EFC Recirculating Chiller

Specification and User Manual

Laird™
THERMAL SYSTEMS

www.lairdthermal.com

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Revision History

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REV	DATE	DESCRIPTION
00	18/03/2024	Initial release

Introduction

The EFC chiller is a refrigeration-based chiller designed for precise and reliable temperature control of equipment. It can be used in several user applications such as Medical, Analytical Instrumentation, Industrial and Semiconductor. This chiller is a semi-closed system for low coolant maintenance.

This user manual provides necessary information to the customer for proper installation, operation, communication, and maintenance of the chiller.

Contact information

If you have questions with respect to this unit, please use the contact information given below. Always communicate the following:

- Company name and address
- Name of contact at your address
- Product data as on identification plate: Type of unit, serial number, part number and year of manufacture

Company contact:

Mail:	Laird Thermal Systems s.r.o. Prumyslová 497 462 11 Liberec Czech Republic
	Phone: +420 488 575 111
Internet:	http://www.lairdthermal.com
E-mail:	Info-lcs@lairdthermal.com
Phone:	+420 488 575 111
Fax:	+420 488 575 303

Safety Precautions

This section provides an overview of all the important safety aspects for optimal protection of personnel as well as safe and trouble-free operation of the equipment.

The operating manual and warning instructions specified herein should be reviewed completely by all personnel prior to operating the unit. Disregarding instructions within this manual may result in considerable danger.

Warning signs

Symbol	Meaning
	Warning with respect to general danger or damage to property
	Warning with respect to electrical hazard
	Warning with respect to highly flammable material

NOTE

Safety labels/signs should not be damaged, and if so then must be replaced

Action signs

Symbol	Meaning
	Protective footwear For protection from falling parts and to prevent slipping
	Protective gloves To protect the hands from rubbing, abrasions, cuts, or more serious injuries
	Protective eyewear To protect the eyes against flying parts or splashing coolant.
	Disconnecting from mains

Guidelines for Safe Operation

Prevent Hazards

Hazards can be prevented by safety-conscious and anticipatory behavior of staff. Individuals working with the unit should keep the following in mind:

- Always keep a complete and legible copy of this operating manual (or the location at which it can be found) available at the installation site of the unit.
- Use personal protection equipment.
- Unit personnel must be familiar with all operating elements of the unit before starting work on the unit.
- Only use the unit for its intended purpose.
- Conduct inspections on a regular basis and ensure the unit is operational and free of damage.
- All unit warning and information signs must be kept in legible condition. If a warning or information sign is lost or illegible, it must be replaced.
- Unit repairs may be carried out by qualified personnel only.
- Any disruption or recognizable change concerning the unit should be reported to the responsible person.
- Adhere to the accident prevention regulations as well as any regional regulations.

Personal Protective Gear

To minimize health hazards, wearing personal protective gear is required when handling the unit. The following personal protective gear must always be worn when handling the unit:

Protective footwear

For protection from falling parts and to prevent slipping.

When cleaning or performing maintenance or repair work on the unit, the following specific personal protective gear is required:

Protective gloves

To protect the hands from rubbing, abrasions, cuts, or more serious injuries. To prevent burns when touching hot coolant.

Protective eyewear

To protect the eyes against flying parts or splashing coolant.

Guidelines Regarding Electrical Equipment

DANGER

Electrical danger

Work on electrical installations must be carried out only by trained and authorized electricians.

- Observe all regional regulations when connecting electrical equipment to mains.
- Electrical shock hazards exist if the electrical installations are defective, or the insulation fails during operation.
- Switch off and disconnect the unit from the electrical mains and follow Lockout-Tagout procedures whenever conducting service work.
- Ensure continuity to ground and isolation from power lines.
- Any changes in the operation of the unit can have an influence on safe operation. All intended changes should be authorized by the manufacturer prior to implementation.
- Keep unauthorized persons away from the working area.
- This unit complies with surge protection standard IEC61000-4-5:2014. If the unit is installed in areas where power surges could exceed the limits in this standard, suitable surge protection devices must be installed to protect the unit.

Inadmissible Operating Conditions

Operating the unit under improper conditions is not permitted as the operator's safety cannot be guaranteed. Some operating conditions not permitted are the following:

- The machine is intended for indoor use only.
- Using the unit for a purpose other than its intended use.
- Using the unit when any part of it is damaged, not working properly, the electrical installation is not correct, or the electrical insulation is damaged.
- Protective or safety equipment is non-functional, defective, improperly installed, or missing.
- The unit or operating parameters were modified without consulting the manufacturer.
- Operation in areas exposed to explosion hazards.
- Operation without a cooling media not recommended by the manufacturer.
- High Temperature Limit on Coolant Return - The maximum allowable coolant return (inlet) is 50°C. It is the responsibility of the customer to ensure that this limit is not exceeded. Laird Thermal Systems recommends a thermal shutoff be used with the equipment connected to the Recirculating Chiller. Methods include:
    - A method to turn off the heat load from injecting additional heat into the coolant. This will allow the Recirculating Chiller to reduce the temperature of the coolant further until stable.
    - A method that stops or restricts the coolant flow into the Recirculating Chiller. This will result in a Coolant High Pressure alarm, which will shut down the system for safety.
    - A method that interrupts the power to the Recirculating Chiller.

  If any of these methods are activated, please reference the Alarms section.

NOTE

The manufacturer is not liable for damage occurring when using the unit in a way it was not intended. This also voids Laird Thermal Systems' warranty.

Specialized Knowledge

NOTE

Authorized persons

Servicing the unit is limited to individuals with adequate knowledge and training pertaining to the required area of service. In some circumstances licensed professionals are required to perform the required service work.

The activities listed *Table 1* in may only be performed by personnel with specialized knowledge.

Table 1: Activities and specialized knowledge

Activities	Qualifications
Working on mechanical and / or hydraulic installations	Industrial technician or sufficiently instructed personnel who can work on the unit under the guidance of the manufacturer's technical support or installation instructions
Working on electrical installations and equipment	Skilled and licensed electrician
Working on refrigeration components and systems	Skilled and licensed refrigeration technician with flammable gas competence

Safety and Signaling Equipment Included in the Unit

The unit is equipped with the following safety equipment:

- The maximum pressure in the refrigeration system is limited by a refrigerant high-pressure switch. This switch will turn off the compressor and activate 'high-pressure alarm' on the display if the pressure exceeds 28 bar on the compressor discharge line. The switch must be manually reset if triggered, refer to Resetting high-pressure switch.
- The maximum pump pressure is limited by a 'coolant supply high pressure' alarm condition. When the coolant supply pressure exceeds a pre-set value, the entire unit is turned off by the controller. In addition to this, there is a secondary customer configurable maximum pump pressure alarm. This alarm alerts the customer once the pressure reaches a pre-set value, it doesn't turn off the unit. This secondary pressure alarm is 'Off' by default. Refer to Customer Configurable Alarms for how to configure it.
- Low coolant pressure is an indication of coolant leakage, pump failure or evaporator freezing and is detected by a low-pressure sensor. If the 'coolant low-pressure alarm' condition is triggered the entire unit is turned off by the controller. On start-up of the unit, the low-pressure alarm is deactivated for 10 seconds to avoid false errors while the pressures are stabilizing.
- The minimum coolant level in the system is detected by 'low fluid level' alarm condition monitored by an optical level switch inside the coolant tank. If the coolant level drops below the "LOW" level marking on the front of the chassis, the controller shuts off the entire unit.
- The coolant set point has a lower limit that is dependent on the coolant selected (by default 10°C for pure water). For details on suitable additives for lower set point refer to Adding Coolant and Priming Unit, and for how to select coolant, refer to Choosing the Coolant.
- The coolant supply temperature is monitored by the controller. The maximum coolant temperature is limited to 50°C and will activate a 'high temperature alarm' if exceeded and turn off the unit. There are also two configurable temperature delta alarms monitoring this. The 'low temperature delta alarm' alerts the customer if the coolant supply temperature is not within certain pre specified temperature delta below the temperature set point in a specified amount of time, after starting the unit or changing the set point. Similarly, the 'high temperature delta alarm' alerts the customer if the coolant supply temperature is not within certain pre-specified temperature delta above the temperature set point in a specified amount of time after starting the unit or changing the set point. The temperature delta alarms as 'Off' by default. Refer to Customer Configurable Alarms for how to configure them.

Pump motor is protected by a 10A fuse. Refer to spare parts for a replacement fuse, refer to Replacing the Pump Fuse for how to replace it.

The Electronic Expansion Valve controller is protected by a 1A fuse. Refer to spare parts for a replacement fuse, refer to Replacing the Expansion Valve Controller Fuse for how to replace it.

Guards

Direct access to hazardous parts or areas of the unit is prevented by the unit covers. The unit covers may only be removed for maintenance or repairs. It must be closed prior operating the unit.

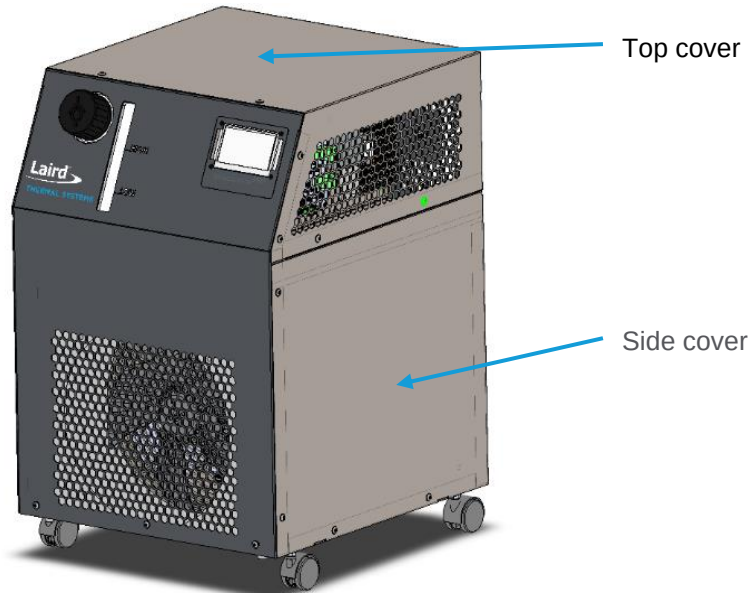


Figure 1 Guards

In Case of Accidents

Should you or another person be injured when working with the unit, do the following:

- Stay calm.
- Perform first aid.
- Always call the company's first aid personnel.
- If necessary, call the applicable emergency number.

First Aid at Accidents with R290

The unit contains the refrigerant R290 in a closed-circuit system. If the system is damaged, the refrigerant can spill and cause hazards including but not limited to the following occurrences:

- Fast vaporizing fluids can lead to frostbite.
- R290 is heavier than air and can lead to asphyxiation in enclosed, poorly ventilated, or low-lying areas.
- Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects and may also cause arrhythmia.

Always adhere to manufacturer safety regulations when handling spilled refrigerant.

Environmental Issues

Environmentally conscious and anticipatory behavior of staff helps avoid environmentally hazardous events. The following apply for environmentally conscious behavior:

- Environmentally hazardous substances must be stored in appropriate containers to avoid releasing them into the soil or drainage systems.
- Environmentally hazardous substances must be used or disposed of according to regional regulations.
- When dealing with working fluids, always be aware of the safety data sheet of the corresponding manufacturer.

Refrigerant R290 (Propane)

The refrigerant used in the unit is classified as highly flammable material.

WARNING

Highly flammable refrigerant

Injuries to persons and significant damage to property can occur in the case of improper handling.

- Do not try to drain the refrigerant.
- The unit must be stored, installed, and operated in sufficiently vented area to prevent accumulation of refrigerant in case of leakage.
- Ensure all ventilation openings are not obstructed.
- Do not use mechanical devices or other means to accelerate the defrosting process.
- Do not damage the refrigerant circuit.

