Froilabo
Precision for life

ULT FREEZERS

ESSENTIAL | EVOLUTION

USER MANUAL

ISSUE 0.3

Froilabo
Precision for life

1. SUMMARY

NOTES

All freezers and electronic equipment must be earthed. This protects users and the equipment.

Only operate a freezer after implementing all required safety measures.

SYMBOLS USED IN THIS MANUAL

Information: this symbol indicates advice and additional information that allows optimal use to be made of the product.

Warning: this symbol warns users that failure to take the information into account may result in damage to the equipment. Precautions to be taken and potential consequences are described in the warning.

Caution: this symbol indicates the safety measures that must be applied by users and technicians to avoid injury to persons near the equipment. It is essential to follow these measures thoroughly.

Danger, extreme cold: this symbol indicates a hazard related to the ultra-low temperature of the freezer chamber and its contents.

CHANGE LOG

Updates are listed in the revision history below:

Date	Issue	Changes	Sections	Author
Jan. 2017	0.1	First issue	All	F. LE CAM
Feb. 2017	0.2	Contents	All	JN PEDEL
Apr. 2017	0.3	Contents	All	M. CADIEU

1. CERTIFICATE OF CONFORMITY

Meyzieu, January 2nd 2017

Froilabo SAS hereby certifies that the equipment listed below:

ULT Freezers, versions:

- Essential, -86°C and -45°C, capacity 340L, 515L and 69L,
- Evolution, -86°C and -45°C, capacity 340L, 515L and 690L.

Comply with the applicable standards and technical directives:

- EN 61010-1 – Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: general requirements,
- 2014/35/EU – Low Voltage Directive,
- 2014/30/EU – EMC Directive, Class A equipment,
- 97/23/EC – Pressure equipment.

Note: these units are not designed for operation in explosive atmospheres (ATEX). Furthermore, they may not be used to store flammable, corrosive or explosive substances.

2. WARRANTY

Froilabo SAS guarantees that the equipment will operate optimally in accordance with the conditions for installation and use set out in this manual.

The duration of the warranty is 24 months, extended to:

- 5 years for the fan, compressors, condenser, regulator* and PLC.
- 10 years for the VIP insulation.

**Only on Essential model.*

During this time, in the event that the equipment malfunctions, the warranty is limited to:

- operational enhancement,
- repair or exchange of equipment, without charge.

It must be clear that the fault or failure is related to a material or manufacturing defect. Any other claims for compensation are excluded.

General information

Froilabo SAS assumes no liability for damage caused by non-compliant use, maintenance operations or unauthorised modifications.

Compliant use shall mean that the instructions in this manual have been followed and that inspection and maintenance have been performed.

The photos used in this manual are not contractually binding.

Please read this manual before using the equipment for the first time.

3. GENERAL INFORMATION

Ensure that all persons using the equipment are suitably trained.

Ensure that all persons installing, using and repairing the equipment are aware of the potential hazards related to their work and the safety measures to be followed, and that they have read and understood the instructions.

If hazardous or potentially hazardous substances are used, only persons fully familiar with the equipment should handle these substances. These persons must be capable of making an overall assessment of the potential risks. Please contact us if you have any questions regarding the use of the equipment or the instructions.

Under no circumstances may Froilabo be held liable for the quality of material stored in the freezers.

Note: the equipment that you have purchased is designed for professional use. Nevertheless, impacts to the frame and vibrations should be avoided. Ensure that the equipment is inspected at regular intervals appropriate for the frequency of use. Also check (at least once every two years) that labels relating to safety and unauthorised use are properly in place. If backup systems using liquid CO_2 or nitrogen vapour injection are used, please refer to the corresponding safety data sheets.

4. SPECIFICATIONS

1. RANGE OF UNITS

There are two ranges of Froilabo freezer, Essential and Evolution, which differ in their man-machine interface.
For each range, several capacities (BM340, BM515 and BM690) and two minimum operating temperatures (-45°C and -86°C) are available.

2. SPECIFICATIONS

FREEZER MODEL	BM340	BM515	BM690
GENERALITIES			
Gross volume (liters)	340	515	690
Number of compartments	2	3	4
Weight (kg)	223	267	330
Power (Watts)	1100	1500	1500
Absorbed current, 230 V 50 Hz model (A)	6	8	8
Absorbed current, 120 V 60 Hz model (A)	12	16	16
OUTSIDE DIMENSIONS			
Height (mm)	1280	1640	2000
Width (mm)	875	875	875
Depth (mm)	970	970	970
Clearance required at the rear of the unit (mm)	200	200	200
Maximum dimension with door open (mm)	1750	1750	1750
Maximum width with door open	1150	1150	1150
Maximum door opening angle	110°	110°	110°
GROSS INTERNAL DIMENSIONS EXCLUDING RACKS			
Height (mm)	716	1076	1436
Width (mm)	630	630	630
Depth (mm)	752	752	752

3. POWER SUPPLY

See the manufacturer's plate at the rear of the unit. Two models are available:

- Voltage 230 V AC ±10%, 50 Hz, protected by aM 12 A fuse.
- Voltage 120 V AC ±10%, 60 Hz, protected by aM 20 A fuse.

4. Refrigeration system

FREEZER MODEL	BM340	BM515	BM690
TWO-STAGE -86°C MODELS			
Stage 1 hermetic compressor power (Watt)	581	778	778
Stage 2 hermetic compressor power (Watt)	378	581	581
Stage 1 R417a refrigerant – load (g)	580	600	600
Stage 2 R508b refrigerant – load (g)	300	300	300
SINGLE-STAGE -45°C MODELS			
Hermetic compressor power	378	581	778
Isceon 89 refrigerant – load (g)	600	600	600
Capillary expansion	yes	yes	yes
Air condenser as standard	yes	yes	yes

5. Performance and ambient temperature

The BM ULT Freezer is factory set to optimise its electricity consumption.

On the -86°C model, the setpoint can be adjusted from -55°C to -90°C. The default setting is -80°C.

On the -45°C model, the setpoint can be adjusted from -20°C to -50°C. The default setting is -45°C.

The ambient temperature (between +18°C and +35°C, ideally between 23°C and 25°C) also has a significant impact on the electricity consumption of the equipment.

5. INSTALLATION

1. DELIVERY - UNPACKING

Use a pallet truck to move the freezer on its pallet. The freezer must be supported during unpacking to avoid any risk of toppling. The unit may be placed on the floor and manoeuvred on casters. Once the unit has been placed in the desired location, remove the protective plastic film and chocks.

Froilabo freezers are delivered on a pallet with an unloading ramp. This means that no special equipment is required to unload them from the pallet. Please refer to the handling and unpacking sheet affixed to the unit.

Do not use sharp objects as they might damage the paintwork.

Note: after unpacking, inspect (if possible with the carrier present) the condition of the unit and its accessories. If any transport damage is observed, state the details on the delivery note and inform Froilabo without delay.

After receipt, please check the items delivered:

340 liters	515 liters	690 liters
1 non-detachable electrical power lead		
1 filter cassette		
1 set of two keys		
1 pressure relief valve + filters		
1 manual		
1 shelf	2 shelves	3 shelves
2 brackets	4 brackets	6 brackets

2. ENVIRONMENT CONDITIONS

The freezer is designed for use under the following ambient conditions (in accordance with EN 61010-1):

- Indoor use.
- Maximum altitude: 2000 m.
- Ambient temperature range between 5°C and 40°C.
- Maximum relative humidity of 80% for temperatures up to 22°C.
- Supply voltage ripple < ±10 % of rated voltage.
- Supply network voltage surges: category II (Standard IEC 60364-4-44).
- Maximum level of room contamination: 2.

BM 3E freezers are Class A devices within the meaning of the EMC Directive.

3. Electrical environment

A 230 V / 50 Hz or 120 V / 60 Hz single-phase electrical power supply is required, as specified on the manufacturer's plate at the rear of the unit.

