klimatix

User Manual

Precision Air Conditioner - CP

Rev. 03 | August. 2022

Mecalor Soluções em Engenharia Térmica S.A. | Rua da Banduíra, 219 | 02181-170 | São Paulo | BraZil

Review History			
First Edition	**Date**	**Elaborated by**	**Approval**
New Version	7/6/2021	GOG	AFS
Revision Description	**Date**	**Change**	**Approval**
Inclusion of Troubleshooting and installation information	1/18/2022	GOG	AFS
Inclusion of electrical interconnections, Modbus connection, space recommendations, Troubleshooting change, control panel screens and optional items	3/8/2022	CPJ	GOG
Inclusion of the optional /Y, networking information, external interconnections, minimum thermal load and oil load. Correction of refrigeration installation information and update of the identification plate	31/08/2022	CPJ	GOG

ABOUT THE MANUAL

This manual is intended to provide sufficient information needed for installation, operation and maintenance for the CP line of Precision air conditioners to ensure the best performance and long life of the equipment for the design conditions.

Considering that technological advances will occur, Mecalor reserves the right to change this manual and the design of the equipments without prior warning, according to the same models specified.

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

Mecalor Soluções em Engenharia Térmica S.A.

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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.

1. Table of Contents

1. General Description of the Product

1.1. Equipment Description

Klimatix precision air conditioners are equipment intended for heat removal in confined environments with high thermal dissipation rate, such as Data Centers, UPS rooms and telephone centers. In these environments, the heat is predominantly generated by electric and electronic components and the main function of the equipment is to stabilize the temperature and relative humidity conditions.

Maintenance of the temperature and relative humidity conditions within the defined range is essential to ensure proper operating conditions, as well as reliability of the data and transmission equipment, and to guarantee the life expectancy of the electrical and electronic components.

Precision air conditioners are designed for high performance or high sensible heat ratio (SHR) conditions for applications where the sensible heat dissipation rate is predominant (Higher than 90% sensible heat compared to the total heat load)

With structure manufactured in minimized galvanized steel (Finishing Z180) painted by an electrostatic process and polyester-based powder paint in RAL 9005, heat exchanger with copper tubes and aluminum fins, EC radial fans, and cooling and humidity control systems according to the equipment configuration.

⚠	**ATTENTION**	It is not allowed to tamper with original installed components of the equipment. This practice may put at risk the safety of the operator, the functioning of the equipment and losing the warranty.

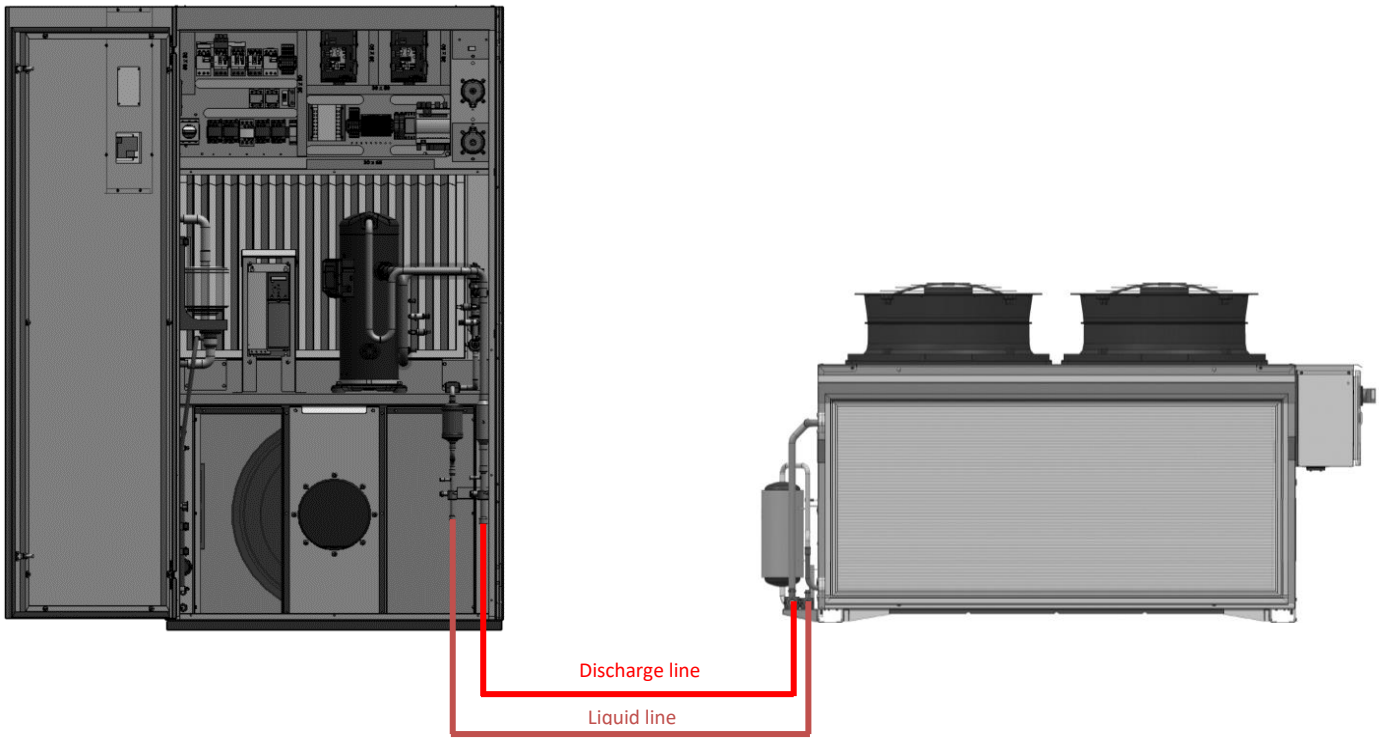
1.2. Direct Expansion Precision Air Conditioner

The precision air conditioner, installed in the room it is to condition, can be a direct or indirect expansion unit (fancoil). When the equipment configuration is direct expansion, the equipment must operate with a remote condenser to dissipate the heat absorbed in the cooling system to the environment.

The CPA is usually installed indoors and in a confined environment, where the racks with the electrical and electronic components of the UPS, telecommunication or data center rooms are located, while the CR must be installed outdoors and in a well-ventilated environment. For this reason the CPA and its respective CR (Remote Condenser) are interconnected by two refrigerant piping lines called:

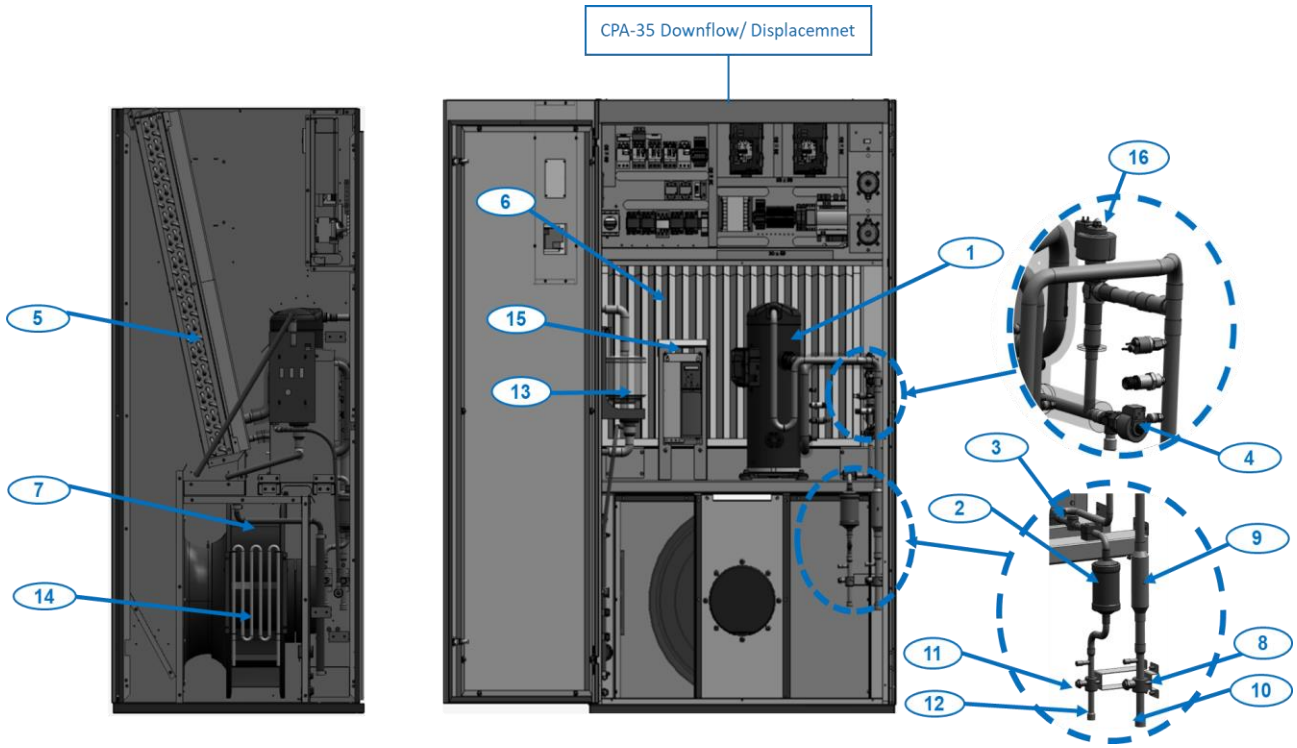
- Discharge line: conducts refrigerant in overheated vapor state at high pressure and temperature, originating from the vapor compression process carried out by the compressor.
- Liquid line: conducts refrigerant in liquid state at high pressure, originating from the condensation process.

The figure below shows the connection points and identifies the cooling lines in an illustrative way to help with the interconnection of the system. Proper cooling interconnection requires the adoption of the good practices and requirements described in this manual.



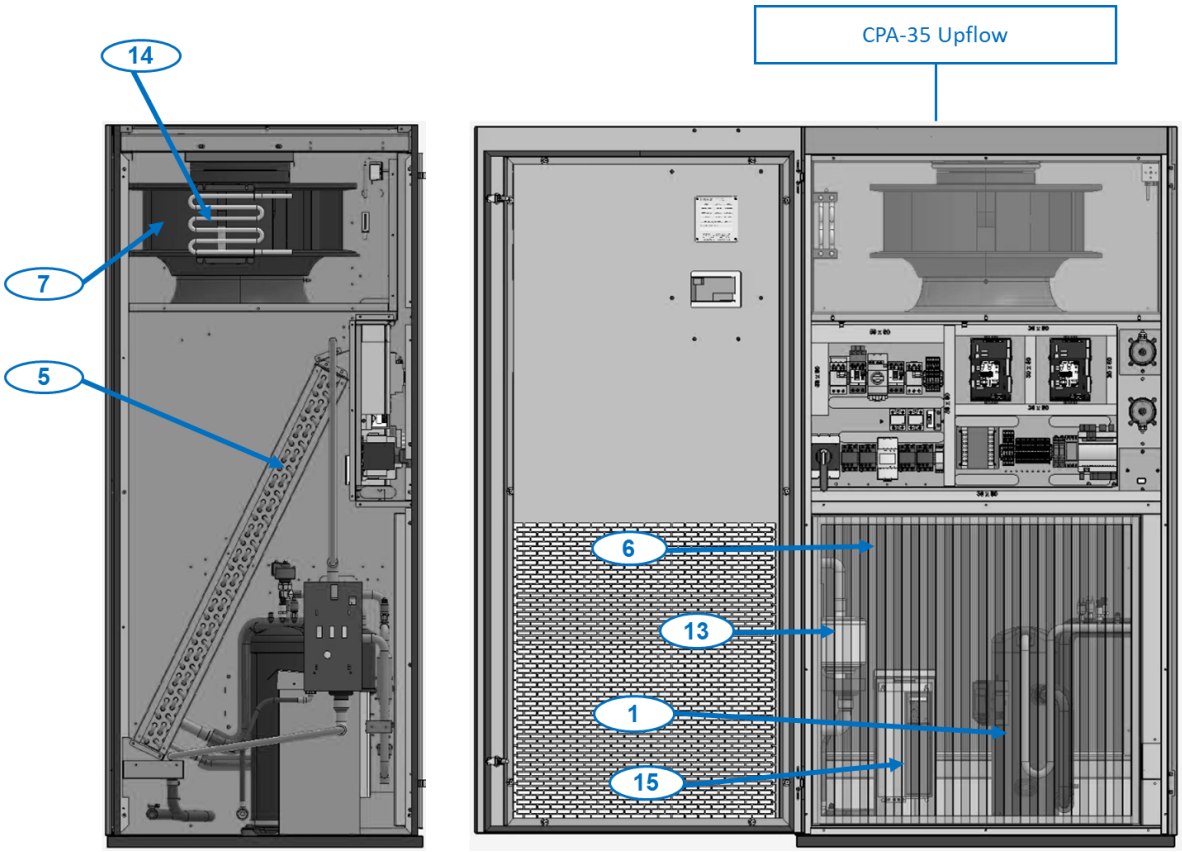
The following are the main components of the equipment in their main configurations:

Equipment with "Downflow" or "Displacement"



Item	Description
1	Hermetic Scroll Compressor
2	Filter Drier
3	Liquid display
4	Check valve
5	Evaporator - Copper tubes and aluminum fins
6	Air Filter G4 (Optionally M5)
7	EC Radial Fan
8	Shut-off valve: Discharge line
9	Check valve: Discharge line
10	Discharge line connection
11	Shut-off valve: Liquid line
12	Liquid line connection
13	Vapor generator
14	Reheating resistor
15	Frequency inverter (Variable capacity control)

Equipment with "Upflow" highlighting only significant position changes in the main components.



1.2.1. Operating Principle

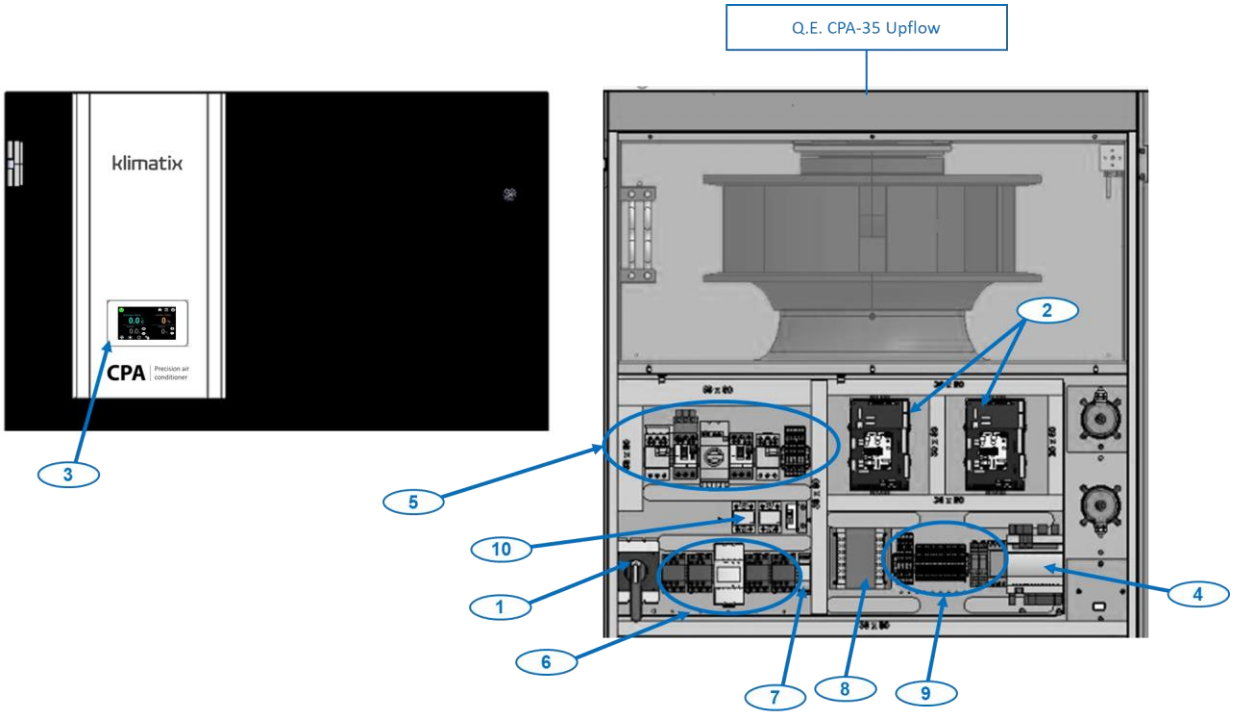
The CPA cooling system consists of a hermetic scroll compressor (1) which is responsible for displacing the refrigerant fluid in the system, directing the flow in the form of hot gas to the condenser for dissipation to the external environment. After passing through the remote condenser the refrigerant fluid reaches the sub cooled liquid state and its flow is conducted again to the evaporator unit (CPA). The refrigerant fluid in the sub cooled liquid condition passes through a filter drier (2), which is responsible for eliminating impurities and moisture present in the system, and a liquid display (3) responsible for visually indicating the situation of the fluid inside the pipe. When passing through the expansion valve (4) the refrigerant suffers a pressure drop, entering in the form of saturated liquid in the evaporator (5). Inside the evaporator the refrigerant fluid receives heat from the process fluid through the forced passage of air through the evaporator, after a G4 air filter (6), by an EC radial fan (7), and therefore, as it absorbs this energy, it undergoes a state transition from saturated liquid to superheated steam, a condition in which it can enter the compressor and restart the cooling cycle.

The equipment also has block valves (8) and check valves (9) in the discharge piping (10) and a block valve (11) installed in the liquid piping (12).

Optionally the CPA can be supplied with Steam generator (13) and Reheating resistor (14), both acting in the humidity control, the former humidifying the air while the resistor ensures the reheating of the air generating

enough thermal load to keep the refrigeration system operating, which with low evaporation temperatures ensures the occurrence of condensation in the evaporator, dehumidifying the air contained in the system. In addition, the system can also be supplied with optional variable capacity control using a frequency inverter (15) and with a hot gas bypass system with an electronic expansion valve (16).

1.2.2. Electrical Components



Item	Description
1	Main disconnector
2	PLC - Programmable Logic Controller
3	HMI - Human Machine Interface
4	Steam Generator Controller (Optional)
5	Circuit Breakers
6	Contactors
7	Sequence/phase loss relay
8	Control voltage transformer
9	Terminal Strip
10	Solid-state relays of the resistor (Optional)

The CPA electric panel has components for switching, control and interconnection installed inside it. The electric supply to the components of the unit can be cut off by activating the disconnecting switch (1), enabling safe intervention during the equipment maintenance process. The system is controlled by a PLC (2) that through signals received from the instruments installed in the equipment performs the activation or shutdown

of the system. The adjustment of the working conditions as well as the monitoring of the parameters is done through a 4.3" color touchscreen HMI.

Each electrical component operating in the equipment has its own circuit breaker (5) as well as individual contactors (6) for activating the component via PLC. The equipment also has a phase loss protection relay (7) to avoid surges in the system.

For the instruments and the control system, the transformer (8) converts the supply voltage to the control voltage (24 VAC) for the controllers and instruments installed in the equipment. The control connections are made through the terminal strip (9), directing all necessary connections between instruments and controller, allowing the PLC control logic of the system to operate.

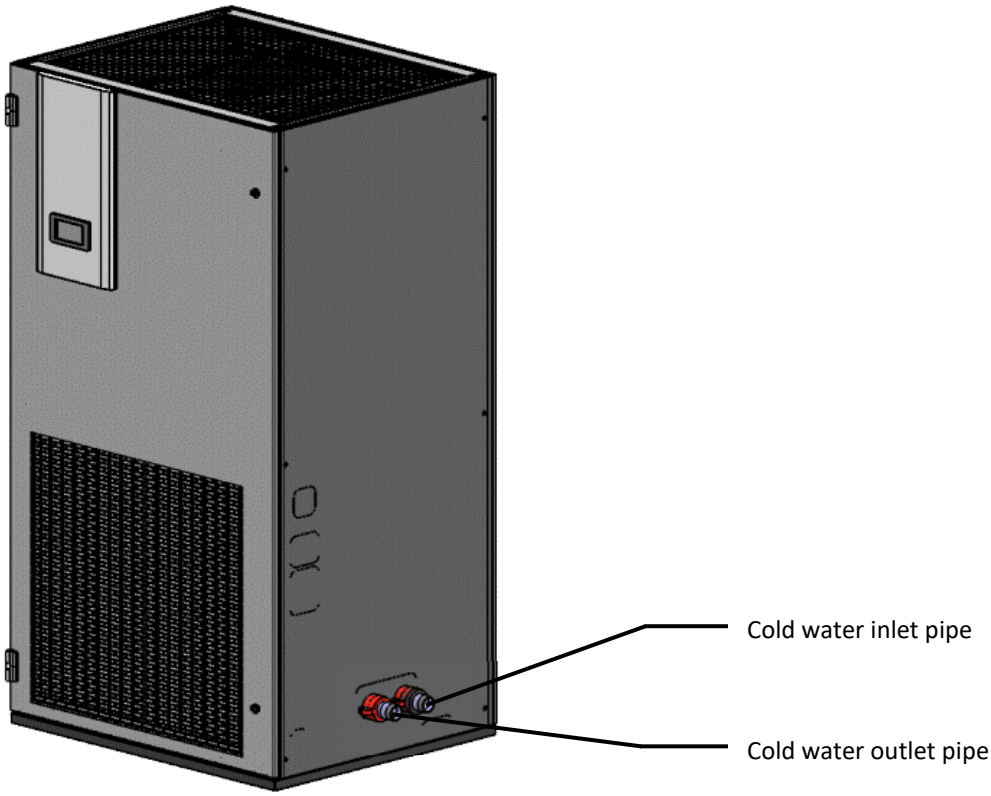
When the equipment configuration includes the steam generator, it is necessary to install its respective controller (4) to drive and control the generator, based on signals received from the PLC for humidity control of the system. Optionally the system can have reheating resistors installed, which are activated by solid state relay (10).

1.3. Indirect Expansion Precision Air Conditioner

In the configuration of the equipment as indirect expansion the equipment should operate being cooled by an external cold water system (Chiller or cold water central) to dissipate the heat absorbed in the cooling system to the environment.

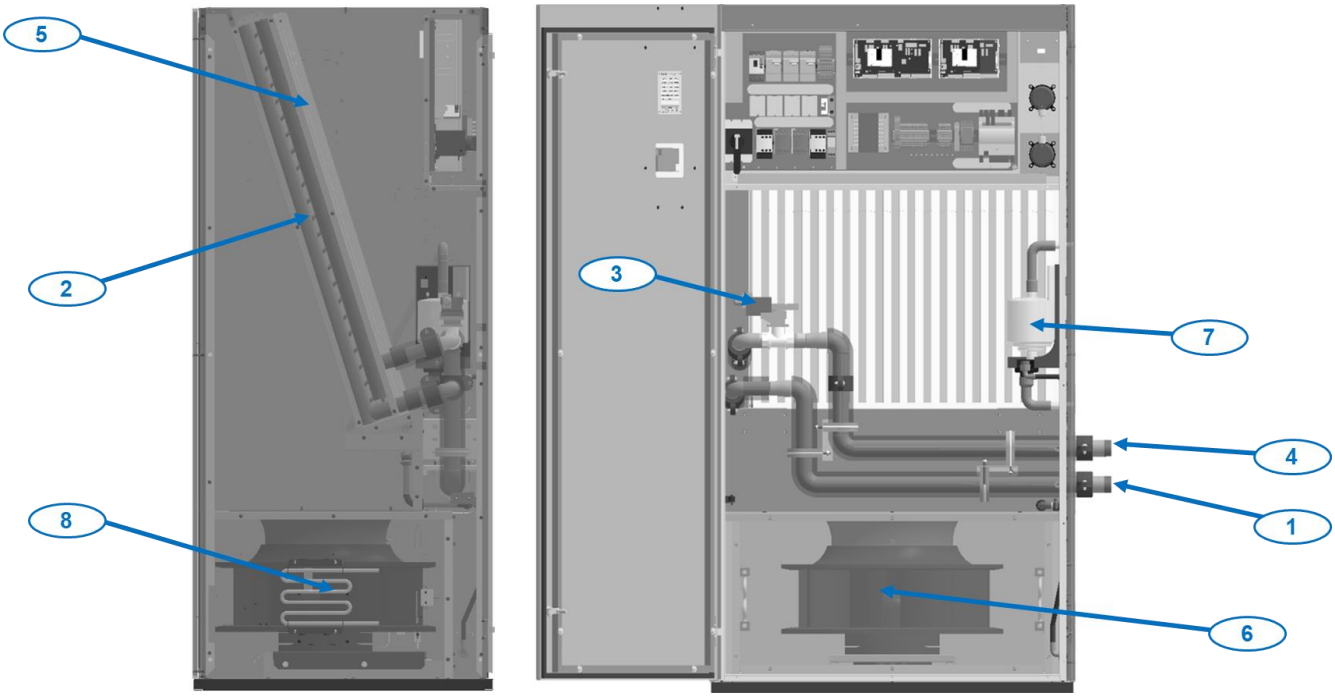
The CPC is usually installed indoors and in a confined environment, where the racks with the electrical and electronic components of the UPS, telecommunication or data center rooms are located, while the CR must be installed outdoors and in a well-ventilated environment. For this reason the CPC is interconnected to the cold water system through two cold water pipelines, one inlet and one outlet.

The figure below shows the piping connection points and identifies the cooling lines in an illustrative way to help with the interconnection of the system.



The following are the main components of the equipment in their main configurations:

Equipment with "Downflow" or "Displacement"



Item	Description
1	Chilled water inlet connection
2	Heat Exchanger - Copper tubes and aluminum fins
3	2-way proportional valve
4	Chilled water outlet connection
5	Air Filter G4 (Optionally M5)
6	EC Radial Fan
7	Vapor generator
8	Reheating resistor

Equipment with "Upflow" highlighting only significant position changes in the main components.

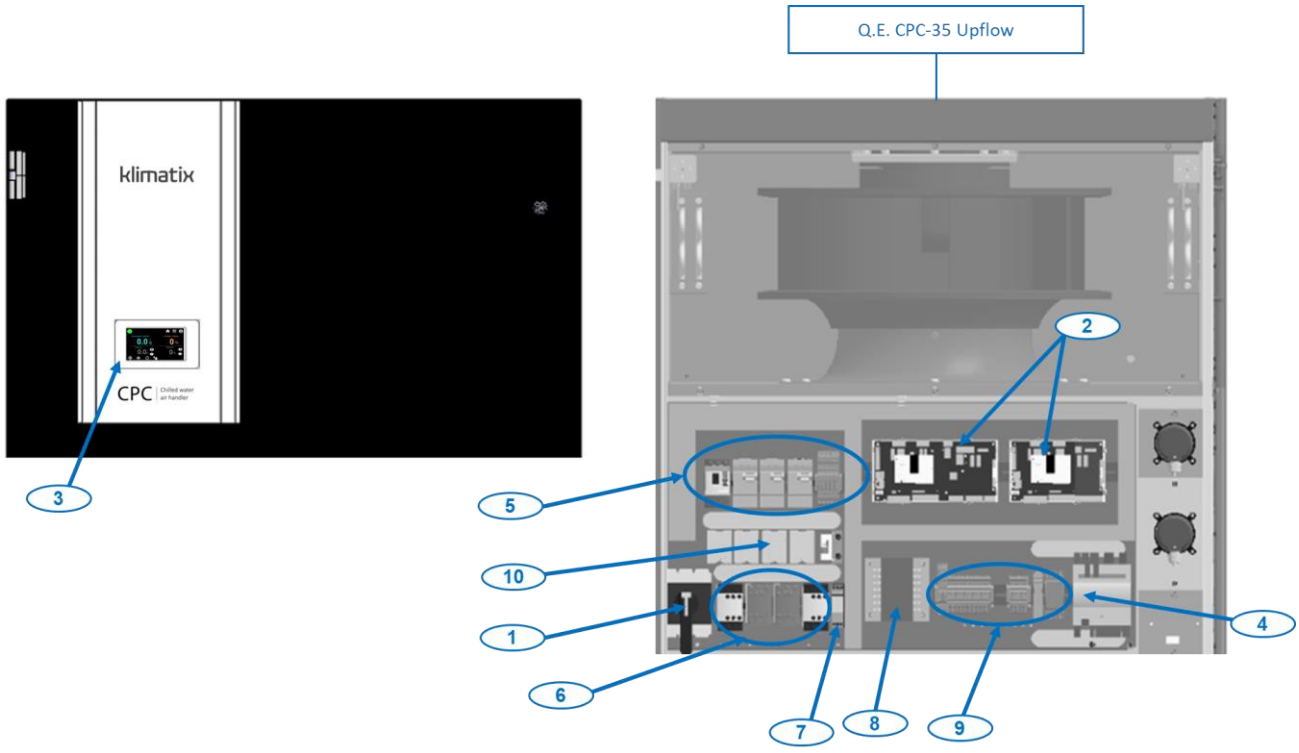
1.3.1. Operating Principle

In the CPC the cooling and dehumidification of the air are performed by circulating cold water from a cold water system (chiller or cold water central). The cold water enters the CPC through the cold water inlet connection (1) and circulates through a finned heat exchanger (2) manufactured with copper tubes and aluminum fins, with flow controlled by a 2-way proportional valve (3) installed at the exchanger outlet, the water absorbs the heat from the system and is sent back to the cold water system, leaving the equipment through the cold water outlet connection (4) of the CPC. The degree of opening of the valve is defined by the air temperature adjustment (Setpoint) performed in the human-machine interface (HMI) of the equipment.

The air is cooled by means of the forced air passage through the heat exchanger, after a G4 air filter (5), by an EC radial fan (6), later sent back to the served room for recirculation and absorption of the heat dissipated in the environment by the installed electronic components.

Optionally the CPC can be supplied with Steam generator (7) and Reheating resistor (8), both acting in the humidity control, the former humidifying the air while the resistor ensures the reheating of the air generating enough thermal load to maintain cold water flow in the exchanger, which with low evaporation temperatures ensures the occurrence of condensation in the heat exchanger, dehumidifying the air contained in the system.

