NIH Freezer Challenge Guide

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Summary

Freezers and refrigerators are essential to the NIH, providing cold storage preservation for everything from samples, enzymes and vaccines to reagents and pharmaceuticals. Improving freezer and refrigerator reliability help to prevent failures, which protects research and materials. Additionally, mechanical freezers and refrigerators consume a significant amount of energy, which results in high energy costs and greenhouse gas emissions. Proactively managing freezers and refrigerators can increase freezer reliability and reduce energy consumption, energy costs and greenhouse gas emissions. The NIH freezer policy, **NIH Manual Chapter 26101-16**, sets the requirements for freezer management at the NIH. **The NIH Freezer Challenge** goes beyond these requirements to further reduce energy consumption to further increase freezer reliability and reduce energy consumption. Labs that complete the NIH freezer challenge will be recognized in meetings, on the NIH Freezer Challenge Page, and NIH publications such as the NIH Green Zone Newsletter and the NIH Record. The NIH Freezer Challenge is modeled after the **International Freezer Challenge**. Upon completion of the NIH Freezer Challenge, the results from each lab will be combined and submitted to the International Freezer Challenge where the NIH will compete with labs around the world for recognition for reducing energy consumption. The NIH has won the international freezer challenge in multiple years. Labs that participated were recognized at an awards ceremony, on the International Freezer Challenge Site and featured in a Nature article.

Requirements

To complete the NIH Freezer Challenge, by the end of the challenge labs shall meet the three minimum requirements detailed below and complete at least one of the challenge initiatives shown in the following section.

Minimum Requirements

These minimum requirements have been taken from **NIH Manual Chapter 26101-16** and are required for all Ultra-Low Temperature (ULT) freezers at the NIH.

1. New ULT freezers must be Energy Star Certified.
2. All ULT freezers must be listed in the NIH Property Database.
3. ULT freezers must have a Preventative Maintenance every six months.

1. **New ULT freezers must be Energy Star Certified.**

Freezer manufacturers and service providers estimate the useful life of a mechanical ULT freezer to be 12 to 15 years. If your lab has a freezer beyond or near the end of its useful life, consider replacing the freezer with a new unit. If you do choose to replace a freezer, **NIH Manual Chapter 26101-16** requires that all new ULT freezers purchased at the NIH must be Energy Star Certified. New Energy Star Certified ULT Freezers can consume half the amount of energy as an older unmaintained ULT freezer. ULT freezers purchased during the challenge must be Energy Star Certified. Energy Star Certified freezers can be found in the **laboratory freezer category of EPA's Energy Star Certified Products**.

2. **All ULT freezers must be listed in the NIH Property Database.**

To maintain an accurate inventory, all ULT freezers at the NIH must be listed in the NIH Business System (NBS) Property Database. Contact your property officer to ensure that the lab's freezer inventory is up to date.

3. **ULT freezers must have a Preventative Maintenance every six months.**

Conducting regular **Preventative Maintenance** (PM) on ULT freezers increases freezer reliability and reduces energy consumption. **NIH Manual Chapter 26101-16** requires that all ULT freezers at the NIH have a PM every six months. PMs can be completed by the lab or contracted out. PMs performed by a properly trained and equipped technician go beyond what a typical user can do. Several companies also provide lab equipment services that include PM on ULT freezers. The following link, **Freezer Maintenance**, has a video and checklist for conducting a user level preventative maintenance. The NIH Division of Environmental Protection (DEP) can provide labs with assistance in conducting a user level preventative maintenance. Contact **DEP** for further information.

Challenge Initiatives

To complete The NIH Freezer Challenge, labs must complete at least one of the challenge initiatives detailed below by the end of the challenge.

1. **Discard samples that are no longer needed**
2. **Change the temperature setting of ULT freezers to -70°C**
3. **Maintain an electronic sample inventory**
4. **Conduct a complete freezer defrost**
5. **Barcode samples**
6. **High density sample storage boxes**
7. **Share freezer space with other researchers**
8. **Retire unnecessary freezers**
9. **Store samples at appropriate temperatures**
10. **Try/Adopt room-temperature sample storage**

1. **Discard samples that are no longer needed**

Labs are encouraged to review their sample inventory and discard samples that are no longer needed. This helps keep collections organized and frees up cold storage space for new samples. When discarding samples, keep track of how many samples of each size are being discarded and the temperature of the freezer or refrigerator they are being discarded from. For example, our lab disposed of approximately 5,000 1.5 ml samples from -20°C freezers and 500 5 ml samples from refrigerators.

2. **Change the temperature setting of ULT freezers to -70°C**

Changing the temperature setting of an ULT freezer from -80°C to -70°C reduces the workload on the compressor. This increases freezer reliability and reduces energy consumption by up to 40%. Many labs are now storing samples at -70°C or warmer. The following Google Doc, **Google Doc Samples Stored at -70C**, shows labs at academic and pharmaceutical research institutions that are storing samples at -70°C or warmer. The Google Doc includes the name of the institution, lab, sample type, sample temperature

and how long the samples have been stored. Not all samples can be safely stored at -70°C. Each lab must determine the appropriate temperature to store their samples to maintain sample viability.