The freezer must be powered via a safety mechanism, such as a correctly rated differential circuit breaker, which automatically cuts off the power supply if an insulation fault occurs.

To enable the unit to be electrically cut off, the circuit breaker must be readily identifiable and within reach of the operator.

4. Location

To minimise power consumption and achieve the specified performance, place the freezer in a ventilated location, away from sources of heat (radiators, heaters, etc.) and avoid locations exposed to sunlight. Place it on a flat surface. For correct operation, it is essential that the freezer be placed level. Use rigid chocks if necessary.

Ensure that there are no obstacles (walls, equipment) that impede the ventilation of the freezer (air inlet and outlet).

Lower the two front legs, turning by an additional quarter-turn after they touch the ground.

Room temperature should not exceed 35°C. The moisture content in the air must not exceed 50% RH. The use of an air conditioning system can considerably extend the service life of the compressors.

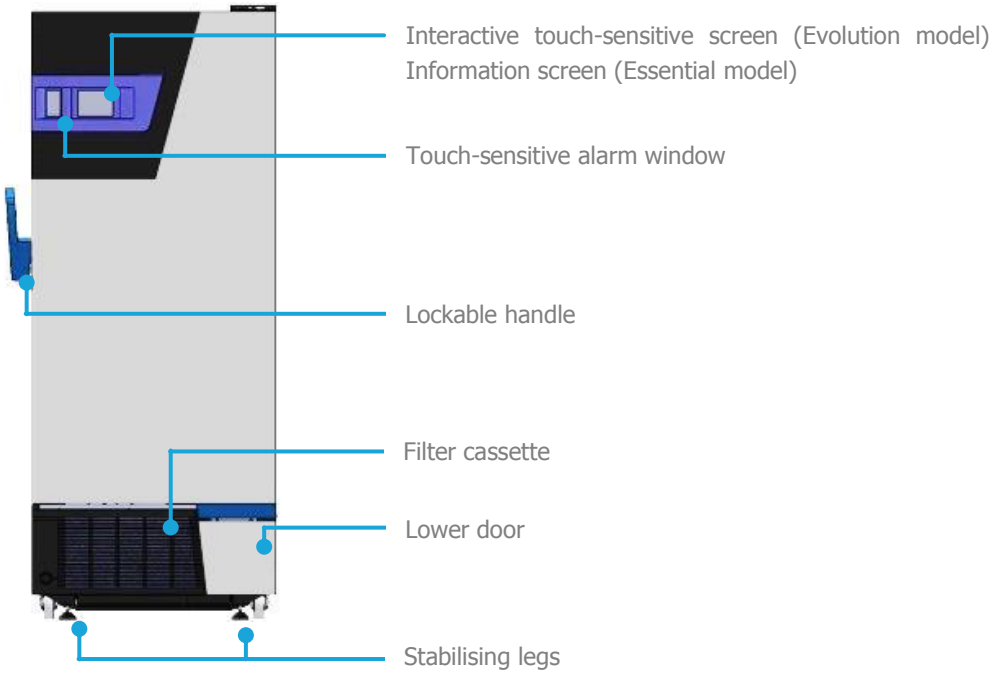
If backup systems using liquid CO_2 or nitrogen vapour injection are used, please refer to the corresponding safety data sheets.

5. Construction and insulation

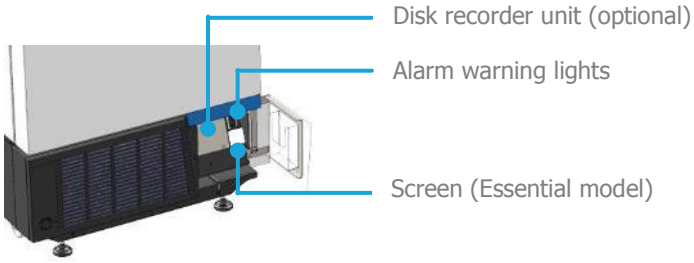
The self-contained outside casing is made from **zinc electroplated steel** sheet protected by epoxy paint.

The inner chamber is made from stainless steel sheet. Thermal insulation is provided by vacuum and polyurethane foam insulating panels. The insulated swivel door is mounted on a hinge.

The door is closed and sealed by a progressive sealing handle.



Front view



Opening of lower door panel

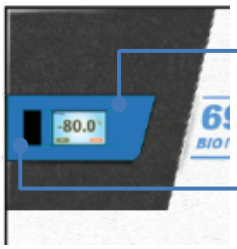
6. Control console

The control console is located towards the top of the door. It comprises a main screen and a touch-sensitive alarm window. The main screen is touch-sensitive only on the Evolution model.

Main screen

Touch-sensitive alarm window

Essential model



Touch-sensitive main screen

Touch-sensitive alarm window

Evolution model

7. Loading

In order to avoid any damage to the freezer and ensure that the specified technical performance is attained, the following instructions must be followed:

- Do not place highly corrosive substances in the freezer.
- Do not place explosive or highly flammable substances in the freezer.
- Leave at least 3 cm clearance along internal walls.
- Do not pull out several shelves at once.

In order to avoid any risk of a heavily loaded freezer toppling, do not pull out several sliding shelves and/or drawers simultaneously.
Do not under any circumstances exceed the maximum allowable load for each sliding shelf or drawer.

These freezers are not explosion-proof.

The interior surfaces of the freezer and the contents can be extremely cold (-86°C): protect yourself accordingly (in particular by wearing suitable gloves).

	BM340	BM515	BM690
Level 4	/	/	1 shelf
Level 3	/	1 shelf	1 shelf or 1 drawer
Level 2	1 shelf	1 shelf or 1 drawer	1 shelf or 1 drawer
Level 1	No fixtures	No fixtures	No fixtures

It is possible to replace a drawer with a shelf. A shelf cannot, however, be replaced with a drawer.

6. General use

1. Commissioning

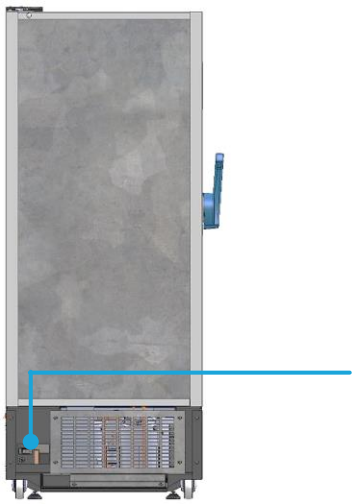
Follow the instructions in the correct order:

1. Install the drawers or shelves in each level.
2. Press the On/Off button (it activates 24V).
3. Connect the freezer to a power outlet (230 V 50 Hz 16 A + neutral + earth) protected by a 30 mA differential circuit breaker.
4. Compressor(s) and fan will start up. The freezer will make a noise.
5. The screen displays "Froilabo" (start-up phase on Evolution model), then shows the temperature inside the chamber.
6. Adjust the setpoint (-45°C or -80°C by default, depending on model).
7. Wait until the freezer reaches the set temperature (3 to 6 hours depending on model).
8. Load the freezer.

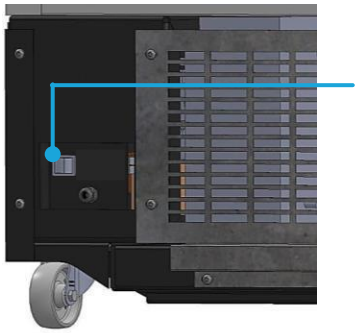
Note 1: the temperature in the freezer may rise if it is loaded with "hot" products. The high temperature alarm may be triggered.

Note 2: the switch cuts off only the internal 24 V power supply required in particular for the processor and display. The freezer is still powered as long as the power cable is connected to the mains.

Any electrical maintenance must be performed by qualified staff.