Specifications

TECHNICAL SPECIFICATIONS	
Model	EFC2400
Performance	
Cooling capacity[1]	2200 Watt
Setpoint Range	-10°C to 40°C
Temperature Stability	±0.1°C
Nominal Flow Rate[1] (50Hz / 60Hz)	12 lpm @ 1.4bar / 12 lpm @ 2.6 bar
Maximum available pressure	3.9 bar
Refrigerant	R 290, 98g±1g
Operating noise (50Hz / 60Hz)	60 dB / 65 dB measured at a distance of 1 m
Storage	
Temperature, w/o coolant	-20°C to 70°C (HGBV max. 70° C ambient)
Humidity	5% to 95%, non-condensing
Operation	
Coolant	Water or Water/Ethylene Glycol/Propylene Glycol
Temperature[2]	10°C to 40°C
Relative Humidity	30% to 80%
Altitude	2,000 meters
Input	
Maximum rated current, Voltage and Frequency	8.5 A @ 230V±10% 50/60 Hz
Physical	
Dimensions, W x D x H	497.5 mm X 529 mmx 742 mm
Weight (w/o coolant)	54.5 kg
Coolant Capacity	5 L
Couplings	1/2” NPT
Compliance	Product Markings: CE, UKCA Main standards applied: - EN ISO 12100:2010 - EN IEC 63000:2018 - EN IEC 61326–1:2020 - EN 61010–1:2010, EN 61010-2-11:2019 Intended electromagnetic environment: INDUSTRIAL

1. Nominal capacity rating is given at a 20°C setpoint, 20°C ambient temperature, sea level, and 50Hz operation.
2. For ambient conditions outside this range, please contact Laird Thermal Systems.

Component Locations

Figure 2 Isometric Views of Unit

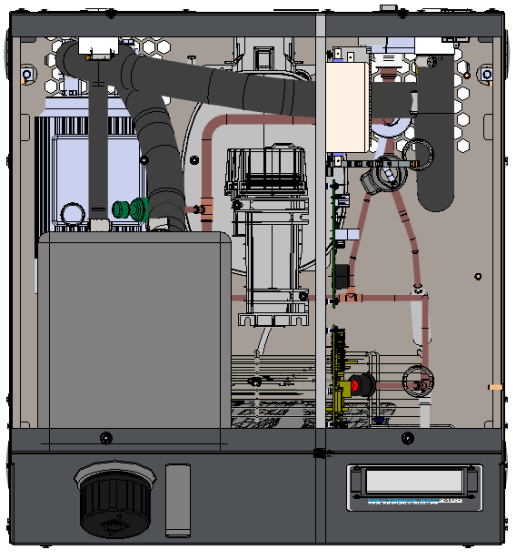


Figure 3 Top View

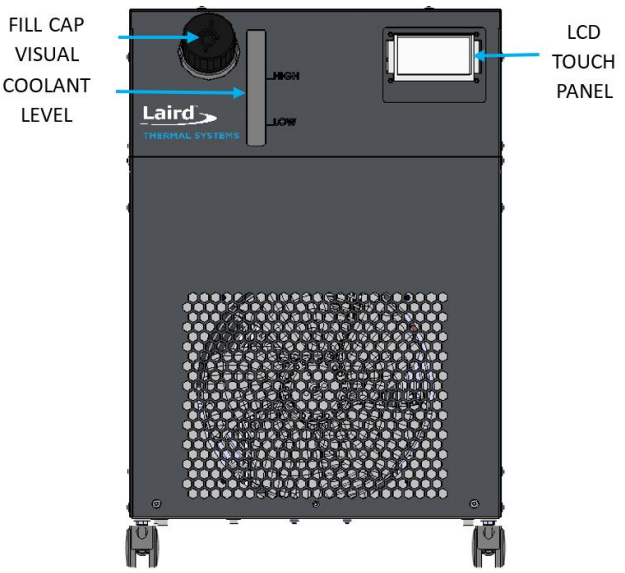


Figure 4 Front View

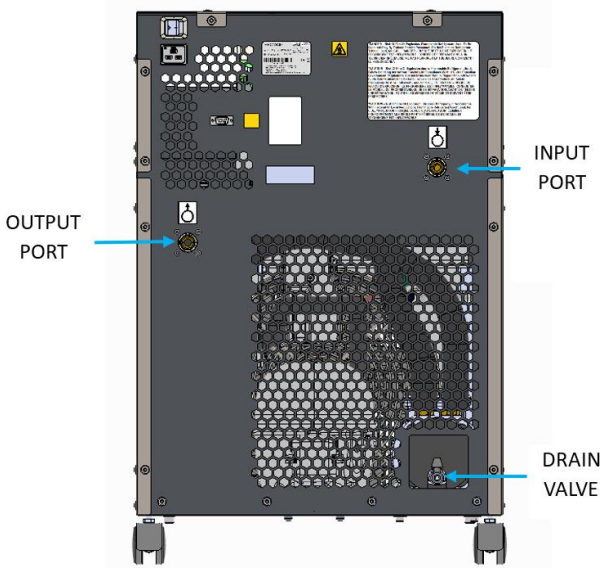


Figure 5 Rear View

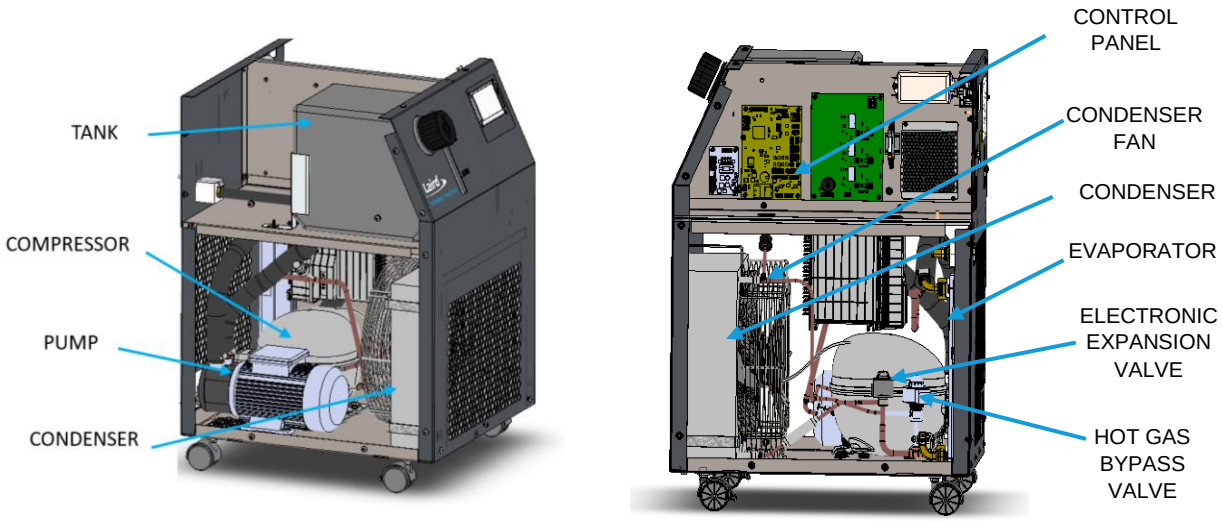


Figure 6 Side Views

Labels and Markings

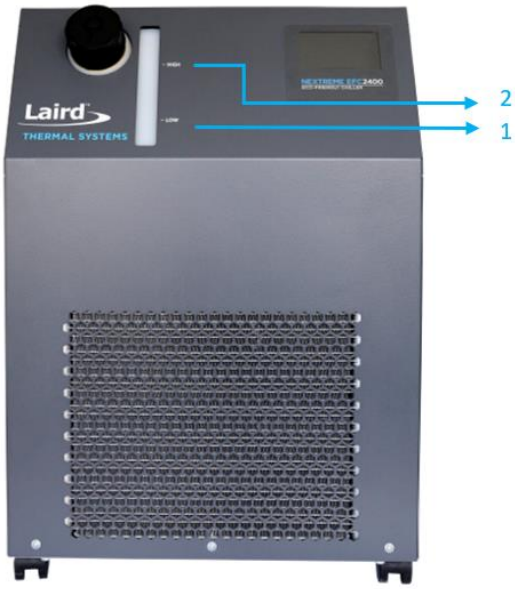


Figure 7 Marking on Unit

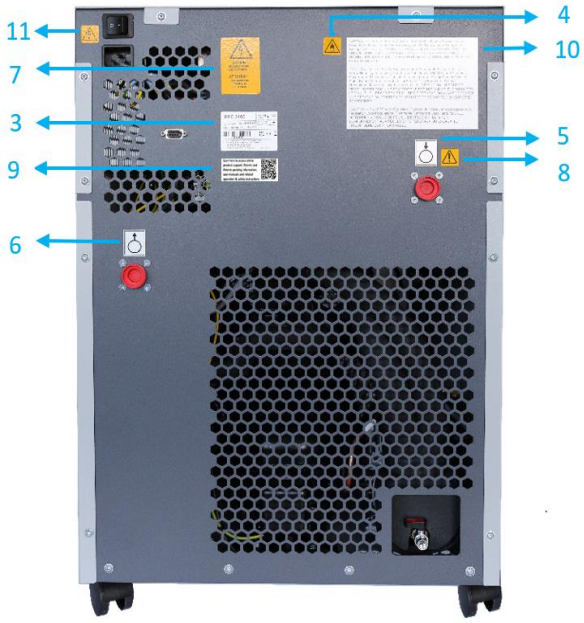


Figure 8 Labels on Unit

1 – Coolant level low marking

2 – Coolant level high marking

3 – Laird serial number label

4 – Flammable label

5 – Coolant return label (to the unit)

6 – Coolant supply label (from the unit)

7 – Caution hazardous voltage label: This label indicates location on the unit where power connections need to be made by the user. Caution labels on the unit such as this must always be easily readable. Illegible caution labels must be immediately replaced.

8 – Caution label: temperature of the coolant into the system must not exceed 50°C

9 – QR code for information on chiller

10 – The refrigeration warnings label

11 – Hazardous voltage label

Transport, Packaging and Storage

Safety

WARNING

Damage due to improper transportation

Injuries to persons and significant damage to property can occur in the case of improper transportation.

- When unloading the packed unit on delivery, including in-house transport, proceed very carefully and obey the symbols and instructions on the packaging.
- Do not remove the packaging until immediately before installing the unit.

NOTE

Risk of damage through improper transportation

The mounting suspensions of different components inside the unit are not secured with transportation locks. In the case of improper transportation, these can be damaged and would need to be replaced.

- Transport the unit upright.
- Unit is not to be tilted or subjected to mechanical impact.

Checking the Delivery Condition

Check the delivery immediately upon receipt for possible transport damage and missing parts.

If any transport damage is noticed, do the following:

- Refuse the delivery or accept it with reservation.
- Note extent of damage on the transport documents or on the delivery note.
- Inform the manufacturer immediately of any damage incurred during transport.

Symbols on the Packaging

The symbols listed in *Table 2* attached to the packaging:

Table 2: Packaging symbols

Symbol	Meaning
	Top The arrows mark the top of the package. The package must be stored and transported in such a way that the arrows always point upwards.
	Fragile, Handle with Care This symbol indicates fragile, easily breakable goods. Goods marked with this symbol must be handled carefully and should never be rolled or tied tightly.
	Keep dry This symbol indicates goods which are sensitive to moisture/humidity. Goods marked with this symbol must be protected from overly high air humidity levels.

Symbol	Meaning
	Do not stack This symbol indicates that goods are sensitive to stacking
	Handle with care This symbol indicates that package must be handled with care
	Team lift This symbol indicates that two or more persons must be used for lifting as the package is heavy
	Keep Upright This symbol indicates the goods are sensitive to tilt Goods marked with this symbol must not be tilted. If the symbol turns red, that means goods were tilted beyond 80° angle
	Flammable material This symbol indicates that the package contains material classified as highly flammable

Packaging

NOTE

Hazard for environment due to improper disposal

Packaging can be reused in many cases or reconditioned and recycled.

- Dispose of packaging materials in an environmentally friendly way.
- Follow local regulations for waste disposal. If necessary, employ a special waste disposal company to dispose of packaging materials.

The unit is packed according to the anticipated transportation conditions (such as packed in sealed plastic or cardboard box on a transport pallet). The packaging function is to protect the unit against damage and corrosion until installation. The packaging material should remain on the unit until just prior to installation. Packaging includes an integrated ramp.

Unpacking

Before unpacking the unit, use appropriate safety measures to make sure no person is injured in this process. Unit may be heavy.

