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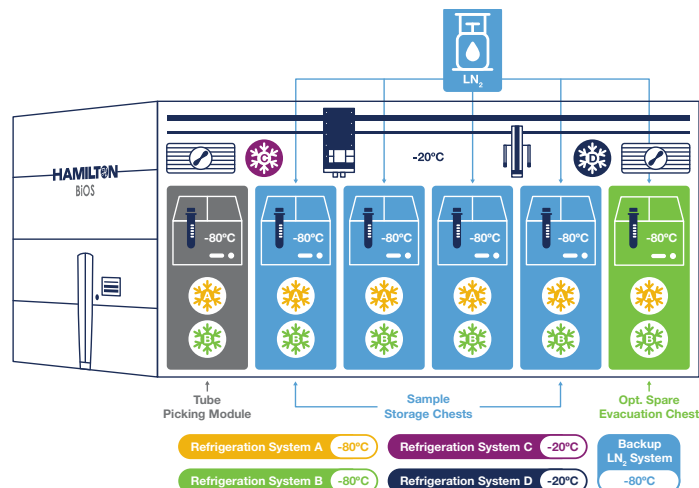
BiOS[®] Models M and L

Modular Refrigeration Systems



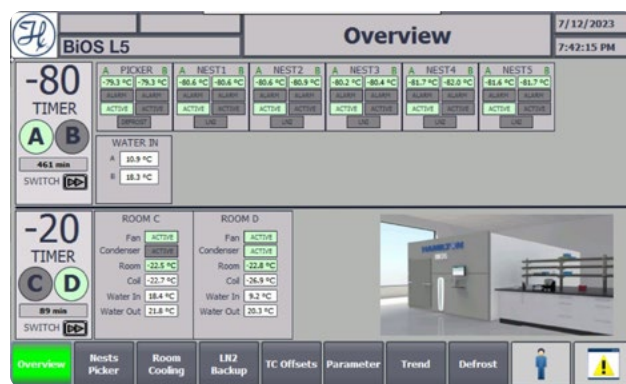
Robust, Reliable, and Environmentally Friendly Refrigeration Systems

BiOS M and L refrigeration systems feature a modular design so that each storage compartment is treated as an independent chest freezer. There are two fully redundant -80°C refrigeration modules dedicated to each chest freezer and -80°C picker module. The entire -80°C refrigeration system is installed in a space-efficient format behind a paneled enclosure designed for a clean aesthetic and serviceability.



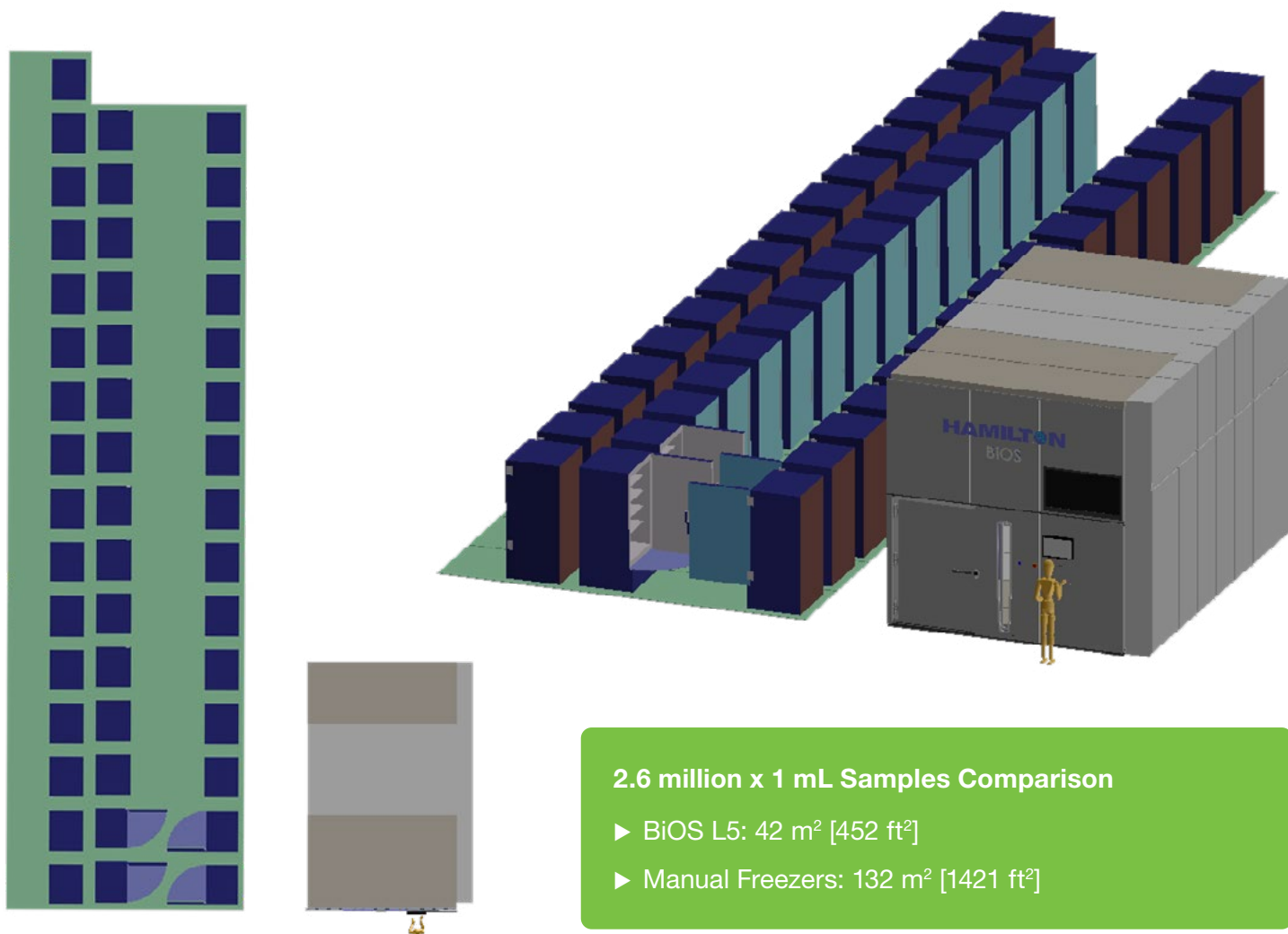
Enhanced Reliability and Easy Serviceability