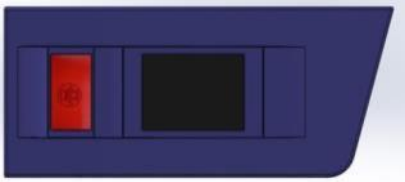
Rear view



Close-up view of the switch

2. Main screen

1. Essential model

Image	Description
	The image opposite is displayed at all times.
	In the event of a malfunction, the screen turns off and the red indicator flashes. A buzzer sounds intermittently.

2. Evolution model

Image	Description	Command
	When the freezer is in use, the screen opposite is displayed at all times.	
	Temperature measured	
	The envelope flashes when a new message is added. The biohazard or radiation symbols may be shown at the top of this screen. These visual reminders can be configured in the user preferences.	

Main display

3. HOME SCREEN

Press anywhere on the main display to show the Home screen. The Home screen provides access to all available menus.

If the screen is not touched for 1 minute, the main display automatically resumes.

Image	Description	Command
 Home screen	User preferences menu	
	Mapping menu	
	Information menu	
	Statistics menu	
	Servicing menu	
	Factory menu (password required)	
	Diagnostics menu	
	Eco menu	
	Access to a free text zone in order to leave messages for subsequent users. The logo flashes to indicate the presence of a new message.	
	Adjust the temperature setpoint	86,0°C
	Return to the main display	

4. Numeric keypad (evolution model)

When a numeric parameter is to be entered, the keypad below is displayed.

Image	Description	Command
 Numeric data entry	Save the change and return to the previous screen.	
	Delete the last digit entered.	
	Return to the previous menu without saving changes.	

5. Entering a message (evolution model)

A text message, visible to all users, can be entered.

Image	Description	Command
	Press the text field.	
	Delete the entire message	
	Return to the main display	
	Access lower case characters	abc
	Access upper case characters	ABC
	Access digits and symbols	123#;

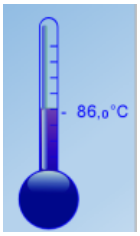
6. ADJUSTING THE TEMPERATURE SETPOINT

Image	Description	Command

On the **Evolution model**, the temperature setpoint adjustment is accessible from the Home screen.

Home screen

To adjust the temperature setpoint, press the pictogram opposite on the Home screen.



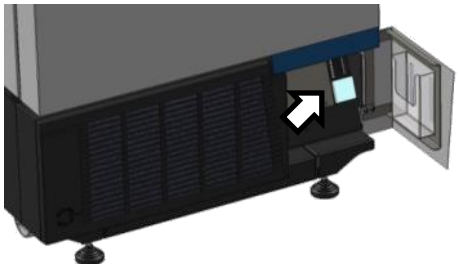
Numeric data entry

The numeric data entry screen is used to enter a negative value within the authorised range.

Enter the desired setpoint.

Confirm.

On the **Essential model**, the setpoint can be adjusted on the display at the bottom of the unit.



Open the door at the bottom right to access the display.

Actual temperature

Temperature setpoint

Essential display

Adjust the value using the two buttons.

No confirmation is necessary. The value is stored directly.

7. « User preferences » menu (Evolution model)

The user can configure certain settings to customise use of the freezer.

Image	Description	Command
	From the Home screen, access the user preferences.	
	Screen brightness setting	
	Standby timer	
	Date setting	
	Time setting	
 User preferences menu	Choice of temperature unit: °C / °F Default value: °C	
	Display of estimated sample temperature. Default value: ON When set to OFF, the chamber air temperature is displayed.	
	Display of biological risk warning: ON/OFF. Default value: OFF. When set to ON, the logo is displayed at the top of the screen.	
	Display of radiation risk warning: ON/OFF. Default value: OFF.	
	Return to previous menu	

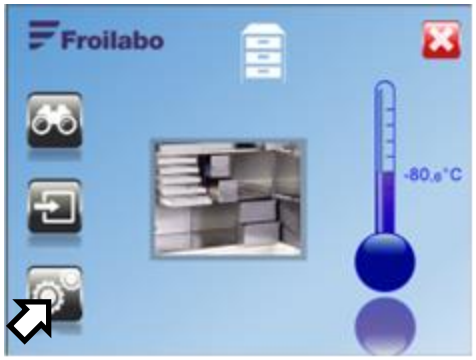
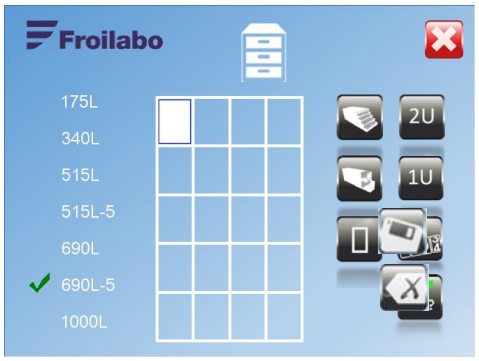
8. « MAPPING » MENU (EVOLUTION MODEL – IN OPTION)

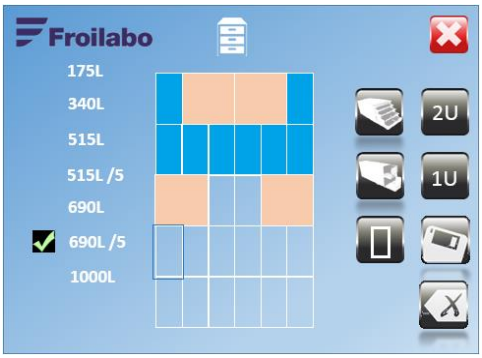
General menu giving access to the three mapping-related functions. This menu is an option on Evolution model.

Image	Description	Command
	From the Home screen, access the mapping menu.	
 Mapping menu	Search for a sample	
	Enter a new sample	
	Configure the freezer storage space	
	Return to the previous menu without saving changes Pressing one of these buttons brings up a username entry screen.	

1. Configuring the freezer

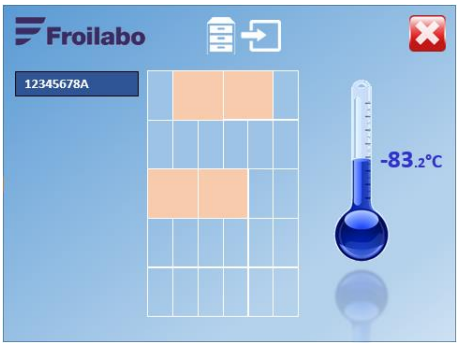
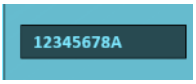
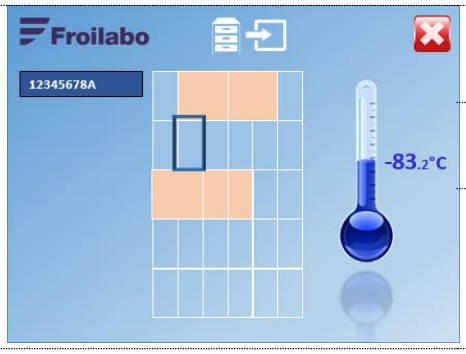
The freezer must be configured to specify the type of storage elements incorporated. Configuration thus entails defining the types and locations of drawers and shelves.

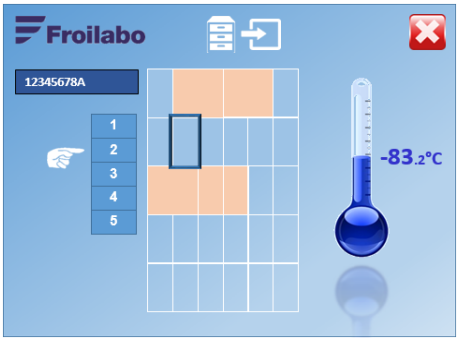
Image	Description	Command
	From the Mapping screen, access the freezer configuration menu.	
	Enter the access code (five digits). Confirm.	
	Select the freezer capacity by pressing the corresponding value. The elementary grid corresponding to the capacity is displayed (factory-set default value). Note: several sample numbers can be stored in the same location.	
	Select a shelf two units wide.	
	Select a drawer one unit wide.	
	Select another accessory two units wide.	
	Select another accessory one unit wide.	
	Empty space.	
	Exit the menu, confirming the configuration.	
	Erase the last item entered.	