1.3.2. Electrical Components



Item	Description
1	Main disconnector
2	PLC - Programmable Logic Controller
3	HMI - Human Machine Interface
4	Steam Generator Controller (Optional)
5	Circuit Breakers
6	Contactors
7	Sequence/phase loss relay
8	Control voltage transformer
9	Terminal Strip
10	Solid-state relays of the resistor (Optional)

The CPC electric panel has components for switching, control and interconnection installed inside it. The electric supply to the components of the unit can be cut off by activating the disconnecting switch (1), enabling safe intervention during the equipment maintenance process. The system is controlled by a PLC (2) that uses signals received from the instruments installed in the equipment. The adjustment of the working conditions as well as the monitoring of the parameters is done through a 4.3" color touchscreen HMI.

Each electrical component operating in the equipment has its own circuit breaker (5) as well as individual contactors (6) for activating the component via PLC. The equipment also has a phase loss protection relay (7) to avoid surges in the system.

For the instruments and the control system, the transformer (8) converts the supply voltage to the control voltage (24 VAC) for the controllers and instruments installed in the equipment. The control connections are made through the terminal strip (9), directing all necessary connections between instruments and controller, allowing the PLC control logic of the system to operate.

When the equipment configuration includes the steam generator, it is necessary to install its respective controller (4) to drive and control the generator, based on signals received from the PLC for humidity control of the system. Optionally the system can have reheating resistors installed, which are activated by solid state relay (10).

1.4. Application Scope

The CP line was designed for precision air conditioning of environments such as data centers, UPS and telecommunication rooms, where there is a high dissipation rate of heat, predominantly sensible heat, from electrical and electronic components. In these environments the equipment must ensure that the operating condition is maintained within the temperature and humidity ranges defined in these systems to maintain reliability and extend the useful life of these components.

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

1.5. Optional Items Installed at the Factory and on the Field

Item	CPA	CPC	Installed in Factory	Installed on Field
Hot gas by-pass	✓	⊘	✓	⊘
Air filter M5	✓	✓	✓	✓
Dual electric power supply	✓	✓	✓	⊘
SNMP Communication	✓	✓	✓	✓
Flooded floor sensor	✓	✓	⊘	✓
Metal base for raised floor	✓	✓	⊘	✓
Damper	✓	✓	⊘	✓
Plenum discharge tank	✓	✓	⊘	✓
Fan base	✓	✓	⊘	✓
Bacnet Communication	✓	✓	✓	✓

2. Technical Features

2.1. Nomenclature

CP A - D - 35 - URF - 380 * /C

- **CP** — Precision Air Conditioner
- **A** — A: Direct Expansion; C: Indirect Expansion (Fancoil)
- **D** — D: Downflow; F: Displacement; U: Upflow
- **35** — Nominal Capacity: 18,26,35,50,70 or 100 kW
- **URF** — 1st Digit: 0: no humidifier; U: humidifier (vapor generator)
  - 2nd Digit: 0: no reheating; R: reheating (electrical resistance)
  - 3rd Digit: F: Fixed Compressor; V: Compressor + Frequency inverter; I: Inverter compressor
- **380** — Standard Voltage of the CPA/CPC
  - 3 F, 220 V, 60 Hz
  - 3 F, 380 V, 60 Hz
  - 3 F, 440 V, 60 Hz
- ***** — *: Special operating frequency: 50Hz
- **/C** — Special character:
  - /C: Special build
  - /E: Out-of-standard refrigerant fluid
  - /G: Hot gas by-pass
  - /M: Air filter M5
  - /D: Dual electric power supply
  - /S: SNMP Communication
  - /I: Flooded floor sensor
  - /P: Metal base for raised floor
  - /R: Damper
  - /O: Plenum discharge tank
  - /F: Fan base
  - /N: Bacnet Communication
  - /Y: Convergent three-way proportional valve

	**INFORMATION**	Check the special documentation described in the annex of this manual for the equipment that has special character (/C). Some data in this manual such as electrical data may not apply to the equipment that has special character.

2.2. CP **Technical Data**

	Description	Unit	Model					
	Evaporator unit		**CPA - 18**	**CPA - 26**	**CPA - 35**	**CPA - 50**	**CPA - 70**	**CPA - 100**
Operating conditions	Total capacity (1)	kW	18.0	26.1	37.3	50.0	75.4	110.0
	Sensible capacity	kW	16.8	25.0	33.7	49.0	67.8	96.6
	Useful capacity	kW	15.8	23.5	32.0	46.1	64.4	91.9
	Efficiency EER (CPA)	-	3.3	3.4	3.5	3.4	3.5	3.5
	Efficiency EER (CPA + CR)	-	2.7	2.8	2.9	2.8	2.9	2.9
	Sensible heat factor	-	0.93	0.96	0.90	0.98	0.90	0.88
	Direction of air insufflation	-	Downflow / Upflow / Displacement					
	Nominal flow rate	m³/h	4750	7000	9000	14000	18000	25000
	Maximum static pressure available	Pa	200	250	250	250	250	250
	Radial Fan	mm	350	450	560	2 x 450	2 x 560	3 x 560
	Specific fan power (SFP) (2)	W/(m³/s)	781	751	682	751	682	680
	Cooling circuits	-	1	1	1	1	2	2
	Filtering class	-	G4					
	Downflow sound pressure (3)	dBA	65	65	61	68	64	65
	Upflow sound pressure (3)	dBA	67	67	63	70	66	67
Dimensional	Width	mm	910	910	1060	1585	2115	2740
	Depth	mm	620	885	885	885	885	885
	Height	mm	2000	2000	2000	2000	2000	2000
	Occupied area	m²	0.56	0.81	0.94	1.40	1.87	2.42
	Weight	kg	415	450	495	580	830	960
	Maintenance	-	Front					
	Maintenance access	mm	900					
	Inlet connection diameter	in	1/2	5/8	5/8	5/8	2 x 5/8	2 x 5/8
	Outlet connection diameter	in	5/8	3/4	7/8	7/8	2 x 7/8	2 x 7/8
	Corresponding Remote Condenser		**CR-25**	**CR-35**	**CR-60**	**CR-100**	**2 x CR-60**	**2 x CR-100**
Operating conditions	Direction of air insufflation	-	Vertical / Horizontal		Vertical			
	Nominal flow rate	m³/h	7000	10000	16000	20000	32000	40000
	Maximum static pressure available	Pa	10	10	10	10	10	10
	Specific fan power (SFP) (2)	W/(m³/s)	484	513	468	513	468	513
	Sound pressure (3)	dBA	62	67	66	67	69	70
Dimensional	Width	mm	1450	1750	1920	2450	2 x 1920	2 x 2450
	Depth	mm	910	820	850	915	2 x 850	2 x 915
	Height	mm	1190	1160	1060	1025	2 x 1060	2 x 1025
	Weight	kg	55	65	80	115	2 x 80	2 x 115
	Maintenance	-	Front / Rear / Side					
	Maintenance access	mm	600					
	Inlet connection diameter	in	5/8"	3/4"	7/8"	7/8"	2 x 7/8"	2 x 7/8"
	Outlet connection diameter	in	1/2"	5/8"	5/8"	3/4"	2 x 5/8"	2 x 3/4"
Refrigerated plant installatio	Maximum equivalent length (5)	m	30					
	Max. level difference (evaporator below condenser) (5)	m	17					
	Max. level difference (evaporator above condenser) (5)	m	5					
Power rating	Nominal power (1) (4)	kW	6.6	9.3	13.0	17.6	25.8	37.7
	Maximum power (4)	kW	9.7	13.3	19.7	24.5	39.7	58.3
	Reheating resistor	kW	4.5	6.0	9.0	12.0	18.0	27.0
	Humidifier	kW	2.25	2.25	2.25	2.25	6.00	11.25

(1) Return temperature 24°C, relative humidity 45% and atmospheric pressure 101.3 kPa; Condensation temperature 45°C

(2) Considering total power of the fans for maximum pressure loss of 250 Pa in the installation

(2) Sound pressure at 2 meters from the source

(4) Power in operation considering evaporator unit and remote condenser

(5) Other measurements consult manufacturer

2.3. CPC Technical Data

	Description	Unit	Model					
	Evaporator unit		**CPC - 18**	**CPC - 26**	**CPC - 35**	**CPC - 50**	**CPC - 70**	**CPC - 100**
Operating conditions	Total capacity (1)	kW	17.4	25.8	33.0	50.9	70.8	98.9
	Sensible capacity	kW	16.6	24.6	31.4	48.8	66.8	92.4
	Useful capacity	kW	15.5	23.1	29.6	45.4	63.0	87.0
	Efficiency EER	-	15.4	17.1	18.2	15.1	19.4	18.4
	Sensible heat factor	-	0.95	0.95	0.95	0.96	0.94	0.93
	Direction of air insufflation	-	Downflow / Upflow					
	Nominal flow rate	m³/h	5000	7000	9500	15000	20000	27500
	Maximum static pressure available	Pa	200	250	250	250	250	250
	Specific fan power (SFP) (2)	W/(m³/s)	811	777	686	808	692	704
	Filtering class	-	G4					
	Downflow sound pressure (3)	dBA	66	66	62	69	65	66
	Upflow sound pressure (3)	dBA	68	68	64	71	67	68
Dimensional	Width	mm	910	910	1060	1585	2115	2740
	Depth	mm	620	885	885	885	885	885
	Height	mm	2000	2000	2000	2000	2000	2000
	Occupied area	m²	0.56	0.81	0.94	1.40	1.87	2.42
	Weight	kg	390	415	465	560	750	925
	Maintenance	-	Front					
	Maintenance access	mm	900					
	Inlet connection diameter	in	1 1/4	1 1/2	1 1/2	1 1/2	2	2 1/2
	Outlet connection diameter	in	1 1/4	1 1/2	1 1/2	1 1/2	2	2 1/2
Power rating	Nominal power (1) (4)	kW	1.2	1.6	1.9	3.5	4.0	5.5
	Maximum power (4)	kW	2.6	2.1	3.5	4.1	6.9	10.3
	Reheating resistor	kW	4.5	6.0	9.0	12.0	18.0	27.0
	Humidifier	kW	2.25	2.25	2.25	2.25	6.00	11.25

(1) Return temperature 24°C, relative humidity 45% and atmospheric pressure 101.3 kPa; Condensation temperature 45°C
(2) Considering total power of the fans for maximum pressure loss of 250 Pa in the installation
(2) Sound pressure at 2 meters from the source
(4) Operating power

2.4. **Minimum thermal load**

To guarantee a stable operation and within the operation limits presented in item 2.4, it is important that the equipment meets the minimum ideal capacity condition for operation. Therefore, we recommend that the thermal load of the room to be acclimatized meet the minimum conditions indicated below:

2.4.1.CPA Line

Model	Compressor	Minimum thermal load
CPA-18	Fixed compressor	15,8 kW
	Fixed compressor + frequency inverter	9 kW
	Inverter compressor	5,4 kW
CPA-26	Fixed compressor	23,5 kW
	Fixed compressor + frequency inverter	13 kW

	Inverter compressor	7,8 kW
CPA-35	Fixed compressor	32 kW
	Fixed compressor + frequency inverter	18,7 kW
	Inverter compressor	11,2 kW
CPA-50	Fixed compressor	46,1 kW
	Fixed compressor + frequency inverter	25 kW
	Inverter compressor	15 kW
CPA-70	Fixed compressor	64,4 kW
	Fixed compressor + frequency inverter	37,7 kW
	Inverter compressor	22,6 kW
CPA-100	Fixed compressor	91,9 kW
	Fixed compressor + frequency inverter	55 kW
	Inverter compressor	33 kW

2.4.2.CPC Line

Model	Minimum thermal load
CPC-18	1,55 kW
CPC-26	2,31 kW
CPC-35	2,96 kW
CPC-50	4,54 kW
CPC-70	6,3 kW
CPC-100	8,7 kW

2.5. Operating **limits**

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

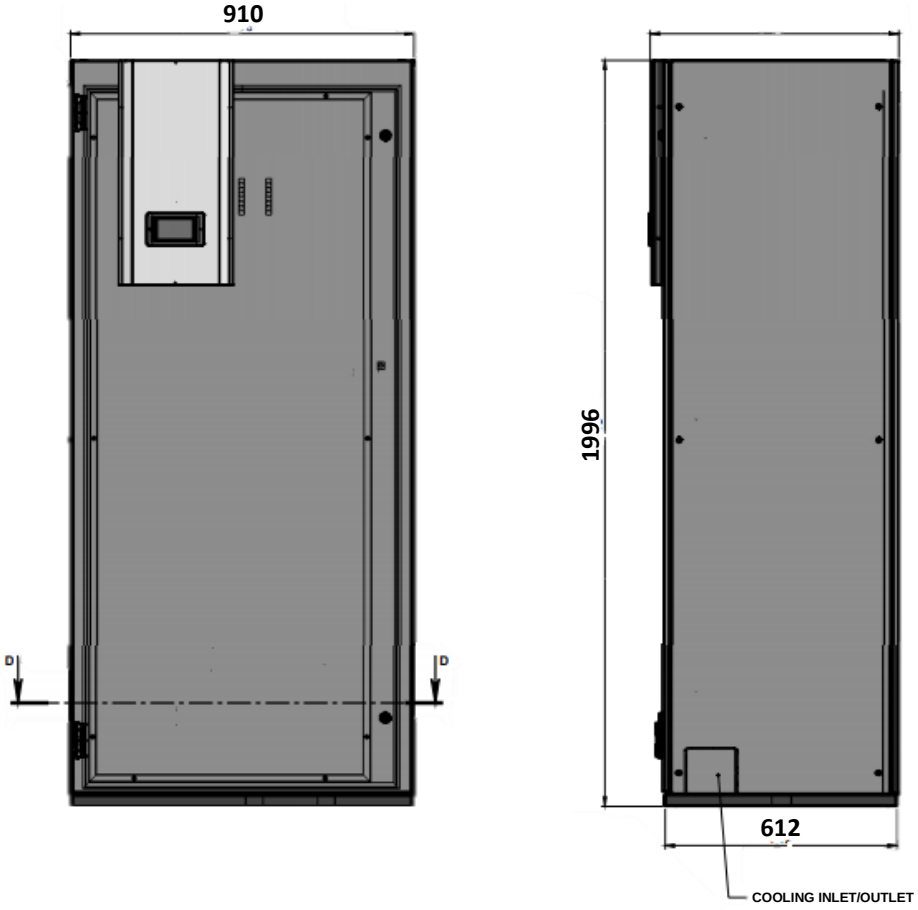
- Maximum outdoor temperature of up to 45°C;
- Minimum outdoor temperature of -10°C.
- Operation with return temperature between 18°C and 35°C;
- Operation with relative humidity in the return between 40 and 60% RH;

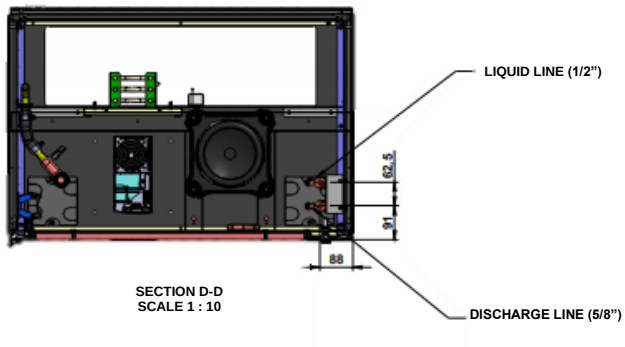
2.6. Identification plate attached to the Precision Air Conditioner

- A — Abbreviation of the model
- B — Voltage (V), phases and frequency (Hz)
- C — Cooling heat capacity (kW)
- D — Type of condensation: air or water
- E — Observations and complementary data of the equipment
- F — Special characteristics
- G — Month and year of manufacture
- H — Maximum electrical demand at full load (kVA)
- I — Cooling fluid
- J — Maximum room temperature
- K — Weight (kg)
- L — Tracking number
- M — Maximum current consumed (A)
- N — Working temperature of the process fluid
- O — Air flow of the condensers
- P — Heating capacity, when applicable

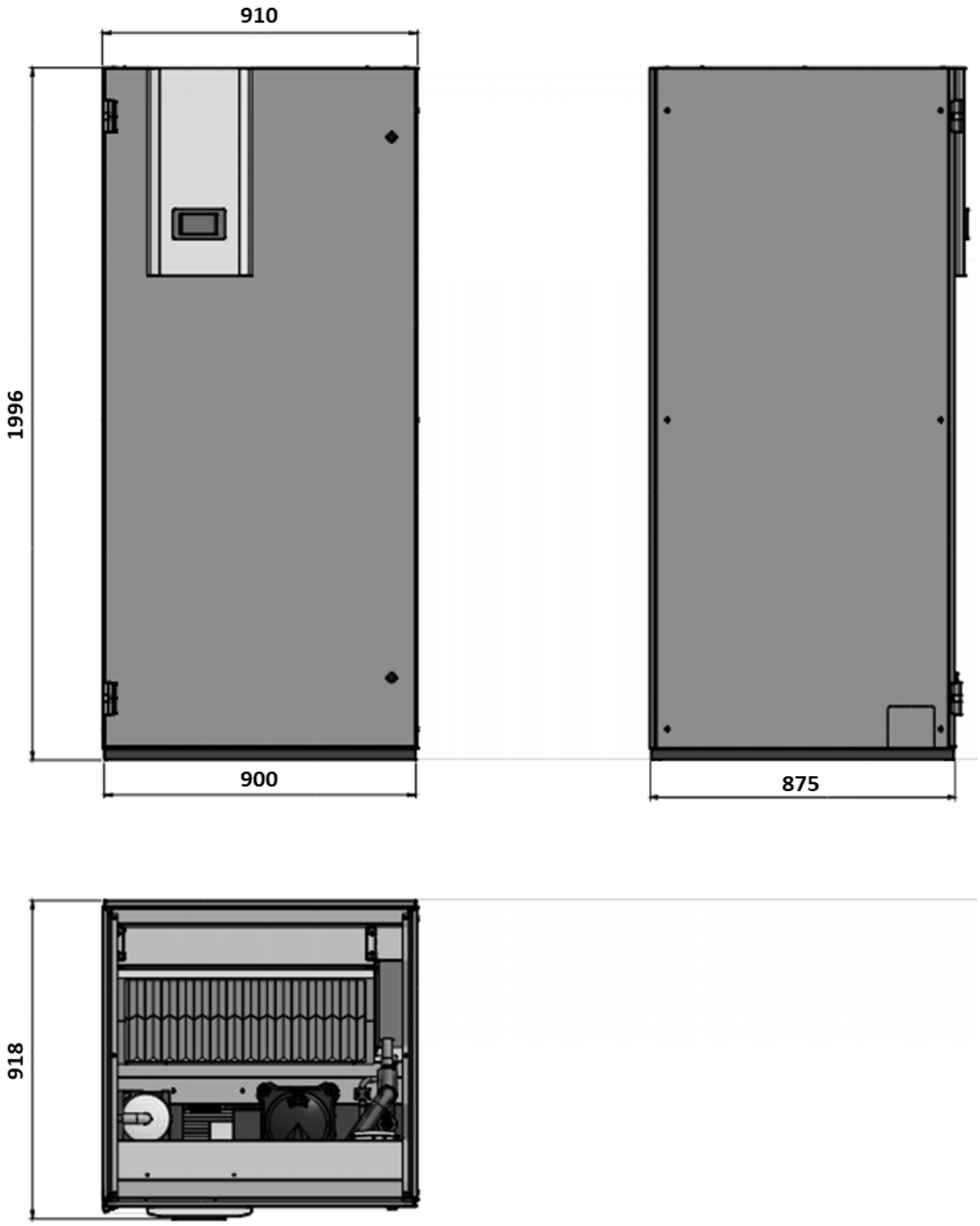
2.7. CPA External Dimensions

2.7.1.CPA-18 (All configurations)

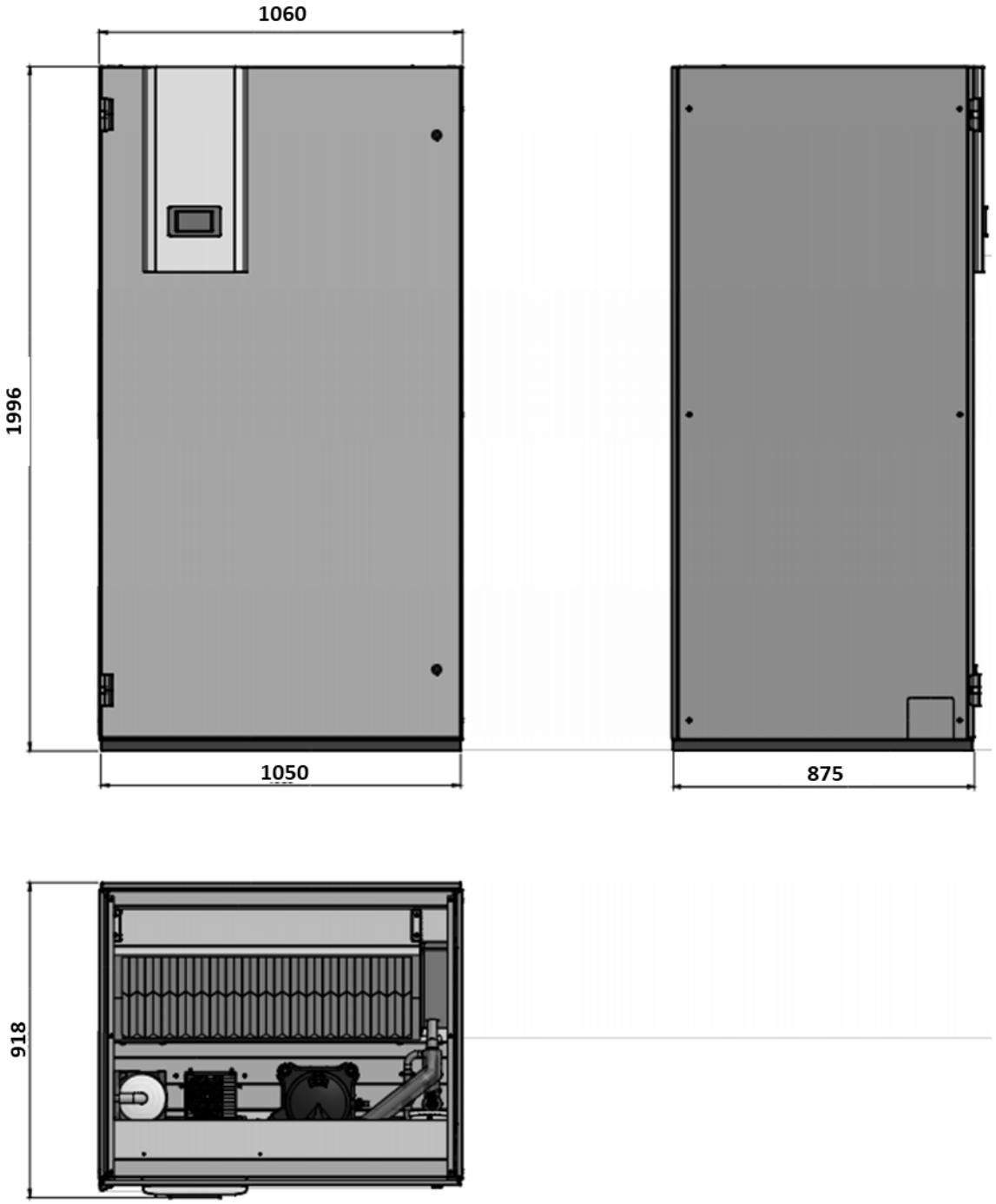




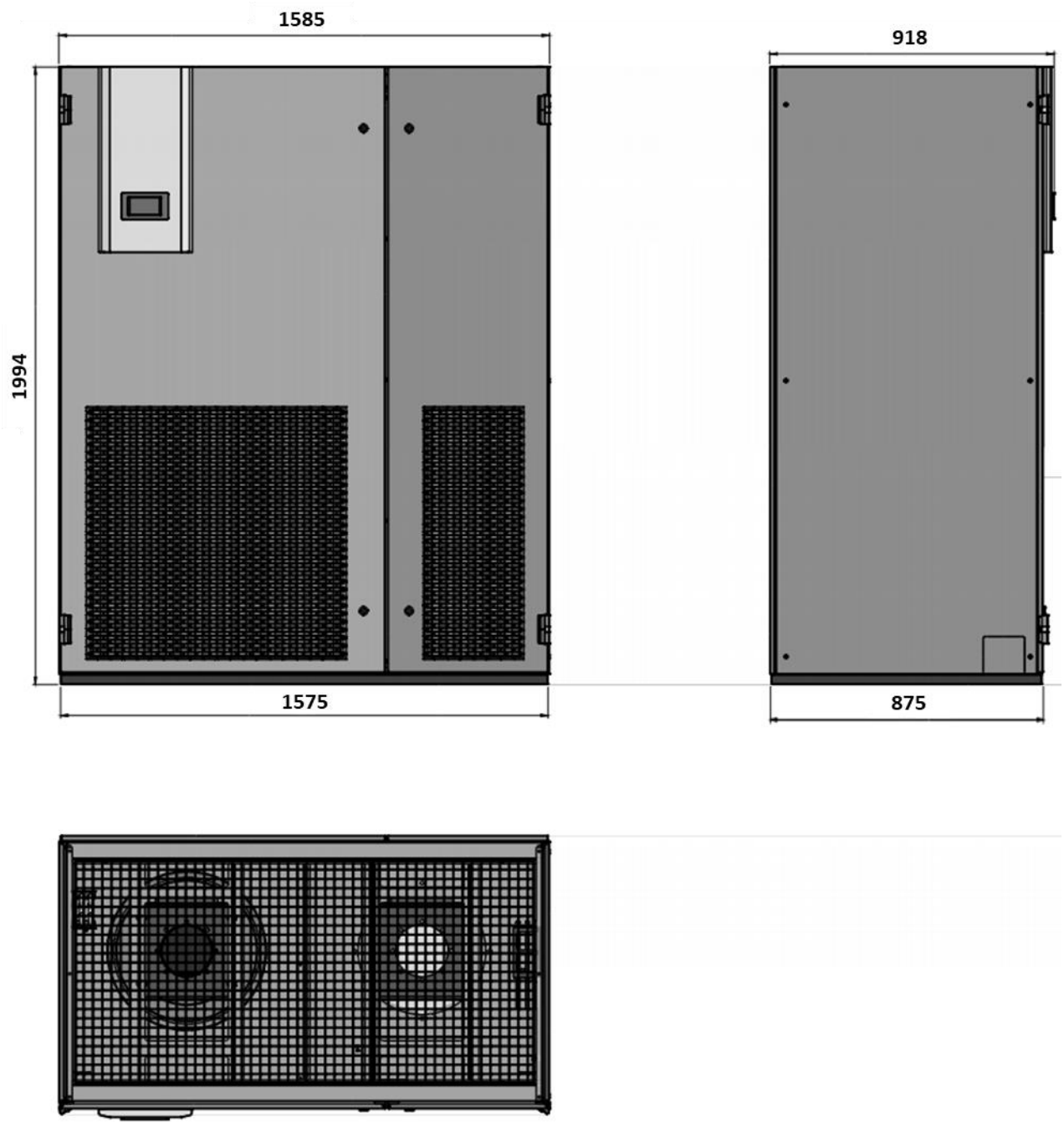
2.7.2.CPA-26 (All configurations)



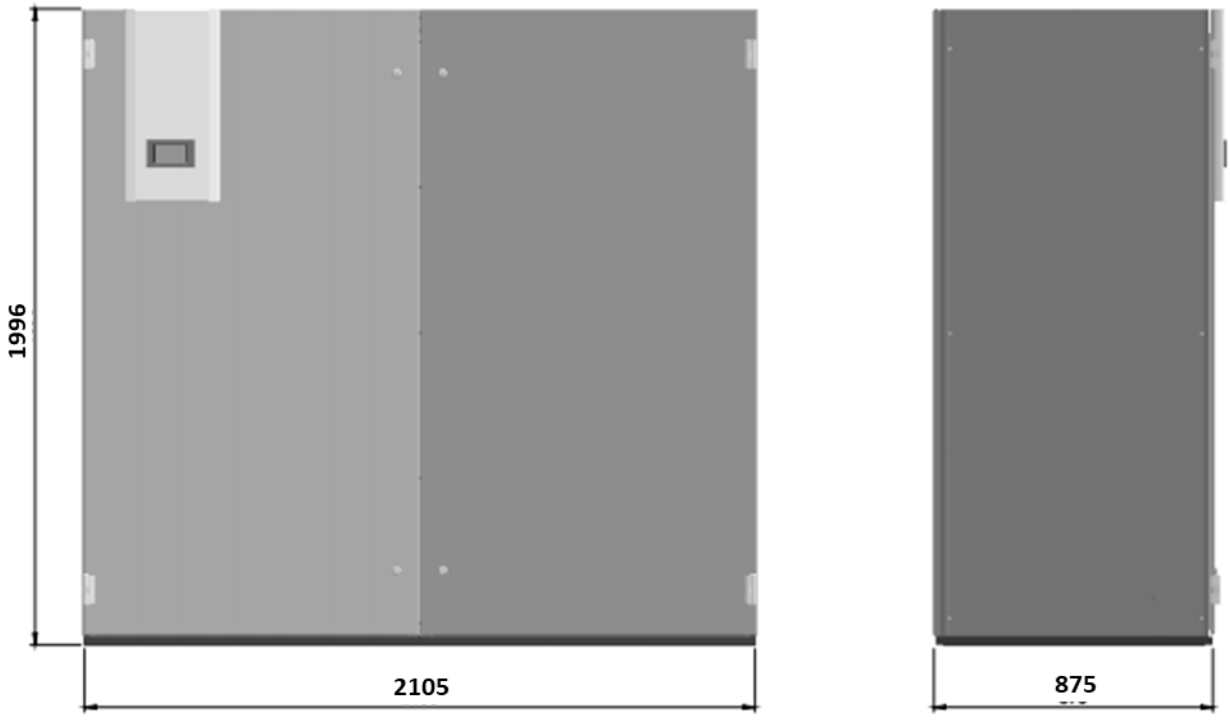
2.7.3.CPA-35 (All configurations)

