CAUTION - SAFETY FIRST!

- REVIEW AND UNDERSTAND ALL SAFETY PROCEDURES IN THE “HANDLE WITH CARE” BOOKLET FORM BEFORE ATTEMPTING TO INSTALL, OPERATE OR PERFORM MAINTENANCE ON THIS CRYOSTORAGE SYSTEM.

- 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.

- BEFORE ATTEMPTING TO OPERATE THIS EQUIPMENT WITH ANY WORTHINGTON INDUSTRIES APPROVED ELECTRONIC CONTROLLER, YOU MUST READ THE SEPARATE OPERATING AND SAFETY MANUAL PROVIDED WITH THAT CONTROLLER.
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Laboratory supplied via a microbulk liquid supply source.

10K, 24K and 38K Series CryoStorage Systems

Typical rack retrieval.
Nitrogen is an inert, colorless, odorless, and tasteless gas making up four-fifths of the air you breathe – and can be **hazardous**. Air is roughly one-fifth oxygen. Liquid nitrogen is at a temperature of -196°C (-320°F) under normal atmospheric pressure.

### Extreme Cold - Cover Eyes and Exposed Skin
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 that it won’t splash or spill. Protect your eyes and cover the skin where the possibility of contact with the liquid, cold pipes and cold 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 is a colorless, odorless, and tasteless gas that cannot be detected by the human senses and will be inhaled normally as if it were air. Without adequate ventilation, the expanding nitrogen will displace the normal air resulting in asphyxiation or death.

### Liquid Nitrogen System
The liquid nitrogen supply pressure at the inlet to the refrigerator should be in the range of 10 psig (0.7 bar/69 kPa) to 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 refrigerator, which can generate false signals to the liquid level controller causing the refrigerator to under-fill. 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 and solenoid valves. Trapped liquefied gas will expand rapidly 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.

For more detailed information concerning safety precautions and safe practices to be observed when handling cryogenic liquids consult CGA pamphlet P-12 “Handling Cryogenic Liquids” available from the Compressed Gas Association, www.cганет.com.

### Dispose of Waste Liquid Nitrogen Safely
Dispose of waste liquid nitrogen out-of-doors where its cold temperature cannot damage floors or driveways and where it will evaporate rapidly. An outdoor pit filled with clean sand or gravel will evaporate liquid nitrogen safely and quickly.
This state-of-the-art Cryogenic System can be used in either liquid or vapor phase. Units are supplied with Worthington Industries approved controllers. If other liquid level controllers are used, please contact Worthington Industries before putting the refrigerator into service.

Worthington Industries K SERIES 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 K SERIES style refrigerator covered by this publication is designed for, but not limited to, the laboratory environment.

The standard model is equipped with a Worthington Industries approved electronic liquid level controller that will monitor and control the supply of liquid nitrogen to the unit. Make sure to read the operating and safety instructions provided with the controller you have selected to use with your K SERIES unit. The addition of a liquid nitrogen supply and inventory control racks for systematic retrieval of stored product completes the total K SERIES Cryostorage System.
K SERIES Cryostorage Specifications

Liquid nitrogen at atmospheric pressure weighs 1.78 lbs./liters (0.8 kg/liter). All Worthington Industries Cryostorage systems are designed to support the full weight of liquid nitrogen and a complete stainless steel or aluminium inventory control system with boxes and specimens.

(1) Evaporation rate and static holding time are nominal. Actual rate may be affected by the nature of the contents, atmospheric conditions, container history, and manufacturing tolerances.

(2) Working Time is an arbitrary, reference-only value to estimate container performance under the actual operating conditions.

(3) Maximum required clearance (with lid open) for the 10K is 69.0 (1753 mm); 24K is 76.0 in. (1930 mm). Depth with lid open for 10K is 34.0 (864 mm); 24K is 48.5 (1232 mm).

(4) Maximum depth 55.0 in. (1397 mm). Maximum height 90.0 in. (2286 mm) with lid open.