	The elementary location being configured is highlighted.	
	Return to the previous menu without saving changes.	
	Drawer elements are shown in blue.	
	Shelf elements are shown in cream.	
	The cursor is positioned on the next zone to be edited.	

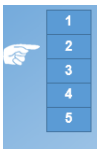
Example after configuring the top three shelves.

2. Adding a sample

Image	Description	Command
	From the Mapping screen, access the Add sample menu. Enter the access code (five digits). Confirm.	
	Press the blue zone to enter a sample identifier. A data entry keyboard is displayed.	
	Enter the sample identifier.	
	Save and confirm the data entered.	
	Select where the sample will be stored.	
	Drawer (blue) OR	
	Shelf (pink)	



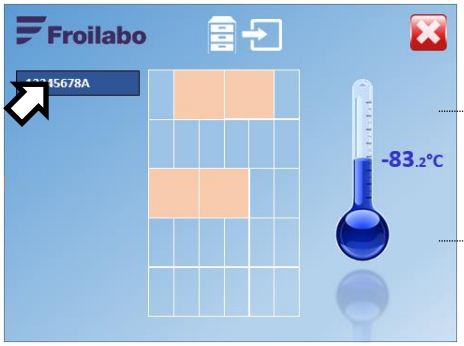
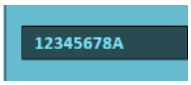
Select the drawer or shelf by pressing the corresponding number.



The selected drawer number is displayed in the location.

Confirm the data entered.

3. Searching for a sample

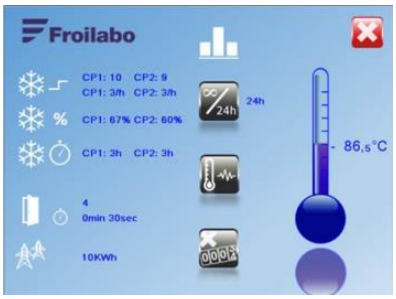
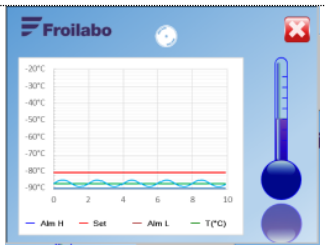
Image	Description	Command
	Searching for a sample	
	Press the blue zone to enter a sample identifier. A data entry keyboard is displayed.	
	Enter the sample identifier.	
	Confirm the data entered.	
	The search is performed. The corresponding storage area is highlighted. The shelf number is shown in the centre.	
	The sample record can be deleted.	

9. « PRODUCT INFORMATION » MENU (EVOLUTION MODEL)

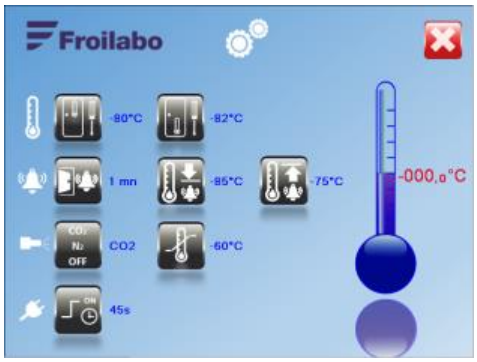
Image	Description	Command
	From the Home screen, access the Product information menu	
	The information cannot be modified. The following information is displayed, in order: - Model name - Capacity in litres - Serial number	
	- Maximum electrical power rating - Electricity consumption converted to BTU/h (1 W = 3.412141633 BTU/h)	
	- System software version - Screen software version	
	- L: Stage 1 refrigerant type Stage 1 load - H: Stage 2 refrigerant type Stage 2 load	
	Return to previous menu	

10. « STATISTICS » MENU (EVOLUTION MODEL)

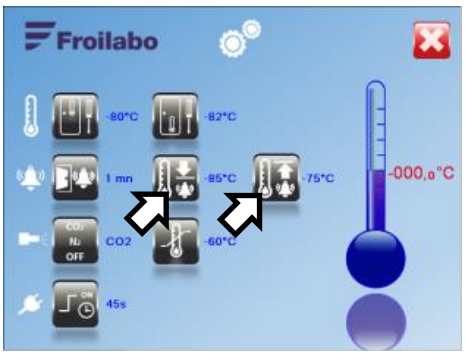
Data is stored in the unit. It can be displayed either for the last 24 hours or for the entire operating life of the freezer.

Image	Description	Command
	From the Home screen, access the Statistics menu.	
	Selection of statistical data displayed: - "24H": last 24 hours - "4EVER": since the freezer was commissioned	
 * *CP1: Stage 1 (bottom) compressor* *CP2: Stage 2 (top) compressor*	Number of start-ups (e.g. 10) and number of start-ups per hour (e.g. 3/h) for each compressor*.	
	Compressor usage rate: compressor operating time relative to the total operating time for the unit.	
	Compressor usage time, in hours.	
	Number of times the door has been opened, and average door open time.	
	Electrical power consumption of the unit.	
	Access to the temperature graph for the last 10 hours.	
	Access to the fault history.	
	Return to previous menu	
 **Temperature graph**	From the Statistics menu, access the temperature graph. The graph shows the actual temperature, the high and low alarm levels and the temperature setpoint. If possible, link the axis limits to the temperature alarm levels. Allow for return.	
 **Fault history**	From the Statistics menu, access the fault history. List of the last 10 errors, followed by the dates and times when the fault occurred and ceased. Access the error codes	

11. « SAV » MENU (EVOLUTION MODEL)

Image	Description	Command
	From the Home screen, access the Servicing menu.	
	Enter the access code (five digits). Default code: "11111". Confirm.	
 **Servicing menu**	Top sensor offset (protected by servicing password)	
	Bottom sensor offset (protected by servicing password)	
	Door open alarm delay	
	Low temperature alarm threshold	
	High temperature alarm threshold	
	Emergency injection configuration: OFF / CO_2 / N_2	
	Emergency injection trigger threshold	
	Start-up delay time	
	Return to the main display	

1. Setting the high and low alarms

Image	Description	Command
	Low temperature alarm threshold: set the desired temperature at which the alarm will be triggered.	
	High temperature alarm threshold: set the desired temperature at which the alarm will be triggered.	
	Return to the main display.	

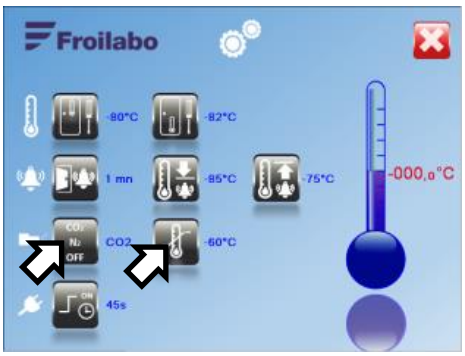
Servicing menu

2. Setting the CO_2 / N_2 injection threshold

To use emergency injection, CO_2 / N_2 injection must be enabled and the injection threshold must be set.

Warning: When the freezer is installed, injection must be enabled only once the temperature setpoint has been reached, otherwise the gas cylinders will be discharged before the temperature drops for the first time.

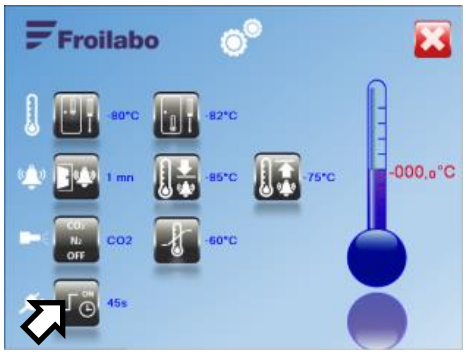
Warning: Using these gases is hazardous. Please refer to the safety data sheet in section 13 **SAFETY**.