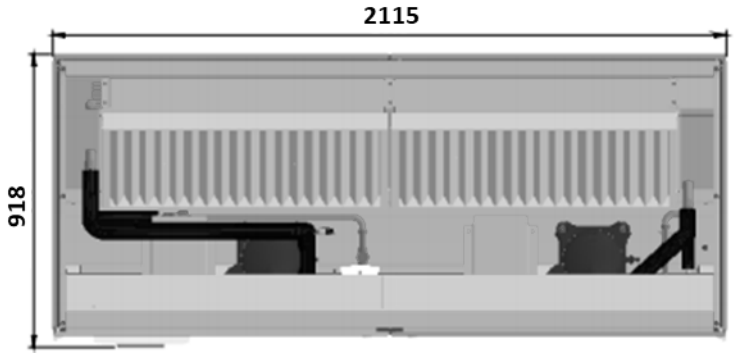


2.7.4.CPA-50 (All configurations)

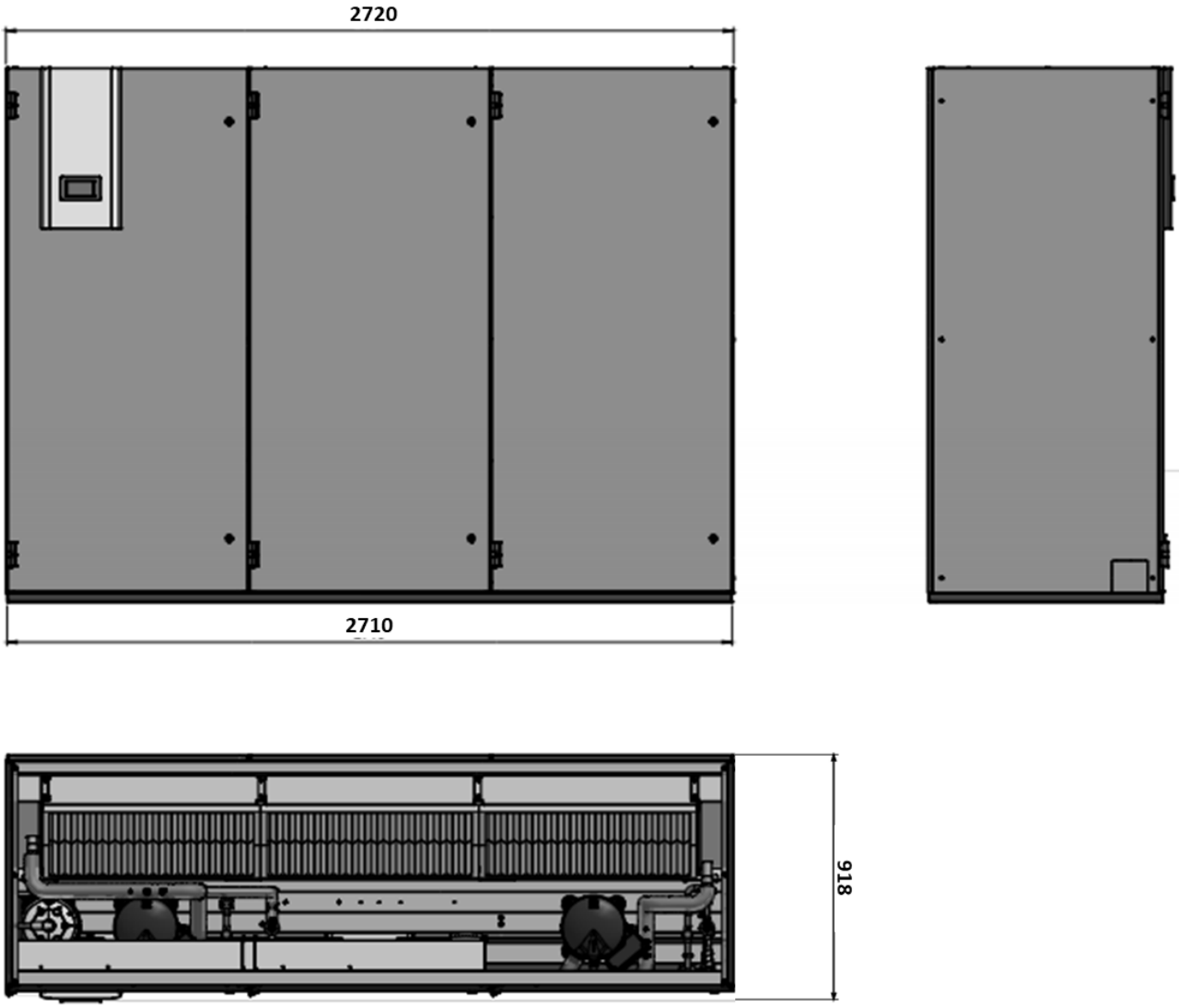


2.7.5.CPA-70 (All configurations)





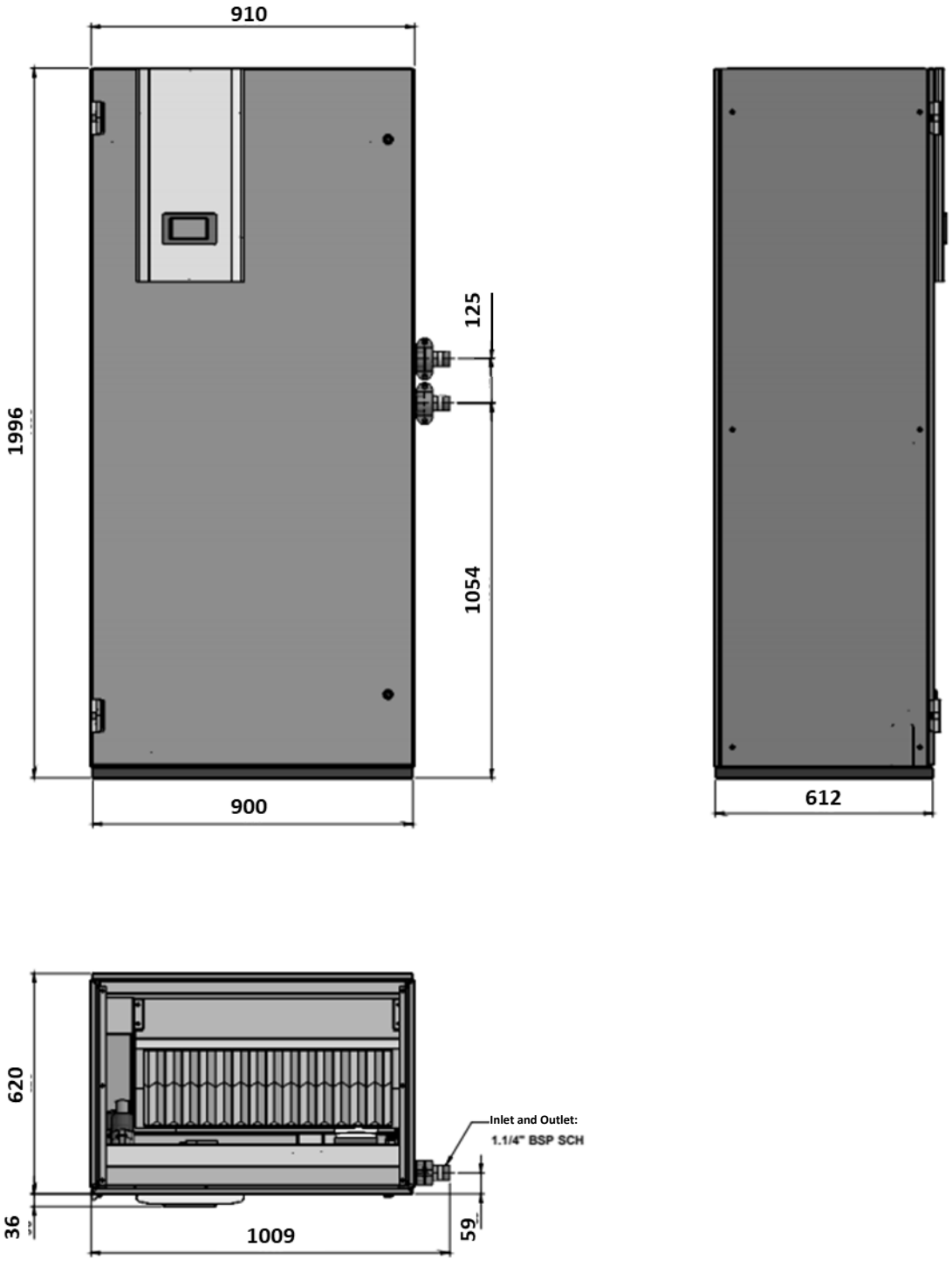
2.7.6.CPA-100 (All configurations)



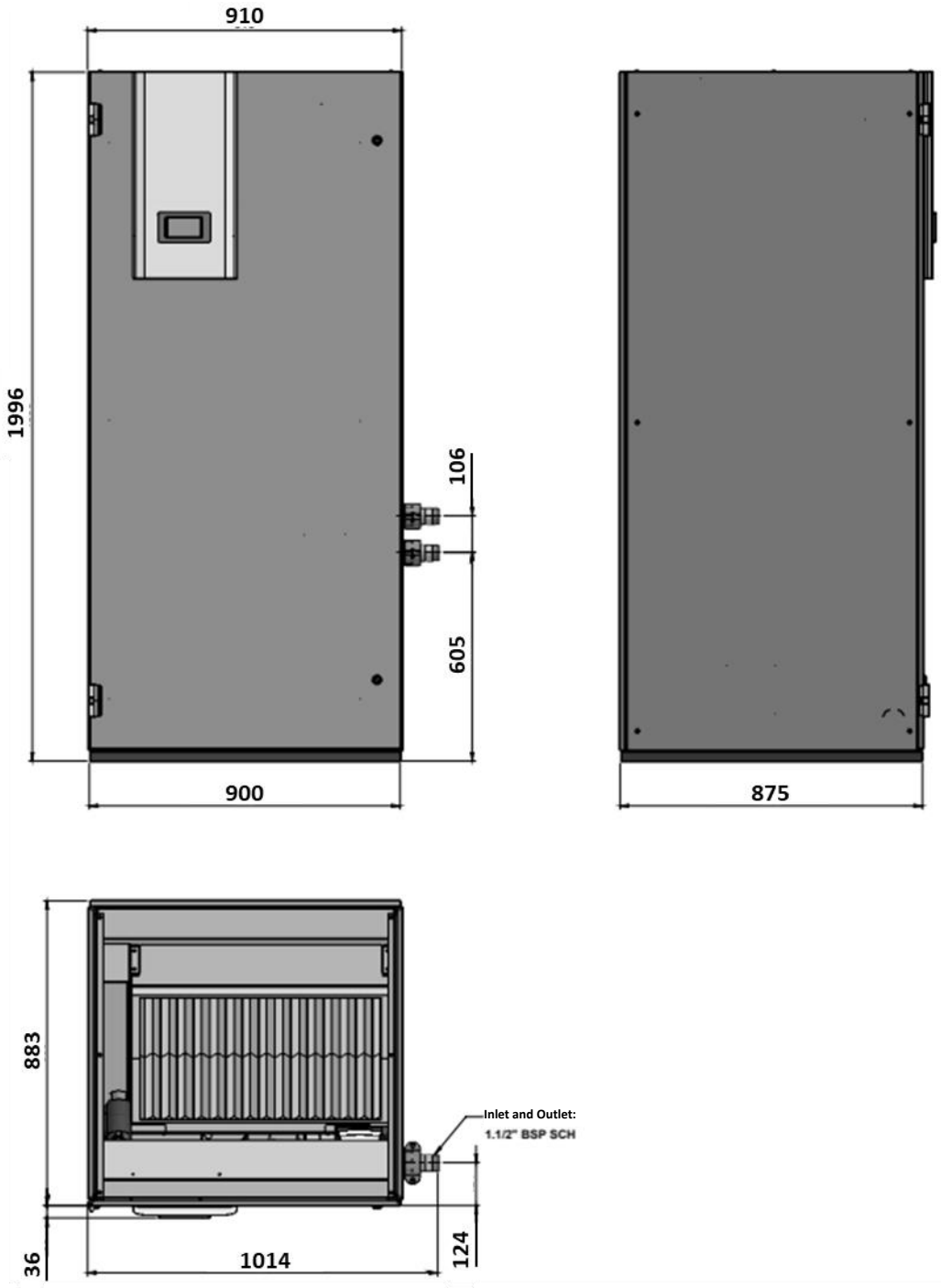
*For more details and connection positions in each CPA configuration, see the dimensions attached to the equipment documentation.

2.8. CPC External Dimensions

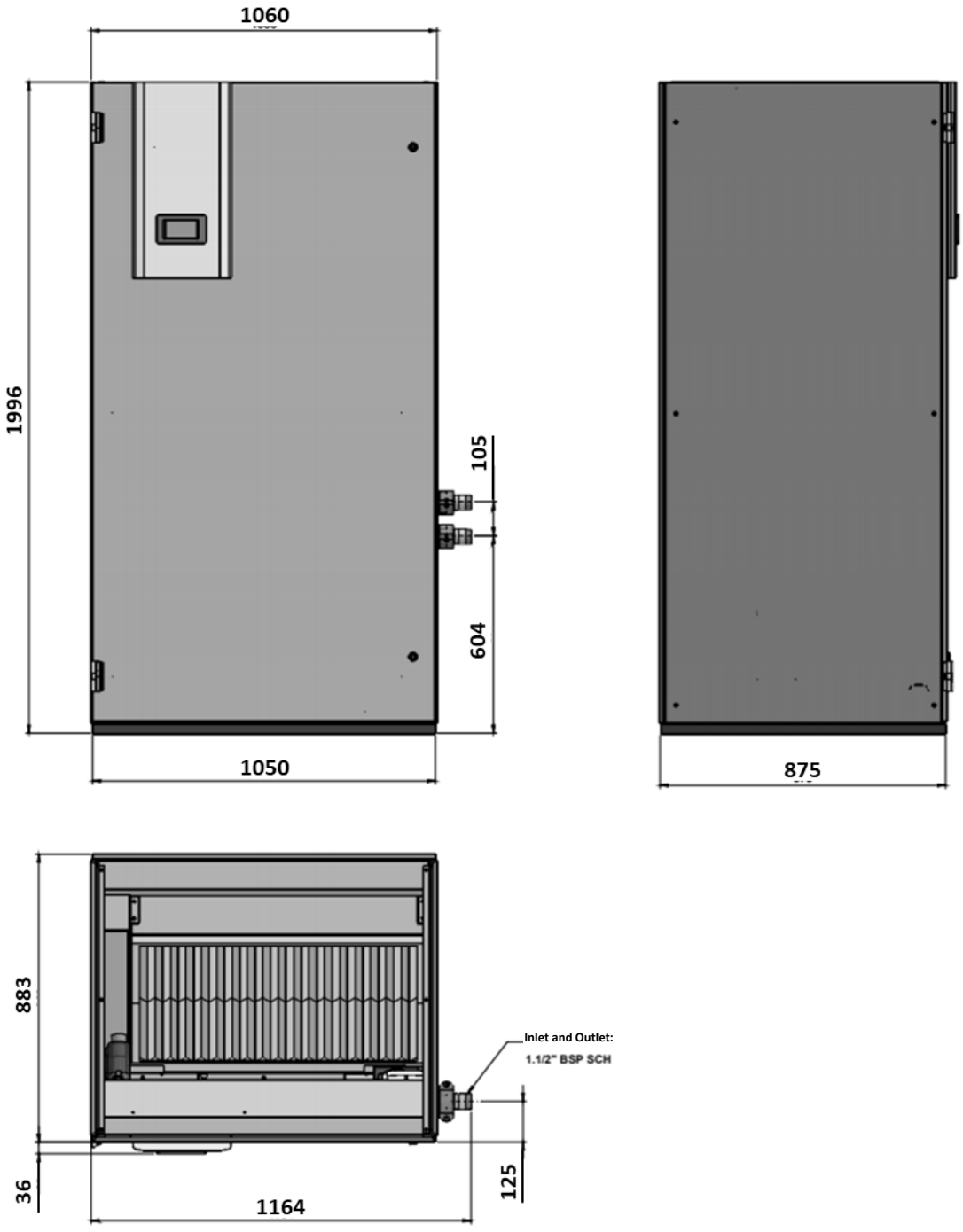
2.8.1.CPC-18 (All configurations)



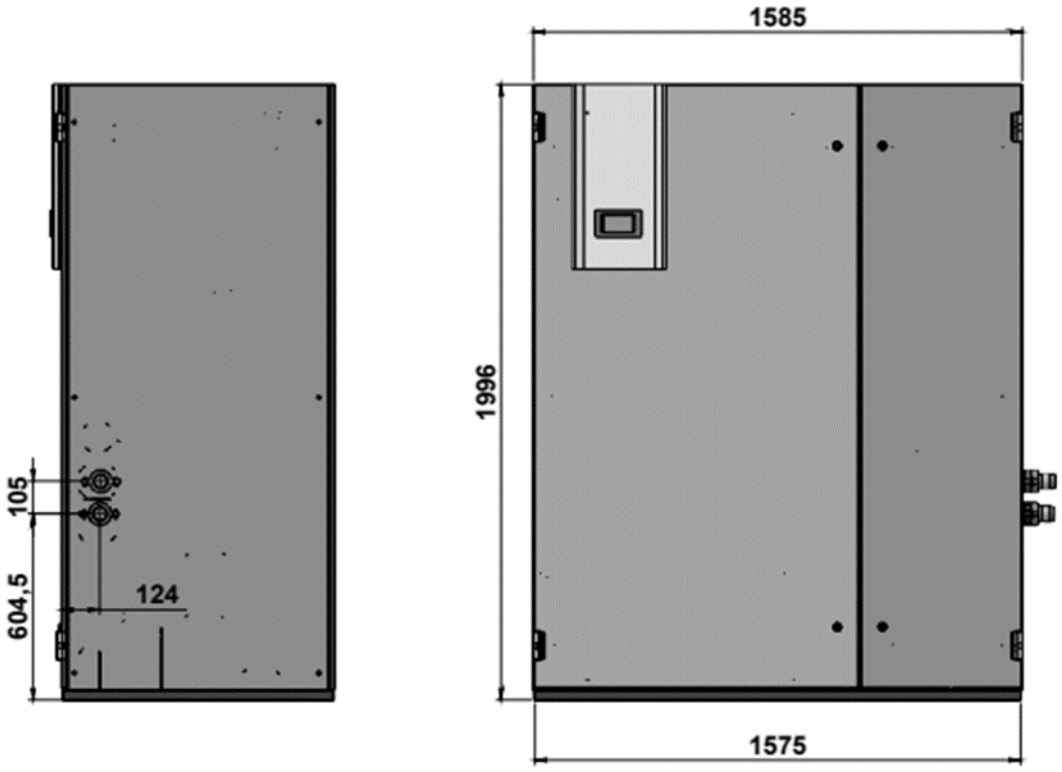
2.8.2.CPC-26 (All configurations)

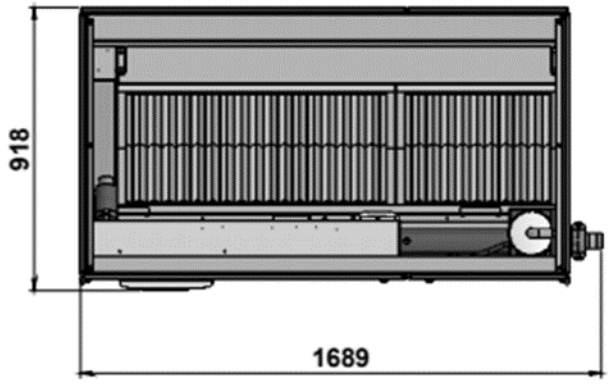


2.8.3.CPC-35 (All configurations)

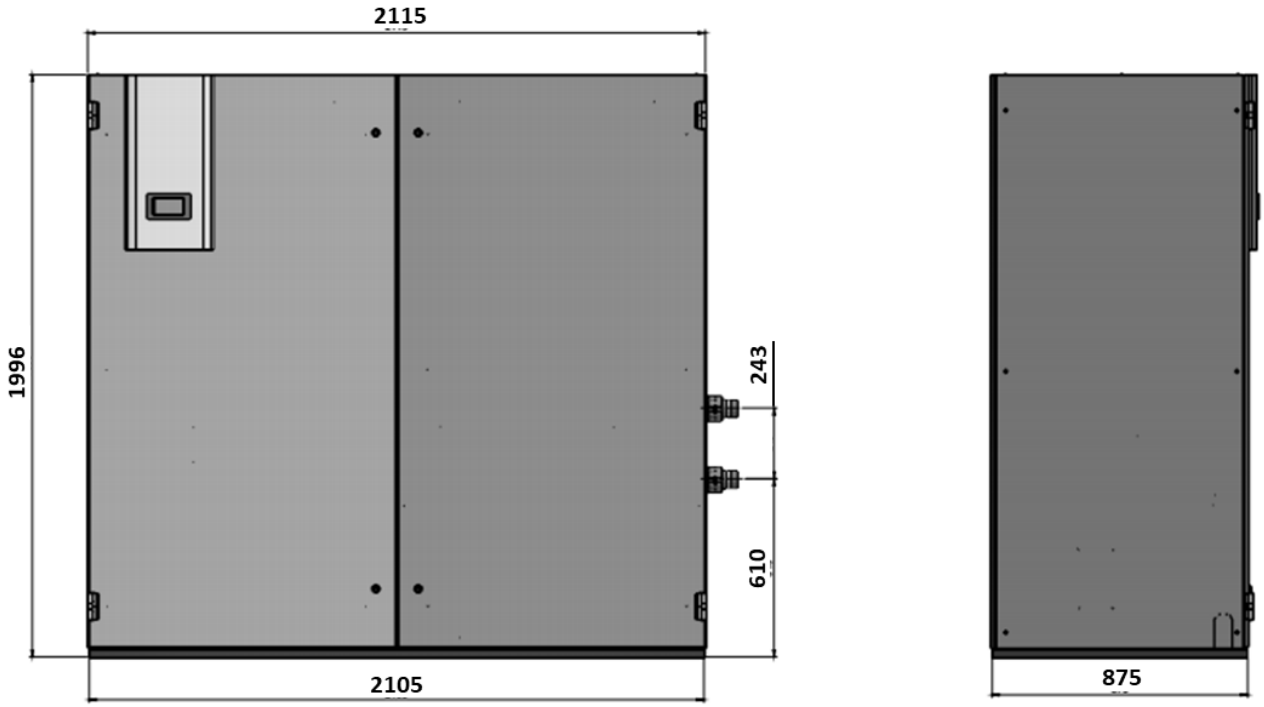


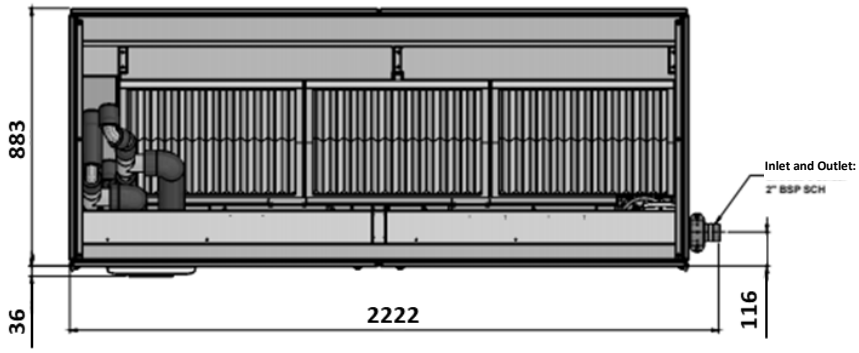
2.8.4.CPC-50 (All configurations)



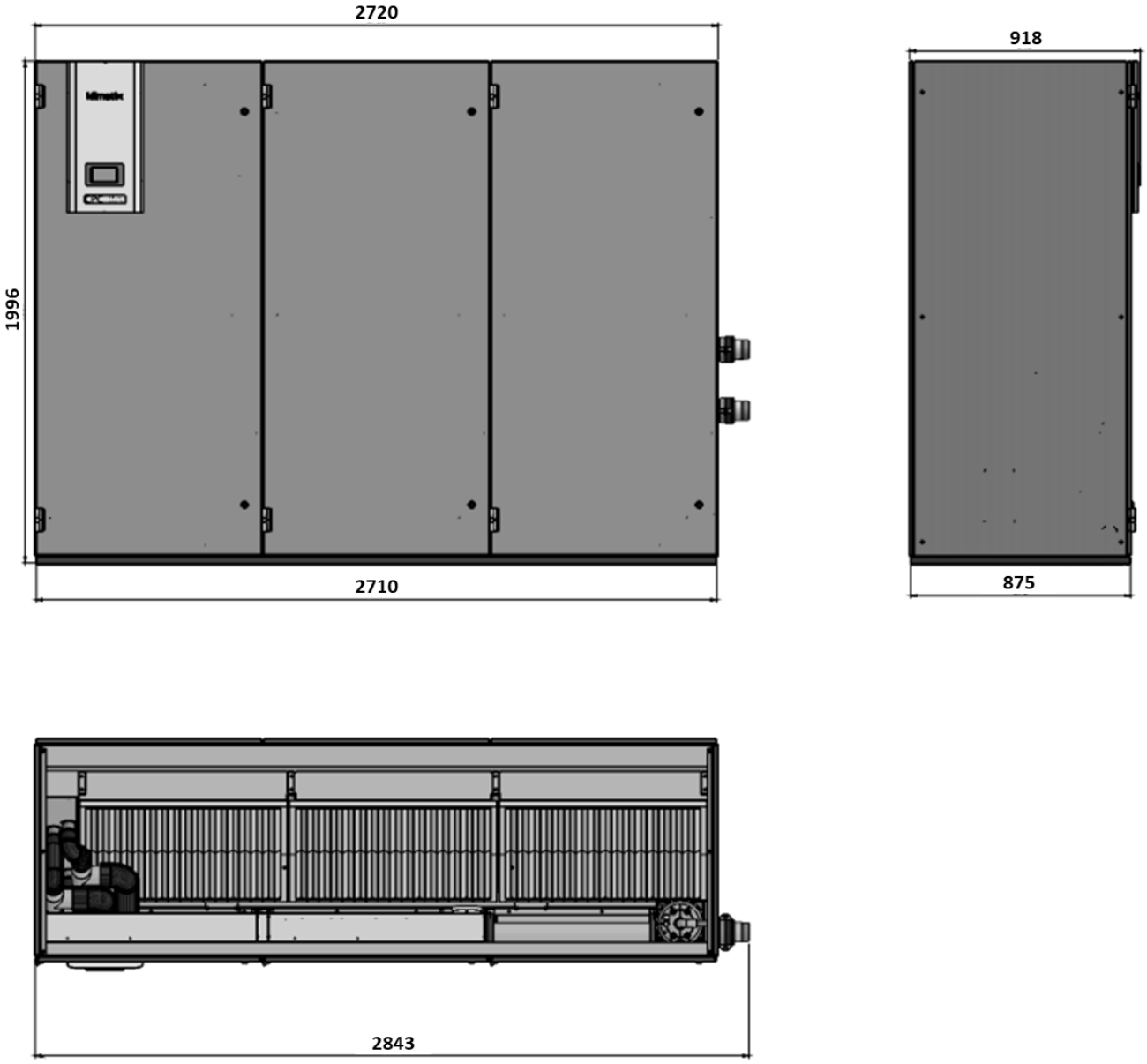


2.8.5.CPC-70 (All configurations)





2.8.6.CPC-100 (All configurations)



*For more details and connection positions in each CPC configuration, see the dimensions attached to the equipment documentation.

2.9. Electrical **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 CP on the identification plate attached to the equipment. The network voltage must comply with the CP voltage and must be within the acceptable limits of ± 10 % (Voltage variations with a tolerance of ± 10 %: 220 V (198 ~242V); 380V (342 ~412V); 440 V (396 ~484V). The electrical data of the equipment will be presented 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.

	**INFORMATION**	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**	DO NOT USE the electrical data of the previous table to size the power supply point in CP models that have special characters (/C, /E and /T) Check the special documentation described in the annex of this manual for CP with special character.

	**ATTENTION**	The maximum power informed on the electrical data table should be used to size the protections and cables. DO NOT USE the power in regime that was calculated based on the nominal operating condition of the equipment.

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

2.9.1.CPA Electrical Data

Equip. [1]	Voltage [2] (V)	Configuration [3]							
		Standard (00)		With Humidification (U0)		With Reheating (0R)		Humidification and Reheating (UR)	
		Maximum Current (A)	Cable [4] (mm²)	Maximum Current (A)	Cable [4] (mm²)	Maximum Current (A)	Cable [4] (mm²)	Maximum Current (A)	Cable [4] (mm²)
CPA-18	220	30.5	10	41.3	16	42.3	16	53.1	25
	380	20.6	4	31.4	6	27.5	6	38.3	10
	440	18.6	4	29.4	6	24.6	6	35.4	10
CPA-26	220	39.3	16	50.1	16	55	25	65.8	25
	380	22.5	6	33.3	10	31.6	10	42.4	16
	440	19.8	4	30.6	10	28.5	10	39.3	16
CPA-35	220	57	25	60.7	25	80.7	35	91.5	50
	380	33	10	43.8	16	46.6	16	57.5	25
	440	29.2	10	40	16	41	16	51.8	25
CPA-50	220	79.4	35	90.2	50	111	70	121.8	70
	380	42.8	16	53.6	25	61.2	25	72	35
	440	37.6	10	48.4	16	53.6	16	64.4	25
CPA-70	220	113	50	130.3	70	160.4	95	177.7	120
	380	65.2	25	73.9	35	92.6	50	101.3	70
	440	57.9	25	65.4	35	81.5	50	89	50
CPA-100	220	179.8	150	212	185	250.6	240	283	2 x 95
	380	105.8	70	122	70	146.9	95	163.1	120
	440	89.9	80	104	70	125.3	70	139.4	95

(1) Equipment in its Upflow, Downflow or Displacement configuration.

(2) Three-phase electrical voltage, at 60 Hz frequency, with an allowable variation of ± 10%.

(3) Equipment configuration according to its accessories

(4) Diameter indication for cable per phase, for power supply of the main switch of the equipment. For distances greater than 50 meters, the cable should be resized.

