ULTRALOW TEMPERATURE FREEZERS

A GUIDE TO PROPER USE AND PREVENTIVE MAINTENANCE

NuAire, Inc. | 2100 Fernbrook Lane | Plymouth, MN 55447 | U.S.A. | 763.553.1270 | WWW.NUAIRE.COM

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Overview

Ultralow temperature (ULT) freezers provide the extremely cold environment needed to preserve biological samples such as cancer cells, stem cells, cord blood, T-cells, or organ/tissue cells, during long-term storage in research laboratories. These cells are valuable and difficult to replace if damaged by a failure to maintain proper temperature. While ULT freezers are capable of operating in the range of -86 to -40 degrees Celsius, the set point is typically -80 or -70 degrees Celsius,[1] depending on the type of cell.

Temperature Uniformity

Uniform temperature from top to bottom and back to front of the unit, is critical to maintain cell viability during multi-year periods of storage. Both the stability and reliability of a ULT freezer depend on proper use and preventive maintenance (PM). The following criteria will help a lab managers train users and maintenance staff on protocols to keep a ULT freezer running optimally and reliably. These recommended practices may also increase the longevity of your unit and your return on research investment.

Temperature Sensor Location

Setup

Proper use and maintenance begins immediately following delivery of a ULT. Carefully select the location of the unit to avoid environmental conditions which can adversely effect the performance of the ULT.

- Choose a location away from air currents, sources of heat, and HVAC vents. Environmental stability aids in minimizing frost and ice buildup.
- Maintain an ambient temperature of 5 to 35 degrees Celsius (41 to 95 degrees Fahrenheit) and 80 percent humidity. Temperatures outside this range may negatively affect the performance of your unit.
- Avoid a location in direct sunlight.
- Provide appropriate power. A consistent source of proper voltage is key to longevity of the compressor. Low voltage may cause the compressor to overheat and prematurely fail. If your location has low-voltage power, a voltage booster can be installed to achieve the correct incoming voltage.

To reduce temperature fluctuations, users must minimize the length of time the unit's door is open. This means quick door openings, quick interaction with the sample, and quick door closings.

Eight Critical Preventive Maintenance Steps for ULT Freezers

A preventive maintenance (PM) checklist is an important tool to aid in protecting both research and equipment. Typically, the lab manager assigns PM tasks to personnel such as lab users, building maintenance employees, or a contracted service. For technical issues beyond PM, a freezer technician is consulted.

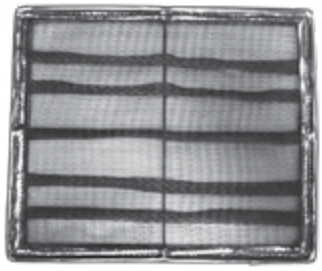
Considerations for Training

When developing a training program, answer the following questions for each of the eight steps that follow the questions:

- What task needs to be done?
- Who is assigned to complete the task?
- Who is trained or needs to be trained?
- What does the assigned person need to know to complete the task from start to finish?
- What is the frequency of the task?
- How is the work documented?
- What types of concerns should be escalated (e.g., loud noise, door won't shut, alarm sounded)?
- What is the process for escalation of a concern?
- How will the lab manager ensure the work has been done at the recommended frequency?

1. Clean the condenser filter (once every one to three months)

The condenser is protected by a filter **[A]** which removes dust and other particulate from the air passing over the condenser coils. Without this filter, a larger amount of debris will accumulate on the coil surfaces, reducing efficiency, increasing power consumption, and reducing condenser longevity.



The filter must be inspected monthly and cleaned once every one to three months. The frequency of filter changes depends on the amount of particulate in the surrounding air. Lower air quality requires more frequent filter cleaning.

The filter is located on the lower front of the freezer, and is easily accessed for inspection and cleaning. The vent cover **[B]** is attached magnetically and can be removed without tools.

If the filter surface has accumulated a significant amount of dust and debris, it may be cleaned with running water and wiping away debris. The filter is washable and reusable, so replacement filters are not necessary.

2. Clean the condenser coil (at least once per year)

Dust and dirt buildup on the condenser coil surfaces **[C]** reduces the efficiency of the condenser, making it more difficult for the freezer to maintain the set operating temperature. To avoid this, clean the condenser assembly at least once per year (depending upon the environmental conditions). Caution: ULT coils are fragile and may be damaged by direct contact. A vacuum can be used to remove debris.

3. Clean the door gaskets (minimum once per month) and scrape gaskets (once per week)

Minimizing frost buildup on the gaskets is important. Gaskets wear out when frost builds up, the door seal loosens, and warm air leaks in. The freezer then must work harder to maintain cooling, and the ice buildup reduces the life of gaskets.

A common mistake occurs when users force the door to shut, instead of cleaning off the ice. This eventually tears the gaskets, leading to even more frost buildup and ice problems because of the leaking. Eventually, the door latch can rip off completely.

To clean the gaskets, first check the door gaskets around the exterior door for punctures or tears. Next, check for leaks. Leaks are indicated by a streak of frost that forms at the point of gasket failure. Use a cloth or scraper to remove any frost buildup from the gasket and door(s). If dirt or excessive frost buildup prevents the door from closing properly, increase the frequency of cleaning.

To prevent gasket damage, be sure to use the scraper provided with your equipment to clean off any frost or ice once per week. Don't wait for a large amount of buildup.

4. Defrost the chamber

Even with proper maintenance, the freezer will need to be defrosted when ice starts to build up inside. After relocating samples to another freezer (follow documented procedures for this move), consider the following process. Disconnect the freezer from power, open both inner and outer doors, and use a fan to direct room-temperature air into the chamber. The fan should hasten melting so that frost and ice can be removed in larger pieces.

