klimatix

User Manual

HVAC Chiller

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Mecalor Soluções em Engenharia Térmica Ltda. | Rua da Banduíra, 219 | 02181-170 | São Paulo | Brasil

Review History			
First Edition	**Date**	**Elaborated by**	**Approval**
New Version	2022	LMRC	WRR
Revision Description	**Date**	**Change**	**Approval**
Rev.01 - Correction of dimensions	3/27/2023	GAAC	WRR
Rev.02 - New version	5/27/2024	CPJ	GOG
Rev.03 - Update of electrical data table (4.2.3) and correction of dimensions (2.5)	6/11/2024	CPJ	GOG
Rev.04 - Update of technical data table (2.2) for 60 Hz version and inclusion of data for 50 Hz version	7/1/2024	CPJ	GOG

ABOUT THE MANUAL

The purpose of this manual is to provide the necessary information for the installation, operation and maintenance, which are enough to ensure the operation of the equipment under the conditions for which it was designed.

Considering that technological advancements will occur, Mecalor reserves the right to change this manual and the design of the equipment without prior warning.

Words like DANGER, ATTENTION and INFORMATION are used in the course of the manual to show warning situations as shown below:

	**DANGER**	Warns about immediate danger that may cause serious injuries or death.
	**ATTENTION**	Warns about unsafe practices, which if not avoided, may cause personal damages or death.
	**INFORMATION**	Relevant information about the equipment or recommendation about good working practices.

MANUFACTURER

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	**INFORMATION**	**Keep this manual in a place that is accessible to the user to consult in case of doubts.** This manual cannot be reproduced whole or in part without the prior authorization from Mecalor.

	**INFORMATION**	**Do not perform any procedure on the equipment in case of doubts after reading this manual.** This manual serves as a guide to operate the equipment safely and it does not have the purpose of informing all the variables of the system. Contact the technical support of Mecalor in case of doubts.

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1. General Description of the Product

1.1. Equipment Description

This equipment incorporates, in a single cabinet, all the components necessary for the continuous supply of process fluid in closed circuit, controlling the temperature accurately and adjusting its capacity according to the heat load variations of the process according to a pre-established temperature (*setpoint*).

Assembled in a compact carbon steel structure, powder-painted with thickness of 70 microns in olive green (RAL 6003), it was designed to work outdoors without having to shelter it in a covered area.

The basic operation is divided into three categories, according to application: refrigeration circuit, hydraulic circuit and control.

	**INFORMATION**	Design developed and built according to standards NR-10 (electrical safety) and NR-12 (operator protection).

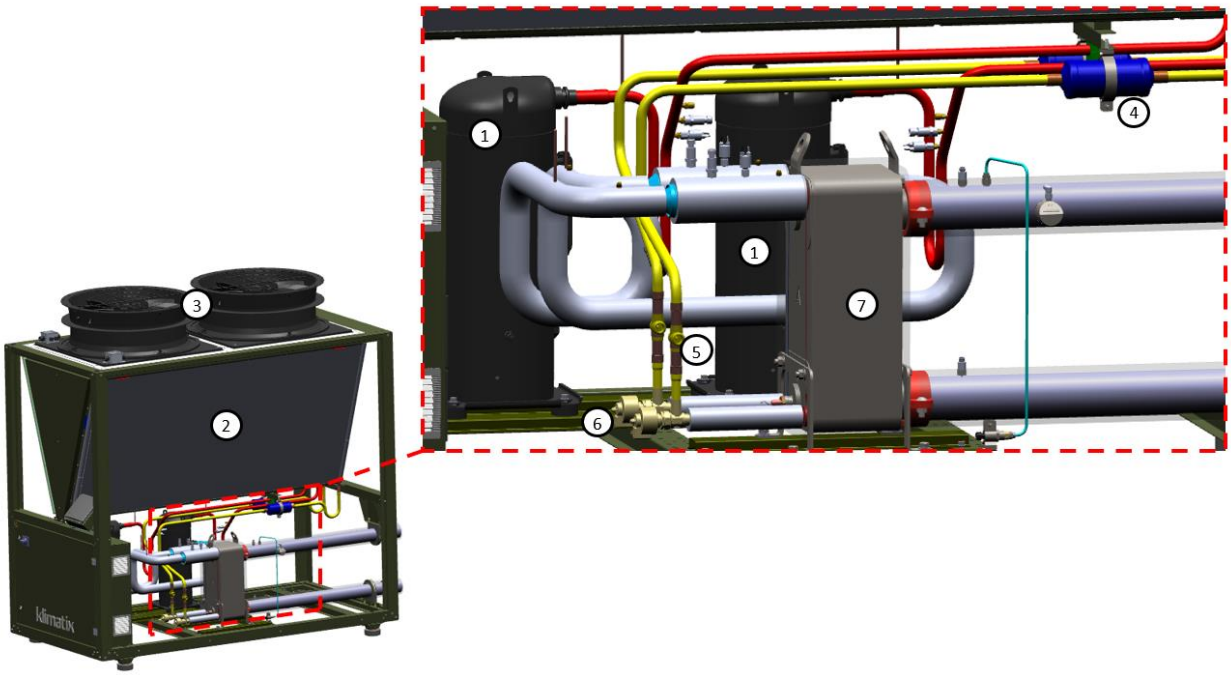
	**ATTENTION**	Tampering with original components installed on the RLAC-S is not allowed. This practice may endanger the safety of the operator, the proper functioning of the equipment, and the loss of warranty.

a) Refrigeration circuit

The cooling system of the RLAC-S consists of a hermetic scroll compressor (1) that is responsible for continuously sending the refrigerant in the form of hot gas to the microchannel condenser (2). In the condenser, the refrigerant transfers heat to the outside air, changing from superheated vapor to sub-cooled liquid. This thermal exchange occurs with the aid of the fans (3) installed at the top of the chiller, which are responsible for forcing the air through the condenser fins.

The refrigerant in the sub-cooled liquid condition passes through a filter drier (4), which is responsible for eliminating impurities and moisture present in the system. The fluid then passes through the sight glass (5), a component that allows a visual inspection of the fluid, making it possible to assess the lack of fluid or detect the presence of humidity, since the sight glass has a humidity level indicator, which changes color according to the level of contamination of the fluid by humidity. When passing through the expansion valve (6), which can be mechanical or electronic, the refrigerant suffers a pressure drop, entering in the form of saturated liquid in the evaporator (7). Inside the evaporator the refrigerant fluid receives heat from the process water, going from the saturated liquid state to overheated steam, condition in which it can enter the compressor and restart the cooling cycle.

	DANGER	**The compressors are equipment that operate with differential pressure between suction and discharge.** In suction, according to the condition of use, the pressure and temperature are low, which may cause burns. In discharge, according to the condition of use, the pressure and temperature are high, which may cause burns. The interior of the equipment should only be accessed by qualified personnel and Personal Protective Equipment (PPE).



Item	Description
1	Hermetic Scroll Compressor
2	Microchannel Condenser
3	Fan
4	Filter Drier
5	Liquid Display
6	Expansion Valve
7	Evaporator

	INFORMATION	This equipment has safety pressure switches on the suction and discharge lines of the compressors. If the pressure reaches values that exceed the safety levels, the equipment will be automatically disabled, indicating a high/low pressure fault on the HMI and triggering the sound alarm of the equipment.

The RLAC-S chiller will automatically adjust the refrigeration capacity control according to the variation in the thermal load of the process. This control is done by switching on/off the compressors installed in the equipment. All chillers in the RLAC-S line have their refrigeration system divided into two circuits. The RLAC-S-25/30/40/50/60 chillers are equipped with two compressors, each connected to a refrigeration circuit, where each compressor accounts for 50% of the total refrigeration capacity of the equipment.

The RLAC-S-80/100/115/150 chillers are equipped with four compressors, two compressors per refrigeration circuit. In this case, each compressor accounts for 25% of the total refrigeration capacity of the equipment.

The RLAC-S-175/220 chillers are equipped with six compressors, three compressors per refrigeration circuit. Each compressor represents approximately 16.67% of the total refrigeration capacity of the equipment.

In addition, RLAC-S chillers are equipped with an electronic expansion valve, which provides greater precision in the control of refrigeration capacity, as well as energy savings and greater safety in the operation of the compressors. These models (Standard version) are supplied with fixed speed fans in the condensing system. All models in the RLAC-S line can be supplied with optional condensation control, ideal for installations where the ambient temperature can reach values below 10°C, as well as providing more precise temperature control. With efficiency in mind, the RLAC-S-30/40/50/60/80/100/115/150/175/220 models are also available in a High Efficiency version, equipped with variable speed EC fans. This version complies with ASHRAE 90.1 efficiency requirements.

The chillers are supplied with fixed speed compressors as standard, but there is the option of supplying the equipment with frequency inverters for the compressors, further increasing the precision of capacity control and energy savings. For RLAC-S-25/30/40 models, the refrigeration system can be made up with an inverter compressor, leaving only the second refrigeration circuit with a fixed speed compressor. For RLAC-S-50/60 models, the system can be made up with a compressor equipped with a frequency inverter, keeping the second circuit with a fixed speed compressor. In the case of RLAC-S-80/100/115/150/175/220 models, it is possible to compose the refrigeration system with a compressor equipped with a frequency inverter in each refrigeration circuit, keeping the other compressors in the tandem or trindem (for RLAC-S-175/220 models) at fixed speed.

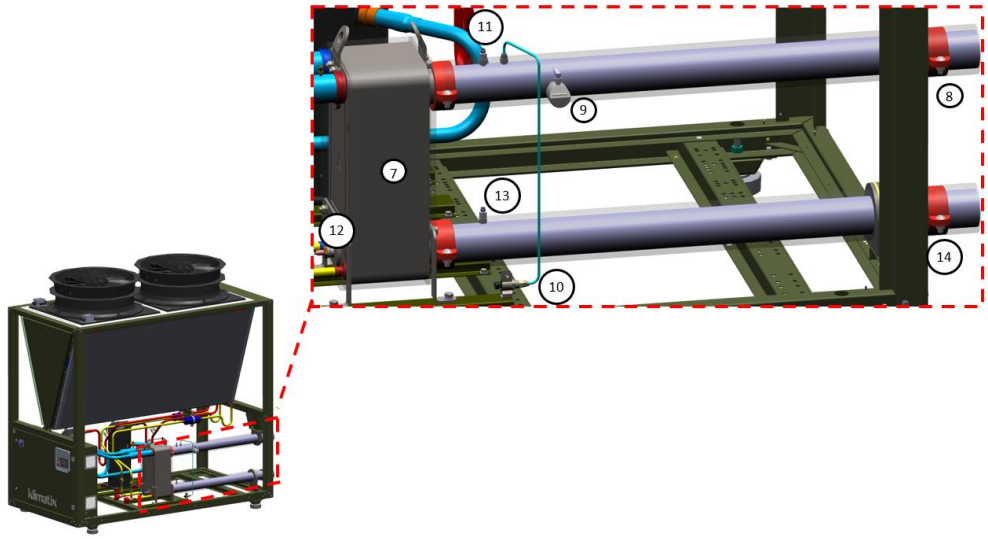
In all the equipment in the RLAC-S line, the compressors are driven and relayed according to the operating time of each compressor, in order to balance the operating time of all the compressors installed in the chiller.

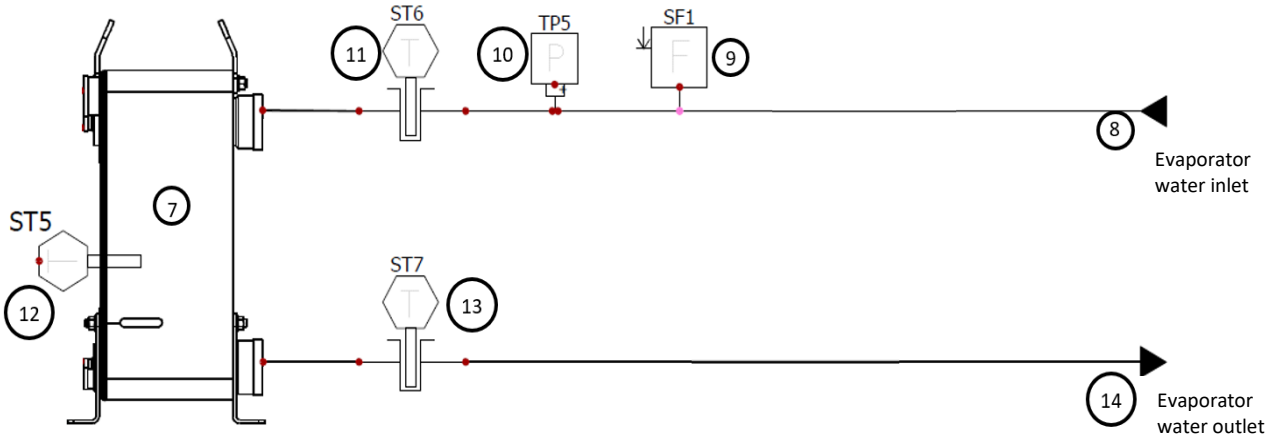
b) Hydraulic circuit

The hydraulic circuit of the chiller is supplied ready for connection to the process of the customer. The water inlet and outlet connections are supplied with Victaulic fittings. Along with the fittings, two stainless steel

pipe ends are also supplied for welding into the existing process piping, if the installation is not yet ready for connection through Victaulic fittings.

Water from the process enters the chiller through the water inlet connection (8), passing through the flow sensor (9), which is responsible for reading the water flow. The flow reading is displayed through the LEDs on the body of the flow sensor, indicated by green LEDs. If the flow rate falls below the minimum permissible, indicated by the red LED, the equipment will stop working, triggering a sound alarm and indicating a fault due to insufficient water on the HMI of the chiller. This instrument is responsible for ensuring that there is a suitable flow of water circulating through the evaporator, since a reduction or interruption in the flow of water can cause the water inside the evaporator to freeze, causing the plates to break, which is irreparable damage to the evaporator and allows water to enter the refrigeration circuit, causing damage to the compressors. After the water has passed through the flow sensor, it passes through the pressure transmitter (10), the instrument responsible for measuring the water pressure and transmitting the information for display on the HMI of the chiller. The water then passes through the return temperature sensor (11), which is responsible for taking a real-time reading of the temperature of the water entering the evaporator and displaying this information on the HMI of the equipment. The water then passes through the evaporator (7), which is a brazed plate heat exchanger, where the water transfers heat to the refrigerant fluid in the refrigeration system of the chiller. The evaporator has a low temperature sensor (12), which is responsible for taking real-time readings of the water flowing through the heat exchanger, ensuring that it does not fall below 2°C, thus preventing the water from freezing and damaging the evaporator plates. If the water temperature exceeds the safety value, the equipment will stop working, triggering a sound alarm and indicating a fault due to low water temperature on the HMI of the equipment. Leaving the evaporator, the water flows through the process outlet pipe, passing through the outlet water temperature sensor (13), which is responsible for taking a real-time reading of the outlet water temperature of the chiller, displaying this information on the HMI of the equipment. Lastly, the water goes on to cool the process through the water outlet connection (14).





Item	Description
7	Evaporator
8	Water inlet connection
9	Flow sensor
10	Pressure transmitter
11	Water return temperature sensor
12	Low temperature sensor
13	Water outlet temperature sensor
14	Water outlet connection

To prevent the evaporator from being clogged by dirt particles in the water, it must be ensured that the process has an efficient filtering system. In the standard configuration, the RLAC-S chiller is supplied without a filter; however, the unit can optionally be supplied with a water filter for installation in the water inlet line.

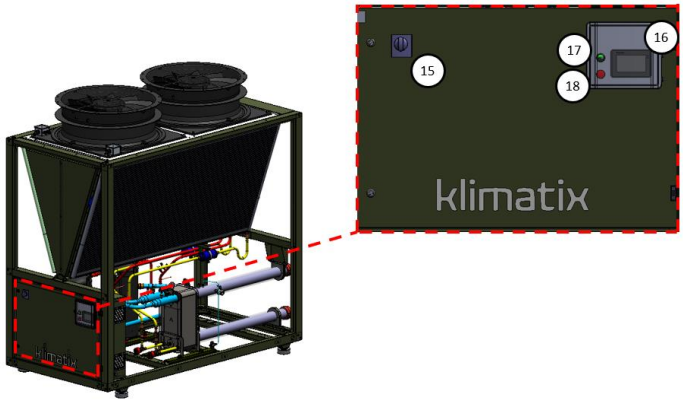
In addition to the filter, the unit can also be supplied with a water pump. The pump is supplied through a hydraulic kit, which is available in versions with one or two pumps, with an operating pressure of 2, 3 or 5 bar.

c) Control

All the control and command electrical components are installed inside the electrical panel, positioned at the front of the equipment. The electrical panel of the entire RLAC-S- line has IP 54 protection grade.

The equipment is supplied with electricity by operating the rotary handle of the main switch (15).

Control is performed through a PLC installed inside the electrical panel. Access for operation and configuration is through the *touch screen* HMI (16) installed on the electrical panel door. The HMI is protected by an acrylic cover with IP 65 protection. Right next to the HMI are the switch button (17) and the alarm LED (18). The switch button has three positions, one for off, one to activate the equipment and one to enable the "remote" function, where the equipment is activated by a remote panel installed in another area (optional). The alarm LED is activated whenever the equipment has a fault, together with the sound alarm and display of the fault description on the HMI. The sound alarm can be inhibited through the HMI. Some faults allow the device to be reset for a new start. However, some occurrences no longer allow this type of action and the cause of the fault must be resolved in order for the alarm to be automatically deactivated and the device to resume operation. For further instructions on alarms, we recommend that you consult section 6 of this manual.



Item	Description
15	Rotary handle
16	HMI
17	Switch button
18	Alarm LED

	INFORMATION	NTC sensors are installed in the outlet and return pipe of the process water. Sensors and pressure transducers are installed at various points in the cooling circuit. They send analog signals to the PLC, which are converted into temperature and pressure indicated on the HMI screen. These signals are used as reference by the PLC to take action on the cooling system in order to control the capacity of the equipment.

	INFORMATION	A phase sequence relay is installed inside the electrical panel of the RLAC, which protects the equipment against phase failure or phase inversion. In case it is inverted, the equipment will not turn on and the R and S phases must be inverted at the electric power inlet of the main switch.

1.2. Application scope

The line of RLAC-S chillers is equipment designed for cooling water or solutions applied in processes and systems that require temperature and/or humidity control.

- Climate control for thermal comfort;
- Air treatment;
- Climate control for industrial processes;
- Climate control for datacenters;
- Climate control for telephone centers;
- Climate control for electrical rooms;

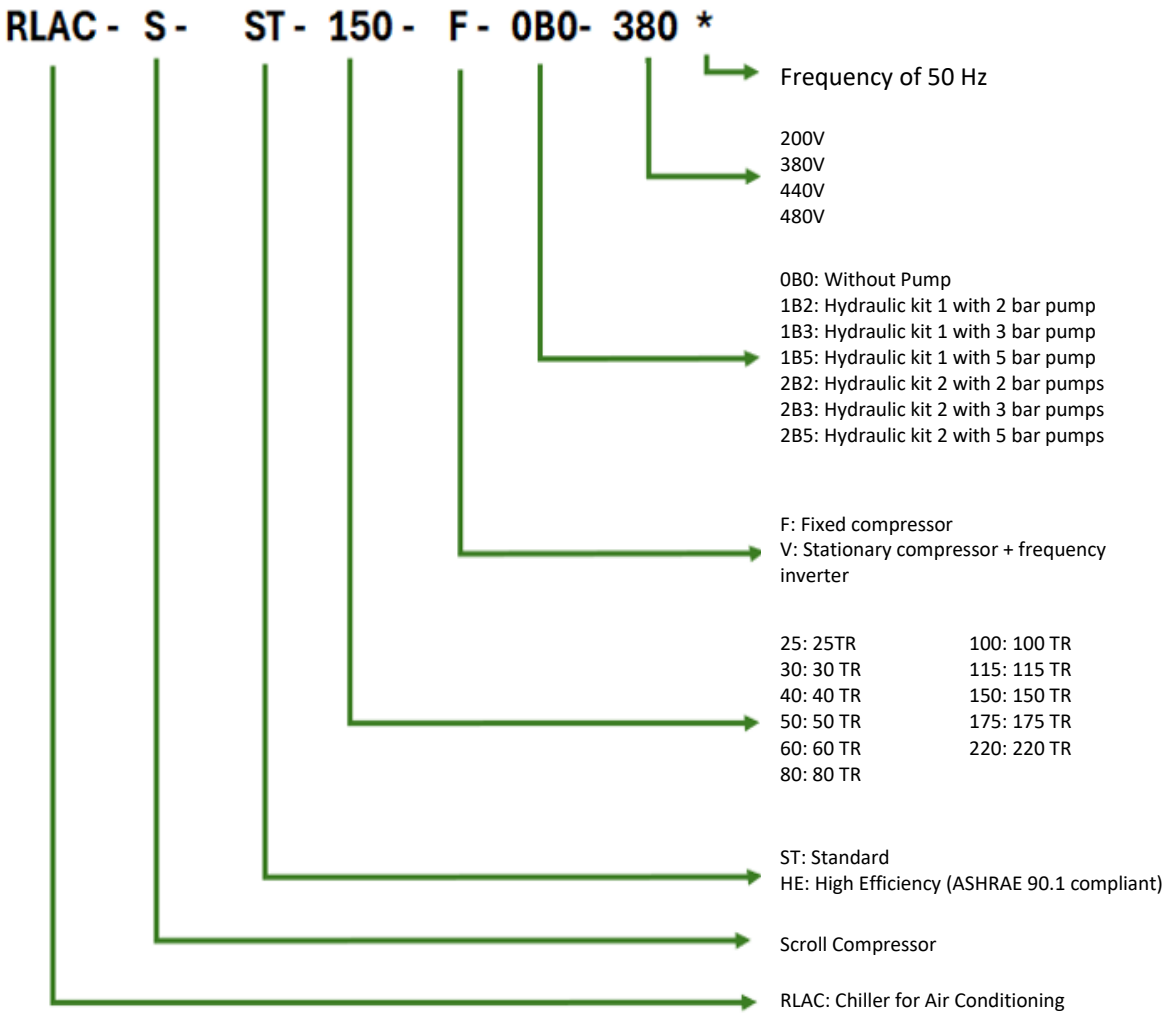
	**ATTENTION**	Applications different from those intended for the product may put at risk the safety of the operator, the performance and even the breakage of a component of the RLAC-S and the loss of warranty.

1.3. Optional items installed at the factory and on the field

Item	Installed in Factory	Installed on Field
Hydraulic Filter	✓	✓
Capacitor bank for compressors and/or pump(s)	✓	⊘
Soft starter for compressors and/or pump(s)	✓	⊘
Bacnet Communication	✓	✓
Hot gas by-pass	✓	⊘
Condenser with E-coating treatment	✓	⊘
Compressor with frequency inverter / Inverter compressor	✓	⊘
NEO monitoring	✓	✓
Hydraulic kit with 1 or 2 pumps	✓	✓
Water bypass	⊘	✓
Hydraulic interconnection for parallel operation	⊘	✓
Remote panel	⊘	✓
Closing screen	✓	✓
Expansion tank	✓	✓
Air filter	✓	✓
Compressor sound enclosure	✓	✓
Heat recovery	✓	⊘
Switch	✓	✓
Condensation control	✓	⊘

2. Technical Features

2.1. Nomenclature



	INFORMATION	Check special documentation described in the annex to this manual for RLAC-S that has a special character (for example /B/C/E/T) Some data in this manual such as electrical data may not apply to the RLAC-S that has special characters.

2.2. Technical Information

2.2.1. Available versions

Aiming for high efficiency while maintaining operational performance, the equipment in the RLAC-S line (except for the RLAC-S-25 model, which is only available in the Standard version) is available in two versions. The

Standard version is equipped with fixed speed axial fans, while the High Efficiency version is equipped with variable speed EC axial fans. This version complies with all the efficiency requirements of ASHRAE 90.1.

Technical data on the equipment in both versions is available below.

