



AB Series

w/Auto-Tend II Control System

Operations Manual

DO NOT ATTEMPT TO USE OR MAINTAIN THIS UNIT UNTIL YOU READ AND UNDERSTAND THESE INSTRUCTIONS. DO NOT PERMIT UNTRAINED PERSONS TO USE OR MAINTAIN THIS UNIT. IF YOU DO NOT FULLY UNDERSTAND THESE INSTRUCTIONS, CONTACT YOUR SUPPLIER FOR FURTHER INFORMATION.

Safety

Liquefied Gases

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

Keep Equipment Well Ventilated –

Although the liquefied gas refrigerant used in this equipment is non-toxic and non-flammable, it can cause asphyxiation in a confined area without adequate ventilation.

An atmosphere that does not contain enough oxygen for breathing will cause dizziness, unconsciousness, or even death. These gases cannot be detected by the human senses and will be inhaled normally as if they were air. Ensure there is adequate ventilation where this

equipment is used and store liquid refrigerant supply containers only in a well ventilated area.

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

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

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

FREIGHT DAMAGE PRECAUTIONS

Any freight damage claims are your responsibility. Cryostorage systems are delivered to your carrier from CryoSafe’s dock in new condition. When you receive our product you may expect it to be in that same condition. For your own protection, take time to visually inspect each shipment in the presence of the carrier’s

agent before you accept delivery. If any damage is observed, make an appropriate notation on the freight bill. Then, ask the driver to sign the notation before you receive the equipment. You should decline to accept containers that show damage which may affect serviceability

AUTOMATIC LIQUID LEVEL CONTROL PRECAUTIONS

Warning: Although the Auto-Tend is a reliable liquid level control system, there is no substitute for manually measuring the liquid nitrogen level. Periodic manual measurements of the liquid nitrogen level are recommended to insure the proper operation of the control as well as the safe storage of your samples. We recommend the following method for manual

measurement of the liquid nitrogen level: Carefully lower measuring stick (plastic or wood only) until it touches the bottom of the tank, count off 3 seconds, immediately remove measuring stick and wave in the air to create a frost-line from which the tank’s liquid nitrogen level can be read.

General Information

CryoSafe 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.

The AB-1, AB-2, AS-1, AS-2 and AS-3 units covered by this publication are designed for, but not limited to, the laboratory environment. The AB-1 and AB-2 feature square, modular cabinets that facilitate grouping several units together in a cryostorage area. The AS 1, AS 2 and AS-3 feature a cylindrical stainless steel cryochamber.

Maximum Refrigerator Contents

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

All of the models will accommodate inventory control systems or provide unobstructed storage area for larger product. All models are supplied with casters to enable limited mobility for cleaning purposes.

These standard models are equipped with the Auto-Tend electronic liquid level controller that will monitor and control the supply of liquid nitrogen to the unit. The controller features an LED display. The addition of a liquid nitrogen supply and inventory control racks for systematic retrieval of stored product completes the total cryostorage system.

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

General Information

Auto-Tend Specifications

Configurations: Designed exclusively for the CryoSafe cryostorage systems AB-1, AB-2, AS-1, AS,-2 and AS-3

Power Supply: 24 VAC, 40 VA

Sensor Assembly: 4 Thermistor,

Thermocouples: 2 Type T Thermocouples

Solenoid Valve: 24 Volt AC

Control Type: Liquid Level Control or Liquid Level Control with Temperature Control

Alarms: Activates an audible and a visual alarm. Description of the alarm condition displays on front panel. Activates remote alarm after user defined delay

Diagnostics: Circuit diagnostics at start-up. Sensor diagnostics from front panel. Manual Test for audible, visual and remote alarms

Specifications	AB-		AS-			
	I	II	I	II	III	
Dimensions						
Height ¹	in.	44.0	44.0	40.69	40.38	49.0
	mm.	1118	1118	1033	1026	1245
Width	in.	23.1	34.0	27.38	40.06	42.0
	mm.	587	864	695	1018	1067
Usable Height, Internal	in.	29.0	29.0	29.0	29.0	29.0
	mm.	737	737	737	737	737
Internal Diameter ²	in.	21.0	31.0	25.13	31.75	39.0
	mm.	533	787	638	958	991
Capacity						
LN2 Capacity	L	165	365	236	375	590
Evaporation Rate³						
	L/day	5.0	7.0	6.0	7.0	8.0
Weight, Empty						
	lb.	245	405	383	530	565
	kg.	111	184	128	240	256
Maximum Gross Weight⁴						
	lb.	540	1050	704	1198	1575
	kg.	245	476	319	543	715
Inventory Control System						
No. 5 x 5 Racks ⁵		7	17	12	17	28
No. 3 x 3 Racks ⁶		4	6	4	6	6
No. Shelves/Rack		13	13	13	13	13
Vial Capacity, 2 ml ⁷		10400	24050	16900	25350	38350

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 five (5) days from receipt of goods. If damage or loss is apparent, please notify the shipping agent immediately.

Open the shipping container; 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

¹ Maximum required clearance (with the lid open) for the SSBA I is 69 in. (1753 mm); SSBA II is 76 in. (1930 mm); and SSBA III is 90 in. (2286).

² Temperature Gradient Suppression System reduces internal diameter by approx. ¼ in. (6.4 mm). Does not apply to SSBA I.

³ Evaporation rate is nominal. Actual rate may be affected by the nature of the contents, atmospheric conditions, container history, and manufacturing tolerances.

⁴ Includes the empty weight and total allowable capacity weight.

⁵ 5 in. x 5 in. (127 mm) 100 cell box.

⁶ 3 in. x 3 in. (76 mm x 76 mm) 25 cell box.

⁷ 2 ml vial size; 12.5mm O.D. internal thread.

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 with the carrier and insurance company. Please advise CryoSafe of such

filings. In case of parts or accessory shortages, advise CryoSafe immediately. CryoSafe cannot be responsible for any missing parts unless notified within 60 days of shipment.

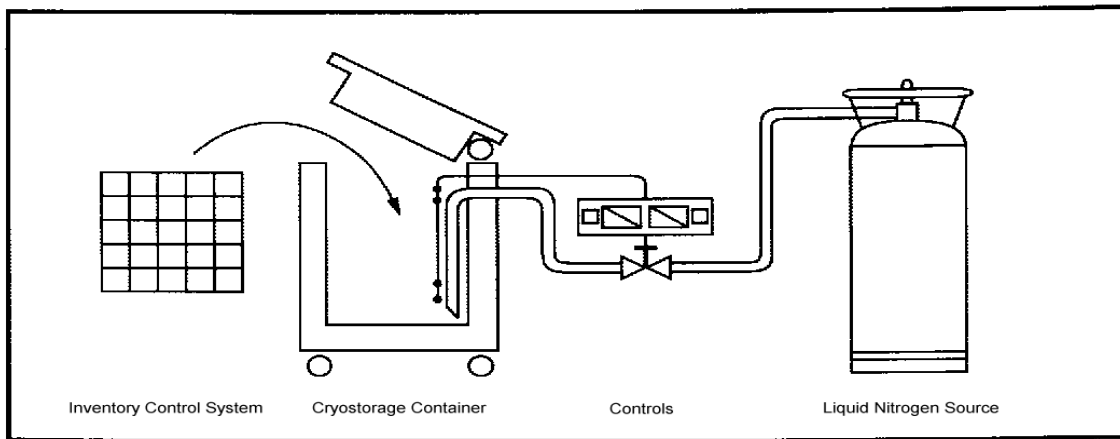
Repackaging for Shipment

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

When returning an instrument for service, the following information must be provided before obtaining an MRA:

- A. System model and serial number, and controller serial number
- B. User's name, company, address, and phone number
- C. Malfunction symptoms
- D. Description of System
- E. Material Return Authorization (MRA) number

If possible, the original packaging material should be retained for reshipment. If not available, consult CryoSafe for shipping and packing instructions. It is the responsibility of the shipper to assure that the goods are adequately packaged for return to the factory.



