



# INSTALLATION AND OPERATION MANUAL

Condensing dehumidifier

Condair DC 50-W / 75-W / DC 100-W / DC 150-W

DC 200-W

DC 50-R / 75-R / DC 100-R / DC 150-R

DC 200-R

# Thank you for choosing Condair

Installation date (MM/DD/YYYY):

Commissioning date (MM/DD/YYYY):

Site:

Model:

Serial number:

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## 1. INTRODUCTION

### 1.1 Preliminary information

Reproduction, storage or transmission of any part of this publication in any form, without the prior written consent of the Company, is prohibited.

The unit to which these instructions refer, is designed to be used for the the purposes described and to be operated in accordance with these instructions.

The Company will not be liable for claims for damage caused to persons, animals, material goods or property caused by improper installation, adjustment and maintenance or improper use. Any use not specified in this manual is prohibited.

This document is intended to provide information only and does not form a contract with third parties.

The Company pursues a policy of constant improvement and development of its products and therefore reserves the right to change the specifications and the documentation at any time, without notice and without obligation to update existing equipment.

### 1.2 Aim and content of the manual

These instructions are intended to provide the information required for the selection, installation, use and maintenance of the unit.

They have been prepared in accordance with the European Union laws and with the technical standards in force at the date of issue of the instructions.

The instructions contain all the necessary information to prevent any reasonably foreseeable misuse.

### 1.3 How to store this manual

The manual must be kept in a suitable place with easy access for users and operators, protected from dust and damp.

The manual must always accompany the unit during the entire life cycle of the same and therefore must be transferred to any subsequent user.

### 1.4 Manual Update

It is recommended that the manual is updated to the latest revision available.

If updates are sent to the customer they must be added to this manual.

The latest information regarding the use of its products is available by contacting the Company.

### 1.5 How to use this manual



The manual is an integral part of the unit.

Users or operators must consult the manual before performing any operation and especially so when transporting, handling, installing, maintaining, or dismantling the unit in order to eliminate uncertainty and reduce risk.



In these instructions symbols have been used (described in the following paragraphs) to draw the attention of operators and users to the operations that have a higher risk and which must be performed safely.

### 1.6 Potential Risks

Whilst the unit has been designed to minimize any risk posed to the safety of people who will interact with it, it has not been technically possible to eliminate completely the causes of risk. It is therefore necessary to refer to the requirements and symbolism below:

LOCATION OF RISK	POTENTIAL RISK	METHOD OF INJURY	PRECAUTIONS
Thermal heat exchangers.	Small stab wounds.	Contact	Avoid any contact, use protective gloves.
Fan and fan grilles.	Cuts, eye damage, broken bones.	Insertion of sharp objects through the grid while the fans are operating.	Never put objects through the protection grilles.
Internal component: compressors and discharge pipes	Burns.	Contact	Avoid any contact, use protective gloves.
Internal component: electric cables and metallic parts	Electrocution, severe burns.	Defect in the supply cable insulation, live metallic parts.	Adequate protection of power cables, ensure correct earthing of all metal parts.
External to unit: unit enclosure	Poisoning, severe burns.	Fire due to short circuit or overheating of the supply cable external to unit.	Size cables and mains protection system in accordance with iee regulations.
Low pressure safety valve.	Poisoning, severe burns.	High evaporating pressure causing a refrigerant discharge during maintenance.	Carefully check the evaporating pressure during the maintenance operations.
High pressure safety valve.	Poisoning, severe burns, hearing loss.	Activation of the high pressure safety valve with the refrigerant circuit open.	If possible, do not open the refrigerant circuit valve; carefully check the condensing pressure; use all the personal protective equipment required by law.
Entire unit	External fire	Fire due to natural disasters or combustions of elements nearby unit	Provide the necessary fire-fighting equipment
Entire unit	Explosion, injuries, burns, poisoning, folgoramento for natural disasters or earthquake.	Breakages, failures due to natural disasters or earthquake	Plan the necessary precautions both electrical (suitable differential magneto and electrical protection of the supply lines; greatest care during the connections of the metal parts), and mechanical (special anchors or seismic vibrations to prevent breakages or accidental falls).

## 1.7 General Description of Symbols Used

Safety symbols combined in accordance with ISO 3864-2:



### **BANNED**

A black symbol inside a red circle with a red diagonal indicates an action that should not be performed.



### **WARNING**

A black graphic symbol added to a yellow triangle with black edges indicates danger.



### **ACTION REQUIRED**

A white symbol inserted in a blue circle indicates an action that must be done to avoid a risk.

Safety symbols combined in accordance with ISO 3864-2:



The graphic symbol "warning" is qualified with additional safety information (text or other symbols).

### 1.8 Safety symbols used



**GENERAL RISK**

Observe all signs placed next to the pictogram. The failure to follow directions may create a risk situation that may be injurious to the user.



**ELECTRICAL HAZARD**

Observe all signs placed next to the pictogram. The symbol indicates components of the unit and actions described in this manual that could create an electrical hazard.



**MOVING PARTS**

The symbol indicates those moving parts of the unit that could create risk.



**HOT SURFACES**

The symbol indicates those components with high surface temperature that could create risks.



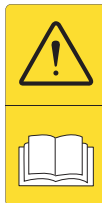
**SHARP SURFACES**

The symbol indicates components or parts that could cause stab wounds.



**EARTH CONNECTION**

The symbol identifies Earthing connection points in the unit.



**READ AND UNDERSTAND THE INSTRUCTIONS**

Read and understand the instructions of the machine before any operations.



**RECOVER OR RECYCLE MATERIAL**

### 1.9 Limitations and prohibited use

The machine is designed and built exclusively for the uses described in "Limitations of use" of the technical manual. Any other use is prohibited because it may pose a potential risk to the health of operators and users.