2.2.1.1. Standard Version – 60 Hz

	Description	Unit	Model					
	RLCA-S Line		**25**	**30**	**40**	**50**	**60**	**80**
Basic Data	Capacity (1)	kW	83	100	124	164	208	269
		TR	24	28	35	47	59	77
	Total power consumed (1)	kW	29.1	33.3	40.7	51.3	71.1	93.5
	COP (1)	kW/kW	2.8532	3.0075	3.0339	3.1969	2.9255	2.8798
	IPLV (1)	kW/kW	3.5746	3.6367	3.8181	4.3137	4.0415	4.6401
Cooling	Condensation	-	Air					
	Cooling circuits	-	2					
	Cooling fluid	-	R410A					
	Compressors	-	Scroll					
	Number of compressors	-	2	2	2	2	2	4
	Condensers	-	Microchannel					
	Fans	-	Axial					
	Evaporator	-	Brazed Plates					
	Expansion valve (2)	-	VET		VEE			
Hydraulic circuit	Flow rate (1)	m^3/h	14.3	17.2	21.4	28.3	35.7	46.5
	Load loss	kPa	21	31	28	30	34	42.9
	Connection type (3)	-	Thread	Victaulic				
	Inlet connections	inch	2	2	3	3	3	3
	Outlet connections	inch	2	2	3	3	3	3
Electrical	Power supply (4)	-	3Ph/220V/60Hz - 3Ph/380V/60Hz - 3Ph/440V/60Hz					
	HMI	-	4.3-inch Graphic Touchscreen					
	Communication	-	Modbus RTU or TCP/IP					
	Key Switch	-	Yes					
	Drive	-	Three-position button (on, off, and remote activation)					
	Light signal	-	Fault summary					
	Sequence and phase failure	-	Yes					
	Audible signal	-	Yes					
Temperature Sensor	Water outlet	-	Yes					
	Water inlet	-	Yes					
	Evaporator anti-freeze	-	Yes					
	Room air	-	Yes					
	Evaporator refrigerant outlet	-	Yes					
	Condenser refrigerant outlet	-	Yes					
Sensors	Low pressure (5)	-	Yes					
	High pressure (5)	-	Yes					
	Water pressure (6)	-	Yes					
	Water flow	-	Yes					
Construction details	Width (7)	mm	961	1046	1254	1926	1926	2283
	Length	mm	2354	2821	2623	2824	2824	2908
	Height (7)	mm	1903	2027	2400	2052	2052	2473
	Net weight	kg	558	604	707	998	1153	1707

	Description	Unit					
	RLCA-S Line		**100**	**115**	**150**	**175**	**220**
Basic Data	Capacity (1)	kW	360	422	514	609	768
		TR	102	120	146	173	218
	Total power consumed (1)	kW	120.5	136.6	179.0	209.0	267.8
	COP (1)	kW/kW	2.9887	3.0902	2.8722	2.9139	2.8674
	IPLV (1)	kW/kW	4.3957	4.5545	4.5210	4.3195	4.3222
Cooling	Condensation	-	Air				
	Cooling circuits	-	2				
	Cooling fluid	-	R410A				
	Compressors	-	Scroll				
	Number of compressors	-	4	4	4	6	6
	Condensers	-	Microchannel				
	Fans	-	Axial				
	Evaporator	-	Brazed Plates				
	Expansion valve (2)	-	VEE				
Hydraulic circuit	Flow rate (1)	m^3/h	61.9	72.8	88.6	105.1	132.4
	Load loss	kPa	52	43	35	48	38
	Connection type (3)	-	Victaulic				
	Inlet connections	inch	4	4	6	6	6
	Outlet connections	inch	4	4	6	6	6
Electrical	Power supply (4)	-	3Ph/220V/60Hz - 3Ph/380V/60Hz - 3Ph/440V/60Hz				
	HMI	-	4.3-inch Graphic Touchscreen				
	Communication	-	Modbus RTU or TCP/IP				
	Key Switch	-	Yes				
	Drive	-	Three-position button (on, off, and remote activation)				
	Light signal	-	Fault summary				
	Sequence and phase failure	-	Yes				
	Audible signal	-	Yes				
Temperature Sensor	Water outlet	-	Yes				
	Water inlet	-	Yes				
	Evaporator anti-freeze	-	Yes				
	Room air	-	Yes				
	Evaporator refrigerant outlet	-	Yes				
	Condenser refrigerant outlet	-	Yes				
Sensors	Low pressure (5)	-	Yes				
	High pressure (5)	-	Yes				
	Water pressure (6)	-	Yes				
	Water flow	-	Yes				
Construction Details	Width (7)	mm	2283	2283	2283	2283	2286
	Length	mm	4018	5125	5130	6212	7310
	Height (7)	mm	2473	2473	2473	2473	2473
	Net weight	kg	2232	2783	2885	3727	4259

(1) Operating conditions according to AHRI 551/591; Ambient temperature 35°C; Inlet water temperature 12°C; Water outlet temperature 7°C: Atmospheric pressure 101 kpa.

(2) TEV thermostatic expansion valve and VEE electronic expansion valve

(3) BSP internal thread and victaulic grooved connection included in the equipment

(4) Check the availability of power supply per product model

(5) Pressure transducers installed in the refrigeration circuits at the suction and discharge of the compressors

(6) Chilled water pipe inlet

(7) Dimensions of equipment without dampers

2.2.1.2. High Efficiency Version – 60 Hz

	Description	Unit	Model				
	RLCA-S Line		**30**	**40**	**50**	**60**	**80**
Basic Data	Capacity (1)	kW	102	127	164	211	279
		TR	29	36	47	60	79
	Total power consumed (1)	kW	32.33	38.7	48.1	67.9	88.8
	COP (1)	kW/kW	3.1551	3.2966	3.4081	3.1060	3.1377
	IPLV (1)	kW/kW	4.0859	4.2531	4.7076	4.2940	5.0248
Cooling	Condensation	-	Air				
	Cooling circuits	-	2				
	Cooling fluid	-	R410A				
	Compressors	-	Scroll				
	Number of compressors	-	2	2	2	2	4
	Condensers	-	Microchannel				
	Fans	-	Axial				
	Evaporator	-	Brazed Plates				
	Expansion valve (2)	-	VEE				
Hydraulic circuit	Flow rate (1)	m³/h	17.52	22.0	28.3	36.2	48.1
	Load loss	kPa	45.7	29	31	35	45.7
	Connection type (3)	-	Victaulic				
	Inlet connections	inch	2	3	3	3	3
	Outlet connections	inch	2	3	3	3	3
Electrical	Power supply (4)	-	3Ph/220V/60Hz - 3Ph/380V/60Hz - 3Ph/440V/60Hz				
	HMI	-	4.3-inch Graphic Touchscreen				
	Communication	-	Modbus RTU or TCP/IP				
	Key Switch	-	Yes				
	Drive	-	Three-position button (on, off, and remote activation)				
	Light signal	-	Fault summary				
	Sequence and phase failure	-	Yes				
	Audible signal	-	Yes				
Temperature Sensor	Water outlet	-	Yes				
	Water inlet	-	Yes				
	Evaporator anti-freeze	-	Yes				
	Room air	-	Yes				
	Evaporator refrigerant outlet	-	Yes				
	Condenser refrigerant outlet	-	Yes				
Sensors	Low pressure (5)	-	Yes				
	High pressure (5)	-	Yes				
	Water pressure (6)	-	Yes				
	Water flow	-	Yes				
Construction Details	Width (7)	mm	1046	1254	1926	1926	2283
	Length	mm	2821	2623	2824	2824	2908
	Height (7)	mm	2113	2457	2138	2138	2530
	Net weight	kg	635	708	1062	1217	1711

	Description	Unit					
	RLCA-S Line		**100**	**115**	**150**	**175**	**220**
Basic Data	Capacity (1)	kW	369	432	528	627	792
		TR	105	123	150	178	225
	Total power consumed (1)	kW	114.6	130.2	170.2	198.7	255.3
	COP (1)	kW/kW	3.2171	3.3184	3.1025	3.1550	3.1025
	IPLV (1)	kW/kW	5.0300	5.1206	4.8817	5.1321	5.0228
Cooling	Condensation	-	Air				
	Cooling circuits	-	2				
	Cooling fluid	-	R410A				
	Compressors	-	Scroll				
	Number of compressors	-	4	4	4	6	6
	Condensers	-	Microchannel				
	Fans	-	Axial				
	Evaporator	-	Brazed Plates				
	Expansion valve (2)	-	VEE				
Hydraulic circuit	Flow rate (1)	m^3/h	63.6	74.5	91.0	107.7	136.5
	Load loss	kPa	55	45	33	50	40
	Connection type (3)	-	Victaulic				
	Inlet connections	inch	4	4	6	6	6
	Outlet connections	inch	4	4	6	6	6
Electrical	Power supply (4)	-	3Ph/220V/60Hz - 3Ph/380V/60Hz - 3Ph/440V/60Hz				
	HMI	-	4.3-inch Graphic Touchscreen				
	Communication	-	Modbus RTU or TCP/IP				
	Key Switch	-	Yes				
	Drive	-	Three-position button (on, off, and remote activation)				
	Light signal	-	Fault summary				
	Sequence and phase failure	-	Yes				
	Audible signal	-	Yes				
Temperature sensor	Water outlet	-	Yes				
	Water inlet	-	Yes				
	Evaporator anti-freeze	-	Yes				
	Room air	-	Yes				
	Evaporator refrigerant outlet	-	Yes				
	Condenser refrigerant outlet	-	Yes				
Sensors	Low pressure (5)	-	Yes				
	High pressure (5)	-	Yes				
	Water pressure (6)	-	Yes				
	Water flow	-	Yes				
Construction Details	Width (7)	mm	2283	2283	2283	2283	2286
	Length	mm	4018	5125	5130	6212	7310
	Height (7)	mm	2530	2530	2530	2530	2530
	Net weight	kg	2237	2789	2891	3735	4268

(1) Operating conditions according to AHRI 551/591; Ambient temperature 35°C; Inlet water temperature 12°C; Water outlet temperature 7°C: Atmospheric pressure 101 kpa.

(2) TEV thermostatic expansion valve and VEE electronic expansion valve

(3) BSP internal thread and victaulic grooved connection included in the equipment

(4) Check the availability of power supply per product model

(5) Pressure transducers installed in the refrigeration circuits at the suction and discharge of the compressors

(6) Chilled water pipe inlet

(7) Dimensions of equipment without dampers

2.2.1.3. Standard Version – 50 Hz

	Description	Unit	Model					
	RLCA-S Line		**25**	**30**	**40**	**50**	**60**	**80**
Basic Data	Capacity (1)	kW	70	83	105	139	175	230
		TR	20	24	30	40	50	65
	Total power consumed (1)	kW	23.0	26.3	33.8	41.0	56.0	77.8
	COP (1)	kW/kW	3.0453	3.1581	3.1006	3.4030	3.1270	2.9512
	IPLV (1)	kW/kW	3.9230	3.9779	3.8852	4.5771	4.3603	4.6866
Cooling	Condensation	-	Air					
	Cooling circuits	-	2					
	Cooling fluid	-	R410A					
	Compressors	-	Scroll					
	Number of compressors	-	2	2	2	2	2	4
	Condensers	-	Microchannel					
	Fans	-	Axial					
	Evaporator	-	Brazed Plates					
	Expansion valve (2)	-	VET		VEE			
Hydraulic circuit	Flow rate (1)	m^3/h	12.0	14.3	18.1	24.0	30.1	39.5
	Load loss	kPa	16	21	20	22	24	31.4
	Connection type (3)	-	Thread	Victaulic				
	Inlet connections	inch	2	2	3	3	3	3
	Outlet connections	inch	2	2	3	3	3	3
Electrical	Power supply (4)	-	3Ph/400V/50Hz					
	HMI	-	4.3-inch Graphic Touchscreen					
	Communication	-	Modbus RTU or TCP/IP					
	Key Switch	-	Yes					
	Drive	-	Three-position button (on, off, and remote activation)					
	Light signal	-	Fault summary					
	Sequence and phase failure	-	Yes					
	Audible signal	-	Yes					
Temperature Sensor	Water outlet	-	Yes					
	Water inlet	-	Yes					
	Evaporator anti-freeze	-	Yes					
	Room air	-	Yes					
	Evaporator refrigerant outlet	-	Yes					
	Condenser refrigerant outlet	-	Yes					
Sensors	Low pressure (5)	-	Yes					
	High pressure (5)	-	Yes					
	Water pressure (6)	-	Yes					
	Water flow	-	Yes					
Construction details	Width (7)	mm	961	1046	1254	1926	1926	2283
	Length	mm	2354	2821	2623	2824	2824	2908
	Height (7)	mm	1903	2027	2400	2052	2052	2473
	Net weight	kg	558	604	707	998	1153	1707

	Description	Unit					
	RLCA-S Line		**100**	**115**	**150**	**175**	**220**
Basic Data	Capacity (1)	kW	304	356	438	516	657
		TR	86	101	125	147	187
	Total power consumed (1)	kW	99.0	111.2	144.8	170.4	217.2
	COP (1)	kW/kW	3.0707	3.2014	3.0249	3.0282	3.0249
	IPLV (1)	kW/kW	4.4863	4.6916	4.7172	4.4516	4.4884
Cooling	Condensation	-	Air				
	Cooling circuits	-	2				
	Cooling fluid	-	R410A				
	Compressors	-	Scroll				
	Number of compressors	-	4	4	4	6	6
	Condensers	-	Microchannel				
	Fans	-	Axial				
	Evaporator	-	Brazed Plates				
	Expansion valve (2)	-	VEE				
Hydraulic circuit	Flow rate (1)	m^3/h	52.2	61.1	75.2	88.6	113.3
	Load loss	kPa	38	31	26	35	28
	Connection type (3)	-	Victaulic				
	Inlet connections	inch	4	4	6	6	6
	Outlet connections	inch	4	4	6	6	6
Electrical	Power supply (4)	-	3Ph/400V/50Hz				
	HMI	-	4.3-inch Graphic Touchscreen				
	Communication	-	Modbus RTU or TCP/IP				
	Key Switch	-	Yes				
	Drive	-	Three-position button (on, off, and remote activation)				
	Light signal	-	Fault summary				
	Sequence and phase failure	-	Yes				
	Audible signal	-	Yes				
Temperature Sensor	Water outlet	-	Yes				
	Water inlet	-	Yes				
	Evaporator anti-freeze	-	Yes				
	Room air	-	Yes				
	Evaporator refrigerant outlet	-	Yes				
	Condenser refrigerant outlet	-	Yes				
Sensors	Low pressure (5)	-	Yes				
	High pressure (5)	-	Yes				
	Water pressure (6)	-	Yes				
	Water flow	-	Yes				
Construction Details	Width (7)	mm	2283	2283	2283	2283	2286
	Length	mm	4018	5125	5130	6212	7310
	Height (7)	mm	2473	2473	2473	2473	2473
	Net weight	kg	2232	2783	2885	3727	4259

(1) Operating conditions according to AHRI 551/591; Ambient temperature 35°C; Inlet water temperature 12°C; Water outlet temperature 7°C: Atmospheric pressure 101 kpa.

(2) TEV thermostatic expansion valve and VEE electronic expansion valve

(3) BSP internal thread and victaulic grooved connection included in the equipment

(4) Check the availability of power supply per product model

(5) Pressure transducers installed in the refrigeration circuits at the suction and discharge of the compressors

(6) Chilled water pipe inlet

(7) Dimensions of equipment without dampers

2.2.1.4. High Efficiency Version – 50 Hz

	Description	Unit	Model				
	RLCA-S Line		**30**	**40**	**50**	**60**	**80**
Basic Data	Capacity (1)	kW	85	110	139	178	242
		TR	24	31	40	51	69
	Total power consumed (1)	kW	25.73	31.8	39.2	54.4	72.4
	COP (1)	kW/kW	3.303	3.4524	3.5570	3.2749	3.3484
	IPLV (1)	kW/kW	4.3382	4.4479	4.8576	4.5861	5.1485
Cooling	Condensation	-	Air				
	Cooling circuits	-	2				
	Cooling fluid	-	R410A				
	Compressors	-	Scroll				
	Number of compressors	-	2	2	2	2	4
	Condensers	-	Microchannel				
	Fans	-	Axial				
	Evaporator	-	Brazed Plates				
	Expansion valve (2)	-	VEE				
Hydraulic circuit	Flow rate (1)	m^3/h	14.77	18.9	24.0	30.7	41.7
	Load loss	kPa	22.9	22	22	25	32.4
	Connection type (3)	-	Victaulic				
	Inlet connections	inch	2	3	3	3	3
	Outlet connections	inch	2	3	3	3	3
Electrical	Power supply (4)	-	3Ph/400V/50Hz				
	HMI	-	4.3-inch Graphic Touchscreen				
	Communication	-	Modbus RTU or TCP/IP				
	Key Switch	-	Yes				
	Drive	-	Three-position button (on, off, and remote activation)				
	Light signal	-	Fault summary				
	Sequence and phase failure	-	Yes				
	Audible signal	-	Yes				
Temperature Sensor	Water outlet	-	Yes				
	Water inlet	-	Yes				
	Evaporator anti-freeze	-	Yes				
	Room air	-	Yes				
	Evaporator refrigerant outlet	-	Yes				
	Condenser refrigerant outlet	-	Yes				
Sensors	Low pressure (5)	-	Yes				
	High pressure (5)	-	Yes				
	Water pressure (6)	-	Yes				
	Water flow	-	Yes				
Construction Details	Width (7)	mm	1046	1254	1926	1926	2283
	Length	mm	2821	2623	2824	2824	2908
	Height (7)	mm	2113	2457	2138	2138	2530
	Net weight	kg	635	708	1062	1217	1711

	Description	Unit					
	RLCA-S Line		**100**	**115**	**150**	**175**	**220**
Basic Data	Capacity (1)	kW	318	368	460	537	690
		TR	90	105	131	153	196
	Total power consumed (1)	kW	92.9	105.8	135.8	159.7	203.7
	COP (1)	kW/kW	3.4216	3.4788	3.3877	3.3619	3.3877
	IPLV (1)	kW/kW	5.2344	5.3900	5.2053	5.3850	5.3176
Cooling	Condensation	-	Air				
	Cooling circuits	-	2				
	Cooling fluid	-	R410A				
	Compressors	-	Scroll				
	Number of compressors	-	4	4	4	6	6
	Condensers	-	Microchannel				
	Fans	-	Axial				
	Evaporator	-	Brazed Plates				
	Expansion valve (2)	-	VEE				
Hydraulic circuit	Flow rate (1)	m^3/h	54.6	63.5	79.3	92.7	119.0
	Load loss	kPa	42	33	28	38	31
	Connection type (3)	-	Victaulic				
	Inlet connections	inch	4	4	6	6	6
	Outlet connections	inch	4	4	6	6	6
Electrical	Power supply (4)	-	3Ph/400V/50Hz				
	HMI	-	4.3-inch Graphic Touchscreen				
	Communication	-	Modbus RTU or TCP/IP				
	Key Switch	-	Yes				
	Drive	-	Three-position button (on, off, and remote activation)				
	Light signal	-	Fault summary				
	Sequence and phase failure	-	Yes				
	Audible signal	-	Yes				
Temperature sensor	Water outlet	-	Yes				
	Water inlet	-	Yes				
	Evaporator anti-freeze	-	Yes				
	Room air	-	Yes				
	Evaporator refrigerant outlet	-	Yes				
	Condenser refrigerant outlet	-	Yes				
Sensors	Low pressure (5)	-	Yes				
	High pressure (5)	-	Yes				
	Water pressure (6)	-	Yes				
	Water flow	-	Yes				
Construction Details	Width (7)	mm	2283	2283	2283	2283	2286
	Length	mm	4018	5125	5130	6212	7310
	Height (7)	mm	2530	2530	2530	2530	2530
	Net weight	kg	2237	2789	2891	3735	4268

(1) Operating conditions according to AHRI 551/591; Ambient temperature 35°C; Inlet water temperature 12°C; Water outlet temperature 7°C: Atmospheric pressure 101 kpa.

(2) TEV thermostatic expansion valve and VEE electronic expansion valve

(3) BSP internal thread and victaulic grooved connection included in the equipment

(4) Check the availability of power supply per product model

(5) Pressure transducers installed in the refrigeration circuits at the suction and discharge of the compressors

(6) Chilled water pipe inlet

(7) Dimensions of equipment without dampers

	INFORMATION	Refrigerant Used: R-410A

	INFORMATION	The power in regime is calculated based on the nominal operating condition of the equipment and it SHOULD NOT be used to size the protections of the RLAC-S, considering that the equipment may operate in conditions close to the maximum power of the equipment.

	DANGER	The R-410A refrigerant has relatively high pressures, reaching 600 psi. No other refrigerants should be used in the RLAC-S refrigeration system. The meters applied should be suitable for operating with pressure fluid R-410A

2.3. Identification plate attached to the RLAC-S

2.4. Operating limits

Some operating limits are described below and must be observed for good performance and operation of the RLAC-S:

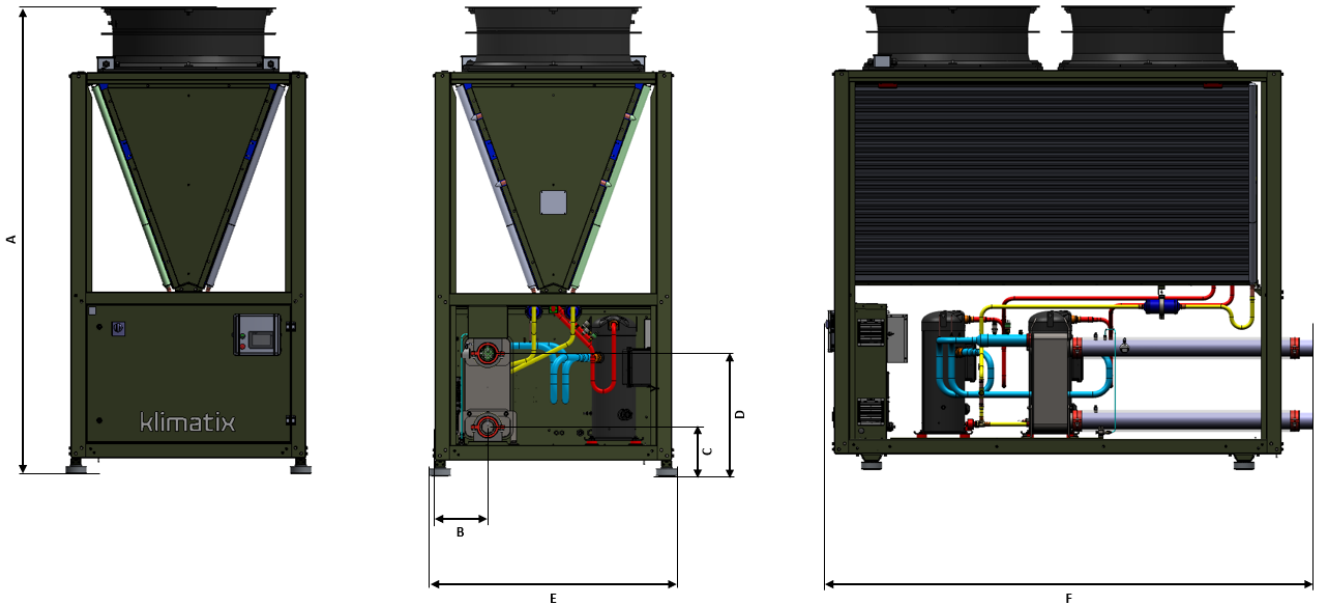
- Maximum room temperature up to 45°C:

  In case the RLAC-S works with room temperature below 10°C it is recommended to install the optional condensation control, which automatically varies the rotation of the fans from 10 to 100% according to the condensation pressure, reducing the room temperature or heat load of the process;
- Outdoor operation:

  The RLAC-S was developed to work in open environments, free from roofs. If it is impossible to install the equipment in an open area, Mecalor engineering should be contacted;
- Supply of chilled water at temperatures from 5°C to 15°C:

  For the process water temperature and room temperature below 5°C, use anti-freeze additive mixed to the process water. Consult Mecalor for adjustments in the RLAC-S in case the equipment is not prepared for this purpose;
- Make sure that the installation site follows all the space recommendations indicated in this manual, ensuring sufficient space around the equipment for proper operation and allowing access for any maintenance;
- The fan system should be inspected regularly, as the suspension of particles can cause imbalance of the propellers. The airflow area of the fan should be cleaned only with water and neutral soap, avoiding abrasives;

2.5. Dimensions



Model	Dimensions in millimeters							*Process Pipe Diameter*
	A ST Version	A HE Version	B	C	*D*	*AND*	*F*	
RLAC-S-25	1988	-	256	305	695	1020	2354	2”
RLAC-S-30	2112	2198	250	305	695	1105	2821	2”
RLAC-S-40	2485	2542	279	262	652	1313	2623	3”
RLAC-S-50	2137	2223	394	302	692	1985	2824	3”
RLAC-S-60	2137	2223	394	302	692	1985	2824	3”
RLAC-S-80	2520	2577	1390	306	696	2283	2908	3”
RLAC-S-100	2520	2577	427	347	937	2283	4018	4”
RLAC-S-115	2520	2577	431	334	929	2283	5125	4”
RLAC-S-150	2520	2577	431	334	902	2283	5130	6”
RLAC-S-175	2520	2577	413	334	902	2283	6212	6”
RLAC-S-220	2520	2577	414	311	906	2286	7310	6”

The dimensional drawing shown is for reference only and does not represent all models in the RLAC-S line

- ATTENTION: Some dimensions may be different from the models that have special characters in the nomenclature. In this case, consult the dimension applicable.