- Modular design:** Each BiOS storage compartment is treated as an independent -80°C chest freezer, ensuring maximum system reliability and sample integrity.
- Protect sample integrity:** Two fully redundant -80°C refrigeration modules dedicated to each BiOS chest freezer and picker module provide uninterrupted cooling. Two fully redundant -20°C refrigeration modules consistently maintain cold room compartment temperatures.
- Prepared for “what-if” scenarios:** An additional LN_2 backup cooling system ensures samples maintain storage temperatures even in the event of a full power outage, and an optional spare freezer chest makes sample evacuation and chest freezer defrost possible without ever having to remove samples from the BiOS system.
- Enhanced serviceability:** Redundant refrigeration system components are housed separately from the sample storage compartments. This allows for set temperatures to be maintained even during refrigeration service. The BiOS -80°C refrigeration modules are designed to be easily swapped from local spare units to minimize downtime. Many components, such as redundant temperature sensors and the local controller box, can be replaced in as little as 30 minutes.
- Intelligent control:** Each of the system’s refrigeration modules has its own independent local controller, which manages refrigeration demand, compressor staging, and alarm states. Primary temperature regulation, assist refrigeration, and A/B switching is provided by No-Go signal sent by a higher-level PLC (Executive Controller) that is not essential to refrigeration. In the event of PLC failure or loss of communications, local controllers continue to run refrigeration and maintain chest freezer temperature.



BiOS Refrigeration HMI monitor and control screen

- Tried and true:** BiOS -80°C refrigeration modules are produced under controlled conditions at the Hamilton headquarters in Franklin, Massachusetts, using robust, reliable, and ultra-low temperature proven components to guarantee superior performance.



Green Benefits

- **Environmentally friendly:** Green refrigerants offer significant benefits in ultra-low temperature refrigeration applications thanks to their high cooling capacity, energy efficiency, negligible ozone depletion potential, and negligible global warming potential (GWP).
- **Reduced carbon footprint:** BiOS consumes a fraction of the electricity of an equivalent-sized collection of manual ULT freezers, and BiOS refrigeration systems have no heat load impact on HVAC systems.
- **Flexible control:** Individual chest freezer set point temperatures may be set and controlled independently from -20°C to -80°C. The system may be run at a warmer temperature if desired (for example, -70°C) to reduce energy consumption.
- **Phased usage:** Each -80°C freezer can be independently activated and deactivated for energy savings so that customers may turn on just the freezer compartments needed at the time.
- **Future-proof:** Refrigerants used in BiOS have unrestricted future availability and use, and align with global efforts to reduce greenhouse gas emissions.
- **Compliance with global standards:** The natural gas refrigerants used in BiOS meet the environmental and safety requirements of US EPA SNAP, IEC 60335-2-89, and European Standard EN 378.

Real-World Example

This is one example of a midsized BiOS system. As the size of the BiOS system increases, so do the power consumption and space savings.

BiOS L5 System vs. Manual Freezer Farm

	BiOS	Manual ULTs
Storage Capacity (assuming filled to max capacity)	2.6 million 1 mL samples	46 upright 740 L capacity manual freezers
Footprint	BiOS L5 occupies 42 m ² [452 ft ²]	46 manual freezers occupy 132 m ² [1421 ft ²]
Power Consumption	225 kW/day	430-860 kW/day, depending on model, maintenance history, and age
Annual Equivalent CO ₂ Emissions*	35.6 metric tons	68.0-135.9 metric tons
Servicing and Maintenance	Redundant refrigeration systems ensure samples do not need to be evacuated during service. Design features in BiOS prevent frost accumulation and the system does not require regular defrost of storage chests.	Evacuation to additional backup freezers is required during emergency and for annual defrosting and other maintenance tasks.
Heat Load Impact to HVAC Systems	None; BiOS refrigeration systems utilize chilled water.	492 W [77,000 BTUs]/hr

*EPA (2021). eGRID. U.S. annual national emission factor, year 2019 data. U.S. Environmental Protection Agency, Washington, D.C. (<https://www.epa.gov/egrid>)



Front and side views of the outside of a BiOS L5 system



View of the -80°C refrigeration systems when enclosure panels are removed

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