(5) Temperature Gradient Suppression System reduces internal diameter by approx. 1/4 in. (6.4 mm). Not included with 10K. When using the 10K in vapor-phase applications, Worthington Industries strongly recommends the use of an aluminum inventory control system.

(6) 2.0 ml vial size: 12.5 mm O.D. internal thread

(7) The 10K/24K/38K containers utilize both the 5 in. x 5 in. (127 mm x 127 mm) 100/81 cell box and the 3 in. x 3 in. (76 mm x 76 mm) 25 cell box.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>10K</th>
<th>24K</th>
<th>38K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Holding Days</td>
<td>33</td>
<td>52</td>
<td>74</td>
</tr>
<tr>
<td>Working Time days</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Evaporation Rate liters/days</td>
<td>5.0</td>
<td>7.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Liquid Nitrogen Capacity liters</td>
<td>165</td>
<td>365</td>
<td>590</td>
</tr>
<tr>
<td>Weight Empty lbs.</td>
<td>245</td>
<td>405</td>
<td>565</td>
</tr>
<tr>
<td></td>
<td>kg.</td>
<td>111</td>
<td>184</td>
</tr>
<tr>
<td>Weight Full lbs.</td>
<td>537</td>
<td>1046</td>
<td>1616</td>
</tr>
<tr>
<td></td>
<td>kg.</td>
<td>243</td>
<td>474</td>
</tr>
<tr>
<td>Neck Diameter in.</td>
<td>21.0</td>
<td>31.0</td>
<td>39.0</td>
</tr>
<tr>
<td></td>
<td>mm.</td>
<td>533</td>
<td>787</td>
</tr>
<tr>
<td>Overall Height in.</td>
<td>44.0</td>
<td>44.0</td>
<td>49.0</td>
</tr>
<tr>
<td></td>
<td>mm.</td>
<td>111.8</td>
<td>111.8</td>
</tr>
<tr>
<td>Overall Dimensions in.</td>
<td>23.1x30.5</td>
<td>34.0x38.5</td>
<td>42.0</td>
</tr>
<tr>
<td></td>
<td>mm.</td>
<td>587x775</td>
<td>864x965</td>
</tr>
<tr>
<td>Usable Height - Internal in.</td>
<td>29.0</td>
<td>29.0</td>
<td>29.0</td>
</tr>
<tr>
<td></td>
<td>mm.</td>
<td>737</td>
<td>737</td>
</tr>
<tr>
<td>Internal Diameter in.</td>
<td>21.0</td>
<td>31.0</td>
<td>39.0</td>
</tr>
<tr>
<td></td>
<td>mm.</td>
<td>533</td>
<td>787</td>
</tr>
<tr>
<td>Capacity</td>
<td>10K</td>
<td>24K</td>
<td>38K</td>
</tr>
<tr>
<td>2 ml Plastic Vials</td>
<td>10400</td>
<td>24050</td>
<td>38350</td>
</tr>
<tr>
<td>Number of 100/81 Cell Racks</td>
<td>7</td>
<td>17</td>
<td>28</td>
</tr>
<tr>
<td>Number of 25 Cell Racks</td>
<td>4</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Number of Shelves</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Box Size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape in.</td>
<td>Square 5x5 (7)</td>
<td>Square 3x3 (7)</td>
<td></td>
</tr>
<tr>
<td>mm.</td>
<td>127x127</td>
<td>76x76</td>
<td></td>
</tr>
<tr>
<td>Vials per box</td>
<td>100</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>0.50cc straws, 10 per goblet, 2-13mm goblets per can.</td>
<td>44,000</td>
<td>59,400</td>
<td>114,000</td>
</tr>
<tr>
<td>Roller Base</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Bag 50 ml (7 Level Rack)</td>
<td>343</td>
<td>805</td>
<td>1407</td>
</tr>
<tr>
<td>Bag 250 ml (5 Level Rack)</td>
<td>235</td>
<td>535</td>
<td>870</td>
</tr>
<tr>
<td>Bag 500 ml (5 Level Rack)</td>
<td>185</td>
<td>475</td>
<td>680</td>
</tr>
</tbody>
</table>
Installation

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 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 Theodore, AL.

