

Rapid Freeze

POIWG #43 | April 2018

Introduction

- “Rapid Freeze” capabilities are provided by two payloads: Glovebox Freezer and Cryo Chiller
- Developed by the University of Alabama at Birmingham
- Glovebox Freezer currently planned for launch on SpX-16
- Cryo Chiller currently planned for launch on SpX-17
- Units will be available for use following an on-orbit checkout

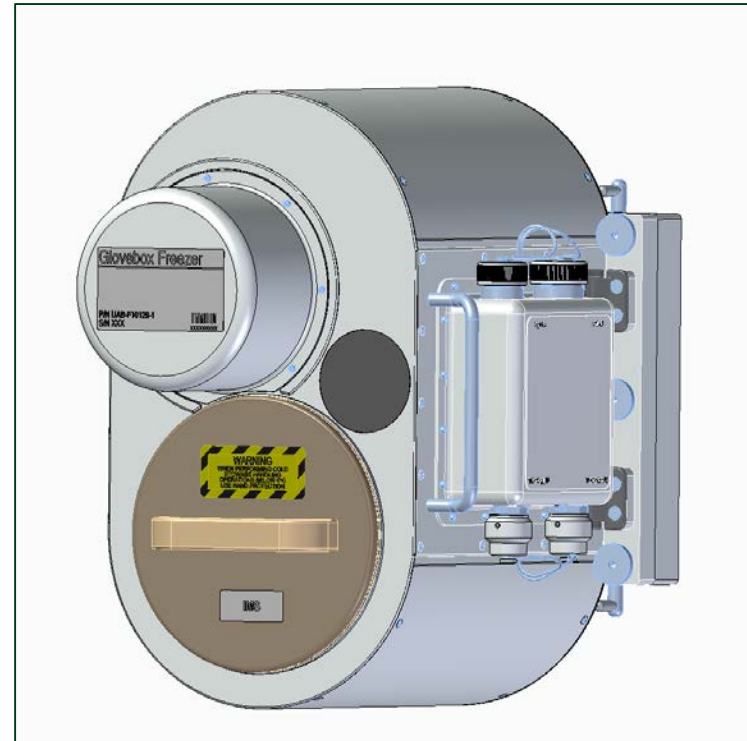
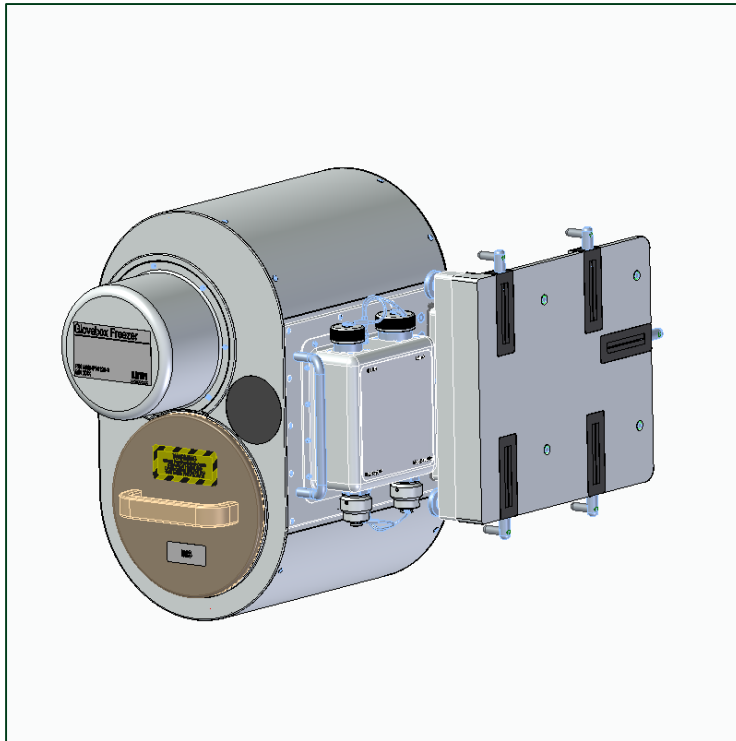


Features

- Capability to rapidly freeze biological samples on the ISS by providing a -185°C interface for sample freezing through conduction
- Freeze samples at 3 locations (LSG, MSG, EXPRESS Rack)
- Freeze multiple samples over short period of time
- Freeze many samples during a crew workday
- Maintain consistent freeze rate from sample to sample

Design

Glovebox Freezer (Cold Box)



Provides the sample interface.