2.9.2.CPC Electrical Data

Equip. (1)	Voltage (2) (V)	Configuration (3)							
		Standard (00)		With Humidification (U0)		With Reheating (0R)		Humidification and Reheating (UR)	
		Maximum Current (A)	Cable (4) (mm²)	Maximum Current (A)	Cable (4) (mm²)	Maximum Current (A)	Cable (4) (mm²)	Maximum Current (A)	Cable (4) (mm²)
CPC-18	220	6.8	2.5	17.6	4	18.6	4	29.4	10
	380	6.8	2.5	17.6	4	13.7	2.5	24.5	6
	440	5.9	2.5	16.7	4	9.1	2.5	22.7	6
CPC-26	220	5.3	2.5	17.6	4	21.1	4	31.6	10
	380	3.5	2.5	14.3	2.5	12.7	2.5	23.5	6
	440	3.1	2.5	13.9	2.5	11.8	2.5	22.6	6
CPC-35	220	10.6	2.5	21.4	4	34.3	10	45.1	16
	380	6	2.5	16.8	4	19.7	4	30.5	29.1
	440	5.2	2.5	16	4	17	4	27.8	10
CPC-50	220	10	2.5	20.8	6	41.6	16	52.4	25
	380	6.4	2.5	17.2	4	24.8	6	35.6	10
	440	5.6	2.5	16.4	4	23	6	33.8	10
CPC-70	220	20.6	4	37.9	16	68	35	85.3	50
	380	11.4	2.5	28.7	10	38.8	16	56.1	25
	440	9.8	2.5	27.7	6	33.4	10	50.7	25
CPC-100	220	30.6	10	63.1	25	101.4	70	133.9	95
	380	16.8	4	33	10	57.9	25	74.1	35
	440	21.7	2.5	28.5	10	49.8	25	63.9	25

(1) Equipment in its Upflow, Downflow or Displacement configuration.

(2) Three-phase electrical voltage, at 60 Hz frequency, with an allowable variation of ± 10%.

(3) Equipment configuration according to its accessories.

(4) Diameter indication for cable per phase, for power supply of the main switch of the equipment. For distances greater than 50 meters, the cable should be resized.

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 the order and invoice, and immediately inform the manufacturer in case of divergence or lack of items;

3.1. Packaging

For transports carried out in the country, the shipping of the CP is performed in a crate of wood wrapped in high resistance plastic. For export, the shipping is carried out in a closed fumigated wooden package. Both packages were designed to be transported exactly the way they are shipped.

	**INFORMATION**	The CP package was designed to ensure the integrity of the equipment during transport. Changes in the design of the package may result in damages on the equipment and loss of warranty

	**ATTENTION**	Do not pile boxes or deposit other volumes over the CP package.

3.2. Unloading, Moving and Storage

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

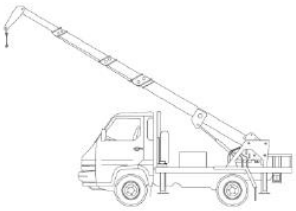
	**INFORMATION**	Check the general condition of the equipment IMMEDIATELY after opening the package. In case any damage is observed, take a picture and send it to the shipping company.

	**INFORMATION**	It is recommended to store the CP 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**	It is recommended to move the CP to the installation site or near the installation site with the original package.

Use a forklift or a pallet jack to unload. Check the weight of the equipment to define the capacity of the forklift that will be used to unload the equipment. Perform the transport with the equipment only in the vertical position. Transport the volume to the installation site or near it and unpack it.

In some cases, it is impossible to use the forklift, because the installation site is inaccessible, requiring the use of a munck truck or hoisting with a crane.



⚠	**ATTENTION**	Use canvas belts appropriate for the weight of the equipment to lift it. Unsafe practices may cause accidents, therefore, this process should be carried out by qualified people and with the suitable safety equipments.

4. Installation

The CR was designed thinking of efficiency, durability and safety of the operator; however, the safety should be ensured by the correct installation, preventive maintenance performed periodically and the operation within the design conditions.

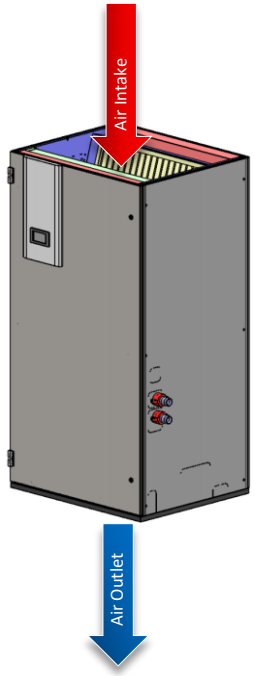
⚠	**ATTENTION**	It is recommended for the installation of the equipment to be performed by Mecalor or by a qualified person. It is imperative for the installer to have a knowledge of local installation codes and regulations in order to ensure that the best mounting and safety practices are used.

⚠	**DANGER**	The CP 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.

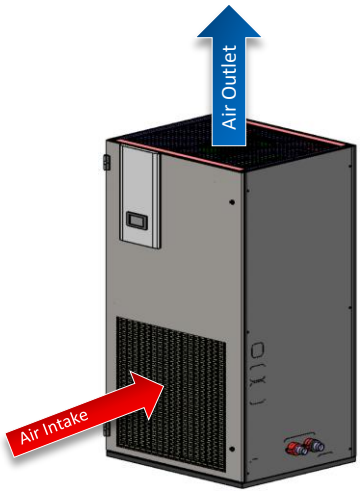
4.1. Airflow

The direct expansion (CPA) or indirect expansion (CPC) precision air conditioners can be supplied in three main air flow configurations, being:

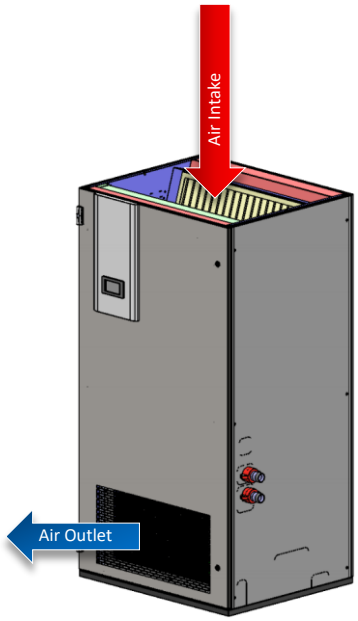
Downflow: The air is captured and accesses the equipment through the upper part, and is directed to the evaporator for temperature and humidity control, driven by the radial fan and returned to the environment by the lower part, directed to the false floor of the room where it is installed, according to the image below.



Upflow: The air is captured and accesses the equipment through the lower front part, and is directed to the evaporator for temperature and humidity control, driven by the radial fan and returned to the environment through the upper part of the equipment, and can be directed directly to the room or to a duct system, as shown in the image below.



Displacement: The air is captured and accesses the equipment through the upper part, and it is directed to the evaporator for temperature and humidity control, driven by the radial fan and returned to the environment through the lower front part, directed to the room, according to the following image.



Normally, in this configuration, the Precision Air Conditioner is positioned to direct the flow to the cold aisle, between the installed racks.

4.2. Installation Site

The CP is designed for installation in data center rooms, UPS rooms or telephone centers. The equipment must be installed on a rigid and leveled base, in case it has Downflow it must be installed on a hollow rigid leveled base, allowing the direction of the air flow to the false floor, its condenser must be installed as close as possible to the served evaporator unit, respecting the distances indicated in the table below.

It is important to emphasize that the siphon must be installed on the discharge line every 6 meters long of the pipe. In applications where there are unevennesses greater than 2 meters, the installation of a siphon must also be foreseen at these unevennesses.

Position between condenser unit and evaporator unit	**Equivalent Length***	Maximum of 30 m
	Height	-5 to 17 meters
Siphon in the discharge line.	**Vertical upward**	Every 6 meters
Check valve		In the discharge line

** The length indicated in the table refers to the equivalent length of piping that comprises the distance between the evaporator and condenser units plus the equivalent length of connections and accessories. The*

limitation of this parameter has the purpose of limiting the load loss in the system in order to ensure nominal capacity of the equipment.

	**ATTENTION**	Never block the air inlet and outlet flow.

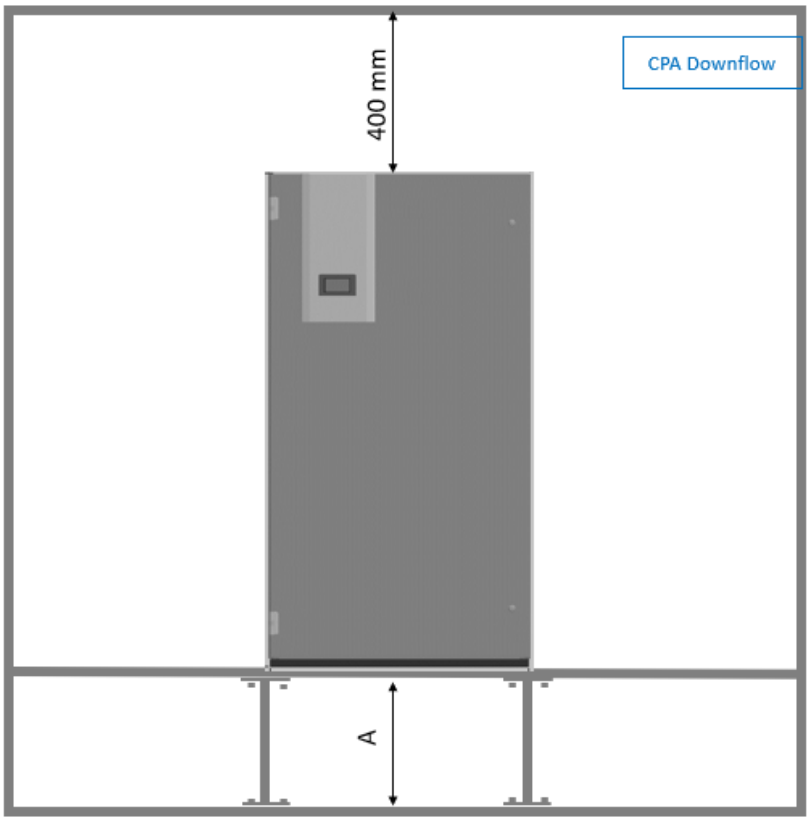
4.3. Positioning

The installation of the precision air conditioners is simple, after defining the installation site the equipment must be positioned on the base, and the ends of the supports can be supported on a rigid structure. In rooms where there is a raised floor, the equipment must be positioned on a base that does not offer load loss in the case of equipment with "downflow" configuration, in other words, with descending air flow. In rooms where there is no raised floor, where upflow and displacement equipment is installed, these can be supported on the floor, provided the floor supports the load of the equipment.

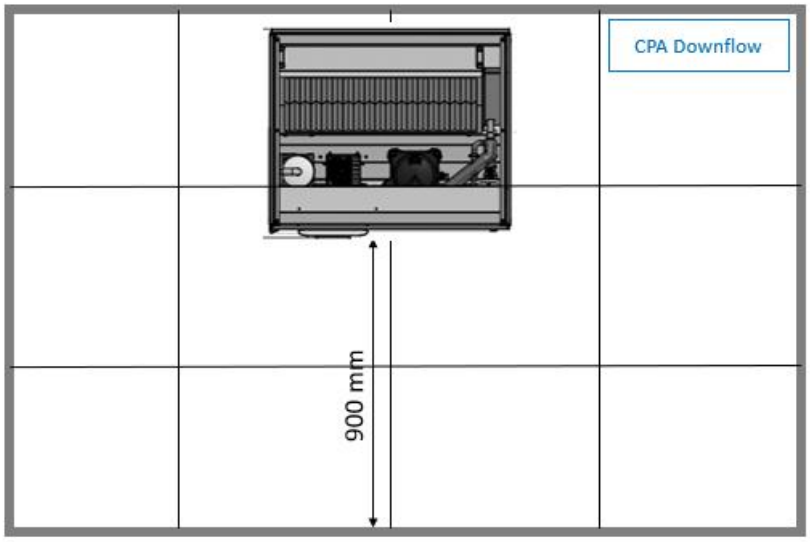
The installation of the equipment must be considered respecting some minimum dimensions to ensure proper maintenance and ventilation conditions for the equipment, as shown in the images below.

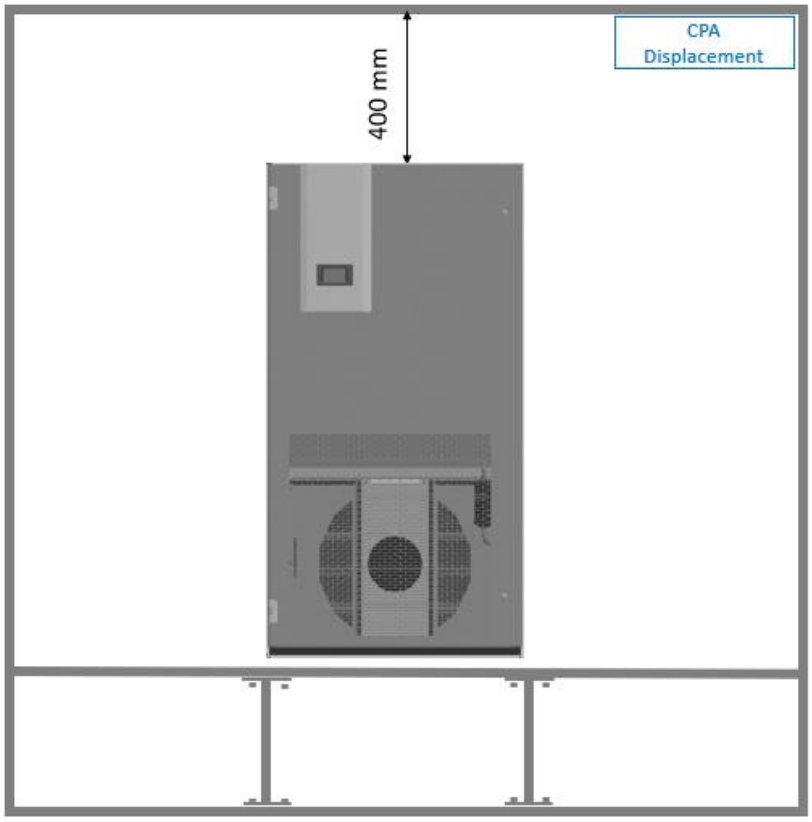
	**INFORMATION**	During installation, it is recommended to protect the CP to prevent dirt from surrounding works from settling in the equipment cabinet. It is recommended to carry out general cleaning after installing the equipment.

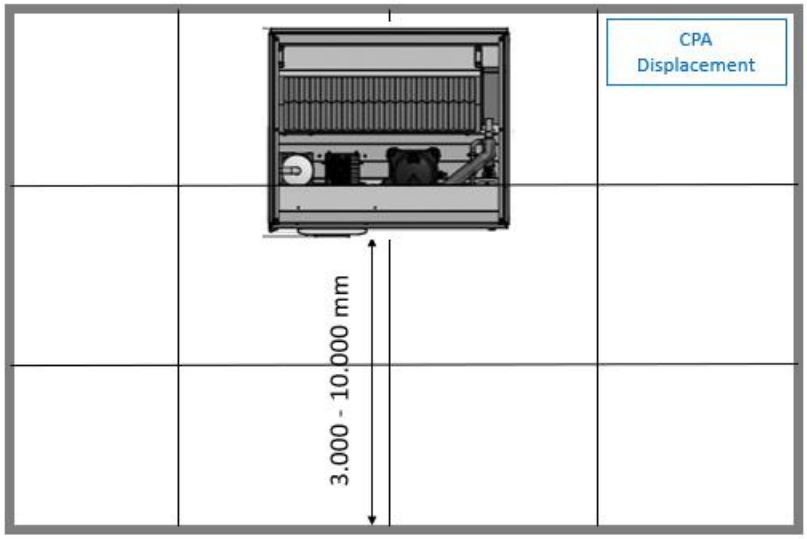
4.3.1.CPA Positioning

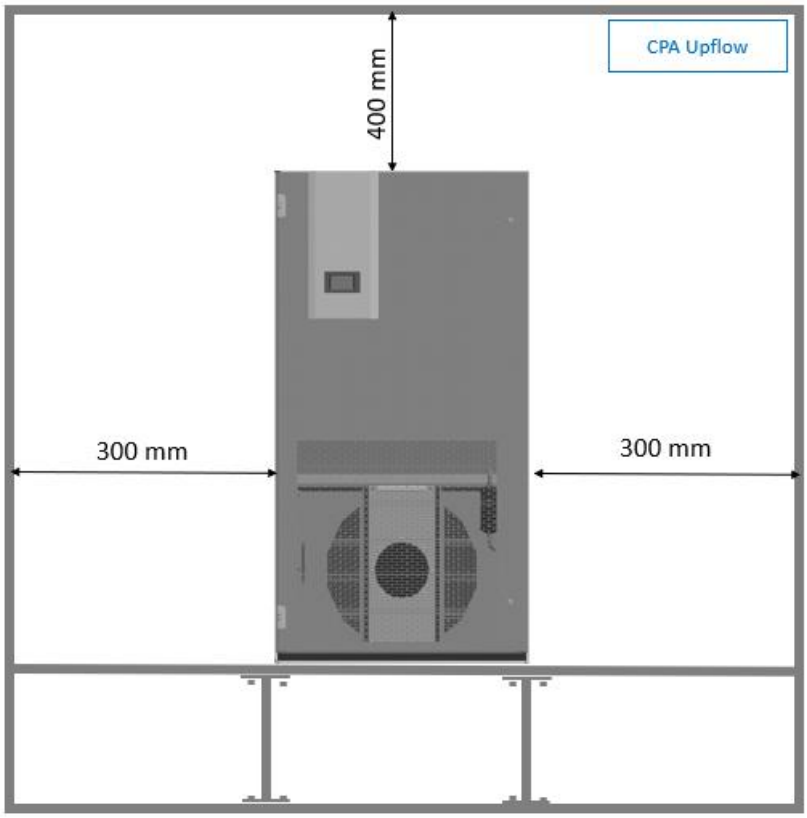


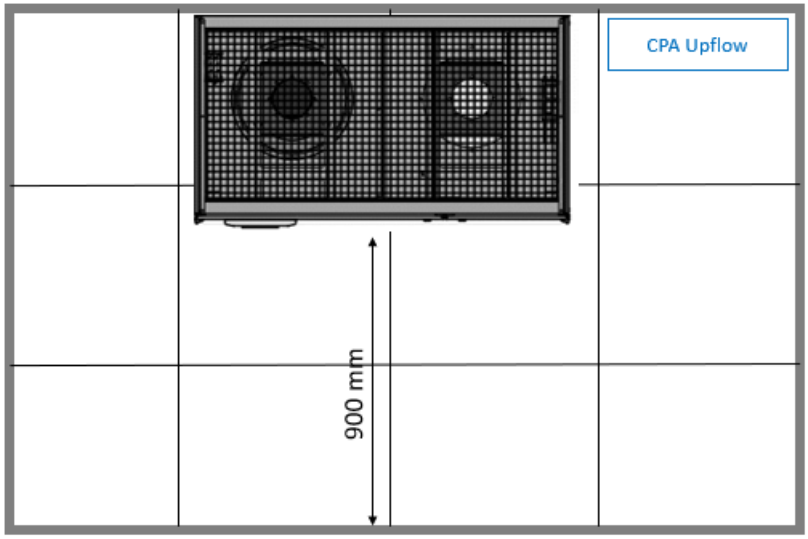
Equipment	Minimum height of false floor (A)
CPA-D-18	300 mm
CPA-D-26	300 mm
CPA-D-35	400 mm
CPA-D-50	400 mm
CPA-D-70	500 mm
CPA-D-100	500 mm



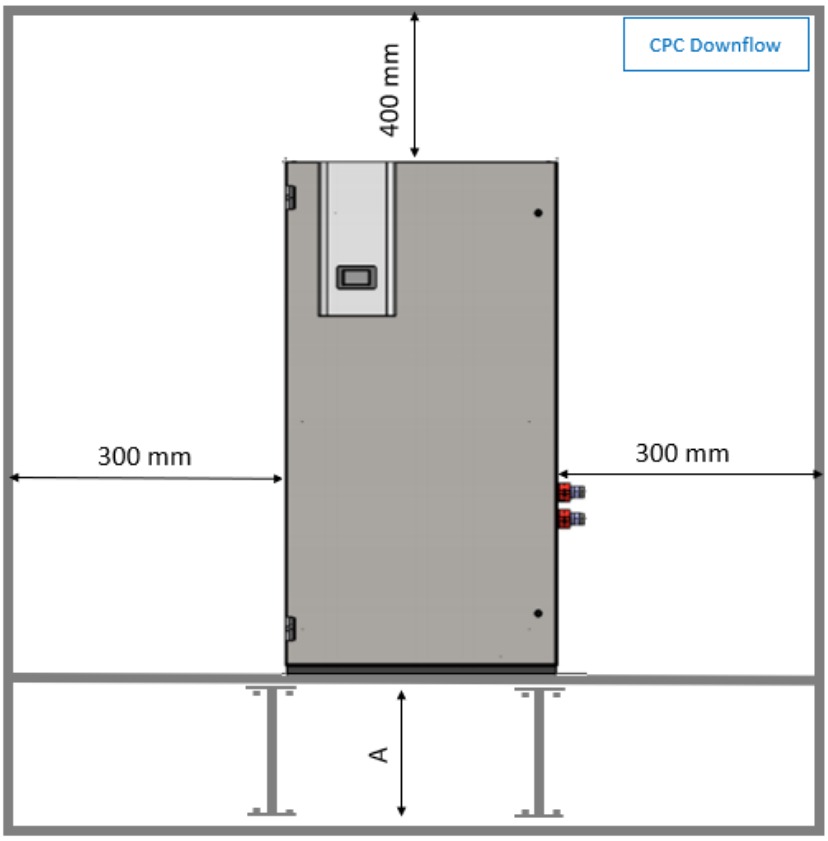

CPA
Displacement
400 mm


CPA
Displacement
3.000 - 10.000 mm

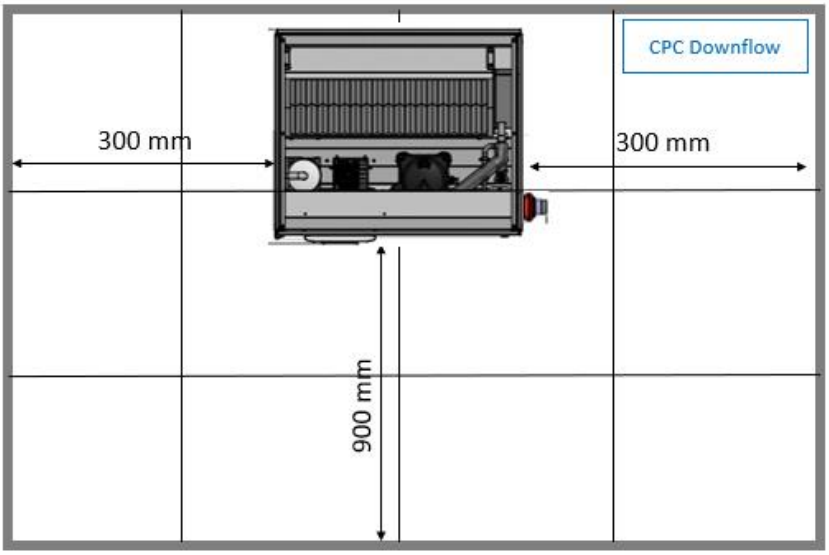

CPA Upflow
400 mm
300 mm
300 mm

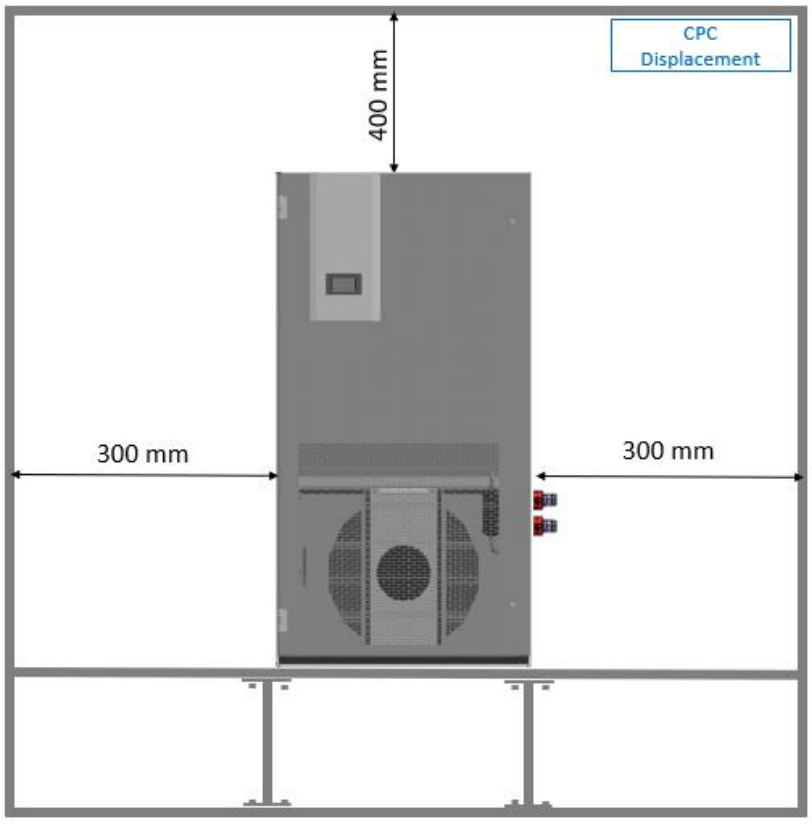

CPA Upflow
900 mm

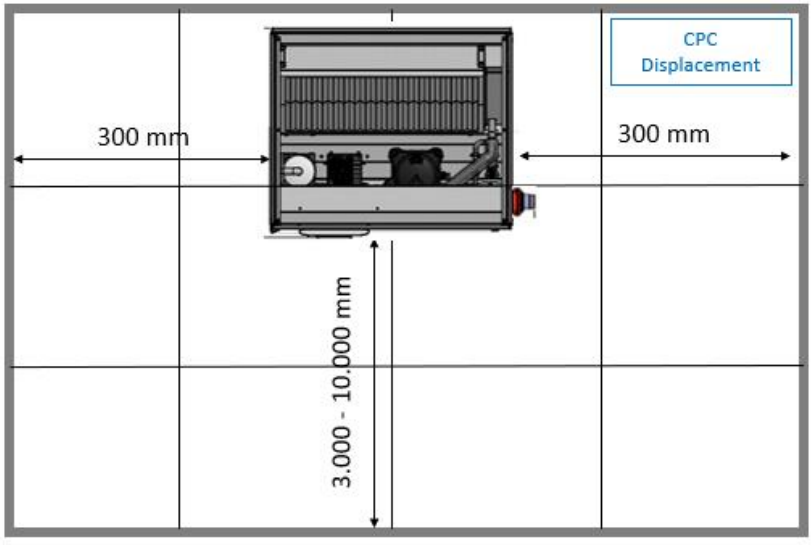
4.3.2. CPC Positioning

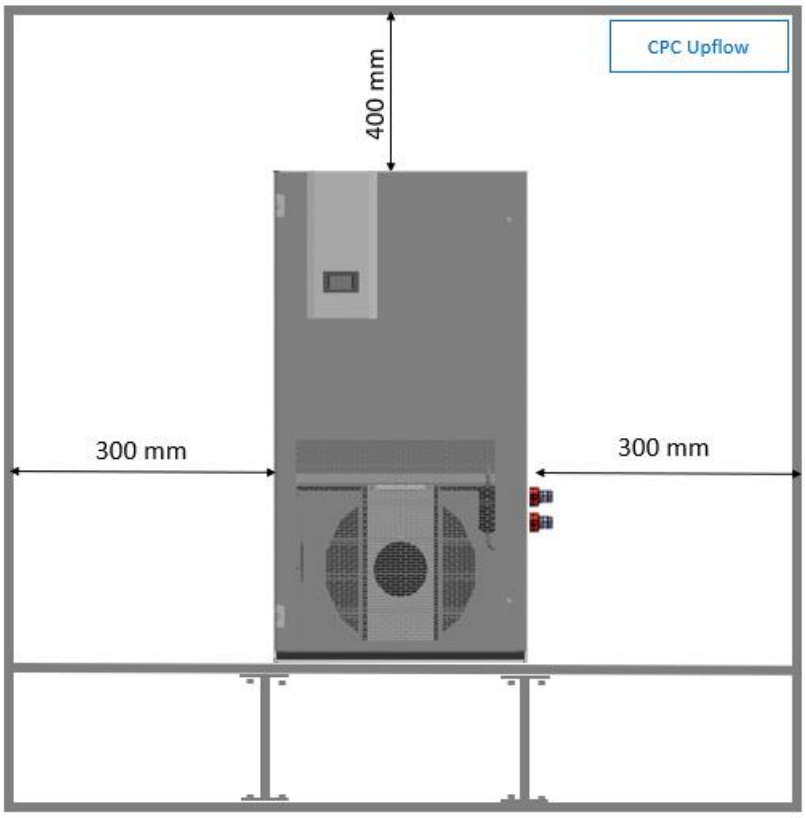


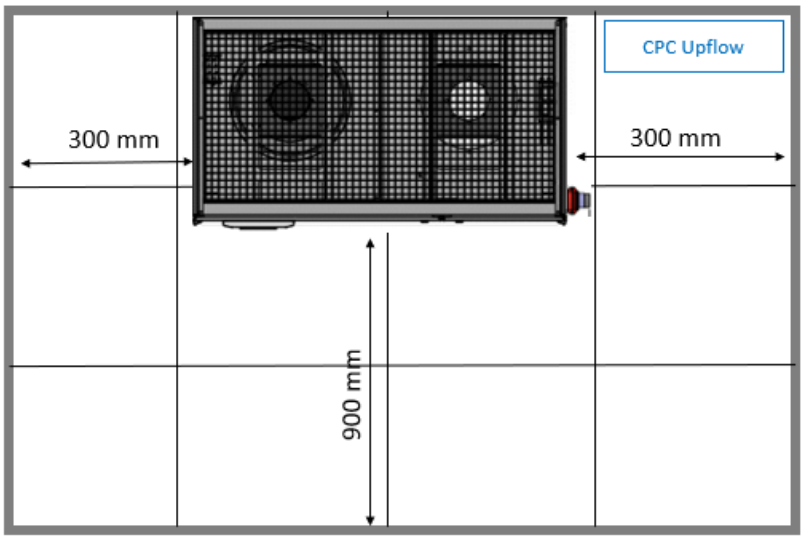
Equipment	Minimum height of false floor (A)
CPC-D-18	300 mm
CPC-D-26	300 mm
CPC-D-35	400 mm
CPC-D-50	400 mm
CPC-D-70	500 mm
CPC-D-100	500 mm




CPC
Displacement
400 mm
300 mm
300 mm


CPC
Displacement
300 mm
300 mm
3.000 - 10.000 mm


CPC Upflow
400 mm
300 mm
300 mm


CPC Upflow
300 mm
300 mm
900 mm

4.4. Electrical **installation**

The electrical installation between the main power point to the terminals of the main disconnector of the CPH Precision air conditioner is the responsibility of the customer or the installer hired by them.