Follow the procedure below to unpack the unit

a) Cut the straps securing the cardboard box to the pallet.

b) Lift the cardboard box and remove from the top.

c) Carefully drop the fold down ramp to the floor.

d) Remove the foam packing material. Slide the plastic covering on the unit to the bottom.

e) Then carefully and steadily roll the unit down the ramp. Care should be taken to make sure the unit does not roll off the side of the ramp.

Laird advises to keep the transport pallet for later transportation of the unit if necessary.

Handling the Unit While in the Packaging

WARNING

Danger due to lifting and carrying heavy loads

Manual handling of the loads (lifting, pushing, and carrying) must be avoided.

- Unit weight – Refer to Specifications.
- Use only suitable means of transport (such as forklift).

WARNING

Danger of injury due to tipping or falling loads

When handling with industrial truck, observe the following basic rules:

- Wear personal protective gear (such as protective footwear and protective gloves).
- Do not walk or stand under a suspended load.
- Use only suitable means of transport (such as an industrial or lift truck).
- Use only industrial trucks with appropriate capacity for loading. Unit weight – Refer to Specifications.
- Secure the unit so that it cannot tip or fall.

Transportation on casters

The unit is equipped with lockable casters on the front end of the unit. The casters on the back end of the unit are non-lockable. To transport the unit over short distances, the unit can be moved on these casters. Extra care should be taken when transporting the unit over gaps in the floor, such as when entering / exiting an elevator. It is recommended to transport the unit to the installation site in the packaging material.

Damage to property due to tipping of the unit.

When rollers are blocked by obstacles, there is a risk that the unit may tip.

- Move the unit slowly and carefully over flat surfaces.
- Keep possible obstacles out of the work area.

Damage to property due to unintended rolling of the unit.

- Place the unit on a level surface.
- Lock the rollers' brakes.

Storing the Unit

These storage conditions apply to the following:

- New units
- Units that were already in operation but will be temporarily out of operation. Refer to Temporary Placing Out of Operation.

Store the units as follows:

- Dry, dust-free environment, protected against direct sunlight.
- According to required storage temperature and relative humidity. Refer to Specifications.
- Protection caps should be installed for the coolant inlet and outlet connections.
- For storage that exceeds three months, it is recommended that the unit is placed inside its original packaging.

WARNING

Damage due to improper storage

Storing the unit in conditions where freezing can occur is only permitted if the unit is primed with anti-freeze additive to coolant before putting to storage. This is because the evaporator can contain coolant even after draining.

- Refer to Adding Coolant and Priming Unit for instructions on how to add anti-freeze additives.

Preparing the Unit for Further Transport

For detailed information and specific instructions on how to prepare the unit, refer to Safety Precautions.

WARNING

Damage due to improper Transportation

Transporting the unit in conditions where freezing can occur is only permitted if the unit is primed with anti-freeze additive to coolant before preparing for storage. This is because the evaporator can contain coolant even after draining.

- Refer to Adding Coolant and Priming Unit for instructions on how to add anti-freeze additives.

NOTE

Risk of damage due to improper transportation

A coolant that has not been drained or packaging with inappropriate dimensions may cause damage during transport.

- Drain the coolant before transporting the unit. Refer to Draining Procedure.
- Use proper packaging.

Transporting the Unit (after use)

Requirements

- Unit is switched off and disconnected from the electrical power source
- Unit and coolant cooled to the ambient temperature
- Coolant is drained. Refer to Draining the Coolant.
- Coolant hoses disconnected from the unit. Refer to Disconnecting the Coolant Hoses.

Procedure

1. Pack the unit according to the transport conditions that can be expected.

   Laird advises to use original packaging, if available, or an equivalent packaging.

2. Mark the packaging with the appropriate symbols. Refer to Symbols on the Packaging.
   The unit can now be transported.

Installation Requirements

1. Minimum Clearance from obstructions is required as shown to ensure that air intake and air discharge is not blocked as this could affect cooling capacity.

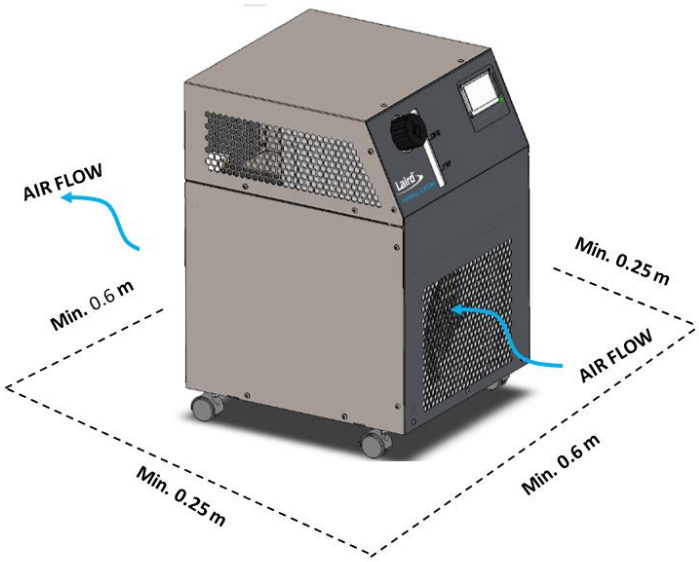


Figure 9 Minimum Clearance required for Unit Installation

2. The location must be level.
3. When choosing the installation location, the following must be kept in mind:
    a. The flow of the cooling air must not be restricted.
    b. Coolant inlet and coolant outlet connections must be easily accessible.
    c. Power Cord must be easily accessible.
    d. All hoses must be installed without sharp bends.

Installation Procedure

Connect Hoses

NOTE

Risk of damage by using improper or faulty coolant hoses

This may lead to damage to persons, damage to property, or corrosion damage.

- When choosing coolant hoses pay attention to burst pressure, operation temperature and compatibility with coolant.
- Only use coolant hoses without any signs of damage.
- If water is being used as coolant, ensure that non-transparent hoses are used to prevent algae growth in the water. Otherwise, appropriate additives must be used.

NOTE

When connecting the coolant hoses pay attention to flow direction. Follow the documentation released by the manufacturer of the unit to be cooled.

The coolant hoses are connected to the unit by means of couplings. Coolant inlet and coolant outlet are labeled with respective symbols.

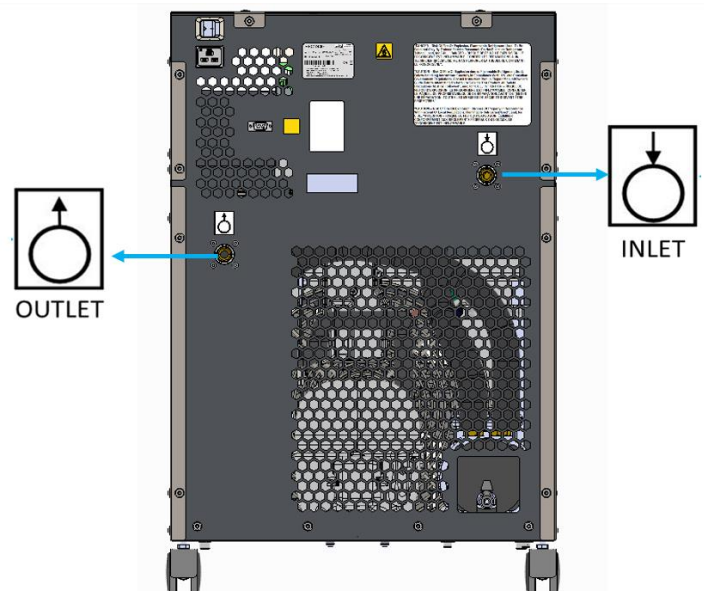


Figure 10 Connecting Hoses

Requirements

- Unit prepared for maintenance. Refer to Preparing the Unit for Maintenance
- Hoses and fittings

Procedure

1. Remove the protection caps from the coolant inlet and coolant outlet connections of the unit.
2. Connect an appropriate coolant fitting to the coolant inlet and coolant outlet.
3. Connect the coolant hoses to the unit and the corresponding connections of the unit to be cooled.

The coolant hoses are now connected to the unit.

Disconnect Hoses

The coolant hoses are connected to the unit at the coolant inlet and coolant outlet connections, labeled with respective symbols.

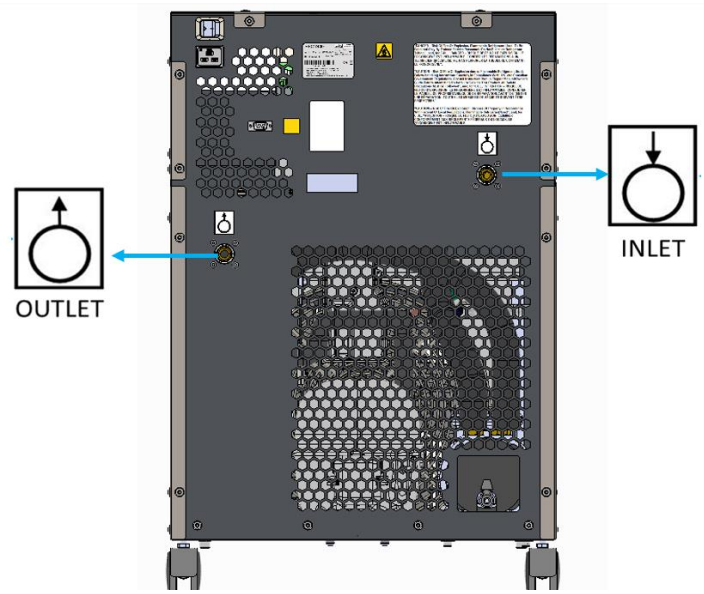


Figure 11 Disconnecting Hoses

Requirements

- Unit prepared for maintenance. Refer to Preparing the Unit for Maintenance.
- Coolant cooled to the ambient temperature.

Required Tools and Materials

- Absorbent cloth
- Protection caps

Procedure

1. If the coolant inlet and outlet fittings have quick disconnects installed by the customer, disconnect the hoses from coolant inlet and outlet fittings on the back of the unit.
2. If the coolant inlet and outlet fittings do not have quick disconnects or valves, the system must be drained before disconnecting the hoses from fittings on the back of the unit.
3. Secure the coolant inlet and coolant outlet connections with protection caps against soiling.

The coolant hoses are now disconnected from the unit.

Connecting Power

Power cord is not supplied with the unit and must be ordered separately. Please see Laird Thermal Systems product webpage for ordering the power cord.

Requirements:

- The unit construction provides protection against the risk of electrical shock by grounding appropriate metal parts. The protection will not function unless the power cord is connected to a properly grounded outlet. **Caution: It is the user's responsibility to assure a proper ground connection is provided.**
- Power Cord with C19 connector (not supplied by Laird Thermal Systems)
- Use cable rated by IEC320-C19. The customer side of the cable must follow required standard for the country of installation.

Procedure

1. Connect the C19 cable to the mains inlet.
2. Turn the Power Switch to I (ON).

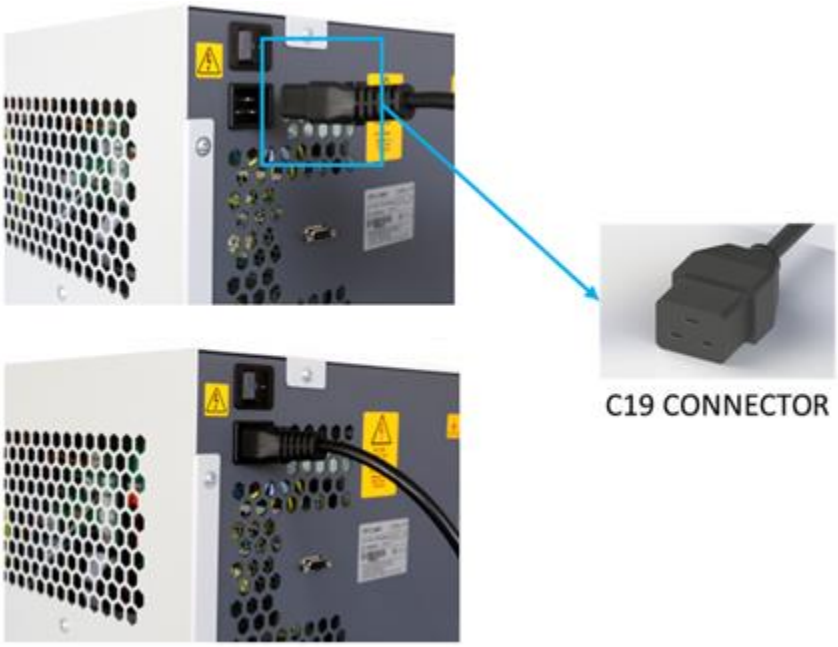


Figure 12 Connecting Power

Adding Coolant and Priming Unit

The unit is not intended for use with corrosive fluids. Automotive antifreeze should never be used as a freezing point depression or corrosion protection fluid. Automotive antifreeze contains additives that can damage system components and will void the warranty.