**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 brokers should also be notified.

In all cases, Worthington Industries should be notified to 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 receipt of shipment.

Freight Damage Procedures
Any freight damage claims are your responsibility. Cryostorage Systems are delivered to your carrier from Worthington Industries’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 might affect serviceability.

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 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:

A. System model and serial number, and controller model and serial number, if available.
B. User’s name, company, address, phone number, and email address
C. Malfunction symptoms or damage
D. Picture of damage or issue

K SERIES Cryostorage System
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 refrigerators returned to Worthington Industries must be clean and sterile before return. See page 13 for cleaning instructions.

**Liquid Nitrogen Supply Connection**

The package included with the refrigerator includes a strainer. Ensure the strainer’s arrow is oriented with the flow of the liquid. The liquid fill hose from a low pressure source of liquid nitrogen must be connected to the inlet through this fitting. 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 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 refrigerator, which can generate false signals to the liquid level controller causing the refrigerator to under-fill.** 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 reseat 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) (see warning). It is recommended to have the freezer relief valve connected to a vent line that exhausts to the outside atmosphere.**

**Electrical -** The liquid level controllers used with these refrigerators operate from 12 VDC. The external transformer is a 100/240 VAC universal power supply. Disconnect the electrical power cord from the outlet before attempting any service.

**Power Supply Connection -** Connect the power supply to the K SERIES Cryostorage System and then plug the power supply into a surge-protected 100/240 VAC outlet.

**Operation**

These instructions are for operators experienced with cryogenic equipment. Before operating the system, become familiar with the safety precautions in this K SERIES manual and in the operating manual for the controller model you are using with your K SERIES unit. 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 K SERIES Cryostorage System comes preset for vapor phase storage from the factory. 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 22 psig (1.5 bar/152 kPa)

---

**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.

**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).
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.

**Operating Parameters**

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

**Liquid Phase Storage**

Liquid phase storage is normally utilized when liquid nitrogen temperatures are required to maintain stored product viability and the storage medium is adequate for storage in liquid nitrogen. To reconfigure the system’s setting for liquid phase, review the operating instructions for the specific controller you have selected to use with your K SERIES unit.

**Thermocouple Positioning**

The thermocouple is a separate sensor used to monitor and/or control the temperature within the refrigerator. The factory-supplied thermocouple in the K SERIES Cryostorage Systems is positioned to monitor the temperature at the top of the inventory control system.

**Adding an Inventory Control System (ICS)**

The purpose of the inventory control system is to bring order to the storage of many small samples, and to allow direct retrieval of the particular sample you need at any time. It is important to note that when you lift an ICS rack from the refrigerator it is being moved to 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 Worthington Industries distributor to keep your system as efficient as possible.

Always wear gloves when handling ICS racks or stored product, as they are very cold. Read all of the precautions in the Safety section of these instructions and in the Worthington Industries publication “Handle With Care” for more detail on handling product stored in liquid nitrogen.

When removing ICS racks to retrieve product, protect the labels, non-metallic, 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.

Do not let ice or debris collect in the bottom of the freezer. Schedule periodic clean out if racks no longer stand upright.
Inventory Control System Layouts (K SERIES Cryostorage System)

2 ml vial storage – ask about other Box types

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Racks 13 x 2 x 100 R23K-8C35</th>
<th>Racks 13 x 2 x 25 R10K-9C44</th>
<th>Boxes-100 N-374187-92 (Case of 24 Polycarbonate)</th>
<th>Boxes-25 N-374180 (Case of 36 Polycarbonate)</th>
<th>Vial Capacity Max. Allowable</th>
</tr>
</thead>
<tbody>
<tr>
<td>10K</td>
<td>7</td>
<td>4</td>
<td>91</td>
<td>52</td>
<td>10,400*</td>
</tr>
<tr>
<td>24K</td>
<td>17</td>
<td>6</td>
<td>221</td>
<td>78</td>
<td>24,050</td>
</tr>
<tr>
<td>38K</td>
<td>28</td>
<td>6</td>
<td>364</td>
<td>78</td>
<td>38,350</td>
</tr>
</tbody>
</table>