The unit is not suitable for operations in environments:

- excessively dusty or potentially explosive atmospheres;
- where there are vibrations;
- where there are electromagnetic fields;
- where there are aggressive atmospheres



### 1.10 Unit identification

Each unit has a rating plate that provides key information regarding the machine. The rating plate may differ from the one shown below as the example is for a standard unit without accessories. For all electrical information not provided on the label, refer to the wiring diagram. A facsimile of the label is shown below:

		Manufacturer: PD322111	
Condair Group AG, Talstrasse 35-37, 8808 Pfäffikon SZ			
<b>1DC0.075A-2B</b> <small>Modello Model</small>		<b>123456</b> <small>Matricola Serial number</small>	
<b>1</b> <small>Categoria PED PED Category</small>		<b>8/2017</b> <small>Data di fabbricazione Manufacture date</small>	
<b>R410A</b> <small>Tipo refrigerante Refrigerant type</small>	<b>2</b> <small>Gruppo fluido Fluid group</small>	<b>2088</b> <small>GWP</small>	
<b>C1 0,6 Kg</b> <small>Carica refrigerante Refrigerant charge</small>	<b>C2</b> <small>C3</small> <small>C4</small>	<b>1,25 ton</b> <small>CO<sub>2</sub> Equivalente CO<sub>2</sub> Equivalente</small>	
<b>230V-1ph-50Hz</b> <small>Tensione-Fasi-Frequenza Voltage-Phases-Frequency</small>	<b>6,10 A</b> <small>F.L.A. (A)</small>	<b>1,40 kW</b> <small>F.L.L. (kW)</small>	
<small>LATO BASSA PRESSIONE LOW PRESSURE SIDE</small>		<small>LATO ALTA PRESSIONE HIGH PRESSURE SIDE</small>	
<b>22 bar</b> <small>PS</small>		<b>42 bar</b> <small>PS</small>	
<small>Min</small> <b>-30 °C</b>	<small>Max</small> <b>+130 °C</b>	<small>Min</small> <b>-30 °C</b>	<small>Max</small> <b>+130 °C</b>
<small>Temperatura di progetto Design temperature</small>		<small>Temperatura di progetto Design temperature</small>	
<b>71 Kg</b> <small>Peso a vuoto Weight</small>			
Contiene gas fluorurati ad effetto serra disciplinati dal protocollo di Kyoto Contains fluorinated greenhouse gasses covered by the Kyoto protocol			
			



The product label should never be removed from the unit.

## 2. SAFETY

### 2.1 Warning re potentially hazardous toxic substances

#### 2.1.1 Identification of the Type of Refrigerant Fluid Used: R410A

- Difluoromethane (HFC-32) 50% by weight CAS No.: 000075-10-5
- Pentafluoroethane (HFC-125) 50% by weight CAS No.: 000354-33-6

#### 2.1.2 Identification of the Type of Oil Used.

The lubricant used is polyester oil. Please refer to the information provided on the compressor data plate.



For further information regarding the characteristics of the refrigerant and oil used, refer to the safety data sheets available from the refrigerant and oil manufacturers.

Main Ecological Information Regarding the Types of refrigerants Fluids used.



**ENVIRONMENTAL PROTECTION** : Read the ecological information and the following instructions carefully.

#### 2.1.3 Persistence and degradation

The refrigerants used decompose in the lower atmosphere (troposphere) relatively quickly. The decomposed products are highly dispersible and therefore have a very low concentration. They do not influence the photochemical smog which is not among the VOC volatile organic compounds (as stipulated in the guidelines to the UNECE). The constituent refrigerants of R410A (R32, R125), do not damage the ozone layer. These substances are regulated under the Montreal Protocol (revised 1992) and regulations EC no. 2037/200 of 29 June 2000.

#### 2.1.4 Effects of discharges

Discharges into the atmosphere of this product does not cause a long-term contamination.

#### 2.1.5 Exposure controls and personal protection

Wear protective clothing and gloves, protect your eyes and face

#### 2.1.6 Professional exposure limits

R410A  
HFC-32 TWA 1000 ppm  
HFC-125 TWA 1000 ppm

## 2.2 Refrigerant handling



Users and maintenance personnel must be adequately informed about the possible risks of handling potentially toxic substances. Failure to follow such instructions can cause damage to personnel or to the unit.

## 2.3 Prevent inhalation of high vapor concentration

Atmospheric concentrations of refrigerant must be minimized and kept to a level that is below the occupational exposure limit. Vapor is heavier than air and can form dangerous concentrations near the ground where the ventilation rate is lower. Always ensure adequate ventilation. Avoid contact with open flames and hot surfaces as this can cause toxic and irritating decomposition products to form. Avoid contact between liquid refrigerant and the eyes or skin.

## 2.4 Procedures to be adopted in the event of accidental release of refrigerant

Ensure suitable personal protection (especially respiratory protection) during cleaning operations.

If deemed safe, isolate the source of the leak. If the leakage is small and if adequate ventilation is provided, allow the refrigerant to evaporate. If the loss is substantial ensure that measures are taken to adequately ventilate the area.

Contain spilled material with sand, earth or other suitable absorbent material.

Do not allow the refrigerant to enter drains, sewers or basements, as pockets of vapor can form.

## 2.5 Main Toxicological Information Regarding the Type of refrigerant used

### 2.5.1 Inhalation

A high atmospheric concentration can cause anaesthetic effects with possible loss of consciousness. Prolonged exposure may lead to irregular heartbeat and cause sudden death. Higher concentrations may cause asphyxia due to the reduced oxygen content in the atmosphere.

### 2.5.2 Contact with skin

Splashes of nebulous liquid can produce frostbite. Probably not hazardous if absorbed through the skin. Repeated or prolonged contact may remove the skin's natural oils, with consequent dryness, cracking and dermatitis.