Image	Description	Command
	Emergency injection configuration: OFF / CO_2 / N_2 Select the corresponding mode.	
	Emergency injection trigger threshold Set the desired temperature.	
	Return to the main display	

Servicing menu

3. Setting the start-up time delay

If several freezers are installed on the same electrical network, the start-up time delay can be used to start the units in turn in order to avoid momentarily overloading.

Image	Description	Command
 Servicing menu	Start-up delay time. Set the delay before the unit starts up. After the freezer is powered up, the first stage compressor will start only after this delay has passed.	

12. « FACTORY » MENU (EVOLUTION MODEL)

Image	Description	Command
	From the Home screen, access the Factory menu. This menu is reserved for use on the production line. Access is protected by a factory password.	
	Return to previous menu	

13. « DIAGNOSTICS » MENU (EVOLUTION MODEL)

Image	Description	Command
	From the Home screen, access the Diagnostics menu.	
	Temperature of the top sensor. Optional.	
	Temperature of the bottom sensor (analogue gauge).	
	Ambient temperature. Optional.	
	Instantaneous power consumption (analogue gauge), in Watts.	
	Door status sensor: Green tick: door closed Red cross: door open	
	Top compressor (H or CP2) control: State of power contactor: ON/OFF	H
	Bottom compressor (L or CP1) control: State of power contactor: ON/OFF	L
	Condenser fan control: State of power contactor: ON/OFF	
	Battery low signal: Green tick: battery charged Red cross: battery discharged	
	Heating gasket control: ON/OFF Default value: ON.	
	Top compressor (H) overpressure sensor: Pressure value in bar.	H
	Bottom compressor (L) overpressure sensor: Pressure value in bar.	L
	Temperature at intermediate condenser	
	Condenser fan flow measurement: percentage of maximum flow measured in factory.	

	User presence detection: Green tick: Movement is detected in front of the keyboard. Red cross: User not present or motionless in front of the door.	
	Remote alarm relay test	
	CO_2 / N_2 solenoid valve test	
	Return to previous menu	

14. « ECO » MENU (EVOLUTION MODEL)

The Eco menu can be used to define the freezer's electricity consumption settings for each day of the week.

Image	Description	Command
	From the Home screen, access the Factory menu. This menu is reserved for use on the production line. Access is protected by a factory password.	
	Select the day of the week to be configured based on the settings shown on the screen. Monday = 1 to Sunday = 7	
	ECO mode: enabled (ON) or disabled (OFF).	
	Set the start time for ECO mode. A numeric keypad is displayed. Enter the start time and then confirm.	
	Set the stop time for ECO mode. A numeric keypad is displayed. Enter the end time and then confirm.	
	Door seal heating mode: enabled (ON) or disabled (OFF). In the OFF position, frost may build up on the seal, which may then harden.	
	User presence detection mode: enabled (ON) or disabled (OFF). If this mode is disabled, the screen does not turn on when movement is detected in front of the door.	
	Energy saving advice is displayed.	
	Setting the ECO mode setpoint. A numeric keypad is displayed. Enter the desired temperature and then confirm.	
	indication of the electricity consumption corresponding to the settings. Green: economical setting. Red: setting with higher electrical consumption.	
	Return to previous menu	

15. CLOSING THE FREEZER

The freezer has a progressive sealing handle with a double-acting mechanism to facilitate opening and closing of the door. The freezer door can be locked using a key-operated lock on the side of the handle.

16. BATTERY-BACKED ALARM FUNCTIONS

In the event of a mains power cut, the buzzer, remote alarm and CO_2 injection (optional) functions remain active, powered by a backup battery supplied as standard. The temperature display is also maintained.

Warning: the compressors are no longer powered and the freezer thus does not cool.

17. CHECKING THE AIR FILTER

At regular intervals (1 month), factory preset, the sound alarm goes off and the LED of alarm filter is enabled. The acquittal of the alarm using the Mute button back selected time the next audit of the filter alarm.

This interval can be changed. It is an intervention to be performed by an authorized technician. Contact the Technical Department of Froilabo.

18. BOSS SYSTEM

The BoSS system ensures that the freezer will operate in the event of a malfunction on the 24 V circuit board **provided that the mains supply is present**. The compressors are then powered continuously, but are not regulated by the PLC.

Your samples are thus safe, with no risk of a temperature rise.

Trigger principle:

1. If the 24 V supply to the regulator is cut off due to a fault on the circuit board, the regulator is powered by the 24 V batteries, the alarm light is not lit and the freezer operates normally, powered by the backup batteries.
2. If the battery voltage drops to 20 Volts (±2 V) or if the controller does not activate its heartbeat signal, the BoSS system is triggered, the alarm indicator and buzzer on the freezer front panel are triggered and the regulator display is lit. The compressors are connected directly to the 230 V supply with no regulation system.
3. The temperature in the freezer may fall to –90°C ±2°C.
4. After 40 hours (±1 hour), the regulator display stops. The compressors remain in continuous operation with no regulation, and the alarm indicator is not lit.

The freezer can operate under the BoSS system for several days without difficulty. However, Froilabo's service department should be contacted to schedule a repair.

WARNING: THESE SPECIFICATIONS WERE OBTAINED USING NEW BATTERIES CHARGED FOR AT LEAST 24 HOURS.

7. OPTIONS

1. REMOTE ALARM

The connector located at the rear of the unit can be used to connect a remote alarm.

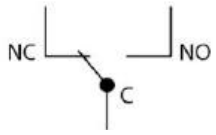
We highly recommend using the NC contact, which also enables an alarm to be transmitted if one of the wires is disconnected.

Maximum allowable current: 5 A at 30 V DC, 5 A at 250 V AC

Note: After connecting the wires, screw the connector to its base to avoid any risk of the wires being pulled loose.

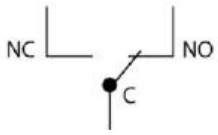
FREEZER AT -80°C, ALARM THRESHOLD SET TO -60°C

Contact position above alarm threshold

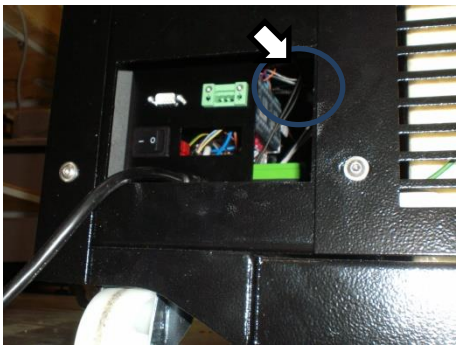


Temperature above alarm threshold (e.g. 59°C): the contact switches to NC

Contact position below alarm threshold



Temperature below alarm threshold (e.g. 80°C): the contact is at NO



2. CO_2 / NO_2 BACKUP

1. Risks and precautionary measures

Whenever a CO_2 or N_2 backup system is used, it is essential to refer to the safety data sheet.

2. Cold burns (cryogenic burns)

The "extreme cold" pictogram must be used to warn of this hazard.

If CO_2 or N_2 injection has been used, the door must not be opened, in order to avoid any risk of cryogenic burns.

In the event of an accident: WARNING! The temperature of the injury site must be returned to body temperature as quickly as possible. The appearance of a cryogenic burn initially seems to be minor and does not cause concern. Rinse the burn with warm water for **at least 15 minutes**.

Cover with a sterile dressing and consult a doctor.

3. Risk of asphyxiation

The "asphyxiation risk" pictogram must be used to warn of this hazard.

Cold vapours are heavier than air and can accumulate in confined locations, particularly at or below floor level.

These gases can result in asphyxiation, even from the second breath, leading to unconsciousness (oxygen content of less than 18%).

To avoid this hazard:

- Ensure that storage and use areas are well ventilated.
- Do not discharge nitrogen into locations where it could build up to dangerous levels (sewers, basements, pits, closed rooms).

In the event of an accident: If asphyxiation occurs, the rescuer must use a self-contained breathing apparatus to access the victim, or must be able to quickly ventilate the room to a sufficient extent without entering it.