Mounts inside inside the work volume of the MSG using thumb screws or inside the LSG using magnets.

Dimensions: 15.00" W x 11.90" H x 14.40" D

Design

Glovebox Freezer Electronics Control Unit (ECU)



Provides the power and drive signals to the cold box and data to the EXPRESS rack.

Mounts in the seat track of an adjacent rack via a Bogen arm.

Dimensions: 12.60" W x 15.50" H x 5.80" D

Design

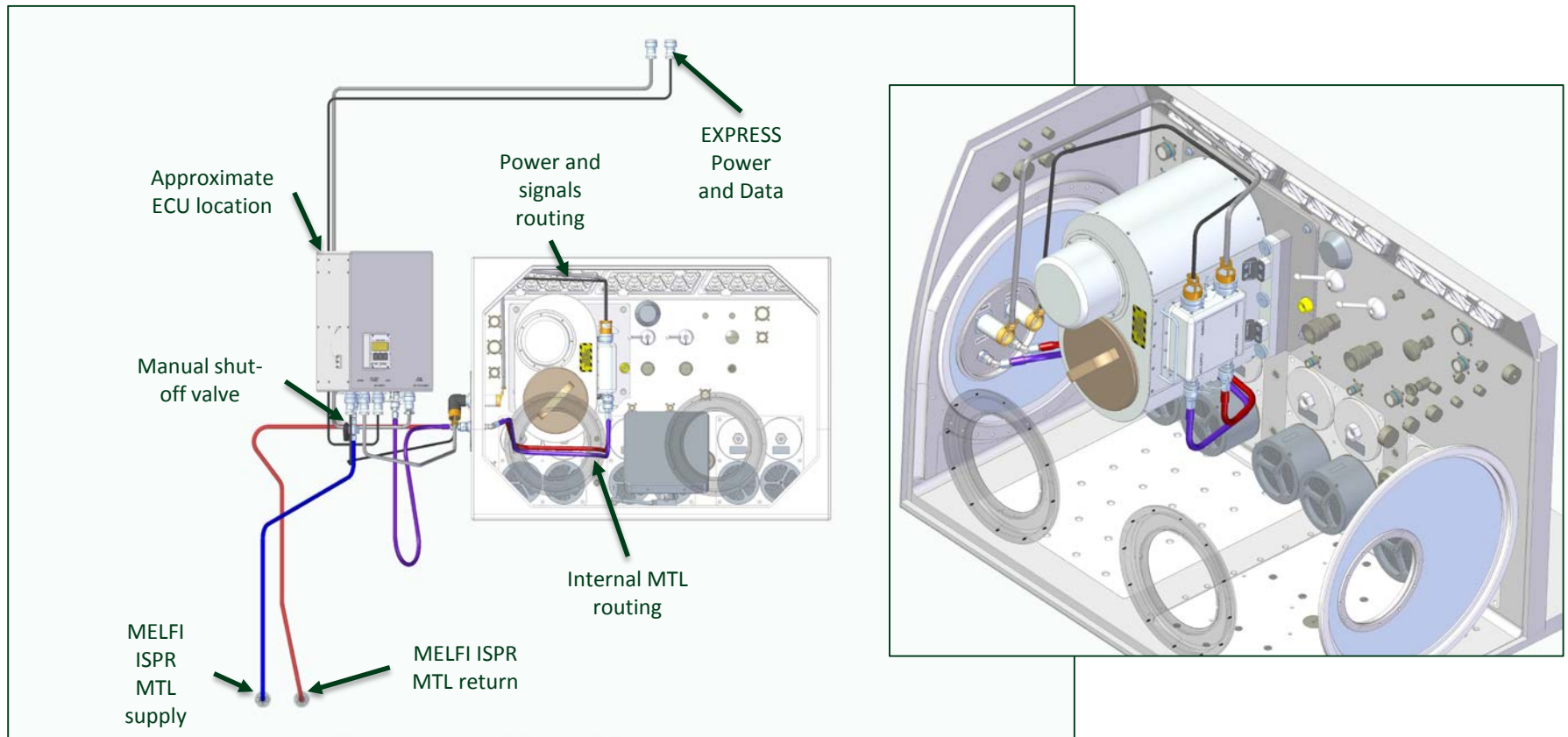


Glovebox Freezer Cold Box and ECU following assembly.