Installation

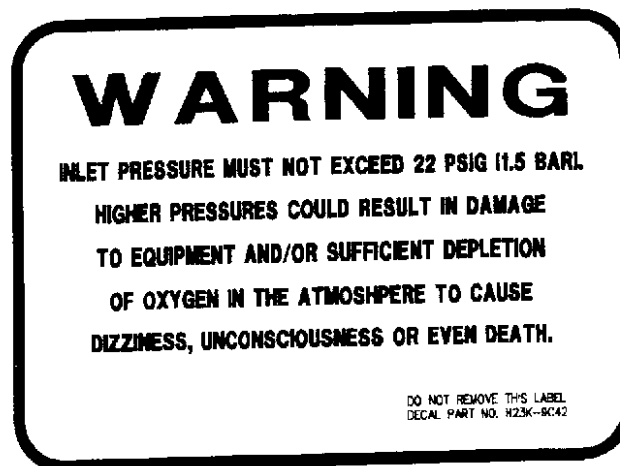
Liquid Nitrogen Supply Connection

The package included with the refrigerator includes a filter and an elbow. The liquid fill hose from a low pressure source of liquid nitrogen must be connected to the inlet through these two fittings. This liquid nitrogen source must have a shut-off valve, and may be any portable liquid cylinder or a bulk supply. The liquid nitrogen supply pressure at the inlet to the refrigerator should be in the range of 10 psig (0.7 bar/69 kPa) to 20 psig (1.4 bar/38 kPa) for optimum performance.

Higher operating pressures will increase transfer losses and create excessive turbulence of the liquid in the refrigerator which can generate false signals to the liquid level controller causing the refrigerator to underfill. In “liquid phase” storage applications, excessive turbulence can cause splashing which could result in personal injury and/or damage to the refrigerator.

If the liquid nitrogen supply pressure at the inlet to the refrigerator rises above the opening pressure of the relief valve on the refrigerator, liquid nitrogen will be discharged into the surrounding area which can cause a rapid and very dangerous depletion of oxygen in the atmosphere. Once this pressure relief device has opened and cooled to liquid nitrogen temperature, it will not reseal until it has warmed to near ambient temperature. This could permit the entire contents of the liquid nitrogen supply system to be discharged into the immediate area of the refrigerator(s).

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



Installation

Auto-Tend Control Field Installation

1. Unplug power from old unit and disconnect battery back-up
2. Close liquid nitrogen supply at valve
3. Remove 4 phillips head screws from controller face bezel
4. Remove 4 phillips head screws from cabinet top and 2 from old control
5. Withdraw old controller from cabinet top, noting how the controller body has been resting in guide slots
6. Unplug all jacks and wires from old controller and set aside
7. Remove 4 phillips head screws from rear electrical panel
8. Unplug all connectors and wires and set panel aside
9. Remove rear plumbing access panel
10. Disconnect supply hose from solenoid valve using a 7/8 inch wrench
11. Remove old solenoid: two ¼ inch hex head screws, one compression fitting using two 3/8 inch wrenches
12. Lower lid and lock hinged lid to cabinet top
13. Raise hinged lid. Cabinet top should also raise out of the way
14. Remove all wire and electrical components other than sensors and thermocouple
15. Remove old sensor tube with sensors left in place
16. Mark old sensor locations with electrical tape
17. Measure and make note of the “Start Fill”, “Stop Fill” and temperature sensors from the bottom of the sensor tube. You will need this information to set up the new controller.
18. Reverse procedure to install Auto-Tend control.

Filling the Refrigerator (Initial Fill)

The AB-1 and AB-2 units the Auto-Tend controller come preset from the factory to operate. For the AS-1,2 & 3, refer to the Installing the Controller section in this manual.

NOTE: The liquid nitrogen supply pressure at the inlet to the refrigerator should be in the range of 10 psig (0.7 bar/69 kPa) to 20 psig (1.4 bar/138 kPa) for optimum performance. Higher operating pressures will increase transfer losses and create excessive

turbulence of the liquid in the refrigerator which can generate false signals to the liquid level controller causing the refrigerator to underfill. In “liquid phase” storage applications, excessive turbulence can cause splashing which could result in personal injury and/or damage to the refrigerator.

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

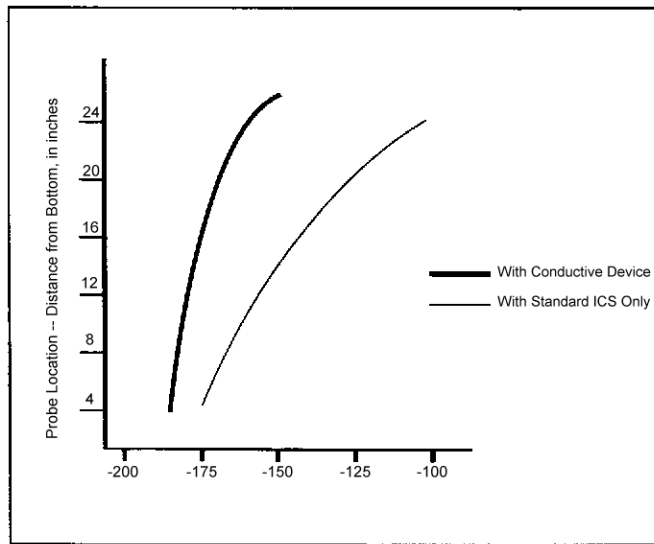
Power Supply Connection

Connect back-up battery and place in battery box. Connect the 16.4 Volt AC power supply to the rear of the cryostorage system; then plug the power supply into a surge protected 110/120 VAC outlet.

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

Operation

The chart below represents typical temperature gradients within a CryoSafe Cryostorage System utilizing the Temperature Gradient Suppression System.



Adding an Inventory Control System

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

Keep ICS inserts (drawers or boxes) and dividers in good repair. Replacement inserts and dividers are available from your CryoSafe representative to keep your system as efficient as possible.

Always wear gloves when handling ICS racks or stored product, as they are very cold – read the precautions in the Safety section of these instructions, and in CryoSafe’s “Handle With Care” brochure for more detail on handling product stored in liquid nitrogen.

When removing ICS racks to retrieve product, protect the labels, plastic, and electronic areas of the refrigerator from liquid nitrogen that may spill from the rack inserts. These parts of the refrigerator are subject to damage from the extreme low temperature of the refrigerant.

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

Fully removing Inventory Control System racks such that frost forms on them, and then setting this frost, along with the racks back into the freezer, will deposit the frost in the bottom of the freezer. Do not let ice or debris collect in the bottom of the freezer. Schedule periodic clean out if racks no longer stand upright.

Maintenance

Filter Cleaning Instructions

The container might not fill properly if the filter is clogged with ice or dirt. To clean the filter first close the supply valve to the refrigerator. Vent the fill line of all pressure. Remove and warm the filter to ambient temperature. Purge the filter from

both directions with dry nitrogen gas or dry oil-free air. Rinse the filter off with alcohol and purge it again with dry nitrogen gas or dry oil-free air to clear contaminants. If the cleaning process does not clear the blockage, replace with a new filter.

