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TN_001

Introduction

Maintaining sample security is crucial for many laboratories with high-value samples often being stored at $-80\text{ }^{\circ}\text{C}$. Sample storage plays a vital, but often over-looked role in a laboratory. Storage conditions can have a significant impact on sample integrity, which in turn affects data results, reproducibility, and reliability. Unreliable storage would not only result in monetary loss, but also a significant loss in time and valuable data.

This technical note outlines a real-life scenario of Froilabo freezers in action, and their continued high performance despite several power cuts. A power outage can be catastrophic in a laboratory. Valuable or irreplaceable samples can be destroyed, and long term research ruined. In this case, four electrical shutdowns occurred in 24 hours. Despite this, Froilabo Evolution freezers were able to maintain the minimum temperature requirement for sample security, so no damage occurred.

Evolution Freezers in a Paris hospital

One hospital in Paris requires a large amount of sample storage at $-80\text{ }^{\circ}\text{C}$ and $-150\text{ }^{\circ}\text{C}$. These samples are of high value, and at present they have thirty $-86\text{ }^{\circ}\text{C}$ ultra-low temperature (ULT) freezers. The majority of these freezers are Froilabo ULT freezers.

Recently, Froilabo developed new improvements to their freezer range, maximizing product quality and performance. These $-86\text{ }^{\circ}\text{C}$ freezers are 690 L Evolution freezers.

Evolution freezers have been used three times as a backup unit to manage the relocation of important samples during the defrosting of other freezers for general maintenance. The target was to evaluate the efficiency of the Evolution units by assessing; recovery time, temperature profile, and homogeneity when compared to existing units.

An unexpected error arose on-site during these routine tests of the Evolution units. During a 24-hour period, four electrical shutdowns occurred in the building where the ULT freezers were located. This resulted in all ULT freezers on the premises losing power at four different times, for several minutes, between 10:00am and 3:00pm

Conditions

The Evolution units were installed in the same room as other $-86\text{ }^{\circ}\text{C}$ freezers, and contained temperature probes which monitored the internal temperature of the units. This temperature was continually recorded in order to assess freezer performance.

The room temperature was recorded at $21\text{ }^{\circ}\text{C}$. The temperature parameters supplied to maintain sample integrity is a maximum temperature of $-60\text{ }^{\circ}\text{C}$.

Results

Pull-down Test

A pull-down test measures how long it takes for the freezer to reach a set temperature from room temperature. For ULT freezers, this set temperature is normally between $-70\text{ }^{\circ}\text{C}$ and $-86\text{ }^{\circ}\text{C}$.

For the Evolution freezer, it takes less than 5 hours to reach $-80\text{ }^{\circ}\text{C}$ ($\pm 4\text{ }^{\circ}\text{C}$) from room temperature. As seen in the Figure 1, to reach $-60\text{ }^{\circ}\text{C}$ ($\pm 5\text{ }^{\circ}\text{C}$), it takes the Evolution unit 1.5 hours. This rapid pull-down time makes the Evolution unit the optimal solution as a backup freezer, as the freezer can be ready to use in as little as 1.5 hours.

Temperature Recovery Following Electrical Shutdown

Figure 2 and Figure 3 display how the temperature of the unit was affected following four electrical shutdowns. The Evolution unit was able to maintain extremely low temperatures (maximum temperature was $-77.97\text{ }^{\circ}\text{C}$) despite the electrical shutdowns. This highlights the excellent performance for maximum protection of high value samples.

Temperature Homogeneity

During a 24-hour period, mapping was performed using nine probes within the Evolution unit to measure the temperature homogeneity. At $-80\text{ }^{\circ}\text{C}$, the homogeneity of the unit was $\pm 4\text{ }^{\circ}\text{C}$. This excellent homogeneity ensures sample stability, excellent recovery, and reliable analysis results.

Figure 4 displays the temperature homogeneity in 15-minute increments over a 3-hour period. Figure 5 shows the temperature homogeneity over a period of 14 days, with one temperature reading every 24 hours.

