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Best Practices for Temperature Monitoring Systems

Whether your industry is regulated and you are required to log storage temperatures or not, it is a good practice to do so. Having a continuous record of the temperatures at which your material is stored makes both practical and financial sense. How else can you be assured that what you are storing remains viable? In many cases, your customers may require that you provide them with a history of the storage temperatures as part of your service. In addition to temperature history, having a system that also provides alerts when the temperatures go out of range gives you the opportunity to act to save the material. The benefit to the alert or alarm can be significant.

While this post is tailored for Life Science applications (primarily Medical/Pharmaceutical spaces), it applies to most applications where product or material is stored in refrigerators or freezers. Temperature is recognized as the most widely measured physical parameter, and with good reason. Temperature has some effect on almost everything. In the Life Sciences area, the effects of temperature can make the difference in efficacy of vaccines and life or death of cells, embryos or tissues. Ensuring that the stored materials do not get too warm OR get too cold is vital.

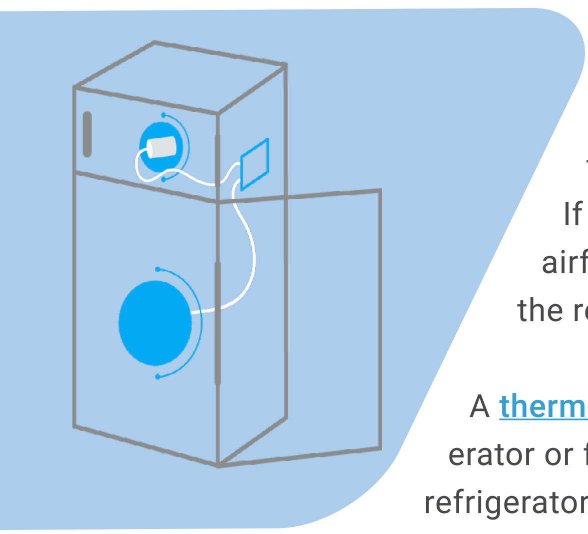
Here are some best practices to guide you through set up and use of a temperature monitoring system:

Initial Setup & Configuration

Choose a sample rate that reflects the potential for your refrigerator/freezer to change. A faster sample rate equals more data over time, but that does not necessarily mean better data. The other consideration to the sample rate is the sensitivity of your material to temperature. If you have a relatively wide range of acceptable storage temperatures, you can accept a slower sample rate. A high sensitivity typically means a faster sample rate. In most cases, a 15 or 30 minute sampling interval is appropriate.

The alarm thresholds should be set so that you have enough time to react to the condition to save the material in the event of an excursion. If your ability to react to the alarm is measured in minutes rather than hours, your alarm settings can be closer to the limits. If the time it takes you to react is some number of hours, you may want the alarm settings to be further from the hard limits. It is also important to have an action plan in the event of an alarm so that you can implement that plan before the material is damaged.

Temperature Probe Placement



The position of the probe in the storage cavity is important, as it measures the temperature at a single point in space. That point should be where it best reflects the temperatures of the material in the refrigerator or freezer. If the refrigerator cools by forced air, having the probe in the airflow will yield more fluctuations than if it is in a still area of the refrigerator.

A thermal buffer should also be considered if the door to the refrigerator or freezer is opened with any frequency. When the door to a refrigerator is opened, cold air rushes out of the bottom of the opening, and warm air enters from the top. This creates a rapid change in air temperature in the cavity. However, the thermal mass of the material you are storing does not respond as quickly.

A thermal buffer surrounds the probe sensing tip with material that will dampen the temperature swings that the probe tip experiences. This more closely mimics most materials you store as their temperature does not change as rapidly as the air surrounding them. Thermal buffers can be solid nylon cylinders, glycol in a bottle, sand, or glass beads. You should also understand how the thermal buffer in concert with the sample rate affects your measurements. If the thermal time constant of the buffer is 10 minutes, a sample rate any faster than 10 minutes will essentially be useless.

Test the Alarms

You should test the function of the alarms before you rely on them. You need to ensure that the e-mail addresses and phone numbers for text messages or voice calls are actually received. Catching a mistyped character during configuration can prevent a loss in the future.

Review the Operation of Your System

In the early stages of using a temperature monitoring system, the data should be reviewed more frequently than a system that has been in place for many years. You need to determine that the system is operating and functioning as you require. This means data is getting recorded as desired (sample rate). The data being recorded is meaningful and accurately represents what the stored material is experiencing. Do you see fluctuations in the measured temperature or is the reading unchanged no matter what is happening with the door to the refrigerator?

Create and follow a periodic review of the system and its functions. This is not a “set it and forget it” operation. Changes will happen that affect how the system is operating. Personnel changes require editing of the alarm contact lists. If the refrigerator or freezer is actively used, damage could occur to the probe wiring or the placement. By checking the data periodically, you can verify continued proper measurement and recording.

Calibration

You may be required to calibrate your temperature monitoring system. This process essentially means comparing the measurement of your probe and data logger against a known standard, frequently traceable to NIST standards or other National standards bodies. This ensures that the data is accurate.

By following these practices with your temperature monitoring system, you will gain the greatest benefits provided by an automated system and achieve the ultimate goal of meaningful data and protection against loss.