### 2.5.3 Contact with eyes

Splashes of liquid may cause frostbite.

### 2.5.4 Ingestion

While highly improbable, may produce frostbite.

## 2.6 First Aid Measures



Adhere scrupulously to the warnings and first aid procedures indicated below.

### 2.6.1 Inhalation

Move the person away from the source of exposure, keep him/her warm and let him/her rest. Administer oxygen if necessary. Attempt artificial respiration if breathing has stopped or shows signs of stopping. If the heart stops, perform external heart massage. Seek medical assistance.

### 2.6.2 Contact with skin

In case of contact with skin, wash immediately with lukewarm water. Thaw tissue using water. Remove contaminated clothing. Clothing may stick to the skin in case of frostbite. If irritation, swelling or blisters appear, seek medical assistance.

### 2.6.3 Contact with eyes

Rinse immediately using an eyewash or clean water, keeping eyelids open, for at least ten minutes. Seek medical assistance.

### 2.6.4 Ingestion

Do not induce vomiting. If the injured person is conscious, rinse his/her mouth with water and make him/her drink 200-300ml of water. Seek immediate medical assistance.

### 2.6.5 Further medical treatment

Treat symptoms and carry out support therapy as indicated. Do not administer adrenaline or similar sympathomimetic drugs following exposure, due to the risk of cardiac arrhythmia.

## 3. TECHNICAL CHARACTERISTICS

### 3.1 Unit description

All dehumidifiers of the serie are high-performances units especially designed for industrial or commercial purposes where humidity level should be controlled or water vapor condensation should be prevented. These units are particularly indicated for archives, ironing rooms, bookstores, cheese factories, underground rooms, cellars and industrial sites where high humidity level is present. This series comprises 5 models which cover a capacity range from 50 to 200 l/24h. The units are designed for easy maintenance and service, each part being readily accessible and, when required, easily replaceable thus reducing service and maintenance costs.

HBA units are designed for easy maintenance and service, each part being readily accessible and, when required, easily replaceable thus reducing service and maintenance costs. The units are supplied with a solenoid valves set for the hot gas injection used to defrost the evaporator in case of severe working conditions.

#### 3.1.1 Frame

All units are made from hot-galvanised thick sheet metal, painted with polyurethane powder enamel at 180°C to ensure the best resistance against the atmospheric agents and to operate in aggressive environments. The frame is self-supporting with removable panels. A PVC drip tray is installed on all units. The colour of the unit is RAL 9010 both for the base and for the frontal panel.

#### 3.1.2 Refrigerant circuit

The refrigerant circuit is made by using international primary brands components and according to ISO 97/23 concerning welding procedures. The refrigerant gas used in these units is R410A. The refrigerant circuit includes: capillary tube, Schrader valves for maintenance and control, pressure safety device (according to PED regulation). All the units are supplied with injection valves kit for hot gas defrost cycle.

#### 3.1.3 Compressors

The compressors are rotative type, with thermal overload protection by a klixon embedded in the motor winding. The compressor is mounted on rubber vibration dampers and it is supplied, standard, with sound-proof cover to reduce noise emission. The inspection is possible through the frontal panel of the unit that allows the maintenance of the compressor.

#### 3.1.4 Condenser and evaporator

Condensers and evaporators are made of copper pipes and aluminium fins.

The diameter of the copper pipes is 3/8" and the thickness of the aluminium fins is 0,1 mm. The tubes are mechanically expanded into the aluminium fins to improve the heat exchange factor. The geometry of these heat exchangers guarantees a low air side pressure drop and then the use of low rotation (and low noise emission) fans. All units are supplied, standard, with a powder coated steel drip tray and all evaporators are supplied with a temperature sensor used as automatic defrost probe.

#### 3.1.5 Fans

The fans are made of galvanized steel, centrifugal type. It is statically and dynamically balanced and supplied. The electric motors are directly connected to the fan; they are all at 3 speeds, with integrated thermal protection. The protection class of the motors is IP 54.

#### 3.1.6 Air filter

It is made of synthetic filtering media, ondulated type, without electro-static charge; they are all removable for differential disposal. Efficiency class G2, according to EN 779:2002.

### 3.1.7 Microprocessors

All units are supplied standard with microprocessor controls. The microprocessor controls the following functions: regulation of the water temperature, antifreeze protection, compressor timing, compressor automatic starting sequence, alarm reset, potential free contact for remote general alarm, alarms and operation leds.

### 3.1.8 Electric enclosure

The electric switch board is made according to electromagnetic compatibility norms CEE 73/23 and 89/336. The accessibility to the board is possible after removing the front panel of the unit and the OFF positioning of the main switch. If the unit is endowed of cabinet, after its removal.

### 3.1.9 Control and protection devices

All units are supplied with the following control and protection devices: defrost thermostat, which signals to the microprocessor control that a defrost cycle is needed and controls its termination, high pressure switch with automatic reset, compressor thermal overload protection, fans thermal overload protection.

### 3.1.10 Test

All the units are fully assembled and wired at the factory, carefully evacuated and dried after leak tests under pressure and then charged with refrigerant R410A. They are all fully operational tested before shipment. They all conforms to European Directives and are individually marked with the CE label and provided with Conformity Declaration.

## 3.2 Other versions

### 3.2.1 Version with cabinet (A)

Unit suitable for vertical installation.

### 3.2.2 Ducted version (P)

Unit suitable for vertical ducted installation in technical room.

### 3.3 Accessori

#### 3.2.1 Remote mechanical hygrostat (HYGR)

To be installed on the wall, it is supplied with a regulation knob and working range from 30% to 100% with precision of 3%.

