

# Guide to Freezer/Refrigerator Monitoring and Alarming

## BACKGROUND

Monitoring of cold storage is a vital requirement for many industries and applications. Biology and pharma labs can have tens of thousands of dollars of materials in cold storage that must remain cold or risk being unusable. Quality systems and federal regulations, such as 21 CFR Part 11, often require proper documentation of temperature in freezers and refrigerators. Similarly, food service and storage facilities have to keep thousand of dollars worth of food cold to ensure it doesn't spoil and to comply with federal regulations such as the Food Safety Modernization Act (FSMA). In some cases it's hard to even put a value on the samples stored in freezers. In the USA this year two separate fertility clinics experienced freezer failures, losing thousands of priceless embryos and eggs stored for people hoping to have babies. So what are your options for keeping valuable samples protected in cold storage?

## INTRODUCTION

Regardless of what specific regulations apply to your industry, a proper temperature monitoring program should be able to answer the following questions. Is my temperature monitoring device accurate? Are we paying proper attention to our cold storage - monitoring regularly and taking some action when an out of temperature condition occurs? Are we keeping sufficient records to ensure our samples remain intact? If regulations exist for our industry, are we keeping sufficient records to satisfy these regulatory requirements?

There are essentially four choices for monitoring freezer/fridge temperatures:

- Manual thermometers
- Chart recorders
- Data Loggers
- Wireless IoT devices

In this guide we will briefly describe each technique, how it's commonly used and what the advantages and disadvantages are of each technique.





## THERMOMETERS

Thermometers have been in use for hundreds of years and represent the most straightforward method for monitoring freezer and fridge temperatures. Typically a laboratory technician or other designated person visits each freezer or fridge at least twice per day and records the temperature reading from a thermometer monitoring the internal temperature. These readings are recorded in a log and can be stored for record keeping.

While it is easy and straightforward to read a thermometer and record the temperature, there are some other issues that might make this technique less desirable. The initial capital cost of a thermometer is very low, but don't ignore the cost of paying people to read and record thermometer information every single day. If you have several cold storage facilities, it could take several hours per day for someone to make all these recordings. That can translate into relatively high operating costs.

In addition, while it's possible to keep records by storing the log sheets, this technique is also the most susceptible to human error. Are all your thermometers positioned in a way that they can be easily read? Is lighting sufficient in all areas to be able to see the thermometer clearly? Manual recordings are also easy to tamper with in the case of a regulatory or liability action.

### PROS

- Continuous monitoring
- Data storage is straightforward
- Relatively simple

### CONS

- Operating cost
- No real-time alarming and notification
- Record keeping is cumbersome
- Poor granularity of data

### PROS

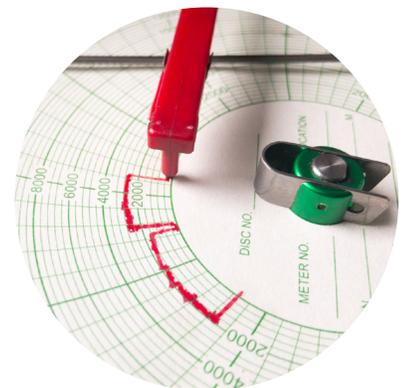
- Low capital cost
- Simple
- Well established

### CONS

- Higher labor cost
- No continuous monitoring
- Record keeping is cumbersome
- No real-time alarming
- Human error

## CHART RECORDERS

Chart recorders have been used for decades to keep a continuous record of freezer and refrigerator temperatures. They are reliable, fairly inexpensive, and easy to use. The charts can be saved and filed away to keep a comprehensive record of temperature. For these reasons chart recorders have found wide usage for monitoring cold storage.



While they are reliable and easy to use chart recorders still require someone to change out the chart paper, usually on a daily or weekly basis, and to file away the chart for compliance. If you want to get more resolution into small temperature differentials you will need to use a

bigger chart recorder. Another thing to consider is operating cost. Charts and pens cost money and need to be replaced. If you have dozens of chart recorders the cost of paper charts and replacement pens can really add up.

It can also be cumbersome to find a place to store all the used charts. The FDA requires that vaccine makers, for example, keep a log of freezer temperatures for three years. That's more than 1000 charts that must be filed away and stored for each freezer.

**👍 PROS**

- Continuous monitoring
- Data storage is straightforward
- Relatively simple

**👎 CONS**

- No remote alarming and notification
- Data typically not available in the cloud

## DATA LOGGERS

Data Loggers are devices that measure and store temperature readings electronically. They offer continuous monitoring of freezer/fridge temperatures and can alarm when temperatures are out of specification.

Data loggers are more expensive than manual thermometers, but they offer the advantages of continuous monitoring and storage of data. They can also be set up to alarm for out of range temperatures. The data saved by a data logger can typically be downloaded and stored using a USB memory device, or they can be connected to a local area network.



Data loggers store a lot of information that can be easily saved and retrieved for regulatory compliance. What data loggers typically aren't set up to do is to alarm users remotely for out of temperature conditions. They also are typically not set up to make data available in the cloud for easy access.

## WIRELESS IOT MONITORING AND ALARMING



Wireless IoT monitoring is easy to set up with no wires or connections needed. All elements are battery operated and seamlessly connect to the internet and to a personalized data portal in the cloud. The portal allows the user to monitor equipment in real time and to receive out of temperature alerts instantaneously via email or SMS alert.

This setup eliminates uncertainty caused by human error, stores data for years, continuously monitors equipment and alerts designated users for out of spec conditions. Data are securely stored in

the cloud and can be easily accessed for regulatory compliance. Users are also alerted to low battery conditions or connectivity issues, so no data gets lost.

**👍 PROS**

- Continuous monitoring
- Data is stored in the cloud
- Simple installation
- Remote alarming

**👎 CONS**

- Somewhat higher initial costs