3. Receiving

The receiving and moving of the equipment should be performed by the customer. In this stage, the following points should be checked:

- The data informed on the identification tag of the equipment should correspond to the information of the purchase order;
- The presence of all items, according to order and invoice. In the event of any discrepancy or missing items, please inform Mecalor immediately.

3.1. Packaging

In the national market, the RLAC-S-25/30 models are shipped in a wooden crate, while the RLAC-S-40/50/60/80/100/115/150/175/220 models are covered by a raffia sheet designed for each model, exactly as they should be transported.

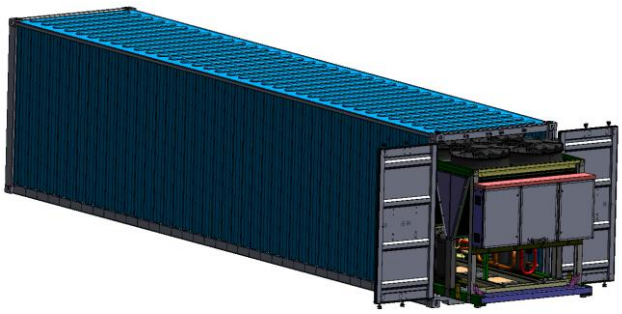
On the international market, the RLAC-S-25/30 models are shipped in a wooden box, while the other models in the RLAC-S line are shipped covered in heat-shrink plastic.

Canvas-type packaging

Wooden box type packaging

3.2. Transportation

To facilitate transportation in national and international markets, the entire structure of the RLAC-S line was developed with the premise of allowing the equipment to be compatible with the internal space available in the cargo containers.



	ATTENTION	Do not place volumes over the equipment during the transport process.

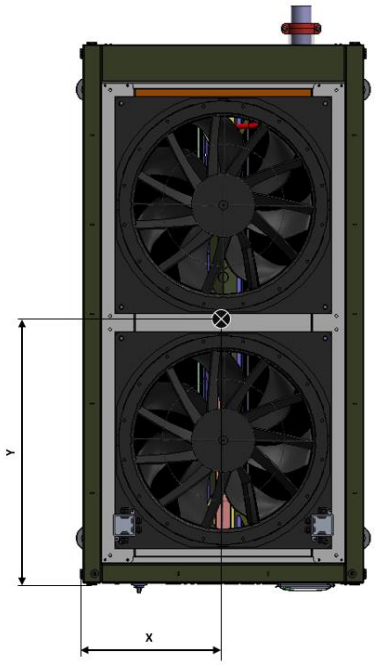
3.3. Unloading, Moving and Storage

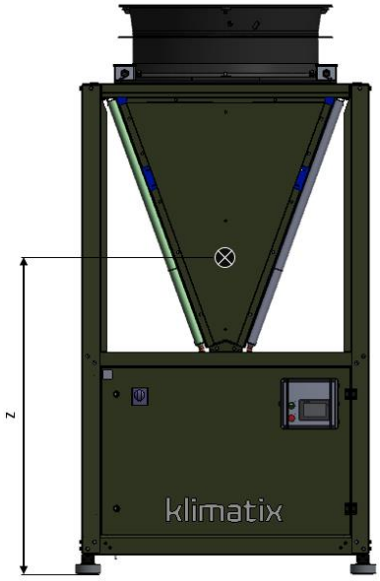
As soon as the unit is received and before unloading, check to see if the package of the RLAC-S does not have any damages caused during transport.

	INFORMATION	It is recommended to store the RLAC-S packaged in a dry place sheltered against dirt and bad weather in case the equipment remains unused for a long period of time before its installation and operation.

	INFORMATION	Damages on the equipment caused during transport should be identified IMMEDIATELY after receiving Take pictures and immediately send them to the shipping company when damages are observed on the RLAC-S.

Some unloading and moving methods are shown below. To avoid the RLAC-S from toppling over during transport, check the position of the center of gravity according to the RLAC-S model in the table below:





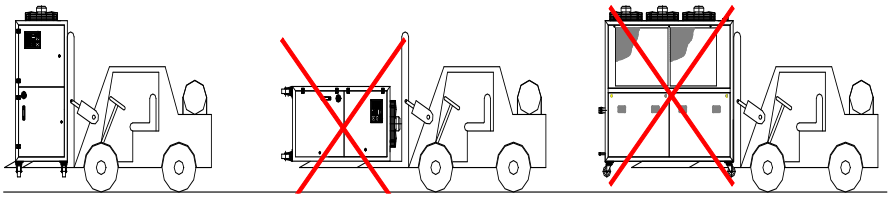
Model	Dimensions in millimeters		
	X	Y	Z
RLAC-S-25	482	948	893
RLAC-S-30	499	1092	918
RLAC-S-40	573	1032	927
RLAC-S-50	908	1148	996
RLAC-S-60	824	1122	948
RLAC-S-80	949	1100	1050
RLAC-S-100	1028	1684	1150
RLAC-S-115	988	1973	1081
RLAC-S-150	983	2118	1056
RLAC-S-175	1193	2303	1028
RLAC-S-220	1185	2949	1047

a) Forklift

Some models in the RLAC-S line can be unloaded using a forklift truck. Refer to the weight of the equipment in section 2.2 of this manual to define the capacity of the forklift truck that will be used to unload the equipment.

The equipment should only be transported in an upright position.

	INFORMATION	Check the general condition of the equipment IMMEDIATELY after opening the package. If any damage is noticed, take photographs and send them to the company responsible for transportation.

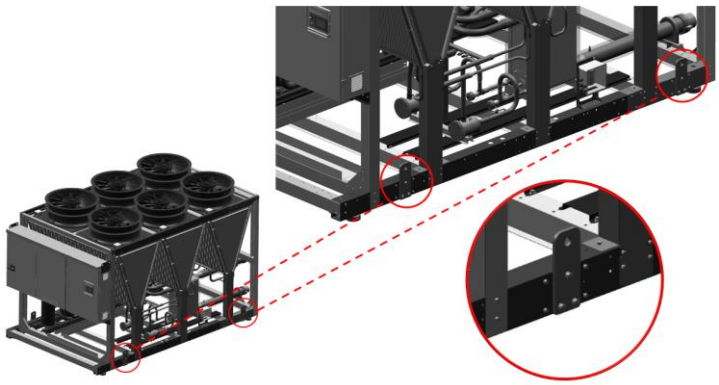


	ATTENTION	Do not topple the equipment to ship it; the RLAC-S should be shipped in the vertical position and by qualified people.

b) Lifting

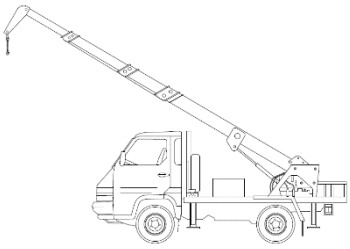
Unloading and moving can be carried out with a munck truck or a crane.

RLAC-S chillers are equipped with eyebolts located on the underside of the structure for attaching the hooks that will be used to tie down and lift the unit.



Before lifting, ensure that the rocker arm used is in compliance with the dimensions of the equipment (see section 2.5 of the manual), as well as ensuring that the straps do not exceed an opening angle of 70°.

	ATTENTION	Use rocker arm or support beam with canvas straps suitable for the weight to perform the lifting. NEVER use straps supported by a single point. Unsafe practices may cause accidents; therefore, this process should be carried out by qualified people and with the suitable safety equipment.



4. Installation

The RLAC-S was designed contemplating the efficiency, durability and safety of the operator. However, safety must be guaranteed by proper installation, periodic preventive maintenance and operation within the design conditions.

	**ATTENTION**	It is recommended for the installation of the equipment to be performed by Mecalor or by a qualified person. It is imperative for the installer to have a knowledge of local installation codes and regulations in order to ensure that the best mounting and safety practices are used.

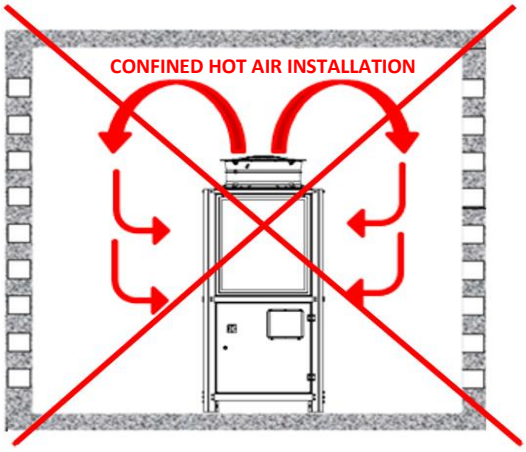
	**DANGER**	The RLAC-S was not designed to work in an area classified as risk of explosion. If the use in these conditions is detected, the equipment will lose its warranty.

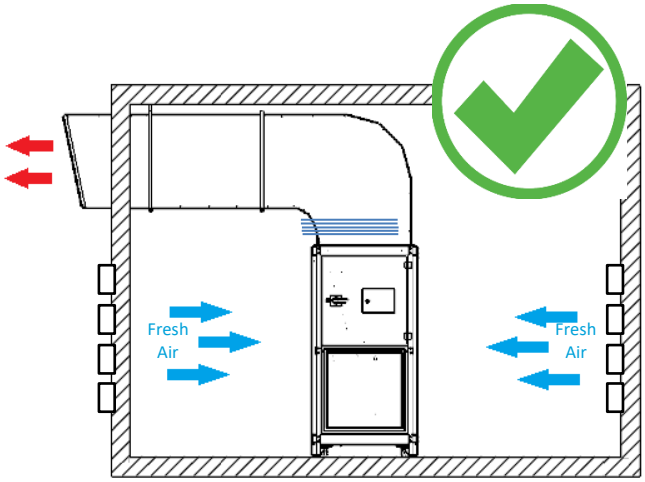
4.1. Installation site

The proper functioning of the RLAC-S depends mainly on the air flow passing through the condenser, so the equipment should be installed in an open area with good air circulation and without the presence of heat sources around it.

4.1.1. Air exhaust duct

When there is no suitable ventilation or when there is the possibility of air recirculation, a hot air exhaust duct should be installed.





	INFORMATION	The RLAC-S is equipped with an axial fan, which is not designed to be ducted. The exhaust duct to be installed is a grille and must have the smallest length possible in order to not cause excess load loss and consequently deactivate the equipment due to high pressure.

Follow the recommendations below for the correct sizing of the air exhaust duct:

- Maximum load loss in the duct: 20 Pa
- The duct must not be installed supported or exert any load on the RLAC-S, avoiding possible overloads on the structure of the equipment
- There should be a flexible canvas/connector placed between the duct and the upper part of the fan in order to avoid the transmission of vibration to the roof/wall and enable maintenance of the fan
- The highest load loss of a duct is mostly on the very short radius curve (<<D/2). Curves of bigger radiuses or close to D/2 avoid turbulent flow and excess load loss.

	INFORMATION	In case of doubts, consult Mecalor or the ASHRAE criteria for the correct size of the hot air exhaust duct.

	INFORMATION	Never restrict the air duct in the hot air outlet, this practice may cause the increase of load loss in the duct and deactivate the RLAC-S due to high pressure in the cooling system.

4.1.2. Base and required space

The base must be level in order to maintain the correct return of oil from the compressors and water from the hydraulic circuit. In case of the installation of various equipment in parallel, the bases must be leveled in the same plane.

A way of checking if the base is leveled is by gauging using an instrument called *bubble level*.

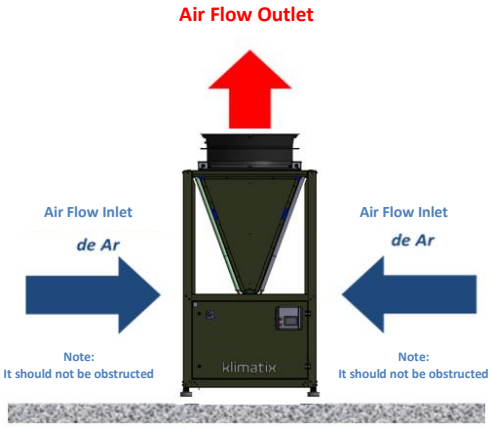
Leave space around the equipment to allow easy access for maintenance, preferably with enough room for forklifts to pass through.

The site chosen for the installation must be as close as possible to the points of use, but, from the point of view of pressure flow and pressure loss, with well sized cold water network, there are no technical limitations for the distance between the RLAC-S and the points of use.

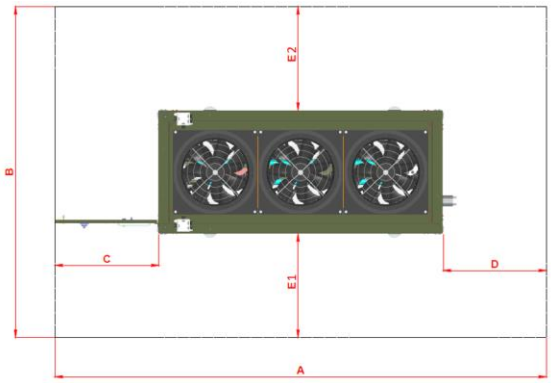
A rigid and leveled base should be provided to support the equipment.

	INFORMATION	It is recommended to install gutters or a drain at the base where the RLAC-S will be positioned in order to facilitate the draining of water around the equipment.

	INFORMATION	During installation, it is recommended to protect the RLAC-S in order to avoid dirt from surrounding works from being deposited on the protection screens of the condenser, blocking the air inlet. General cleaning is recommended after installation and before the RLAC-S is activated.



The following table contains the minimum space recommended for each unit in the RLAC-S line. This recommendation is intended to guarantee the safe operation of the RLAC-S, as well as ensuring that there is sufficient space for any maintenance work, enabling the internal components of the unit to be replaced.



	Model										
Dimensions in mm	RLAC-S	25	30	40	50	60	80	100	115	150	175	220
	A	3360	4190	4010	6170	6170	1200	5080	6155	6215	7305	8400
	B	3960	4050	4250	4930	4930	5950	5950	5950	5950	5950	5950
	C	800	890	1100	1090	1090	750	750	750	750	750	750
	D	350	700	510	2480	2480	775	525	515	575	575	575
	E1	1500	1500	1500	1500	1500	2210	2210	2210	2210	1500	1500
	E2	1500	1500	1500	1500	1500	1500	1500	1500	1500	2210	2210

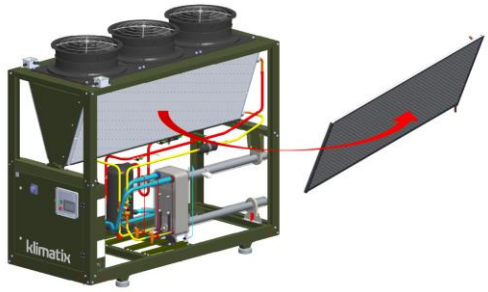
	INFORMATION	If around the RLAC-S base is a place with a lot of grass or sand, the application of gravel around the base is recommended to avoid the deposit of materials in the protection screens.

	INFORMATION	Avoid installing the RLAC-S in machining centers or in places with possible chips that may be deposited on the paint of the equipment. The chip deposited on the paint of the equipment may generate future problems of corrosion. In case it is not possible to install it in another place, clean the cabinet whenever the cutting process of metal parts is completed.

4.1.3. Maintenance access

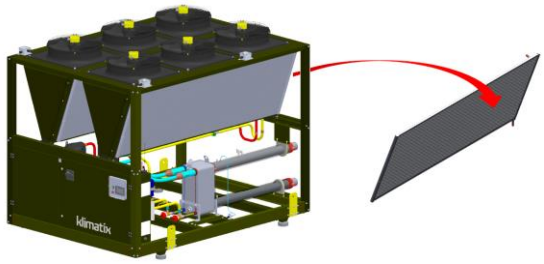
4.1.3.1. RLAC-S-25/30/40

For smaller units, access to the refrigeration and hydraulic components is easier. To remove the condensers, we recommend removing them from the sides of the RLAC-S.



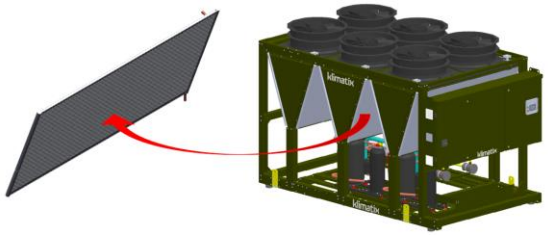
4.1.3.2. RLAC-S-50/60

In the case of models with two pairs of condensers (RLAC-S-50 and 60), the condensers should be removed from the rear of the unit.



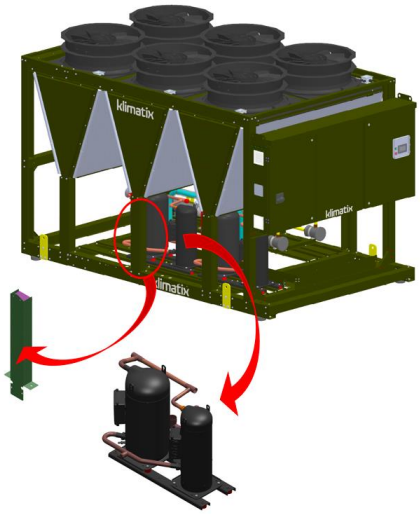
4.1.3.3. RLAC-S-80 to 220

For larger capacity units, the condensers must be removed from the side.



Due to the greater number and size of internal components, in order to facilitate access to the compressors, for example, one of the columns of the RLAC-S structure can be removed, as illustrated below. It is important to emphasize that at no time should more than one column be removed simultaneously, as this could lead to accidents and damage to the RLAC-S structure. In addition, during maintenance where it is

necessary to remove one of the columns from the RLAC-S structure, it must be ensured that no load is added to the structure.



⚠	**ATTENTION**	Never remove more than one column from the RLAC-S structure at the same time.

4.2. Electrical installation

The electrical installation from the main power point to the main switch of the RLAC-S is under the responsibility of the customer or the installer hired by him.

⚠	**DANGER**	Keep the master switch of the equipment off at all times when installing or performing maintenance on the RLAC-S. Failure to do so may result in personal injury or even death. High voltage in the connection box of the electrical panel, compressor, fan and pump. Risk of injury or death. Only qualified personal with suitable safety equipment can handle these components with the prior authorization from Mecalor. Use non-tinned cables and with terminals at the points where the terminals are to be installed. Stripped cables can overheat, cause damage to equipment, personal injury and even death.

	**ATTENTION**	Use locks and warnings such as *Equipment under Maintenance* when carrying out any work on the RLAC-S. Consult standard NR10 and local references for the correct signal of the equipment in case of installation or maintenance.

Use an exclusive disconnection device (breaker) for the equipment and disconnect the three phases.

The circuit breaker and power cable must be sized according to the electrical data in the tables in section 4.2.3 of this manual.

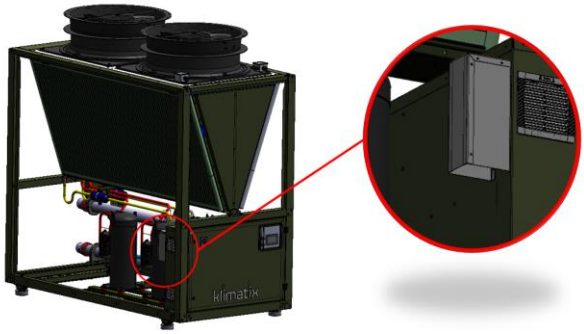
	**ATTENTION**	Sizing and selection of the RLAC-S exclusive disconnect device is the responsibility of the customer. Improper sizing or sizing outside of local regulations can endanger the safety of the installation, damage the equipment and cause loss of warranty. DO NOT USE the current in regime to size the circuit breaker and power cable. Electrical safety devices must always be sized according to the installed/maximum current of the RLAC-S. See section 4.2.3 of this manual for correct sizing. Consult the standards applicable to the electrical installation at the site so as to ensure that the installation of the RLAC-S is according to the specified standards and prerequisites. For installations in Brazil, consult standard NBR5410 “Low Voltage Electrical Installations"

For the lowest capacity equipment (RLAC-S-25 to 60), the power supply cables must enter through the access available at the rear of the electrical panel.

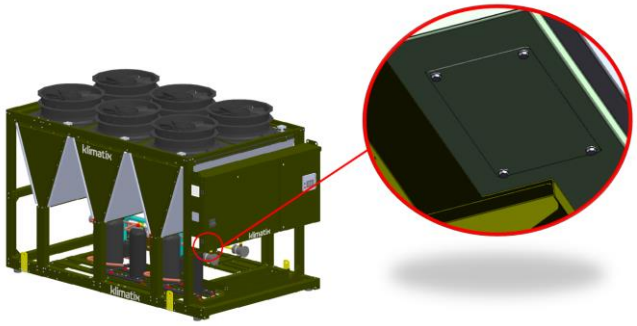
For higher-capacity equipment (RLAC-S-80 to 220), access must be through the access cover at the bottom of the electrical panel.

Items 4.2.1 and 4.2.2 contain illustrations indicating the access points for the power supply cables for each equipment model.

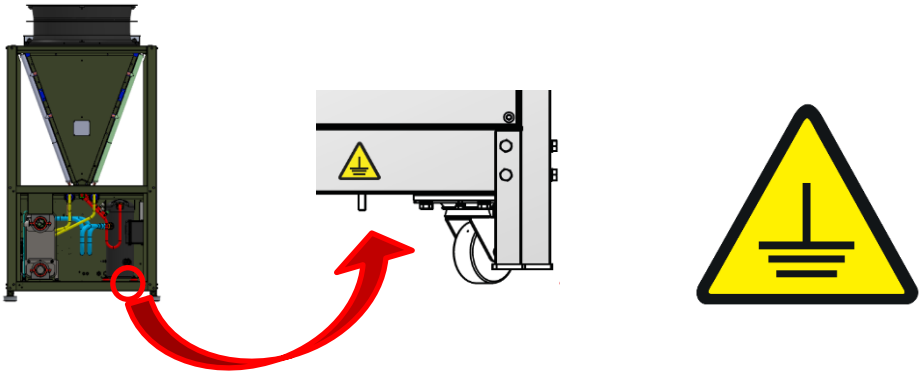
4.2.1. Access point for power cable - RLAC-S-25 to 60



4.2.2. Access point for power cable - RLAC-S-80 to 220



⚠	**DANGER**	The cabinet of the RLAC-S can be electrically charged. The non-grounding of the equipment may cause electric shocks, short circuits, personal damages or even death. Ground the RLAC-S through the point located on the lower part of the rear part of the equipment.



4.2.3. Electric data

The customer is responsible for laying the electric cable up to the equipment and it must be performed by a qualified person.

Check the electrical features of the RLAC-S on the identification plate attached to the equipment. The network voltage must be according to the voltage of the RLAC-S and within the limits shown in the electrical data tables below.