Defrosting your AB/AS- Class Cryostorage System

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

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

Ice and frost buildup in the fill tube may block the flow of liquid nitrogen into the refrigerator during fill. This blockage can result in the liquid level dropping to dangerously low levels, and may result in the Low Alarm sensor being activated. In addition, a fill line blockage may cause the Low LN2 Supply Alarm to be activated. If the fill line becomes blocked, it must be removed from the refrigerator, allowed to thaw to room temperature, and purged with dry nitrogen or oil-free dry air to remove all traces of moisture before being re-installed.

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

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

Cleaning your CryoSafe Cryostorage System

The cryogenic vessel of all AB-AS Class Cryostorage Systems may need to be cleaned and sterilized if the type of stored product is changed or the unit is taken out of service. The vessel must be cleaned and sterilized, regardless of the type of stored product, prior to return to CryoSafe for repair or maintenance⁸.

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

Spray the entire inner vessel surface with ample amounts of an approved disinfectant⁹. Allow surface contact to be maintained for a minimum of five minutes. Rinse the inner vessel with water, remove all water and debris, and towel dry the surface. Spray the inner vessel surface with a 70% alcohol to water solution and maintain surface contact for fifteen minutes. Rinse the inner vessel surface with water and towel dry.

WARNING: Never use chlorine-based disinfectants to clean a AB or AS Class Cryostorage System.

Normal Evaporation Rate (NER) Test

If the nitrogen consumption of your AB- Class Cryostorage System seems excessive, it may be appropriate to perform an estimated Normal Evaporation Rate (NER) test on the unit. To perform an NER test:

- 1) Fill the Cryostorage unit to the "High Level" sensor.
- 2) Measure the liquid nitrogen level with a plastic or wooden rule.

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

- 3) Close and lock the lid of the Cryostorage System for forty-eight (48) hours.

- 4) Open the CryoStorage System and measure the liquid nitrogen level. Typically, liquid nitrogen levels will drop approximately 1 inch (25.4 mm) per day. If your measurement indicates a drop in excess of 2 inches (51 mm) per day, please contact your CryoSafe distributor or a CryoSafe Representative for further information.

WARNING: The source of power supply at 110/120VAC can cause a lethal electric shock. Un-plug the power cord before proceeding with any repairs.

⁸ All CryoSafe Cryostorage systems must be cleaned and sterilized prior to return to CryoSafe for repair or maintenance and must be accompanied by written statement to this effect. Any CryoSafe SSBA Class system received without this statement will be returned to the sender, freight collect.

⁹ For cleaning and sterilizing of the SSBA Class cryostorage systems, CryoSafe recommends EXSPOR™ Cold Sterilant, manufactured by Alcide Corp., 8561 154th Ave, NE, Redmond, WA. (206-882-2555)

Maintenance (con'd)

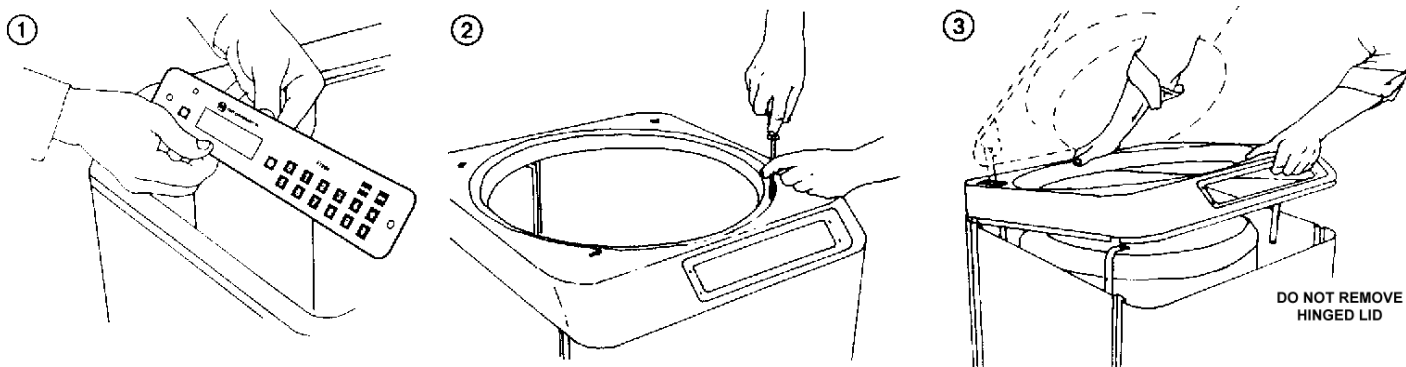
The Auto-Tend controller has been designed for easy setup and maintenance. All connectors on the controller are uniquely identified snap-on plugs. The thermocouple, sensor assembly, solenoid valve, power, remote alarm, temperature recorder and data lines can be connected or disconnected in seconds.

Removing/Installing the Controller

AB-1/AB-2

To remove the cabinet top, follow the steps illustrated in Figure below. Remove two (2) screws from the Protector Controller front panel and lift it from the unit far enough to detach its ribbon cable. Remove four (4) screws from the top of the unit and lift the cabinet top to gain access to the area between the cabinet and the insulated inner vessel. On the AB-1 and 2 it may only be raised as shown in Figure 5. because of the lid hinges. Do not remove the hinged lid on these models.

After the cabinet top is removed, (or loosened and propped-up), the power supply chassis may be detached and raised to allow access to its terminal strips. Locate the chassis between the cabinet front and the unit inner container. The Protector Controller may be lifted straight up out of the cabinet. Be careful with the attached cabling; it has a limited reach and can be damaged if stretched excessively. After completion, return the chassis to the cabinet and reverse the above cabinet top removal procedure to return the unit to operation.



Removing/Installing the Sensor Probes

Removing 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.

NOTE: Ice or frost in the sensor tube may restrict the movement of sensor probes in the tube. Do not pull excessively on the sensor wiring while attempting to 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.

Removing/Installing the Solenoid Valve

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

AB-3

Unscrew the two (2) screws that attach the controller to the container. Remove the controller. Disconnect the thermocouple, sensor probes and solenoid valve leads from the controller board. After maintenance or repairs have been made to the controller refer to the procedure outlined for your refrigerator in Removing/Installing the Controller section.

To install the controller, connect the thermocouple, sensor probes and solenoid valve leads to the bottom of the controller box.

Locate the two (2) sets of mounting holes on the refrigerator. When facing the container, these holes will be located at the 10 o'clock and 2 o'clock positions. Remove the two (2) screws in the position that has been chosen. Mount the controller to the outside of container using these two (2) screws. Be sure to follow all of the necessary installation procedures for the thermocouple, sensor probes and solenoid valve before you start to fill the refrigerator. To start filling refer to Filling the Refrigerator (Initial Fill) section of this manual.

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.

NOTE: After disconnecting the solenoid valve leads do not pull on wires. The wires are tied together.

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.

Controller Electrical Tests

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

Troubleshooting

The key to troubleshooting 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 sub-systems: Supply Vessel, Transfer Line, Power Source, Level Sensing, Security, Solenoid Valve, Control Display, Alarm System. After determining which sub-system is having the problem, isolate the problem further by performing sub-system tests. Once the problem is isolated and defined, it will be easier to solve.

CONTROLLER WILL NOT TURN ON

1. Turn POWER key. If display is blank and dark go to next step.
2. Check all connections. Start with jacks at the foot of the controller. Pay special attention to jacks labeled "POWER". Wall transformer must be plugged into an

Sensor Probes

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

-At Room Temperature	2 ohms to 10 ohms
-In Cold Nitrogen Gas	8K ohms to 18K ohms
-In Liquid Nitrogen	18K ohms to 35K ohms

outlet providing AC voltage between 100 and 130 to deliver AC voltage 24 to the back of the freezer.