Approved fluids and their normal operating temperature ranges are:

- Filtered/Single Distilled water, +10°C to +40°C
- Up to 40% Inhibited Ethylene Glycol (EG) /Water, -10°C to +40°C
- Up to 40% Inhibited Propylene Glycol (PG) /Water, -10°C to +40°C

It is important to maintain the proper mixture of EG or PG and water over time. Instruments are available on the market to measure glycol content and should be used periodically and when refilling the system to check the coolant mixture ratio.

Inhibited EG or PG should be used when the coolant is being exposed to aluminum components to prevent galvanic corrosion.

Suggested Contaminant Limits:

	PPM
Organics	
Algae, Bacteria, etc.	0
Inorganic Chemicals	
Calcium	<10
Chloride	<25
Copper	<1.0
Iron	<0.2
Lead	0
Magnesium	<5
Manganese	<0.05
Nitrates \ Nitrites	<10
Potassium	<2
Silicate	<5
Sodium	<4
Sulfate	<25
Hardness	<1
Total Dissolved Solids	<25
Other Parameters	
pH	6.8. 7.5
Resistivity	<0.1 MΩ-cm

Requirements

- Unit prepared for maintenance. Refer to Preparing the Unit for Maintenance.
- Power connected to unit.
- Coolant hoses connected to the unit (Make sure the hoses are corrected to the correct ports).

Required Tools and Materials

- Filling funnel
- Absorbent cloth

Procedure

1. Remove the Fill Cap.
2. For information regarding coolant to be used and quantity, refer to Specifications. Use a filling funnel to avoid spillage of coolant on any electrical components.
   Note: If refilling coolant, go to through these last steps.
3. Add coolant up to required level. Ideal coolant level is just below the 'HIGH' marking on the front view port of the tank.
4. Press the 'PUMP' button on the LCD panel to fill the coolant lines to the application.
5. When the tank level starts reducing, continue adding coolant through the fill port, until the ideal coolant level is reached with the pump continuously running.
6. Note: Do not let the pump run dry as it can be damaged.
7. Mount the coolant cap again.

The coolant is now added.

Chiller Operation

The chiller unit consists of the following subunits:

1. Refrigeration Circuit
   The refrigeration circuit consists of an evaporator, compressor, condenser, expansion valve and refrigerant. The coolant returning from the customer's application exchanges with the refrigerant in the evaporator. The evaporated refrigerant is compressed by the compressor and sent to the condenser. In the condenser, heat is rejected from the refrigerant to the ambient air with the help of the condenser fan. Here refrigerant is condensed and enters the electronic expansion valve. The expansion valve allows the liquid refrigerant to expand into the evaporator resulting in lowering the pressure and temperature of the refrigerant which can then absorb heat from the higher temperature liquid/water through the evaporator walls and this cycle continues. The system also consists of a 'Hot gas bypass valve' in the heating loop, where the condenser coil and expansion valve are bypassed partially or completely. The refrigerant flows through this loop for cases where the customer heat load is too low or where raising the temperature of the coolant is necessary to maintain stable application temperature.

2. Coolant Circuit
   This circuit consists of the coolant tank, pump, evaporator, and coolant. Temperature of the coolant is regulated in the evaporator by automatic adjustment of the compressor speed and in-turn regulates the mass flow, which indirectly adjusts the coolant temperature. The coolant is then pumped directly though the evaporator and then transferred to the outlet. Coolant from the customer application is circulated back to the tank, then pump and evaporator and this cycle continues.

3. Control Panel
   The control panel is responsible for the interaction of the different components with each other and to integrate the sensors in order to achieve the required temperature setpoint. This is also used for monitoring the state of the system.

Additional information on the system can be found in the Plumbing & Refrigeration Diagram and Wiring Diagrams.

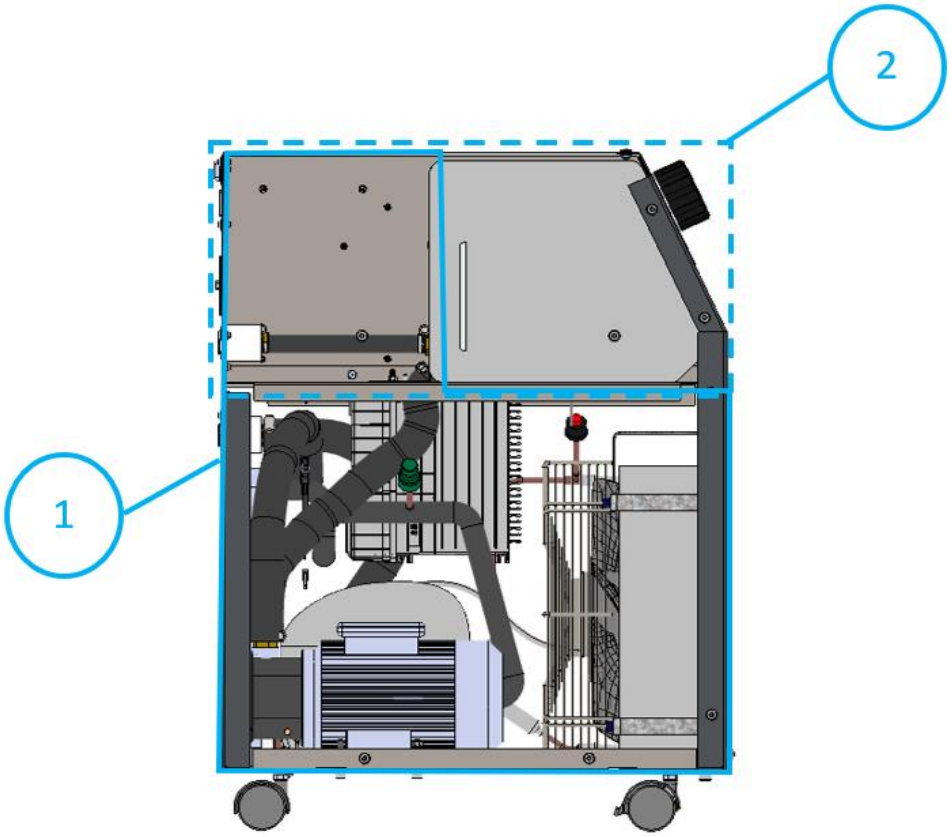


Figure 13 Refrigerant Circuit and Coolant Circuit

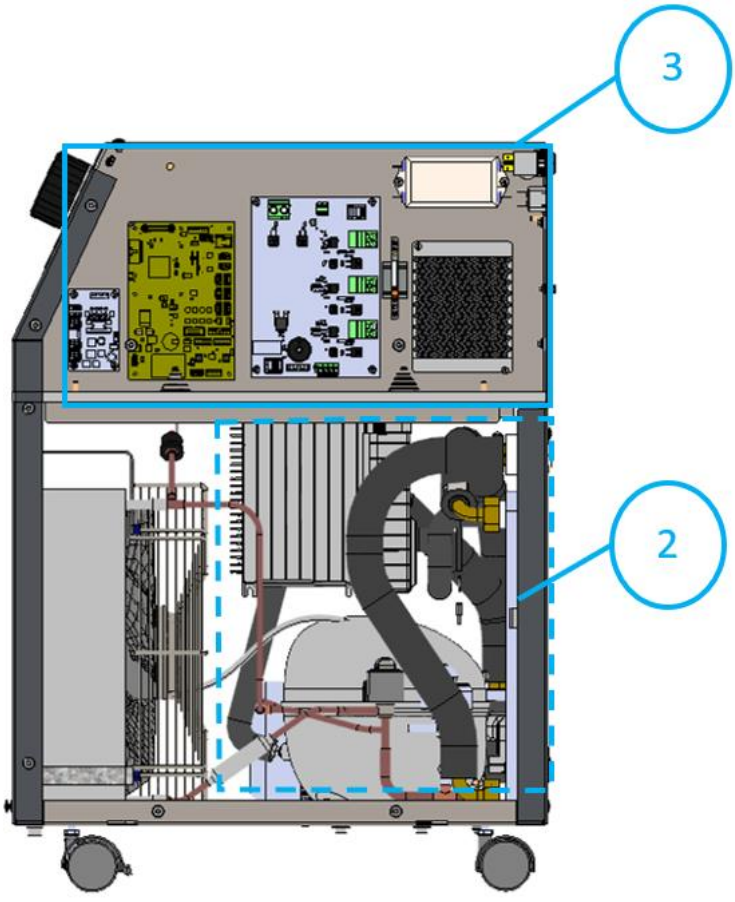
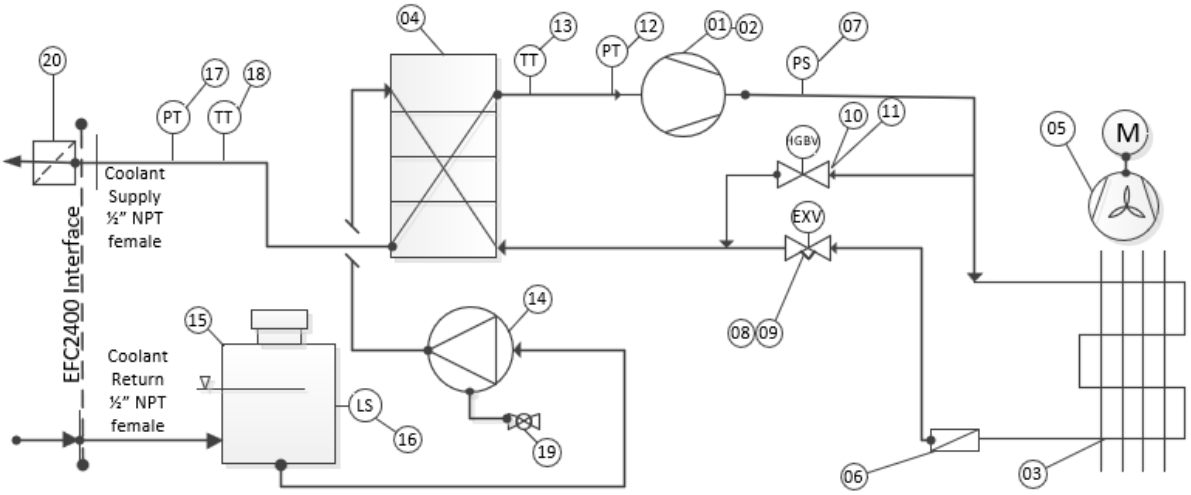


