status wheel flash or to trigger an immediate remote alarm.

Logging

On-board memory logging is one of the most powerful and useful features of the CS200 SERIES Control System. It provides a historical record for the freezer and a complete record of the environment in which specimens are stored.

Controller Operation

1. **System Log:** System logs are events that occur in the system including lid opening/closing, LN₂ filling, Quick-Chill and Defog.
2. **Error Log:** Error logs are outside the activated preset limits detected by the system.
3. **Temperature #1 Log and Temperature #2 Log (for use with optional thermocouple #2):** The two temperature logs are simply records of the temperatures recorded by the thermocouples in the system.

All logs are kept in a non-volatile memory, meaning that the information is saved regardless of whether the controller has power.

Display Brightness

DISPLAY BRIGHTNESS changes the intensity of the display. The default setting is 10.

Making Adjustments to the CS200 SERIES Control System Sensor Assembly

CRYOSTORAGE SYSTEM	LOW LEVEL ALARM	START FILL	STOP FILL	HIGH LEVEL ALARM
LABS 20K, 38K, 40K, 80K	2 in. (50 mm)	3 in. (76 mm)	5 in. (127 mm) (at carousel)	6 in. (152 mm)
LABS 94K	5 in. (127 mm)	6 in. (152 mm)	9 in. (228 mm) (at carousel)	10 in. (254 mm)
K Series 10K, 24K, 38K	2 in. (50 mm)	3 in. (76 mm)	6 in. (152 mm)	7 in. (178 mm)

Table 9.0: CS200 SERIES Control System Sensor Assembly Factory Settings

The sensor assembly is preset at the factory for vapor phase storage. If adjustments need to be made, the following procedure will simplify the process.

The CS200 SERIES Control System control installed on the Worthington Industries Cryostorage units operates with specially designed software to match the design characteristics of your freezer. Refer to the chart below to see the versions and their difference.

To make adjustments to a sensor assembly in a freezer filled with LN₂, the following procedure can be used:

- Measure the LN₂ in the freezer.
- Take this measured level and subtract the offset to determine how many sensors should be in liquid.
 - a. Remove sensors.
 - b. Fill to correct level and turn off Liquid supply.
 - c. Eg. Level is to be 15 in. (381 mm) and sensor number 6 is currently and will remain the Stop Fill. 15 in. (381 mm) – 6 in. (152 mm) = 9 in. (228 mm) offset. Set Offset to 9 in (228 mm).
- Go to “Test Level Sensor” through the CS200 SERIES Control System menu. “L” means a sensor is in liquid and “G” means a sensor is in gas.
- Move the sensor up or down so that the appropriate numbers of sensors are in liquid (read “L”).
- Return to the CS200 SERIES Control System main screen and the level indicated should match the physically measured reading.

The *Sensor Offset*, the *START FILL* and the *STOP FILL* can be set through the CS200 SERIES Control System menu system.

Removing/Installing the Solenoid Valve

The LN₂ and power must be turned off before beginning work on the solenoid valve.

For LABS Electrical Units

Disconnect the solenoid valve lead connection from the back of controller board.

To remove the solenoid valve, loosen the compression fitting that connects the plumbing tubing to the fill tube. Remove the two (2) mounting screws that hold the solenoid valve to the solenoid bracket. 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, attach the compression fitting to the fill tube then connect the compression fitting to the elbow connected to the outlet side of the solenoid valve. Use Teflon tape (three wraps) on all threaded connections. Attach the compression fitting to the fill tube first and then connect the compression fitting to the elbow that is connected to the outlet side of the solenoid valve. Position the solenoid valve onto the solenoid valve bracket and reattach and tighten the two (2) mounting screws. Attach the solenoid valve lead connection to the controller board.

Removing/Installing the Controller 10K/24K Units

Remove the cabinet top, follow the steps illustrated in Figure 17. Remove two (2) screws from the display and lift it from the refrigerator far enough to detach its electrical connection 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. On the 10K and 24K, the cabinet top may only be raised as shown 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 access to its back panel connection. At the completion of maintenance or repairs, reattach the electrical connection wiring from the controller to the display.

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 remove sensors. It may be necessary to remove the sensor tube from the container and allowed it to thaw before the sensors can be removed.

To install the controller, install the electrical supply connections panel to the back of the refrigerator. Feed the wiring harness from the electrical supply connections panel to the front of the refrigerator and through the opening to where the display will be mounted. Attach the electrical supply connections to the controller board. Be sure to follow all of the installation procedures for the thermocouple, sensor probes and solenoid valve before you reattach the cabinet top. Reattach the cabinet top with the (4) four screws that were removed (See Item 2 of Figure 16.0) out to remove the cabinet top. Carefully lower the display into the cabinet. Attach the display to the cabinet top with the (2) two supplied 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.