4. CO_2 backup

General remarks

CO_2 The pressure in the cylinders and hoses reaches **70 bar**. It is therefore recommended to call on qualified personnel for any servicing of this system.

Cylinders of **liquid CO_2** must be used.

Connection

Principle: the freezer injects liquid CO_2 into the chamber if the interior temperature rises. The temperature is regulated by the CO_2 injection solenoid valve.

Connect the hose to the solenoid valve located at the rear of the freezer, then to the distribution manifold or the CO_2 cylinder, after checking that Teflon tape is applied to the thread.

Warning: if the ambient temperature is higher than +37°C, all of the CO_2 in the cylinder will be transformed to a gas. The pressure may exceed 90 bar (temperature of +40°C). If gaseous CO_2 is injected into the freezer chamber, no cooling effect occurs.

CO_2 detector

When CO_2 or N_2 are injected, the oxygen content in the air gradually decreases. To avoid potential asphyxiation of personnel in the room, Froilabo can supply CO_2 detectors. An audible alarm is sounded if the oxygen level is low.

To order or install a CO_2 detector on an existing system, please contact our customer service department.

5. N_2 backup

Principle: the freezer injects liquid nitrogen (vapour phase) into the chamber if the interior temperature rises. The solenoid valve regulates the temperature by pulsing the N_2 injection.

Connecting the N_2 option:

1. Connect the N_2 hose supplied with the freezer (**1**).
2. Check that all couplings are properly tightened.
3. Connect the liquid nitrogen supply.

Parts to be assembled:

- ¼" copper pipe + short nut + safety valve (part A)
- pre-assembled kit (tee piece + two male-female unions) (part B).

1. Check that the pre-assembled kit is covered with Teflon tape.
2. Screw the pre-assembled kit onto the solenoid valve, ensuring that the tee points upwards.
3. Connect the copper pipe to the tee.
4. Attach the copper pipe to the freezer using Colson clamps, ensuring that the safety valve points downwards.
5. Check that all couplings are properly tightened.
6. Connect the liquid nitrogen supply.

3. DELAYING TEMPERATURE RISES

Principle: the cryo-accumulator system is incorporated into the useful volume of the freezer and does not reduce its storage capacity.

It provides additional autonomy before the temperature rises due to refrigeration stoppages.

For example, the time taken for the temperature in a BM 3E 690L freezer to rise from -80°C to -40°C is:

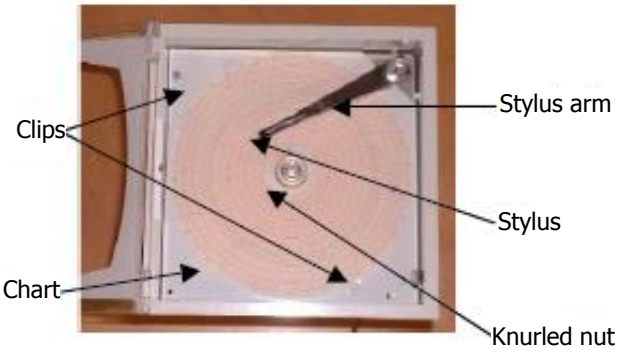
- 6½ hours without a cryo-accumulator.
- 13 hours with a cryo-accumulator.

Note: these tests were conducted with a freezer half full, at an ambient temperature of 25°C, without opening the door.

4. CHART RECORDER

Froilabo proposes an optional chart recorder, capable of recording the temperature over a 24-hour or 7-day period (selectable on the unit). Two models are available: disc or digital.

Description



Changing the paper disc (diagram):

1. Unlock and open the recorder door.
2. Raise the stylus arm.
3. Unscrew the knurled nut.
4. Remove the chart.
5. Position the new disc, inserting it beneath the clips, and then tighten the knurled nut **without forcing.**

Note: the chart is perfectly aligned with the axis.

1. Time setting

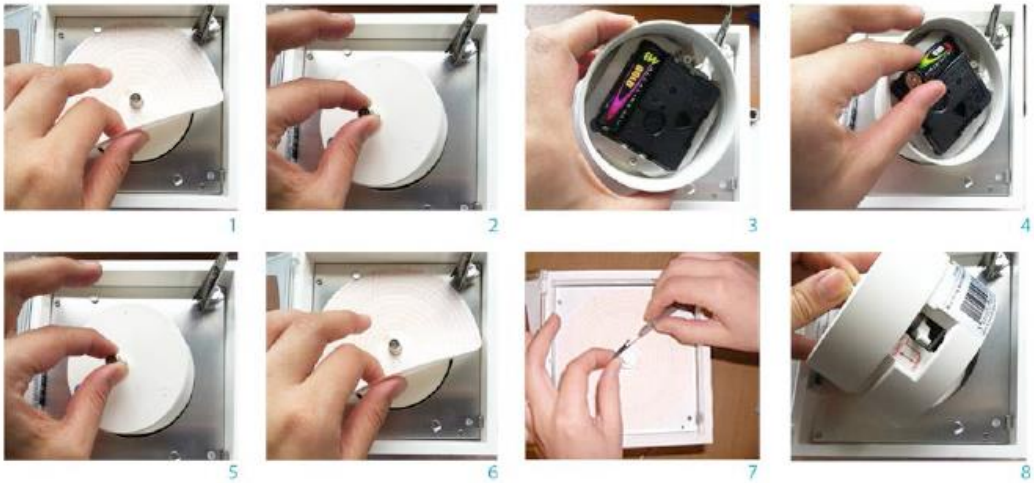
Manually turn the axis clockwise to the desired date and time.

Use the end of the stylus as a reference point. It is essential to turn clockwise to avoid backlash in the timer mechanism.

2. Replacing the LR6 (AA) battery

1. The battery compartment is located underneath the paper disc in the recorder (1).
2. Remove the paper disc (1).
3. Remove the drive mechanism and turn it upside down (2 and 3).
4. Replace the battery, ensuring that the polarity is correct (4).
5. Replace the drive mechanism (5).
6. Position the disc beneath the clips and then tighten the knurled nut (knurling on outside) without forcing (6).
7. Set the time (7).

Note: The operating speed can be selected (1× 24 h or 7× 24 h). To change the speed, move the drive mechanism switch downwards (8).



3. Replacing the stylus in the recorder

The felt stylus is supplied in a sealed silver-coloured bag.

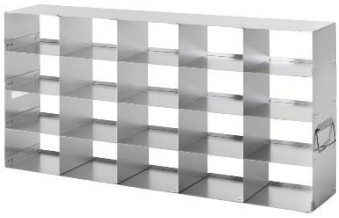
1. Raise the arm.
2. Remove the stylus, holding the arm between your thumb and index finger *(photo).*
3. Insert the new stylus.
4. Remove the protective cap.
5. Lower the arm.
6. Set the time.

8. STORAGE ELEMENTS

To facilitate storage in your freezer, an extensive range of storage elements is available: fixed shelves, sliding shelves, drawers, etc.

For further information, please contact our sales department.

Drawers (ELMP690)



Shelves (ELE)

Drawer unit (ELT)

9. MAINTENANCE AND CUSTOMER SERVICE

1. User maintenance

Due to the intense cold, microorganisms from packaging, handling and contact can survive and remain fully virulent. All necessary precautions must be taken when accessing freezers:

- Outer surfaces must be cleaned regularly.
- Gloves must be worn.
- The door must be opened only briefly.
- Tissue samples and packaging must be handled under a laminar flow hood.

The freezer must be switched off before cleaning. A water jet must not be used for cleaning, to avoid splashing the freezer.

2. Outer surfaces

Wash with warm water and soap or a non-corrosive neutral detergent. Rinse and dry thoroughly.

3. Interior chamber

Bleach must not be used, even at very low concentrations.

The stainless steel surfaces must not be cleaned with steel wool or any other abrasives.

