TECHNICAL NOTE

MEASUREMENTS OF PERFORMANCES OF NEW BIO MEMORY DUAL COOLING -86°C 718 L FREEZER

[Technical Note 2026-006] /
Olivier VARET

Enhanced Dual Cooling Technology Delivering High Thermal Performance with Only 8.5 kWh/24h Energy Consumption

INTRODUCTION

Ultra-low temperature (ULT) freezers operating at –80 °C are mission-critical systems used for the long-term preservation of biological, pharmaceutical, and industrial materials. Maintaining temperature stability and ensuring operational continuity are essential to prevent irreversible sample degradation.

Dual Cooling technology is based on two independent refrigeration circuits integrated within a single unit. Each circuit includes its own compressor, evaporator, and control regulation. Under normal operating conditions, both systems function in a coordinated manner to ensure optimal temperature uniformity and balanced compressor workload.

In the event of a failure of one refrigeration circuit, the second independent system is capable of maintaining the storage chamber at –80 °C, providing longer time, up to several day, for service intervention.

This built-in redundancy increases operational safety, reduces the risk of sudden temperature excursions, and enhances system resilience. In addition, alternating or shared compressor operation may reduce mechanical stress and contribute to improved long-term reliability of the refrigeration components.

Dual Cooling architecture therefore represents a risk-mitigation strategy designed to enhance sample security, improve uptime, and ensure compliance with laboratory quality and safety requirements.

TEST CONDITIONS

To measure the performance of the Bio Memory Dual Cooling -86°C 718L, following tests have been conducted:

- Pull down test (from ambient temperature to -80 °C). Temperature distribution was monitored using 9 probes mapping based on NFX 15-140 standard.
- Power consumption and temperature distribution of the empty freezer were evaluated following the Energy Star protocol and the NFX 15-140 temperature-mapping methodology.
- Beyond the Energy Star requirements, additional temperature-recovery tests were conducted using a more realistic door-opening duration to better reflect typical customer usage.
- A defrosting assessment was carried out to quantify cold loss during simulated emergency shutdown conditions.
- Temperature homogeneity was calculated based on a 9-probe mapping layout compliant with the NFX 15-140 standard.

For all tests, we used : set temperature -80°C or -70°C,

Testing was carried out in an air-conditioned room tempered between 20°C and 21°C. Nine PT100 probes were placed within the tank as shown in figure 1 :

- 4 probes were placed on the highest shelf,
- 4 probes were places on the base of the freezer
- 1 probe was placed in the centre of the freezer.

The freezer was connected to a power consumption measuring device (OceaSoft).

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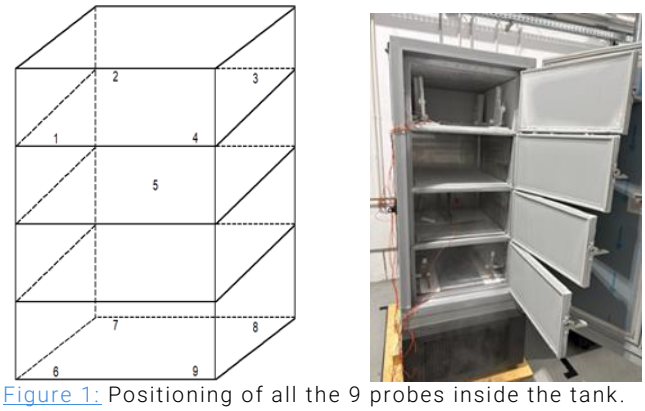

Figure 1: Positioning of all the 9 probes inside the tank.

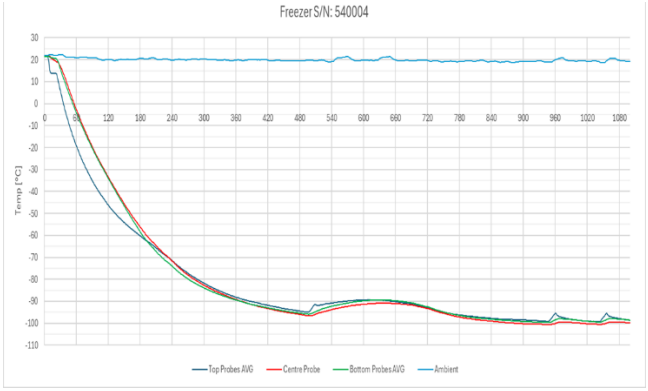

Figure 2: PullDown test, temperature profile

PULL DOWN TEST

We ran a pull-down test to see how quickly the freezer could cool from room temperature down to −80 °C (±5 °C), and to confirm the lowest temperature it can reach.