NOTE: 12" ruler shown in image to provide scale.

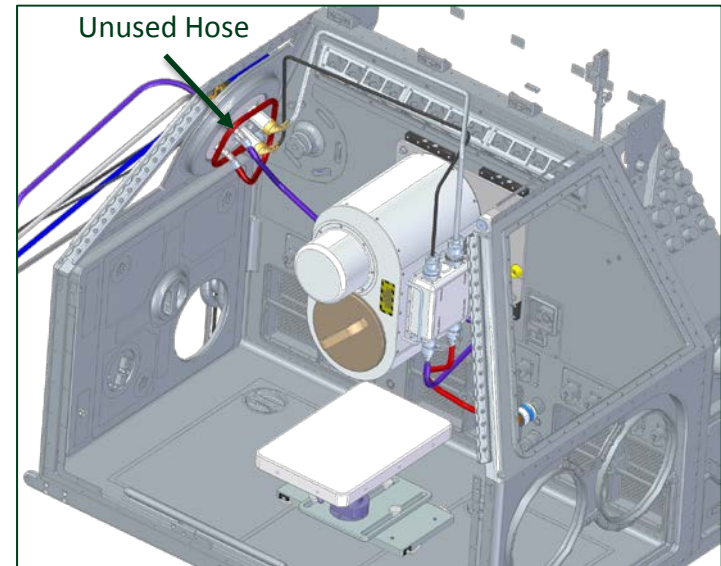
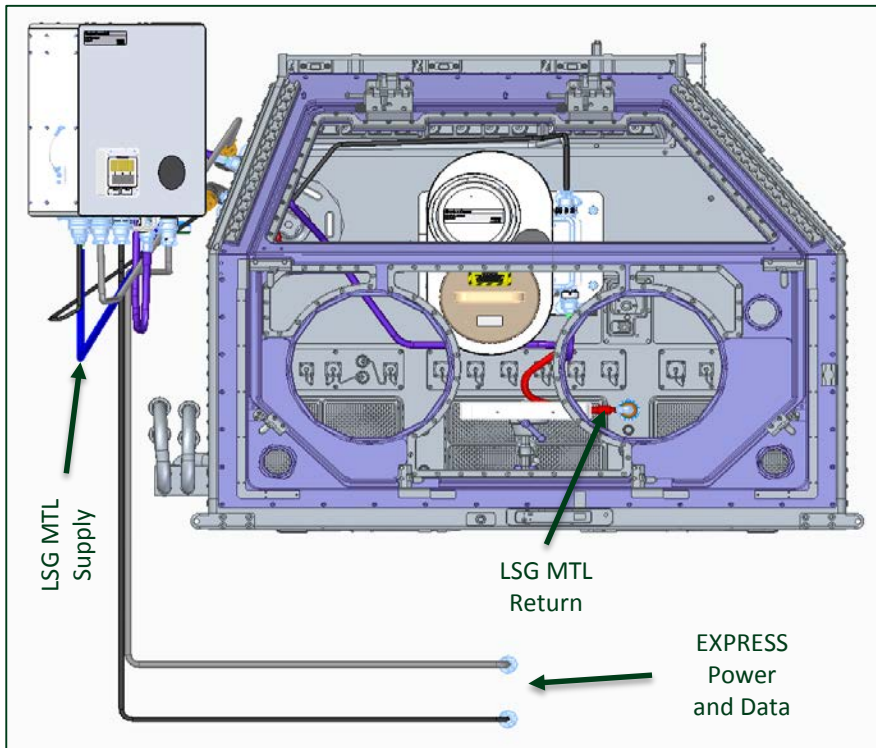
Design