	**ATTENTION**	Use blockades and warnings like *Equipment Under Maintenance* when the installation or intervention is occurring on the CP. Consult standard NR12 and local references for the correct signal of the equipment in case of installation or maintenance.

	**DANGER**	Keep the main switch of the equipment always switched off at the time of installation or maintenance of the CP. The noncompliance of this practice may cause personal damage or even death.

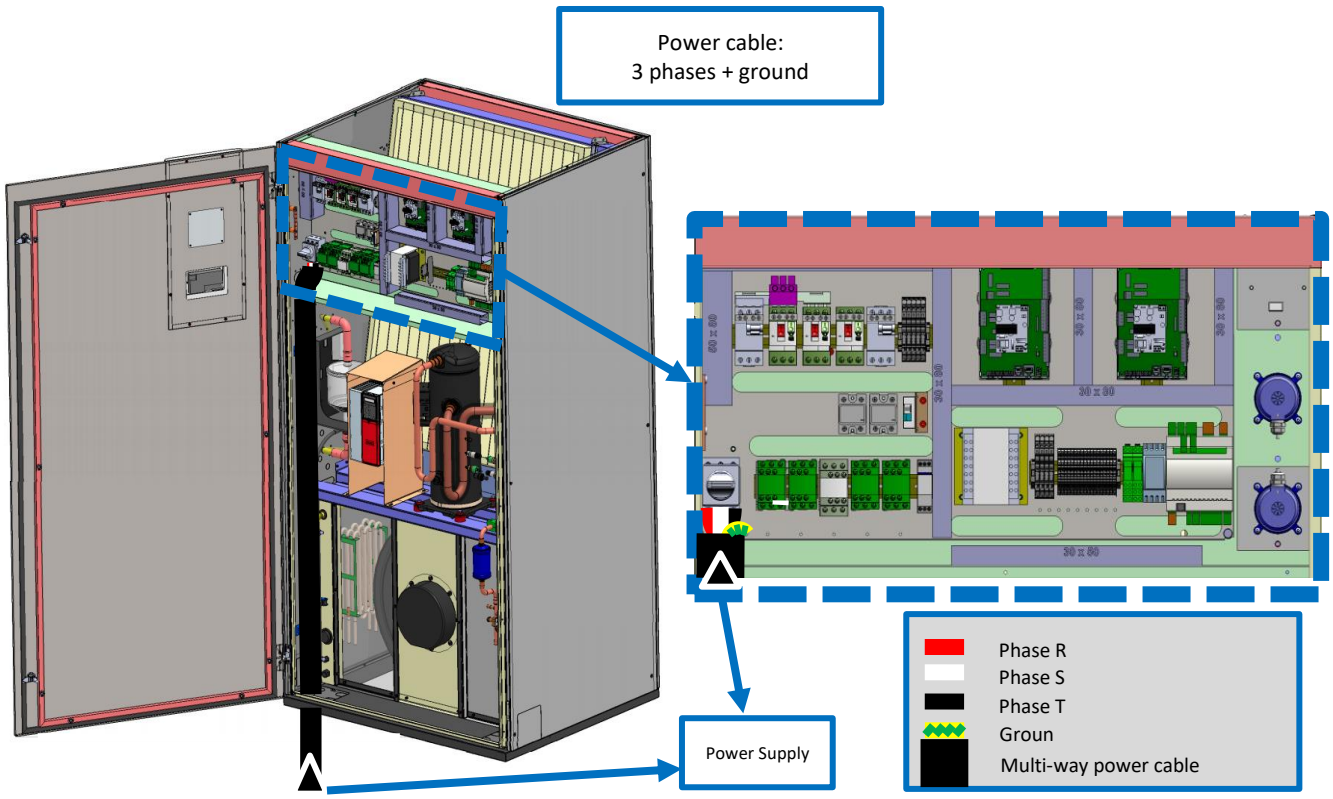
	**DANGER**	High voltage in the connection boxes of the electrical panel, compressor, fan, reheating electric resistor and steam generator. Risk of injury or death. Only qualified personal with suitable safety equipment can handle these components and with the prior authorization from Mecalor.

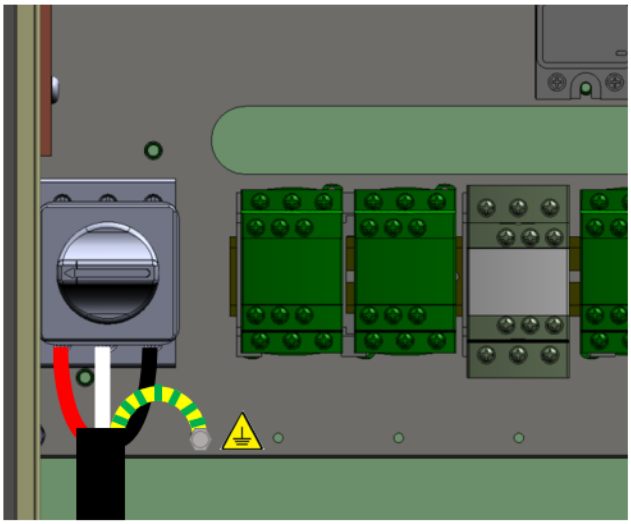
	**ATTENTION**	The customer is responsible for the sizing and selection of the exclusive disconnection device of the CP. Unsuitable sizing or out of the local regulations may put at risk the safety of the installation, causes damages to the equipment and loss of warranty.

	**ATTENTION**	DO NOT USE the power in regime to size the circuit breaker and power cable. The electric safety devices should always be sized according to the installed/maximum power of the CP.

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

The power supply cable should enter through the electrical panel of the equipment. Phases R, S and T should be connected to the main switch and the ground cable attached to the panel as indicated below:



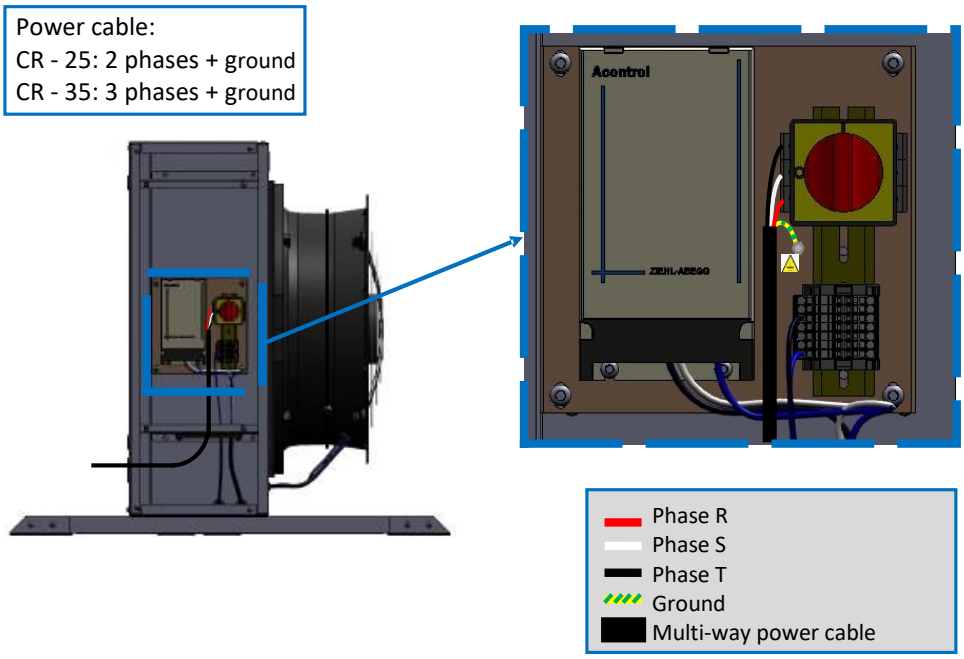


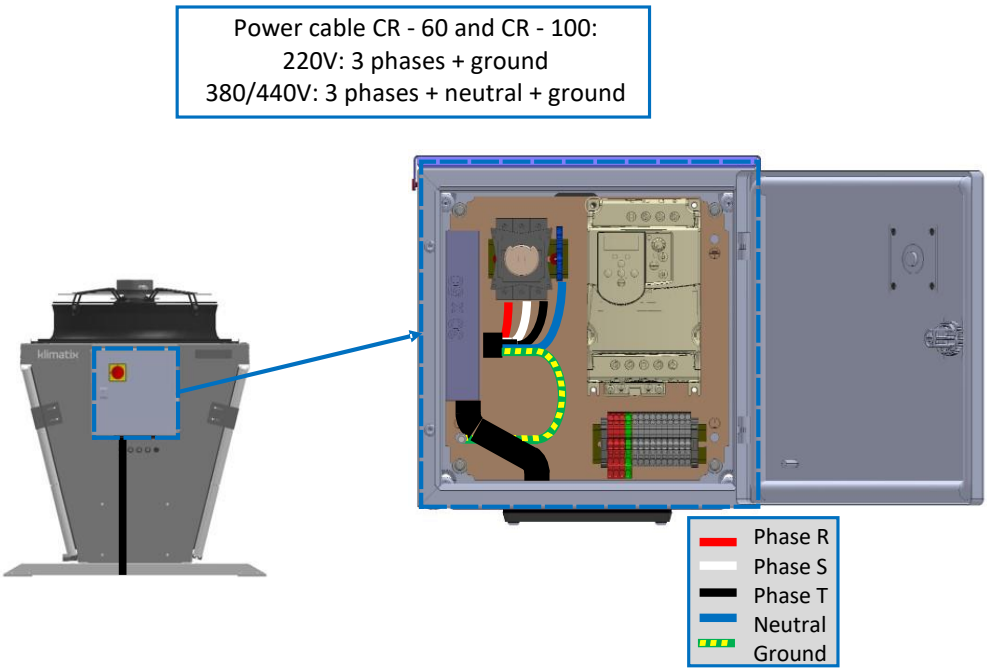
	INFORMATION	The piping for routing the power cable must be planned according to the installation. The wiring described in the figure are only an example general electrical installation and it does not consider the installation variables of the customer. The electrical pipe should comply with the applicable local codes.

	INFORMATION	In case of power supply failure with the CP in operation and if the main disconnector is in the “ON” position, in normalization, the equipment will start operating automatically. Therefore, no action should be taken by the operator in this case.

	DANGER	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.

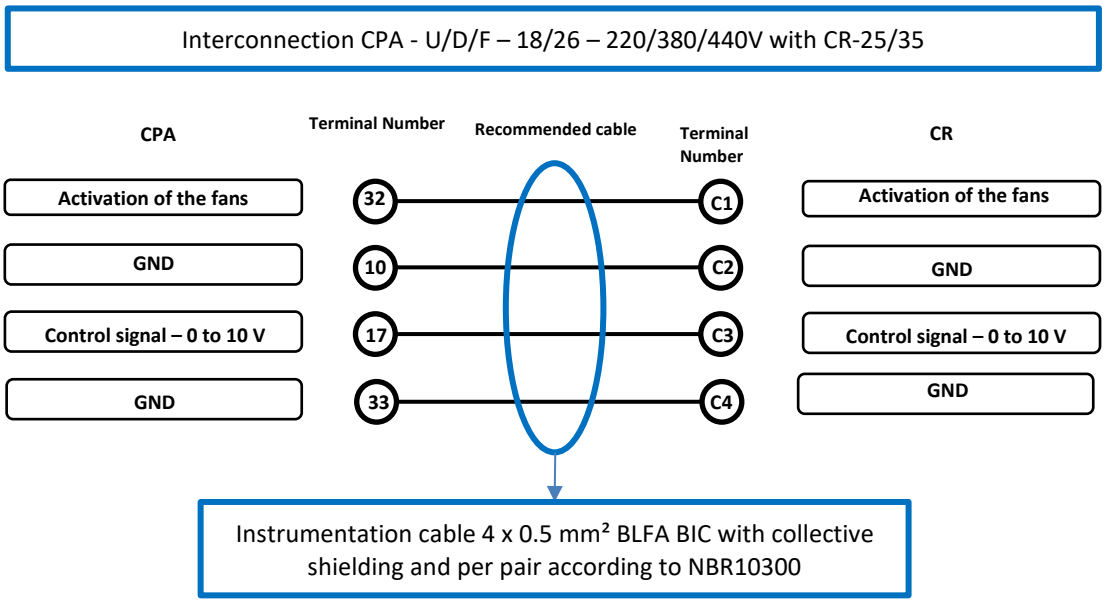
	DANGER	The cabinet of the CP can be electrically charged. The non-grounding of the equipment may cause electric shocks, short circuits, personal damages and even death. Ground the CP in the grounding grid. Location according to NBR-5410/NBR-5419.



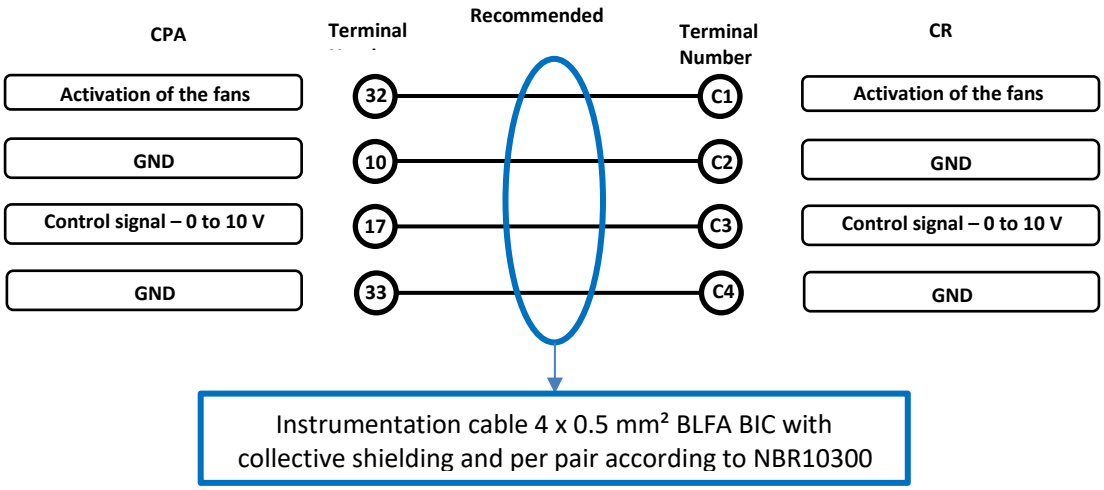


4.4.1.Interconnection between CPA and CR

The interconnection between CPA and CR is made for control between the PLC installed in the CPA and the fan installed in the condenser. For this connection it is recommended to use a 2 pairs x 0.5mm² BLFA BIC instrumentation cable according to NBR 10300 with collective shielding and per pair. The terminals and function for connection in each equipment of the line are indicated below.

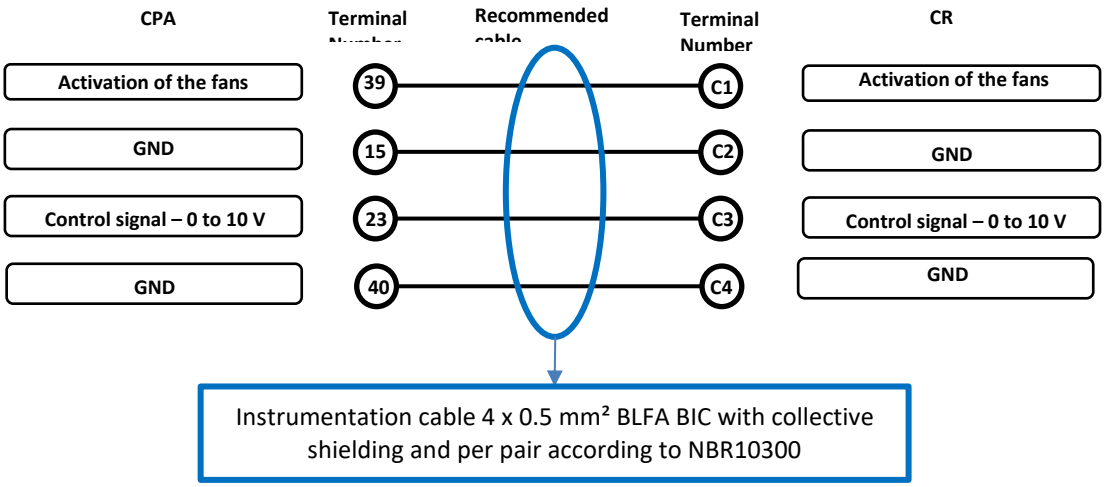


Interconnection CPA - U/D*/F* – 35 – 220/380/440V with CR-60

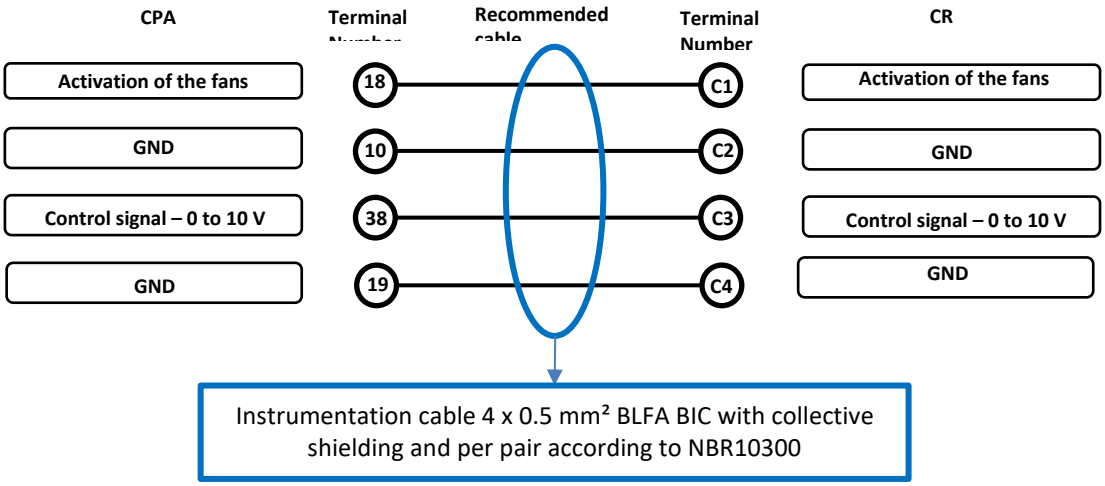


*: For Downflow and Displacement 380V version consider the interconnection below

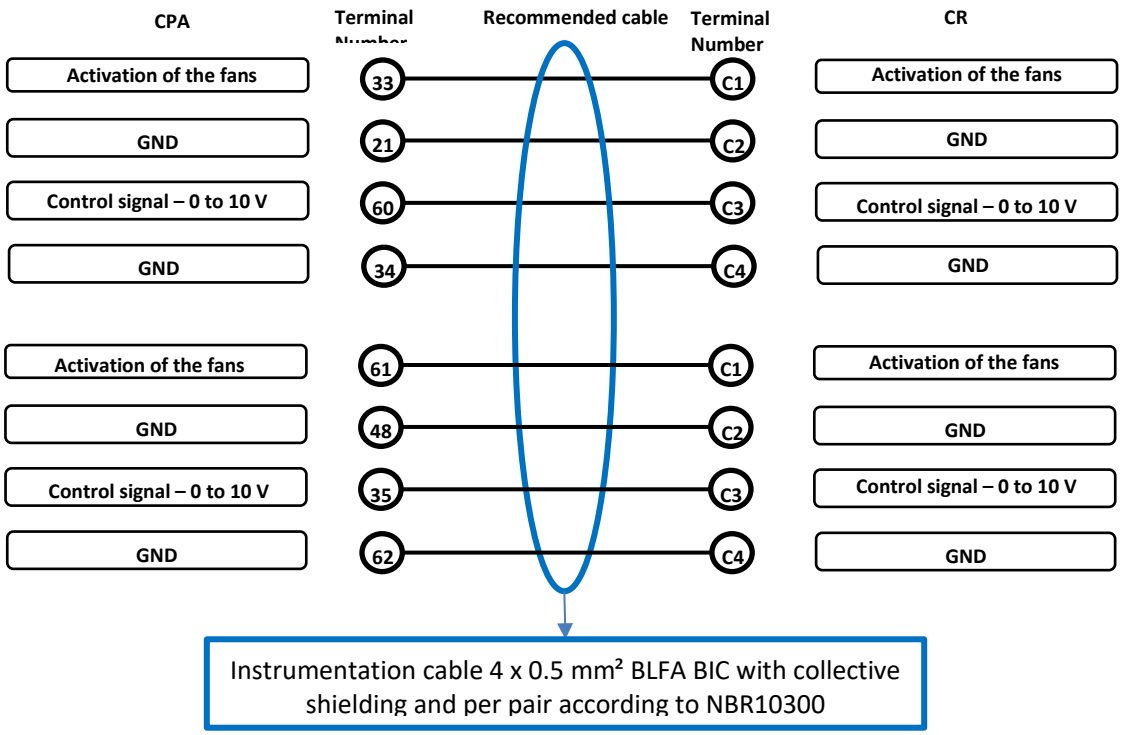
Interconnection CPA - D/F - 35 - 380 with CR-60



Interconnection CPA - U/D/F – 50 – 220/380/440V with CR-100

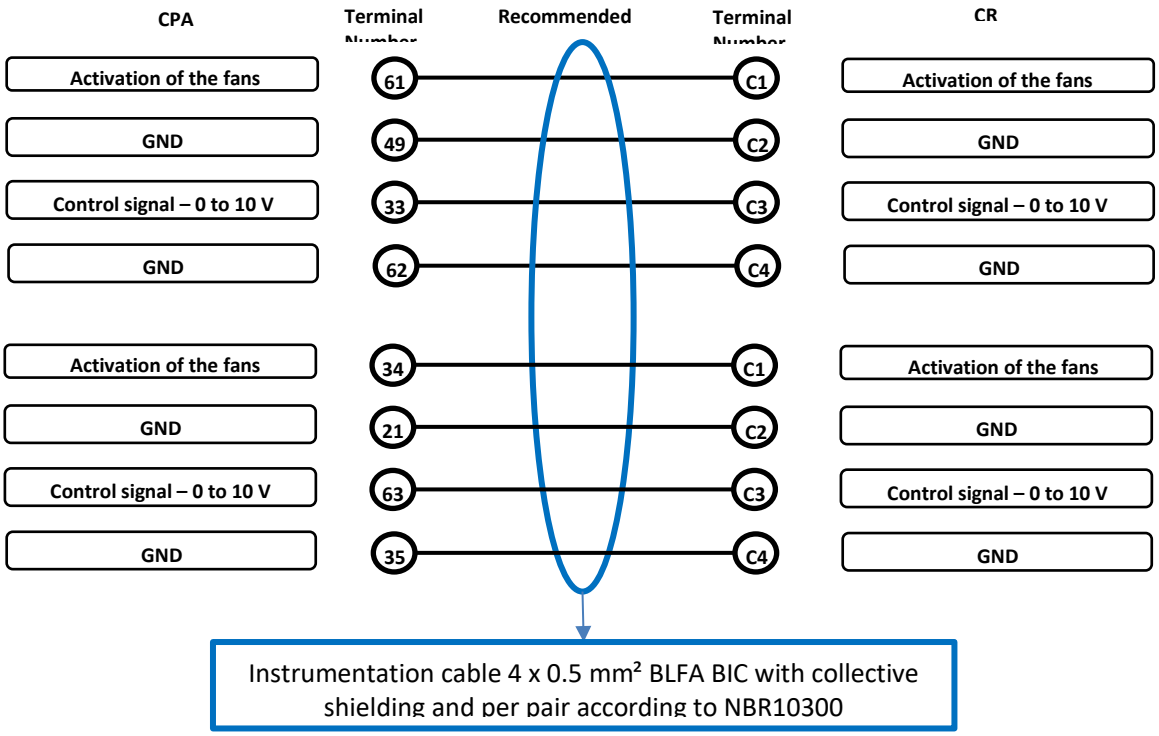


Interconnection CPA - U*/D/F - 70 - 220/380/440V with 2 x CR-60

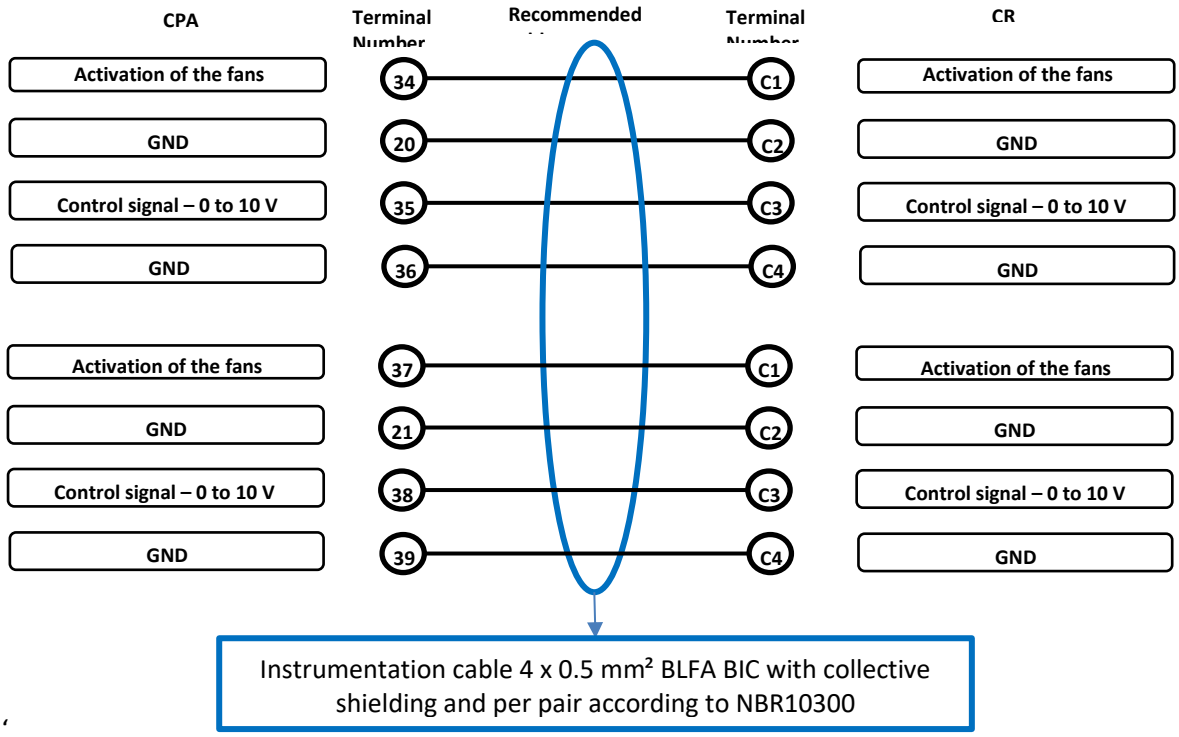


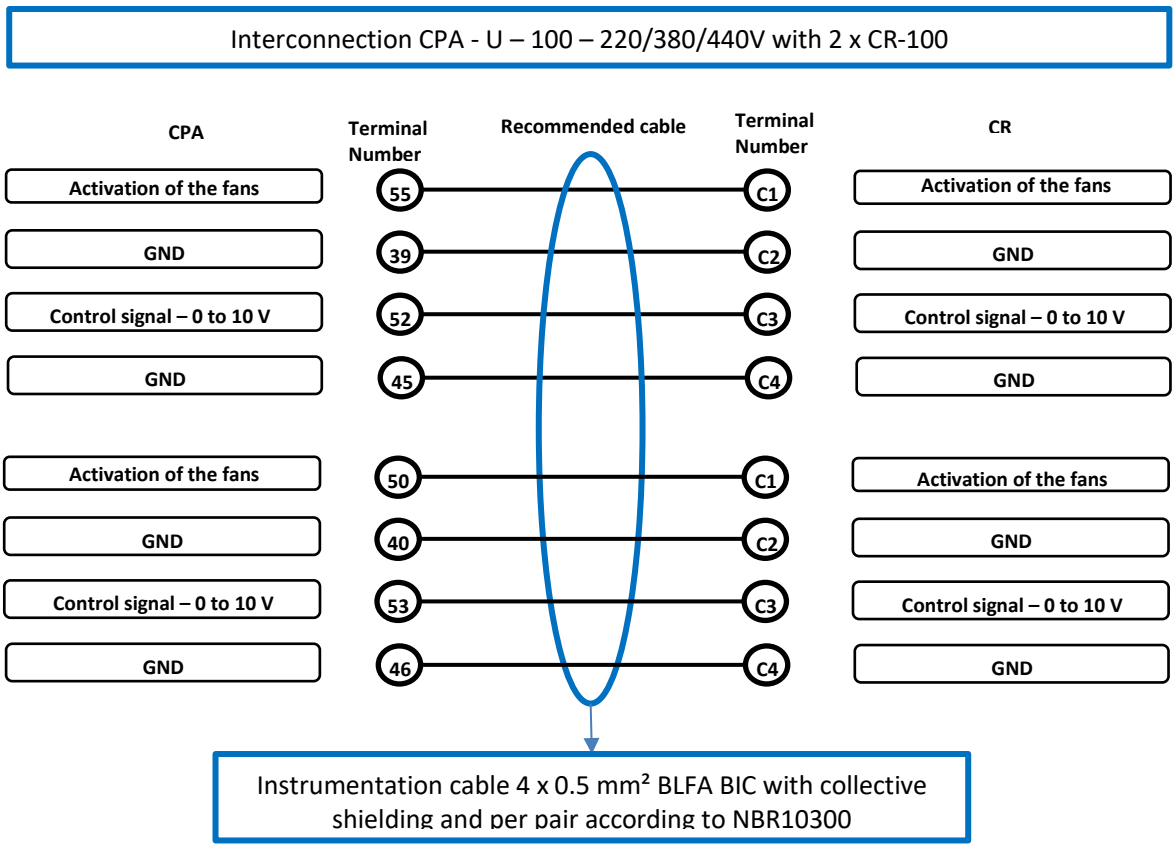
*: For 380V Upflow version consider the following