Figure 2 shows how the temperature changed over time, using the average of the top probes, the center probe, and the average of the bottom probes.

Bio Memory Dual Cooling -86°C 718L ULT freezer (BMDC70880G) reaches -80°C (+/-5°C) in 4 h 40 min (mean value calculated on all probes). To reach -60°C (+/-5°C), it takes BMDC70880G 3 h (mean value calculated on all probes).

This rapid pull-down performance, unique for a Dual Cooling ULT freezer, makes the BMDC70880G both efficient and dependable. Because it reaches a safe storage temperature in just three hours after start-up, it becomes fully operational long before most failed ULT freezers climb past the critical −60 °C threshold. This rapid response helps for samples transfer/loading.

To measure maximum performance of our equipment, we set a temperature lower than -90°C. Figures 2 shows Bio memory Dual Cooling 718 L model reached -95°C. This level of performance creates confidence in reliability of our models at -80°C.

TEMPERATURE HOMOGENEITY ANALYSIS

Consistent temperature throughout the storage chamber is essential for maintaining sample integrity, no matter where the samples are placed inside the ULT freezer. The system's real-time compressor-cycling control adjusts cooling output as needed, which helps keep temperatures stable and predictable. As shown in Figure 3, the temperature-variation data demonstrates smooth, regular cycling across all probes, confirming uniform performance throughout the chamber. This controlled operating pattern also reduces mechanical stress on the refrigeration components, supporting longer compressor lifespan and overall system reliability.

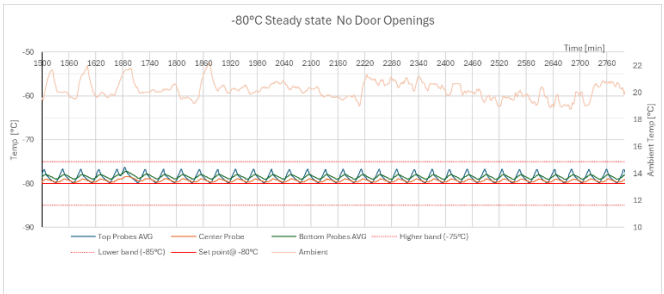

Figure 3: Temperature variation for a setpoint of -80°C for 9 probes

The chamber's design, including high-performance double door design, sealing gaskets on both the main outer door and the inner doors, along with the latest-generation vacuum insulation panels (VIP), all play a crucial role in achieving these high performance levels.

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In the ULT freezer market, the standard benchmark for temperature uniformity at −80 °C is a maximum deviation of ±2 °C. For the BMDC708880G, the results shown in Figure 4 demonstrate a uniformity of ±1.91°C—significantly surpassing the current industry reference and highlighting the system's superior thermal stability.

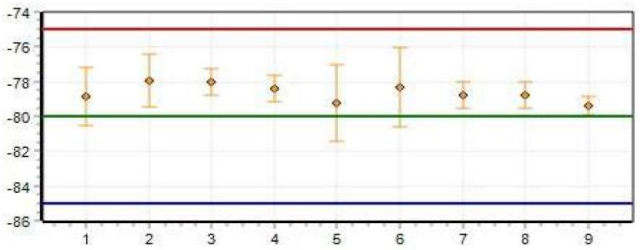

Figure 4: Temperature homogeneity for a set point of -80°C for 9 probes.

Thermal imaging analysis of the external surfaces of the ULT freezer cabinet (data not shown) indicates temperatures ranging between 20 °C and 24 °C, consistent with ambient room conditions. No measurable cold leakage through the cabinet walls was observed, confirming the effectiveness of the insulation system.

POWER CONSUMPTION

The freezer was operated for 24 hours at −80 °C and subsequently for 24 hours at −70 °C in order to measure energy consumption in accordance with the Energy Star protocol. The results are presented in Table 1.

With an energy consumption of only 8.5 kWh per 24 hours, the BMDC70880G delivers outstanding efficiency without compromising thermal performance. This level of performance positions the unit among the most energy-efficient ULT freezers available on the market.