Figure 14 Coolant Circuit and Control Panel

P&ID

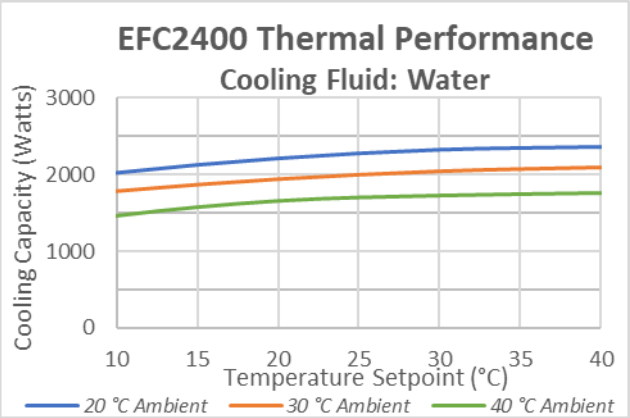


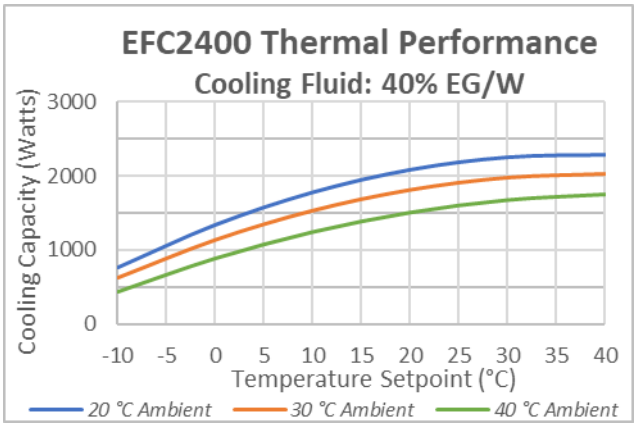
	DESCRIPTION
01	COMPRESSOR
02	COMPRESSOR DRIVER
03	CONDENSER
04	EVAPORATOR
05	FAN
06	FILTER DRYER
07	PRESSURE SWITCH
08	EXPANSION VALVE
09	COIL FOR EXPANSION VALVE
10	HOT-GAS BYPASS VALVE
11	COIL FOR HOT-GAS BYPASS VALVE
12	PRESSURE TRANSMITTER
13	TEMPERATURE TRANSMITTER
14	PUMP
15	TANK
16	LEVEL SWITCH
17	PRESSURE TRANSMITTER
18	TEMPERATURE TRANSMITTER
19	DRAIN VALVE
	OPTIONS
20	FILTER

Figure 15 P&ID for EFC

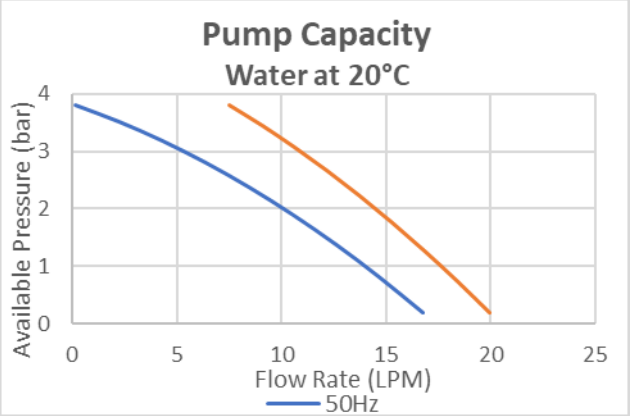
Performance Graphs

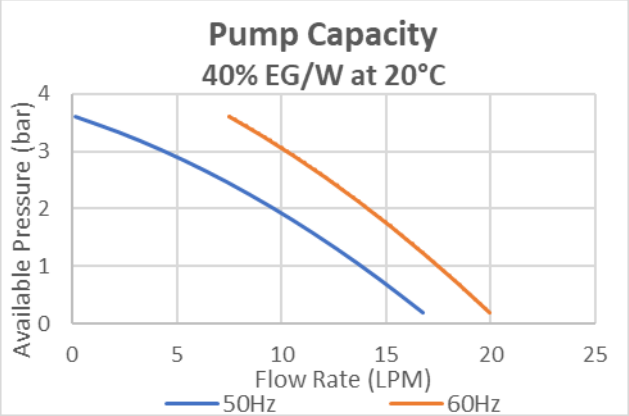
Thermal Performance





Pump Performance





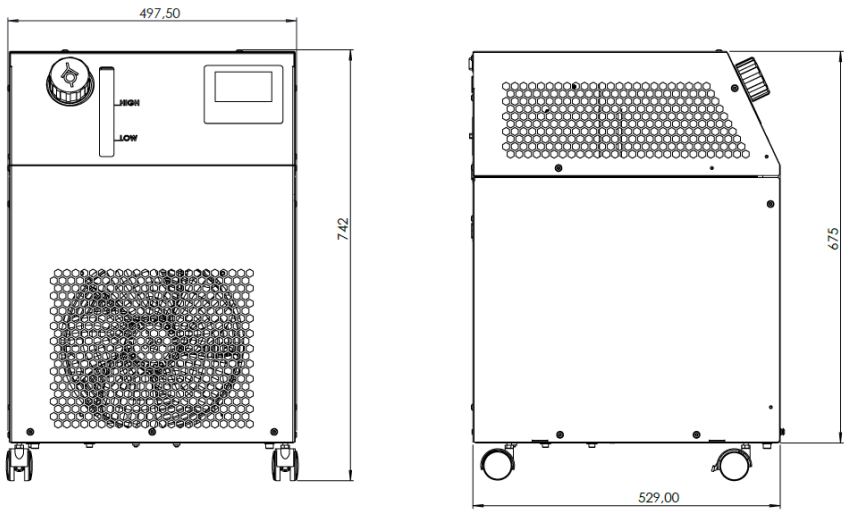


Figure 16 NRC2400 Chiller Overall Dimensions

NOTE:

1. Dimensions are in mm

Controller Display Panel Functions

Startup Screen

When the unit is first powered on, the touch panel shows this screen for 10 seconds.

Figure 17 Start-up Screen

Main Screen

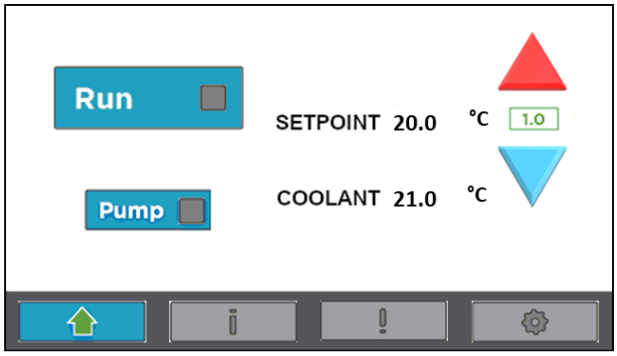
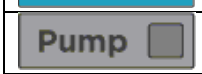
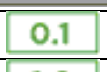


Figure 18 Main Menu

Buttons	Description
	Main Menu is selected
	Information Menu is selected
	Alarm menu is selected
	Settings menu is selected
	Pump is OFF
	Pump is ON
	Chiller is OFF
	Chiller is running
	Pump Button is disabled since Chiller is running
	Setpoint increments/decrements in 0.1
	Setpoint increments/decrements in 1.0

	Increase setpoint by selected increment level
	Decrease setpoint by selected decrement level
	Stores set point in flash memory

Running the Pump

The pump can be switched on by pressing the PUMP button on the screen. The box will turn from grey to green which indicates that the pump is on. By clicking the PUMP button again, the pump will switch off turning the box back to grey.

Note: Pump ON/OFF function is disabled during running of machine.

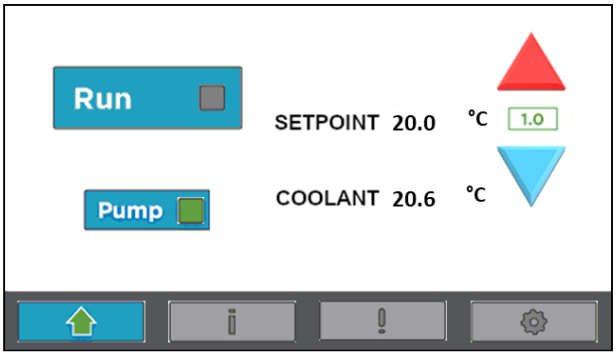


Figure 19 Running Pump

Choosing the Coolant Setpoint

The Coolant setpoint can be set by choosing values using the arrows and changing the increments accordingly. By clicking on the increments, the increment can be changed from 0.1 to 1.0 and vice versa.

Running the system

The system can be run by pressing the RUN button on screen. The box will turn from grey to green which indicates that the machine is running. In order to switch OFF the machine, click the button again.

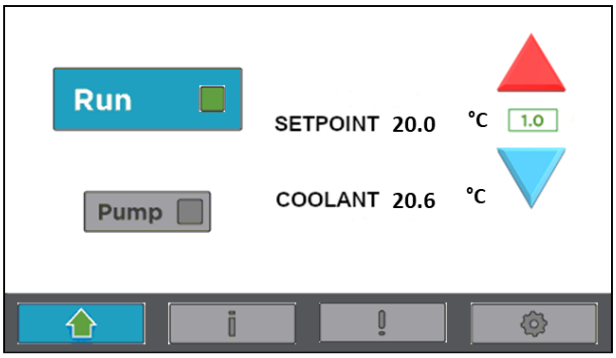


Figure 20 Running the Machine

Sleep Screen

The touch panel goes to sleep when the screen has been inactive for 3 minutes and shows coolant supply temperature. The system does not go to sleep screen when the information screen is being displayed or when the unit is not running.

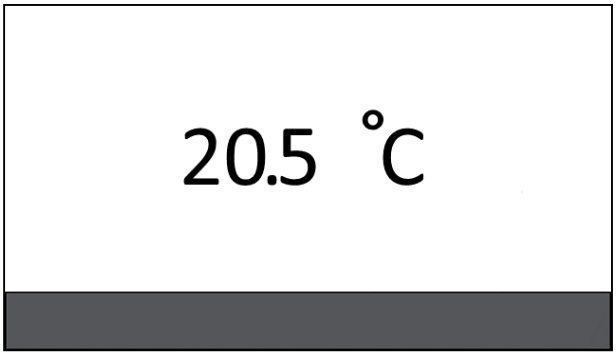


Figure 21 Sleep Screen

Information Screen

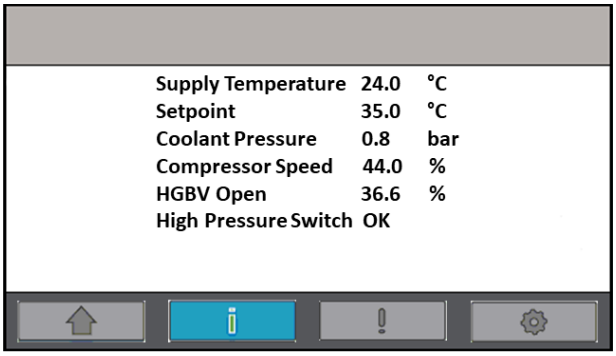


Figure 22 Information Screen

In order to see information related to Coolant Supply and Refrigerant, click on the Information Menu. According to the units selected in the settings menu, the Temperature unit and Pressure unit will be shown at the bottom. The following information is displayed:

	Information	Description
Coolant Supply	Supply Temperature	This is the Supply Temperature from the chiller to the application
	Setpoint	This is the Temperature Setpoint set by User in the Main Menu
	Coolant Pressure	This is the Supply Pressure to your application from the chiller
Refrigerant	Compressor Speed	This is the speed % of the compressor, 100% speed is the full speed of compressor
	HGBV Open	This is the hot gas bypass valve open %
	High Pressure Switch	This is the high-pressure switch status of the refrigerant after passing through the condenser

Alarms Display Screen

If the system is not in an alarm condition, then the alarms tab doesn't show any alarm. If the system experiences an alarm condition, the alarm button changes on the home screen to indicate this.

Figure 23 Alarm screen with no active alarms

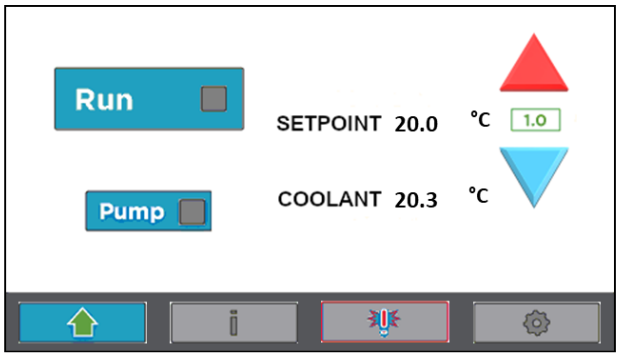


Figure 24 Home screen with an active alarm

Acknowledging Alarms

Alarms can be acknowledged individually by selecting them and then pressing the ACKNOWLEDGE button. When there are multiple alarms, they can be acknowledged together by pressing the SELECT ALL button and then the ACKNOWLEDGE button.