Interconnection CPA – U – 70 – 380V with 2 x CR-60



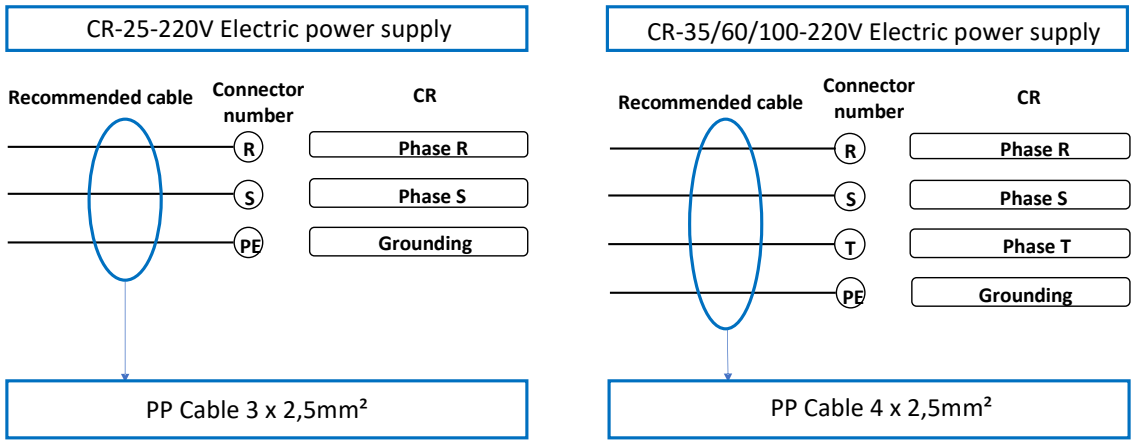
Interconnection CPA - D/F – 100 – 220/380/440V with 2 x CR-100

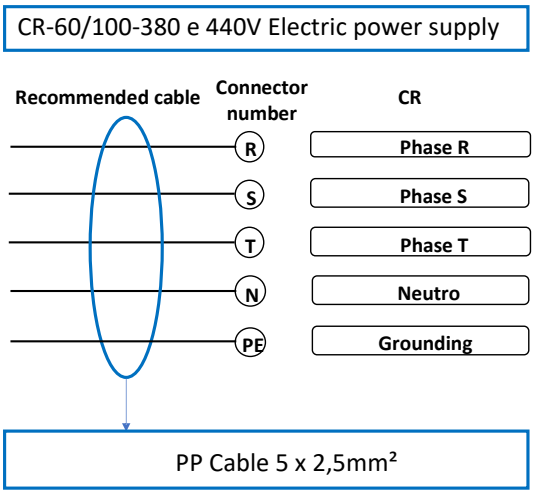




4.4.2.CR Electric power supply

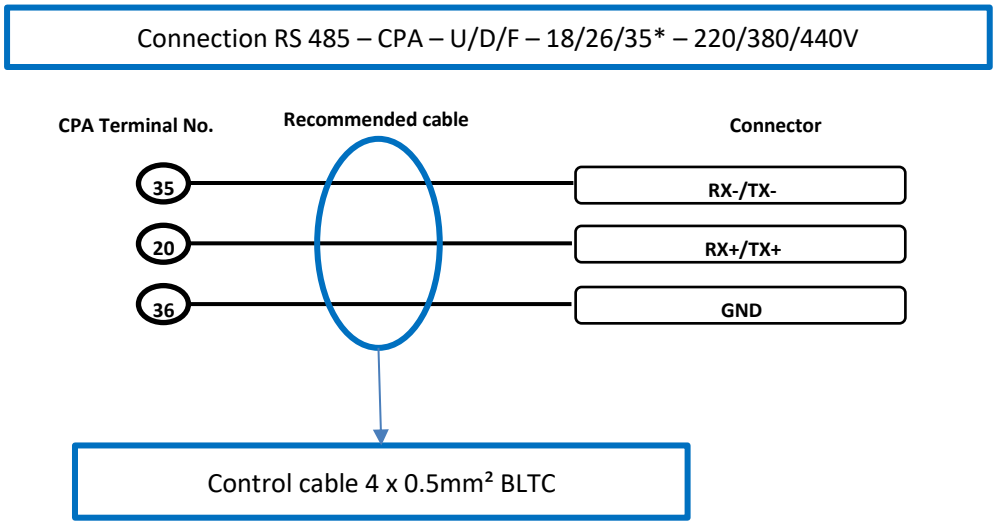
In addition to the electrical interconnection between the CPA and the CR it is necessary to install a cable for the power supply of the CR. The CR unit is also supplied with a user manual containing essential information for the correct installation of this equipment. Therefore, we recommend that the manual be consulted before starting the equipment. The following are the connections and cable recommendations for the power supply of the equipment.





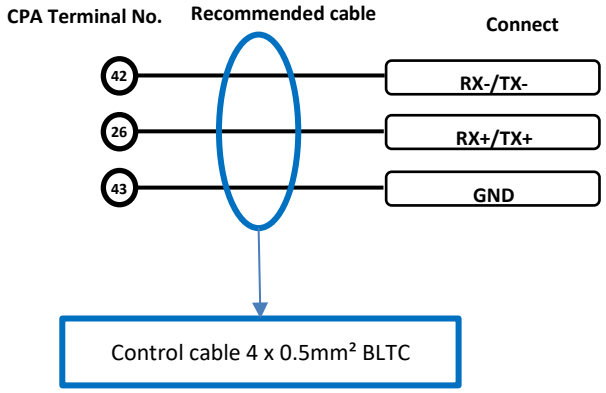
4.4.3. Interconnection via Modbus network

To connect the system via Modbus RTU via RS485 we must use a 4 x 0.5 mm² BLTC control cable according to NBR 7289. The connection must be made through the following points:

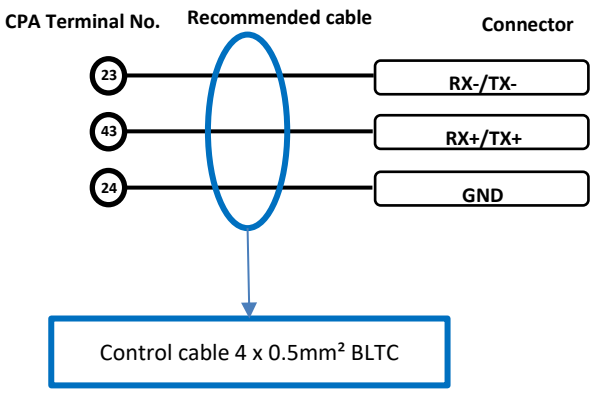


*: For CPA-35 Downflow and Displacement version at 380V consider the following connection

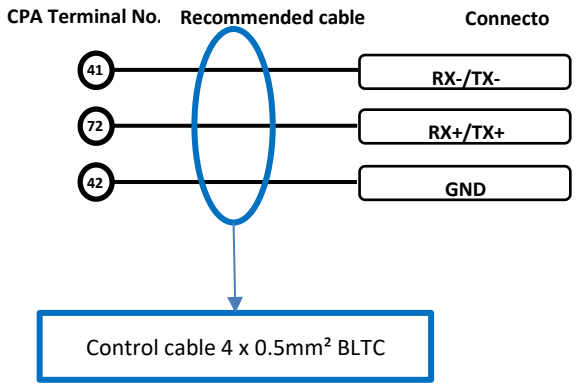
Connection RS 485 – CPA – D/F – 35 – 380V



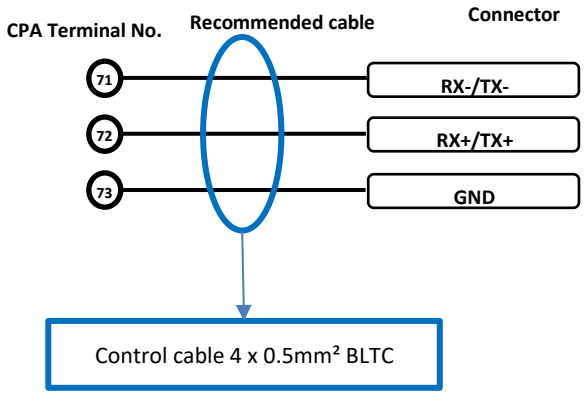
Connection RS 485 – CPA – U/D/F – 50 –



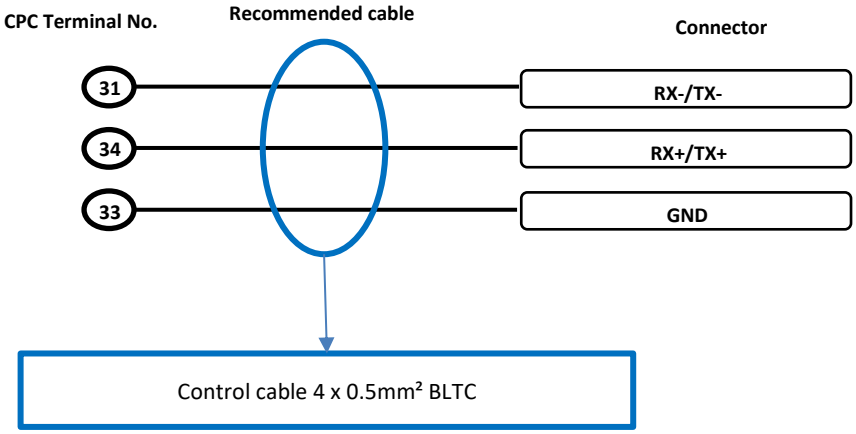
Connection RS 485 – CPA – D/F – 100 – 220/380/440V



Connection RS 485 – CPA – U – 100 – 220/380/440V

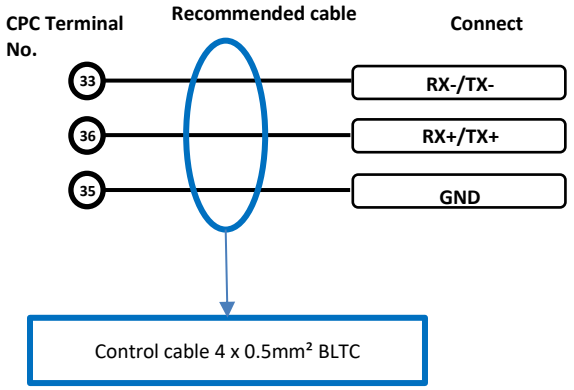


Connection RS 485 – CPC – U/D/F – 18/26*/35 – 220/380/440V

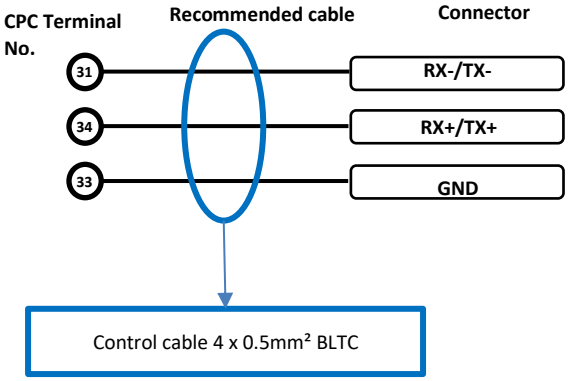


*: For CPC-26 Downflow and Displacement version at 380V consider the following connection

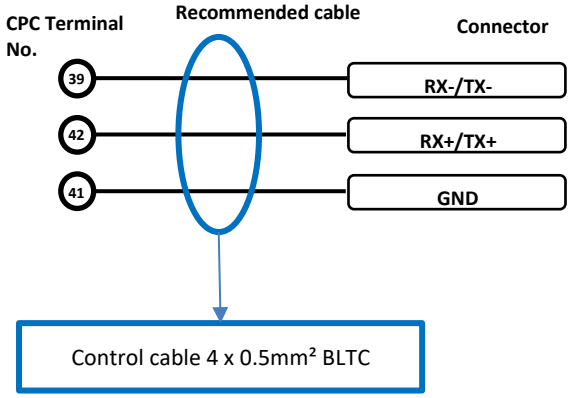
Connection RS 485 – CPC – D/F – 26 – 380V



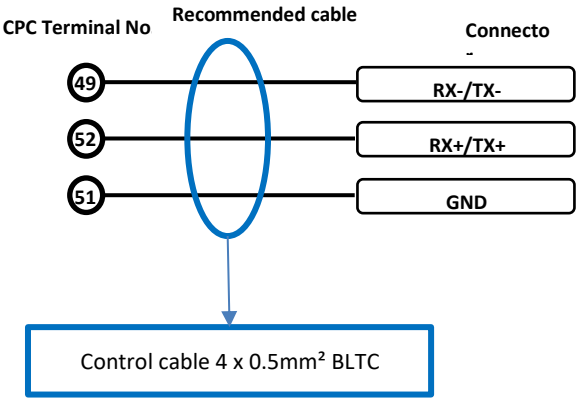
Connection RS 485 – CPC – U/D/F – 35 –



Connection RS 485 – CPC – U/D/F – 50/70 – 220/380/440V



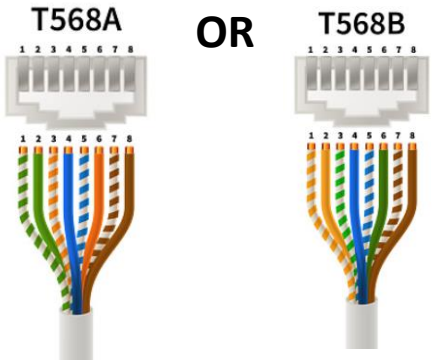
Connection RS 485 – CPC – U/D/F – 100 – 220/380/440V



4.4.4. Interconnection via Ethernet network

CAT5 cable must be used for interconnection between equipment and network and between pieces of equipment. The connection should be made through a switch for which the customer is responsible.

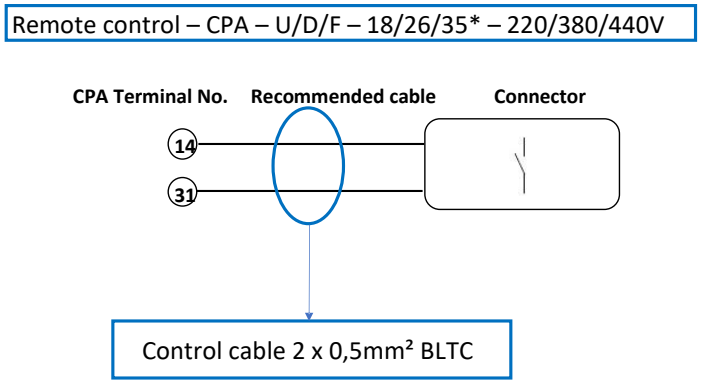
Parallel configuration must be used for terminal connection (the terminals must be crimped in an identical way in both terminals) and connection standard T568A or T568B can be followed, as shown in the figure below:



4.4.5. External interconnections

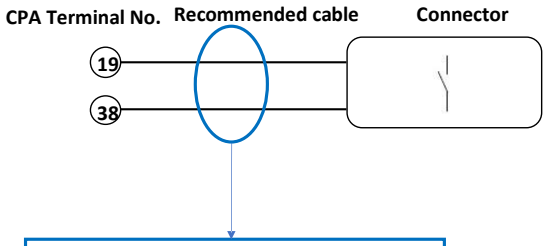
The cooling units provide some contacts for interaction with external interfaces, for example, integration of a button for remote operation of the cooling unit or a fault signal contact (alarm summary). The contacts are all available for connection directly on the terminal strip. The connection should be made as follows:

4.4.5.1. Remote control – CPA



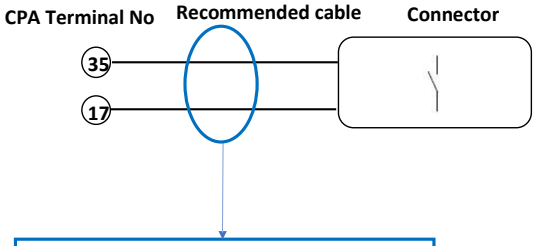
*: For CPA-35 Downflow and Displacement version at 380V consider the following connection

Remote control – CPA – D/F – 35 – 380V



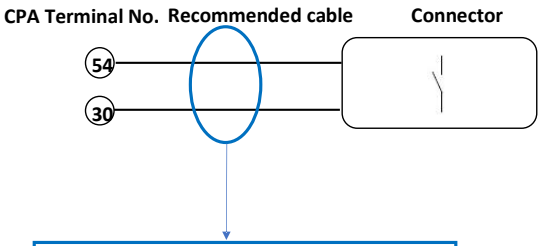
Control cable 2 x 0,5mm² BLTC

Remote control – CPA – D/F – 35 – 380V



Control cable 2 x 0,5mm² BLTC

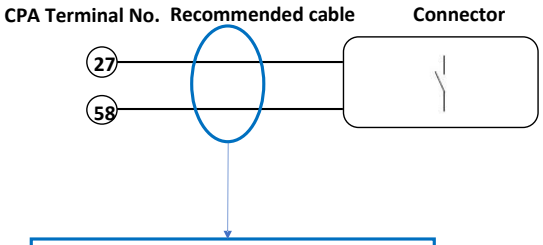
Remote control – CPA – U/D/F – 70* – 220/380/440V



Control cable 2 x 0,5mm² BLTC

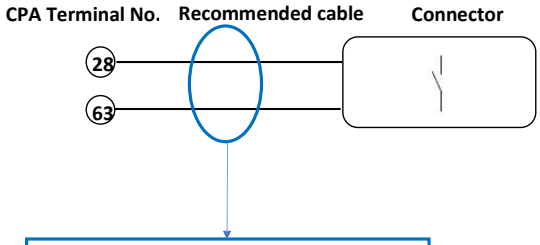
*: For CPA-70 Upflow version at 380V consider the following connection

Remote control – CPA – U – 70 – 380V



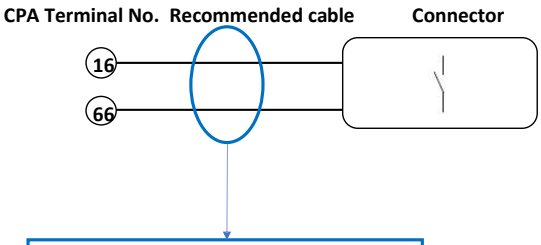
Control cable 2 x 0,5mm² BLTC

Remote control – CPA – D/F – 100 – 220/380/440V



Control cable 2 x 0,5mm² BLTC

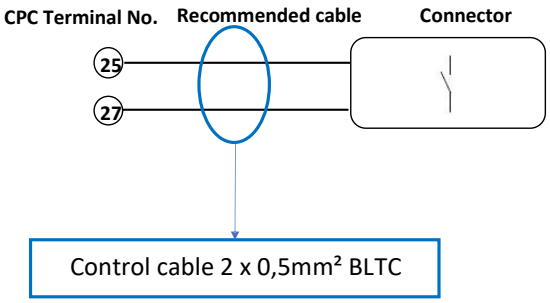
Remote control – CPA – U – 100 – 220/380/440V



Control cable 2 x 0,5mm² BLTC

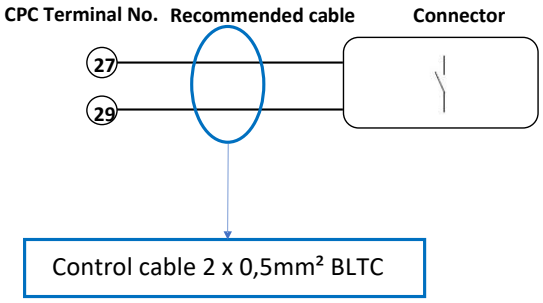
4.4.5.2. Remote control – CPC

Remote control – CPC – U/D/F – 18/26*/35 – 220/380/440V

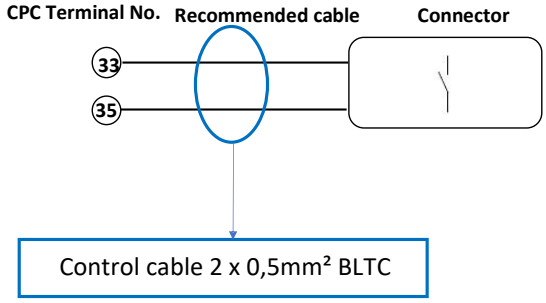


*: For CPC-26 Downflow and Displacement version at 380V consider the following connection

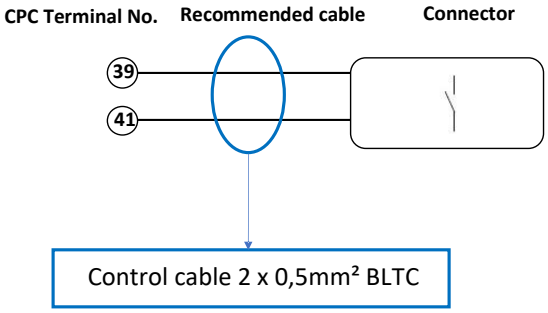
Remote control – CPC – D/F – 26 – 380V



Remote control – CPC – U/D/F – 50/70 – 220/380/440V

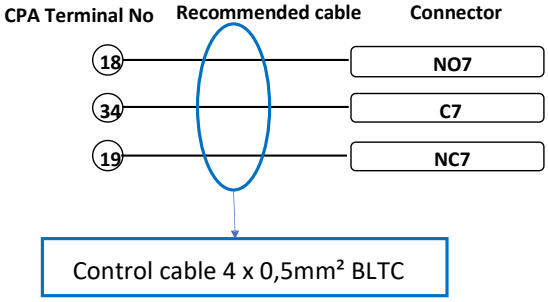


Remote control – CPC – U/D/F – 100 – 220/380/440V



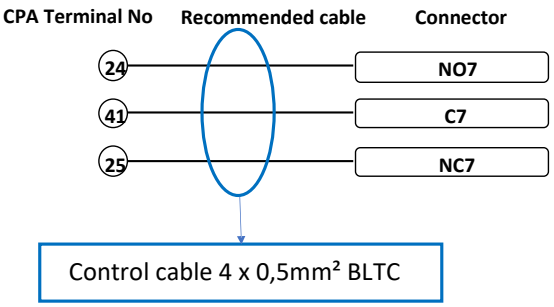
4.4.5.3. Alarm Summary – CPA

Alarm Summary – CPA – U/D/F – 18/26/35* – 220/380/440V

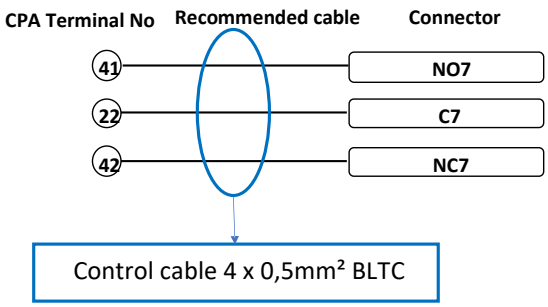


*: For CPA-35 Downflow and Displacement version at 380V consider the following connection

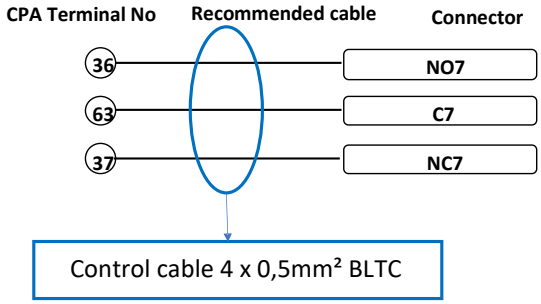
Alarm Summary – CPA – D/F – 35 – 380V



Alarm Summary – CPA – U/D/F – 50 – 220/380/440V

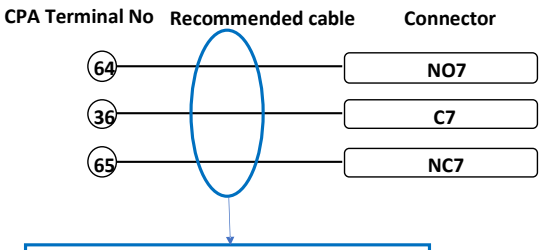


Alarm Summary – CPA – U/D/F – 70* – 220/380/440V

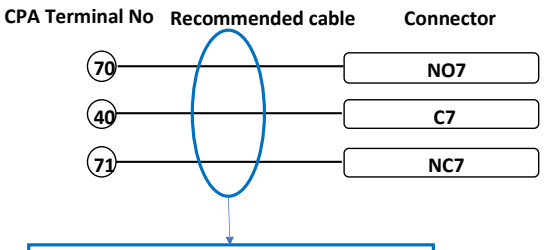


*: For CPA - 70 Upflow version at 380V consider the following connection

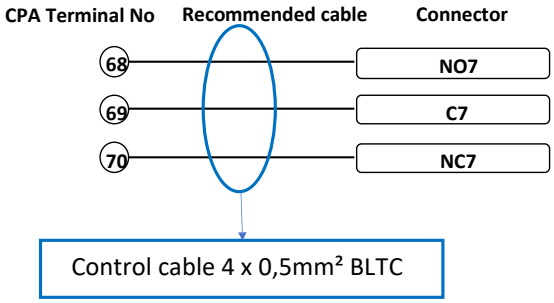
Alarm Summary – CPA – U – 70 – 380V



Alarm Summary – CPA – D/F – 100 – 220/380/440V

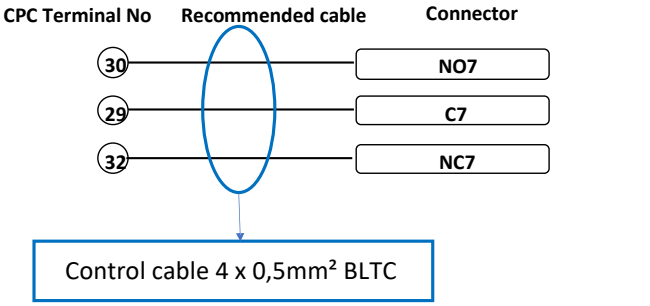


Alarm Summary – CPA – U – 100 – 220/380/440V

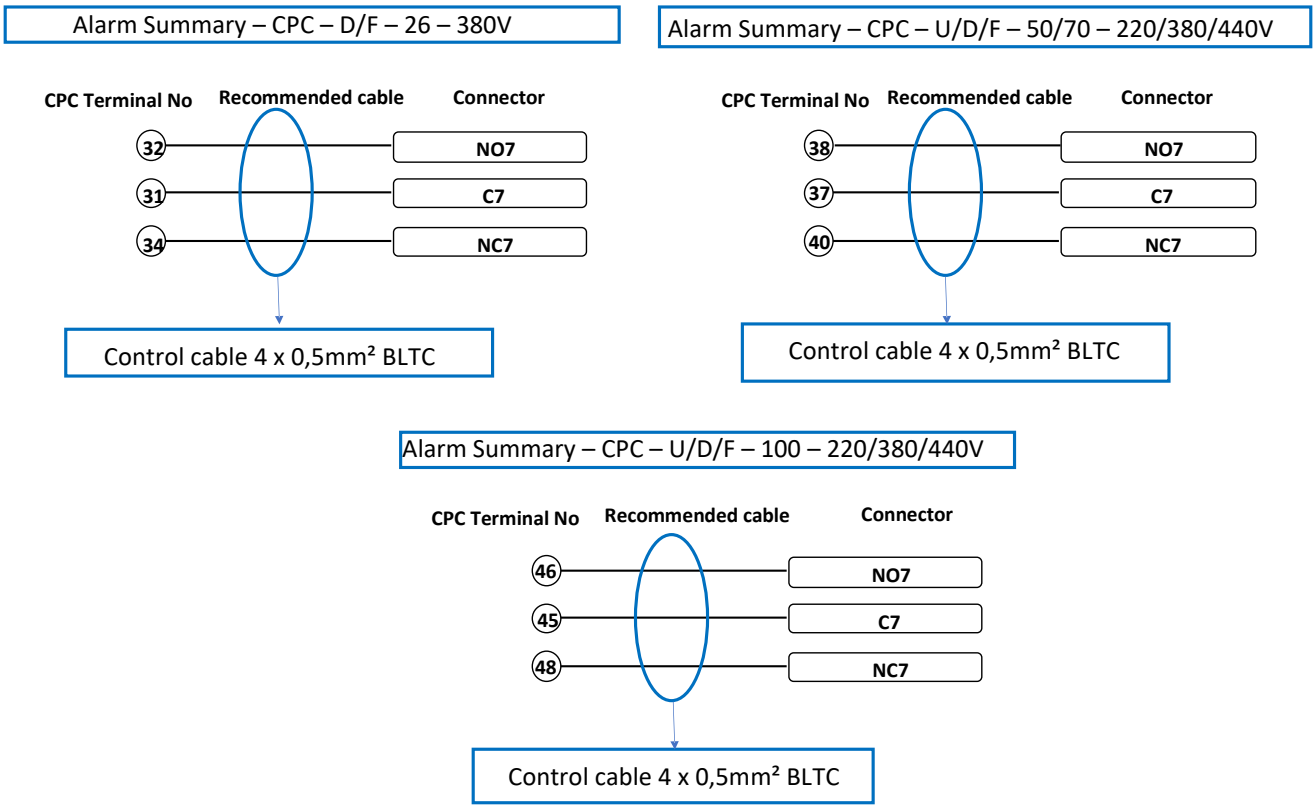


4.4.5.4. Alarm Summary – CPC

Alarm Summary – CPC – U/D/F – 18/26*/35 – 220/380/440V



*: For CPC-26 Downflow and Displacement version at 380V consider the following connection



4.4.6. Interconnection of units for rotation regime

In an installation with more than one unit it is possible to realize a network communication between the controllers to enable the rotation regime between the units, determining the time for rotation between them and the number of units in simultaneous operation. To perform the communication between the units, cables must be used according to the specifications in item 4.4.3 and a switch must be installed. After interconnecting the units, consult the controller setup for configuration of the "Multi Weather" and "Network Configuration" session within the controller settings menu.