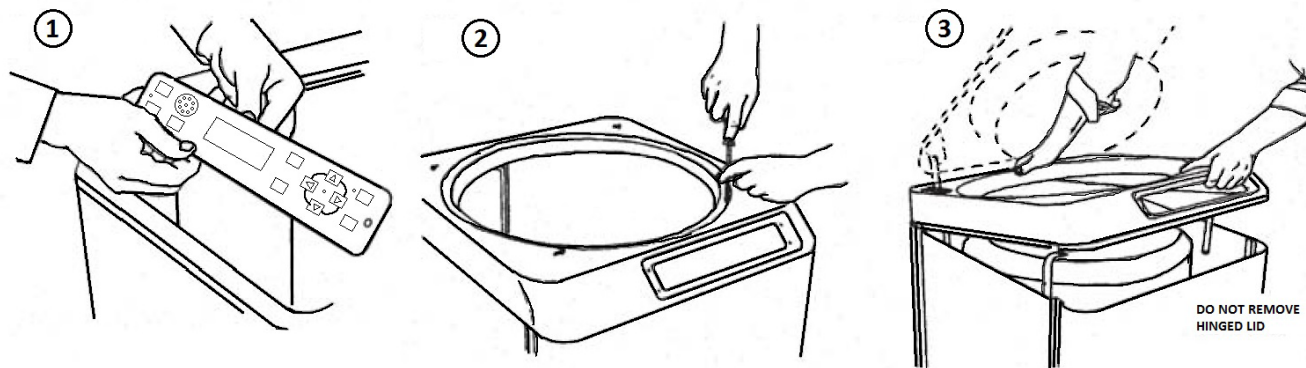


Figure 15.0 K Series Controller Removal

Removing/Installing the Thermocouple

Remove the controller using the procedures outlined for your particular refrigerator model in Removing/Installing the Controller section. Disconnect only the thermocouple lead connection from the controller board. Gently pull the thermocouple from the sensor tube. (See Pg. 39)

NOTE: Depending on your Cryostorage model, the thermocouple may be secured to the level sensor assembly; mark the level sensor assembly so there is a reference point.

To install a thermocouple, feed the thermocouple lead into the sensor tube to the elevation in the storage chamber you want to monitor. Connect the thermocouple to the controller board. At the completion of maintenance or repairs, install the display using the procedure outlined for your refrigerator model in the Removing/Installing the Controller section. (See Pg. 39)

Removing/Installing the Sensor Probes

Remove the controller using the procedures outlined for your particular refrigerator model in Removing/Installing 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.

Making Adjustments to the Level Settings

The factory settings for the CS200 control system are as follows:

- Low Level Alarm = 2 (Always 1" below the start fill)
- Start Fill Sensor = 3
- Stop Fill Sensor = 6
- High Level Alarm = 7 (Always 1" above the stop fill)

The sensor (See Table 9.0, pg.38 for specific model information) assembly is installed at the bottom of the refrigerator as delivered from the factory. If adjustments need to be made, the following procedure will simplify the process.

- Determine the range of LN₂ level in the refrigerator (i.e. Start Fill = 9; Stop Fill = 12) Offset will be 6.
- Determine the appropriate offset by subtracting 3 from the Start Fill. (i.e. Offset = 9 - 3 = 6)
- Set the sensor assembly so that the very bottom of the assembly matches the desired offset.

This can be done as follows:

- Push the sensor down the sensor tube until it touches the bottom of the refrigerator.
- Mark the sensor wire where it emerges from the top of the sensor tube.
- Using the marked wire as a reference, pull the sensor up the same distance as the offset setting.

The sensor assembly is now in the correct location.

To make adjustments to a sensor assembly in a refrigerator filled with LN_2 , the following procedure can be used:

- Measure the LN_2 liquid level in the refrigerator.
- Take this measured level and subtract the offset to determine how many sensors should be in liquid.
- Select **MENU**, Change Settings, Level, Thermistor Status. "L" means a sensor is in liquid while "G" means a sensor is in gas.
- Move the sensor up or down so that the appropriate numbers of sensors are in liquid "L".
- Get back to the Thermistor status screen and the level indicated should match the physically measured reading. The Sensor Offset, the Start Fill and the Stop Fill can all be set through the MENU, Change Settings, Level, Sensor Position.

Removing/Installing the Solenoid Valve

Remove the controller using the procedures outlined for your particular refrigerator model in the Removing/Installing 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.

To remove the solenoid valve loosen the compression fitting that connects the plumbing tubing to 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, attach the connecting plumbing to the inlet and outlet connections of the valve using Teflon tape. Attach the compression fitting to the fill tube first and then connect the compression fitting to the elbow that is connected 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 Removing/Installing the Controller section. (See Pg 39).