Glovebox Freezer MSG Setup



Design

Glovebox Freezer LSG Setup

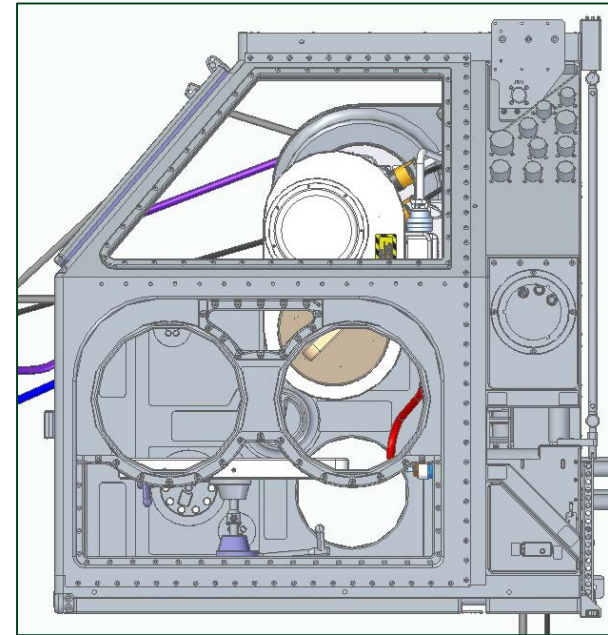
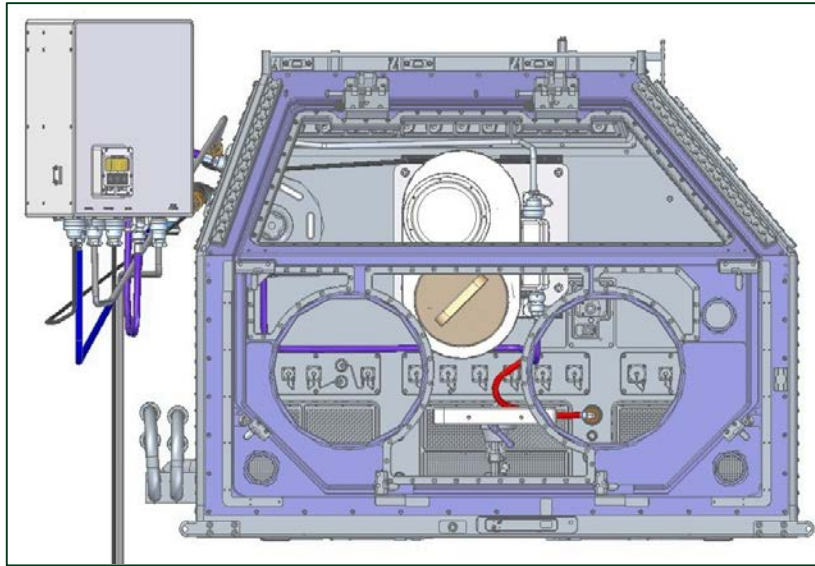


MTL is routed from the external LSG MTL connection, through the ECU, Feedthru, and Glovebox Freezer, returning to the internal LSG MTL connection.

The unused Feedthru MTL return hose will be tethered out of the way.