3. **Maintain an electronic sample inventory**

Maintaining an accurate electronic sample inventory makes it easier to manage and retrieve samples. Labs may choose to create a digital inventory using programs like Microsoft Excel or purchase a sample management program. Several companies offer software specifically designed to manage laboratory samples.

4. **Conduct a complete freezer defrost**

Freezer Operation Manuals detail how to conduct a freezer defrost and how often the freezer should be defrosted. Depending on the manufacturer, the operation manual may state to conduct a full defrost under the following conditions: once per year, when excessive frost builds up, or when the ice buildup exceeds 3/8". Freezer Operation Manuals detail how to conduct a freezer defrost, which generally consists of the following: transfer the samples to another freezer, turn off the freezer, open all of the outer doors, open all of the inner doors, let the ice completely melt, use a dry cloth to wipe up the water and moisture, turn on the freezer, replace the samples. Some freezer repair companies will provide labs with a spare freezer for temporary storage while a freezer is being defrosted.

5. **Barcode samples**

Barcoding samples enables labs to efficiently maintain sample inventories and retrieve samples.

6. **High density sample storage boxes**

Several companies offer 13x13, 169 cell, sample storage boxes for .5 ml and/or 1 ml samples. These boxes are the same size as 10x10, 100 cell, 1.5 ml sample boxes. High density sample boxes can store 69% more samples in the same amount of space. When transferring samples to high density storage boxes, keep track of how many samples of each size are being transferred.

7. **Share freezer space with other labs**

While many labs at the NIH that share freezers within their lab, it isn't as common to share freezer space with another lab. If your lab has some extra room in a freezer, offer to share with another nearby lab. Consider starting by sharing an emergency freezer that is only to be used as a backup in the event of a freezer failure. Inspections have found that in some NIH buildings, 10% of the freezers are running and being operated solely as backup freezers. We may be able to significantly reduce the number of backup freezers by sharing with a nearby lab.

8. **Retire unnecessary freezers**

By completing initiatives in this challenge, such as discarding samples and sharing freezer space, labs may now have more freezer space than required. Additionally, labs that have multiple backup freezers are encouraged to evaluate how many backup freezers are required. If a lab determines that they have an unnecessary freezer, labs are encouraged to retire their oldest freezers or freezers that are in the worst condition. Retiring unnecessary freezers is one of the most effective ways to reduce energy costs

and greenhouse gas emissions. Retiring unnecessary freezers also eliminates maintenance and repair costs. Finally, retiring freezers frees up floor space which is in very high demand at the NIH.

9. **Store samples at appropriate temperatures**

This initiative is challenging labs to evaluate their sample inventory to determine if any samples are being stored in -80°C freezers that can be safely stored in a -40°C freezer, -20°C freezer or refrigerator. When moving samples, keep track of how many samples of each size are being moved and the temperature of the freezers they are moved to. For example, our lab transferred approximately 2,000 1.5 ml samples from -80°C freezers to -20°C freezers.

10. **Try/Adopt room-temperature sample storage**

DNA, RNA and some other compounds are able to be stored at room temperature in a dried state. Several companies offer Room Temperature Sample Storage (RTSS) solutions. RTSS can be used to reduce cold storage requirements. This can be especially beneficial during sample transportation, eliminating the constraints of using dry ice for shipping. The University of Colorado Boulder has piloted room temperature storage and compiled papers on their webpage **CU Bolder RTSS**.

International Freezer Challenge

The NIH Freezer Challenge is modeled after the **International Freezer Challenge**, run by the non-profit organizations My Green Lab and the International Institutes of Sustainable Laboratories (I^2SL)**.** The International Freezer Challenge site (link above) has additional information about the freezer challenge initiatives. Upon completion of the NIH Freezer Challenge, each lab's initiatives will be combined. The total results for the NIH will be submitted to the International Freezer Challenge where the NIH will compete with other organizations to see who reduced the most energy. Additionally, each lab may submit their individual results to the International Freezer Challenge to compete in the individual lab category. **The NIH won the 2020 and 2021 International Freezer Challenge in the Government Organization and Individual Laboratory Categories!**

Resources

Any NIH lab can complete the freezer challenge. Regardless of whether the lab has a fully developed freezer management program, or the lab is just learning about freezer management practices. Here are some resources that can help.

1. Contact the NIH Division of Environmental Protection Freezer Challenge POC, **Jaroslav Sebek**, for more for more information on any of the challenge requirements and/or initiatives.

Resources (continued)

2. Use the **NIH Freezer Challenge MS Team** to connect with other challenge participants to ask questions on any of the requirements and/or challenge initiatives.

3. The EPA maintains a webpage with all the lab grade refrigerators and freezers that have received Energy Star Certification. **EPA Energy Star Certified Lab Grade Freezers**.
4. The, **International Freezer Challenge**, site has more information on the International Freezer Challenge.
5. The International Freezer Challenge resources page, **International Freezer Challenge Resources**, with additional information on many of the initiatives.
6. The University of Colorado Boulder has piloted room temperature storage and compiled papers on their webpage **CU Bolder RTSS**.