Replacement Parts

Plumbing Assembly

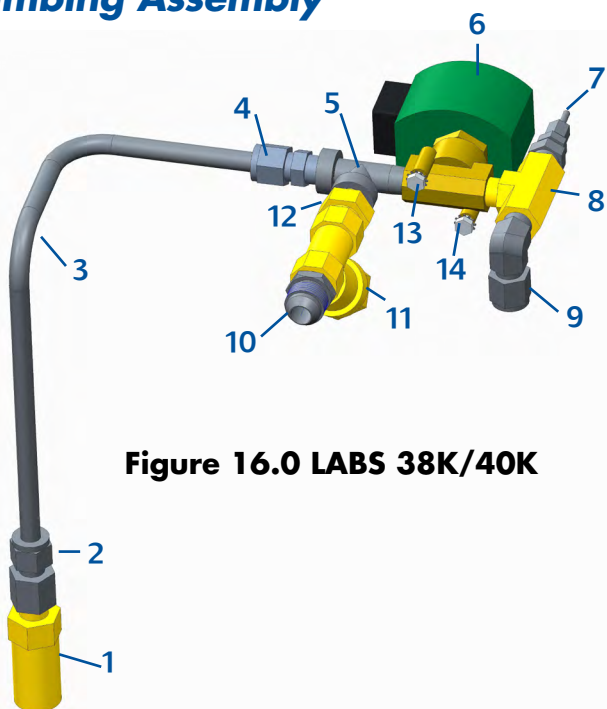


Figure 16.0 LABS 38K/40K

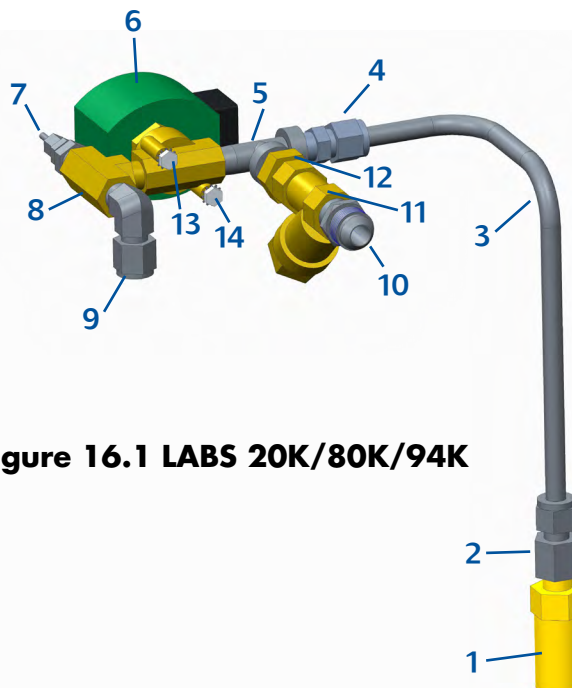


Figure 16.1 LABS 20K/80K/94K

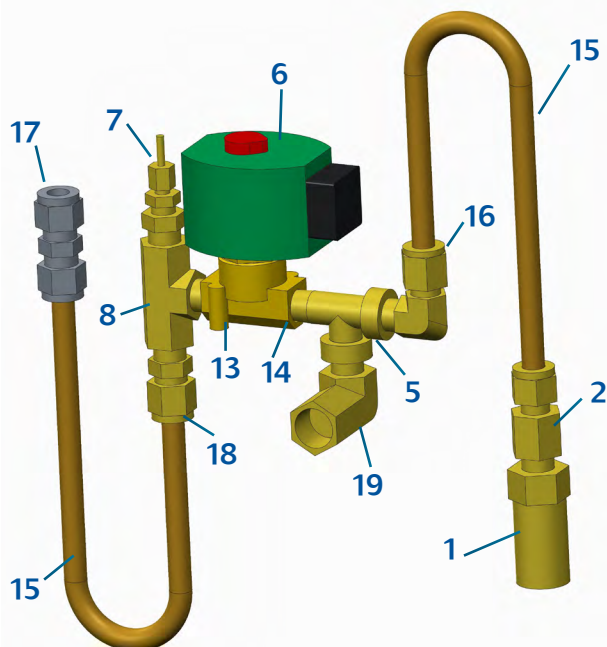


Figure 16.2 K Series 10K/24K

Plumbing Assembly Parts

Item	Part No.	Description
1	367276	Valve, Relief, 1/4" MPT, 100 psig
2	367168	Connector, 3/8" ODT x 1/4" FNPT
3	367511	Tube, Relief Valve - LABS20K/38K/40K
	367445	Tube, Relief Valve - LABS80K/94K
4	367175	Connector, Male 1/4"
5	367265	Tee, Street 1/4" NPT
6	367778	Valve, Solenoid, 2 Way 1/4" FPT, 12 VDC
7	367789	Sensor, Valve Monitoring Assy. (Freeze Guard)
8	367267	Tee Branch, 1/4" NPT
9	367169	Elbow, 3/8" ODT x 1/4" MNPT, SS
10	367318	Connector, CGA295 x 3/8" MNPT
11	367326	Strainer, 3/8" NPT, Brass
12	367254	Nipple, HX, RED, BR, 3/8" x 1/4"
13	367246	Washer, Extrenal Tooth #10
14	367723	Screw, Machine, Hex Head, 10-32 UNC x 0.44 LG
15	366889	Tube, Fill Kit
16	367264	Elbow, 90 Deg., 1/4" MNPT x 3/9" ODT Brass
17	367170	Union 3/8" ODT x 3/8" ODT, SS
18	367174	Connector, Male, 3/8" ODT x 1/4" MNPT, Brass
19	367259	Elbow, 90 Deg, Street, 3/8" x 1/4" Brass