Design

Glovebox Freezer LSG Setup



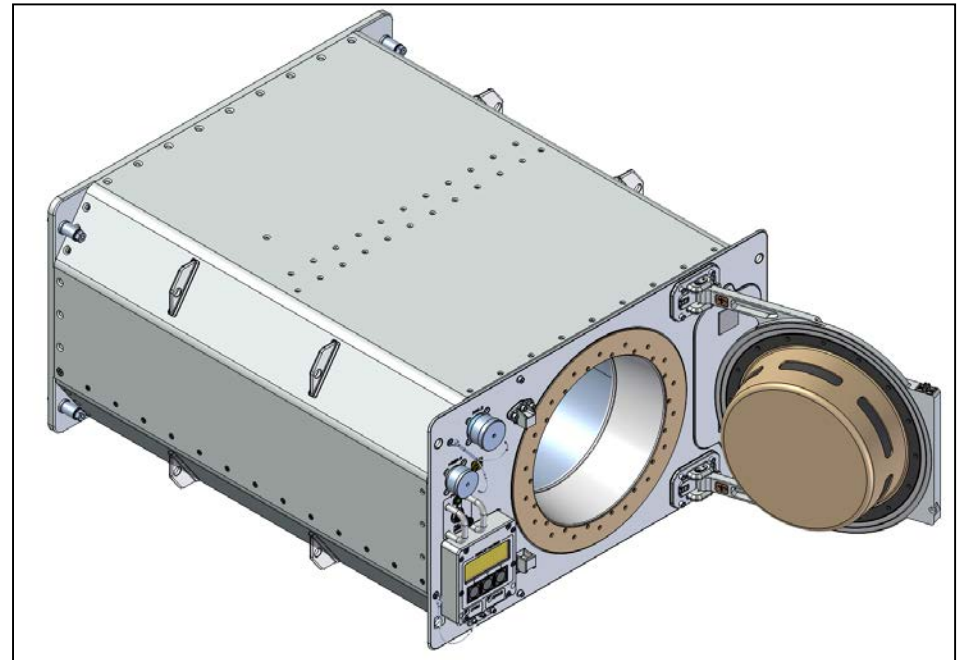
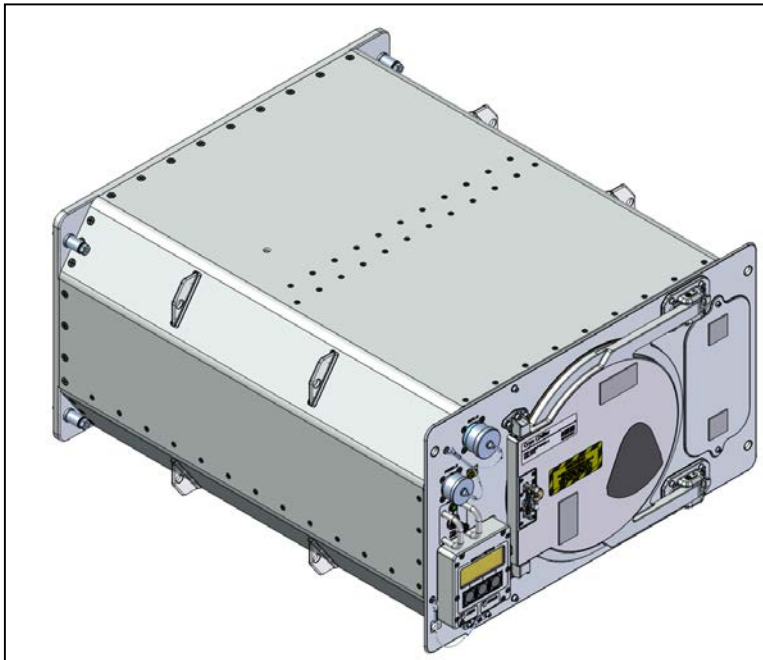
The hinged mounting plate allows access from both the front and side glove ports in the LSG.

Design | Glovebox Freezer Hardware List

P/N	OpNom	Setup Applicability
UAB-F10128	Glovebox Freezer	MSG and LSG
UAB-F10129	Glovebox Freezer ECU	MSG and LSG
UAB-F10130	Glovebox Freezer Feedthru	MSG and LSG
UAB-F10134	ECU Water Sply Hose 94"	MSG only
UAB-F10135	ECU Water Sply Hose 39"	MSG and LSG
UAB-F10136	Rack Water Rtrn Hose 94"	MSG only
UAB-F10138	ECU Water Sply Hose 37"	LSG only
UAB-F10141	Glovebox Freezer Water Rtrn Hose 24"	LSG only
UAB-F10142	Lid	MSG and LSG
UAB-F10143	Sample Cartridge	MSG and LSG
UAB-F10144	Cartridge Tool	MSG and LSG
UAB-F10151	Cartridge Sample Tool	MSG and LSG
UAB-F50474	ECU Signal Cable 30"	MSG and LSG
UAB-F50476	ECU Drive Cable 34"	MSG and LSG
UAB-F50503	ECU Pwr Cable 155"	MSG and LSG
UAB-F50504	ECU Data Cable 165"	MSG and LSG