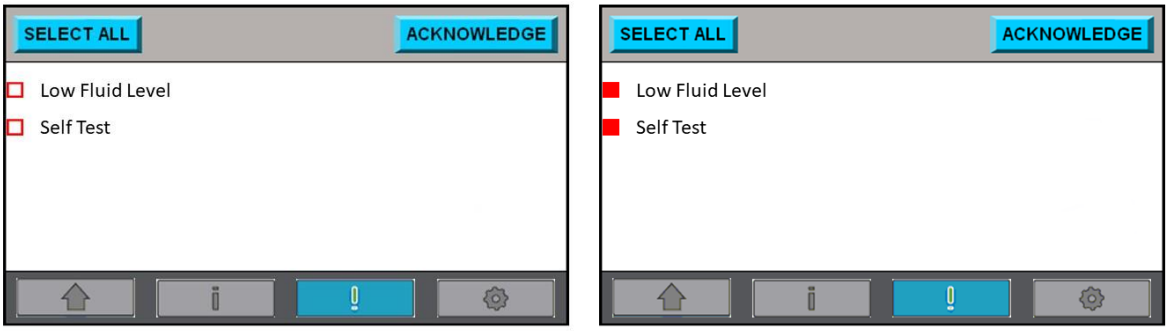


Figure 25 Acknowledging Alarms

Buttons	Description
	Alarm has been set
	Amber alarm
	Amber alarm Selected
	Red Alarm
	Red Alarm Selected

Red alarms are used to indicate an abnormal system condition and are usually associated with the shutdown of a component or the whole system. There is an audible alarm for this condition and requires an action from the customer for the system to restart.

Amber alarms are warnings to indicate an abnormal system condition, but the system or components are not shut down. There is no audible alarm for this condition.

For specific alarm conditions and troubleshooting information, refer to section Alarms

Settings Screen

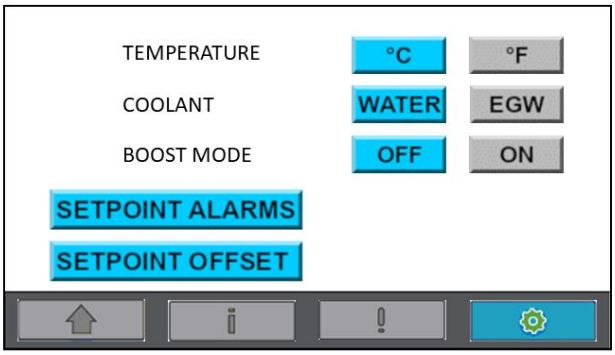


Figure 26 Setting Menu

Setting Units

The units of measure for temperature and pressure can be selected in the Settings Menu. The options available for temperature are °C/°F and for Pressure are Bar/PSI.

Choosing the Coolant

The coolant (Water/ Ethylene Glycol) can be chosen on the Settings Menu. The Ethylene Glycol Percentage can be chosen once the EGW button is pressed. This selection limits the temperature set point value that the customer can select. Below are the temperature range for different glycol percentages. Note that selecting the correct coolant is the responsibility of the customer and should match what is filled in the system by the customer. Selecting the wrong coolant may cause damage to the equipment.

Water: 10°C to 40°C
10% Ethylene Glycol: 5°C to 40°C
20% Ethylene Glycol: 0°C to 40°C
30% Ethylene Glycol: -5°C to 40°C
40% Ethylene Glycol: -10°C to 40°C

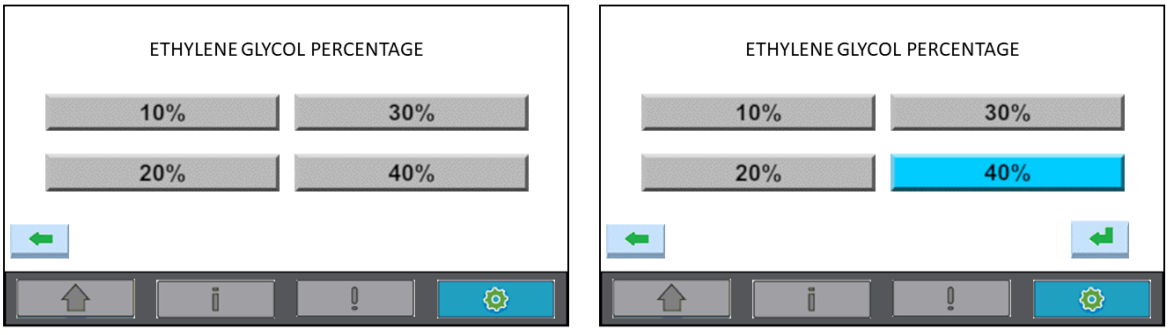


Figure 27 Choosing the Coolant

Customer Configurable Alarms

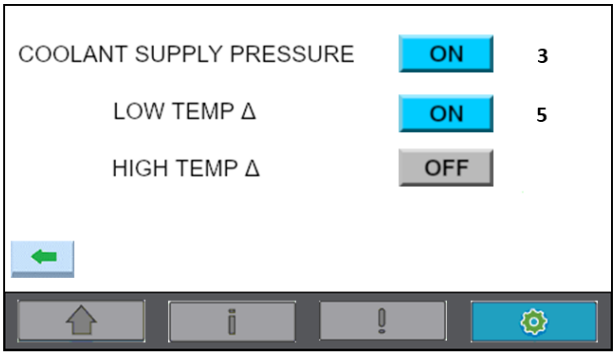


Figure 28 Setpoint Alarms

Alarms such as Coolant Supply Pressure, Low Temperature Δ and High Temperature Δ can be set in the Setting Menu Each Alarm can be turned ON or OFF as required and the value can be changed by clicking on the number.

Coolant supply pressure

This secondary coolant supply pressure alarm is disabled by default. If the customer does not enable this alarm, then the unit would shut off according to the primary high coolant supply pressure value specified in alarms table. If this alarm is enabled, the default value is 5 bar for this.

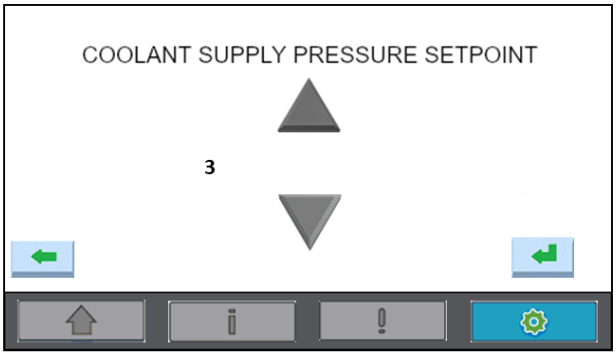


Figure 29 Coolant Supply Pressure

Low temp delta

This alarm is to alert the customer if the coolant supply temperature doesn't come within this specified deltaT from below the set point in a set amount of time. This alarm is disabled by default. If the customer enables this alarm, then the default value of delta T is 1 and default time is 30 minutes.

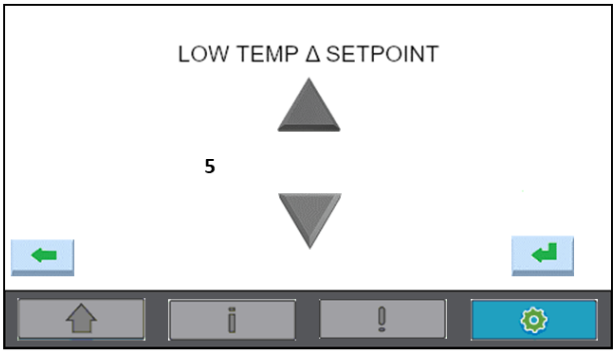


Figure 30 Low Temperature Delta

High temp delta

This alarm is to alert the customer if the coolant supply temperature doesn't come within this specified deltaT from above the set point in a set amount of time. This alarm is disabled by default. If the customer enables this alarm, then the default value of delta T is 1 and default time is 30 minutes.

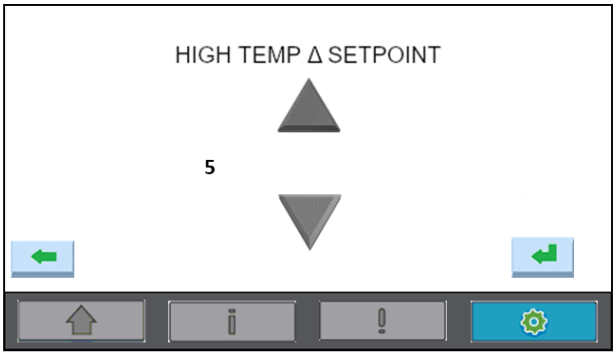


Figure 31 High Temperature Delta

Troubleshooting

For troubleshooting, use the following:

- Alarm status screen
- Plumbing & Refrigeration Diagram
- Troubleshooting table (below)

Issue	Possible Cause	Corrective Measures	Clearance By
Unit does not start	Power not applied. Electrical connection is not correct or no mains connection	Check power supply and ensure proper voltage in the line. Check connection, insert mains plug.	Operator
	Coolant level too low. Alarm for low coolant will be active	Check coolant level and top off, if necessary. Refer to Adding Coolant	Operator
	Main switch not turned on	Turn main switch on	Operator
	Fuse blown	Switch off unit. Replace or trip fuse switch to on position then attempt to start unit again being cautious.	Operator
Unit running but cooling capacity is too low.	Buckled or pinched coolant hoses	Install the hoses with a larger radius to avoid sharp bends.	Operator
	Improperly placed unit	Required clearance with the wall of the unit. Refer to Installation Requirements.	Operator
	Blocked Condenser	Clean condenser. Refer to Cleaning the Heat Exchanger.	Operator
	Coolant level too low	Check coolant level and top up, if necessary. Refer to Adding Coolant.	Operator
	Disconnected coolant hoses	Connect the coolant hoses. Refer to Connecting the Coolant Hoses.	Operator
	Dirty coolant filter	Clean or replace filter. Refer to Replace filter.	Operator
	No flow in cooling circuit	Refer to coolant high/low pressure alarm condition or optional low flow alarm condition.	Operator
	Fan does not rotate	Check to determine if the fan is rotating.	Operator
	Ambient air temperature too high	Operate unit within allowable ambient temperature range.	Operator
	Refrigeration circuit not working properly	Confirm that all alarm conditions are cleared. Warm air is usually expelled from the rear of the unit indicating the refrigeration circuit is functioning.	Operator
Noise	Blocked cooling circuit	Ensure that cooling circuit is not blocked.	Operator
	Dirty coolant filter	Clean filter strainer. Refer to Replace filter.	Operator
	Blocked Condenser	Clean condenser. Refer to Cleaning the Heat Exchanger.	Operator

Alarms

*- **Red: Critical with Stop, Amber: Notify, Green: Status**

	Alarm	Criticality	Alarm Description	Cause	Effect	Action Required/ Troubleshooting
Coolant	Refrigerant condenser side pressure high	Red	Refrigerant Condenser side pressure have exceeded 28 bar and triggered the high-pressure switch.	Ambient temperature is high or Thermal load on the system is high or Condenser fan is not running or Condenser fan air flow is blocked	Compressor stops running, pump and the condenser fan keep running	Check if the ambient temperature is too high or above operating limits. Check if the load on the system is beyond the specified capacity for specific operating temperatures. Check if the air intake to the condenser fan is blocked or obstructed by something. Check the fan is running. After resolving the above issue, manual reset of the high-pressure switch is required. Refer to Resetting high-pressure switch. If the problem persists, contact LTS customer service.
	Coolant supply pressure high	Red	Coolant supply pressure is higher than 4.1 bar. Alarm will reset after pressure drops below 3.5 bar.	Possible blockage in the coolant line	Entire system stops running	Check if there are any blockages or kinks on the coolant line. Check to make sure all the valves are open on customer installed connections. If the unit is equipped with a coolant filter, check if the filter needs replacement. After fixing the above issue, acknowledge the alarm on the LCD screen. This will clear the alarm. Now run the unit. If the problem persists, contact LTS customer service.
	Coolant supply pressure low	Red	Coolant supply pressure is lower than 0.5 bar. Alarm will reset after pressure is greater than 1 bar. After starting the unit there must be a delay until reaching 1bar.	Possible leak in the coolant line and further frozen evaporator	Entire system stops running	Check if there is any leakage on the coolant line. Check if the coolant level is low. Check that the low temperature setting (below 10 °C) is not activated and if activated using correct % of glycol. After fixing the above issue, acknowledge the alarm. This will clear the alarm on the LCD screen. Now run the unit. If the problem persists, contact LTS customer service.
	Low fluid level	Red	Coolant fluid level is low.	Possible leak in the coolant line	Entire system stops running	Check to see if the coolant level is at the recommended level on the front fill port. Add coolant if necessary and acknowledge the alarm on the LCD screen. This will clear the alarm. Now run the unit. If the problem persists, contact LTS customer service.
	Coolant supply temperature sensor failure	Red	Coolant supply temperature sensor is not working properly	Coolant supply temperature sensor is not working properly	If this happens during system start-up, unit will not Run. If this happens while the system is running, then the entire system shuts down.	Turn off the power switch to the unit off. Wait 5 seconds to turn the power switch on again and run the unit. If the problem persists, contact LTS customer service.
	Coolant supply pressure sensor failure	Red	Coolant supply pressure sensor is not working properly	Coolant supply pressure sensor is not working properly	If this happens during system start-up, unit will not Run. If this happens while the system is running, then the entire system shuts down.	Turn off the power switch to the unit off. Wait 5 seconds to turn the power switch on again and run the unit. If the problem persists, contact LTS customer service.