Controller Assembly

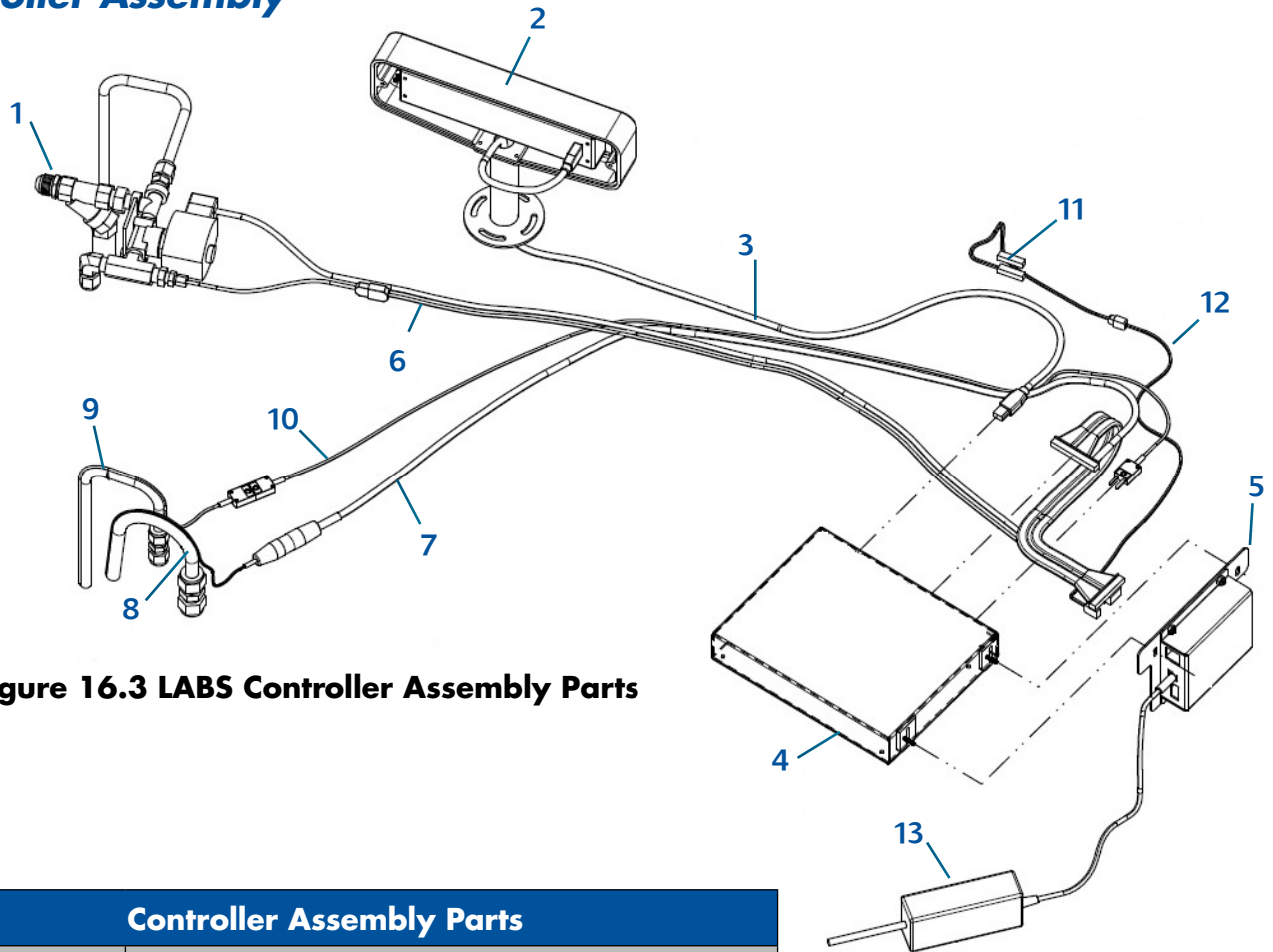


Figure 16.3 LABS Controller Assembly Parts

Controller Assembly Parts		
Item	Part No.	Description
1	367893	Final Plumbing Assembly LABS20K/38K/40K/80K/94K CS
2	367779	Controller Display, CS200
3	367783	Fire Wire CS LABS20K/38K/40K
	367784	Fire Wire CS LABS80K/94K
4	367780	Controller Box, CS LABS
5	367781	Junction Box, CS LABS
6	367791	Valve/Freezegaurd Harness LABS20K/38K/40K
	367792	Valve/Freezegaurd Harness LABS80K/94K
7	367782	Harness Assembly, CS LABS
8	367788	Level Sensor, 8-Thermistor CS200
9	367785	Thermocouple Assembly, CS LABS
10	367786	Thermocouple Wire, Short LABS20K/38K/40K
	367787	Thermocouple Wire, Short LABS80K/94K
11	367795	Lid Switch Assembly
12	367796	Lid Switch Extension Wire
13	367823	12 VDC Transformer, EL-V, No Plug
N/S	367185	Remote Alarm Connector