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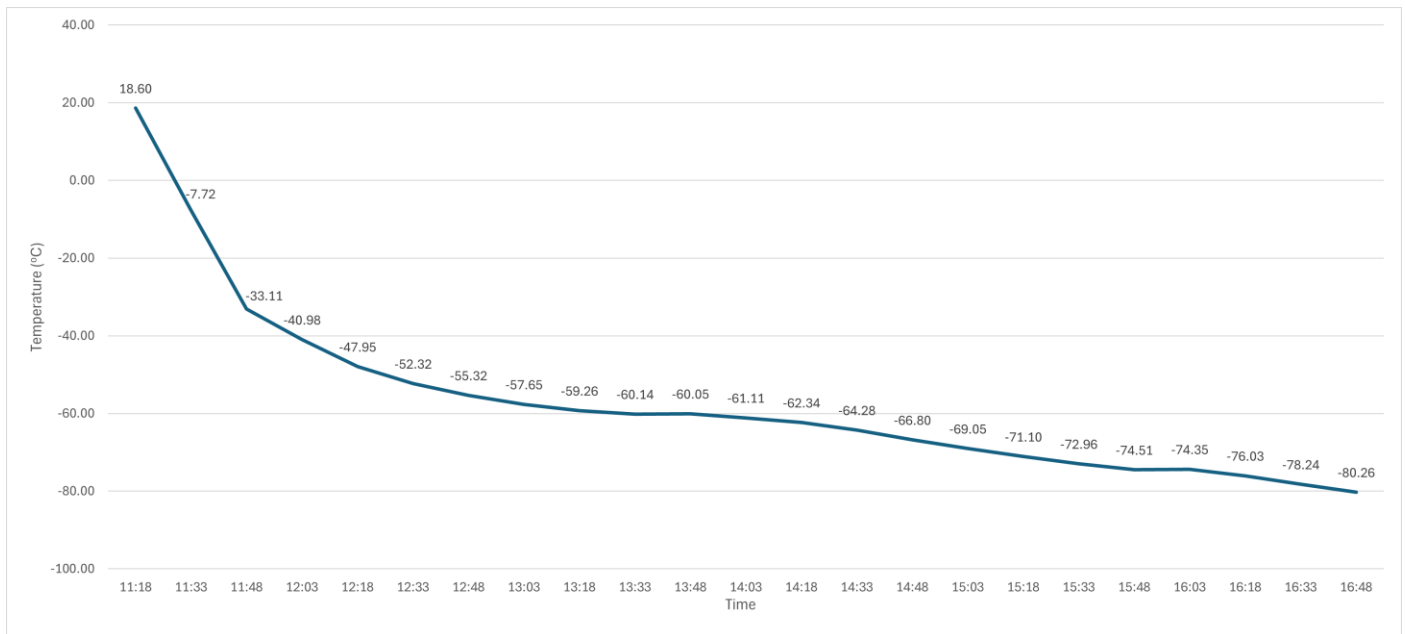


Figure 1: Pull down time. Temperature profile recorded when Evolution turned on. Evolution unit was empty. Set temperature is -80°C.