#### 3.2.2 Serial interface card RS485 (INSE)

This interface card enables the controller to communicate with other devices using Modbus protocol.

#### 3.2.3 Built in-electronic sensor (temp.+humidity) (RGDD)

Built-in Electronic temperature and humidity probe.

#### 3.2.4 Louver kit and case for ducted version (KGBH)

Air grille double row adjustable brushed aluminium fins, equipped for wall mounting with subframe.

#### 3.2.5 Remote control panel (PCRL)

This panel can be mounted up to 50m (maximum) from the unit and replicates all of the control functions. It is connected using a twin cable of 0.5 mm sq section.

#### 3.2.6 Delivery and return plenum 90° (2 PIECES) (PMBH)

To be used for "P" version to direct inlet/outlet air from/to the hall and vice versa. Galvanized steel made, coated with polyurethane powder to grant best resistance to weathering and operation in harsh environments.

#### 3.2.7 Metallic Feet (ZOCC)

Metallic galvanized steel feet, painted (RAL 9010), used to install the unit on unsuitable walls (too thin, etc...). The feet can not be used in case the supply and return plenums are present.

## 3.4 Technical data

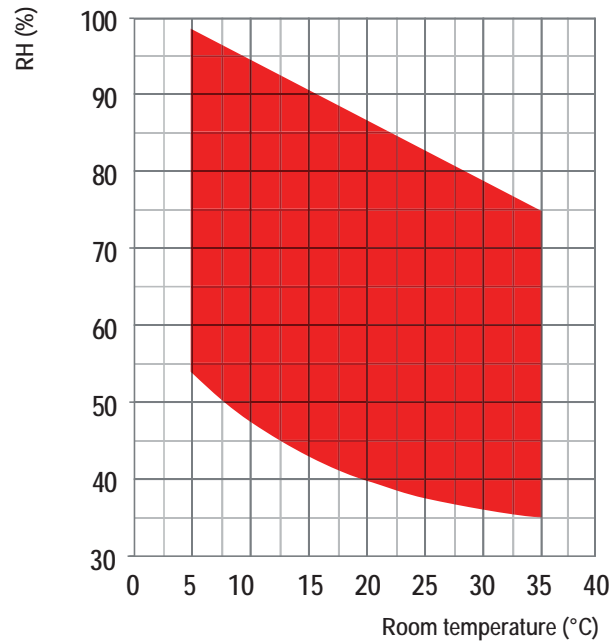
Models DC-W / DC-R		50	75	100	150	200
<b>Dehumidification capacity at 30°C - 80%</b>	l/24h	49,0	73,0	95,0	155,0	190,0
<b>Dehumidification capacity at 30°C - 60%</b>	l/24h	40,1	56,6	77,3	113,1	143,5
<b>Dehumidification capacity at 27°C - 60%</b>	l/24h	35,6	50,7	68,9	96,6	131,7
<b>Dehumidification capacity at 20°C - 60%</b>	l/24h	25,8	35,6	51,3	71,5	96,6
<b>Dehumidification capacity at 10°C - 70%</b>	l/24h	17,3	26,6	33,7	44,3	60,9
<b>Nominal input power at 30°C - 80%</b>	kW	0,9	1,2	1,6	1,9	2,5
<b>Maximum input power</b>	kW	1,2	1,5	2,0	2,3	3,1
<b>Maximum input current</b>	A	3,9	5,6	8,4	10,5	13,2
<b>Input current</b>	A	19,1	20,1	38,4	44,7	63,7
<b>Air flow</b>	m <sup>3</sup> /h	500	800	1000	1400	1650
<b>Available static pressure</b>	Pa	40	40	40	40	40
<b>Refrigerant</b>		R410A	R410A	R410A	R410A	R410A
<b>Refrigerant charge</b>	Kg	0,47	0,60	0,70	1,20	1,20
<b>Global warming potential (GWP)</b>		2088	2088	2088	2088	2088
<b>Equivalent CO<sub>2</sub> charge</b>	t	0,98	1,25	1,46	2,51	2,51
<b>Sound power level <sup>(1)</sup></b>	dB(A)	54	57	57	59	61
<b>Sound pressure level <sup>(2)</sup></b>	dB(A)	47	50	50	52	54
<b>Power Supply</b>	V/Ph/Hz	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50

Performances are referred to the following conditions:

(1) Sound power level calculated according to ISO 9614.

(2) Sound pressure level measured in free field, at 1 mt from the unit, directional factor Q=2 according to ISO 9614.

### 3.5 Operation limits



The units MUST be used within the operation limit indicated in the diagrams (see above). the warranty will be invalidated if the units are used in ambient conditions outside the limits reported. If there is the necessity to operate in different conditions, please contact our technical office.



The units are designed to operate within false ceiling and/or heated technical room. The units are NOT suitable for outdoor installations and / or technical room w/o heat (attics, rooms communicating with the outside) as it may form condensation on the walls and inside the unit cabinet causing damages.



The units are designed to work in clean ambients and with the standard characteristics of the ambient air. It's suitable not to install the unit in swimming pools or ambient with polluted and/or aggressive air. Contact the Company in case of necessity.



### 3.6 Sound data

Sound data											
Modd.	Octave band (Hz)								Lw		Lp
	63	125	250	500	1K	2K	4K	8K	dB	dB(A)	dB(A)
	dB	dB	dB	dB	dB	dB	dB	dB			
50	67,1	58,3	52,2	50,7	49,6	44,2	40,8	31,7	67,9	54	47
75	70,1	61,3	55,2	53,7	52,6	47,2	43,8	34,7	70,9	57	50
100	70,1	61,3	55,2	53,7	52,6	47,2	43,8	34,7	70,9	57	50
150	72,1	63,3	57,2	55,7	54,6	49,2	45,8	36,7	72,9	59	52
200	74,1	65,3	59,2	57,7	56,6	51,2	47,8	38,7	74,9	61	54

Lw: Sound power level according to ISO 9614.