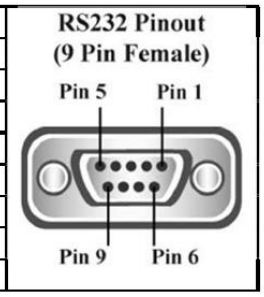
	Alarm	Criticality	Alarm Description	Cause	Effect	Action Required/ Troubleshooting
	Coolant supply high temp Δ	Red	Alerts the customer if the coolant supply temperature is not within certain pre-specified temperature delta above the temperature set point, within a specified amount of time after starting the unit or changing the set point	High load on the system than the specified capacity or ambient temperature is too high	Unit alarms to indicate customer the condition. Unit continues running.	Check if the ambient temperature is too high or above operating limits. If possible, check if the load on the system is beyond the specified capacity for specific operating temperatures. After fixing the above issue, acknowledge the alarm on the LCD screen. This will clear alarm. If the problem persists, contact LTS customer service.
	Coolant supply low temp Δ	Red	Alerts the customer if the coolant supply temperature is not within certain pre-specified temperature delta below the temperature set point, within a specified amount of time, after starting the unit or changing the set point	Hot gas bypass heating loop is not functioning properly, or ambient temperature is too low	Unit alarms to indicate customer the condition. Unit continues running.	Check if the unit has been sitting in ambient temperature below the specified operating temperature. If so, move the system to recommended operating ambient temperature and wait for few minutes for the system refrigerant to warm up. After fixing the above issue, acknowledge the alarm on the LCD screen. This will clear alarm. If the problem persists, contact LTS customer service.
	Coolant supply pressure High (secondary alarm)	Red	Alerts the customer if the coolant pressure is higher than the customer selectable pressure setting value.	Blocked coolant flow	Unit alarms to indicate customer the condition. Unit continues running until the high-pressure limit is reached	Check if there are any blockages or kinks on the coolant line. Check to make sure all the valves are open on customer installed connections. If the unit is equipped with a coolant filter, check if the filter needs replacing. After fixing the above issue, acknowledge the alarm on the LCD screen. This will clear the alarm. If the problem persists, contact LTS customer service.
	Coolant supply temperature high.	Red	Alerts the customer if the supply temperature exceeds 50°C. Alarm will reset when the temperature drops below 40°C	Coolant supply temperature is higher than 50°C	Unit alarms to indicate customer the condition. Compressor, pump and fan stop running	Verify the heat load has not exceeded the rating of the recirculating chiller. If the unit is still powered, check the alarm screen to find the referenced alarm in this table. After fixing the issue, acknowledge the alarm on the LCD screen. This will clear the alarm. Now run the unit. If the problem persists, contact LTS customer service.
Self-Test	Self-Test	Red	Controller checks whether all the sensors are functioning properly after the power switch is turned on	Sensors not connected properly or component failure	System will not Run if self-test fails	Check if there are any other alarms listed on the alarms page of the LCD screen along with this alarm. Check if those issues can be resolved using the guidelines above. After fixing the issue, acknowledge the alarm on the LCD screen. This will clear the alarm. Now Run the unit. If the problem persists, contact LTS customer service.

Communications Interface

Instructions for Setup

RS232 serial communication is available. It is accessible via the DB-9 connectors on the rear of the chiller. Refer Inadmissible Operating Conditions to avoid any safety hazards. A Terminal Emulator or other comparable device will need to be connected to the DB-9 to allow commands to be entered. The DB-9 pinout at the rear of the chiller is as follows:

Pin 1	--
Pin 2	TXD
Pin 3	RXD
Pin 4	--
Pin 5	GND
Pin 6	--
Pin 7	--
Pin 8	--
Pin 9	--



Terminal Settings: Baud Rate 115200, Data – 8-bit, Parity – none, Stop – 1 bit, Flow Control - none

Commands and responses:

Command	Description	General Response
CMP	Compressor On//Off	Status of Compressor query (returns "ON/OFF")
COL	Set/Get Coolant Type	Coolant Percentage (returns "xx")
CSP	Coolant Supply Pressure	Coolant Supply Pressure query (returns “xx.xx bar/psi”)
CST	Coolant Supply Temp	Coolant Supply Temperature query (returns “xxx.xx C/F”)
CTL	Set/get Control Loop	System Control Loop [R {Run}, S {Stop}]
DAT	Set/Get Date	Set/Get Date (returns "mm/dd/yy)
LVL	Coolant Level Sensor	Coolant Level Switch status query (returns “LOW”, “OK”)
MOD	Model	Displays the model number
PBP	Pressure Bar/Psi	Set Pressure in bar/psi (returns "bar/psi")
PMP	Pump On//Off	Control Power to Pump [ON, OFF] (default = OFF)
RDP	Get R_CSP	Refrigerant Discharge Pressure query (returns “xx.xx bar/psi”)
REF	Refrigerant Type	Refrigerant type R290
SCF	Degrees C or F	Select °C or °F [C, F] (default = C)
SSN	System Serial Number	Serial number is displayed
TIM	Set/Get Time	Time [00:00:00-23:59:59] (default = 00:00:00)
TSP	Temp Set Point	Control Temperature Set Point [-10.0 to 40.0] (default = 20)
VER	Get Firmware Version	Version query (returns “FIRMWARE VERSION X.X”)

FCommand entry format

$[2-character source ID] [3 Character Command], [Data Field if required]

Command strings without contents in Data Field will be interpreted as a query.

Source ID

PC Serial link to a PC or external digital serial interface

Command Structure Examples

$PCCST (Requests current Temperature of Coolant Supply Line via PC)

$PCVER (Returns [VER FIRMWARE VERSION x.x.x]) (Returns [CBS Firmware version x.x.x])

System Maintenance and Service

Diligent maintenance is the prime factor for assuring an error-free and efficient operation of the unit. All the maintenance tasks contained in this chapter must be performed according to the maintenance intervals.

Safety

All safety and warning instructions must be reviewed completely by all personnel prior to maintenance work of the unit. Refer to Safety Precautions.

Improper Maintenance

WARNING

Danger of injury due to improperly performed maintenance.

Improper maintenance can lead to personal injury or material damage.

- Disconnect the unit from all sources of power during maintenance work.
- Ensure that there is enough working area at the beginning of the maintenance work.
- Provide all components and tools required for maintenance work.
- Keep the working area clean and tidy. Loose components and tools, which are lying on each other or lying around, are sources of accidents.
- Check all components for soiling and damage. Do not use damaged or incorrect components.
- Handle the components with care, to avoid damage.
- Assemble components properly.
- Secure components, to prevent them from falling or tipping over.
- Only perform maintenance work using conventional tools. Improper or damaged tools can result in personal injury.

Handling Coolant

CAUTION

Danger of slipping or endangering the environment due to spilled coolant.

Spilled coolant can cause slipping and endanger those working in the environment.

- Do not spill coolant.
- Immediately remove spilled coolant with an appropriate bonding agent.
- Dispose of the bonding agent and coolant mixture in accordance with regional regulations.

NOTE

Testing and replacing external coolant hoses.

Coolant hoses can become brittle through age and must be checked at regular intervals.

- Observe the specifications of the coolant hoses manufacturer.

Environmental Issues

NOTE

Danger to the environment due to improper handling

Environmentally conscious and anticipatory behavior of staff avoids environmentally hazardous impacts.

The following principles apply for environmentally conscious behavior:

- Environmentally hazardous substances must not get into the soil or into the drains. They should be kept in appropriate containers.
- Environmentally hazardous substances must be used and disposed according to regional regulations.
- When dealing with working fluids, remain aware of the safety data sheet of the corresponding manufacturer.

Personnel

Unless otherwise noted, all maintenance tasks described in this chapter can be performed by the operator of the unit.

Other maintenance tasks must be performed by specially trained qualified personnel. This is specially noted in the description of the single maintenance task.

Personal Protective Gear

The following personal protective gear for all maintenance work must be worn:

- Protective footwear
- Protective gloves
- Protective eyewear

Maintenance Schedule

Follow maintenance task described in table 3 to ensure proper operation of the unit.

The interval between maintenance are only recommendations and may vary depending on use of the unit and operating environment.

Table 3: Maintenance

Interval	Required Activities	Criteria	Personnel
Every six months	Clean heat exchanger. Refer to Cleaning the Heat Exchanger.	Plate fins and ventilation grids polluted	Skilled employee
	Check the coolant level and replenish it, if necessary. Refer to Adding Coolant and Priming Unit.	Coolant level at or below “Low” level	Operating personnel
	Inspect coolant hoses, connections, and pipes for cracks and for leaks (visual inspection)	Coolant hoses, pipes and connections are leaking	Operating personnel
	Inspect the coolant quality (visual inspection)	Turbidity, airborne particles	Operating personnel
	Replace the coolant filter. Refer to Replacing the Coolant Filter.	Coolant supply pressure has increased over time	Operating personnel

Preparing the Unit for Maintenance

All necessary safety measures must be taken to prevent accidents when carrying out the maintenance. The following preparations must be made:

- Terminate the cooling operation.
- Let the unit and its coolant cool down to the ambient temperature.
- Switch off the unit.
- Disconnect the unit from the mains by pulling the mains plug.
- Secure the unit against being switched on again.
- Verify that the unit is de-energized.
- Keep unauthorized persons away from the working area.
- Place the unit on a level surface.

Verification of Safe State after Maintenance

- Visually inspect the refrigerant line to make sure there are no leaks.
- Ensure that all screws are securely fastened.
- Make sure that there are no loose electrical connections.
- Ensure that the controller completes the diagnostic.

Draining Procedure

NOTE

Risk of Damage to the pump

When the coolant level in the coolant tank is too low and if it runs the pump dry, the pump can be damaged or destroyed.

- Avoid running the pump dry to prevent damage

Requirements

- Unit prepared for maintenance. Refer to Preparing the Unit for Maintenance.
- Coolant hoses disconnected from the unit. Refer to Disconnect Hoses.
- Coolant cooled down to the ambient temperature.

Required Tools and Materials

- Collection container/Hose – Note, unit holds approximately 5-9 liters of fluid.

Procedure

1. Make sure Drain Valve is closed.
2. Connect hose/place collector container under the drain valve.
3. Disconnect the hose from the outlet port (lower of the two ports).
4. Using a wet vacuum, connect the vacuum source to the outlet port until air can be heard passing through the system cleanly with no water noises.
5. Reconnect the hose or put plastic cover on the ports when drained completely.
6. Open Drain Valve. (Position shown in Fig.34)
7. Close Drain Valve once drained completely.

The coolant is now drained.

Valve OPENED

Valve CLOSED

Figure 32 Draining the Coolant

Coolant Maintenance

Periodically inspect the coolant for contamination. Replace if the coolant becomes dirty/contaminated.

Replace filter

As filter ages, it will become clogged with particles and contamination. Visually inspect and replace filter as necessary. Refer to spare parts for filter part number.

Cleaning the Heat Exchanger

Cooling capacity is heavily reduced if the heat exchanger is contaminated. The heat exchanger must be checked for contamination (particulates) regularly and be cleaned, if required.

The cleaning of the heat exchanger must be performed in accordance with the maintenance intervals.