	**INFORMATION**	A power supply point is not necessary for the command/control circuit, because it is powered by the internal transformer of the equipment. Command/control circuit voltage of 24V according to standards NR10 and NR12. Components installed on the equipment door does not represent the risk of electric shock to the operator.

	**ATTENTION**	Consult the standards applicable to the electrical installation at the site so as to ensure that the installation of the RLAC-S is according to the specified standards and prerequisites. For installations in Brazil, consult standard NBR5410 “Low Voltage Electrical Installations"

4.2.3.1. RLAC-S-25

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-25	Standard Version	220	60	39.05	114.41	1x 70
		380			67.2	1x 35
		440 / 480			56.95	1x 25
		380 / 400	50	31.62	56.4	1x 25
	Standard version + 1 pump (2 bar)	220	60	41.25	122.65	1x 95
		380			71.97	1x 35
		440 / 480			61.07	1x 25
		380 / 400	50	33.82	61.17	1x 25
	Standard version + 1 pump (3 bar)	220	60	42.05	125.21	1x 95
		380			73.45	1x 35
		440 / 480			62.35	1x 25
		380 / 400	50	34.62	62.65	1x 25
	Standard version + 1 pump (5 bar)	220	60	44.55	133.81	1x 95
		380			67.2	1x 35
		440 / 480			66.67	1x 35
		380 / 400	50	37.12	67.7	1x 35
	Standard version + 2 pumps (2 bar)	220	60	43.45	130.89	1x 95
		380			76.74	1x 35
		440 / 480			65.19	1x 35
		380 / 400	50	36.02	65.94	1x 35
	Standard version + 2 pumps (3 bar)	220	60	45.05	136.01	1x 95
		380			79.7	1x 35
		440 / 480			67.75	1x 35

		380 / 400	50	37.62	68.9	1x 35
	Standard version + 2 pumps (5 bar)	220	60	50.05	153.21	1x 120
		380			78.5	1x 35
		440 / 480			76.39	1x 35
		380 / 400	50	42.62	79	1x 35

4.2.3.2. RLAC-S-30

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-30	Standard Version	220	60	43.25	140.4	1x 95
		380			85.1	1x 50
		440 / 480			69.9	1x 35
		380 / 400	50	37.15	68.4	1x 35
	Standard version + 1 pump (2 bar)	220	60	45.45	148.64	1x 120
		380			89.87	1x 50
		440 / 480			74.02	1x 35
		380 / 400	50	39.35	73.17	1x 35
	Standard version + 1 pump (3 bar)	220	60	46.25	151.2	1x 120
		380			91.35	1x 50
		440 / 480			75.3	1x 35
		380 / 400	50	40.15	74.65	1x 35
	Standard version + 1 pump (5 bar)	220	60	48.75	159.8	1x 120
		380			96.4	1x 70
		440 / 480			79.62	1x 35
		380 / 400	50	42.65	79.7	1x 35
	Standard version + 2 pumps (2 bar)	220	60	47.65	156.88	1x 120
		380			94.64	1x 50
		440 / 480			78.14	1x 35
		380 / 400	50	41.55	77.94	1x 35
	Standard version + 2 pumps (3 bar)	220	60	49.25	162	1x 120
		380			97.6	1x 70
		440 / 480			80.7	1x 50
		380 / 400	50	43.15	80.9	1x 50
	Standard version + 2 pumps (5 bar)	220	60	54.25	179.2	1x 150
		380			107.7	1x 70
		440 / 480			89.34	1x 50
		380 / 400	50	48.15	91	1x 50
	High Efficiency Version	220	60	44.9	143.4	1x 95
		380			84.5	1x 50
		440 / 480			67.5	1x 35
		380 / 400	50	39.7	71.1	1x 35
	High Efficiency version + 1 pump (2 bar)	220	60	47	151.64	1x 120
		380			89.27	1x 50

		440 / 480			71.62	1x 35
		380 / 400	50	42	75.87	1x 35
	High Efficiency version + 1 pump (3 bar)	220	60	48	154.2	1x 120
		380			90.75	1x 50
		440 / 480			72.9	1x 35
		380 / 400	50	43	77.35	1x 35
	High Efficiency version + 1 pump (5 bar)	220	60	50	162.8	1x 120
		380			95.8	1x 70
		440 / 480			77.22	1x 35
		380 / 400	50	45	82.4	1x 50
	High Efficiency version + 2 pumps (2 bar)	220	60	49	159.88	1x 120
		380			94.04	1x 50
		440 / 480			75.74	1x 35
		380 / 400	50	44	80.64	1x 50
	High Efficiency version + 2 pumps (3 bar)	220	60	51	165	1x 120
		380			97	1x 70
		440 / 480			78.3	1x 35
		380 / 400	50	46	83.6	1x 50
	High Efficiency version + 2 pumps (5 bar)	220	60	56	182.2	1x 150
		380			107.1	1x 70
		440 / 480			86.94	1x 50
		380 / 400	50	51	93.7	1x 50

4.2.3.3. RLAC-S-40

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-40	Standard Version	220	60	52.2	155	1x 120
		380			89.2	1x 50
		440 / 480			77.4	1x 35
		380 / 400	50	46.2	79.8	1x 35
	Standard version + 1 pump (2 bar)	220	60	54.4	163.24	1x 120
		380			93.97	1x 50
		440 / 480			81.52	1x 50
		380 / 400	50	48.4	84.57	1x 50
	Standard version + 1 pump (3 bar)	220	60	55.9	167.8	1x 150
		380			96.59	1x 70
		440 / 480			83.78	1x 50
		380 / 400	50	49.9	87.19	1x 50
	Standard version + 1 pump (5 bar)	220	60	59.7	180	1x 150
		380			103.7	1x 70
		440 / 480			89.9	1x 50
		380 / 400	50	53.7	94.3	1x 50
	Standard version + 2 pumps (2 bar)	220	60	56.6	171.48	1x 150
		380			98.74	1x 70
		440 / 480			85.64	1x 50
		380 / 400	50	50.6	89.34	1x 50

	Standard version + 2 pumps (3 bar)	220	60	59.6	180.6	1x 150
		380			103.98	1x 70
		440 / 480			90.16	1x 50
		380 / 400	50	53.6	94.58	1x 50
	Standard version + 2 pumps (5 bar)	220	60	67.2	205	1x 185
		380			118.2	1x 70
		440 / 480			102.4	1x 70
		380 / 400	50	61.2	108.8	1x 70
	High Efficiency Version	220	60	52.6	154.6	1x 120
		380			87.8	1x 50
		440 / 480			74.8	1x 35
		380 / 400	50	46.8	79	1x 35
	High Efficiency version + 1 pump (2 bar)	220	60	55	162.84	1x 120
		380			92.57	1x 50
		440 / 480			78.92	1x 35
		380 / 400	50	49	83.77	1x 50
	High Efficiency version + 1 pump (3 bar)	220	60	56	167.4	1x 150
		380			95.19	1x 50
		440 / 480			81.18	1x 50
		380 / 400	50	51	86.39	1x 50
	High Efficiency version + 1 pump (5 bar)	220	60	60	179.6	1x 150
		380			102.3	1x 70
		440 / 480			87.3	1x 50
		380 / 400	50	54	93.5	1x 50
	High Efficiency version + 2 pumps (2 bar)	220	60	57	171.08	1x 150
		380			97.34	1x 70
		440 / 480			83.04	1x 50
		380 / 400	50	51	88.54	1x 50
	High Efficiency version + 2 pumps (3 bar)	220	60	60	180.2	1x 150
		380			102.58	1x 70
		440 / 480			87.56	1x 50
		380 / 400	50	54	93.78	1x 50
	High Efficiency version + 2 pumps (5 bar)	220	60	68	204.6	1x 185
		380			116.8	1x 70
		440 / 480			99.8	1x 70
		380 / 400	50	62	108	1x 70

4.2.3.4. RLAC-S-50

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-50	Standard Version	220	60	73.3	201.6	1x 185
		380			126	1x 95
		440 / 480			108	1x 70
		380 / 400	50	60.5	104.8	1x 70
	Standard version + 1 pump (2 bar)	220	60	76.3	212.4	1x 185
		380			132.25	1x 95
		440 / 480			113.4	1x 70
		380 / 400	50	63.5	111.05	1x 70
	Standard version + 1 pump (3 bar)	220	60	77	214.4	1x 185
		380			133.39	1x 95
		440 / 480			114.38	1x 70
		380 / 400	50	64.2	112.19	1x 70
	Standard version + 1 pump (5 bar)	220	60	82.5	231.7	1x 240
		380			143.4	1x 95
		440 / 480			123.1	1x 95
		380 / 400	50	69.7	122.2	1x 95
	Standard version + 2 pumps (2 bar)	220	60	79.3	223.2	1x 240
		380			138.5	1x 95
		440 / 480			118.8	1x 70
		380 / 400	50	66.5	117.3	1x 70
	Standard version + 2 pumps (3 bar)	220	60	80.7	227.2	1x 240
		380			140.78	1x 95
		440 / 480			120.76	1x 95
		380 / 400	50	67.9	119.58	1x 70
	Standard version + 2 pumps (5 bar)	220	60	91.7	261.8	2x 95
		380			160.8	1x 120
		440 / 480			138.2	1x 95
		380 / 400	50	78.9	139.6	1x 95
	High Efficiency Version	220	60	86.8	234.6	1x 240
		380			128.4	1x 95
		440 / 480			106.8	1x 70
		380 / 400	50	65.3	109.6	1x 70
	High Efficiency version + 1 pump (2 bar)	220	60	90	245.4	1x 240
		380			134.65	1x 95
		440 / 480			112.2	1x 70
		380 / 400	50	68	115.85	1x 70
	High Efficiency version + 1 pump (3 bar)	220	60	91	247.4	1x 240
		380			135.79	1x 95
		440 / 480			113.18	1x 70
		380 / 400	50	69	116.99	1x 70
	High Efficiency version + 1 pump (5 bar)	220	60	96	264.7	2x 95
		380			145.8	1x 120

		440 / 480			121.9	1x 95
		380 / 400	50	75	127	1x 95
	High Efficiency version + 2 pumps (2 bar)	220	60	93	256.2	2x 95
		380			140.9	1x 95
		440 / 480			117.6	1x 70
		380 / 400	50	71	122.1	1x 95
	High Efficiency version + 2 pumps (3 bar)	220	60	94	260.2	2x 95
		380			143.18	1x 95
		440 / 480			119.56	1x 70
		380 / 400	50	73	124.38	1x 95
	High Efficiency version + 2 pumps (5 bar)	220	60	105	294.8	2x 120
		380			163.2	1x 120
		440 / 480			137	1x 95
		380 / 400	50	84	144.4	1x 120

4.2.3.5. RLAC-S-60

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-60	Standard Version	220	60	91.9	271.8	2x 95
		380			169.8	1x 150
		440 / 480			137	1x 95
		380 / 400	50	84.3	140.4	1x 95
	Standard version + 1 pump (2 bar)	220	60	95.6	284.6	2x 95
		380			177.19	1x 150
		440 / 480			143.38	1x 95
		380 / 400	50	96.8	147.79	1x 120
	Standard version + 1 pump (3 bar)	220	60	97.4	291.2	2x 120
		380			181.1	1x 150
		440 / 480			146.72	1x 120
		380 / 400	50	104.3	151.7	1x 120
	Standard version + 1 pump (5 bar)	220	60	101.1	301.9	2x 120
		380			187.2	1x 150
		440 / 480			152.1	1x 120
		380 / 400	50	114.3	157.8	1x 120
	Standard version + 2 pumps (2 bar)	220	60	99.3	297.4	2x 120
		380			184.58	1x 150
		440 / 480			149.76	1x 120
		380 / 400	50	109.3	155.18	1x 120
	Standard version + 2 pumps (3 bar)	220	60	102.9	310.6	2x 120
		380			192.4	1x 185
		440 / 480			156.44	1x 120
		380 / 400	50	124.3	163	1x 120
	Standard version + 2 pumps (5 bar)	220	60	110.3	332	2x 150
		380			204.6	1x 185
		440 / 480			167.2	1x 150
		380 / 400	50	144.3	175.2	1x 150

	High Efficiency Version	220	60	105.4	304.8	2x 120
		380			172.2	1x 150
		440 / 480			135.8	1x 95
		380 / 400	50	89.1	145.2	1x 120
	High Efficiency version + 1 pump (2 bar)	220	60	109	317.6	2x 120
		380			179.59	1x 150
		440 / 480			142.18	1x 95
		380 / 400	50	102	152.59	1x 120
	High Efficiency version + 1 pump (3 bar)	220	60	111	324.2	2x 120
		380			183.5	1x 150
		440 / 480			145.52	1x 120
		380 / 400	50	109	156.5	1x 120
	High Efficiency version + 1 pump (5 bar)	220	60	115	334.9	2x 150
		380			189.6	1x 185
		440 / 480			150.9	1x 120
		380 / 400	50	119	162.6	1x 120
	High Efficiency version + 2 pumps (2 bar)	220	60	113	330.4	2x 150
		380			186.98	1x 150
		440 / 480			148.56	1x 120
		380 / 400	50	114	159.98	1x 120
	High Efficiency version + 2 pumps (3 bar)	220	60	116	343.6	2x 150
		380			194.8	1x 185
		440 / 480			155.24	1x 120
		380 / 400	50	129	167.8	1x 150
	High Efficiency version + 2 pumps (5 bar)	220	60	124	365	2x 150
		380			207	1x 185
		440 / 480			166	1x 150
		380 / 400	50	149	180	1x 150

4.2.3.6. RLAC-S-80

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-80	Standard Version	220	60	138	374.4	2x 150
		380			261.2	1x 185
		440 / 480			208.8	1x 150
		380 / 400	50	103.6	178.4	1x 150
	Standard version + 1 pump (2 bar)	220	60	141.7	387.2	2x 150
		380			268.59	1x 240
		440 / 480			215.18	1x 150
		380 / 400	50	116.1	185.79	1x 150
	Standard version + 1 pump (3 bar)	220	60	141.7	387.2	2x 150
		380			268.59	1x 240
		440 / 480			215.18	1x 150
		380 / 400	50	123.6	185.79	1x 150
	Standard version + 1 pump (5 bar)	220	60	153	424.2	2x 185
		380			290	1x 240

		440 / 480			233.7	1x 185
		380 / 400	50	133.6	207.2	1x 185
	Standard version + 2 pumps (2 bar)	220	60	145.4	400	2x 150
		380			275.98	1x 240
		440 / 480			221.56	1x 150
		380 / 400	50	128.6	193.18	1x 185
	Standard version + 2 pumps (3 bar)	220	60	145.4	400	2x 150
		380			275.98	1x 240
		440 / 480			221.56	1x 150
		380 / 400	50	143.6	193.18	1x 185
	Standard version + 2 pumps (5 bar)	220	60	168	474	2x 240
		380			318.8	2x 95
		440 / 480			258.6	1x 240
		380 / 400	50	163.6	236	1x 240
	High Efficiency Version	220	60	138.8	373.6	2x 150
		380			258.4	1x 185
		440 / 480			208.8	1x 150
		380 / 400	50	104.8	176.8	1x 150
	High Efficiency version + 1 pump (2 bar)	220	60	143	386.4	2x 150
		380			265.79	1x 185
		440 / 480			215.18	1x 150
		380 / 400	50	117	184.19	1x 150
	High Efficiency version + 1 pump (3 bar)	220	60	143	386.4	2x 150
		380			265.79	1x 185
		440 / 480			215.18	1x 150
		380 / 400	50	125	184.19	1x 150
	High Efficiency version + 1 pump (5 bar)	220	60	154	423.4	2x 185
		380			287.2	1x 240
		440 / 480			233.7	1x 185
		380 / 400	50	135	205.6	1x 185
	High Efficiency version + 2 pumps (2 bar)	220	60	146	399.2	2x 150
		380			273.18	1x 240
		440 / 480			221.56	1x 150
		380 / 400	50	130	191.58	1x 185
	High Efficiency version + 2 pumps (3 bar)	220	60	146	399.2	2x 150
		380			273.18	1x 240
		440 / 480			221.56	1x 150
		380 / 400	50	145	191.58	1x 185
	High Efficiency version + 2 pumps (5 bar)	220	60	169	473.2	2x 240
		380			316	2x 95
		440 / 480			258.6	1x 240
		380 / 400	50	165	234.4	1x 240

4.2.3.7. RLAC-S-100

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-100	Standard Version	220	60	160.4	441.4	2x 240
		380			289.6	2x 120
		440 / 480			238	1x 240
		380 / 400	50	141.8	239.8	1x 240
	Standard version + 1 pump (2 bar)	220	60	165.9	460.8	2x 240
		380			300.9	2x 120
		440 / 480			247.72	1x 240
		380 / 400	50	154.3	251.1	1x 240
	Standard version + 1 pump (3 bar)	220	60	167.9	466.4	2x 240
		380			304.1	2x 120
		440 / 480			250.5	1x 240
		380 / 400	50	161.8	254.3	2x 95
	Standard version + 1 pump (5 bar)	220	60	175.4	491.2	2x 240
		380			318.4	2x 120
		440 / 480			262.9	2x 95
		380 / 400	50	171.8	268.6	2x 95
	Standard version + 2 pumps (2 bar)	220	60	171.4	480.2	2x 240
		380			312.2	2x 120
		440 / 480			257.44	2x 95
		380 / 400	50	166.8	262.4	2x 95
	Standard version + 2 pumps (3 bar)	220	60	175.4	491.4	2x 240
		380			318.6	2x 120
		440 / 480			263	2x 95
		380 / 400	50	181.8	268.8	2x 95
	Standard version + 2 pumps (5 bar)	220	60	190.4	541	3x 150
		380			347.2	2x 150
		440 / 480			287.8	2x 95
		380 / 400	50	201.8	297.4	2x 120
	High Efficiency Version	220	60	161.6	440.2	2x 240
		380			285.4	2x 95
		440 / 480			233.2	1x 240
		380 / 400	50	143.6	237.4	1x 240
	High Efficiency version + 1 pump (2 bar)	220	60	167	459.6	2x 240
		380			296.7	2x 120
		440 / 480			242.92	1x 240
		380 / 400	50	156	248.7	1x 240
	High Efficiency version + 1 pump (3 bar)	220	60	169	465.2	2x 240
		380			299.9	2x 120
		440 / 480			245.7	1x 240
		380 / 400	50	164	251.9	2x 95
	High Efficiency version + 1 pump (5 bar)	220	60	177	490	2x 240
		380			314.2	2x 120

		440 / 480			258.1	2x 95
		380 / 400	50	174	266.2	2x 95
	High Efficiency version + 2 pumps (2 bar)	220	60	173	479	2x 240
		380			308	2x 120
		440 / 480			252.64	2x 95
		380 / 400	50	169	260	2x 95
	High Efficiency version + 2 pumps (3 bar)	220	60	177	490.2	2x 240
		380			314.4	2x 120
		440 / 480			258.2	2x 95
		380 / 400	50	184	266.4	2x 95
	High Efficiency version + 2 pumps (5 bar)	220	60	192	539.8	3x 150
		380			343	2x 120
		440 / 480			283	2x 95
		380 / 400	50	204	295	2x 120

4.2.3.8. RLAC-S-115

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-115	Standard Version	220	60	182.8	541.2	3x 150
		380			338.8	2x 150
		440 / 480			285.2	2x 95
		380 / 400	50	168.8	282.4	2x 95
	Standard version + 1 pump (2 bar)	220	60	190.3	566.2	3x 150
		380			353.3	2x 150
		440 / 480			297.7	2x 120
		380 / 400	50	181.3	299.9	2x 120
	Standard version + 1 pump (3 bar)	220	60	192	571.3	3x 185
		380			356.2	2x 150
		440 / 480			300.3	2x 120
		380 / 400	50	188.8	311.6	2x 120
	Standard version + 1 pump (5 bar)	220	60	201.3	602	3x 185
		380			374	2x 150
		440 / 480			315.6	2x 120
		380 / 400	50	198.8	324.3	2x 120
	Standard version + 2 pumps (2 bar)	220	60	197.8	591.2	3x 185
		380			367.8	2x 150
		440 / 480			310.2	2x 120
		380 / 400	50	193.8	317.4	2x 120
	Standard version + 2 pumps (3 bar)	220	60	201.2	601.4	3x 185
		380			373.6	2x 150
		440 / 480			315.4	2x 120
		380 / 400	50	208.8	340.8	2x 150
	Standard version + 2 pumps (5 bar)	220	60	219.8	662.8	3x 240
		380			409.2	2x 185
		440 / 480			346	2x 150
		380 / 400	50	228.8	366.2	2x 150

	High Efficiency Version	220	60	184.4	539.6	3x 150
		380			333.2	2x 150
		440 / 480			278.8	2x 95
		380 / 400	50	171.2	279.2	2x 95
	High Efficiency version + 1 pump (2 bar)	220	60	192	564.6	3x 150
		380			347.7	2x 150
		440 / 480			291.3	2x 120
		380 / 400	50	184	296.7	2x 120
	High Efficiency version + 1 pump (3 bar)	220	60	194	569.7	3x 185
		380			350.6	2x 150
		440 / 480			293.9	2x 120
		380 / 400	50	191	308.4	2x 120
	High Efficiency version + 1 pump (5 bar)	220	60	203	600.4	3x 185
		380			368.4	2x 150
		440 / 480			309.2	2x 120
		380 / 400	50	201	321.1	2x 120
	High Efficiency version + 2 pumps (2 bar)	220	60	199	589.6	3x 185
		380			362.2	2x 150
		440 / 480			303.8	2x 120
		380 / 400	50	196	314.2	2x 120
	High Efficiency version + 2 pumps (3 bar)	220	60	203	599.8	3x 185
		380			368	2x 150
		440 / 480			309	2x 120
		380 / 400	50	211	337.6	2x 150
	High Efficiency version + 2 pumps (5 bar)	220	60	221	661.2	3x 240
		380			403.6	2x 185
		440 / 480			339.6	2x 150
		380 / 400	50	231	363	2x 150

4.2.3.9. RLAC-S-150

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-150	Standard Version	380	60	216.8	376.8	2x 150
		440 / 480			338.8	2x 120
		380 / 400	50	204	340.4	2x 150
	Standard version + 1 pump (2 bar)	380	60	224.3	391.3	2x 185
		440 / 480			351.3	2x 120
		380 / 400	50	211.5	354.9	2x 150
	Standard version + 1 pump (3 bar)	380	60	227.8	398.1	2x 185
		440 / 480			357.2	2x 120
		380 / 400	50	215	361.7	2x 150
	Standard version + 1 pump (5 bar)	380	60	246.8	419.2	2x 185
		440 / 480			375.4	2x 150
		380 / 400	50	234	382.8	2x 185
	Standard version + 2 pumps (2 bar)	380	60	231.8	405.8	2x 185
		440 / 480			363.8	2x 150

		380 / 400	50	219	369.4	2x 150
	Standard version + 2 pumps (3 bar)	380	60	238.8	419.4	2x 185
		440 / 480			375.6	2x 150
		380 / 400	50	226	383	2x 185
	Standard version + 2 pumps (5 bar)	380	60	276.8	461.6	2x 240
		440 / 480			412	2x 185
		380 / 400	50	264	425.2	2x 185
	High Efficiency Version	380	60	218.4	371.2	2x 150
		440 / 480			332.4	2x 120
		380 / 400	50	206.4	337.2	2x 150
	High Efficiency version + 1 pump (2 bar)	380	60	225.9	385.7	2x 185
		440 / 480			344.9	2x 120
		380 / 400	50	214	351.7	2x 150
	High Efficiency version + 1 pump (3 bar)	380	60	229.4	392.5	2x 185
		440 / 480			350.8	2x 120
		380 / 400	50	217	358.5	2x 150
	High Efficiency version + 1 pump (5 bar)	380	60	248.4	413.6	2x 185
		440 / 480			369	2x 150
		380 / 400	50	236	379.6	2x 185
	High Efficiency version + 2 pumps (2 bar)	380	60	233.4	400.2	2x 185
		440 / 480			357.4	2x 120
		380 / 400	50	221	366.2	2x 150
	High Efficiency version + 2 pumps (3 bar)	380	60	240.4	413.8	2x 185
		440 / 480			369.2	2x 150
		380 / 400	50	228	379.8	2x 185
	High Efficiency version + 2 pumps (5 bar)	380	60	278.4	456	2x 240
		440 / 480			405.6	2x 150
		380 / 400	50	266	422	2x 185