An alternative method is to power down the freezer (after relocating samples) and allow the doors to remain open overnight. Be certain to place enough absorbent material, such as towels, to prevent water from pooling on the floor, or entering the lower compartment which houses the compressor and other electrically powered controls.

Once the unit is defrosted and at ambient temperature, clean the inside of the unit, including chamber walls and shelves, with non-chloride detergent.

5. Backup battery replacement (once per two and a half years)

The temperature gauge and alarm controls on a ULT freezer require a redundant source of power. Should the main power source fail, a battery in the unit powers the temperature gauge and alarm(s) to indicate an internal temperature above the set operating range.

The backup battery must be replaced by a certified technician every two and a half years. Most modern ULT freezers have a means to alert users of the need to replace the battery. In addition, remaining battery capacity can often be checked by entering the proper control codes. A qualified technician can provide laboratory service personnel with a procedure to check battery life.

Some ULT freezers have a factory-installed CO_2 or LN_2 kit as a backup to keep the chamber cold during a power outage. The kits can also be purchased separately as an add-on.

6. Removal of frost and ice buildup (once per week)

Frost and ice will build up in the inner chamber as ULT freezer usage increases. It will be necessary to periodically scrape frost and ice off doors and the inner chamber.

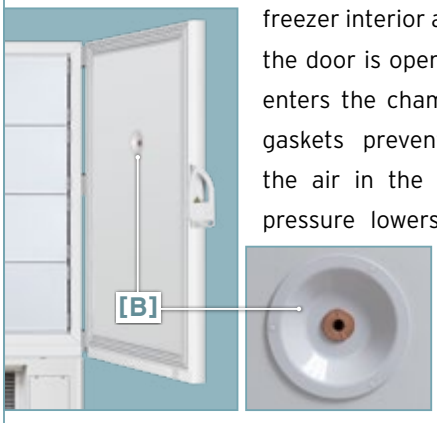
To minimize ice buildup inside of the freezer:

- Locate the freezer away from drafts and air flow from heating/cooling vents
- Minimize door openings
- Minimize the length of time door is open
- Ensure the door latch secures the door tightly after closing
- Periodically inspect door handles and latches to ensure proper closure and seal.
  If repeated attempts to forcibly close and latch a door have been made when too much ice or frost buildup is present, door latches may have been bent or broken. A latch failure may lead to costly loss of samples, and/or repairs.

A common user error is letting the ice or frost build up on the inside to the point where the freezer has very little room for storage. A manual defrost is necessary at this point. The most effective way to avoid problems with frost or ice buildup is to scrape the inner chambers weekly.

7. Monitor the vacuum relief port (once per use)

The vacuum relief port is a common feature on a ULT freezer. The purpose is to release the partial vacuum created in the freezer interior after the door is closed. When the door is opened, ambient temperature air enters the chamber. Upon closing, the door gaskets prevent pressure equalization as the air in the chamber cools and interior pressure lowers relative to the surrounding environment. This pressure differential may make it difficult to open the door for several minutes.



The vacuum relief port enables users to quickly equalize the internal and external pressure so the door can be opened immediately.

Ice can build up on the vacuum relief port over time. A visual inspection should be completed every time the freezer door is opened. If necessary, ice buildup must be scraped away. The port should be cleaned/scraped on the same schedule as gaskets. The more the ULT freezer is used, the more frequently the ice will build up.

Users should also be made aware of the fragility of the vacuum relief port, which is essentially a twist-off plug. This small piece of plastic can easily be broken if the unit is pushed into a wall. Newer ULTs will feature an internal relief port, typically found behind the main door.

8. Calibration service (once per year)

The purpose of calibration is to ensure the temperature gauge on the ULT freezer is accurate. This service is recommended once per year. A qualified service technician performs the test by placing an NIST-approved probe in the geometric center of the chamber and verifying the temperature displayed on the unit matches that indicated by the internal temperature probe.

Whether you are installing a new ULT freezer or reviewing your usage protocols and maintenance program, the criteria above can guide the development of your training program. With proper usage and routine preventive maintenance, you can keep your freezer running optimally, protect valuable research samples, and achieve high research productivity over an extended life.

ULT freezers generally have a service life of 12 to 15 years. The service life of a ULT freezer may be increased by following the recommendations in this document for setup, operation, and preventative maintenance.

For a repair beyond the capabilities of users and maintenance personnel, a freezer technician should be consulted. To find a freezer technician in your area, visit https://www.nuaire.com/support/find-a-service-technician.

Sources

1. Key Considerations When Purchasing an Ultralow Temperature Freezer, NuAire

Reference

NuAire Technical Bulletin: *ULT Freezer Preventive Maintenance*

About NuAire

NuAire offers our customers a safer choice solution by minimizing human error and maximizing productivity through unique, quality, and innovative laboratory products with responsive, knowledgeable support throughout the life of our products. NuAire is a manufacturer of Biosafety Cabinets, Laminar Airflow Workstations, Containment Ventilated Enclosures, Animal Transfer Stations, CO_2 Incubators, Centrifuges, Ultralow Freezers, Polypropylene Fume Hoods and Casework.

About The Author

Adam Christensen is a family man first and attempts to be a service technician second. Born and raised in the heart of MN with a fishing pole in hand. Trained by experts at South Central College in Mankato, MN for HVAC, he ended up putting time and effort into the Biological industry at Nuaire. Learning about Biosafety cabinets, incubators, centrifuges and eventually taking hold of the Ultralow Freezer responsibilities in the service department. Adam has now become a customer service specialist in the Biological and Ultralow industry.

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