FILL SOLENOID MAKES HUMMING NOISE

1. Turn fill valve on and off using the control panel. If humming continues, it should continue to operate reliably. If the noise is excessive, replace solenoid valve.

TRANSFORMER MAKES HUMMING NOISE

This noise is a normal byproduct of most block transformers. The transformer has a non-renewable internal fuse to protect the transformer output. If the noise is excessive, replace the transformer.

CryoSafe WARRANTY for LIQUID NITROGEN DEWARS

CryoSafe warrants that each of its Dewars will be free from defects in material and workmanship, in the normal service for which the product was manufactured, for a period of one year from date of shipment to the original purchaser. The product is further warranted to maintain a Normal Evaporation Rate (NER) within 10% of CryoSafe's published specifications for the product, on the date of purchase. This NER warranty is in effect for all SSB Lcass products for a period of three (3) years and for all SSBA Class products for a period of two (2) years from date of shipment to the original purchaser if the product is used and maintained according to CryoSafe's published instructions.

To make a claim under this warranty, the purchaser must: 1) give CryoSafe written notice within ten (10) days after discovery of a claimed defect, 2) immediately discontinue use of the product, and 3) return such product freight prepaid to the location specified by CryoSafe for evaluation to validate the warranty claim. If the claimed defect is confirmed by CryoSafe's inspection, CryoSafe will, at its option and as the purchaser's sole remedy, repair or replace such product or any component part thereof, or refund the original purchase price.

This warranty is voided by alterations or by repairs of others. CryoSafe shall not be liable under this warranty, or otherwise, for defects caused by negligence, abuse or misuse of the product, corrosion, fire, heat, or the effects of normal wear. Any related components or other equipment manufactured by others which may be sold with cryoSafe's product are not covered by this warranty.

THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THIS REMEDIES SET FORTH HEREIN ARE EXCLUSIVE. CRYOSAFE SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES RESULTING FROM THE DELIVERY, USE OR FAILURE OF THE PRODUCT (INCLUDING LOSS OF ANY MATERIAL STORED IN THE PRODUCT), OR FROM ANY OTHER CAUSE WHATSOEVER. BY ACCEPTING DELIVERY OF THE PRODUCT SOLD HEREUNDER, THE PURCHASER ACKNOWLEDGES THAT THIS LIMITATION OF REMEDIES IS REASONABLE AND ENFORCEABLE. IN NO EVENT SHALL CRYOSAFE'S LIABILITY EXCEED THE PURCHASE PRICE FOR THE PRODUCT.

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OPERATING INSTRUCTIONS
for the
Auto-Extreme CONTROL SYSTEM

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Safety:

Please use proper handling procedures when working with Liquid Nitrogen. It is an extremely cold refrigerant and can cause serious injury. Also, the liquefied gas can cause asphyxiation in a confined area so be sure that all confined areas have adequate ventilation. For detailed information on the handling of cryogenic liquids, refer to the publication: P12 "Safe Handling of Cryogenic Liquids" available from the Compressed Gas Association Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

Introduction:

The Auto-Extreme LN₂ level controller is a micro-controller based control designed for easy operation and uninterrupted, reliable service. This controller will maintain the selected liquid level range of LN₂ in your refrigerator and will provide audible and visual alarms for any alarm conditions that may occur.

System Components:

The following components comprise the Auto-Extreme system:

- Control Board (Cabinet Mount or External Mount)
- Sensor Assembly
- Wiring Harness Assembly
- 24 VAC Cryogenic Solenoid Valve
- 24 VAC Wall Transformer
- Thermocouple Assembly

Overview of the Control System:

The Auto-Extreme utilizes thermistors to determine the level of LN₂ in the freezer and uses a Type T thermocouple to determine the temperature. Using a 2-thermistor sensor assembly or a 4-thermistor sensor assembly, the control will attempt to maintain the LN₂ level between the appropriate thermistors. In addition, the temperature in the refrigerator is measured at the location of the thermocouple. The controller will continuously monitor the temperature and display it on the temperature readout of the control. The control comes equipped with a relay to provide for a remote alarm output. We strongly recommend that the remote alarm be used to provide an alert to the user in case of a problem.

Operation:

When the Auto-Extreme is first powered up, "000" will be displayed for about 4 seconds as the control runs a diagnostic test and gathers temperature data.



Level Control

The level of LN₂ in the freezer is determined by the physical location of the thermistors in the sensor assembly. The sensors are thermistors (thermal resistors) that change resistance with

temperature. The automatic filling occurs when the LN₂ level drops below the Start Fill thermistor and then stops when the level reaches the Stop Fill thermistor.

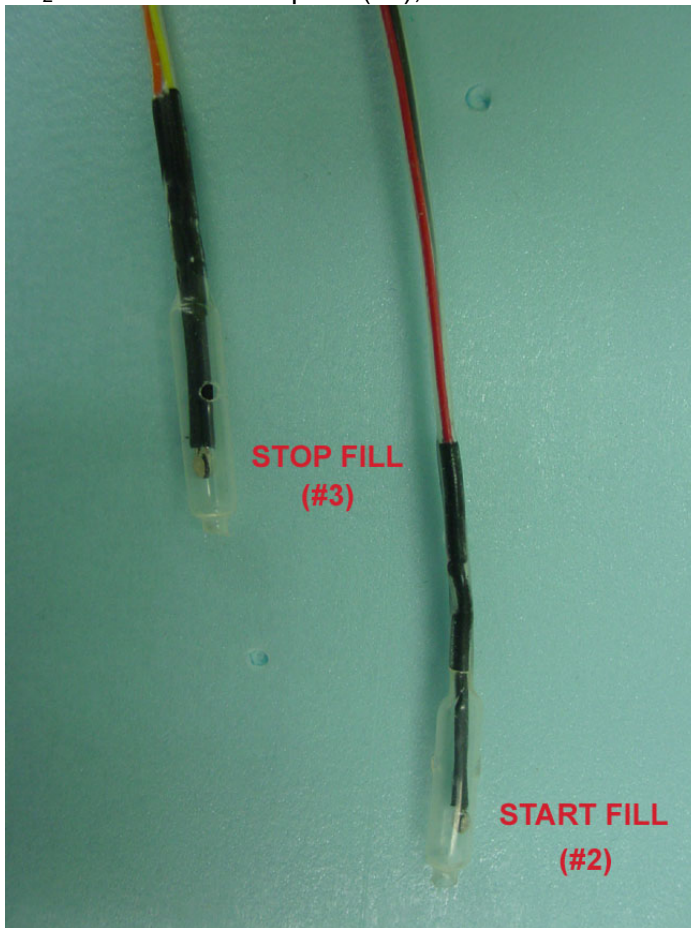
Thermistor Descriptions:

The characteristics of the thermistors in the sensor assemblies are illustrated in the following table.

	Thermistor	Nickname	4-Thermistor In LN2	4-Thermistor Out of LN2	2-Thermistor In LN2	2-Thermistor Out of LN2
Top of Assembly	4 (4-Thermistor sensor only)	High Alarm	Hi Alarm	Normal	N/A	N/A
	3	Stop Fill	Stops Fill	Normal	Stops Fill	Normal
	2	Start Fill	Normal	Starts Fill	Normal	Starts Fill
Bottom of Assembly	1 (4-Thermistor sensor only)	Low Alarm	Normal	Low Alarm	N/A	N/A

Operation with the 2-Thermistor Sensor Assembly:

If a 2-thermistor sensor assembly is used, the control recognizes the thermistors as Start Fill (#2) and Stop Fill (#3). If the LN₂ level drops below Start Fill (#2), the **LOW** LED flashes red. If the LN₂ level is between the two thermistors, the **NORMAL** LED is illuminated green. If the LN₂ level is above Stop Fill (#3), the **HIGH** LED flashes red.