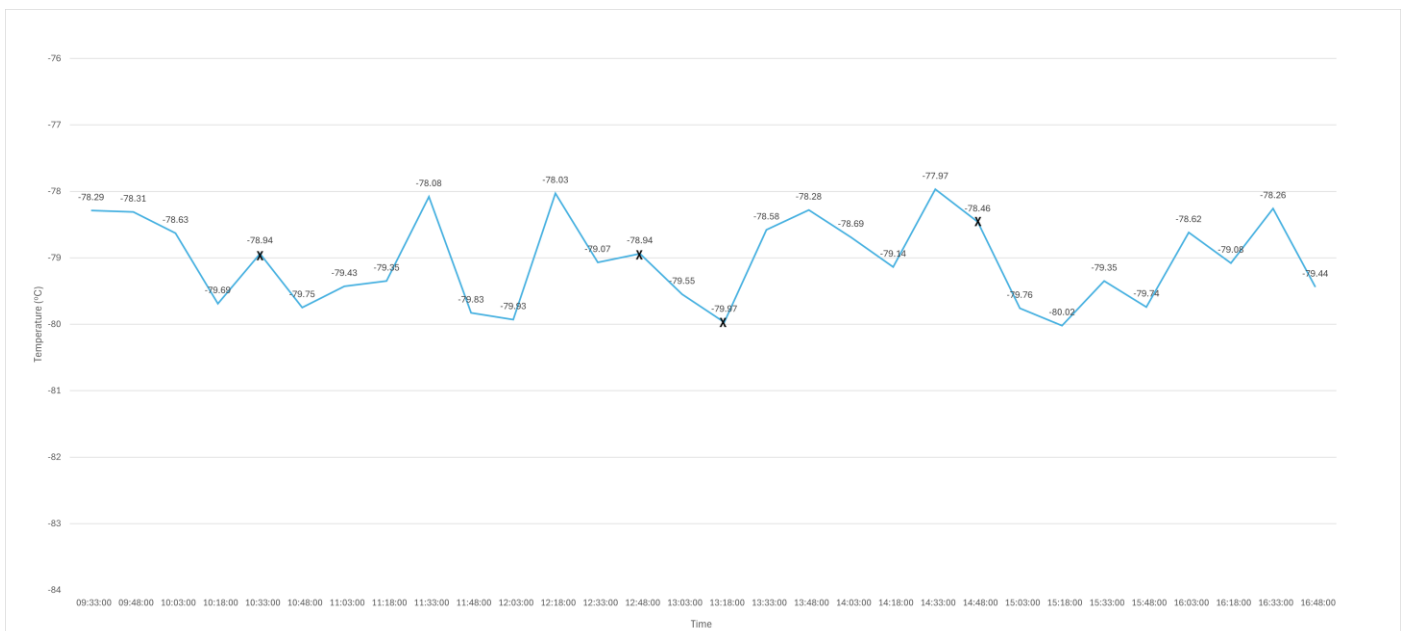


Figure 2: Temperature profile following four electrical shutdowns. Temperature profile recorded for BM Evolution 690L, -86°C model. Set temperature is -80°C. The black crosses refer to the times where an electrical shutdown occurred.

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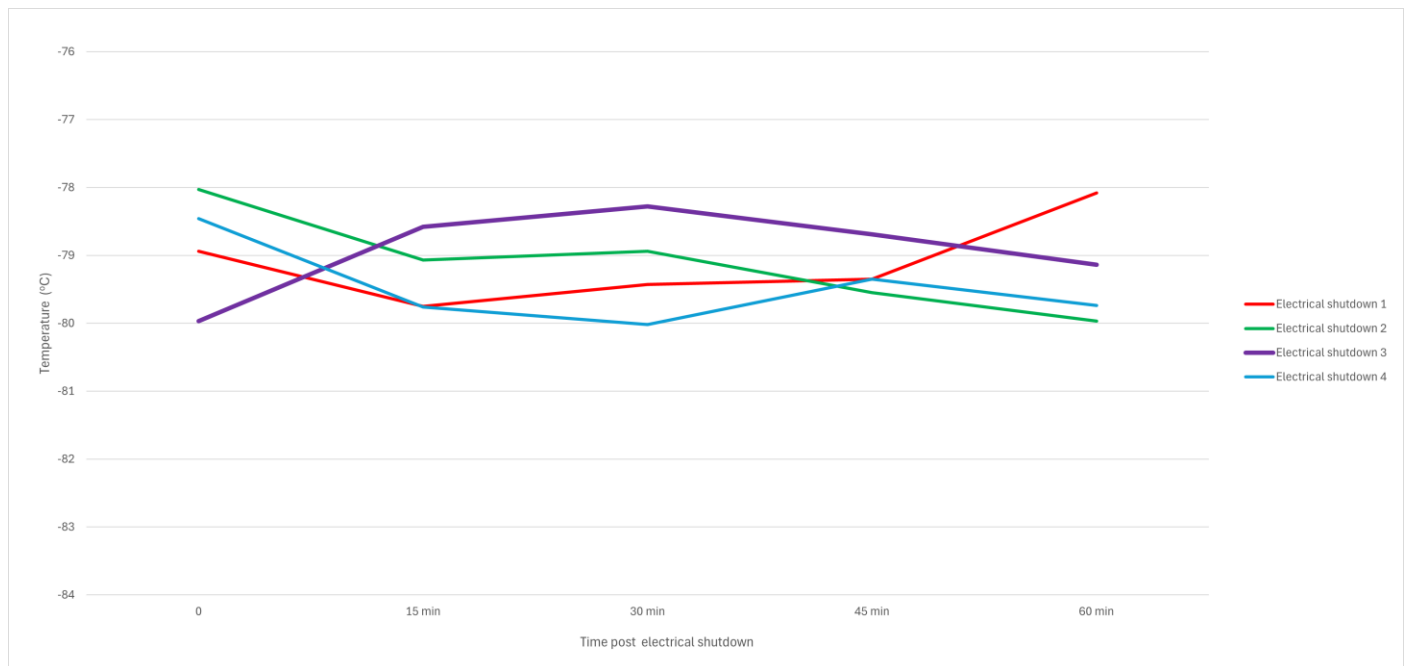


Figure 3: Temperature profile following four electrical shutdowns. Temperature profile recorded for BM Evolution 690 L, -86°C model. Set temperature is -80°C. The time 0 refers to the time the electrical shutdown occurred, and displays the temperature an hour post shutdown for all four electrical shutdowns. Maximum temperature reached during this period was -77.98°C.