Lp: Sound pressure level measured at 1 mt from the unit in free field conditions direction factor Q=2 according to ISO 9614.

### 3.7 Safety devices

#### 3.7.1 High pressure switch

The high pressure switch stops the unit when the discharge compressor pressure is higher than the set value. The restart is automatic, done when the pressure is under the level set in the differential value.

#### 3.7.2 Defrost thermostat

It's a device which signals to the electronic control, the necessity to make the defrost cycle. Once the defrost cycle is activated, the defrost thermostat determines also its conclusion.

#### 3.7.3 Defrosting

The frost on the coil, obstructs the air flow, reduces the available exchange area and consequently the unit performances and can seriously damage the system. All the units are supplied, standard, with a control which defrost automatically the heat exchanger if necessary. This control provides a temperature probe (defrost thermostat) on the unit evaporator. When the defrost cycle is required, the microprocessor control (according to set parameters), activates a hot gas injection, while the fan remains in operation. At the end of the defrost cycle, there is a timer delay to allow condensate water to clear from the coil.

## 4. INSTALLATION

### 4.1 General safety guidelines and use of symbols



Before undertaking any task the operator must be fully trained in the operation of the machines to be used and their controls. They must also have read and be fully conversant with all operating instructions.



All maintenance must be performed by TRAINED personnel and be in accordance with all national and local regulations.



The installation and maintenance of the unit must comply with the local regulations in force at the time of the installation.



Avoid contact and do not insert any objects into moving parts.

### 4.2 Health and safety Considerations



The workplace must be kept clean, tidy and free from objects that may prevent free movement. Appropriate lighting of the work place shall be provided to allow the operator to perform the required operations safely. Poor or too strong lighting can cause risks.



Ensure that work places are always adequately ventilated and that respirators are working, in good condition and comply fully with the requirements of the current regulations.

### 4.3 Personal protective equipment



When operating and maintaining the unit, use the following personal protective equipment listed below as required by law.



Protective footwear.



Eye protection.



Protective gloves.



Respiratory protection.



Hearing protection.

## 4.4 Inspection

When installing or servicing the unit, it is necessary to strictly follow the rules reported on this manual, to conform to all the specifications of the labels on the unit, and to take any possible precautions of the case. Not observing the rules reported on this manual can create dangerous situations. After receiving the unit, immediately check its integrity. The unit left the factory in perfect conditions; any eventual damage must be questioned to the carrier and recorded on the Delivery Note before it is signed. The company must be informed, within 8 days, of the extent of the damage. The Customer should prepare a written statement of any severe damage.

Before accepting the unit check:

- The unit did not suffer any damage during transport;
- The delivered goods are conforming to what shown in the delivery note.

### In Case of Damage

- List the damage on the delivery note
- Inform the Company of the extent of the damage within 8 days of receipt of the goods. After this time any claim will not be considered.
- A full written report is required for cases of severe damage.

## 4.5 Storage

Units should be stored under cover and ideally, should remain in their packaging. The tools that are supplied for opening the electric box should be formally transferred to the person responsible for the plant.

## 4.6 Unpacking



Packaging could be dangerous for the operators.

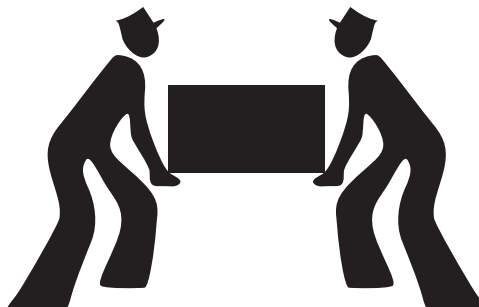
It is advisable to leave packaged units during handling and remove it before the installation. The packaging must be removed carefully to prevent any possible damage to the machine. The materials constituting the packaging may be different in nature (wood, cardboard, nylon, etc.).



The packaging materials should be separated and sent for disposal or possible recycling to specialist waste companies.

## 4.7 Lifting and handling

When unloading the unit, it is strongly recommended that sudden movements are avoided in order to protect the refrigerant circuit, copper tubes or any other unit component. Units can be lifted by using a forklift or, alternatively, using belts. Take care that the method of lifting does not damage the side panels or the cover. It is important to keep the unit vertical at all time to avoid damage to the internal components.