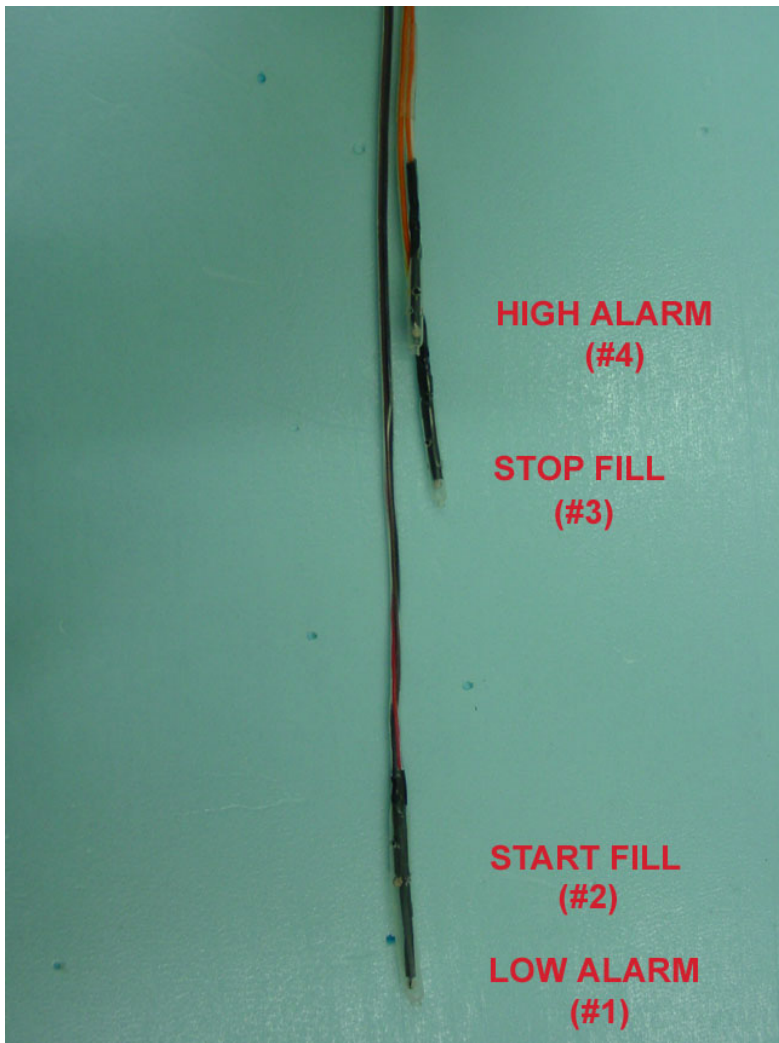
During an automatic fill, the control turns the solenoid valve on when the level is low (below the Start Fill thermistor) and turns it off when the level is high (above the Stop Fill thermistor).

When the level is normal, the valve can be manually turned on or off by the user. For automatic shutoff, the high level thermistor must be in LN₂ for 15 seconds before the control will shut off the solenoid. The audible alarm is not activated for any level when a 2-thermistor sensor assembly is being used.

LN ₂ Level / Thermistors	LEDs lit	Audible
Below #2	Flashing Red Low	No
Between #2 & #3	Solid Green Normal	No
Above #3	Flashing Red High	No

Operation with the 4-Thermistor Sensor Assembly:

If a 4-thermistor sensor assembly is used, the control recognizes the thermistors as Low Alarm (#1), Start Fill (#2), Stop Fill (#3) and High Alarm (#4). If the LN₂ drops below Low Alarm (#1), the Low LED flashes red and an audible tone is activated. If the LN₂ level drops below Start Fill (#2), the **LOW** LED flashes red. If the LN₂ level is between the Start Fill and the Stop Fill, the **NORMAL** LED is illuminated green. If the LN₂ level is above Stop Fill (#3), the **HIGH** LED flashes red. If the LN₂ level is above the High Alarm (#4), the High LED flashes red and an audible tone is activated. During a high alarm, the red LED will start flashing when thermistor #4 is submerged in LN₂ and 30 seconds later, the audible will sound. This prevents false audible alarms due to splashing.



During an automatic fill, the control turns the solenoid valve on when the level is low (below the Start Fill thermistor) and turns it off when the level is high (above the Stop Fill thermistor). When the level is normal, the valve can be manually turned on or off by the user. When the LN₂ level is below the start fill thermistor but above the low alarm thermistor, the user can turn off the valve by pressing and holding the **STOP FILL / TEST** button. When the LN₂ level is above the stop fill thermistor but below the high alarm thermistor, the user can turn on the valve by pressing and holding the **START FILL** button. For automatic shutoff, the high level thermistor must be in LN₂ for 15 seconds before the control will shut off the solenoid.

LN ₂ Level / Thermistors	LED's lit	Audible
Below #1	Flashing Red Low	Yes
Between #1 and #2	Flashing Red Low	No
Between #2 and #3	Solid Green Normal	No
Between #3 and #4	Flashing Red High	No
Above #4	Flashing Red High	Yes

Manual Defog:

The fog that is created when the lid is opened can be disbursed by starting a fill operation. If the level is above the Stop Fill sensor, the **START FILL** button can be pressed and held to keep the valve open. After 8 seconds the valve will close. Press the valve again if the fog is not yet cleared.

Opening the valve when a sensor is damaged:

The solenoid valve can still be opened if the sensor is damaged or unplugged. To open the valve, the user must press and hold the **START FILL** button. After 8 seconds the valve will close. Press the valve again if more filling is required.

Sensor Selection:

The Auto-Extreme can automatically detect which type of sensor assembly is plugged into the control. To allow the control to determine which sensor is being used, unplug the sensor assembly and power up the Auto-Extreme with no sensor plugged into the control. Then turn power off, plug the sensor in and power up the control again. It will detect which sensor assembly is being used. Alternatively, the sensor assembly can be changed through the menu system.

Temperature:

The Auto-Extreme monitors temperature in the freezer through the use of a Type T thermocouple assembly. The temperature displayed will be accurate to within +/- 1 degree C or +/- 1.5% of the temperature whichever is greater.

To verify that the temperature is correct at any time, the thermocouple can be dipped in an ice water bath and the temperature displayed on the control should be 0°C. Then the thermocouple should be dipped in LN₂ and the display will read -196°C. If the temperature readings are correct at these two reference points then they will be correct over the entire temperature curve. The control is shipped from the factory with the temperature calibrated, however, if the control needs

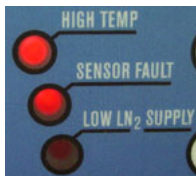
to be re-calibrated, be sure to calibrate when the control has been running and is warm. This insures the best possible calibration. See Appendix B for instructions on temperature calibration.

Please Note: All temperatures are displayed in °C on the Auto-Extreme.

Alarms:

High Temp Alarm

A high temperature alarm point can be set through the menu system. If the temperature at the location of the thermocouple exceeds the high temperature alarm set point, an alarm is triggered. The alarm consists of a flashing red LED on the control panel and an audible tone. The error will continue until the problem is corrected. The High Temperature Alarm can be set from -192 to +57. Also, the control can be programmed for a delay of the audible alarm. This can be accessed through the Temperature Alarm Delay (tAd) option in the menu system. This allows the user to work in a freezer or dewar without an annoying audible alarm every



time the lid is opened.