Beyond its technical advantages, the freezer's lower power consumption directly reduces the Total Cost of Ownership (TCO). Using less energy leads to meaningful savings over the equipment's lifetime, while also lowering environmental impact and supporting more sustainable laboratory operations.

	Power consumption [kw / 24hr]
	Energy Star
24hr door closed	8.5
15sec door opening	9.2
1min door opening	9.7

Table 2: Power consumption based on energy star protocol

DOORS OPENINGS

Dual Cooling ULT freezers are well known for their low energy consumption, but users often express dissatisfaction with how long these systems take to return to the −80 °C setpoint during routine operation.

In daily laboratory practice, freezer doors may be opened frequently throughout the day, sometimes more than 10 to 20 times. It is therefore essential that the temperature returns quickly to the setpoint to preserve sample integrity and ensure safe storage.

As described in the Energy Star protocol, the test procedure consists of opening the main outer door and the inner door of the upper compartment for durations of 15 seconds, 1 minute, or 3 minutes.

After closing both doors, the time required to return to the setpoint temperature (−80°C) is measured according to the NFX 15-140 method (9-point temperature mapping, COFRAC-accredited procedure). The results are presented in Table 2, and the corresponding temperature profiles are shown in Figure 5.

The results show that the door-opening scenarios described above have no measurable effect on the central or lower sections of the cabinet, whether the door remains open for 15 seconds, 1 minute or 3 minutes. In the upper compartment—the area directly exposed during the test due to the internal door being opened—only 6 minutes are needed to return to −80 °C after a door opening of 15 sec.

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When the same test is performed with a 1-minute door opening, recovery remains impressively fast:

- 13 minutes for the upper compartment
- No significant impact in the central or lower sections

The 3-minute door-opening test further confirms the strong real-world performance of the Bio Memory Dual Cooling –86 °C 718 L model, demonstrating its ability to maintain stable conditions even under demanding operating scenarios.

	Freezer S/N: 540004		
Probe Location	**Recovery Time for Each Specific Opening Duration @ -80°C ± 5°C**		
	15 sec Opening	**1 min Opening**	**3 min Opening**
Top Probes (T1,T2,T3,T4):	**0hr : 6m**	**0hr : 13m**	**0hr : 32m**
Centre Probe (T5):	**0hr : 0m**	**0hr : 0m**	**0hr : 0m**
Bottom Probes (T6,T7,T8,T9):	**0hr : 0m**	**0hr : 0m**	**0hr : 0m**

Table 1: Temperature homogeneity for a set point of -80°C for 9 probes.

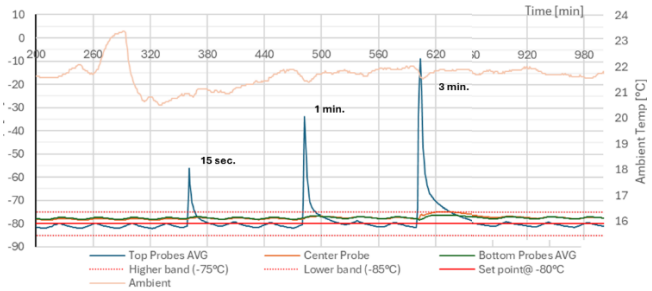

Figure 5: Recovery time to set point of -80°C (+/-5°C) for 15 sec, 1 min and 3 min door opening.

A fast return to the setpoint temperature is essential for ensuring sample safety, especially under demanding daily use. These recovery capabilities fully support the needs of shared-use environments, where the freezer may be accessed frequently by multiple users throughout the day.

CONCLUSION

In medical, scientific, and industrial settings, –80 °C freezers are mission-critical tools for safeguarding sensitive materials. Their performance directly influences sample integrity, regulatory compliance, operational continuity, and overall risk management.

With the Bio Memory Dual Cooling –86 °C, 718 L ULT freezer, FROILABO introduces a solution that uniquely combines exceptionally low energy consumption with high thermal performance.

This technical note demonstrates that the BMDC70880G meets—and in several areas exceeds—the performance expectations of laboratories requiring reliable –80 °C storage, including those operating under strict regulatory frameworks such as ISO standards and GMP.

Building on its long-standing reputation for durable, high-quality equipment, FROILABO expands the Bio Memory range with 568 L, 718 L and 838 L Dual Cooling ULT freezers engineered for long-term reliability and consistent performance throughout years of demanding use.

You can find all informations on our website at Dual Cooling Unit | Bio Memory ULT Freezer

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