4.2.3.10. RLAC-S-175

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-175	Standard Version	380	60	269.8	500	2x 240
		440 / 480			399	2x 185
		380 / 400	50	250	416.6	2x 185
	Standard version + 1 pump (2 bar)	380	60	279	517.5	3x 150
		440 / 480			413.9	2x 185
		380 / 400	50	257.5	434.1	2x 240
	Standard version + 1 pump (3 bar)	380	60	280.8	521.3	3x 150
		440 / 480			417.4	2x 185
		380 / 400	50	259.2	445.8	2x 240
	Standard version + 1 pump (5 bar)	380	60	299.8	558.7	3x 150
		440 / 480			449.7	2x 240
		380 / 400	50	268.5	458.5	2x 240
	Standard version + 2 pumps (2 bar)	380	60	288.2	535	3x 150
		440 / 480			428.8	2x 185

		380 / 400	50	265	451.6	2x 240
	Standard version + 2 pumps (3 bar)	380	60	291.8	542.6	3x 150
		440 / 480			435.8	2x 240
		380 / 400	50	268.4	475	2x 240
	Standard version + 2 pumps (5 bar)	380	60	329.8	617.4	3x 185
		440 / 480			500.4	2x 240
		380 / 400	50	287	500.4	2x 240
	High Efficiency Version	380	60	271.8	493	2x 240
		440 / 480			391	2x 185
		380 / 400	50	253	412.6	2x 185
	High Efficiency version + 1 pump (2 bar)	380	60	281	510.5	3x 150
		440 / 480			405.9	2x 185
		380 / 400	50	261	430.1	2x 185
	High Efficiency version + 1 pump (3 bar)	380	60	283	514.3	3x 150
		440 / 480			409.4	2x 185
		380 / 400	50	262	441.8	2x 240
	High Efficiency version + 1 pump (5 bar)	380	60	302	551.7	3x 150
		440 / 480			441.7	2x 240
		380 / 400	50	272	454.5	2x 240
	High Efficiency version + 2 pumps (2 bar)	380	60	290	528	3x 150
		440 / 480			420.8	2x 185
		380 / 400	50	268	447.6	2x 240
	High Efficiency version + 2 pumps (3 bar)	380	60	294	535.6	3x 150
		440 / 480			427.8	2x 185
		380 / 400	50	271	471	2x 240
	High Efficiency version + 2 pumps (5 bar)	380	60	332	610.4	3x 185
		440 / 480			492.4	2x 240
		380 / 400	50	290	496.4	2x 240

4.2.3.11. RLAC-S-220

Model	Assembly	Voltage (V)	Frequency (Hz)	Maximum power (kW)	Supply point	
					Maximum current (A)	Cable (mm²)
RLAC-S-220	Standard Version	380	60	325.2	627.6	3x 185
		440 / 480			525.6	3x 150
		380 / 400	50	306	510.6	3x 150
	Standard version + 1 pump (2 bar)	380	60	336.2	648.9	3x 240
		440 / 480			544	3x 150
		380 / 400	50	315.2	529.1	3x 150
	Standard version + 1 pump (3 bar)	380	60	340.2	656.4	3x 240
		440 / 480			550.5	3x 150
		380 / 400	50	321	539.8	3x 150
	Standard version + 1 pump (5 bar)	380	60	355.2	684.9	3x 240
		440 / 480			575.1	3x 185
		380 / 400	50	328	552.5	3x 150
	Standard version + 2 pumps (2 bar)	380	60	347.2	670.2	3x 240
		440 / 480			562.4	3x 150

		380 / 400	50	324.4	547.6	3x 150
	Standard version + 2 pumps (3 bar)	380	60	355.2	685.2	3x 240
		440 / 480			575.4	3x 185
		380 / 400	50	336	569	3x 150
	Standard version + 2 pumps (5 bar)	380	60	385.2	742.2	3x 240
		440 / 480			624.6	3x 185
		380 / 400	50	350	594.4	3x 185
	High Efficiency Version	380	60	327.6	619.2	3x 185
		440 / 480			516	3x 150
		380 / 400	50	309.6	505.8	3x 150
	High Efficiency version + 1 pump (2 bar)	380	60	339	640.5	3x 185
		440 / 480			534.4	3x 150
		380 / 400	50	319	524.3	3x 150
	High Efficiency version + 1 pump (3 bar)	380	60	343	648	3x 240
		440 / 480			540.9	3x 150
		380 / 400	50	325	535	3x 150
	High Efficiency version + 1 pump (5 bar)	380	60	358	676.5	3x 240
		440 / 480			565.5	3x 150
		380 / 400	50	332	547.7	3x 150
	High Efficiency version + 2 pumps (2 bar)	380	60	350	661.8	3x 240
		440 / 480			552.8	3x 150
		380 / 400	50	328	542.8	3x 150
	High Efficiency version + 2 pumps (3 bar)	380	60	358	676.8	3x 240
		440 / 480			565.8	3x 150
		380 / 400	50	340	564.2	3x 150
	High Efficiency version + 2 pumps (5 bar)	380	60	388	733.8	3x 240
		440 / 480			615	3x 185
		380 / 400	50	354	589.6	3x 185

	**ATTENTION**	DO NOT USE the electrical data of the previous table to size the power supply point in RLAC-S models that have special characters (for example /B/C/E/T). Check the special documentation described in the annex of this manual for RLAC-S with special character. The maximum current informed on the electrical data table should be used to size the protections and cables. DO NOT USE the current in regime that was calculated based on the nominal operating condition of the equipment.

4.3. Hydraulic Installation

The hydraulic installation of the RLAC-S must be according to the engineering good practices and in agreement with the local regulations applicable to the standards of the industry.

Mecalor does not impose strict criteria for the selection of the materials that should be used in the design of the hydraulic pipe, but it recommends the minimum necessary for the correct installation of the RLAC-S.

4.3.1. Material

For the hydraulic system piping, we recommend using stainless steel pipes, due to their resistance to corrosion, durability and low maintenance requirements, making them ideal for applications in a wide range of environments. However, other materials can be used for the hydraulic system. In this case, we emphasize that it is necessary to carefully analyze the installation design, especially the pressure drop of the system and the water flow required for the correct operation of the chiller, to ensure that the material selected is suitable for the application.

	**INFORMATION**	The internal pipe of the hydraulic circuit of the RLAC-S and it is fully manufactured in stainless steel. Mecalor recommends the use of stainless steel for the design of the hydraulic pipe of the RLAC-S. Install heat insulation on the entire length of the pipe to prevent power consumption due to heat exchange of the pipe with the environment. The RLAC-S can be designed to work in redundancy. It is recommended to predict the possible expansions in the installation in order to facilitate the future interconnection. Contact Mecalor for the correct sizing of the system.

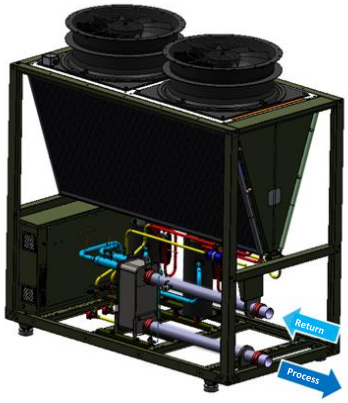
4.3.2. Interconnection Points

The RLAC-S has two interconnection points, one for the cooling water return point and the other for the cooling water outlet from the process. The RLAC-S is supplied with Victaulic coupling type fittings. After the coupling, a stainless steel AISI 304 pipe tip is supplied, allowing the welding of this tip on the process piping or the direct connection on the Victaulic coupling.

We recommend that block valves be installed at the entrance and exit of the equipment, with the objective of facilitating eventual maintenance on the equipment, as well as preventing the circulation of water inside the heat exchanger at times when the equipment is inoperative and another unit installed in the circuit is in operation (parallel installation of equipment).

In addition to the shut-off valves, we recommend installing a by-pass in the line to ensure a constant flow of water circulating through the RLAC-S evaporator. Low water flow rates can result in the water inside the evaporator freezing, causing severe damage to the plates of this component, resulting in water entering the refrigeration circuit, causing irreversible damage to the compressors and loss of warranty.

The RLAC-S points that should be interconnected are described below:



	INFORMATION	We recommend the installation of the shut-off valves in the cold water return and outlet of the RLAC-S for eventual maintenance.

	INFORMATION	Mecalor recommends the installation of automatic air traps at the highest point of the hydraulic pipe.

	INFORMATION	An NTC safety sensor monitors the water temperature in the evaporator. It switches off the equipment in case the temperature remains close to the freezing point of water (0°C). Only after the water temperature has risen can the equipment resume operation.

	INFORMATION	Do not use valves that “strangle” the pipe. This practice may deactivate the equipment due to lack of flow.

	**ATTENTION**	Do not use the chilled water pipe of the RLAC-S to support tool boxes or lean objects. The pipe was not designed to support objects; this practice may result in the rupture of the pipe and the stresses may be transmitted to the RLAC-S, which may cause damages.

	**ATTENTION**	It is expressly forbidden to restrict the RLAC-S pipe in the cold water return and outlet. This practice may cause undue load loss in the system and even the lack of water at the consumption point. The return and outlet pipe of the RLAC-S was designed thinking on minimum load loss of the system, speed and flow suitable for the smallest tube diameter possible.

	**DANGER**	Never climb on the RLAC-S pipe to carry out works at heights. The pipe was not designed to suffer specific overloads. This practice may result in the rupture of the pipe and cause personal damages or even death.

4.3.3. Interconnection in parallel

The RLAC-S can be interconnected in parallel with one or more RLAC-S, limited to up to ten interconnected units. Consult the application engineering department of Mecalor to carry out the design and execution of the process installation interconnection.

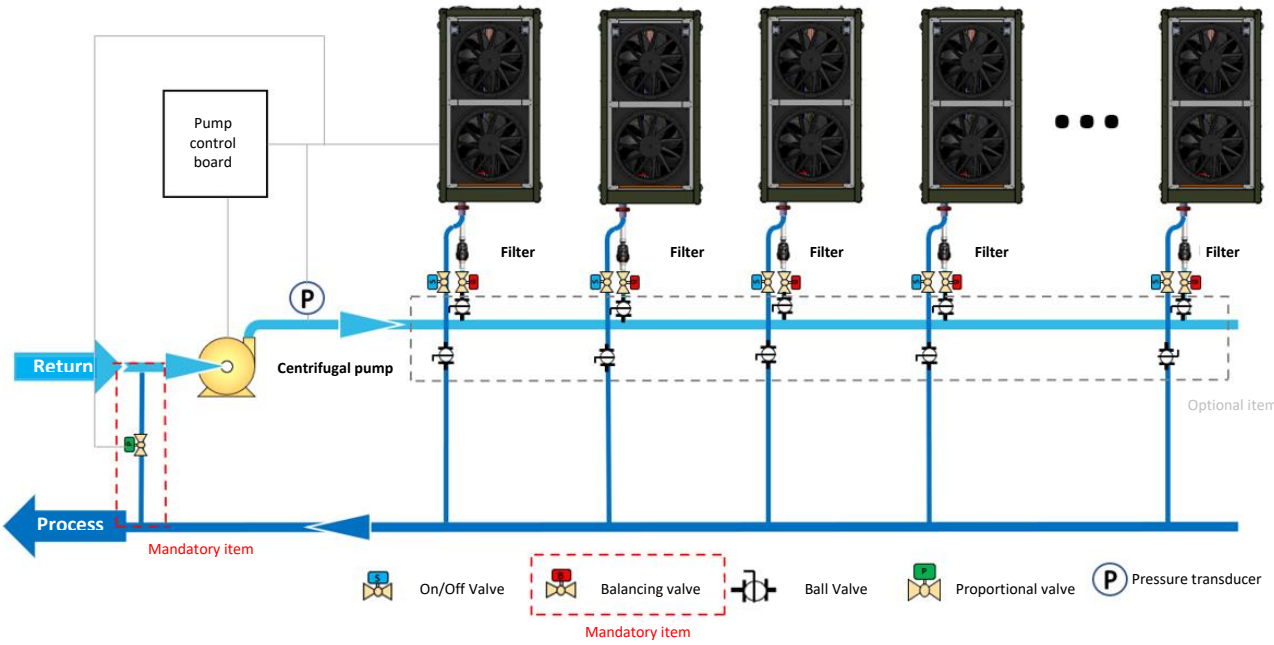
By default, the RLAC-S is supplied without a pump, but it is possible to supply the equipment with the optional hydraulic kit, available consisting of one or two pumps, as indicated in section 4.4 of this manual. The same applies to the water filter, which is not supplied with the RLAC-S by default, but can be supplied as an optional item if the hydraulic system does not have a water filter system.

Below are some typical flowcharts for parallel operation, with the possibility of using a single pump for the entire system or a pump for each piece of equipment installed.

4.3.3.1. Interconnection with a single pump

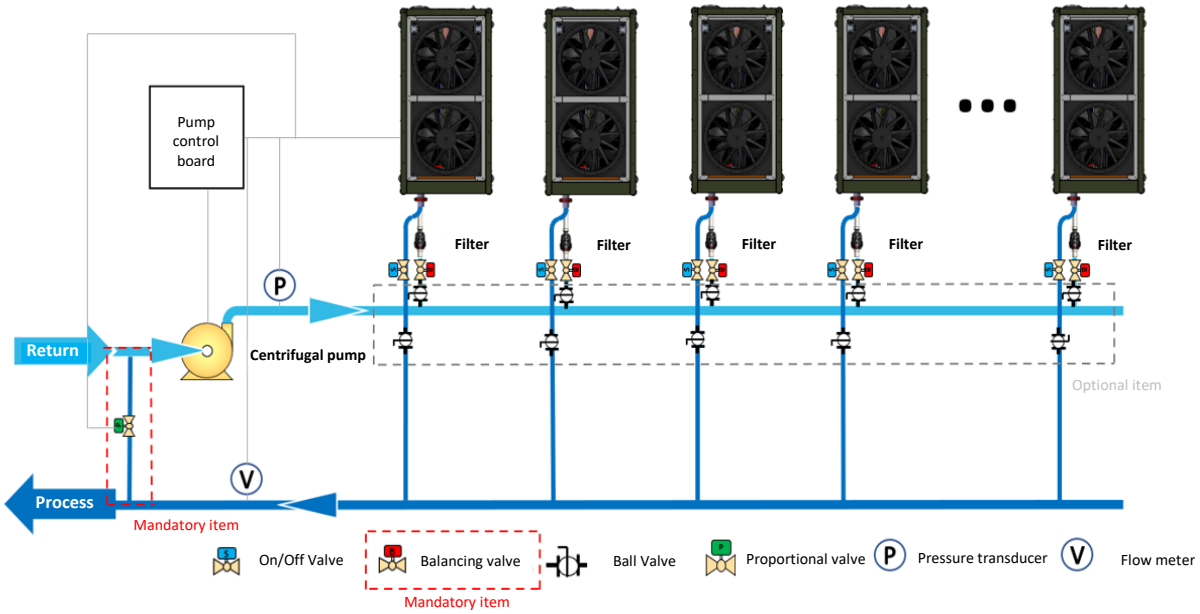
When installing a single supply pump for the system, it is necessary to install an ON/OFF valve for each RLAC-S. With this, only the valve of the operating RLAC-S will remain open, closing immediately as soon as the units are switched over, or in the event of a fault that interrupts the operation of the operating RLAC-S. Optionally, block valves can be installed at the entrance and exit of each equipment, with the purpose of

facilitating eventual maintenance. The system must have flow balancing valves in each equipment, in addition to a by-pass in the line, thus ensuring constant pressure and flow of water in the system.



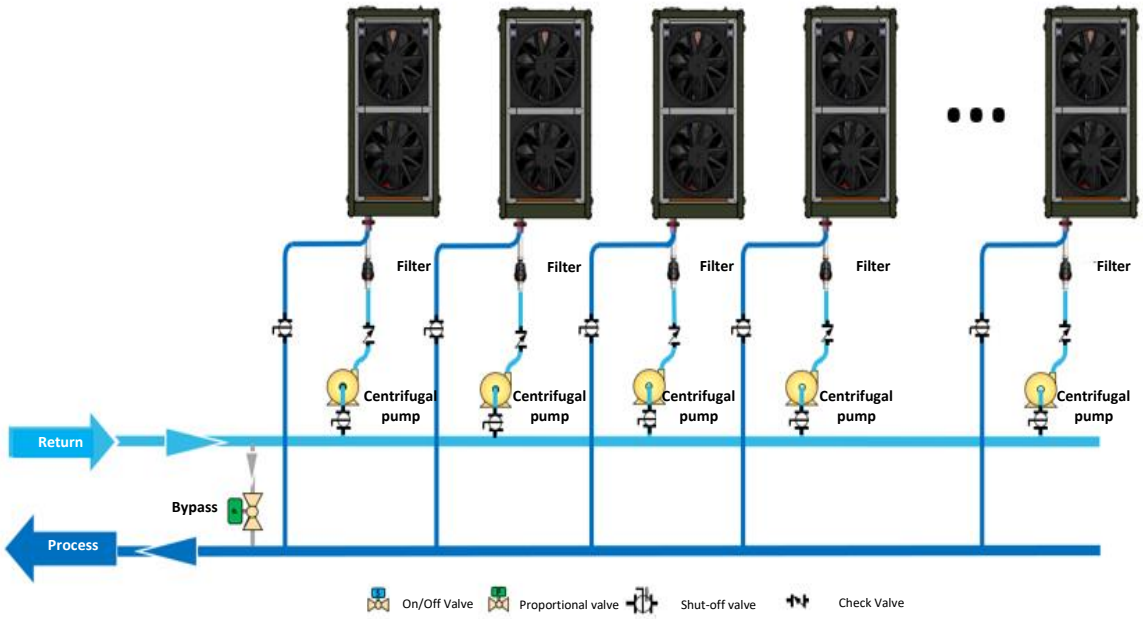
4.3.3.2. Interconnection with single pump - Variable speed pump

In the single pump configuration, there is still the possibility of controlling the rotation speed of the pump, thus enabling more precise control of the water flow and pressure of the system. The system configuration should follow the same recommendations of the system with fixed rotation single pump, with the only requirement being to implement the flow meter that will be interconnected to the pump controller.



4.3.3.3. Interconnection with individual pumps

In this installation format, each RLAC is interlocked with its respective pump, where the pump is automatically shut off when the RLAC-S ceases operation. This installation facilitates the balancing of the water flow between the modules, eliminating the need for balancing valves. We recommend the installation of a check valve in the return line of each RLAC-S, to avoid the return of water through this line in inoperative equipment.



4.3.4. Need to add anti-freezing agent

Due to the operating range of the equipment being between 5 and 15°C, it is not necessary to add antifreeze to the process water. However, for applications where the ambient temperature can reach values below 2°C, we recommend adding antifreeze to the water, as freezing the water inside the RLAC-S could cause severe damage to the equipment. We recommend the use of a solution of water and antifreeze according to the table below:

Room temperature (°C)	**Monoethylene-glycol**	**Propylene glycol**
	Volume (%)	Volume (%)
-5	20	23
-8	30	33

In case the process is directly connected to the food industry, it is necessary to use propylene glycol.

	**INFORMATION**	In case another anti-freeze is used, care must be taken so that the freezing temperature of this solution is at least 5°C lower than the minimum working temperature.

	**INFORMATION**	To specify the quantity of the antifreeze, remember to consider the volume of the hydraulic pipes and the process.

	**ATTENTION**	For applications where the fluid may come into contact with food production processes, monoethylene glycol should not be used due to its toxicity.

4.3.5. Pipe Cleaning

After completing the hydraulic interconnection services between the RLAC-S and the process, make sure the cleaning of the pipe is performed before start-up of the equipment. This service should be performed to prevent small particles from fouling the RLAC-S components, especially the evaporator.

Both fouling with the existence of suspended solids reduces the flow capacity of the water and increases load loss in the pipe, able to cause an increase in power consumption. Also, fouling may even cause corrosion in the major components depending on the crusted material.

To clean the hydraulic circuit, we recommend that it is initially carried out with the equipment isolated from the rest of the circuit, so that most of the solids are not directed into the RLAC-S.

Then open the shut-off valves and start up the equipment, allowing water to circulate for a certain period. After this procedure, stop the circulation of water and clean the water filter. Remount the clean filter and carry out one more circulation of water in the system. Clean the filter again. Carry out this procedure until the water filter is clean.

After observing that the filter is clean, drain all the water from the system and fill it again, after which the system is ready for operation.

We recommend the daily cleaning of the water filter during the beginning of operations, gradually spacing the cleaning time to that recommended in the preventive maintenance.

	INFORMATION	The equipment should not be switched on without prior authorization from Mecalor, under the penalty of suspension of the warranty.

4.4. Optional

4.4.1. Water filter

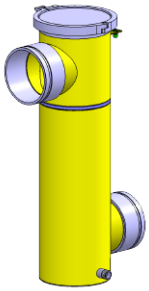
The RLAC-S must, mandatorily, operate with a hydraulic filter in the process water return. Mecalor offers this item as an option for the entire line. If the customer wishes to install the filter themselves, or already has a filter installed in the hydraulic system to which the RLAC-S will be integrated, they must ensure that the filter has a minimum filtration degree of 400 microns.

The maintenance of the filter supplied by Mecalor is done by removing the filtering element through the opening of the clamp that gives access to the inside of the filter and washing the filtering elements with running water.

Hydraulic Filter RLAC-S-25

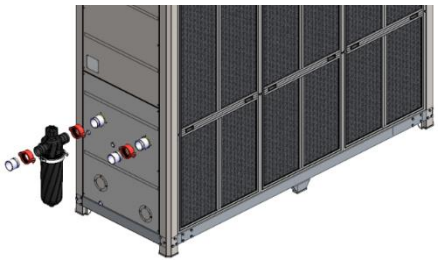
Hydraulic Filter RLAC-S-30/40/50/60

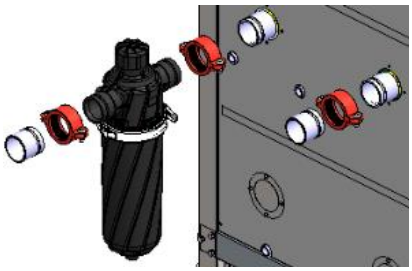
Hydraulic Filter RLAC-S-80/100/115



Hydraulic Filter RLAC-S-150/175/220

- Installation - Victaulic Connections





1. Mount the sealing ring on the fitting already installed on the RLAC-S. Use neutral detergent to make it easier to insert the ring into the fitting;
2. Install the connection supplied wit the equipment at the fixed end of the RLAC-S;
3. Assemble and attach the clamp with the use of screws and nuts;
4. Apply the sample procedure in the filter connections.

	INFORMATION	Never put the RLAC-S into operation without water filter. This practice will leave the system vulnerable to evaporator obstruction, resulting in equipment breakdown and loss of warranty.

4.4.2. Remote Panel

The remote panel has the following functionalities:

- Show outlet temperature of the equipment;
- On and off the equipment remotely;
- Emit a sound alarm in case the RLAC-S experiences failure;
- Reset alarms.

The remote panel is generally fixed in the control room in order to provide instant analysis of the process and, if necessary, switch off the RLAC-S.

➢ Items supplied

- Remote panel;
- Electrical interconnection cable with length of 25 meters;
- HMI Dixell.

- Procedure for electrical connection
  - The remote panel is connected directly to the terminal strip of the RLAC-S, dispensing the use of other power sources
  - Check the wiring diagram for terminal numbers (also indicated in section 4.5 of this manual)
  - Use 6x22AWG cable to carry out the electrical connection
  - In case it is necessary to extend the sensor cable, use PP 2x1mm cable (up to 50m).
- Fixation Procedure
  - Fix to the wall with the use of holes located on the back of the panel. 150 mm of distance between holes and 7 mm in diameter;
  - Use M6 screws with bushings installed in the reinforcement of the drywall or, preferably, on the stone wall;
  - Welding, gluing, splicing, plaster finishing or any other means that makes it impossible to remove the panel in the event of maintenance is not allowed

4.4.3. *E-coating* treatment for condensers

For installations in environments subject to sea air or aggressive atmospheres, the conventional condenser may suffer corrosion due to its total aluminum composition, thus reducing its durability. To avoid this type of occurrence, it is possible to supply the RLAC-S with condensers with e-coating paint, which is a surface treatment in aluminum that provides protection against corrosion.