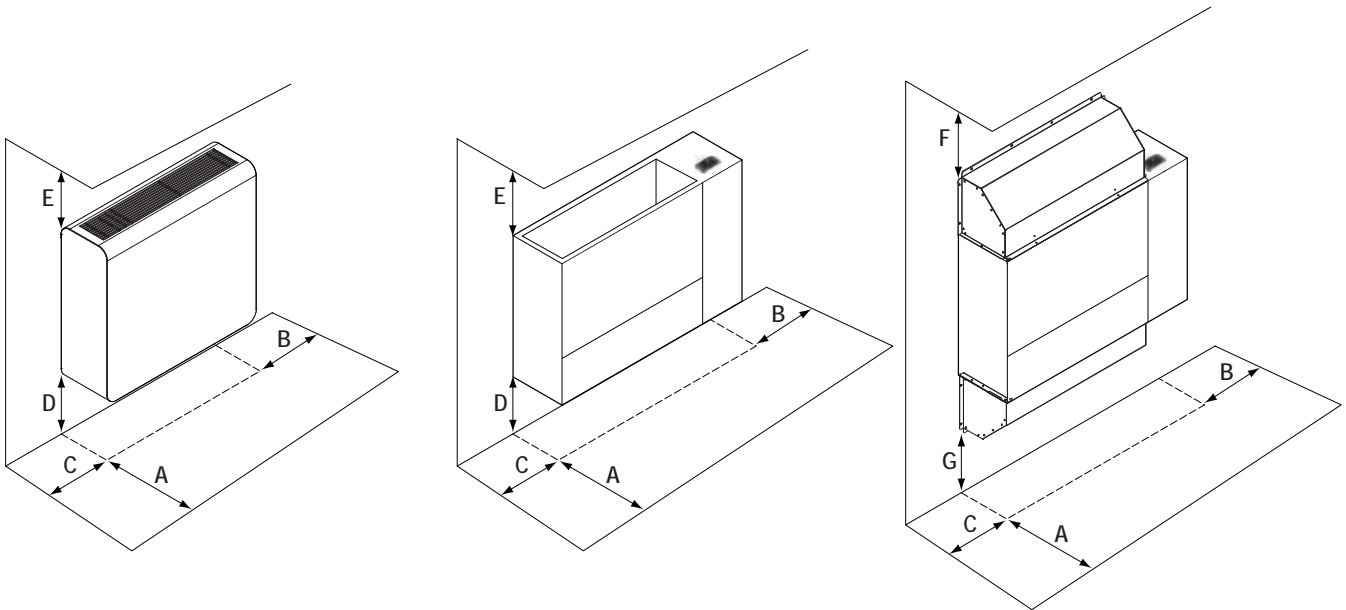
### 4.8 Location and minimum technical clearances



The unit has to be installed such that maintenance and repair is possible. The warranty does not cover costs for the provision of lifting apparatus, platforms or other lifting systems required to perform repairs during warranty period.



The installation site should be chosen in accordance with EN 378-1 and 378-3 standards. When choosing the installation site, all risks caused by accidental refrigerant leakage should be taken into consideration.

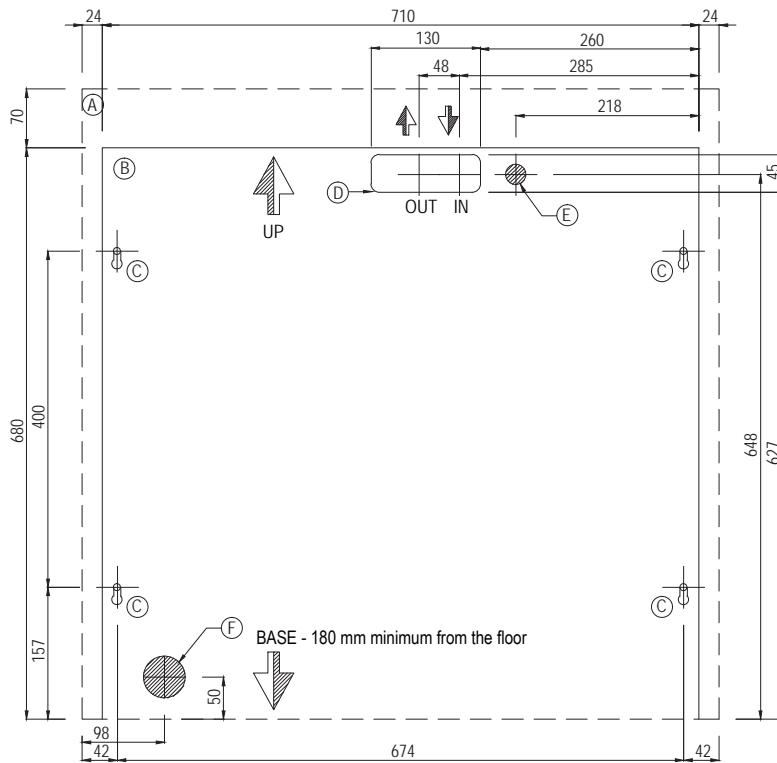


Mod.	A	B	C	D	E	F	G
050	1000	400	250	180	1500	150	150
075	1000	400	250	180	1500	150	150
100	1000	400	250	180	1500	150	150
150	1000	400	250	180	1500	150	150
200	1000	400	250	180	1500	150	150

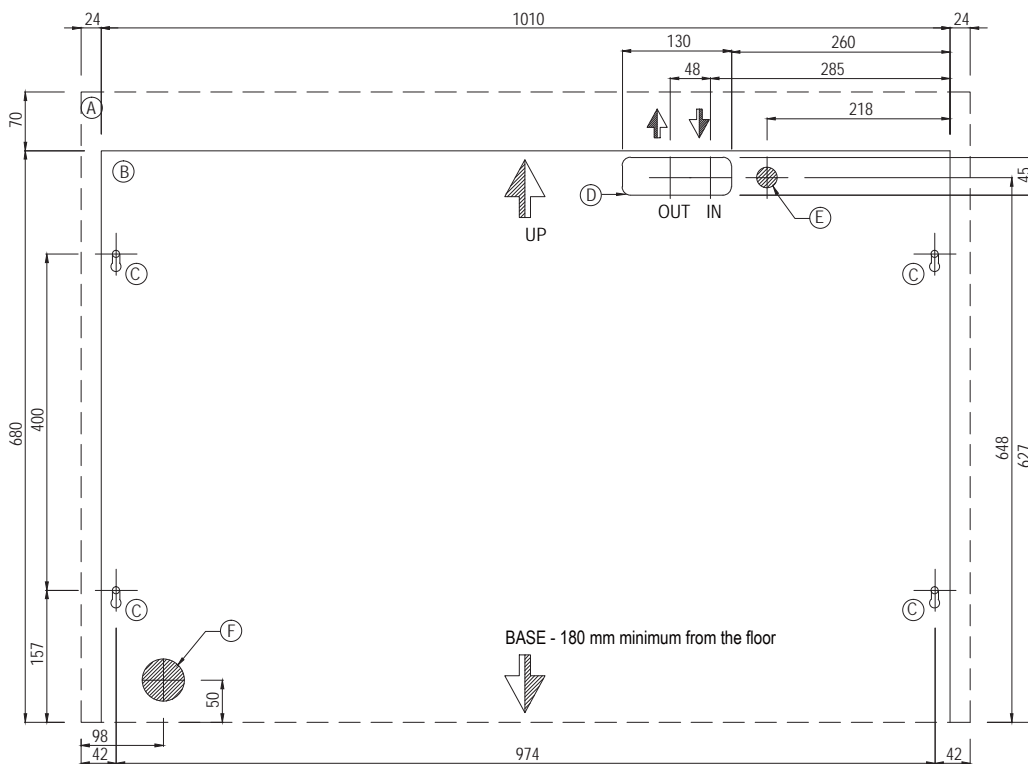
### 4.9 Unit installation

To install the units use M8 screws.