4. Door seal

The door seal is heated by a resistive wire located within the joint in order to minimise frost build-up. Frost may nonetheless build up between the lips of the seal, especially if the door is opened frequently. The silicone seal should be cleaned with dry compressed air or using the plastic blade supplied by Froilabo.

5. Pressure relief valve

Froilabo freezers have a pressure relief valve enabling the chamber to be quickly returned to ambient pressure, either when opening the door or after injection of CO_2 or N_2.

Frequent opening of the doors increases humidity in the freezer and may result in ice forming in the air intake tube in which the pressure relief valve is located. A set of calibrated foam blocks is placed in the air intake tube to minimise this phenomenon.

If the air intake tube is blocked by ice, opening the door becomes difficult.

If this occurs, remove the safety valve and the calibrated foam blocks and then insert a screwdriver (or other long, thin object) in the air intake tube and push the ice into the freezer chamber.

Clean the pressure relief valve (on the side of the unit) and the calibrated foam blocks on a regular basis (every one to three months, as needed). Ensure that the valve and blocks are replaced correctly.

6. AIR FILTER

In order to maintain the refrigeration performance of the freezer and prolong the life of the compressors, an air filter is located on the front panel, in front of the condenser.

This filter must be cleaned of dust as often as necessary. To do this, simply remove the filter and wash it (using water with no cleaning products). After drying (without wringing) the filter, put it back in place.

Freezers must not be operated without filters (except in a clean room).

7. STOPPING FOR EXTENDED PERIODS

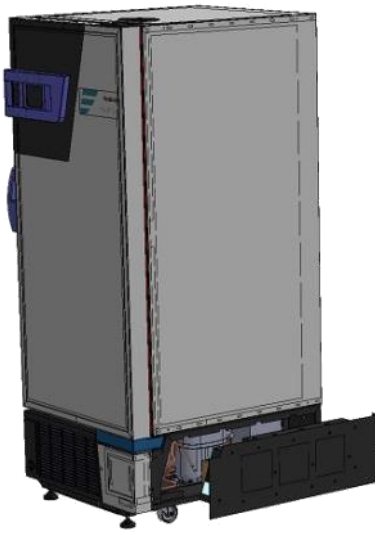
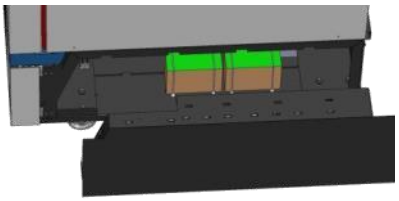
If the unit is to remain unused for a long period of time, the following operations should be performed:

1. Turn off the freezer.
2. Unplug the mains lead.
3. Defrost, clean and wipe the chamber.
4. Leave the door ajar to avoid any unpleasant odours.

10. MAINTENANCE PERFORMED BY TECHNICAL SERVICES

1. SAFETY RULES

Before performing any servicing on the freezer, turn it off using the On/Off button and disconnect it from the mains. Cut off at the main fuse holder (on the electrical cabinet, accessible by dismantling the bottom right section.

Image	Description
	Remove the rack mounting system.
	Withdraw the rack and place it carefully on the floor.

2. SERVICING / SERVICE CONTRACT

In the same way that motorists service their vehicles to keep them in the best possible working order, so the use of a freezer requires a certain minimum level of maintenance in order to keep it in good working order.

Accordingly, an annual service is recommended, to check various aspects (performance, safety, alarms), to pre-empt certain failures and to carry out preventive actions to minimise the risks of unexpected shutdowns. This service may be performed by the customer's maintenance department, if it possesses the equipment needed and has received training from Froilabo, or by a Froilabo technician during an annual inspection. Notwithstanding the above, any serious issues will require a visit from our maintenance service, or diagnosis and assistance by telephone.

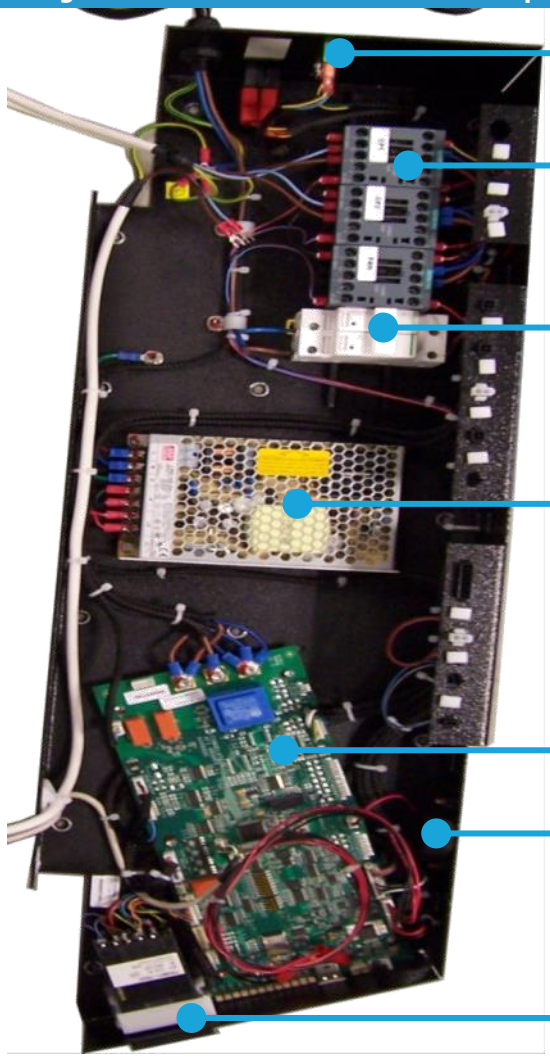
Inspection points:

- Fully clean the condenser and replace the filter.
- Check the refrigerant load.
- Check the motor current loads.
- Check the safety mechanisms, alarms and thermostats.
- Check all mechanical parts (latches, chamber fixtures)

- Check the internal chamber temperature.
- Check the refrigerating circuit for leaks.
- Check the compressor dampers (vibration reduction).
- Replace the stylus in the recorder.
- Check the fan bearings.

Depending on the type of service contract, Froilabo undertakes to respond within set lead times in the event of a failure.

To take out a service contract, please return the service contract request form (see section 12 SERVICE CONTRACT) by fax.

Image	Description	Command
	Remote alarm connector	
	Power contactors (×3) The BoSS protection system makes use of these normally-closed power contactors.	
	Fuse holder	
	24 V supply	
	Artic board	
	Buzzer	
	Regulator (Essential model)	

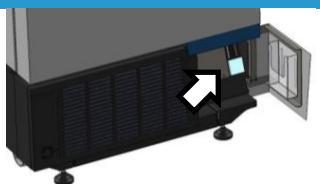
Power and control rack

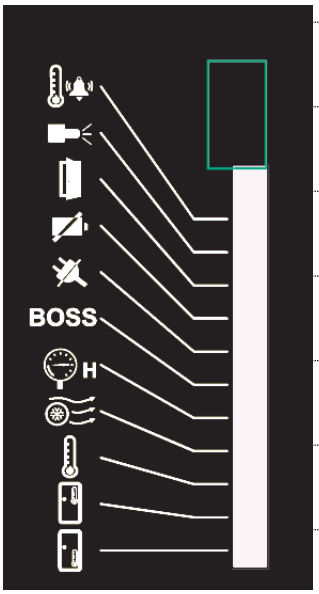
11. FAULTS AND ERROR CODES

On the **Evolution model**, faults are indicated on the screen on the door.

Image	Description	Command
	If a fault occurs, the screen turns red. The temperature is displayed. Press the "i" button for details of the fault.	
	A pictogram illustrating the fault is displayed in the centre of the screen. A brief description and the action to be taken are displayed in English beneath the pictogram.	

On the **Essential model**, faults are indicated on the display at the base of the unit. The same pictograms are used on the Essential and Evolution models.