4.4.4. Capacitor bank for compressors and/or pump(s)

In order to optimize the energy efficiency of the equipment, RLAC-S chillers can be supplied with a capacitor bank for the compressors and/or hydraulic pumps (if the equipment has a hydraulic kit included). The capacitor bank helps to correct the power factor of the installation, thus reducing the loss of reactive energy in the system. As a result, energy demand will be reduced, contributing to a reduction in operating costs and improving the stability of the electrical system.

4.4.5. Hot gas by-pass

For applications with large variations in thermal load, it is possible to supply the RLAC-S with a hot gas by-pass installed in the refrigeration system. The hot gas bypass consists of an electronic expansion valve installed connecting the compressor discharge pipe to the evaporator inlet. In situations where there is a reduction in the thermal load of the system, the by-pass valve will inject gas from the compressor discharge

directly into the evaporator inlet line, thus generating a "false thermal load" in the system. This prevents the compressor(s) from going out of operation, reducing the number of compressor starts, thus reducing energy consumption and compressor wear due to excessive starts.

4.4.6. Soft Starter for compressors and/or pump(s)

By default, the motors installed in the RLAC-S are supplied with direct start. However, it is possible to supply the equipment with a soft starter for the compressors and/or pumps, if the equipment has a hydraulic kit included. The soft starter provides a gradual start, avoiding current peaks and reducing mechanical stress on motor components. This results in greater electrical stability, minimizing voltage variations during the drive of electric motors, thus increasing the durability of the equipment and promoting greater energy efficiency.

4.4.7. Hydraulic Kit

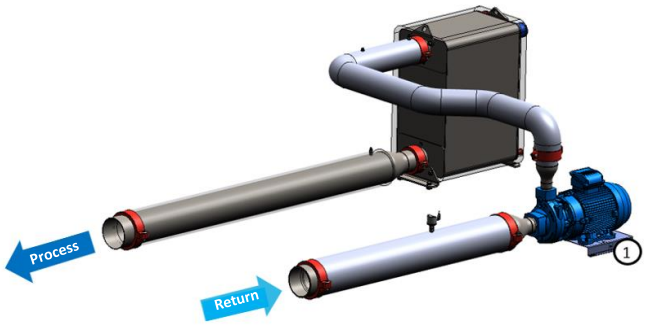
RLAC-S chillers are supplied without a hydraulic pump in their standard assembly; however, it is possible to supply the RLAC-S with a hydraulic kit included in its cabinet.

The hydraulic kit is available with a single pump or with two pumps in parallel. In both versions, pumps can be supplied for operation at 2, 3 or 5 bar. In all cases, the kit is supplied integrated into the RLAC-S, without the need for any additional assembly.

Below are the components included in each kit, as well as an illustration of their assembly.

4.4.7.1. Hydraulic kit with 1 pump

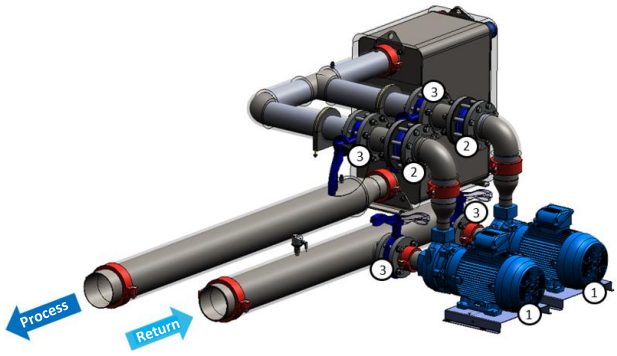
In the single pump version, the kit consists only of the pump, hydraulic piping and Victaulic fittings.



Item	Description
1	Centrifugal pump

4.4.7.2. Hydraulic kit with 2 pumps

In the two-pump version, the kit already includes the pumps, hydraulic piping, Victaulic fittings, shut-off valves in the suction line and check and shut-off valves in the pumps' discharge line.



Item	Description
1	Centrifugal pump
2	Check valve
3	Shut-off valve

4.4.8. NEO monitoring

The NEO monitoring system is an option available for the entire RLAC-S line. It is a remote monitoring system that does not require a connection to the local network. The system works with a 4G modem connected to a switch connected to the equipment to be monitored. This system records and transmits the operating data of the equipment in real time to a server that can be accessed through an internet browser. In addition, the system also indicates any faults in the equipment by sending an automatic e-mail to the registered addresses. The system has a history of occurrences and also automatically indicates predictive maintenance, which is monitored by recording the hours of operation of the components in relation to their hours of use.

4.4.9. Bacnet Communication

By default, the RLAC-S unit is equipped with a Dixell PLC and has communication available through MODBUS TCP/IP or MODBUS RTU RS-485, allowing parameter monitoring, remote on/off and setpoint adjustment. Optionally the equipment can be supplied with a plugin for Bacnet communication, if necessary for compatibility with management or monitoring software of the plant where the equipment is installed.

4.4.10. Fixed compressor + frequency inverter / Inverter compressor

The use of frequency inverters in compressors allows control of the rotation speed, which results in more dynamic control of the cooling capacity according to the demand of the process, providing more stable control of the water temperature. This also results in improved efficiency and energy savings, since the number

of compressor starts will be considerably reduced, thus reducing the electric current peaks that are needed to drive the compressors. This provides a more stable condition in the power supply network connected to the RLAC-S and reduces wear and tear on the internal components of the compressors.

Model RLAC-S-25/30/40 chillers can be supplied with one of the refrigeration circuits with an inverter compressor, leaving only the second circuit with a fixed compressor. Model RLAC-S-50/60 chillers can be supplied with one of the refrigeration circuits equipped with an inverter compressor, leaving only the second circuit with a fixed compressor. Chillers consisting of two or three compressors per circuit (RLAC-S-80/100/115/150/175/220) can be supplied with two compressors equipped with frequency inverters, one in each refrigeration circuit.

4.4.11. Expansion tank

If the hydraulic installation suffers from variations in water pressure, the RLAC-S can be supplied with an expansion tank. The expansion tank has the function of compensating for pressure variations in the system and keeping the hydraulic circuit constantly pressurized. Its use provides a more stable pressure in the system.

4.4.12. Air filter

Optionally, all chillers in the RLAC-S line can be supplied with filter screens for the condensers. Dirt build-up in condensers hinders heat exchange between the refrigerant and the air, causing a reduction in refrigeration capacity and an increase in the working pressures of the system, which can result in faults due to high pressure.

The use of air filters facilitates maintenance since there is no need to wash the condensers, and the filters can be washed in an area outside the chiller installation site if necessary, as well as being easily installed and removed from the equipment.

4.4.13. Closing screen

Closing screens can be integrated into all chillers in the RLAC-S line, thus offering greater security and integrity of the internal components of the chiller. Enclosure screens are used to prevent unauthorized access by people or animals to the refrigeration and hydraulic circuits of the chiller, as well as offering greater protection against damage or accidents caused by objects or equipment hitting the chiller at its installation site or during transport.

4.4.14. Compressor sound enclosure

For environments where there is concern about the operational noise of the equipment, RLAC-S chillers can be supplied with compressors equipped with acoustic enclosures. This option significantly reduces the noise generated during compressor operation, making operation quieter, ideal for installations in offices, hospitals or residential areas.

4.4.15. Heat recovery

In order to optimize the energy efficiency of the system, RLAC-S chillers can also be supplied equipped with a heat recovery system in the refrigeration circuit. This system uses the heat from the superheated refrigerant in the compressor discharge line. Before the fluid in a state of superheated steam enters the condensers for heat rejection and condensation of the fluid, the steam passes through a plate heat exchanger, allowing the heat from the fluid to be used to heat water that can be used for heating other applications, without generating additional energy costs.

4.4.16. Condensation control

RLAC-S units in the Standard version is supplied with fixed rotation fans in its condensation system. With a view to installations where the ambient temperature can reach temperatures below 10°C, the units can be supplied with a condensation control system. The condensation system adjusts the rotation speed of the fans according to variations in condensation pressure, ambient temperature and/or the thermal load of the system.

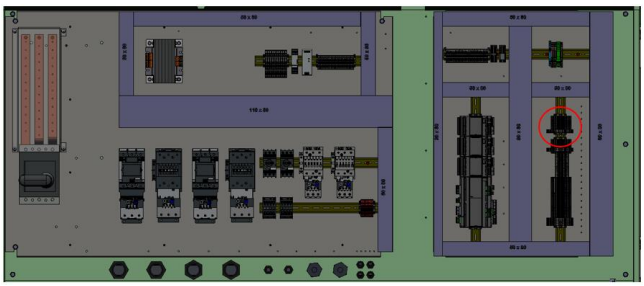
4.5. External connections

The units in the RLAC-S line has a number of contacts for interaction with external interfaces, all of which are available for connection directly to the terminal block inside the electrical panel. The contacts available are:

- Remote start;
- Remote setpoint;
- Alarm summary;
- Digital input for energy management;
- Flow control / Analog process variable;
- Water pressure control;
- Chilled water flow rate.

On model RLAC-S-25 to 60 units, the terminals for external connections are located as shown below:

For model RLAC-S-80 to 220 units, the terminals are located as shown below:

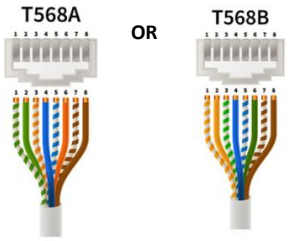


Check the wiring diagram supplied with the unit for the terminal numbers corresponding to each connection.

4.5.1. Ethernet

The RLAC-S controller has an Ethernet port, which allows the unit to be integrated into the network through Modbus TCP/IP communication or to interconnect machines. In the case of units supplied for parallel operation, the RLAC-S is equipped with a 5-port switch. For units supplied as a single unit, the Ethernet port is located on the PLC of the unit, inside the electrical panel. In the case of units supplied for parallel operation, the connection must already be made to one of the ports available on the switch, also installed inside the electrical panel.

CAT5e or higher cable must be used to connect the equipment to the network or between equipment. The cable terminals must be crimped identically on both terminals (parallel configuration) and can follow the T568A or T568B connection standard, as shown in the figure below:



4.6. Connection and communication in network

It is possible to monitor the RLAC - S via network communication through the Modbus TCP/IP communication - Ethernet physical medium or Modbus RTU - RS-485 physical medium. For Modbus TCP/IP communication, simply connect a network cable with an RJ-45 connector to the port located on the PLC inside the panel of the RLAC-S or on the Switch (if this option has been purchased) and for Modbus RTU communication, use the terminals indicated on the terminal strip in the RLAC-S electrical panel.

The communication can be carried out through supervisory or an HMI or at the discretion of the customer, and it requires the table below with the address of the variables of the equipment.

	**INFORMATION**	A phase sequence relay is installed inside the electrical panel of the RLAC-S, protecting the equipment against phase failure or phase inversion. If there is a phase inversion, the unit will not turn on, and it will be necessary to invert the R and S phases at the power supply input of the main switch.

4.6.1.1. Modbus Addressing

Description	R/W	Data Type	Group	Address Hex	Address Dec
Inhibits Alarm	R/W	Hold Register	Alarrl	F0F1	61681
Reset of alarms	R/W	Hold Register	Alarrl	F0F0	61680
High Pressure 1	R	Hold Register	Alarrl	4036	16438
High Pressure 2	R	Hold Register	Alarrl	403B	16443
Low Pressure 1	R	Hold Register	Alarrl	4037	16439
Low Pressure 2	R	Hold Register	Alarrl	403C	16444
Low temperature alarm - Failure	R	Hold Register	Alarrl	4009	16393
Low temperature alarm - Low	R	Hold Register	Alarrl	400 A	16394
Thermistor alarm of compressor 1	R	Hold Register	Alarrl	4039	16441
Thermistor alarm of compressor 2	R	Hold Register	Alarrl	403D	16445
Thermistor alarm of compressor 3	R	Hold Register	Alarrl	4042	16450
Thermistor alarm of compressor 4	R	Hold Register	Alarrl	4043	16451
Process Temperature Alarm	R	Hold Register	Alarrl	4001	16385
Process Temperature Alarm	R	Hold Register	Alarrl	4003	16387
Failure or phase sequence alarm	R	Hold Register	Alarrl	4032	16434
Flow Failure Protection	R	Hold Register	Alarrl	40EF	16623
High Condensation Temperature Protection 1	R	Hold Register	Alarrl	40F0	16624
High Condensation Temperature Protection 2	R	Hold Register	Alarrl	40F1	16625
Low Evaporation Temperature Protection 1	R	Hold Register	Alarrl	40F2	16626
Low Evaporation Temperature Protection 2	R	Hold Register	Alarrl	40F3	16627
Low Flow Protection	R	Hold Register	Alarrl	40F4	16628
Process Temperature Failure Protection	R	Hold Register	Alarrl	40F5	16629
Heat alarm of compressor 1	R	Hold Register	Alarrl	4035	16437
Heat alarm of compressor 2	R	Hold Register	Alarrl	403 A	16442
Heat alarm of compressor 3	R	Hold Register	Alarrl	4040	16448
Heat alarm of compressor 4	R	Hold Register	Alarrl	4041	16449
Fan alarm group 1	R	Hold Register	Alarrl	4034	16436
Circulation pump alarm 1	R	Hold Register	Alarrl	4033	16435
Insufficient water alarm	R	Hold Register	Alarrl	4038	16440
Maximum Setpoint for modulation of the by-pass valve	R/W	Hold Register	ByPass	1202	4610

Minimum Setpoint for modulation of the by-pass valve	R/W	Hold Register	ByPass	1201	4609
Setpoint for modulation of the by-pass valve	R/W	Hold Register	ByPass	1200	4608
Outlet for modulation of the by-pass valve	R	Hold Register	AO	200	512
On / Off via network (Enabled via parameter)	R/W	Hold Register	EnableChiller	1004	4100
Compressor status 1	R	Hold Register	DO	400	1024
Compressor status 2	R	Hold Register	DO	407	1031
Compressor status 3	R	Hold Register	DO	40 A	1034
Compressor status 4	R	Hold Register	DO	40B	1035
Maximum cold water setpoint	R/W	Hold Register	Compressors	1319	4889
Minimum cold water setpoint	R/W	Hold Register	Compressors	1318	4888
Adjustment of the cold water temperature	R/W	Hold Register	Compressors	1317	4887
Current operating capacity	R	Hold Register	Compressors	1312	4882
Condensation fluid temperature	R	Hold Register	AI	106	262
Status of group 1 of fans	R	Hold Register	DO	401	1025
Exchanger inlet temperature	R	Hold Register	AI	11E	286
Process water return temperature	R	Hold Register	AI	102	258
Low temperature of process cold water	R	Hold Register	AI	104	260
Outlet temperature of process cold water	R	Hold Register	AI	100	256
Process pump status 1	R	Hold Register	DO	402	1026
Sound alarm status	R	Hold Register	DO	404	1028
Alarm summary status	R	Hold Register	DO	405	1029
System flow	R	Hold Register	AI	299	665
Process cold water pressure	R	Hold Register	AI	108	264

4.7. Web Server

The Web Server is a remote monitoring feature available on the entire RLAC-S line, accessed by Ethernet using the IP of the controller through a web browser.

With this real-time remote monitoring it is possible to carry out parameterization, view temperature sensor readings, as well as view and reset alarms.

The Web Server integrates a management system for chillers connected in parallel, making it possible to view all the equipment connected to the network on a single screen.

This feature is a great facilitator for operational analysis, and can be used by the customer for monitoring, or by the Mecalor technical support team to analyze possible occurrences.

4.8. Final Inspection Checklist of the Installation Before Start-Up

Before energizing and starting to operate the RLAC-S, it is important to ensure that all precautions regarding the installation of the equipment have been taken. Failure to comply with any of the recommendations contained in this manual may result in damage to the equipment and consequently loss of the warranty.

Operating the RLAC-S is quite simple; however, we recommend that Mecalor is contacted before the equipment is put into operation. This will ensure that the equipment operates correctly and in suitable conditions. The RLAC-S must only be operated by trained personnel.

If necessary, Mecalor can be contracted to carry out the start-up of the equipment in the field with the technical support team.

Fill in the checklist below and send the requested information to our technical support team by e-mail to partida@mecalor.com at least 48 hours in advance, so that the information can be analyzed.

If the Mecalor technical support team is contracted to carry out the start-up in the field, we ask that the information be sent at least one week before the visit is scheduled.

		Yes	**No**
Customer data			
Company		-	-
Responsible		-	-
Telephone		-	-
E-mail		-	-
Serial number		-	-
Model		-	-
Estimated start-up date		-	-
Installation address		-	-
Is a technician required? If yes, please send the list of documents required			
		Yes	**No**
Equipment			
Installation site			

What space is available around the equipment?		-	-
Front	mm	-	-
Side	mm	-	-
Rear	mm	-	-
Is the equipment installed outdoors or indoors?		-	-
If indoors, has the duct been installed according to the specifications in the manual?			
Is the base or floor where the equipment is installed level?			
Does the base or floor have channels or drains to drain accumulated water?			
Antifreeze / Additives			
Will the equipment work in an environment with a temperature below 2°C?			
Will the equipment work with a set point below 5°C?			
Does the equipment use any antifreeze or additives? Which one? Inform the concentration	%		
Hydraulic piping			
Has a water filter been installed in the process return pipe?			
Is the process piping connected to the chiller?			
What is the diameter of the process piping?	inch	-	-
Has the pipe diameter been reduced?			
Is there a valve installed in the pipe? If so, which one? On which line?			
Has an air vent been installed at the highest point of the hydraulic circuit?			
Has the hydraulic circuit been filled, flushed, the water replaced and the filters cleaned?			
Has the hydraulic circuit been tested for leaks?			
Electrical panel			
Are the R, S and T phases connected correctly?			
What is the voltage measured between phases?		-	-
R-S	V	-	-
S-T	V	-	-
R-T	V	-	-
What is the voltage measured between phase and ground?		-	-
R-GND	V	-	-
S-GND	V	-	-
T-GND	V	-	-
Has the equipment been grounded?			
When the equipment is switched off, is there any current in the ground?			
What is the gage of the power cables for the equipment?	mm	-	-
Has an exclusive three-pole circuit breaker been considered for the equipment? What is the rated current, trip curve and voltage?			
What is the gage of the PE conductor (grounding conductor)?	mm	-	-
Is the PE conductor connected to the metal structure of the equipment also connected directly to the main equipotential bonding bar (MEB) or the local equipotential bonding bar (LEB)?			
Have any screws been retightened in the power and control circuit of the electrical panel?			
Photos			

Send photos of the electrical and hydraulic installation and the space where the equipment was installed with the checklist.

	**INFORMATION**	After completion of the electric and hydraulic installation, fill the inspection checklist of the installation and request from the Technical Support department for execution of the start-up of the equipment with a minimum of 48 hours in advance.

	**INFORMATION**	The equipment should not be switched on without prior authorization from Mecalor, under the penalty of suspension of the warranty.

	**INFORMATION**	Although it is a very simple procedure, it is important for the customer to contact Mecalor to check the installation and support conditions during the start-up of the equipment. Start-up should only be carried out by trained personnel. It is also possible to contract Mecalor to carry out this service in the field with the technical support team.

5. Operation

Below is a set of instructions for the correct operation of the RLAC-S, as well as the change of the control temperature of the equipment and access to the alarm screens.

The operating actions do not require the use of PPEs unless the environment where the RLAC-S is located requires it. The customer is responsible for establishing which PPEs the operator must use.

The customer must provide suitable lighting for the RLAC-S installation environment, in which maintenance services will be carried out if necessary.

Before starting to operate the equipment, the following points should be checked:

- Check the electrical connections between the components, cables and terminals, tightening when necessary;
- Check the gauges and fittings of the electrical conductors;
- Check the gauges and fittings of the pipes;
- Check to see if the safety devices of the equipment and installation are not activated;
- Check the control fuses;
- Check the voltage and difference between the electric power supply phases;
- Check that the air flow to the equipment is not obstructed and that there is suitable ventilation at the installation site;
- Check that the hydraulic circuit is full and that no shut-off valves are closed;

The control of the equipment is done through the PLC installed in the electrical panel, including all the functions related to temperature control.

	ATTENTION	It is recommended for the operator to go through training before operating the equipment. The RLAC-S is easy to operate, but the operator must be qualified and have the minimum knowledge to operate the equipment safely.

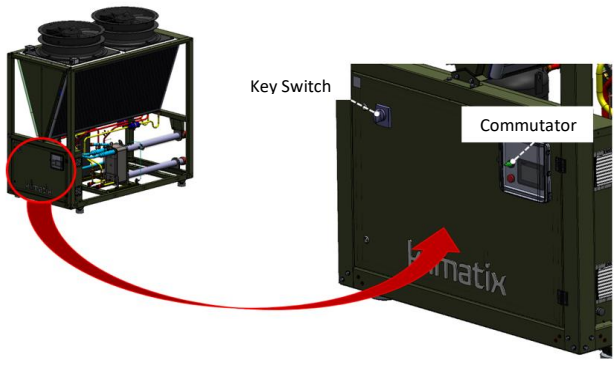
5.1. Start-up

	INFORMATION	The equipment should not be switched on without prior authorization from Mecalor, under the penalty of suspension of the warranty.

	INFORMATION	Fill out the *"Final inspection checklist of the installation before Start-up"* before contacting Mecalor's Technical Support for startup of the RLAC-S.

To start the equipment, turn the handle of the main switch located on the door of the equipment to the ON position.

To switch on the RLAC-S in local mode, turn the commutator to the "ON" position, the HMI should start and soon after the RLAC-S should start operating automatically. If the equipment does not turn on, check that there is voltage at the input of the Main Switch. In the event of an inversion in the power supply phases, the



HMI will start and indicate the sequence alarm or lack of phase, which will keep the equipment inoperative. To solve this problem, correct the sequence by inverting the RS phases.

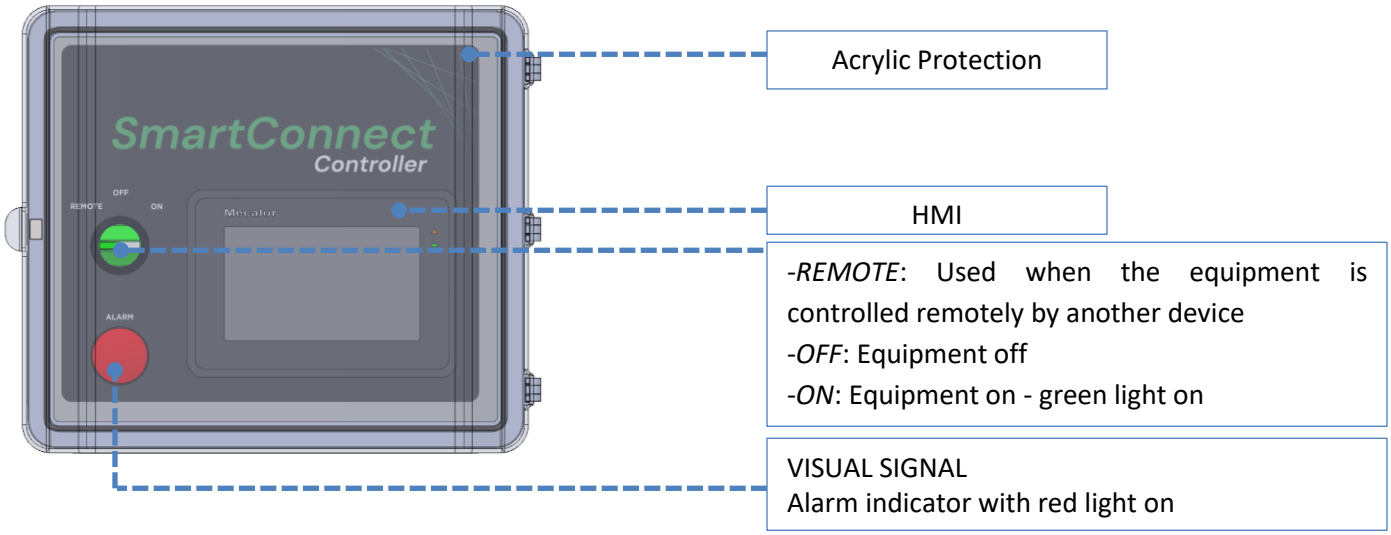
To put the RLAC-S into operation through the remote command, turn the commutator of the command panel to the "REMOTE" position. In this position, the HMI will start and display the message "Off" until the equipment is remotely activated.