Design

Cryo Chiller



- Single middeck locker equivalent payload designed for operation in the EXPRESS Rack or in visiting vehicles
- Air cooled via EXPRESS AAA
- Functionally comparable to Glovebox Freezer, with regard to sample accommodations
- Science transport at -160°C (TBC) in COTS vehicles at 75W input power

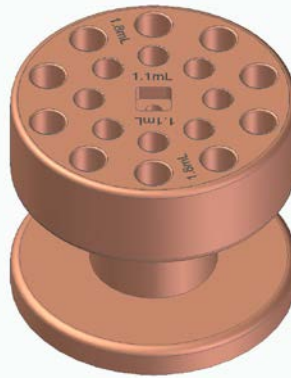
Design

Cold Volume Comparison and Sample Cartridge Concepts

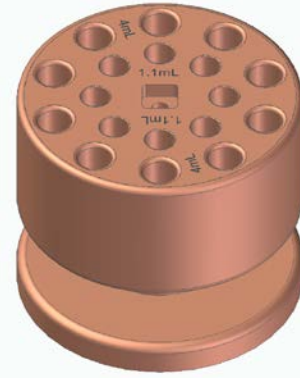
	Glovebox Freezer		Cryo Chiller	
	Cold Volume	Max Sample Cartridge	Cold Volume	Max Sample Cartridge
Diameter	4.452"	4"	6.45"	6.25"
Depth	4.723"	4"	6.75"	6.25"
Volume	1.20 L	~ 0.82 L	3.41 L	~3.39 L