Open Thermocouple Alarm

If the thermocouple is not plugged in or becomes damaged the control will detect it and trigger an open thermocouple alarm. This is indicated with a flashing red LED on the panel, an audible alarm and "OPn" displayed on the temperature readout.



Low Level Alarm

A Low Level alarm point is automatically set at 1 inch below the low level sensor on the 4-thermistor sensor assembly. If the LN₂ liquid level falls below the lowest thermistor, an alarm is triggered. The alarm consists of a flashing red LED on the control panel and an audible tone. The error will continue until the problem is corrected. This alarm is only available when a 4-thermistor sensor assembly is used.



High Level Alarm

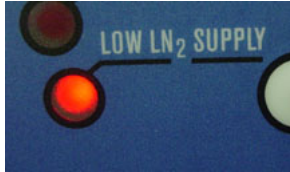
A High Level alarm point is automatically set at 1 inch above the high level sensor on the 4-thermistor sensor assembly. If the LN₂ liquid level covers the highest thermistor, an alarm is



triggered. The alarm consists of a flashing red LED on the control panel and an audible tone. The error will continue until the problem is corrected. This alarm is only available when a 4-thermistor sensor assembly is used.

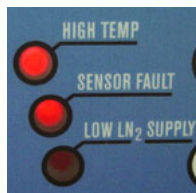
Low LN₂ Supply Alarm

When the level of LN₂ has not reached the high level sensor within 30 minutes of the solenoid valve being turned on, the controller interprets this as an insufficient LN₂ supply and an alarm is activated. The alarm consists of a flashing red LED on the control panel and an audible tone. The error will continue until the problem is corrected



Sensor Fault Alarm

When the control detects an open circuit on any of the thermistors, an alarm is activated. The alarm consists of a flashing red LED on the control panel and an audible tone. Also, the LED's that display the level will all go dark. The error will continue until the problem is corrected.



If the sensors are placed in the freezer incorrectly such that a higher level thermistor is located below a lower level thermistor, an error condition occurs. The alarm consists of audible tone and both the Low and High LED's flashing. The alarm will be triggered after a 30 second delay. The error will continue until the problem is corrected.

Remote Alarm Output

A remote alarm output connection is provided on the back panel of the refrigerator. The relay on the control board can make or break a circuit capable of conducting 2 amps of current. The remote alarm relay is activated if an alarm condition is not corrected within the amount of time as specified in the remote alarm delay (rAd) timer. See Appendix C for a connection diagram.

Test Button

The Auto-Extreme has a test button to test the audible and all the LED's. When the **STOP FILL / TEST** button is pressed and held for 8 seconds, the audible sounds and all the LED's light up to show they work. Continue holding the **STOP FILL / TEST** button for another 5 seconds and the remote alarm relay will be changed to the alarm state. The test button will activate a test only when the actual LN₂ level is above the Start Fill sensor. This allows the user to press and hold the **STOP FILL / TEST** button to close the valve when the level is below the Start Fill sensor.

Watch Dog Test

The Auto-Extreme has the capability to monitor power and to reset itself should a problem develop, this is called the "watch dog." To manually test the "watch dog" circuit, put the control into test mode by pressing and holding the **STOP FILL / TEST** button for 8 seconds.

While continuing to hold the **STOP FILL / TEST** button, press and hold the **TEMP/MUTE** button. The control will reset itself and “000” will be displayed for about 4 seconds.

Mute

The **TEMP/MUTE** button can be pressed to silence the audible alarm. The amount of time that the alarm is silenced can be changed by accessing the “AAAd” (Audible Alarm delay) in the menu system. If the “AAAd” is set to “nO” then the audible will not re-activate for the same error. If a time interval is set in the “AAAd” then the audible is re-activated after the time interval expires.

Default Settings:

The Auto-Extreme comes ready to run with the following default values:

Temperature Setpoint	-100 ⁰ C (High Temperature Alarm)
Temperature Alarm Delay	5 minutes
Audible Alarm Delay	15 minutes (Mute delay)
Remote Alarm Delay	30 minutes
Sensor	2-Thermistor assembly




The Menu System:







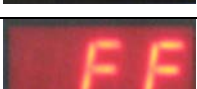


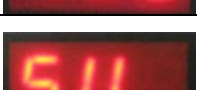
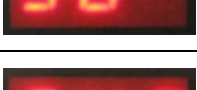
The menu system on the Auto-Extreme utilizes 3 buttons on the front panel to navigate the menu. To enter the menu system, press and hold the **TEMP/MUTE** button for 8 seconds. This button is located immediately to the left of the temperature display. The **START FILL** and **STOP FILL / TEST** buttons can be used to scroll through all the menu choices. To select a menu choice, press the **TEMP/MUTE** button. Once a menu selection is chosen, settings can be changed by pressing the **START FILL** and **STOP FILL / TEST** buttons to increment and decrement the setting values. To save the setting, press the **TEMP/MUTE** button. When the setting is saved, the menu will go back to the menu root which is indicated with three dashes (---). To exit the menu without saving the settings, turn the power off before pressing the **TEMP/MUTE** button. If the menu system is accessed but no button activity occurs for 3 minutes, the control will time out of the menu and revert back to full operational mode.

Please Note: When the Auto-Extreme menu system is accessed, the valve is turned off and the level LEDs are blanked out.

Pressing and holding the **START FILL** and **STOP FILL / TEST** buttons will increment/decrement the values more quickly while pressing these buttons repeatedly will increment/decrement the values more slowly.

The menu choices are as follows:

Menu Symbol		
- - -	Menu Root – Entry into the menu system	
tSP	Temperature Set Point – Adjust the temperature alarm setting.	
SEN	Sensor Choice – Manually adjust the sensor type.	

tAd	Temperature Alarm Delay – Adjust the amount of time before the audible sounds after the temperature exceeds the temperature alarm setting.	
AAd	Audible Alarm Delay – Adjust the amount of time that the audible alarm is silenced after the MUTE button is pressed.	
rAD	Remote Alarm Delay – Adjust the amount of time that the remote alarm is triggered after an error condition occurs.	
VEr	Version of firmware – Display the firmware version of the control.	
SEr	Control Serial Number – This identifies the control should it be required.	
SS	Sensor State – This identifies if a thermistor is in “G” or “L”. Pressing the START FILL and STOP FILL / TEST buttons and holding will identify which thermistor and then releasing the button will indicate the value.	
	2-Thermistor Sensor with sensor fault (unplugged)	
	2-Thermistor Sensor with Start Fill in LN2 and Stop Fill in gas.	
	4-Thermistor Sensor. Reading from left to right (High Alarm in gas, Low Alarm in LN2, Stop Fill in gas, Start Fill in LN2)	
SU	Sensor Value – This is the filtered value of each thermistor. Pressing the START FILL and STOP FILL / TEST buttons and holding will identify which thermistor and then releasing the button will indicate the value.	
SU2	Sensor Value 2 – This is the unfiltered value of each thermistor. Pressing the START FILL and STOP FILL / TEST buttons and holding will identify which thermistor and then releasing the button will indicate the value.	



Menu Symbol	Possible Settings

tSP	+57 to -192 °C
SEN	2 or 4 thermistor sensor assembly
tAD	5, 15, 30, 45, 60, 75, 90, 105 minutes
AAd	No, 15, 30, 45, 60, 75, 90, 105 minutes (No → No retrigger for the same error when the audible is muted)
rAD	0, 15,30, 45, 60, 75, 90, 105 (0 → Immediate remote alarm)
VEr	Screen 1 is Major revision and screen 2 is the minor revision
SEr	Screen 1 are the first 2 digits and screen 2 are the second 2 digits of the serial number

To view the version of the firmware, go into the menu system and then press the **START FILL** button until VEr is displayed. Press the **TEMP/MUTE** button to see the major revision and then press the **TEMP/MUTE** button again to see the minor revision.