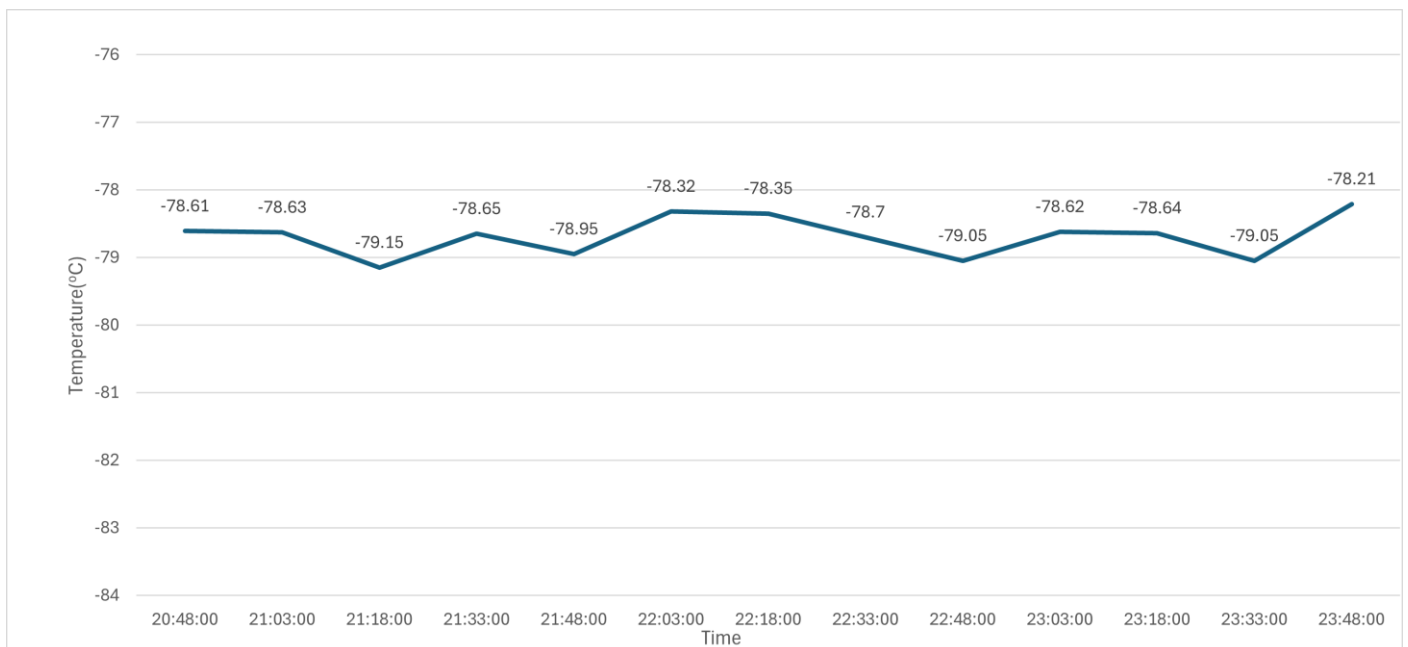


Figure 4: Temperature homogeneity. Nine probe mapping test performed on Evolution Graph displays temperature homogeneity over a 2.75 hour period. Set temperature : -80°C.