	INFORMATION	Avoid wear in components. Use the main switch to turn off the RLAC-S power only in cases of maintenance. The control panel monitors the variables of the RLAC-S and it must be powered even with the commutator of the RLAC-S in the *OFF* position.

5.2. Command Panel

The Command Panel of the RLAC-S has a touch screen and is installed on the door of the electrical panel, together with a commutator button to on/off the equipment and the visual alarm signal that lights up in case of failure. In case of failure, the sound signal will emit a sound alarm.

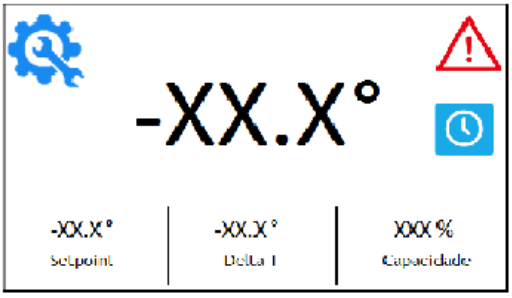
These components are protected by a mobile acrylic cover that has the purpose of protecting the components against rain and direct sunlight.



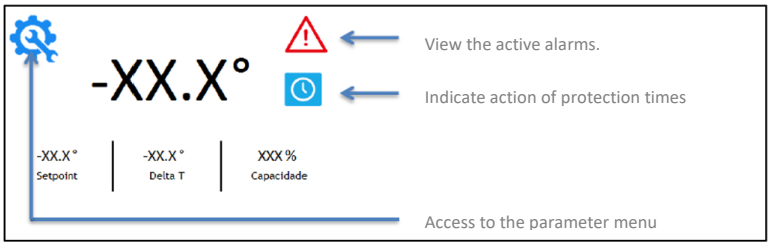
5.2.1. Operating description of the HMI

HMI MASK

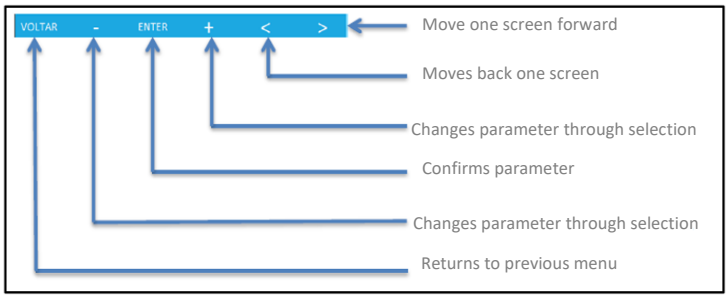
PRESENTATION SCREEN



MAIN SCREEN – MAIN VARIABLES OF THE PROCESS

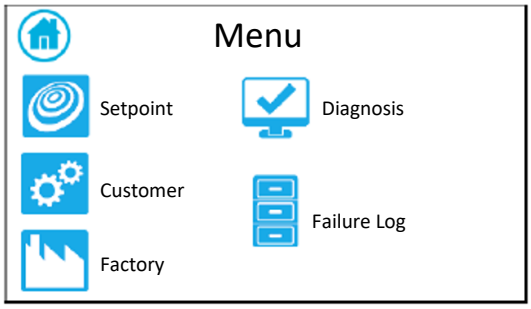


DESCRIPTION OF THE MAIN SCREEN

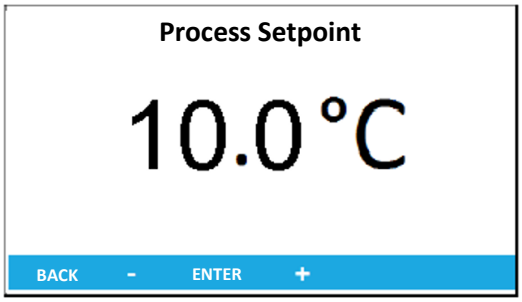


DESCRIPTION OF LOWER ICONS OF THE SCREEN

ICON DESCRIPTION



MENU SCREEN

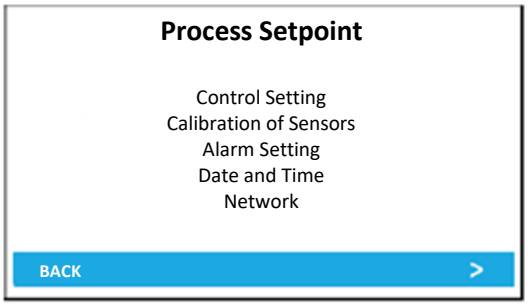


SETPOINT SCREEN

There are two ways of changing the setpoint of the water temperature:

1 – Touch the screen and then on the value of the temperature, a virtual key will appear, type the value of the new temperature and confirm, or

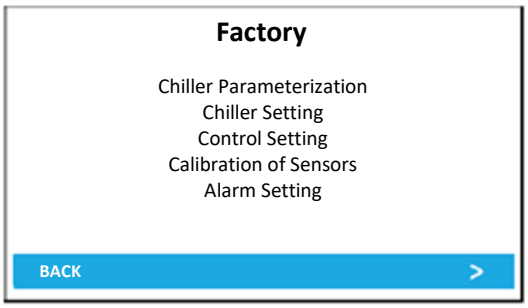
2 – Touch the *'ENTER'* icon located below the temperature value indicated on the screen, the temperature will be highlighted, then touch the icon "-" or "+" to change the value, later confirm by touching the *'ENTER'* icon.



CUSTOMER SCREEN

In the Customer icon it is possible to access the parameters to adjust the equipment at user level, but, for safety reasons, the access is only released when the user inserts a password that is provided by technical

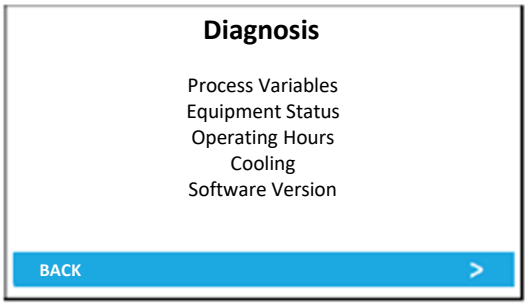
support. Adjustments on the equipment can only be carried out with the authorization and monitoring of Mecalor.



FACTORY SCREEN

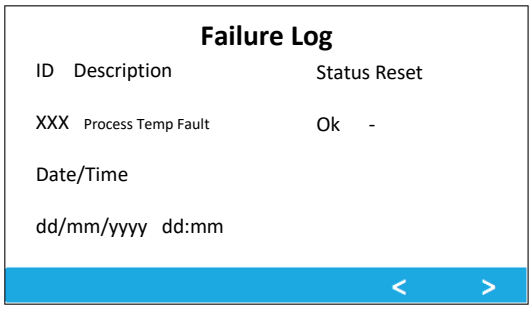
The '*Factory*' screen allows access to the programming screens of the systems variables at supervisor level. A special password is necessary to access this area. This screen is accessed only by a qualified person, since the change of the parameters can put at risk the control and service life of the equipment.

	**DANGER**	It is not allowed to change the software, parameters or operating conditions on the HMI screen in the factory menu. This practice can put at risk the operator and the operation of the equipment, able to cause loss of control of the process, breakage of the equipment and physical damages to the operator, in addition to loss of warranty.



DIAGNOSTIC SCREEN

The '*Diagnostic*' screen allows the visualization of the variables of the process, equipment status, hours of operation of the equipment, variables of the cooling system and information on the version of the software installed.



FAILURE LOG SCREEN

In the '*Diagnostics*' screen it is possible to see the failures that occurred on the equipment and the ones that are active. It is also possible to browse between the last failures.

After solving the failure, carry out its reset in order to operate the equipment again.

6. Maintenance

6.1. Corrective Maintenance - Occurrence diagnosis

All RLAC-S occurrences are indicated on the HMI alarm screen and, depending on the type, will also trigger the sound alarm. It is possible to silence the sound alarm through the HMI.

Occurrences are divided into two types: alerts and alarms.

Alerts do not interrupt the operation of the equipment, but are displayed on the HMI to indicate that a deviation has been detected and that the equipment needs to be given due attention.

Alarms, on the other hand, are more serious occurrences that cause the equipment to stop automatically. Some alarms allow a reset to be carried out through the HMI so that the equipment can resume its operation. However, if the equipment is reset many times in a row, the reset can be disabled for equipment safety, and the cause of the occurrence must be corrected before a new operation attempt is made. Other alarms no longer allow a manual reset, so the cause of the fault must be corrected in order for the alarm to be reset automatically, allowing the unit to resume operation.

	**ATTENTION**	The procedures described below can only be performed by qualified people who have the knowledge on the operation of the equipment. Procedures performed by the layman may result in injuries or breakage of a component.

6.1.1. Warnings and Protection Mode

Alerts are occurrences that do not interrupt RLAC-S operation or trigger the sound alarm, but are displayed on the HMI to indicate the detection of a deviation in equipment operation.

Some alerts do not require intervention, as they are a one-off deviation, such as the high process temperature alert, which can occur during the start of the unit's operation, when the process temperature is above the setpoint. However, other occurrences must be analyzed carefully so that the situation does not escalate into a fault, with the occurrence of an alarm, which will cause the equipment to be disabled for safety reasons.

The controller has a feature called "protection mode", which can be enabled to monitor certain events, as indicated in this section of the manual. When this is enabled, the controller starts to monitor and, when any

deviation in operation is detected, the controller automatically makes adjustments to prevent the equipment from interrupting its operation.

Alerts are indicated on the HMI as follows:

Indicative Warning Icon on the HMI

The following are all the alerts that can be indicated on the RLAC-S HMI, their possible causes and the procedure to be adopted for correction.

Warnings applicable to RLAC-S

Description of the Alarm	Cause	Procedure	Possible Alarm
High Process Temperature (Setpoint + 6°C)	- Badly positioned sensor	- Check to see if the sensor is installed inside the well	-High Pressure 1 or 2 - Warning: High Cond Temp 1 or 2
	- Others Failure	- Check to see if there are no of other active warnings. Carry out the procedures applicable to other active alarms if existent	
	- Excess heat load	- Check to see that there is no heat load increase in the system	
High Condensation Temperature 1 or 2 (>= 55°C)	- High process water temperature	- Check to see if the equipment is not operating outside the working range	-High Pressure 1 or 2
	- Dirty water filter (Water condensation)	- Carry out cleaning of the filter [1)]	
	- Dirty air filter (Air condensation)	- Remove the screens and wash them with WAP[1)]	
	- Obstructed condenser (Air condensation)	- Remove the air filters (screens) and wash with WAP[1)]	
		- Wash the microchannel condenser using a WAP[1)]	
	- Obstructed condenser (Water condensation)	- Hire a specialized company to clean the condenser through the accesses existing in the condensation pipe	
Low Condensation Fluid Temperature	- Temperature below 15°C	- Air condensation: contact technical support to check the operation of the equipment	Low Pressure 1 or 2
		- Water condensation: check the operation of the cooling tower	

High Condensation Fluid Temperature	- Room air temperature above 42°C	- Check to see if there are no of obstacles preventing the circulation of air around the equipment	-High Pressure 1 or 2
		- Check to see if there is no recirculation of air from other equipment that dissipate heat around the Chiller	
		- Check if the required space criteria around the Chiller were met (according to section 4 of this manual)	
	- Temperature of condensation water above 35°C	- Check the operation of the cooling tower	
Low Water Pressure (optional)	- Low load loss in the system	- Check the load loss of the system	- Low Flow - Insufficient Water
	- Pump Cavitation	- Contact technical support	
High Water Pressure (optional)	- Possible obstruction in the process pipe	- Check that there are no restrictions on the diameter of the water pipe	- Low Water Flow
		- Check to see if any stop valve in the system is closed	
		- In case of no obstructions, contact technical support to check the operation of the equipment	
Indirect Low Temperature (optional)	- Process temperature on customer side below pre-established value	- Process temperature on customer side below the established value	-
Indirect High Temperature (optional)	- Process temperature on customer side above pre-established value	- Process temperature on customer side above the established value	-
Off	- Commutator in “off” position	- Turn equipment on	-
	- Commutator in “on” position	- Contact technical support to check the operation of the equipment	
	- Commutator in “Remote” position	- Check the physical interconnection with the remote panel and, if correct, contact technical support to check the parameterization of the remote command	
CS_n Short Cycle Warning	- Excess start-ups of compressor with less than 3-minute operation within a period of 24 hours	- Contact technical support to check the operation of the equipment	- Compressor Thermistor CPn
Humidification System Failure (only in air equipment with adiabatic condenser cooling)	- Dirty humidification system pump tank	- Clean the pump tank	-
	- Pump locked or shorted	- Contact technical support to change the pump	
High Evaporator TD (Temperature difference between evaporator inlet and outlet above 8°C)	- Low flow circulating through the evaporator	- Check for the existence of water flow, checking to see if the pressure indicated in the pressure gauge of the Chiller is the same or close to that indicated on the plate of the equipment	- Low water flow

Listed below are the alerts that have the protection mode feature available for activation in the RLAC-S settings:

Warnings with the "Protection Mode" feature

Description of the Alarm	Application	Antecedent Alarm	Possible Subsequent Alarm	Description
Process Temperature Failure Protection	All the Chillers	- Process Temperature Failure	-	- In case of failure of the process temperature sensor, the low temperature sensor will be used as reference until the defective sensor is replaced
Low Temperature Failure Protection	All the Chillers	- Low Temperature Failure	-	- In case of low temperature sensor failure, the process temperature, low evaporation temperature and low suction temperature will be used as cutting and deactivation criteria of the compressors
LOP Protection 1 or 2	Chillers with electronic expansion valve	-	- LOP Alarm 1 or 2 - Low Pressure 1 or 2	- Measures taken by the electronic expansion valve for 5 minutes to prevent the deactivation of the Chiller. If the problem persists, the Chiller will be deactivated.
MOP Protection 1 or 2	Chillers with electronic expansion valve	-	- MOP Alarm - High Pressure 1 or 2 (Hot days) - Warning: Temp. Cond. High (Hot days) - Low Pressure 1 or 2 (Cold days)	
Low SH Protection 1 or 2	Chillers with electronic expansion valve	-	- Low Pressure 1 or 2	
High Process Temperature Protection	Chiller with automatic by-pass	- Warning: High Process Temperature	- High Cond Fluid Temp - Safety Process Temp	- The pressure control valve of the water is forced to remain open. If the problem persists, the Chiller will be deactivated
Low Flow Protection	Chiller with automatic by-pass	- Warning: High Evaporator TD	- Low Flow - Low pressure 1 or 2 - Low Temp	
Flow Failure Protection	Chillers with electronic expansion valve and Automatic By-Pass	- Insufficient Water	-	- The Chiller remains in operation and the failure is disregarded if the Smart Connect observes that the pump is operating at nominal pressure and if the TD of the evaporator and the evaporation temperature are within the safety value, but the alarm continues to be active until the problem is solved
High Condensation Temperature Protection 1 or 2	Chillers with 4 and 6 compressors	- Warning: High Cond Temp 1 or 2	- High Pressure 1 or 2	- The compressors are turned off one by one every 5 minutes in the expectation that the problem will be resolved. At the limit, one of the compressors of each circuit will continue operating. The process temperature may be stabilized above the desired value, but the process will continue to be served, even if precariously. If the problem persists, the Chiller will be deactivated
Low Evap. Protection 1 or 2	Chillers with 4 and 6 compressors	- Warning: Low Evaporation Temperature	- Warning: LOP Protection 1 or 2 - Low pressure	

6.1.2. Alarms

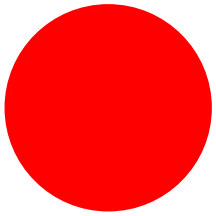
Alarms are occurrences that trigger the sound alarm and interrupt the operation of the RLAC-S partially, or completely. Through the HMI it is possible to view the description of the occurrence and deactivate the sound alarm. However, in order for the equipment to resume normal operation, the cause of the fault must be rectified. Otherwise, the alarm will remain active and the RLAC-S inoperative. Once the cause has been rectified, the alarm will be reset automatically and the RLAC-S will then resume operation.

The following are the alarms that can occur in the RLAC-S, along with their probable causes and the procedure for correcting them. If the problem persists even after following the procedure indicated, contact Mecalor technical assistance.

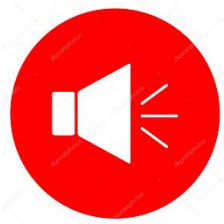
In case the failure cannot be corrected by following the procedure below, contact the Technical Support of Mecalor.

The warnings are indicated as follows:

Indicative Warning Icon on the HMI



Red Signal Alarm Indication



Sound Alarm Alarm Indication

	**INFORMATION**	Carry out failure diagnostics immediately after the occurrence of an alarm. The reset of the chiller is deactivated for 10 minutes in case 3 consecutive failure resets occur within a period of 2 minutes between them.

	**INFORMATION**	Mecalor has access to the failure log of the RLAC-S and if it is observed that an eventual break or defect in the component was caused by continuous resets of the alarms the equipment will lose its warranty.

		Alarm Description	Component		Consequence	Rearm[1)]	Probable Cause	Procedure
			TAG	Description				
1	System	Failure or phase sequence	RSF1	Failure / Phase Sequence Relay	Switch off Chiller	Auto	- Failure or no phase in the electric power supply	- Check the electric power supply
							- Inversion between phases	- Check if the LED of sequence relay/phase failure in the electric panel

								is on. In case it is off, invert the phases
2		Low water flow	FS1	Flow Sensor	Turn Off Refrigeration 1 and 2	Manual	- Dirty water filter	- Carry out cleaning of the filter [5)]
							- Flow rate below 50% of rated value	- Check to see if there are any valves obstructing the return of the process water
							- Malfunction of the by-pass	- Contact technical support to check the operation of the by-pass
							- Pump with obstruction	- Contact technical support to check the operation of the pump
3		Insufficient Water	RI1 VB1 FS1	Tank Float valve Flow Sensor	Switch off Chiller	Manual	- Low level of water in the tank	- Check to see if the float meter is jammed or damaged
							- Insufficient replacement water	- Check to see if the water supply pipe is open
							- Failure of or dirty flow sensor	- Carry out cleaning of the flow sensor
4		igh Pressure 1 or 2	PA1 or 2 CO_n VT_n	High pressure switch 1 or 2 Condenser Fan	Turn Off Refrigeration 1 or 2	Manual	- Low condensation fluid flow (Air condensation)	- Check to see if there are no of obstacles preventing the circulation of air around the Chiller
								- Check to see if the fan is operating
							- Low condensation fluid flow (Water condensation)	- Check to see if the cooling tower is providing the water flow required by the condenser as indicated in the Chiller nameplate
							- Dirty water filter (Water condensation)	- Carry out cleaning of the filter [5)]
							- Dirty air filter (Air condensation)	- Remove the screens and wash them with WAP[5)]
							- Obstructed condenser (Air condensation)	- Remove the air filters (screens) and wash with WAP[5)]
								- Wash the microchannel condenser using a WAP[5)]
							- Obstructed condenser (Water condensation)	- Hire a specialized company to clean the condenser through the accesses existing in the condensation pipe
							- High temperature of the condensation fluid	- Check to see if the room temperature of the installation site does not exceed the maximum temperature of 42°C
								- Check if the required space criteria around the Chiller were met (according to section 4 of this manual)

5		Low Pressure 1 or 2	PB1 or 2	Low pressure switch 1 or 2	Turn Off Refrigeration 1 or 2	Manual	- Lack / leak of refrigerant	- Contact technical support to check the operation of the refrigeration circuits
6		Water Pressure Failure[4)]	TP1	Pressure Transmitter	Loss of control[4)]	Manual	- Failure of the pressure transmitter of the process water	- Contact technical support to change the pressure transmitter
7	**Sensors**	Process Temperature Failure	ST1	NTC Sensor	Turn Off Refrigeration 1 and 2	Manual	- Bad sensor connection contact	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the sensor	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor
8		Safety Process Temperature	ST1	NTC Sensor	Switch off Chiller	Auto	- High process temperature (≥ 50°C)	- Change the tank water, put the Chiller to operate on by-pass and check if the Chiller deactivates again
								- Check to see that there is no heat load increase in the system
9		Return Temperature Failure	ST2	NTC Sensor	None (Reference only)	Manual	- Bad sensor connection contact	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the sensor	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor

10		Low Temperature Failure[2)]	ST3	NTC Sensor	Turn Off Refrigeration 1 and 2	Auto	- Bad sensor connection contact	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the sensor	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor
11		Low Temp	ST3	NTC Sensor	Turn Off Refrigeration 1 and 2	Auto	- Low circulation of water through the evaporator	- In case of recurrent alarms during the time of the day the Chiller is in operation, contact the technical support of Mecalor
							- Water temperature below the value indicated in the “low limit” parameter	- Check to see if the temperature adjustment in the HMI is below 5°C or below the minimum temperature indicated on the identification plate.
							- Incorrect measurement	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor
12		Low Safety Temperature	ST3	NTC Sensor	Switch off Chiller	Manual	- Water safety temperature below the value indicated in the “low safety limit” parameter	- Contact the technical support of Mecalor to check the operation of the Chiller
13		Condensation Fluid Temperature Failure	ST4	NTC Sensor	None	Manual	- Bad sensor connection contact	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the sensor	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor
14		Failed indirect temp (optional process control at customer's side)	-	NTC Sensor	None	Manual	- Bad sensor connection contact	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment

							- Defect in the sensor	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor
15		Temp. Exchanger Failure	ST5	NTC Sensor	None	Manual	- Bad sensor connection contact	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the sensor	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor
16		Universal Input failure	-	NTC Sensor	None	-	- Bad contact in the component (sensor / transmitter, etc.)	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the component (sensor / transmitter, etc.)	- In a container with water, place the sensor with a calibrated sensor; if the difference or lack of measurement is observed contact technical support to change the sensor

17	**Engines**	Heat Pump 1	FE9	Engine circuit breaker	Switch off Chiller	Manual	- Overcurrent in the pump engine	- Reset the circuit breaker and measure the electric current. Compare with the current indicated in the electrical data. The electric current of the cables should be less than that of the electrical data
								- Check the inlet and outlet voltage, voltage drop, temperature (< 50°C) and the current of the circuit breaker
								- In case of recurrent alarms during the time of the day the Chiller is in operation, contact the technical support of Mecalor
							- Working point not within the pump curve	- Check the pressure indicated on the pressure gauge of the Chiller The pressure should be within the curve of the pump
								- Check the adjustment of the circuit breaker. The adjustment should be equal or higher than the nominal current (between 5 to a MAXIMUM of 10%)
18		Thermal Fan VT_n (equipment with air condensation)	FE7 FE8	Engine circuit breaker	Switch off Refrigeration	Manual	- Overcurrent in the fan engine	- Reset the circuit breaker and measure the electric current. Compare with the current indicated in the electrical data. The electric current of the cables should be less than that of the electrical data
								- Check the inlet and outlet voltage, voltage drop, temperature (< 50°C) and the current of the circuit breaker
								- In case of recurrent alarms during the time of the day the Chiller is in operation, contact the technical support of Mecalor