Replacement Parts

Controller Assembly

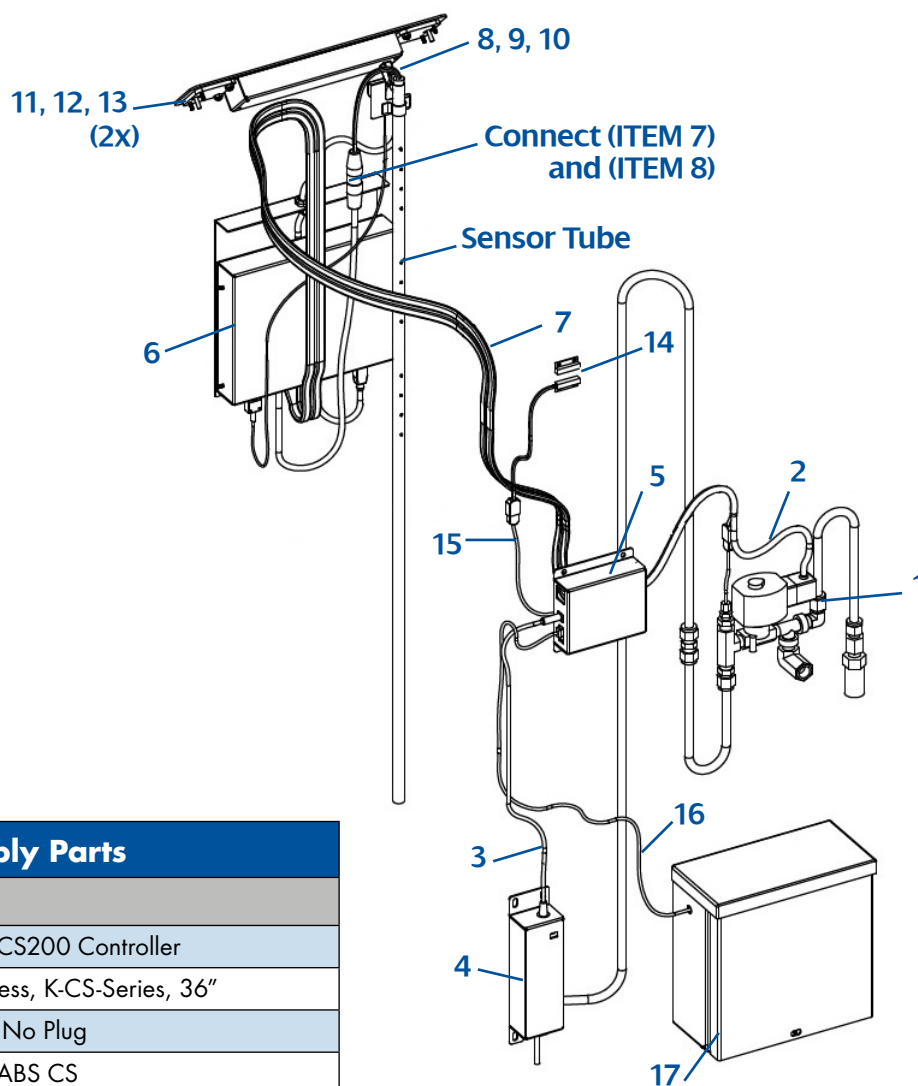


Figure 16.4 K Series Controller Assembly Parts

Controller Assembly Parts		
Item	Part No.	Description
1	366903	Plumbing Assembly, CS200 Controller
2	367909	Solenoid Valve Harness, K-CS-Series, 36"
3	367823	12 VDC Transformer No Plug
4	367824	Transformer Cover, LABS CS
5	367913	Junction Box, With No T Plate, CS200
6	367908	Controller Module, 10K/24K CS200
7	367911	Harness Assembly 10K-CS, 74" Cable
	367912	Harness Assembly 24K-CS, 104" Cable
8	367788	Level Sensor, 8-Thermistor CS200 Control
9	366891	Thermocouple Assembly
10	367859	Plug, Sensor Tube
11	367907	CS200 Display Module With Mounting Wings
12	367509	Display Module, Bezel
13	367205	Screw, Flat HD, 8-32 UNC X 3/4" LG
14	367795	Lid Switch Assembly
15	367796	Lid Switch Extension Wire
16	367910	Battery Extension Wire
17	367793	Battery (Optional)

Symptoms

The key to troubleshooting your CS200 SERIES Control System and your Cryostorage system is to determine which component in the system is the source of the problem. Determine if the problem is occurring in any of the following subsystems: Supply Vessel, Transfer Line, Power Source, Temperature, Level Sensing, Security, Lid Switch, Solenoid Valve, Control Display, Alarm System, Communications. After determining which subsystem is having the problem, isolate the problem further by performing subsystem tests. Once the problem is isolated and defined, it will be easier to solve.

Controller Will Not Turn ON

Press POWER button. If display is blank and dark go to next step.

Check all connections. Power cord must be plugged into an outlet providing 100/240 VAC (50/60 Hz).

High Liquid Level

1. Determine physical liquid level using a dipstick, then select **MENU**, VIEW ONLY, LEVEL, THERMISTOR STATUS through the controller display. An "L" or "G" will indicate individual thermistor status. "L" indicates the thermistor is submerged in liquid and "G" indicates that the thermistor is in gas (vapor). A solenoid valve that fails to close will typically empty the supply cylinder and may cause a high level alarm. **Replace the solenoid valve if it has failed even once.**
2. Liquid level is determined by thermistors located in the sensor tube. If the sensor tube is blocked or iced at the top, the liquid level in the sensor tube may not rise and fall at the same rate as the liquid level in the freezing chamber. Make sure the sensor tube is not obstructed.
3. The pool of LN₂ can become turbulent during a fill. Bubbling and splashing can be amplified by the rack arrangement. The deeper the pool, the less turbulent the surface of the pool will be during a fill. The turbulence can cause liquid to splash on a thermistor and cause a false alarm or premature fill termination.
4. Confirm that sensor assembly is responding to changing liquid level with a dip-test.
 - Close liquid supply valve at source.
 - Mark the sensor assembly with reference to the top of tube to assure the sensor assembly is reinstalled to the original position.
 - Remove sensor assembly from sensor tube. DO NOT FORCE. Solenoid valve should open and LOW LEVEL alarm should be activated.
 - Select **MENU**, VIEW ONLY, LEVEL, THERMISTOR STATUS. An "L" or "G" will indicate individual thermistor status (L = Liquid, Gas = Gas, O = Open).
 - Dip each thermistor in succession into LN₂. Observe the controller display noting that each thermistor changes from "G" to "L" as each is submerged. Response time may vary.
 - Return to the main menu and submerge the START FILL THERMISTOR IN LIQUID. Note that the low level alarm ceases, fill solenoid valve is still open. Control is flashing FILLING.
 - Manually press STOP button and note that the fill solenoid valve closes.

Troubleshooting

- Press FILL button to re-open the fill solenoid valve.
- Continue to lower the sensor until the STOP FILL thermistor is immersed in the LN₂. The fill should stop after a slight delay.
- Simulate an over fill by lowering the HIGH LEVEL Alarm thermistor into the LN₂. HIGH LEVEL alarm should sound within 10 seconds.
- Re-install sensor assembly and thermocouple into sensor tube as before. Open supply valve on LN₂ supply.

Indicates Low LN₂ Supply

When the START FILL thermistor is uncovered, the controller opens the Fill solenoid valve. If the STOP FILL thermistor is not covered with LN₂ in the pre-determined amount of time, the controller is programmed to interpret this as a LN₂ supply shortage.