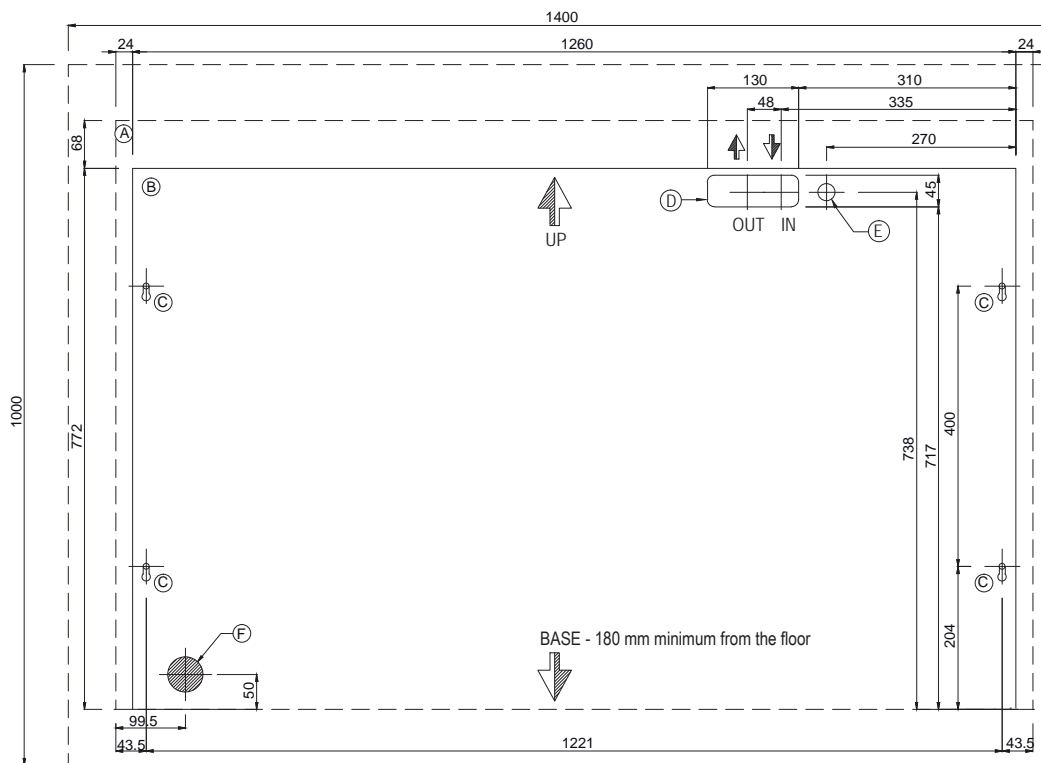
#### 4.9.1 Template DC-W 50 / DC-W 50



#### 4.9.2 Template DC-W 75 - 100 / DC-R 75 - 100

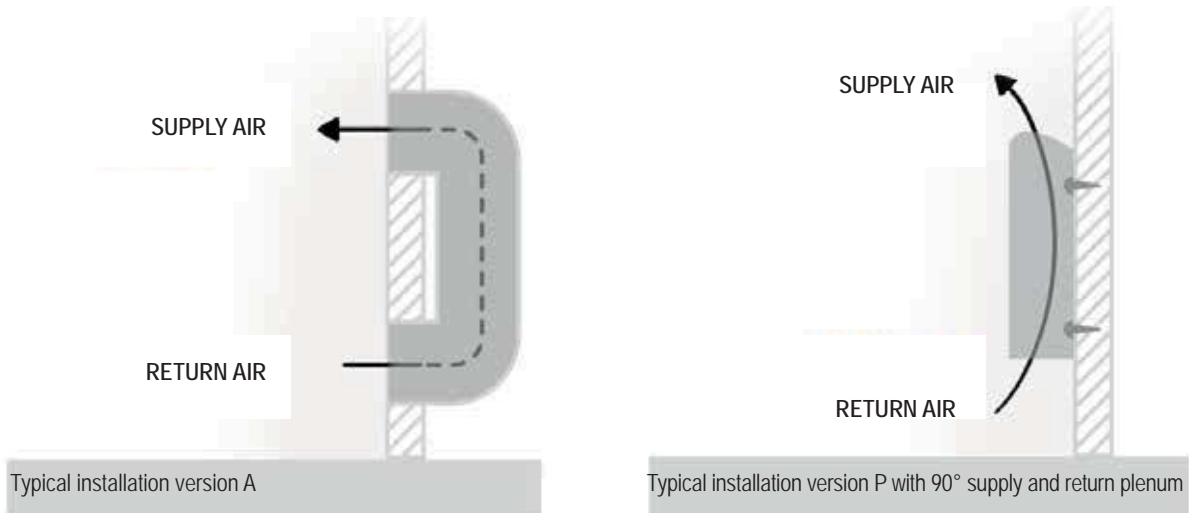


4.9.3 Template DC-W 150 - 200 / DC-R 150 - 200



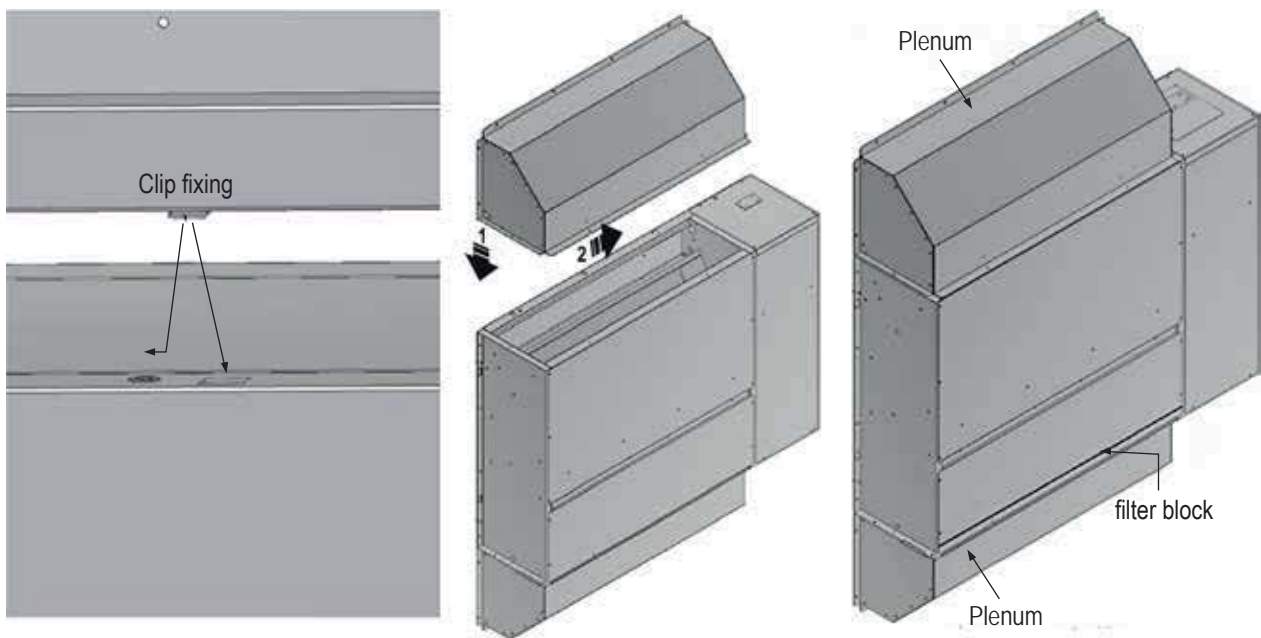
1	Connection with PLENUM
2	Unit with feet
A	Galvanized steel hood
B	Internal structure
C	Wall fixing points
D	Pipes inlet
E	Power inlet
F	Condensate discharge

### 4.10 Type of installation



### 4.11 Installation of the 90° plenum (PMBH)

As shown in the previous image, the unit DC (version R) can be installed in a technical vane near the area to be dehumidified thanks to the 90° plenum. Here below there are two images which show how to fix the plenums to the unit et the unit with the plenum. The plenums must be fixed with screws with diameter 3,5 mm.