To enable rotation regime it is necessary to adjust the addressing of the controllers, since the unit controllers are supplied with default addressing. Inside the "Network Configuration" menu are located all the addressing parameters of the units. Each unit must be set to a unique IP range, so that there is no communication failure between the units.

4.5. CPA Cooling installation

The cooling interconnection between the evaporator unit (CPA) and remote condenser (CR) must be made with copper pipes, according to ASTM C12200, and the suggested piping diameters and wall thickness are indicated according to the table below:

CPA Model	Connection dimensions			
	Discharge line	Wall thickness	Liquid line	Wall thickness
CPA-18	5/8”	1/16”	1/2”	1/16”
CPA-26	3/4”	1/16”	5/8”	1/16”
CPA-35	7/8”	1/16”	5/8”	1/16”
CPA-50	7/8”	1/16”	3/4”	1/16”
CPA-70	2 x 7/8”	1/16”	2 x 5/8”	1/16”
CPA-100	2 x 7/8”	1/16”	2 x 3/4”	1/16”

The refrigeration circuit piping must be sized according to the installation conditions and must be limited according to the restrictions, recommendations and distances defined in section 4.2 of this manual, such as bends, reductions, valves and other accessories, maintaining the equivalent length and the positioning of the remote condenser can be done at the same level, above or below the evaporator unit. The tubes used for interconnection between evaporator and condenser units, as well as accessories, must be clean and free of moisture.

The connection between pipes and components should be made through spigots, never through butt weld, using a brazing process and filler material containing 15% silver according to DIN EN 1044.

To avoid the formation of oxide contaminants inside the tubes and accessories, the brazing process must be carried out with the injection of nitrogen.

The discharge and liquid pipes must be at least 25mm apart and secured by supports at a distance of not more than 2 meters.

The following table shows some additional recommendations for assembly, considering the level of the remote condenser in relation to the evaporator unit.

Installation Settings		
CR above the CPA	**CR at CPA level**	**CR below the CPA**
• The maximum level difference allowed between the units is 17 meters; • A double siphon should be provided every 6 meters for the overheated vapor line (discharge); • A siphon must be provided every 2 meters of level difference; • The horizontal stretch should be designed with minimum inclination of 0.5% in the direction of the refrigerant flow.	• The horizontal stretch should be designed with minimum inclination of 0.5% in the direction of the refrigerant flow.	• The maximum level difference allowed between the units is 5 meters; • The horizontal stretch should be designed with minimum inclination of 0.5% in the direction of the refrigerant flow.

	**ATTENTION**	The pipes must be cleaned before being connected to the evaporator unit and remote condenser, and only nitrogen should be used for this.

	**ATTENTION**	The temperature of the discharge pipe can reach values over 90°C, so do not attach elements or components that may suffer damage or malfunction.

	**ATTENTION**	Always use an inverted siphon in the inlet and outlet lines of the unit that must be at least 150 mm above the level of the condenser.

4.5.1. Leak check

Perform the procedure to detect leak by pressurizing the refrigeration circuit with nitrogen. The system should be pressurized to maximum pressure of 4.0 MPa (40 bar).

After 1 hour check for any pressure variation and check for leak points in case variation is observed.

	**ATTENTION**	Do not apply pressure greater than 4.0 MPa (40 bar) in the refrigeration circuit.

4.5.2. Vacuum

To ensure performance in air conditioner operation it is essential to remove the moisture contained in the refrigeration circuit through an evacuation process.

The procedure to be adopted is started by connecting the vacuum pump to the service valves, installed on the high and low pressure sides of the refrigeration circuit, followed by activating the pump. When the pressure in the refrigeration circuit reaches an absolute value of 40 Pa (300 mmHg) close the connections and switch off the pump.

Then follow the pressure rise, and if the pressure increases quickly, repeat the procedure to check for leaks, because the rapid pressure variation is an indication of a leak.

Three hours after switching off the pump the value measured in a vacuum gauge must not exceed 160 Pa (1200 mmHg). In case the pressure exceeds the value specified, the procedure for leak check should be carried out.

4.5.3. Oil charge

Due to the length of the piping that interconnects the evaporator and condenser units, it is necessary to add lubricating oil to the system. The amount of oil to be added varies based on the length of the interconnection path of the units.

It is recommended to add 0.1 to 0.13 liters of oil for each Kg of coolant added to the refrigerant circuit.

4.5.4. Refrigerant load

With the refrigerant cylinder connected to the liquid tank, open the regulator and let the refrigerant in the liquid phase enter the system until the pressure reaches approximately 0.3 MPa.

The completion of the coolant load will be carried out with the equipment in operation. This requires connecting the cylinder with refrigerant to the suction line using a manifold, then opening the cylinder valve and slowly opening the manifold regulator. Allow the refrigerant to enter the system until there are no more bubbles in the liquid display. In this condition, the overheating should be between 5 and 6°C and sub-cooling should be between 6 and 9°C.

	**ATTENTION**	The refrigerant load should be executed exclusively in the liquid phase.

	**ATTENTION**	Do not activate the compressor with a suction pressure below 0.05 Mpa. Operating the compressor in this situation for more than a few seconds can cause the compressor to overheat, causing irreversible damage.

4.6. CPC Hydraulic Installation

The hydraulic installation of the CP should follow the good engineering practices and comply with the local recommendations applicable to hydraulic installation standards. Mecalor does not impose strict criteria for selecting materials that should be used in the design, but it recommends the minimum required for the correct installation of the CPC line equipment.

4.6.1. Material

The material used in the hydraulic pipe may be in increasing order of cost, PVC, carbon steel, galvanized steel, copper and stainless steel. The installation with copper pipes and welded Yorkshire fittings presents the best cost-effective. Galvanized steel pipes have reasonable protection against corrosion and must be mounted with thread. An installation with PVC pipes connected with glue is the most economic solution, but it has the disadvantage of having low mechanical strength, and the tendency to break and crack with time. In counterpart, it is resistant to corrosion and the installation (as well as repair) is very simple.

	**INFORMATION**	The internal pipe of the hydraulic circuit of the CP and it is fully manufactured in stainless steel. Mecalor recommends the use of stainless steel for the design of the hydraulic pipe of the CP.

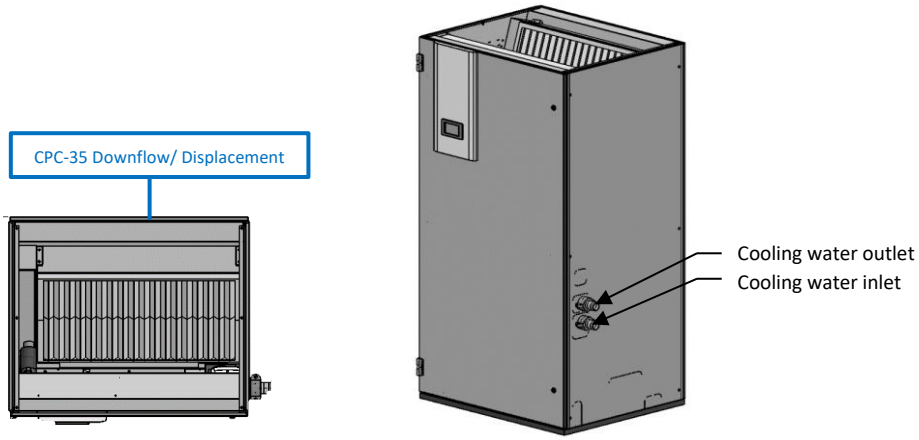
	INFORMATION	Install heat insulation on the entire length of the pipe to prevent power consumption due to heat exchange of the pipe with the environment.

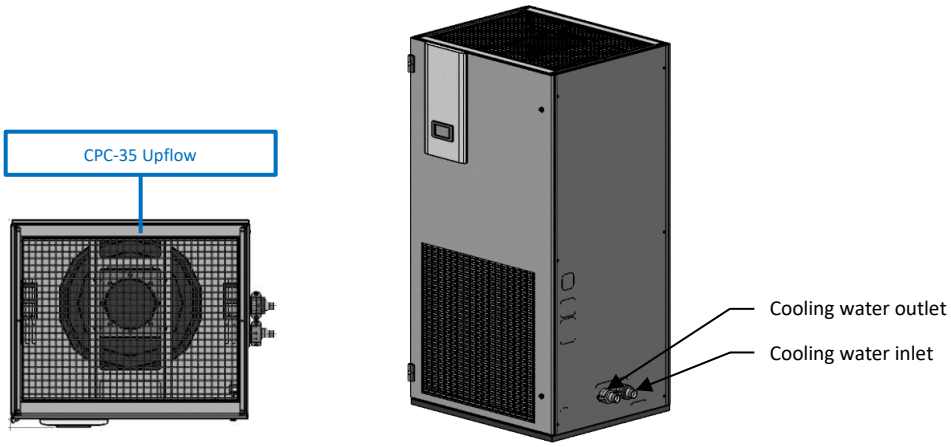
4.6.2. Interconnection points and diameters

The CPC line always contains three interconnection points consisting of a cooling water inlet point, a cooling water outlet point, and a drain point (Common to the CPA line). The diameters of the connections are shown below:

CPC Model	Connection dimensions	
	Diameter (in)	Type
CPC-18	1.1/4”	BSP Thread
CPC-26	1.1/2”	BSP Thread
CPC-35	1.1/2”	BSP Thread
CPC-50	1.1/2”	BSP Thread
CPC-70	2”	BSP Thread
CPC-100	2.1/2”	BSP Thread

The following is an image highlighting the positions of the connections in the Downflow/displacement and Upflow configuration equipment.





	INFORMATION	We recommend the installation of the shut-off valves in the cold water return and outlet of the CP for future maintenance.

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

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

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

	ATTENTION	Do not use the cold water pipe of the CP to support tool boxes or parts. 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 CP, which may cause damages to its components.

	DANGER	Never climb on the CP 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 consequent personal damages or even death.

4.6.3. Pipe cleaning

After completing the hydraulic interconnection services between the cold source and the CP, make sure the cleaning of the pipe is performed before start-up of the equipment. This service should be performed to prevent fouling of small particles in the main components of the CP.

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 cause corrosion in the major components depending on the crusted material.

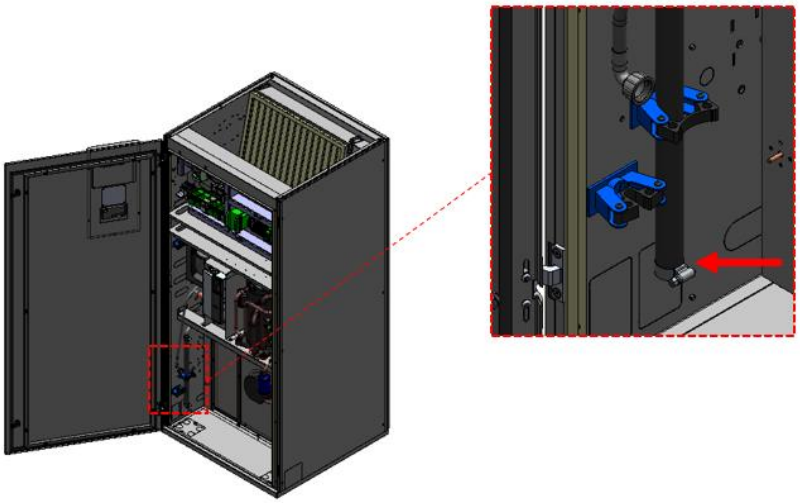
We indicate the installation of at least on filter in the hydraulic piping to clean the pipe. Cleaning should be performed after filling and purging the system, putting the equipment into operation and circulating water for a certain period of time. After this procedure, stop the circulation of water and clean the water filter installed in the line. 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.

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

4.7. Drain installation

Due to the low temperature of the refrigerant fluid that passes through the evaporator and the ambient air humidity, condensation can occur on the evaporator. There is a tray inside the CP unit to collect the condensation water from the evaporator. This tray is hydraulically connected to a 3/4" hose, which is directed to the base of the equipment connected to a 3/4" female BSP thread connector. It is the responsibility of the customer to make the connection to the drain network at the equipment installation site. The hose outlet available on the CP can be made through the base of the equipment or through the side.



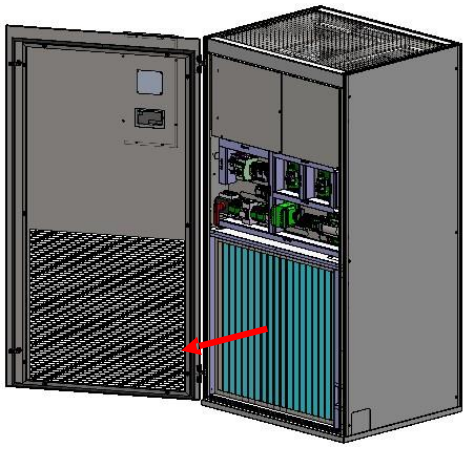
4.8. Replacement of the air filter

The CP air conditioner is supplied with G4 air filters by default, with the possibility of purchasing equipment with M5 filters in accordance with ABNT NBR 16101:2012.

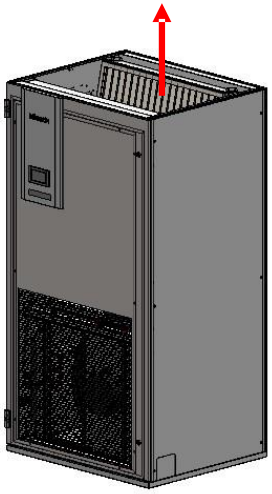
The filters are located inside the CP. In the Upflow version, the filter is positioned in the front region of the CP, below the electrical panel, while in the Downflow and Displacement versions, the filter is positioned in the upper part of the CP, parallel to the evaporator.

As time goes by, depending on the installation environment conditions, the filters will become saturated with dirt, and it will be necessary to replace them. Optionally, the equipment can be supplied with a digital differential pressure switch, which measures the pressure drop in the inlet and outlet of the filter, indicating an alert on the IHM when the loss exceeds the pressure switch limits.

The replacement of the filters is very simple, with no need to use tools. In the case of the Upflow version equipment, simply pull the filter in the opposite direction to the equipment, while in the Downflow and Displacement versions, the filter must be removed above the equipment, as illustrated below:



CPA/C Upflow Version -
Pull the Filter in the
opposite direction of the equipment



CPA/C Downflow/Displacement Version –
Pull the Filter up

For this equipment we recommend the use of pleated filters that meet the specifications below:

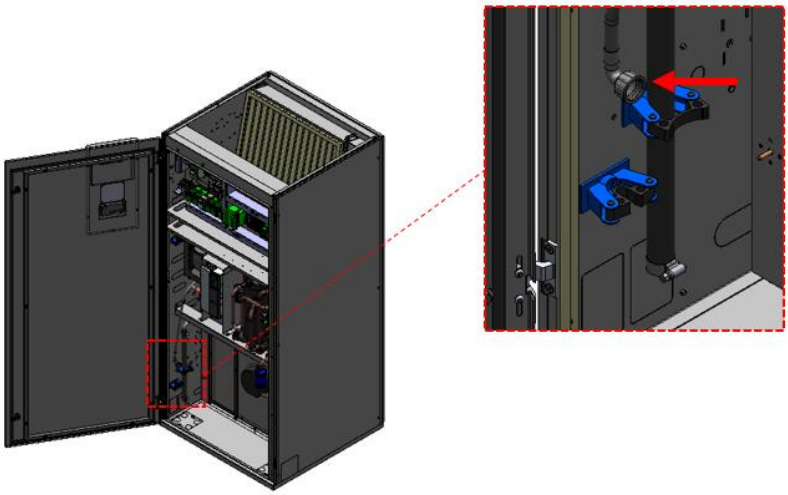
CPA model	Configuration	Filter specifications					
		Filtration grade	Dimensions	Initial load loss	Final load loss	Filtering area	Speed
CPA-18	Downflow / Displacement	G4 (Standard)	764 x 745 x 25	80 Pa	300 Pa	0,57 m²	2,3 m/s
CPA-18		M5 (Optional)	764 x 745 x 25	80 Pa	300 Pa	0,57 m²	2,3 m/s
CPA-18	Upflow	G4 (Standard)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	2,0 m/s
CPA-18		M5 (Optional)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	2,0 m/s
CPA-26	Downflow / Displacement	G4 (Standard)	1145 x 745 x 25	80 Pa	300 Pa	0,9 m²	2,2 m/s
CPA-26		M5 (Optional)	1145 x 745 x 25	80 Pa	300 Pa	0,9 m²	2,2 m/s
CPA-26	Upflow	G4 (Standard)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	2,0 m/s
CPA-26		M5 (Optional)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	2,0 m/s

CPA-35	Downflow / Displacement	G4 (Standard)	895 x 1145 x 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPA-35		M5 (Optional)	895 x 1145 x 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPA-35	Upflow	G4 (Standard)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,2 m/s
CPA-35		M5 (Optional)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,2 m/s
CPA-50	Downflow / Displacement	G4 (Standard)	1145 x 525 x 25	80 Pa	300 Pa	0,6 m²	2,4 m/s
CPA-50		G4 (Standard)	895 x 1145 x 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPA-50		M5 (Optional)	1145 x 525 x 25	80 Pa	300 Pa	0,6 m²	2,4 m/s
CPA-50		M5 (Optional)	895 x 1145 x 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPA-50	Upflow	G4 (Standard)	857 x 382 x 25	80 Pa	300 Pa	0,3 m²	3,6 m/s
CPA-50		G4 (Standard)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,6 m/s
CPA-50		M5 (Optional)	857 x 382 x 25	80 Pa	300 Pa	0,3 m²	3,6 m/s
CPA-50		M5 (Optional)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,6 m/s
CPA-70	Downflow / Displacement	G4 (Standard)	895 x 1145 x 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPA-70		M5 (Optional)	895 x 1145 x 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPA-70	Upflow	G4 (Standard)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,2 m/s
CPA-70		M5 (Optional)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,2 m/s
CPA-100	Downflow / Displacement	G4 (Standard)	1145 x 815 x 25	80 Pa	300 Pa	0,94 m²	2,5 m/s
CPA-100		M5 (Optional)	1145 x 815 x 25	80 Pa	300 Pa	0,94 m²	2,5 m/s
CPA-100	Upflow	G4 (Standard)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	3,6 m/s
CPA-100		M5 (Optional)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	3,6 m/s

CPC model	Configuration	Filter specifications					
		Filtration grade	Dimensions	Initial load loss	Final load loss	Filtering area	Speed
CPC-18	Downflow / Displacement	G4 (Standard)	745 X 865 X 25	80 Pa	300 Pa	0,66 m²	2,1 m/s
CPC-18		M5 (Optional)	745 X 865 X 25	80 Pa	300 Pa	0,66 m²	2,1 m/s
CPC-18	Upflow	G4 (Standard)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	2,1 m/s
CPC-18		M5 (Optional)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	2,1 m/s
CPC-26	Downflow / Displacement	G4 (Standard)	745 X 1220 X 25	80 Pa	300 Pa	0,9 m²	2,1 m/s
CPC-26		M5 (Optional)	745 X 1220 X 25	80 Pa	300 Pa	0,9 m²	2,1 m/s
CPC-26	Upflow	G4 (Standard)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	3,0 m/s
CPC-26		M5 (Optional)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	3,0 m/s
CPC-35	Downflow / Displacement	G4 (Standard)	895 X 1220 X 25	80 Pa	300 Pa	1,1 m²	2,3 m/s
CPC-35		M5 (Optional)	895 X 1220 X 25	80 Pa	300 Pa	1,1 m²	2,3 m/s
CPC-35	Upflow	G4 (Standard)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,4 m/s
CPC-35		M5 (Optional)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,4 m/s
CPC-50	Downflow / Displacement	G4 (Standard)	895 X 1220 X 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
		G4 (Standard)	525 X 1221 X 25	80 Pa	300 Pa	0,6 m²	2,4 m/s
CPC-50		M5 (Optional)	895 X 1220 X 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
		M5 (Optional)	525 X 1221 X 25	80 Pa	300 Pa	0,6 m²	2,4 m/s
CPC-50	Upflow	G4 (Standard)	857 x 382 x 25	80 Pa	300 Pa	0,3 m²	3,9 m/s
		G4 (Standard)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,9 m/s
CPC-50		M5 (Optional)	857 x 382 x 25	80 Pa	300 Pa	0,3 m²	3,9 m/s
		M5 (Optional)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,9 m/s
CPC-70	Downflow / Displacement	G4 (Standard)	625 X 1245 X 25	80 Pa	300 Pa	0,8 m²	2,3 m/s
CPC-70		M5 (Optional)	625 X 1245 X 25	80 Pa	300 Pa	0,8 m²	2,3 m/s
CPC-70	Upflow	G4 (Standard)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,6 m/s
CPC-70		M5 (Optional)	857 x 911 x 25	80 Pa	300 Pa	0,8 m²	3,6 m/s
CPC-100	Downflow / Displacement	G4 (Standard)	1250 X 825 X 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPC-100		M5 (Optional)	1250 X 825 X 25	80 Pa	300 Pa	1,1 m²	2,4 m/s
CPC-100	Upflow	G4 (Standard)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	3,9 m/s
CPC-100		M5 (Optional)	857 x 761 x 25	80 Pa	300 Pa	0,65 m²	3,9 m/s

4.9. Humidifier Installation

Optionally the CP can be supplied with humidification control. The humidifier is installed inside the CP, with power supply and control already integrated to the electrical panel of the CP, requiring only the water replacement and drain connections. Both connections are for ¾" hose, and the drain connection is already supplied integrated to the evaporator tray drain.

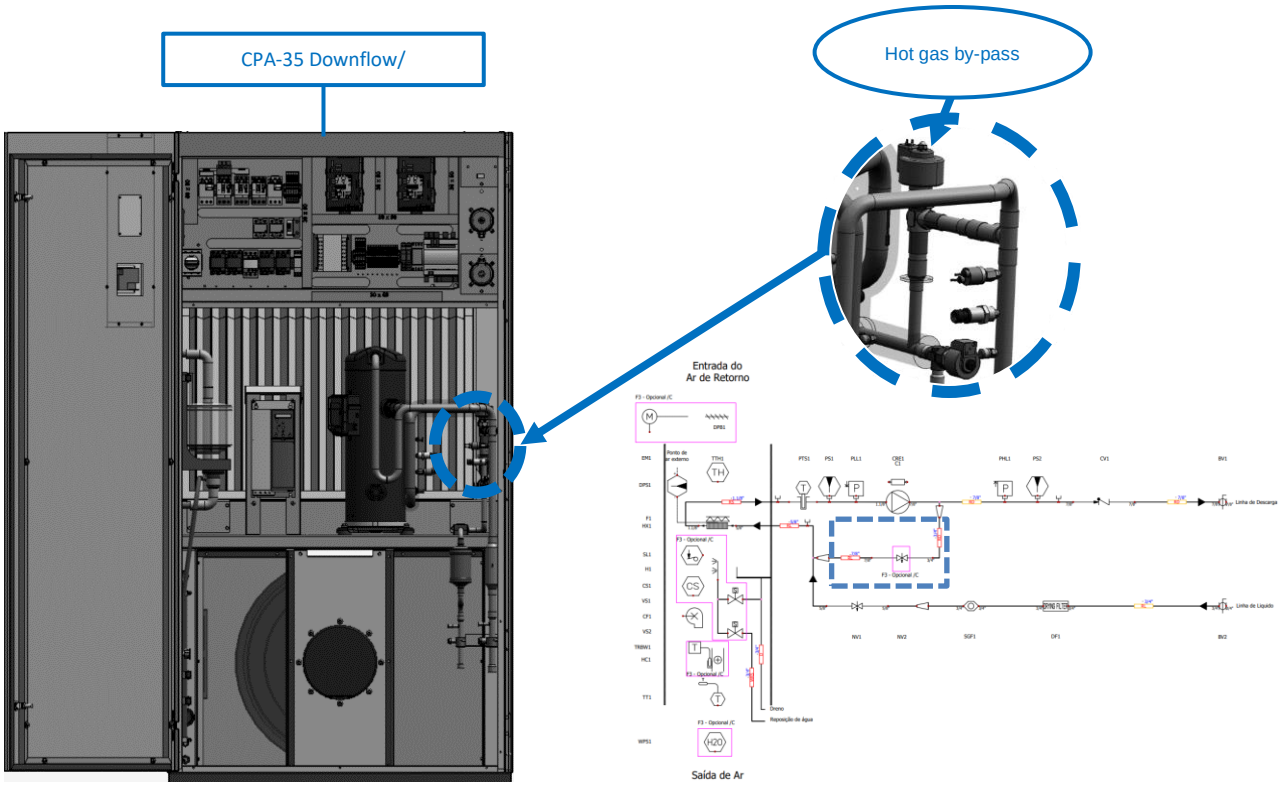


4.10. Installation of the Options

4.10.1. Hot gas by-pass

Optionally, it is possible to supply the equipment with a partial control system of the cooling capacity through the injection of superheated steam (hot gas bypass) at the inlet of the evaporator. This system is used in situations where there is a reduced thermal load condition and can also operate in combination with a variable control system (Compressor + Frequency Inverter).

This option is installed in the cooling piping of the equipment and can therefore only be factory installed. The system consists of an electronic expansion valve selected for operation in the hot gas bypass system.



4.10.2. Air filter M5

It is possible to replace the G4 air filter supplied with the equipment to ensure a finer degree of filtration. The equipment has an optional M5 air filter supplied according to ABNT NBR 16101:2012. The filter can be supplied with the equipment or installed on site, and must be replaced when it is saturated.

4.10.3. Dual electric power supply

The system is prepared for operation with an "ATS switch" for dual power supply and automatic switching in case of main power failure. In this way the system can be linked to on-site generators to maintain operation in the event of a power failure in the system.

The equipment can optionally be supplied together with the ATS switch, which must be installed at the factory.

4.10.4.SNMP Communication

The standard equipment has a Carel PLC and standard communication via MODBUS TCP/IP or MODBUS RTU RS-485, allowing the monitoring of parameters, remote on/off and setpoint adjustment. Optionally the system can be supplied with a plugin for SNMP communication, if necessary for compatibility with management or monitoring software of the plant where the equipment is installed.

4.10.5. Bacnet Communication

Besides the possibility of providing the SNMP communication plugin, it is possible to supply the equipment with a plugin for Bacnet communication, another communication option for compatibility with management or monitoring software of the plant where the equipment is installed.

4.10.6. Flooded floor sensor

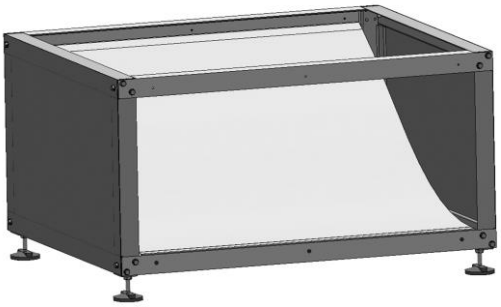
In its downflow configuration, the equipment supplies air to the false floor, which operates as a duct/plenum for air distribution in the room served by the equipment. Due to the humidity control in the room, when the system operates in dehumidification, water condensation occurs on the surfaces of the evaporator fins and tubes, generating a flow of condensate into the equipment tray. It is important that this volume of water is directed to the drainage network, because on the floor there is passage of cables, connections, and water accumulation can generate problems in the operation of the room in question, therefore, it is important to mitigate this possibility.

To avoid this problem, the system can optionally be supplied with a flooded floor sense, in order to detect and act on a possible condition where water accumulates on the floor. The sensor is installed on site, on the floor under the equipment.

4.10.7. Metal base for raised floor

When supplied in the Downflow configuration, the equipment must be installed on a metallic base leveled to the raised floor, which ensures good air distribution conditions, with low pressure drop, supports the equipment in a stable and perfectly leveled condition, and avoids height differences between the equipment and the false floor.

Optionally, a metallic base can be supplied along with the equipment, with a flow director for positioning on the raised floor, allowing fine adjustment of the height to level it with the floor, according to the images below:



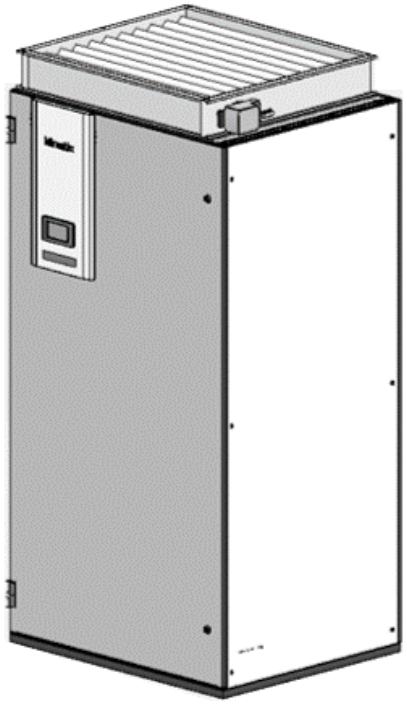
This option can be supplied in the following configurations:

		Height (mm)			
		300	400	500	600
Equipment	CPA/CPC-18	X	X	X	
	CPA/CPC-26		X	X	X
	CPA/CPC-35		X	X	X
	CPA/CPC-50		X	X	X
	CPA/CPC-70			X	X
	CPA/CPC-100			X	X

The leveling foot installed at the base allows the fine adjustment of ± 30 mm in travel, so that the height adjustment of the equipment can be perfectly aligned to the raised floor.