19		Compressor Heat CPn	FE1 to 6	Engine circuit breaker	Turn Off Refrigeration 1 or 2	Manual	- Overcurrent in the compressor engine	- Reset the circuit breaker and measure the electric current. Compare with the current indicated in the electrical data. The electric current of the cables should be less than that of the electrical data
								- Check the inlet and outlet voltage, voltage drop, temperature (< 50°C) and the current of the circuit breaker
								- In case of recurrent alarms during the time of the day the Chiller is in operation, contact the technical support of Mecalor
								- Check for failure in the inverter or Soft Starter of the compressors
							- Excess refrigerant	- Check to see if refrigerant load was not carried out in the refrigeration circuits as a result of maintenance
20		Compressor Thermistor CPn (Chillers with Thermistor)	TM_n	Thermistor	Turn Off Refrigeration 1 or 2	Manual	- Deactivated CPn compressor engine thermistor	- Check the value of the electrical voltage that is supplying the compressor contactors. There should be no +- 10% variation in the nominal value
							- High temperature of the compressor engine	- Contact technical support to check if the circuit overheating is high
21	**Chillers with CoreSense These failures appear alongside the failure of the thermistor as the cause**	CS_n Loss of Communication / Offline	TM_n	CoreSense	Turn Off Refrigeration 1 or 2	Manual	- Bad contact of module connection	- Locate the module connection in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the module	- Contact technical support to change the module
22		CS_n Internal Thermistor Warning	TM_n	CoreSense	Turn Off Refrigeration 1 or 2	Manual	- Chiller temperature control oscillating	- Contact technical support to check the operation of the Chiller
							- CoreSense Configuration	- Contact technical support to reset the Coresense module

23		CS**n** Low Voltage	TM_n	CoreSense	Turn Off Refrigeration 1 or 2	Manual	- Bad contact of module connection	- Locate the module connection in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the module	- Contact technical support to change the module
24		CS**n** Internal High Temp CSn High Discharge Temperature CSn Engine Shutdown Temperature	TM_n	CoreSense	Turn Off Refrigeration 1 or 2	Manual	- High overheating	- Contact technical support to check the cooling system
							- Defect in the internal compressor sensor	- Contact technical support to change the sensor
							- Defect in the module	- Contact technical support to change the module
25		CS*n* Reversed Phase Shutdown CSn Lack of Phase Shutdown	TM_n	Thermistor	Turn Off Refrigeration 1 or 2	Manual	- Bad contact in phase connection	- Locate the module connection in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Inversion between phases	- Check the connection between panel and compressor
							- Circuit breaker / contactor problems	- Check the inlet and outlet voltage, voltage drop, temperature (< 50°C) and the current of the circuit breaker / contactor
26	**Chillers with Electronic Expansion Valve**	LOP Alarm 1 or 2	DVE1DVE2	Expansion valve module	Turn Off Refrigeration 1 or 2	Manual	- Lack / leak of refrigerant	- Contact technical support to check the operation of the refrigeration circuits
							- Equipment operating outside the operating conditions	- Contact technical support to check the operation of the Chiller
27		MOP Alarm 1 or 2	DVE1 DVE2	Expansion valve module	Turn Off Refrigeration 1 or 2	Manual	- High process water temperature	- Contact technical support to check the operation of the Chiller
28		Low SH Alarm 1 or 2	DVE1 DVE2	Expansion valve module	Turn Off Refrigeration 1 or 2	Manual	- Liquid return to the compressor	- Contact technical support to check the operation of the Chiller
							- Reading problems on the pressure sensor and/or transmitter	- Check the electrical connection according to the electrical scheme of the Chiller

							- Defect in the module	- Contact technical support to change the module
29		EVD 1 or 2 Offline	DVE1 DVE2	Expansion valve module	Turn Off Refrigeration 1 or 2	Manual	- Controller of Expansion valve 1 or 2 disconnected	- Check the physical communication medium
30		EVD 1 or 2 Probe 1 EVD 1 or 2 Probe 2 EVD 1 or 2 Probe 3[3)] EVD 1 or 2 Probe 4[3)]	DVE1 DVE2	Expansion valve module	Turn Off Refrigeration 1 or 2	Manual	- Bad sensor connection contact	- Locate the sensor in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the sensor	- Contact technical support to change the sensor
31		EVD 1 or 2 Engine Error	DVE1 DVE2	Expansion valve module	Turn Off Refrigeration 1 or 2	Manual	- Failure of the engine of the Expansion valve 1 or 2	- Check coil measurements of the expansion valve in failure and compare with that of the circuit in operation, they must be the same
							- Bad contact of module connection	- Locate the module connection in the electrical panel through the TAG and check to see if the wires are not loose. The connection can be checked in the electrical scheme of the equipment
							- Defect in the module	- Contact technical support to change the module
32		EVD 1 or 2 EEPROM Damaged	DVE1 DVE2	Expansion valve module	Turn Off Refrigeration 1 or 2	Manual	- Defect in the module	- Contact technical support to change the module
33	**Communication**	Chiller Standby Offline (Networked chillers)	-	Physical communication medium	None	-	- Communication failure between the equipment	- Check the physical communication medium
								- Check the network configurations of the Chillers
34		IPX Offline (Chiller with 6 compressors or screw compressor)	-	Physical communication medium	None	-	- Communication failure with the expansion module	- Check the physical communication medium
								- Check the network configurations of the Chillers
35		Watchdog	-		None	-	- Communication failure between the	- Check the physical communication medium

		(For serial Modbus RTU communication)		Physical communication medium			Chiller and the network master	- Check the network configurations of the Chillers

1) It is disabled for 10 minutes after the occurrence of the reset of 3 consecutive failures (time of 2 minutes between failures)

2) Active protection mode: the process temperature sensor is used as reference and the criterion for switching off the refrigeration becomes due to low evaporation and suction temperature

3) Chiller with condensation control: forces control signal to 100% until the sensor is changed. Low pressure failure may occur due to loss of control

4) Only in equipment with water pressure control Forces the control signal top open 50% of the valve until the transmitter is changed. Insufficient water failure may occur due to loss of control

5) See procedure in the preventive maintenance section

6.2. Preventive Maintenance

In order to increase durability and prevent equipment breakdowns and/or shutdowns, you must ensure that the RLAC-S has a preventive maintenance routine.

Below are our maintenance recommendations for all the components that make up the RLAC-S, with the recommended procedure and frequency. Depending on where the equipment is installed, it may be necessary to increase the frequency of maintenance.

Preventive maintenance – general			
Item	**Frequency**	**Procedure**	**Notes**
Painted Structure	Annual	- Check the general condition of the cabinet painting and retouch if necessary	Color specifications: For RLAC-S cabinets: color OLIVE GREEN RAL 6003
Stainless Steel Structure	Monthly	- Clean the structure with water, neutral detergent diluted in water and a soft cloth or nylon sponge;	The structure is supplied in stainless steel. Cleaning is essential to protect the structure against impurities that may cause oxidation points
Insulation of the pipe	Every six months	Check the insulation conditions of the pipes and replace damaged insulations	Damaged insulations or insulations with excess moisture should be replaced.
Vibration	Every six months	Check for the existence of excess vibration in the Equipment	Check for possible cracks on welded points
		Place your hand on the body of the compressor and visually check the pipe; this procedure is necessary to obtain a reference standard in relation to the normal vibration of the equipment	
Fixations of the components	Every six months	Check the fixation of the engines: pump, compressor and fan	Retighten loose bolts
Air filter (side closing screens)	Monthly	Clean the side closing screens	It is recommended to increase the cleaning frequency in environments with high rate of suspended particles
		Check the condition of the closing screen	Replace it if damaged
Water leak	Monthly	Check if the hydraulic pipe/connections have water leakage	Retighten the connections
Electrical Panel Door	Monthly	Open and close the door	The door should be aligned and closed without difficulty

Locks of the Electrical Panel Door	Monthly	Close the door, lock it and then unlock it	There should be no interferences between the lock and the door. The door should be pressed against the rubber seal and not allow gaps

Alignment and closing of the set of Plates	Monthly	Check the alignment of the closing plates of the cabinet	They should be aligned and must not have any fixation bolts
Insulation of the electrical panel	Monthly	Check to see if the seal of the electrical panel door is well attached throughout the internal part of the electrical panel door. There should not be any detached points	Replace if damaged
Process water condition	Monthly	Check the appearance of the process water	It should be translucent and not have any solid particles
			If not, collect a sample and send to analysis
Preventive maintenance – mechanical			
Item	**Frequency**	**Procedure**	**Notes**
Condenser	Monthly	Clean the fins of the condenser with the use of a WAP (be careful not to dent the fins of the condenser)	It is recommended to increase the cleaning frequency in environments with high rate of suspended particles
		Check the room air temperature	The ambient temperature must not exceed 42°C
Pump	Monthly	Check for leaks in the mechanical seal	In case of leaks, the seal should be replaced
		Check the rotation direction of the pump	The engine must be turning according to the direction indicated on the pump
		Observe for abnormal noises in the pump	There may be air bubbles inside the pipe or cavitation
Compressor	Monthly	Check the oil level in compressors with oil display	With the compressor switched off, the oil level should at least be 1/4 and at most 3/4 of the display
Fan	Monthly	Check for the existence of excess vibration in the fan	Retighten the bolts
Refrigeration Pipe	Monthly	After 2 minutes of operation, check to see if the liquid display indicates the dark color and no bubbles	If the display indicates a light color, there is moisture in the system. If it shows bubbles, there is refrigerant leak
		Check for signs of oil leak in the pipe	The refrigerant gas leak should be corrected as quickly as possible
			Complete the refrigerant gas and oil load of the compressor, if necessary
Water filter	Monthly	Remove the filter element, wash and reinstall	It should not be mounted with missing discs
By-pass valve	Monthly	With the equipment operating, close the return valves of the customer's process for a few seconds and then open	The valve should open and allow the passing of water for the return. Then it should close when the process is opened. There should be no excessive liquid blow in the line when the process return is closed
			The equipment should not be deactivated by low water flow
Water reservoir	Quarterly	Check the cleaning of the water tank	It should be clean, without accumulated dirt and solid particles
Pressure Gauge	Monthly	With the Equipment in operation, check the conditions of the pressure gauge	It should not be locked. It should be oscillating according to the conditions of the pump

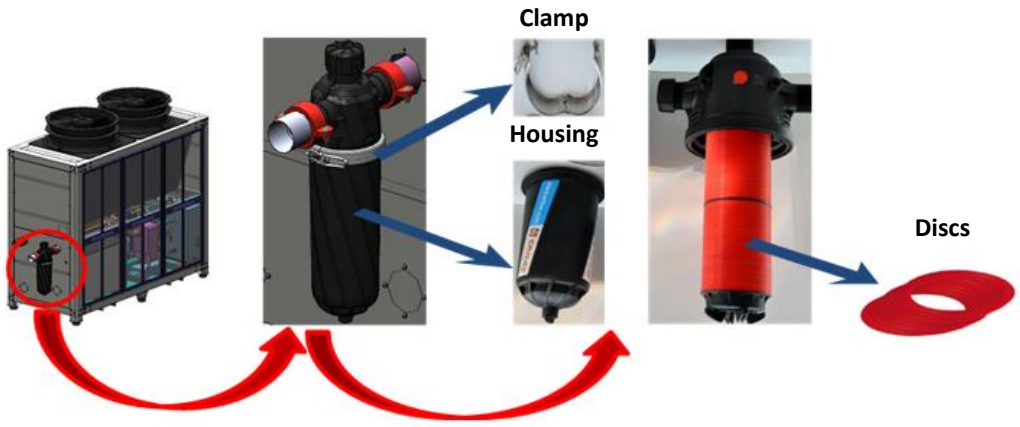
Preventive maintenance – electrical

Item	Frequency	Procedure	Notes
Electrical panel	Every six months	Check for any loose components of the electrical panel	Retighten the terminals or bolts
Clean the electrical panel	Every six months	Clean inside the electrical panel	The electrical panel should be clean, without dust and fillings
Sealing of the through-holes of the Electrical Panel and cables gland	Monthly	Visually check to see if all the through-holes of cables are covered and the cables gland are duly tightened	There should be no holes open or cables not suitably tightened on the cable gland
Engine switch box	Every six months	Check to see if the terminals of the switch box of the engines (pump, compressor and fan) are loosening up	Retighten the terminals or bolts
Temperature sensors	Monthly	Check the calibration of the temperature sensors	Compare the process outlet and return temperatures with a calibrated standard thermometer
Terminal strips	Every six months	Check to see if all the electric cables are connected to their respective terminals	There should be no loose wires or "jumpers" inside the electrical panel
Pump	Monthly	Measure the current of phases R, S and T	Compare with the currents indicated in the electrical data of the equipment
		Check the voltage variation between phases	It should not exceed 10%.
Fan	Monthly	Measure the current of phases R, S and T	Compare with the currents indicated in the electrical data of the equipment
		Check the voltage variation between phases	It should not exceed 10%.
Compressor	Monthly	Measure the current of phases R, S and T	Compare with the currents indicated in the electrical data of the equipment
		Check the voltage variation between phases	It should not exceed 10%.

6.2.1. Cleaning procedure for the water filter and micro-channel condenser.

a) Water Filter

To clean the polyamide housing water filter reinforced with fiberglass and disc filtering element, perform the following steps:

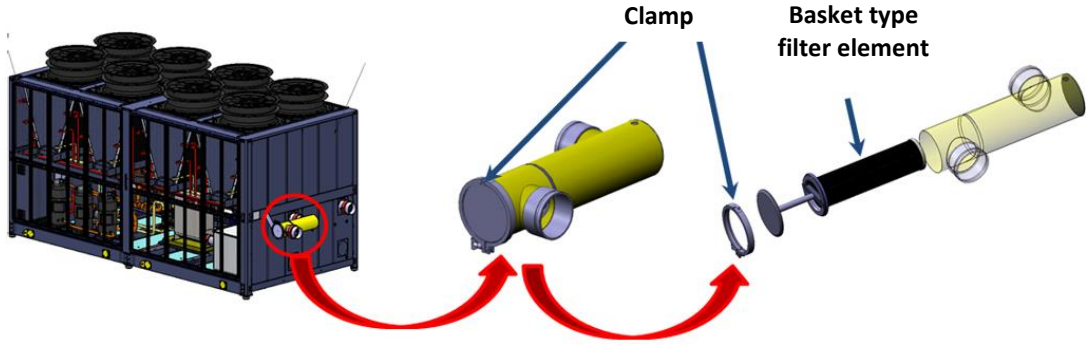


I. Switch off the RLAC-S and close the stop valves;
II. Release the fixation clamp of the casing and remove the filtration element;
III. Slacken the bolt that keeps the discs attached to the body of the element;
IV. Wash the discs with running water preferably with a high pressure washer;
V. Retighten the nut and re-assemble the filtering element in the housing
VI. Assemble the clamp in the filter housing

	INFORMATION	Leave a small gap between the discs when retightening the bolt of the filter element. Excess torque applied the torque will leave the filter element rigid and will compromise the filtration process.

	INFORMATION	The use of the filter without the filter element or with a reduced number of discs compromises the efficiency of the filtration and the equipment and may result in the suspension of the warranty.

To clean the stainless steel housing water filter with basket type filter element, perform the following steps:



I. Switch off the RLAC-S and close the stop valves;
II. Release the fixation clamp of the filter casing and remove the filtration element;
III. Wash the basket with running water preferably with a high pressure washer;
IV. Install the filter element in the filter housing again;
V. Assemble the clamp in the filter housing.

	INFORMATION	Never put the RLAC-S into operation without water filter. This practice will leave the system vulnerable to obstruction or to damages and the equipment may lose the warranty.

b) Microchannel condenser

It is extremely important for the cleaning of the microchannel condenser to be carried out periodically. This process, in addition to extending the useful life of the condenser, prevents equipment breakdowns from occurring due to obstructions caused by dirt, filings or dust.

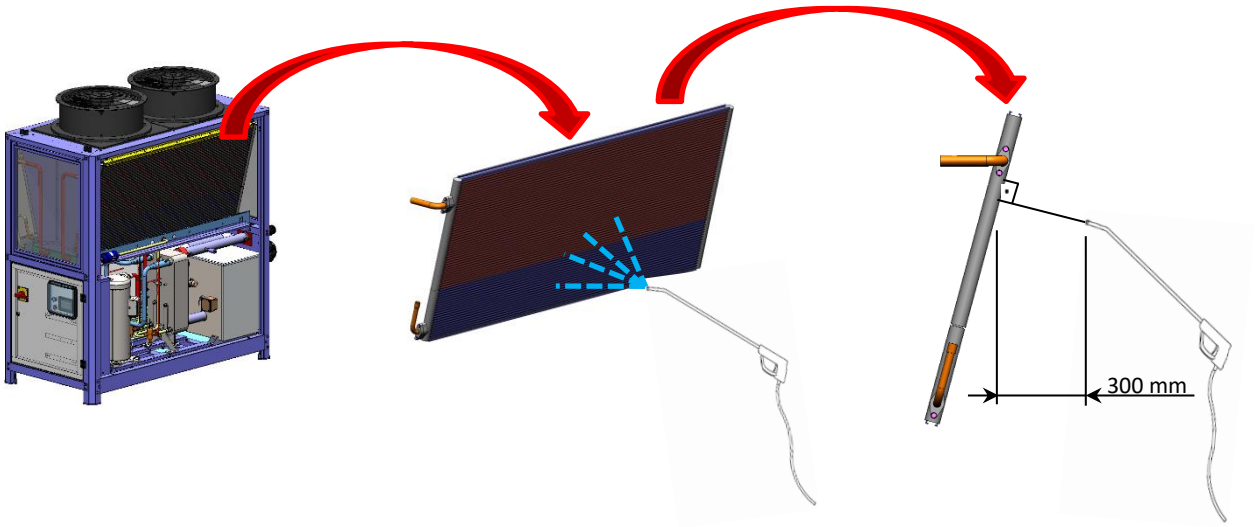
The following precautions should be taken when cleaning the condenser:

I. Use a high pressure washer with spray nozzle to wash the condensers with clean water;

II. The jet of water from the spray nozzle should be in the form of a fan and directed perpendicular to the surface of the condenser to prevent the fins from being dented.

III. The jet of water cannot be applied on a direct point of the surface of the condenser;

IV. Keep a distance of 300mm between the spray nozzle and the surface of the condenser.



	INFORMATION	Do not direct jets of water at the internal components of the RLAC-S cabinet. Only use the high-pressure washer with the fan spray option directly on the condensers.

	**INFORMATION**	Do not use the water jet option to wash the condensers, this practice may dent the fins and increase the air load loss causing reduced performance and eventual deactivation of the equipment.

	**INFORMATION**	Do not use chemical products to clean the condensers. These products can cause corrosion of the surface of the condensers. In this case use ONLY neutral detergent and clean water.

7. Technical Services

In addition to quality Mecalor offers its customers customized service through a specialized team up to date with the technological innovations and prepared to suggest suitable solutions for each issue. Contact the technical support team for further information.

7.1. Start-Up

Despite being a very simple procedure, it is important for the customer to contact Mecalor in order for the installation conditions to be checked and for the start-up to be authorized. Start-up should only be carried out by trained personnel under the guidance of the Mecalor technical support team. It is also possible to contract Mecalor to carry out this service in the field with the technical support team.

7.2. Preventive Maintenance Agreements

In order to prevent faults, premature wear of components and ensure a longer service life for the equipment, Mecalor offers customized preventive maintenance contracts. The contracts consist of periodic visits by Mecalor technicians, who clean the equipment in general, check and retighten all the motor contacts and electrical panel components, as well as checking the operation and performance of the equipment.

This service can be contracted on an individual basis, or through a maintenance plan with a frequency of visits defined according to the needs of the customer. These contracts can also include plans to cover the replacement of components or emergency support in the event of a fault.

7.3. Retrofitting (Machinery Reform)

In many cases an equipment with outdated technology may be technologically updated through the application of modern techniques developed by Mecalor.

Mecalor Retrofitting Service consists of:

- Study of the current conditions of the equipment, evaluating whether retrofitting is worthwhile;
- Study of the adaptability of the equipment to the new technology;
- Execution of the scope;

- Try-out;
- Project Documentation.

7.4. Training

Mecalor conducts specific training to meet the most diverse preparation needs of the maintenance and operation teams. The trainings are provided according to the specific needs of each customer.

8. Disposal and the environment

The RLAC-S should be disposed at the end of its service life so as to reduce any negative impact on the environment. The following are recommended for such:

- Dismount the equipment according to all the safety recommendations applicable in the execution of the maintenance services;
- Reuse components in good condition that can be integrated into other applications or processes, such as electric motors (pumps, fans);
- Separate recyclable materials to be sent to the correct destination (steel components, bronze, plastic parts);
- Separate non-reusable materials and components and dispose of them in compliance with current legislation. Special attention should be given to batteries, lubricant oil and refrigerant.

If oil leaks from the RLAC-S compressor onto any surface, it must be contained immediately. We recommend using wood sawdust over the entire area affected by the leak. Once the oil has been absorbed by the sawdust, remove all the sawdust from the area to clean it up properly. Contaminated sawdust should be placed in a dedicated container and disposed of properly.

When replacing or substituting compressor oil, ensure that surplus oil and/or removed oil is stored in a suitable place and container so that it can be recycled at a later date.

If a refrigerant leak is detected, request the equipment to be serviced as soon as possible by a specialized refrigeration technician.

Observe current regulations when disposing of any component that is part of the RLAC-S.

9. Warranty Term

1. OBJECT AND VALIDITY

1.1. The warranty includes repair and/or replacement of any faulty component, as long as it is due to fabrication defect.

1.2. The validity of the warranty of the equipment manufactured by Mecalor is 365 days counted from the date of issuance of the sales invoice of the product, of which there are 90 consecutive days of legal warranty and 275 consecutive days of complementary warranty, the latter provided by Mecalor as an additional benefit to the customer.

1.3. In case the equipment is purchased with extended warranty, this should be recorded in the official business proposal issued by Mecalor and it exclusively consists of the increase of the complementary warranty, being that the legal warranty will always be 90 consecutive days.

1.4. This warranty term is valid only for products sold and used in Brazil.

2. WARRANTY VALIDATION

2.1. The customer should inform Mecalor technical support in writing immediately after identification of the possible manufacturing defect.

2.2. Once the information of the possible defect is received, the technical support team of Mecalor should evaluate the possible causes and issue a technical opinion.

2.3. In case the manufacturing defect is confirmed, Mecalor must provide the replacement or repair of the defective component within the shortest period of time possible.

2.4. The Warranty period offered by Mecalor covers the costs for repair and replacement of parts with manufacturing defect, including expenses with the transport of technicians and tools, equipment freight or expenses with shipping of parts and components to the billing address of the equipment.

2.5. It is mandatory for the customer to return the defective components to Mecalor to confirm the failure at the supplier (if applicable), under the penalty of bearing the costs involved.

2.6. The warranty establishes the execution of services during business hours, with additional charge for extra hours of services provided outside this period and transport fee for services performed on the installations of third parties.

3. LOSS OF WARRANTY

3.1. The warranty will lose its validity in case it is confirmed through technical evaluation that the defect is as a result of failures during transport, installation, startup, maintenance or improper use by the customer or third parties.

3.2. Start-up of the equipment can only be performed by the customer with the written authorization form the technical support of Mecalor or with the presence of our authorized technicians, when this optional service is part of the Mecalor scope of supply, under the penalty of loss of warranty.

3.3. Incompatibility caused by products purchased from third parties and installed with Mecalor products or application in noncompliance with the information established in our technical and business proposal.

3.4. The warranty will lose its validity if the contracting party fails to comply with purchase and sales agreement, even if the agreement is tacit, including regarding the compliance of the equipment purchased.

4. GENERAL EXCLUSIONS AND LIMITATIONS

4.1. Once Mecalor provides technical support in warranty within the limits established by law and by the good service practices, we shall not be held responsible for direct or indirect costs or loss of revenue eventually supported by the customer as a result of eventual equipment defect.

4.2. The customer will be responsible for the expenses with eventual shipping of the equipment to the factory or to any authorized technical representative of Mecalor to carry out technical support.

4.3. The replacement of components due to use or natural wear of the equipment, such as seals, sensors, engines, contactors, circuit breakers, among others.

4.4. Normal operating adjustments, maintenance and application of the equipment, such as sending of technicians to check the safety alarms, parameterization and technical assistance to optimize the performance of the product.

Customer	Serial number	Warranty period

10. Annexes

The documents that complement this manual are described below and can be different from the standardized documents in case the nomenclature of the RLAC-S model has a special character.

	**INFORMATION**	Always use the complementary documents in case of special characters in the nomenclature of the RLAC-S as described in section 2.1.

- Dimensional
- Wiring diagram
- Flowchart
- List of Components
- Water quality
- Setup
- Electrical Data Table