1. Check contents gauge and pressure gauge of supply cylinder. Both liquid contents and pressure (15 to 22 psi - 0.7 bar/69 kPa to 1.5 bar/152 kPa) are required to complete a fill.
2. Confirm that no other transfer hose or apparatus is attached to the supply cylinder. Either could compromise adequate tank pressure required to complete a standard fill in 30 minutes.
 - Check the distance that the LN₂ must travel to reach the freezer. Observe the time it takes for Liquid LN₂ to reach the Freezer through the usual piping conditions. Liquid should be entering the chamber within 4 minutes under normal (usual) line temperature conditions.
3. Confirm that the solenoid valve is open when a fill is called for.
 - If no flow is detected, the solenoid valve is not getting the signal to open, or it is opening and there is a blockage in the line. Check the connections on the leads near the solenoid itself, as well as the connection at the controller.
 - Confirm that the wires have not been pinched, creating a short circuit.
4. If a longer fill time is desired, change the setting by selecting: MENU, CHANGE SETTINGS, SYSTEM, SYSTEM ALARMS, LN₂ SUPPLY ALARM DELAYS.

Indicates Open Sensor

1. Normally, this message is associated with a loose plug or connector. Check all connections.
2. To determine this select: MENU, LEVEL SENSING, TEST LEVEL SENSORS. An "L", "G", or "O" (open) will indicate individual thermistor status.
3. Thermistor assembly is not repairable. Replacement assembly is required.

Temperature Reading 10° to 20° Warm

- Prepare an ice water slurry with crushed ice and tap water. Dip or pour LN₂ into a styrofoam cup to prepare an LN₂ bath. Calibrate the controller. Select MENU, TEMPERATURE, CALIBRATE TEMPERATURE. Follow the on-screen instructions. Hold the thermocouple in each bath until the control completes its self-calibration.

- Make sure the thermocouple is clean and dry before and after each bath.
- Reposition the thermocouple at the desired location to monitor or control temperature.

Fill Solenoid Cycles On and Off

CS200 SERIES Control System features a timer function whereby the valve open duration is limited, allowed to shut for a short warm-up and then opened again. To confirm or change the valve open duration:

- Select **MENU**, USER OPTIONS, CONTROL OPTIONS, FREEZE-GUARD OPTIONS, VALVE OPEN DURATION.

If the controller Freeze-Guard function detects that the valve is stuck in the open position (i.e., continues to fill after the valve is de-energized), it will attempt to De-Ice the valve by causing a rapid cycling of the valve in an attempt to dislodge the blockage.

- To activate or de-activate this feature: Select **MENU**, USER OPTIONS, CONTROL OPTIONS, FREEZE-GUARD OPTIONS, VALVE DE-ICING.

Repeated cycling of the Solenoid Valve, caused by excessive turbulence, power/low battery, bad connection, or circuit board corrosion, could be attributable to moisture invasion on the controller circuit board.

To troubleshoot proper operation of the fill valve:

1. Confirm the pressure of the supply vessel is not higher than 22psig (1.5 bar/152kPa).
2. Watch the interface panel on the controller to verify if the Start and Stop Fill cycles are repeating. You should see and hear each cycle.

Solenoid Makes Excessive Humming Noise

During normal operation, the solenoid valve will make a soft humming noise. If the noise is excessively loud, turn the valve on and off using the control panel. If a soft humming noise is heard, the valve should continue to operate reliably. If the humming noise is excessive, replace solenoid valve. It is recommended the solenoid valve be replaced every two (2) years.

Lid Open Alarm

A lid switch is located near the hinge. The proximity switch should actuate when the lid is opened and again when it is closed.

Confirm that there is a ½ in. (12 mm) gap between the sensors.

QCF (Quick Chill Feature) Will Not Operate

See LID OPEN ALARM

To activate or adjust times: Select **MENU**, CHANGE SETTINGS, QUICKCHILL, TIMER.

Auto Defog Feature Will Not Operate

See LID OPEN ALARM.

To activate or adjust times: Select **MENU**, CHANGE SETTINGS, AUTO DEFOG.

Troubleshooting

Push Buttons Will Not Respond

Moisture may have migrated into the sealed faceplate. Call your distributor for a Return Material Authorization. Refer to the Service and Maintenance section of this manual to obtain information regarding equipment returns.

Liquid Level Readout is Incorrect

Liquid level is determined by a 8-thermistor assembly inside the protective sensor tube. The user may adjust the desired START FILL elevation and STOP FILL elevation for the pool of liquid nitrogen within the confines of 6 in. (152 mm). START FILL cannot be assigned to thermistor number 1. STOP FILL cannot be assigned to thermistor number 8. The factory installs 8-thermistor assembly at the bottom of the sensor tube, which positions thermistor number 1 at 1 in. (25.4 mm) above the floor (i.e.; the first thermistor is offset from the floor zero inches).

If you would like to stop the fill at a depth greater than seven inches from the floor, the sensor assembly must physically be raised inside the sensor tube. The distance that it has been raised becomes the new OFFSET and the controller must be notified of this offset from the floor. The factory settings are START FILL at 3 in. (76 mm) and STOP FILL at 5 in. (127 mm), with an OFFSET of zero. The factory settings for the LABS94K are START FILL at 6 in. (152 mm) and STOP FILL at 9 in. (228 mm), with an OFFSET of 3.

Power Failure Alarm

If power is interrupted, a log of the time and duration will be recorded. If the unit is not connected to a battery back-up or an external alarm, no local alarm will sound unless a high temperature is detected after power is restored. A Remote Alarm will be triggered anytime the power is interrupted.

A complete list of Replacement Parts and Accessories for the CS200 Series Controllers is available from the following Worthington Industries Customer Service Centers:

US Toll Free: 844-273-7517 or Global: +1 614-438-7968 / +43 7485 606 286

SERVICE AND MAINTENANCE HISTORY LOG

Fill in top section at installation. Copy this form each time service is required.