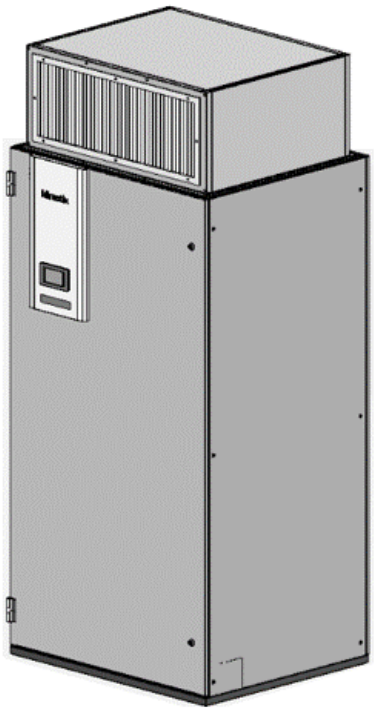
4.10.8. Damper

In installations with more than one CP unit, the inoperative units can generate a reduction in the air flow to the room if the air intake remains open, due to the air recirculation that will occur in the equipment. To avoid this type of situation, the equipment can be optionally supplied with a damper driven by an electric actuator. The damper will be closed when the equipment stops operating, either by shutting down or by automatic rotation between units. The damper will be opened automatically when the unit is activated again.



4.10.9. Plenum discharge tank

For the Upflow configuration there is the option of providing a plenum box installed at the air discharge of the unit. This allows a change in the air flow direction, where originally it would be directed in the vertical direction. With the installation of the plenum box the airflow is directed into the room in the horizontal direction.



The plenum boxes have the following dimensions for each equipment model:

		Length	Width	Height
Equipment	**CPA/CPC-18**	860 mm	553 mm	400 mm
	CPA/CPC-26	860 mm	817 mm	400 mm
	CPA/CPC-35	1010 mm	817 mm	400 mm
	CPA/CPC-50	1535 mm	817 mm	400 mm
	CPA/CPC-70	2065 mm	817 mm	400 mm
	CPA/CPC-100	2670 mm	817 mm	400 mm

4.10.10. Fan base

In the Downflow configuration besides the possibility of supplying the raised floor there is also the option of supplying a base with the air circulation fan. In this configuration, the circulation fan is installed at the same level as the false floor instead of the standard installation of the fan inside the CP unit, eliminating the need for directing air from the CP unit outlet to the false floor, thus reducing the load loss of the system.

4.10.11. Convergent three-way proportional valve.

CPC line air conditioners can be supplied with a convergent three-way proportional valve in place of the two-way proportional valve supplied in the standardized equipment. The application of this valve eliminates the need to install a by-pass valve on the hydraulic connections of the air conditioner, providing even greater accuracy in the water flow of the heat exchanger, which results in an improvement in cooling response time.

5. Operation

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

The operating actions do not require the use of PPEs unless the environment where the CP is located requires it. The customer is responsible for establishing which PPEs the operator must use. The customer must provide suitable lighting for the environment where the CP is installed and where maintenance services will be performed, if necessary.

Before starting operation with equipment, we must:

- Check the position of the service valves of the CPA cooling circuit, which must be open;
- 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 to see if the air flow of the unit is not blocked and if there is suitable ventilation in the equipment installation site.

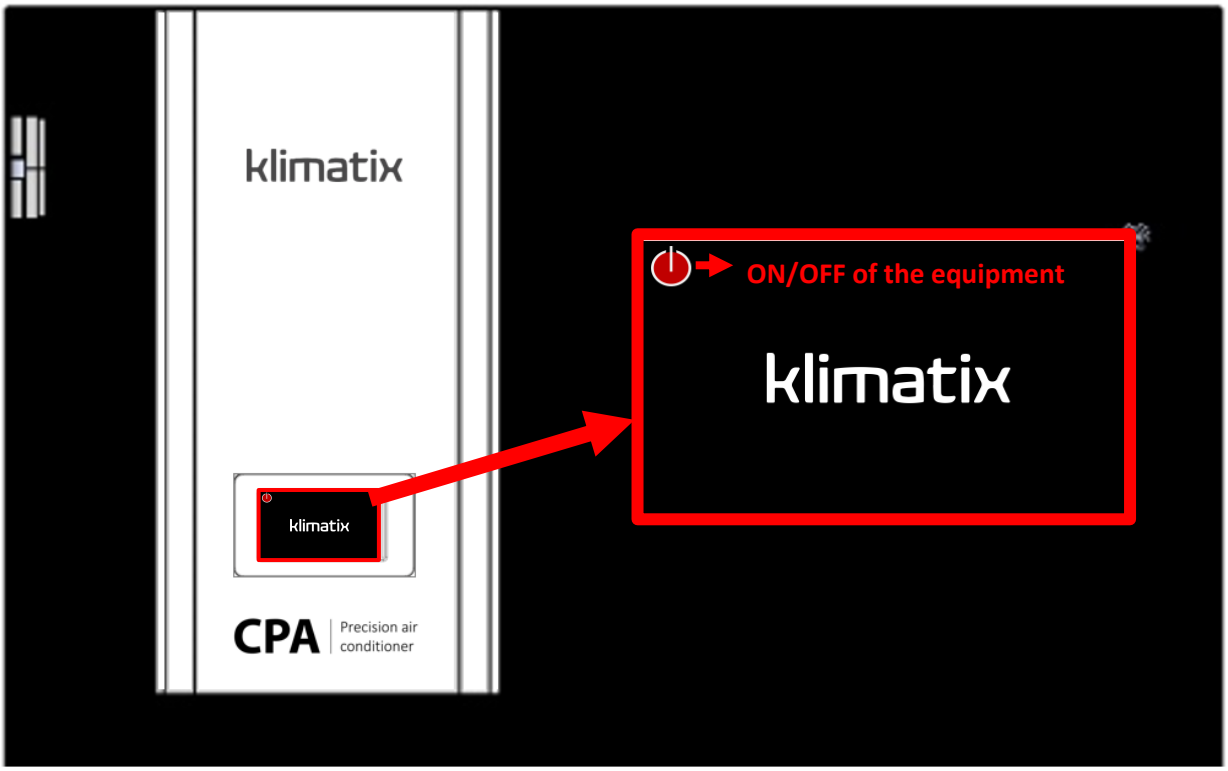
The equipment control is done through the PLC installed in the Precision Air Conditioner, including all the functions related to the temperature and humidity control of the system, including, in the case of the system with direct expansion, the drive control and rotation of the condenser fan.

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

5.1. Start-up

After performing the electrical installation, change the position of the main disconnector to the 'ON' position. The equipment will be energized.

With energized equipment the HMI should be initiated and to activate the equipment, just press the button on the top left corner of the screen, as shown in the figure below. In case the HMI does not start operating, check to see if voltage is reaching the inlet of the Main Switch and if there is no phase inversion failure. If a fault occurs, correct the phase sequence by inverting the RS phases.



	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 Mecalors Technical Support for startup of the MS.

	INFORMATION	Use the main switch only to turn off the CP power in cases of maintenance. The main switch should not be used to switch the equipment on and off routinely. For this, use the HMI. The control panel monitors the CP variables and must be powered.

5.2. Command Panel

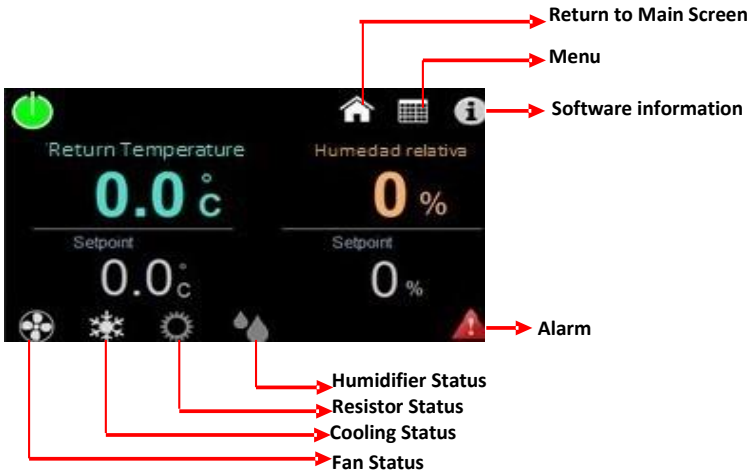
The Control Panel of the CP consists of a touch screen and it is installed on the door of the equipment, as shown in the image above. In case of a fault the HMI will present an alarm signal and the led located on the right side will turn on in red, as shown in the image below:

Alarm indication icon

5.2.1. Operating description of the MMI

MMI Mask **Presentation Screen**

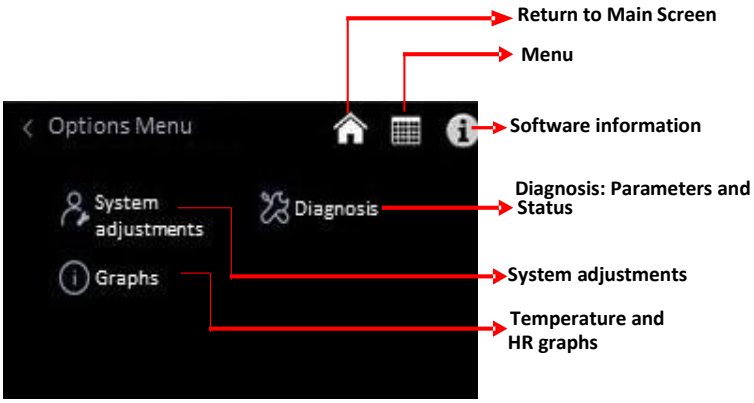
Main Screen



To change the setpoint of the return temperature or relative humidity, touch the screen and then touch the setpoint value of the parameter, a virtual keyboard will appear, type the desired value and confirm.

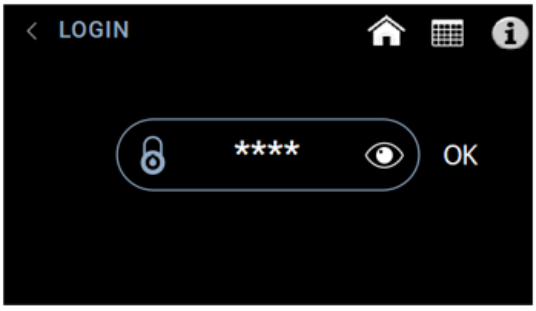
Accessing the Menu will show the other available commands:

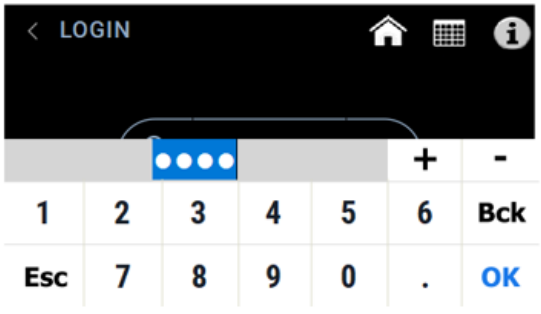
Menu



The Settings screens allow access to the configurations of the system and its components, as well as PID parameters, operating parameters, operating modes, activation of optional features (when applicable), and reading of variables.

A user or factory password is required to access it. The password entry screen is displayed when the Settings icon is touched. When you click on the field to fill in the password, the virtual keyboard will be displayed. Use the password provided in the equipment setup and then confirm it.

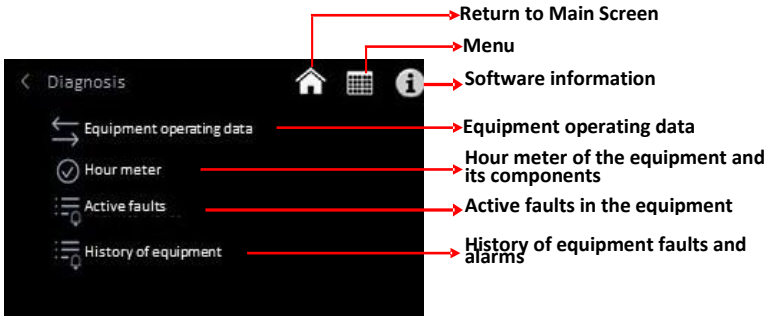




⚠	**DANGER**	It is not allowed to change the software, parameters or operating conditions on the MMI screen in the factory menu. This practice can put at risk the operator and the operation of the equipment, able to cause loss of control of the process,

		breakage of the equipment and physical damages to the operator, in addition to loss of warranty.

Diagnosis



The 'Diagnostics' screen allows the visualization of the process variables, equipment status, hours of operation of the equipment, components, and variables of the cooling system besides the active faults and the history of faults presented. After solving the fault, reset it in order to resume the operation of the equipment.

6. Maintenance

Carrying out the maintenance procedures at the recommended intervals will ensure the proper functioning of the equipment within the conditions for which it was designed and manufactured.

The maintenance activity must be carried out only by technical specialists who must observe and respect the safety rules in any type of intervention on the equipment.

It is recommended to record and control the maintenances performed.

	**DANGER**	Never perform any type of maintenance while the equipment is energized. 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.

6.1. Corrective maintenance

All CP faults are indicated on the HMI alarm screen. The failures of the CP are divided into two types: Warnings and Alarms. In case a failure occurs on the CP, before applying the procedures described below, check the failure log as described in the previous session.

When the fault is an Alert, it is only recorded in the fault history; however, in alarm conditions, the alarm icon is displayed on the HMI and the red LED on the left side of the Interface is activated, as shown in section 5.2 of this manual.

	**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.

6.2. Fault indication

All equipment faults are recorded in the HMI fault history, however, the alert signal is only issued when there are active alerts. Some alarms stop the operation of the equipment partially or completely and depending on the situation require an immediate diagnosis and solution.

When an alarm is identified, it is recommended to check the fault history to identify previously registered alerts, complementing the information for an accurate diagnosis.

Description of the fault	Component		Consequence	Type		Rearm		Probable cause	Procedure
	TAG	Description		Alert	Alarm	Manual	Automatic		
Control turned off		Enables climate (Customer interface)	Alert	X				External contact responsible for activating the open HC contact.	Check for poor contact or anomaly in the activation contact of the unit present in the customer interface.
Sequence or lack of phase	RST	Phase sequence relay	Disable cooling circuit, humidifier and resistor		X	X	X	Failure or no phase in the electric power supply	Check the 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

Electrical protections - Compressor	C	Compressor	Turns off the cooling system		X	X	X	Disarm the compressor thermal relay	Check if the compressor is operating with current within the specifications in the electrical data table. If it is identified that the current is above the nominal value of the compressor operation, check if the supply voltage is correct or if there is a bad contact in the electrical connection.
								Disarm the compressor circuit breaker	Check to see if the supply voltage of the compressor is within the specifications in the electrical data table or whether there is poor contact in the electrical connection.
High pressure fault	PHL	High pressure switch	Turns off the cooling system		X	X	X	High pressure switch disarm	Check the cleaning conditions of the condenser and the existence of hot air recirculation in the installation room of the remote condenser.
Low pressure fault	PLL	Low pressure switch	Turns off the cooling system		X	X	X	Lack/leak of refrigerant	Call a refrigeration technician to check the operation of the cooling system.

Electrical protections – Evaporator fan	CF	Circulation fan	Turns off the cooling system		X	X	X	Circulation fan thermal relay disarm	Check if the circulation fan is operating with current within the specifications in the electrical data table. If it is identified that the current is above the nominal value of the fan operation, check if the supply voltage is correct or if there is poor contact in the electrical connection. Also check if the fan is presenting any malfunction.
Electrical protections of the CU	CR	Remote condenser	Turns off the cooling system		X	X	X	Remote condenser fan thermal relay disarm	Check to see if the remote condenser fan is operating with current within the specifications of the electrical data table. If it is identified that the current is above the nominal value of the fan operation, check if the supply voltage is correct or if there is a poor contact in the electrical connection of the remote condenser.
								Remote condenser fan circuit breaker disarm	Check to see if the supply voltage of the remote condenser is within the specifications in the electrical data table or whether there is poor contact in the electrical connection.
Clogged filter	F	Air filter	Alert	X		X	X	Dirt accumulation in the air filter	Replace the air filter

Electrical protections - Resistor	Q	Resistor circuit breaker (Optional)	Disable heating resistor		X	X	X	Disarm the circuit breaker	Try to reset the circuit-breaker and check if the voltage and current of the resistor are as specified in the electrical data table.
	TRBW	Resistor safety thermostat (Optional)						Operating current of the resistor is above nominal	Check to see if the operating current of the resistor is according to the electrical data table of the equipment. If abnormalities in the operation current are identified, check for poor contact in the electrical connection or discrepancy in the supply voltage to the resistor.
Alarm for the presence of water on the floor.	CNBE1	Low Level Switch of the external tray (Optional)	Alarm		X	X	X	Water accumulation in the external tray	Check for possible clogging in the external tray drain
High Water Level in Tray Alert			Alert	X					
Fault in the sensor – Suction temperature	PTS	Suction temperature sensor of the compressor	Turns off the cooling system		X	X	X	Poor contact or defect in the suction temperature sensor of the compressor	Check for contact or fault in the temperature sensor reading
High temperature in suction	PTS	Suction temperature sensor of the compressor	Alert	X				Temperature above the limit established in the equipment setup	Check if the temperature sensor is reading the correct temperature and if it is positioned correctly in the piping. If it is, check to see if the compressor is functioning within the operating limits.
Low temperature in suction								Temperature below the limit established in the equipment setup	
Fault in the sensor – Water inlet temperature	PTS	Cold water inlet temperature sensor	Alarm		X	X	X	Poor contact or defective temperature sensor	Check for contact or fault in the temperature sensor reading

High cold water inlet temperature	PTS	Cold water inlet temperature sensor	Alert	X				Temperature above the limit established in the equipment setup	Check if the temperature sensor is reading the correct temperature and if it is positioned correctly in the piping. If it is, check to see if the compressor is functioning within the operating limits.
Low cold water inlet temperature								Temperature below the limit established in the equipment setup	
Fault in the sensor - Humidity Of the air return	TTH	Temperature and humidity sensor	Turn off the humidifier and heating resistor		X	X	X	Humidity not within sensor reading range	Check to see if the sensor is properly in the equipment
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.
High/low humidity in the air return			Alert	X				Humidity not within setpoint	Check for the existence of other alerts/alarms that are preventing the operation of the Humidifier.
Fault in the sensor – Air return temperature	TTH	Temperature and humidity sensor	Disable cooling circuit, humidifier and resistor		X	X	X	Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.
High/low temperature in the air return			Alert	X				Temperature not within setpoint	Check for the existence of other alerts/alarms that are preventing the operation of the equipment.
Fault in the sensor – Air outlet temperature	SA	Air outlet temperature sensor	Disable cooling circuit, humidifier and resistor		X	X	X	Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.
High/low temperature in the air outlet			Alert	X				Temperature not within setpoint	Check for the existence of other alerts/alarms that are preventing the operation of the equipment.

Fault in the sensor – High pressure	HP	Discharge pressure transmitter	Disable cooling circuit, humidifier and resistor		X	X	X	Pressure not within transmitter reading range	Check to see if the sensor is properly in the equipment.
								Poor contact in the transmitter connection	Check to see if the electrical connection of the sensor is according to the electrical diagram.
High/low condensation temperature			Alert	X				Pressure not within limits established in the PLC setup	Check for the existence of other alerts/alarms that are preventing the operation of the equipment. Check the cleaning conditions of the condenser and the existence of hot air recirculation in the installation room of the remote condenser.
Fault in the sensor – Low pressure of system 1	HP	Discharge pressure transmitter (Remote Unit)	Disable cooling circuit, humidifier and resistor		X	X	X	Pressure not within transmitter reading range	Check to see if the sensor is properly in the equipment.
								Poor contact in the transmitter connection	Check to see if the electrical connection of the sensor is according to the electrical diagram.
High/low evaporation temperature – System 1			Alert	X				Pressure not within limits established in the PLC setup	Check for the existence of other alerts/alarms that are preventing the operation of the equipment. Check for bubbles in the liquid display during compressor operation, symptom of possible lack/leakage of refrigerant fluid in the system.
Fault in the sensor – Water outlet temperature	SA	Water outlet temperature sensor	Disable cooling circuit, humidifier and resistor		X	X	X	Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.

High/low temperature in the water outlet			Alert	X				Temperature not within setpoint	Check for the existence of other alerts/alarms that are preventing the operation of the equipment.
Protection – Suction Sensor	PTS	Suction temperature sensor of the compressor	Disable the cooling system		X	X	X	Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.
Protection – Air return temperature sensor	SA	Temperature sensor	Alert	X				Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.
Protection - High temperature of the water inlet	SA	Temperature sensor	Alert	X				Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.
Protection – Air outlet temperature sensor	SA	Temperature sensor	Alert	X				Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.
Protection – Low air outlet temperature	SA	Temperature sensor	Alert	X				Temperature not within sensor reading range	Check to see if the sensor is properly in the equipment.
								Bad sensor connection contact	Check to see if the electrical connection of the sensor is according to the electrical diagram.

Protection - Condensation pressure sensor	HP	Discharge pressure transmitter (Remote Unit)	Alert	X				Pressure not within transmitter reading range	Check to see if the transmitter is properly positioned in the equipment.
								Poor contact in the transmitter connection	Check to see if the electrical connection of the transmitter is according to the electrical diagram.
Protection - High/low condensation temperature	HP	Discharge pressure transmitter (Remote Unit)	Alert	X				Pressure not within transmitter reading range	Check to see if the transmitter is properly positioned in the equipment.
								Poor contact in the transmitter connection	Check to see if the electrical connection of the transmitter is according to the electrical diagram.
Protection – Low evaporation temperature	HP	Suction pressure transmitter	Alert	X				Pressure not within transmitter reading range	Check to see if the transmitter is properly positioned in the equipment.
								Poor contact in the transmitter connection	Check to see if the electrical connection of the transmitter is according to the electrical diagram.
Low SH protection	NV	Electronic expansion valve	Alert – Expansion valve will perform modulations to adjust the SH. If the problem persists, the system will give off an alarm	X				Low superheating	Call a refrigeration technician to check the operation of the cooling system.
								Reading error in the pressure sensors/transmitters	Check to see if the temperature sensors and pressure transmitters are making the correct reading. In case of abnormalities, check to see if the connection of the component is according to the electrical diagram.

Low SH alarm	NV	Electronic expansion valve	Disable the cooling system		X	X	X	Low superheating	Call a refrigeration technician to check the operation of the cooling system.
								Reading error in the pressure sensors/transmitters	Check to see if the temperature sensors and pressure transmitters are making the correct reading. In case of abnormalities, check to see if the connection of the component is according to the electrical diagram.
LOP Protection	NV	Electronic expansion valve	Alert – Expansion valve will perform modulations to adjust the LOP. If the problem persists, the system will give off an alarm	X				Low pressure	Call a refrigeration technician to check the operation of the cooling system.
								Reading error in the pressure sensors/transmitters	Check to see if the temperature sensors and pressure transmitters are making the correct reading. In case of abnormalities, check to see if the connection of the component is according to the electrical diagram.
LOP Alarm	NV	Electronic expansion valve	Disable the cooling system		X	X	X	Low pressure	Call a refrigeration technician to check the operation of the cooling system.
								Reading error in the pressure sensors/transmitters	Check to see if the temperature sensors and pressure transmitters are making the correct reading. In case of abnormalities, check to see if the connection of the component is according to the electrical diagram.

MOP Protection	NV	Electronic expansion valve	Alert – Expansion valve will perform modulations to adjust the MOP. If the problem persists, the system will give off an alarm	X				High pressure	Check the cleaning conditions of the condenser and the existence of hot air recirculation in the installation room of the remote unit.
								Reading error in the pressure sensors/transmitters	Check to see if the temperature sensors and pressure transmitters are making the correct reading. In case of abnormalities, check to see if the connection of the component is according to the electrical diagram
MOP Alarm	NV	Electronic expansion valve	Disable the cooling system	X		X	X	High pressure	Check the cleaning conditions of the condenser and the existence of hot air recirculation in the installation room of the remote unit.
								Reading error in the pressure sensors/transmitters	Check to see if the temperature sensors and pressure transmitters are making the correct reading. In case of abnormalities, check to see if the connection of the component is according to the electrical diagram
Fault in the inverter	INV	Frequency inverter	Disable the cooling system	X		X	X	Fault in the frequency inverter	Check the alarm indicated on the frequency inverter display and consult the causes and possible solutions in the frequency inverter setup
Fault in humidifier control thermal relay	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Disarm the humidifier thermal relay	Check to see if the power voltage of the humidifier is correct.
Required replacement of the cylinder								Humidifier cylinder life exhausted	Replace humidifier cylinder

High conductivity in the humidifier water	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Bad quality of the supply water of the humidifier	Carry out cleaning of the cylinder of the humidifier and the electrodes of the conductivity sensor. If the problem persists, install a demineralization system for the supply water of the humidifier.
Configuration error	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Incorrect parameterization	Check to see if the parameters of the controller are according to the setup.
Humidity controller memory error	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Damaged controller	Check to see if the parameters of the controller are according to the setup. If the fault persists, contact technical support.
High current in the electrode of the humidifier	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Very high conductivity	Drain part of the water and reset the alarm.
								High water level	Check to see if the drain valve is okay.
								Fault in the electrode	Search for leaks on the water supply valve.
Low steam production in the humidifier	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Water conductivity not within the limits	Check the quality of the water used in the humidifier supply.
								Excessive dirt in the humidifier cylinder	Clean the cylinder and replace the water.
								Incorrect parameterization	Check to see if the parameters of the controller are according to the setup.
High level of water in the humidifier	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Excessive water in the humidifier cylinder	Check to see if the drain valve is okay.
External signal not connected	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Incorrect parameterization	Check to see if the parameters of the controller are according to the setup.
								Poor contact	Check to see if all connections of the humidifier controller are according to the electrical diagram.

Fault in the filling of the humidifier	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Lack of supply water of humidifier cylinder	Check for possible lack of water in the supply system of the humidifier or clogging in the hydraulic circuit.
Fault in humidifier drainage	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Fault in the drainage valve	Check to see if the electric power supply of the drainage valve is correct. Also check for possible clogging in the drainage system.
Cleaning in the humidifier is required	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Dirt accumulation in the humidifier cylinder	Clean the humidifier cylinder and replace the water.
Foam in the cylinder	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Foam accumulation in the humidifier cylinder	Check for chemical products in the supply water of the humidifier. Clean the cylinder and replace the water.
Salt accumulation in the humidifier	HU1 (Optional)	Humidifier	Disable the humidifier	X		X	X	Bad quality of the supply water of the humidifier	Clean the cylinder and replace the supply water. Install a water demineralization system if the problem persists.

6.3. Preventive Maintenance

The correct Preventive Maintenance of the equipment may avoid future breakdowns and shutdowns of the equipment. For this, we recommend the procedures described below.

Preventive Maintenance – General			
Item	**Frequency**	**Procedure**	**Notes**
Painting Structure	Monthly	Check the general condition of the cabinet painting and retouch if necessary	Cabinet color specifications: white color: RAL 9003 black color: RAL 9005
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 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	
Fixation of components	Every six months	Check the engine fittings: fan and compressor	Retighten loose bolts.
Air filter	Monthly	Check the condition of the air filters	Replace if saturated or damaged.
Equipment door	Monthly	Open and close the door	The door should be aligned and closed without difficulty.
Equipment door locks	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 the fastening of the seal and possible damages to the seal of the panel.	Carry out the replacement of the electrical panel seal.
Preventive Maintenance - Mechanical			
Item	**Frequency**	**Procedure**	**Notes**
Fan	Monthly	Check for excess vibration in the fan	Retighten the bolts
		Check cleaning of the fan	Clean the fan
Evaporator	Every six months	Check to see if it is necessary to clean the evaporator fins.	Clean the blades of the condensers with compressed air at low pressure (be careful not to bend the exchanger fins)
		Check for signs of encrustation on the fins of the heat exchanger	In case of signs of encrustation, call for technical support to assess and eventually carry out technical cleaning of the exchanger.
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
Proportional Valve	Quarterly	Check for leaks, fastening and tightening the terminals	Review fastening, retighten terminals and remake the connections of the valve, if necessary
		Check manual operation of the valve	In case of damages, call technical support to assess the need to replace the valve
Refrigeration piping	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 fluid leak should be corrected as soon as possible. Complete the refrigerant gas and oil load of the compressor, if necessary

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
		Measure the fan currents and compare them to the current specified in the equipment checklist	Motor operation should be checked when currents are above specified
Engine switch box	Every six months	Check to see if the junction box terminals of the engines are coming loose	Retighten the terminals or bolts
Temperature sensors	Monthly	Check the calibration of the temperature sensors	Compare the outlet and return air temperatures with a calibrated standard thermometer
Clean the electrical panel	Every six months	Clean inside the electrical panel	The electrical panel should be clean, without dust and fillings
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
Electrical Resistance	Quarterly	Check fastening, cleaning and tightening the terminals	Carry out cleaning and retighten terminals and bolts
		Measure the current of phases R, S and T	Compare 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 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 the currents indicated in the electrical data of the equipment
		Check the voltage variation between phases	It should not exceed 10%

7. Technical Services

In addition to quality products, 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.

7.2. Preventive Maintenance Agreements

With aim to prevent failures, Mecalor offers customized preventive maintenance agreements. The agreements consist of the periodic visits of technicians who check, gauge and test the condition and performance of the equipments.

The Mecalor Preventive Maintenance Plan ensures a longer service life of the equipment and reduces the possibility of shutdowns due to failure.

7.3. Retrofitting (Reform of Equipments)

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 CP 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 its components by their application in other machines or in the production process, for example: reuse the CP fans, or their electric engines, the frequency inverter, etc.
- Separate materials that can be recycled and send them for recycling; for example: recycle aluminum, stainless steel, bronze, plastics of the CP.
- Separate non-reusable materials and components and dispose of them, observing the effective legal recommendations. Special attention should be given to batteries, lubricant oil and cooling gas.

In case cooling fluid leakage is detected in the equipment, the maintenance of the leak should be requested urgently.

Any mechanical or electric component that is replaced due to failure or upgrade should be disposed according to the recommendations and effective rules.

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 equipments 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. Attachments

The documents that complement this manual are described below and may be different from standardized documents. In case the nomenclature of the CP has a special character, consult the specific documentation applied to the equipment.

	**INFORMATION**	Consult the special documents in case the nomenclature of the CP has a special character as described in the *nomenclature* section in the *technical characteristics* chapter of this manual..

Complementary documents of this manual:

1. Engineering design, containing:
   - Dimensional;
   - Electrical Data;
   - Layout of the electrical panel;
   - Wiring diagram;
   - Flowchart;
   - List of Components.
2. Fan Operation Curve;
3. Equipment setup;
4. Modbus and SNMP addressing table.