DANGER

The use of water/chemicals for cleaning the heat exchanger can cause short circuit and damage the fan

The use of water/chemicals for cleaning the heat exchanger can damage the fan and result in a short circuit. In this case persons are in danger to get an electric shock.

- Do not clean the heat exchanger with water/chemicals.

NOTE

Damage to the fins of the heat exchanger due to improper handling of the unit.

Damaged fins of the heat exchanger lead to a reduced cooling capacity.

- Take care not to damage the fins of the heat exchanger when cleaning the heat exchanger.
- Air pressure used to clean the fins must be controlled to prevent damage to the fins.
- If the fins of the heat exchanger are not in a suitable condition, the unit must only be used again once the damage has been rectified.

Requirements

- Unit prepared for maintenance. Refer to Preparing the Unit for Maintenance.

Required Tools and Materials

- Vacuum cleaner
- Compressed air pistol/pressurized air spray
- Hand brush
- Brush

Procedure

1. Clean the condenser and grill with a vacuum cleaner, or compressed air.
2. Care must be taken not to damage the fins.

High-pressure switch information

The maximum pressure in the refrigeration circuit is limited by a refrigerant high-pressure switch. This switch is located on the compressor discharge line and switches power on the power board, this in turn opens and closes power to the compressor. There is also a signal given to the controller which displays a fault). This switch opens when the pressure exceeds 28 bar. The switch must be manually reset when the refrigerant pressure falls below 21 bar pressure.

Resetting the high-pressure switch after activation:

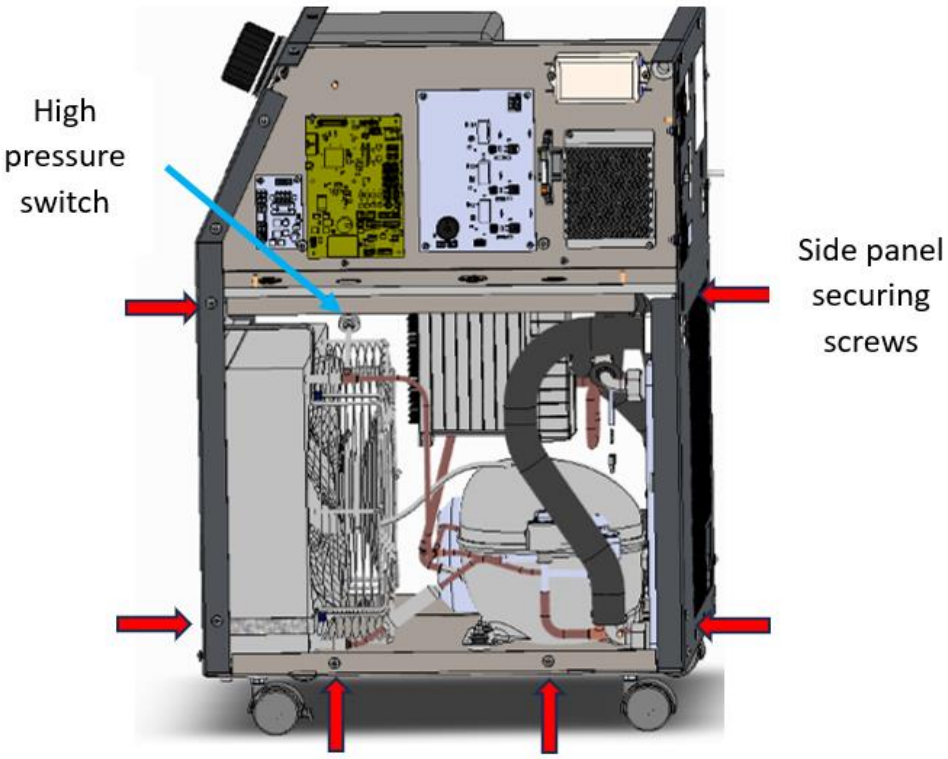
1. Before resetting the high pressure-switch check there is no obstruction, neither in front nor back of the unit. Visually look at the front of the condenser to determine whether there is dust or anything obstructing the condenser intake.

2. Disconnect the power supply from the backside of the unit. Remove the righthand side panel screws and carefully remove the panel being careful not to damage the earthing cable.

3. Carefully push-in the soft red plastic top of the high-pressure switch which will re-set the switch.

4. Replace the panel, connect the power cord, and attempt to run the unit (compressor). Check the that the compressor is showing RPM % on the display which indicates the compressor is running and high-pressure switch is reset.

5. Finally check the condenser fan is running; air should be drawn in at the front and discharged from the back of the unit.

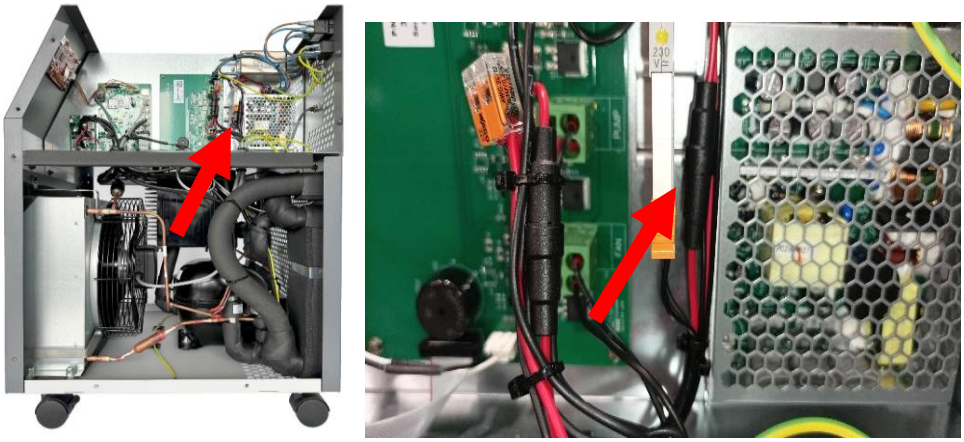


Replacing the expansion valve controller fuse

1. **Turn off the machine and disconnect the power cable.**
2. **Remove the top panel:**
    - To remove the top panel, you need to open 16 screws, as shown in the picture below.

3. **Locate the expansion valve controller fuse:**

    The fuse is inside the fuse holder. Open the fuse holder by gripping the top and bottom of the holder, turning it to the left or counterclockwise.



4. **Replace the damaged fuse:**
    - Take out the damaged fuse and replace it with a new one (1A Fast 5x20).

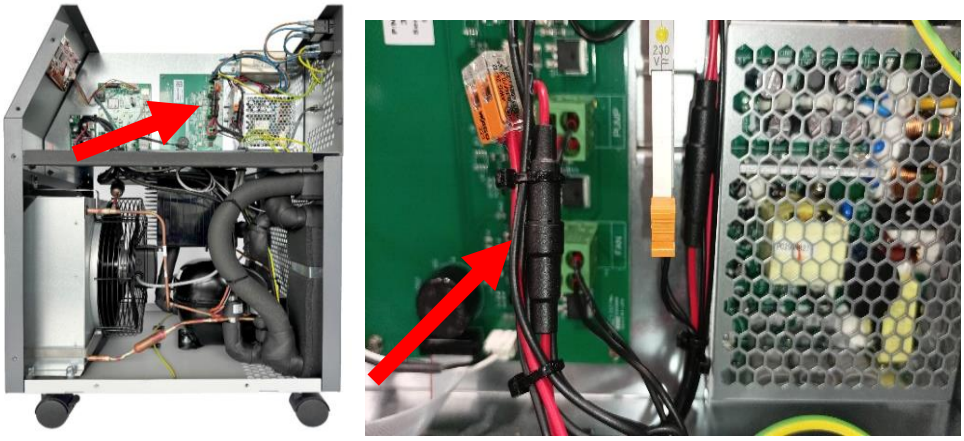
Please make sure to follow safety guidelines, including ensuring the machine is powered off and the power cable is disconnected, before attempting any maintenance.

Replacing the Pump Fuse

1. **Turn off the machine and disconnect the power cable.**
2. **Remove the top panel:**
    - To remove the top panel, you need to open 16 screws, as shown in the picture below.

3. **Locate the Pump Fuse:**

    The fuse is inside the fuse holder. Open the fuse holder by gripping the top and bottom of the holder, turning it to the left or counterclockwise.



4. **Replace the damaged fuse:**
    - Take out the damaged fuse and replace it with a new one (10A Fast 5x20).

Please make sure to follow safety guidelines, including ensuring the machine is powered off and the power cable is disconnected, before attempting any maintenance.

Spare Parts

NOTE

Spare parts must comply with the technical specifications defined by LAIRD THERMAL SYSTEMS. Original LAIRD THERMAL SYSTEMS parts are subject to strict obligations and fulfil these requirements. LAIRD THERMAL SYSTEMS does not provide warranty service in case of damages caused by the use of spare parts made by manufacturers other than LAIRD THERMAL SYSTEMS.

The type of the unit and the article number can be found on the identification plate of the unit. The corresponding numbers shown in drawings below as well as the part description are listed in the spare part list (table 7).

Please direct your inquiries and orders to LAIRD THERMAL SYSTEMS (see "Contact information" on page 11) with the following detailed information:

- Type of unit
- Article number
- Serial number
- Part description
- Quantity
- Shipping details
- Picture of the item in question

Name	EFC2400 Spare P/N
Pump + motor 230V 50/60Hz	387005798-SP
Condenser Fan 230V	387005785-SP
Tank Cap	387011245-SP
Casters locking	387002174-SP
Casters non-locking	387002056-SP
Fuse for EEV controller T1AL250VP (1A, 250V, Slow)	387006972-SP
Fuse for pump motor name (10A, 250V, Fast)	REL-08100-SP
PSU	387005846-SP

Decommissioning and Disposal

Temporarily Placing Out of Operation

DANGER

Electrical danger

Work on electrical installations may be carried out by trained and authorized electricians only.

- Switch off the unit before starting your work.
- Disconnect the unit from mains by pulling the mains plug.
- Secure the unit against being switched on again.
- Verify that the unit is disconnected.
- Carry out necessary earthing connections.
- Keep unauthorized persons away from the working area.

The decommissioned unit must be stored in a dry and dust-free room.

For recommended storage conditions, refer to Storing the Unit.

Prior to Decommissioning

Procedure

1. Finish the cooling operation.
2. Disconnect the unit from mains.
3. Let the unit and the coolant cool down.
4. Disconnect coolant hoses from the unit. Refer to Disconnect Hoses.
5. Drain the coolant. Refer to Draining Procedure
6. Clean the unit. Refer to System Maintenance and Service.
7. Secure the coolant inlet and coolant outlet connections with protection caps against soiling.

The unit has now been decommissioned.

Returning the Unit to Service After Decommissioning

Procedure

1. Thoroughly clean the unit. Refer to System Maintenance and Service.
2. Check that the unit is in operating condition.
3. Install the unit and put it into operation. Refer to Installation Procedure.

Final Decommissioning or Disposal

Final decommissioning or disposal of the unit must be performed in accordance with the regulations of the country of use.

Contact Laird Thermal Systems to return end-of-life units through the official website at https://www.lairdthermal.com/contact or contact a company specializing in the disposal and recycling of equipment.

Disposal of Operating Materials

The operating materials of the unit can be hazardous to the environment and to health.

- Make sure the operating materials are disposed of or recycled according to local regulations.
- Also, the safety specifications of the coolant manufacturer must be obeyed.

Disposal of Refrigerant

Follow all applicable federal, state/provincial and local regulations for refrigerant disposal. The refrigerant used in the unit is classified to be flammable.

- Do not release into water sources or rivers/streams.
- Do not release into atmosphere.
- Storage only in approved containers.
- Waste disposal only by qualified contractors.

Always adhere to manufacturer safety requirements when handling operating supplies.

Return of the Unit to Laird Thermal Systems

Declaration of decontamination

Before re-shipment of the unit a declaration of decontamination must be sent to Laird Thermal Systems.

Return Procedure

All returns must be assigned a Return Materials Authorization number (RMA#) in advance. To start a return process, simply fill out the form at https://www.lairdthermal.com/about/product-return-policy

Returns received without RMA # may be refused. All returns must be securely packed to prevent shipping damage and must be clearly marked with the RMA# on the box. Consignor shall pay freight charges on all returns.

For any questions, please contact us via the website https://www.lairdthermal.com/contact

List of figures