*without temperature gradient suppressor

Figure: Vial Storage in Boxes on Racks

NOTE: Racks are not square. Orientation is important.
Rack Arrangements

Figure 6.0 Rack Arrangements for 50 ml Cassettes

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Capacity</th>
<th>Frames</th>
<th>Cassettes</th>
</tr>
</thead>
<tbody>
<tr>
<td>10K</td>
<td>343</td>
<td>49</td>
<td>343</td>
</tr>
<tr>
<td>24K</td>
<td>805</td>
<td>115</td>
<td>805</td>
</tr>
<tr>
<td>38K</td>
<td>1407</td>
<td>201</td>
<td>1407</td>
</tr>
</tbody>
</table>

*All units utilize a 7-level rack configuration.*
### Part Number | Capacity | Frames | Cassettes
---|---|---|---
10K | 235 | 47 | 235
24K | 535 | 107 | 535
38K | 870 | 174 | 870

*All units utilize a 5-level rack configuration.*
Rack Arrangements

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Capacity</th>
<th>Frames</th>
<th>Cassettes</th>
</tr>
</thead>
<tbody>
<tr>
<td>10K</td>
<td>185</td>
<td>37</td>
<td>185</td>
</tr>
<tr>
<td>24K</td>
<td>475</td>
<td>95</td>
<td>475</td>
</tr>
<tr>
<td>38K</td>
<td>680</td>
<td>136</td>
<td>680</td>
</tr>
</tbody>
</table>

Figure 8.0 Rack Arrangement for 500 ml Cassettes

*All units utilize a 5-level rack configuration.*
**Strainer Cleaning Instructions**

The container will not fill properly if the strainer is clogged with ice or dirt. To clean the strainer, first close the liquid nitrogen supply valve to the refrigerator. Vent the fill line of all pressure. Remove and warm the strainer to ambient temperature. Purge the strainer from both directions with dry nitrogen gas or dry oil-free air. Rinse the strainer with alcohol and purge it again with dry nitrogen gas or dry oil-free air to clear contaminants. If the cleaning process doesn’t clear the blockage, replace with a new strainer (P/N 367326) in the correct orientation.

**Defrosting Your K SERIES Cryostorage System**

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

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 activation of the Low Level Alarm. In addition, a fill line blockage may cause the Low LN\textsubscript{2} Supply Alarm to be activated. If the fill line becomes blocked, it must be warmed until the ice blockage is cleared.

If it is determined that defrosting is necessary the following procedure must be followed. Cryogenic freezers of these types must be carefully warmed to ambient temperatures to avoid the ingress of water. As long as liquid nitrogen is present in the unit, the evaporation of the liquid nitrogen provides slightly positive gas pressure in the unit, preventing the entrance of moisture-laden air. When all of the liquid nitrogen has evaporated and the unit temperature is still below the dew point of the surrounding atmosphere, condensation will start to collect in the unit. When frost and condensation collect in the unit, damage to the level sensors may occur. If one of these units is to be taken out of service for any reason, the following steps must be performed to avoid damaging the unit.

1. Disconnect power and liquid nitrogen source.
2. Remove all stored product and inventory control system components, including the bottom platform.
3. Remove sensors.
4. A source of dry nitrogen gas must be used to purge the unit as the temperature rises to ambient. The purge gas can be installed on the sensor tube or fill tube or directly into the liquid via a tube or hose after the appropriate components have been removed. The purge gas may also simply be delivered to the unit through a bent metal tube under the lid. A flow rate of 5 to 10 SCFM (8-17 M\textsuperscript{3}/h) regulated to 5-7 psig / 0.30 - 0.50 bar is sufficient to prevent water from collecting inside the unit. This flow of purge gas will also speed the warming of the unit to ambient temperature.