Fill bottom section with service notes to keep a complete log of each freezer service and maintenance history.

End User Company Name _____ LOG NO _____

Service Contract/Company Name _____

Service Contract Phone Number/Fax _____

Model/Serial Number _____

Controller Serial Number _____

Controller Version Number _____

In-service Date _____

Describe Conditions – Actual

Liquid Level – via Dipstick _____

Level Sensor Type _____ FG _____ 8T _____

Lid _____ Open _____ Closed

Filling _____ Yes _____ No

Temperature _____

LN₂ Supply _____ ltr _____ psi

Note: Ice Build-up _____ a little _____ a lot

Note: Gasket condition _____ Seals _____ Leaks

Display Lights _____ On _____ Off

Describe Conditions – Controller Reading

Liquid Level – Per Controller _____

Liquid Level Setting _____ HIGH _____ LOW

Lid _____ Open _____ Closed

Filling _____ Yes _____ No

Temperature _____

Supply Alarm _____ On _____ Off

Remote Alarm _____ On _____ Off

Audible Alarm _____ On _____ Off

Temp. control set point @ _____ degrees

Worthington Industries Technical Services

Phone: US Toll Free: 844-273-7517 Global: +1 614-438-7968 / +43 7485 606 286

Email: customerservice@worthingtonindustries.com

Service History Log (note date and log number on each service entry)

Date: _____

Date: _____

Date: _____

Date: _____

Date: _____

Date: _____

Date: _____

NOTE: All Worthington Industries Cryostorage Systems must be cleaned and decontaminated prior to return to Worthington Industries for repair or maintenance and must be accompanied by a written statement to this effect. Any Cryostorage System received without this statement will be returned to the sender, freight collect. Contact Customer Service by telephone: US Toll Free: 844-273-7517
Global: +1 614-438-7968 / +43 7485 606 286. Or email: customerservice@worthingtonindustries.com.

Certifications & Listings

This product complies with the following standards and directives:

- CB Scheme Report and Certificate
- EN 60101-1
- IEC 61010-1
- UL 61010-1
- CAN/CSAC22.2#61010-1
- 93/42/EEC Medical Device Directive for the European Union
- IEC 60601-1-2, 2007 Edition 3.0 (EMC Directive)
- RoHS Directive
- WEEE Directive
- Packaging Directive
- ETL/cETL Listing for North America
- CE marked to the Low Voltage Directive

TABLE 10: Guidance and Manufacturer's Declaration – Electromagnetic Emissions

The CS CONTROL SYSTEM is intended for use in the electromagnetic environment specified below.
The customer or the end user of the CS CONTROL SYSTEM should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic environment - guidance
RF Emissions - CISPR 11 (Radiated & Conducted)	Group 1	The CS CONTROL SYSTEM uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emissions - CISPR 11 (Radiated & Conducted)	Class B	The CS CONTROL SYSTEM is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions EN/IEC 61000-3-2	Class A	
Voltage fluctuations/ Flicker Emissions EN/IEC 61000-3-3	Complies	

TABLE 11: Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The CS CONTROL SYSTEM is intended for use in the electromagnetic environment specified below.
The customer or the end user of the CS CONTROL SYSTEM should assure that it is used in such an environment.

Immunity Test	EN/IEC 60601 Test Level	Compliance Level	Intended Electromagnetic Environment
Electromagnetic Discharge (ESD) EN/IEC 61000-4-2	± 6kV contact ± 8kV air	± 6kV contact ± 8kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst EN/IEC 61000-4-4	± 2kV for power supply lines ± 1kV for input/output lines	± 2kV for power supply lines ± 1kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge EN/IEC 61000-4-5	± 1kV differential mode (line-line) ± 2kV common mode (line-earth)	± 1kV differential mode (line-line) ± 2kV common mode (line-earth)	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines EN/IEC 61000-4-11	<5% UT (>95% dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5 seconds	<5% UT (>95% dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5 seconds	Mains power quality should be that of a typical commercial or hospital environment. If the user of the CS CONTROL SYSTEM requires continued operation during power mains interruptions, it is recommended that the CS CONTROL SYSTEM be powered from an uninterruptible power supply or a battery.
Power frequency (50/60Hz) magnetic field EN/IEC 61000-4-8	3A/m	3A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Note UT is the a.c. mains voltage prior to application of the test level.

TABLE 12: Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The CS CONTROL SYSTEM is intended for use in the electromagnetic environment specified below.
The customer or the end user of the CS CONTROL SYSTEM should assure that it is used in such an environment.

Immunity Test	EN/IEC 60601 Test Level	Compliance Level	Intended Electromagnetic Environment
			Portable and mobile RF communications equipment should be used no closer to any part of the CS CONTROL SYSTEM, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF EN/IEC 61000-4-6	3Vrms 150kHz to 80MHz	3Vrms 150kHz to 80MHz	Recommended separation distance $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ 80MHz to 800 MHz
Radiated RF EN/IEC 61000-4-3	3V/m 80MHz to 2.5GHz	3V/m 80MHz to 2.5GHz	$d = 2.3\sqrt{P}$ 800MHz to 2.5GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended minimum separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey ^A , should be less than the compliance level in each frequency range ^B . Interference may occur in the vicinity of equipment marked with the following symbol:



NOTE 1: At 80MHz and 800MHz, the higher frequency range applies

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from objects, structures and people.

A. Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the CS CONTROL SYSTEM is used exceeds the applicable RF compliance level above, the CS CONTROL SYSTEM should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the CS CONTROL SYSTEM.

B. Over the frequency range 150kHz to 80MHz, field strengths should be less than 3V/m.

TABLE 13

Recommended separation distances between portable and mobile RF communications equipment and the CS CONTROL SYSTEM.