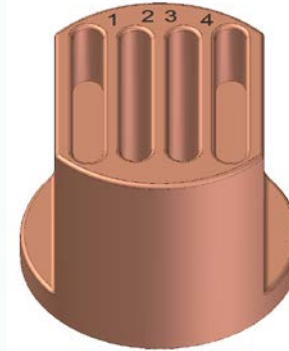
Blood Cartridge
10-1.1 mL Vials



Mixture 1 Cartridge
8-1.1 mL Vials
10-1.8 mL Vials



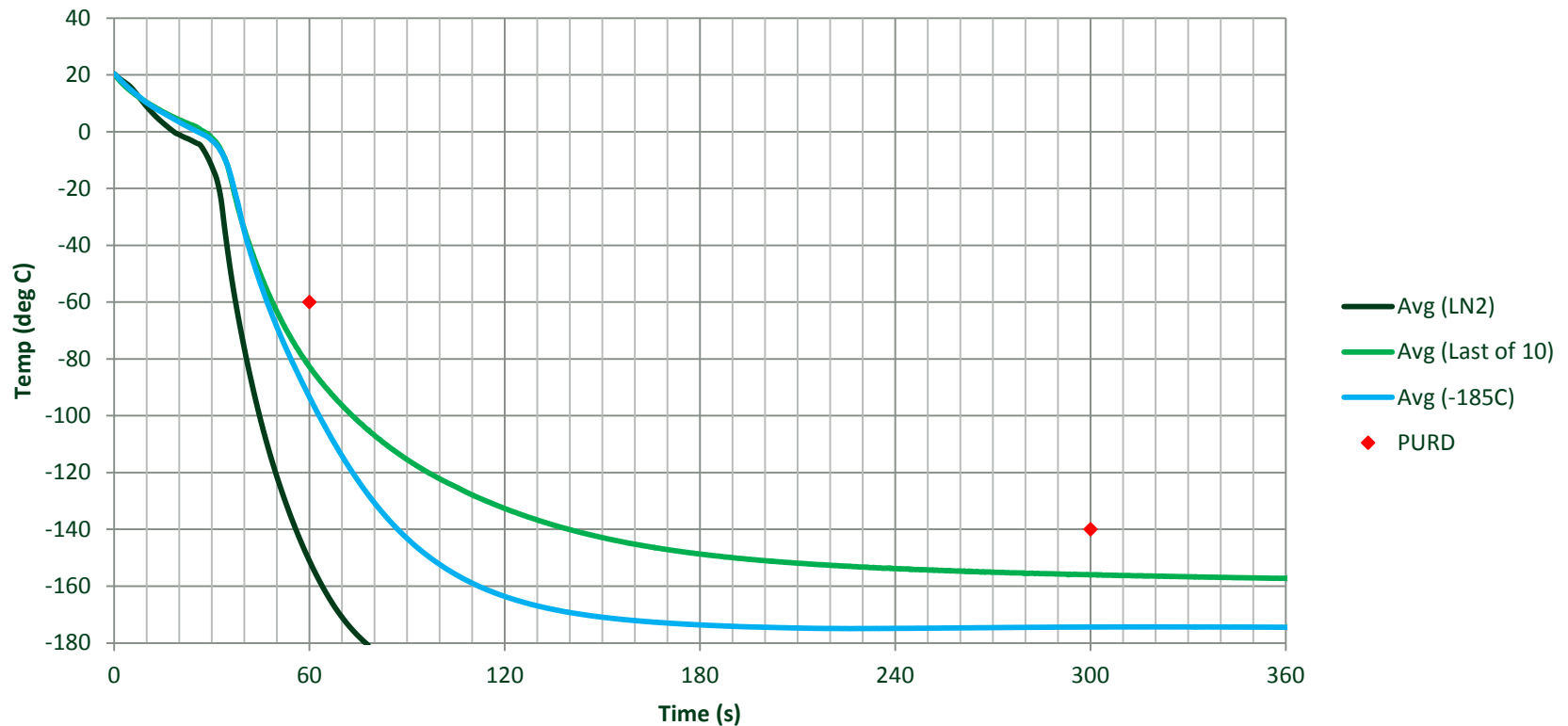
Mixture 2 Cartridge
8-1.1 mL Vials
10-4 mL Vials



Bag Cartridge
2-7 mL Bags
2-30 mL Bags

Cooling Capability

1mL Vial Test Averages



Performance requirements may be found in JSC-47130, Rapid Freeze Payload Unique Requirements Document

Operations Overview

Launch and Return		
	Soft-stowed	Hard-mounted
Glovebox Freezer	✓	
Cryo Chiller	✓	✓

On-Orbit				
	Location	Power	Data	Thermal
Glovebox Freezer	MSG	EXPRESS (200 W max)	EXPRESS	MTL from MELFI Rack
	LSG	EXPRESS (200 W max)	EXPRESS	MTL from LSG
Cryo Chiller	EXPRESS	EXPRESS (200 W max)	EXPRESS	AAA
	Dragon or Cygnus (75 W max)			

Operations Overview

Operations Sequence

Pre-Ops	Ops	Post-Ops
Installation (Glovebox Freezer – MSG/LSG, Cryo Chiller – EXPRESS Rack)	Following setup, nominally operates without need for crew intervention	Warm-up
Installation of Sample Cartridges	PD support will include H&S monitoring and technical support	Decontamination and desiccant insertion
Activation and cooling initiation via ground commanding (day prior to ops)	Science will be transferred to other cold stowage assets after frozen	Deactivation via ground commanding
		Removal from MSG/LSG (Glovebox Freezer only)

Operations Overview

Additional Operational Considerations

Glovebox Freezer

MSG Ops	<ul style="list-style-type: none">The Feedthru protrusion requires that MSG be partially extended overnight prior to the day of crew ops
LSG Ops	<ul style="list-style-type: none">The Feedthru protrusion requires that all Glovebox Freezer hardware be installed in the work volume overnight prior to the day of crew opsAdditional setup time is required on the day of ops to move the ECU outside the work volume, install the Feedthru, and reconnect cables & hoses

Glovebox Freezer and Cryo Chiller

Sample Cartridges	<ul style="list-style-type: none">Sample cartridges are being designed to accommodate standard sample sizes; science needs will be assessed as experiment concepts of operations are developed.
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Questions?