**Cleaning Your Cryostorage System**

The cryogenic vessel of all K SERIES Cryostorage Systems may need to be cleaned and sterilized if the type of stored product is changed or the unit is taken out of service. **WARNING:** Never use chlorine-based disinfectants to clean a K SERIES Cryostorage System.
The vessel must be defrosted, cleaned, and sterilized regardless of the type of stored product, prior to return to Worthington Industries for repair or maintenance.

Prior to cleaning, the unit must be warmed and defrosted as described in the previous section.

To clean and sterilize your defrosted K SERIES Cryostorage System, spray the entire inner vessel surface with ample amounts of an approved & compatible disinfectant. Allow surface contact to be maintained for a minimum of five minutes. Rinse the inner vessel with water, remove all water and debris, and vacuum or 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 vacuum or towel dry excess water. Lastly, dry the inner container sensor tube and fill line using a dry nitrogen gas purge.

Normal Evaporation Rate (NER) Test

Nitrogen consumption is an accumulation of all system components and user introduced evaporation. The storage chamber is a double walled, vacuum insulated vessel and contributes to the daily consumption of liquid nitrogen. The liquid nitrogen supply vessel and transfer hose also contribute greatly to the daily consumption rate. Choosing to control the vapor temperature, combined with the liquid level and temperature specified, will affect the overall nitrogen consumption. In addition to these variables, opening the lid to retrieve product, and adding new product into the storage chamber will play a role in the accumulative liquid nitrogen consumption.

If the nitrogen consumption of your Cryostorage System seems excessive, it may be appropriate to perform an estimated Normal Evaporation Rate (NER) test on the Cryostorage chamber. 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 measuring rod.
3. Close and lock the lid of the K SERIES Cryostorage System for forty-eight (48) hours.
4. Open the K SERIES Cryostorage System and measure the liquid nitrogen level. Typically, liquid nitrogen levels will drop approximately 1” (25mm) per day. If your measurement indicates a drop in excess of 2” (51mm) per day, please contact your Worthington Industries distributor or Worthington Industries for further information. Please have your serial number, this manual and service history available.

Symptoms

The key to troubleshooting your K SERIES Cryostorage System is to determine which component in the system is the source of the problem. Utilizing this manual along with your controller’s manual, determine if the problem is occurring in any of the following sub-systems: Supply Vessel, Transfer Line, Power Source, Temperature, Level Sensing, Security, Lid Switch, Solenoid Valve, Control Display, Alarm System, Communications. 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.
A complete list of Replacement Parts and Accessories for the K SERIES is available by calling Worthington Industries Customer Care:

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

**REFRIGERATOR 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 refrigerator service and maintenance history.

End User Company Name_________________________ LOG NO_________________________
Service Contract/Company Name__________________________________________________
Service Contract Phone Number/Fax________________________________________________
K Series Model/Serial Number____________________________________________________
Controller Serial Number________________________________________________________
Controller Version Number_______________________________________________________
In-service Date_______________________________________________________________

**Describe Conditions – Actual**

Liquid Level – via Dipstick ____________________________
Level Sensor Type _____ FG _____ 8T _____ 4T _____
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 setpoint @__________ degrees

Worthington Industries Technical Services
Phone: US Toll Free: 844-273-7517  Global: +1 614-438-7968 / +43 7485 606 286
Email: techservices@worthingtonindustries.com

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

Date:__________________________
Date:__________________________
Date:__________________________
Date:__________________________
Date:__________________________
Date:__________________________

NOTE: All Worthington Industries Cryostorage Systems must be cleaned and sterilized prior to return to Worthington Industries for repair or maintenance and must be accompanied by a written statement to this effect. Any K SERIES-Service 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.