Major Revision  Minor Revision 

To view the Serial Number of the control, go into the menu system and then press the **START FILL** button until SEr is displayed. Press the **TEMP/MUTE** button to see the first 2 digits and then press the **TEMP/MUTE** button again to see the last 2 digits.

Serial Number = 1001 will look like this →  

Serial Communications:

The Auto-Extreme is compatible with Cryo-Com Interface software supplied by Pacer Digital Systems. This allows data pertaining to temperature and errors to be collected on a computer.

Routine Maintenance:

It is important to protect your investment in your Cryo-Storage system and its control system by performing routine examinations and maintenance. The first step in the maintenance process is to examine the components for wear or damage. The following components should be checked routinely:

- Lid - The lid should be checked for fit and for the buildup of ice.
- Gaskets - The gasket should be checked for a tight fit between the lid and the cabinet and between the tub and the cabinet. On some models of freezer, the gasket keeps the cold air and the moisture from reaching the control, so it is important to maintain a good gasket seal.
- Sensors and Sensor Tube - Ice buildup should be kept to a minimum around the top and bottom of the sensor tube. Ice can cause damage to the sensor assembly. The control will detect if the sensor assembly has a failure but preventing the damage in the first place is preferable.
- Control – The control should be checked periodically for any signs of exposure to moisture. Signs of moisture include white deposits (like calcium) on the circuit board, signs of water on the aluminum backplate or smeared labels. Controls that have been exposed to moisture should be replaced immediately. In addition, the cause of the moisture should be eliminated (many times this can be a bad gasket or insufficient moisture protection where the sensor assembly runs into the cabinet).

Validation:

Due to the fact that the validation process requires testing of individual components in the control system, this work should only be done by personnel who are familiar with the freezer, the control system and the handling of LN₂.

Level Sensing Validation:

The LN₂ level checking in the control can be validated by performing a dip test. The sensor should be removed from the sensor tube and then slowly dipped into LN₂. The person validating should verify that the control recognizes when each thermistor is submerged in LN₂. This validates that both the control and the sensor are working properly.

Temperature Validation:

The temperature displayed by the control can be validated by dipping the thermocouple into liquids with known temperatures as reference points. Remove the thermocouple from the freezer and dip it into ice water (0°C). The control should display this reading +/- 1°C. Then dip the thermocouple in LN₂ (-196°C) and verify that the control reads -196°C +/- 3°C. If the readings are correct then the thermocouple and the temperature readings on the control have been validated. If not, a re-calibration may be needed.

Please Note: Impurities in water may cause temperature differences of a few degrees.

Visual and Audible Alarm Validation:

All the LED's and the audible alarm on the Auto-Extreme can be validated by pressing the **STOP FILL / TEST** button for 8 seconds. If the audible sounds and all the LED's light up, then the visual and audible alarms have been validated.

Remote Alarm Validation:

The remote alarm on the Auto-Extreme can be validated by pressing the **STOP FILL / TEST** button for 13 seconds or by removing power from the control. If the relay drops out then the remote alarm has been validated.

Frequently Asked Questions:

Can I change the amount of time before the Remote Alarm is triggered?

Yes. This setting can be changed through the menu system on the Auto-Extreme. See the section in this manual about The Menu System for details.

I seem to be getting a warmer temperature than I expect at the thermocouple location. What is the cause?

If the thermocouple is placed in the sensor tube it can get readings that are warmer due to influence from the sensor assembly. The sensor assembly is composed of thermal resistors (thermistors). As the LN₂ level drops, the liquid is no longer carrying away the heat generated by the thermistors. The heat from these thermistors rises up the sensor tube causing the thermocouple to read warmer than the actual temperature. The solution to this problem is to take the thermocouple out of the sensor tube and secure it with wire ties it to the outside of the sensor tube.

During the calibration process, I dip the thermocouple in LN₂ when it should be dipped into ice water and ice water when it should be in LN₂. Will the temperature displayed by the control be incorrect?

No. The control evaluates the reference points and switches them if necessary to insure a good calibration.

Why offer the control with either a 2-thermistor or a 4-thermistor sensor assembly?

Some customers prefer a high and low level alarm provided by the 4-thermistor assembly while some prefer a lower cost provided by the 2-thermistor assembly.

Why delay an audible alarm on a high temperature?

The delay is provided to eliminate nuisance alarms. A customer typically does not want to hear the audible alarm for high temperature while working in the freezer.

Should we connect the remote alarm?

Absolutely YES! It is essential that the customer provide means for notification should a problem occur. The customer may also consider a redundant alarm, a dialer and/or procedural protocol to insure the protection of the contents in the freezer.

Describe how the audible works on an alarm condition and the flexibility provided?

An audible alarm is provided whenever an alarm condition occurs. The user can mute the audible to silence it. The audible will re-trigger after a duration of time set into the “Audible Alarm Delay” timer. This can be accessed by the user through the menu system. If a different alarm condition occurs, the audible is activated for the new alarm condition.

Identifying Problems:

If the control system does not seem to be operating properly, the first step is to determine the problem and the second step is to fix the problem. The system is easier to troubleshoot if it can be determined what part of the system is not functioning properly.

- Power
- Level Sensing
- Valve Control
- Temperature Sensing

Please see Appendix A: Troubleshooting in Detail for information on troubleshooting the control.

Specifications:

Power:	24 VAC
Display	LEDs for level indication, errors and valve operation. 7-segment LEDs for temperature indication.
Sensor Assembly:	2-Thermistor Assembly <ul style="list-style-type: none">• Start Fill and Stop Fill 4-Thermistor Assembly <ul style="list-style-type: none">• Start Fill and Stop Fill• Low Level Alarm and High Level Alarm Sensor Auto-detect Minimum separation between Start Fill and Stop Fill sensors is 2".
Temperature:	Type T Thermocouple (+/- 1° C or +/- 1.5% of value).
Solenoid Valve:	24 VAC Cryogenic Solenoid Valve
Control Type:	Liquid Level Control & Temperature Monitoring
Alarms:	Alarms <ul style="list-style-type: none">• High Alarm (4-Thermistor Sensor only)• Low Alarm (4-Thermistor Sensor only)• High Temperature• Low LN₂ Supply Alarm• Sensor Open Alarm• Thermocouple Open Alarm• Each alarm provides both an audible (beep) and a visual (red flashing LED) indicator.• A Remote alarm relay is activated after a user defined amount of time elapses following an alarm condition.
Diagnostics:	Circuit diagnostics. Sensor Assembly diagnostics. Temperature circuit diagnostics.
Communications:	Serial Output to CryoCom

Replacement Parts:

The replacement parts list includes the description and part numbers necessary to allow you to identify and order parts to keep your Auto-Extreme controller in service.