The CS CONTROL SYSTEM is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the CS CONTROL SYSTEM can help prevent electromagnetic interference by maintaining a minimum distance between the portable and mobile RF communications equipment (transmitters) and the CS CONTROL SYSTEM as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter in watts (W)	Separation distance according to frequency of transmitter in meters (m)		
	150kHz to 80MHz $d = 1.2\sqrt{P}$	80MHz to 800MHz $d = 1.2\sqrt{P}$	800MHz to 2.5GHz $d = 2.3\sqrt{P}$
0.01	.12	.12	.23
0.1	.38	.38	.73
1.0	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

EC Declaration of Conformity

The undersigned representing the manufacturer:

Pacer Digital Systems, Inc.

Attn: Kevin Oeff

8658 Castle Park Drive, Suite 103

Indianapolis, IN 46256, USA

Herewith declared that the Product: LN₂ Level Control for Cryostorage System

Model/Type ref.: CS CONTROL SYSTEM

is in conformity with the Essential requirements of the following EC Directives when subject to correct installation, maintenance and use conforming to its(their)intended purpose, to the applicable regulations and standards, to our operation and maintenance manual.

93/42/EEC Medical Device Directive

2004/108/EC EMC Directive

2006/95/EC Low Voltage Directive

and that the Standards and/or technical specifications referenced below have been applied:

- EN 60601-1:2006+A11:2001 Medical Electrical Equipment – General Requirements for basic safety and essential performance.
- IEC 61010-1:2001 (Second Edition)- Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements
- IEC 60601-1-2: 2007 Edition 3 Medical Electrical Equipment – General Requirements for basic safety and essential performance – Collateral standard : Electromagnetic Compatibility
- IEC/CISPR 11:2009+A1:2010 Radiated & Conducted Emissions.
- IEC61000-3-2:2005+A1:2008+A2:2009. Harmonics
- IEC 61000-3-3:2008. Flicker

Year of CE Marking: 2012

Manufacturer: Pacer Digital Systems, Inc.

Signature: Kevin Oeff (*Digitally signed by Kevin Oeff*)

Position: President

Date: 24 May 2012

Place: Indianapolis, IN USA

Warranty

Worthington Industries warrants that each of its electronic controllers and displays will be free from defects in material and workmanship, in the normal service for which the product was manufactured, for a period of two (2) years from the original date of purchase. Parts and components are warranted for ninety (90) days. Worthington Industries at its option will either repair or replace any item covered under this warranty.

This warranty is void if the product is used for any other purpose than that for which it was designed, including but not limited to connection with third party systems. This warranty is void if the product is in any way altered or repaired by others. Worthington Industries and/or its suppliers shall not be liable under this warranty, or otherwise, for defects caused by negligence, abuse or misuse of this product, corrosion, fire or the effects of normal wear.

The remedies set forth herein are exclusive. Worthington Industries shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products, resulting from the delivery, use or failure of the product or for any other cause. By accepting delivery of the product, the purchaser acknowledges that this limitation of remedies is reasonable and enforceable. In no case shall Worthington Industries' liability exceed the purchase price for the product.

Labels

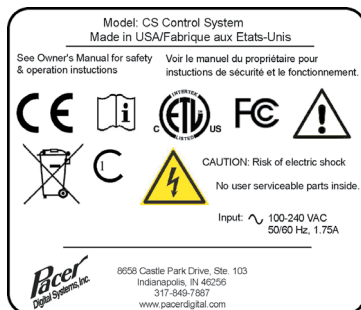


Figure 17.0
Main Rating Label

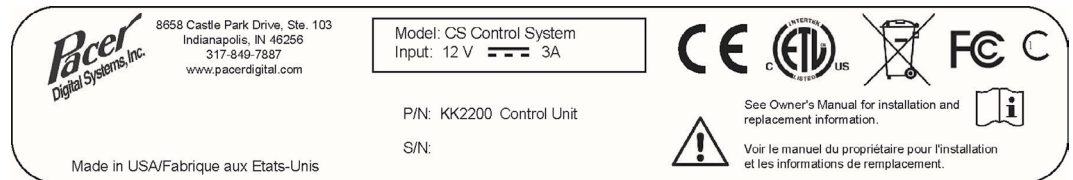


Figure 17.1 Control & Display Label

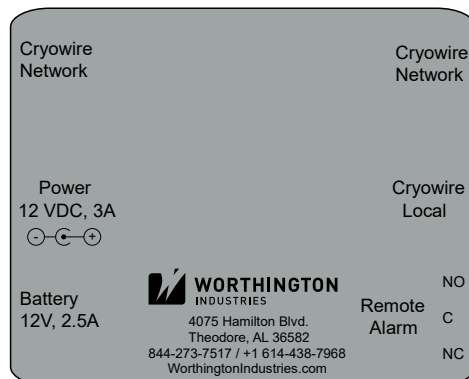


Figure 17.2 Connector Box Label

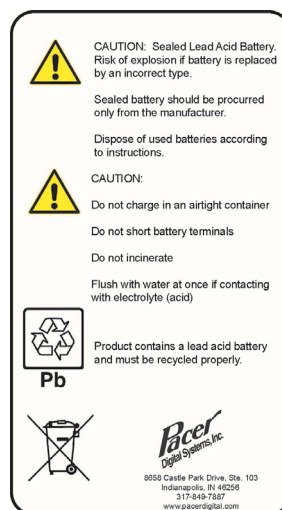


Figure 17.3 Battery Label - (Optional)



CONTACT US

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Sales Support/Order Placement:
customerservice@worthingtonindustries.com