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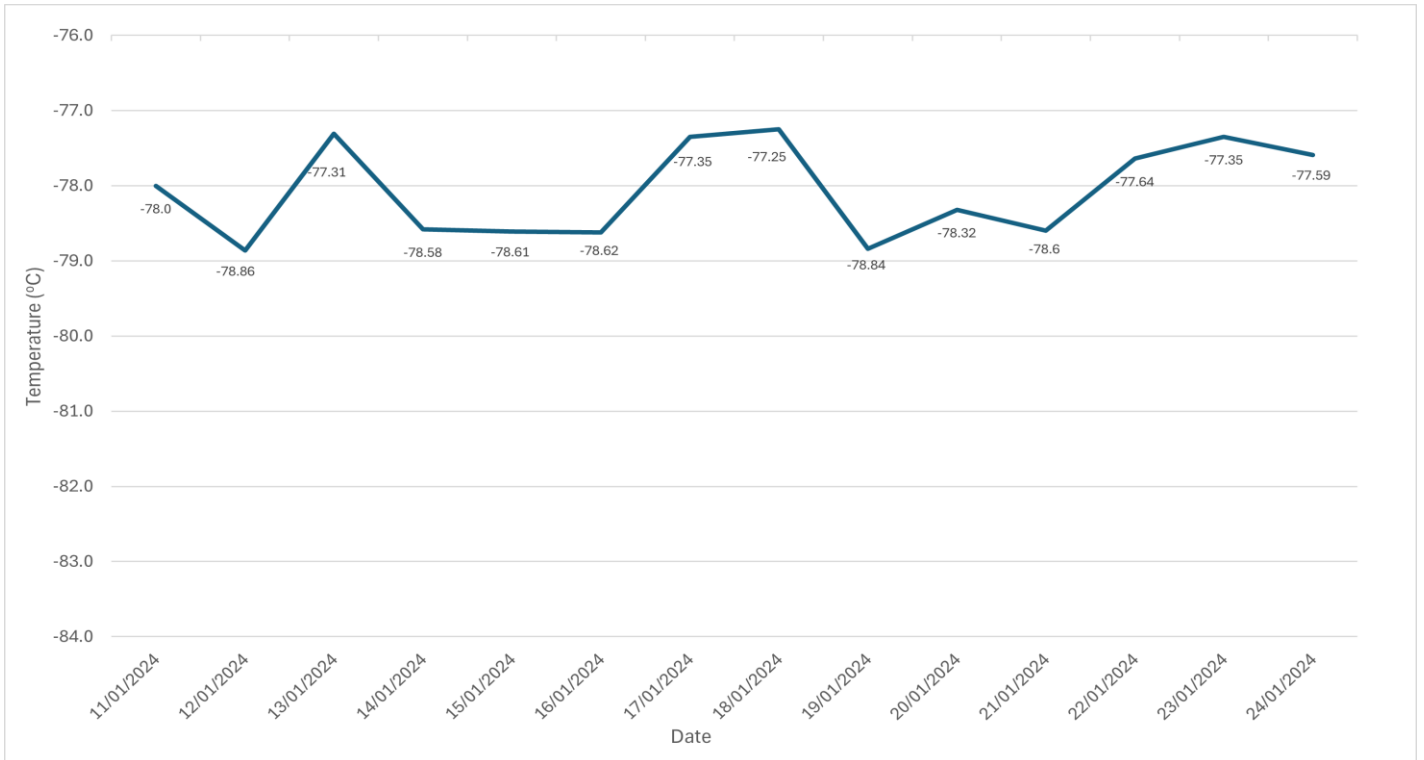


Figure 5: Temperature homogeneity. Temperature profile recorded for BM Evolution 690 L, -86°C model. Set temperature is -80°C. Graph displays temperature profile of the freezer over 14 days, each temperature reading was taken at the same time each day.

Discussion

Evolution offers the highest level of performance and accuracy, even during an unexpected event like a power outage. This is why Froilabo are dedicated to ensuring excellent temperature retention; to maintain your sample integrity and prevent freeze-thaw damage, even during a worst-case scenario situation.

This impressive level of stability and temperature recovery is a direct result of the recent developments made on Evolution units. These improvements include an increase in quality of insulation, and a new gasket which offers enhanced insulation between the door and tank. This new gasket also results in minimal frost formation on the internal door, Figure 6, and smooth door closing.



Figure 6: The new gasket on Froilabo Evolution units.

Conclusion

Froilabo by Techcomp Lab Products offers the highest quality of cold storage products, with the latest improvements to Evolution corresponding to premium quality equipment. With excellent temperature homogeneity, high accuracy, and temperature retention following several electrical shutdowns, you can be sure your samples receive the highest standard of safety. This high level of performance is a direct result of several improvements added to the Evolution units, which includes a new gasket and better quality of insulation of the tank, offering the highest level of protection for your high-value samples.

At Froilabo, your samples are our priority. We understand that this isn't just a freezer, it's an assurance on sample integrity and scientific success. This is the motivation behind the development of the Evolution - ensuring the highest level of protection for your samples, always.

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