Part Number	Description
	Control:
AE-C-HS1	AutoTend-Extreme, Internal Mount for 10K, 24K freezer
AE-C-HS2	AutoTend-Extreme, in painted box for 6K dewar
AE-C-HS3	AutoTend-Extreme, in blue anodized box for 38K
	Transformer
R08K-9C04	24 VAC Wall Transformer
	Harness
AE-WH	AutoTend-Extreme wiring harness for internal mount controls (10K, 24K)
	Solenoid Valve
R08K-9C03	24 VAC Cryogenic Solenoid Valve
	Sensor Assembly & Thermocouple
5140-1188	2-thermistor sensor assembly for 10K, 24K, 38K
R08K-9C01	4-thermistor sensor assembly for 10K, 24K, 38K
AE-S2-6K	2-thermistor sensor assembly for LS6000
AE-S4-6K	4-thermistor sensor assembly for LS6000
R08K-9C51	Thermocouple assembly
	Other
R06K-8C20	Plug with Leads

Appendix A: Troubleshooting in Detail

The Auto-Extreme control is an electrical device so care should be taken when working on the system. Although the system operates on 24 VAC and is a low voltage system, all proper precautions should be taken before working on the control or any of the other components in the system.

Provide a detailed description of the problem. Observe the display and describe it in accordance to the problem being reported.

Problem Description:

Power Issues	Reference
The control will not turn on	Power
Level Sensing Issues	
The control goes into High Alarm	Level Sensing
The control goes into Low LN ₂ Supply	Level Sensing
The control indicates an open sensor	Level Sensing
The control is filling in short frequent fills	Level Sensing
Temperature Issues	
The temperature does not seem correct	Temperature Sensing
The temperature display reads OPn	Temperature Sensing
Valve Issues	
The valve will not open	Valve
The valve appears to leak	Valve

Power

General

- Check all power connections. This would include:
 - Transformer to electrical panel
 - Power plug in electrical panel to connector onto control.
- Check or change out the transformer.
 - Should be 24 VAC under load or about 27 VAC no load

Level Sensing

General

- *Check the level sensing on the control by performing a dip test. Operation should be consistent with description for the 2-thermistor and 4-thermistor sensor assembly in the owner's manual.*
- Check the valve connection into the control. When the valve is in normal range the valve can be turned on and off by pressing the fill / stop fill button.
- Check to see if the valve is leaking. Turn on the supply of LN₂ from the supply tank. Turn off the solenoid. Wait a few minutes and the frost on the supply hose and valve should disappear. If the frost does not disappear, the valve is still leaking and should be cleaned or replaced.

Specific Problems

The control goes into high alarm:

- Check the tank pressure to make sure it is not too high. Too high a pressure will

- cause increased turbulence in the freezer, possibly causing a high alarm.
- Turbulence related to lack of racks, rack orientation, direction the fill tube is pointing. All of these can cause increased turbulence which may cause a momentary high alarm.
- Restricted air flow in the sensor tube. Over the years, different freezers have had different sensor tubes (solid stainless, polycarbonate, perforated stainless). If the tube gets clogged so it cannot “breathe”, the level of LN₂ inside the tube may not match the level of LN₂ in the freezer. High level alarms can occur if a lag occurs in LN₂ entering the sensor tube due to restricted air flow. Keep the sensor tube free and clear of ice and snow both at the bottom of the tube and at the top of the tube for best operation.

The control goes into low LN₂ supply alarm:

- Check the pressure in the LN₂ Supply tank. It should be approximately 22 psi. Sometimes the supply cylinder may be full of LN₂; however, there may not be enough head pressure to push the LN₂. Check with your gas distributor to remedy this problem.
- Check the distance of the freezer from the supply tank and the number of items connected into the supply line. The distance and the location of the freezer in the supply line will affect the pressure and the fill time.

The control indicates an open sensor:

- **Check to make sure that the sensor is plugged into the back of the control.**
- **A thermistor may be broken. Change out the sensor assembly.**

The control is filling in short frequent fills:

- **Turbulence will cause this problem. The level goes up to the Stop Fill sensor which will close the valve. The valve closing stops the flow of LN₂ allowing the liquid to settle, which drops the level below the Start Fill sensor starting the flow of LN₂ and causing turbulence. The cycle continues.**

Temperature

General

- Check the thermocouple to make sure that it is plugged into the back of the control. + on the plug should be connected into + on the blue plug on the board.
- Check the temperature displayed by the control when the thermocouple is dipped into ice water and into LN₂. If it is correct at these two points then it will be correct for all temperatures along the temperature curve.

Specific Problems

- The control does not read the correct temperature at one of the reference points of ice water and LN₂.
 - Re-calibrate the control

The control is indicating that the thermocouple is Open.

- Look for damage to the thermocouple wire. Replace if necessary.

Wild fluctuations in temperature readings.

- Check to make sure the shrink tubing on the tip of the thermocouple is intact and that the tip is not causing a short circuit with another piece of metal.

Thermocouple readings change very, very slowly.

- Check to make sure that the tip of the thermocouple is not insulated with tape if it was taped to the sensor assembly for level.

The temperature seems to be reading warm.

- Locate the thermocouple outside of the sensor tube. It can be wire-tied to the outside of the tube.

Valve

General

- Check the valve to make sure that it is plugged into the control.
- Check to insure that the proper valve is installed. The Auto-Extreme uses a 24 VAC Cryogenic valve.

Specific Problems

- The valve will not turn on
 - Check all the wiring from the valve to the control
 - Check to insure the valve has been opened by the control. This can be done by examining the filling LED on the front of the control panel. If it is lit, the control has opened the valve.
 - Check to make sure the sensor assembly is plugged into the control. The control cannot automatically fill (turn the valve on) unless the sensor is plugged in.
 - Check to make sure the High Alarm sensor is not in LN₂. The valve can only be opened by pressing and holding the **START FILL** button when this sensor is in LN₂.

Appendix B: Calibration of Control and Thermocouple:

To perform a calibration, you will need to know the room temperature (ambient) and then follow the sequence of steps below. The best calibrations occur when the control has been running for at least 10 minutes allowing it to warm up.

1. Press and hold the **TEMP/MUTE** button. Two seconds later, while continuing to press the **TEMP/MUTE** button, also press and hold the **STOP FILL / TEST** button. After approximately 8 seconds. "CAL" will appear on the temperature display.

A red LED display showing the text "CAL" in a simple, blocky font.

2. Release the **TEMP/MUTE** and the **STOP FILL / TEST** button and the display will indicate an "A" followed by a number. Press the **START FILL** or **STOP FILL / TEST** buttons to raise or lower the ambient temperature to the correct value as indicated by a thermometer in the room. Press the **TEMP/MUTE** button to lock in the value.

A red LED display showing the text "A24" in a simple, blocky font.

3. "ICE" will now be displayed. Dip the thermocouple in ice water and wait for five minutes while the temperature reaches equilibrium. As this occurs the "ICE" message will flash as will the green "Normal" LED. As the readings settle, the display of "ICE" and the Normal LED will flash less frequently. When the Normal LED stays solidly lit, press the **TEMP/MUTE** button to lock in the value.

A red LED display showing the text "ICE" in a simple, blocky font.

4. "LN₂" will now be displayed. Dip the thermocouple in LN₂ and wait for a couple of minutes while the temperature reaches equilibrium. As this occurs the "LN₂" message will flash as will the green "Normal" LED. As the readings settle, the display of "LN₂" and the Normal LED will flash less frequently. When this occurs press the **TEMP/MUTE** button to lock in the value.

A red LED display showing the text "LN2" in a simple, blocky font.

The temperature has now been calibrated. If the user wants to abort the calibration in the middle of the process, simply unplug the Auto-Extreme and no calibration data will be saved. Also, the control checks the calibration data and can perform the following functions:

1. Switches the ice water calibration data and the LN₂ calibration data if the control is accidentally calibrated with the reference points reversed.
2. Indicates "bAd" if the calibration data is entered before it reaches a suitable temperature stability point or if the calibration data is inconsistent with known values.

A red LED display showing the text "bAd" in a simple, blocky font.