Image	Description	Error codes	Pictogram	Possible states
	Indicator LEDs can be seen by opening the door at the bottom right.	/	/	
	Intermediate exchanger information (no fault even if lit)	/	First LED, no logo	
	Temperature alarm	1 & 2	/	/
	Temperature too high	1		Steady
	Temperature too low	2		Flashing
	CO_2 or N_2 injection required	3		Steady
	Door open	4		Steady



Backup battery discharged	5		Steady
Power supply cut & BoSS system activated	6	+ BOSS	Steady
Not used	7	/	Steady
Compressor alarm	8 & 9	/	/
Compressor 1 pressure too high	8	H	Steady
Compressor 2 pressure too high	9	H	Flashing
Air filter dirty or missing.	10		Steady
Main temperature sensor fault	11		Steady
Not used	12	N/A	/
Not used	13	N/A	/
Intermediate exchanger temperature sensor fault	14		Flashing
Compressor 1 contactor fault	15	H	2 pulses
Compressor 2 contactor fault	16	H	2 pulses
Fan contactor fault	17		Flashing
Compressor 1 pressure sensor fault	18	H	3 pulses
Compressor 2 pressure sensor fault	19	H	3 pulses
Target temperature not reached	20	+ H	Steady
Not used	/		/
Not used	/		/

12. SERVICE CONTRACT

Please contact Froilabo After Sales Service at +33 (0)1 60 95 15 70.

13. SAFETY

1. LIQUID CO_2 BACKUP

1. Precautions for the use of CO_2

Properties of CO_2:

- Does not sustain life or combustion.
- Present in low concentrations (0.03%) in air.
- Makes the atmosphere unbreathable at concentrations exceeding 3%.
- Accelerates respiratory rate, induces faintness, vomiting, coma or **even death.**
- Heavier than air (d=1.53).
- Non-flammable, colourless gas with a slightly acidic odour at high concentrations.
- When liquid CO_2 is released at atmospheric pressure, carbon dioxide snow is generated at a temperature of –80°C.

Ensuing risks:

- Risk of asphyxiation. Loss of consciousness occurs when concentration exceeds 8 to 10%.
- CO_2 builds up in low areas.
- Risk of frostbite.
- Risk of corrosion of steels in the presence of humidity.

Essential precautions to be taken:

- Areas where CO_2 is stored or used must be well ventilated (extraction or ventilation at both high and low levels in the room).
- Areas liable to contain an unbreathable atmosphere must be indicated with a **CO_2 – risk of asphyxiation** hazard pictogram.
- Never enter a room that has contained CO_2 without taking predefined precautionary measures.
- Eliminate links between areas where CO_2 is stored or used and low points (pits, drainage channels, basements) where it could accumulate and render the atmosphere unbreathable.
- Use a CO_2 concentration detector (or O_2 concentration detector) to check that the CO_2 concentration is less than 0.5% (as recommended by INRS, the French National Research and Safety Institute).

In the event of an incident or accident:

- If asphyxiation has occurred
  - Check the oxygen concentration in the room and then take the victim to the open air (taking an insufflator with you).
  - Begin artificial respiration and call the emergency services.

- In the event of a leak
  - Do not enter the room without breathing apparatus if the carbon dioxide concentration is higher than 3%.
  - Close the valve on the cylinder.
  - Air the room at length, ensuring that low points are ventilated.

2. Precautions with regard to equipment

Warning: cylinders are pressurised!

- Handle cylinders with care.
- Secure cylinders in place.
- Do not expose cylinders to excessive temperatures.
- Treat valves with care (operate gently, do not dismantle or lubricate valves).
- Ensure that hoses and pressure regulators are fit for use. Check the condition of gaskets and use original parts only.
- Before installing the pressure regulating valve, open the valve briefly to expel dust (do not stand in front of the valve outlet at this time).
- Never transfer gas from one cylinder to another.
- Never lay a cylinder on its side during use.

After use:

- Close the valve carefully.
- Drain the outlet circuit.
- Loosen the adjustment screw on the pressure regulating valve.
- Close the valve on the receiving equipment.
- Regulations apply to the transportation of cylinders.
- Frames must be handled with care in the same way as cylinders.

Users of the equipment, who are fully aware of the conditions of use and thus best placed to monitor the equipment, are solely responsible for proper use.

2. LIQUID NITROGEN BACKUP

1. Precautions for the use of Nitrogen

Strict rules must be followed when handling cryogenic fluids such as liquid nitrogen. These rules are intended to avert two key risks: **anoxia and burns** from contact or splashes. Air contains 21% oxygen and 78% nitrogen, by volume. At atmospheric pressure, liquid nitrogen evaporates at temperatures greater than –196°C.

In a cryogenic room, natural evaporation from recipients, filling, and handling of stored samples result in continuous evaporation of liquid nitrogen. This can increase significantly if a fault occurs. If the room is not sufficiently well ventilated, the nitrogen gas generated can cause the atmosphere to be depleted in oxygen.

Properties of nitrogen liquid:

- Does not sustain life or combustion.
- Present in air (78%).
- The evaporation of one litre of liquid nitrogen generates 680 litres of gas.
- Heavier than air at low temperatures.
- Non-flammable and colourless.

Ensuing risks:

- Risk of asphyxiation and loss of consciousness. An atmosphere with less than 16% oxygen is hazardous (nitrogen gas displaces oxygen in the air).
- Nitrogen gas builds up in low areas.
- Risk of frostbite.
- Risk of corrosion of steels in the presence of humidity.

- In closed vessels, the pressure can reach very high values (in the order of 700 bar) resulting in a risk of bursting.

Essential precautions to be taken:

- Areas where liquid nitrogen is stored or used must be well ventilated (extraction or ventilation at both high and low levels in the room).
- Areas liable to contain an unbreathable atmosphere must be indicated with an **asphyxiation hazard** pictogram.
- Never enter a room that has contained liquid nitrogen without taking predefined precautionary measures.
- Eliminate links between areas where liquid nitrogen is stored or used and low points (pits, drainage channels, basements) where it could accumulate and render the atmosphere unbreathable.
- **Use an O_2 concentration detector** to ensure that the oxygen concentration is greater than 18%.
- Avoid uninsulated liquid nitrogen pipes in any areas.
- Call on the services of a specialist to determine the layout of facilities.

In the event of an incident or accident:

- If asphyxiation has occurred:
    - Check the oxygen concentration in the room and then take the victim to the open air (taking an insufflator with you).
    - Begin artificial respiration and call the emergency services.
- In the event of a leak:
    - Evacuate the room.
    - Do not enter the room without breathing apparatus if the oxygen concentration is lower than 18%.
    - Close the valve on the leaking circuit.
    - Air the room at length, ensuring that low points are ventilated.
- If liquid nitrogen is splashed:
- **In the eyes**: rinse the eye thoroughly for at least 20 minutes. **Call a doctor**.
    - **On the skin**: do not rub. Remove clothing if necessary. Warm up the affected areas as quickly as possible under running water for 20 minutes. **Call a doctor**.

2. Precautions with regard to equipment

Warning: nitrogen is liquid at extremely low temperatures and is stored in a double-walled tank. A high vacuum between the walls ensures good thermal insulation. This equipment, especially mobile storage tanks, must be handled with care.

- Avoid impacts. Never lay a cryogenic container on its side.
- Do not expose containers to excessive temperatures.
- Treat valves with care (operate gently, do not dismantle or lubricate valves).
- All equipment used must be in good condition and designed for use at the intended temperature and pressure.
- Mobile equipment must be sheltered from inclement weather. Open-necked containers must be fitted with stoppers to avoid the neck becoming blocked by cryopumping of ambient humidity.
- Use suitable connection hoses; never use intermediate couplings.
- Monitor the pressure of closed containers and check safety equipment (pressure relief valve).
- Regulations apply to the transportation of recipients.

Users of the equipment, who are fully aware of the conditions of use and thus best placed to monitor the equipment, are solely responsible for proper use.

14. CUSTOMER SERVICES

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