Unit with supply and discharge plenum. Both the unit and the plenum are arranged with some holes for the fastening screws, as showed in the picture.

Insert and shift the plenum towards right till alignment of the screw holes.

#### 4.12 How to dismount the cabinet

To fix the unit to the wall and to connect the water pipes and the wiring diagram, it is necessary to remove the cabinet of the unit.



Pull the cabinet up.

Before removing completely the cabinet, disconnect the ground electric cable.

#### 4.13 How to access to electronic control

The electronic control is located underneath discharge grill, on the right side of the unit; this grill is fixed with magnetic strips to the unit cabinet.

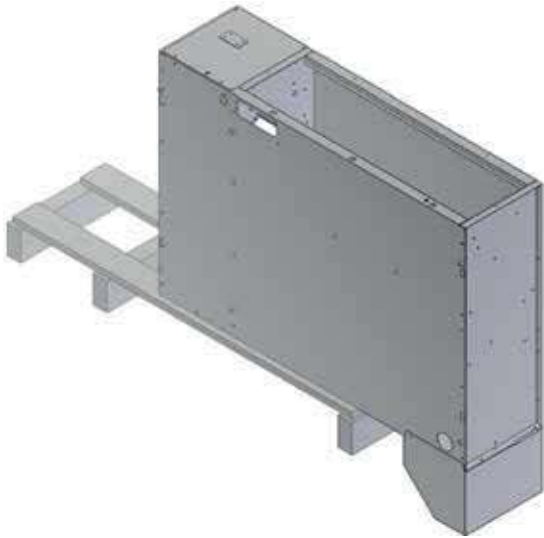
Lift up the grill to access to the control panel.



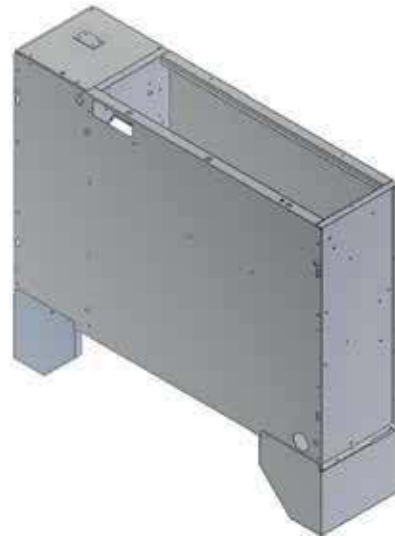


### 4.14 How to mount the feet (Accessory) (ZOCC)

All HBA units can be supplied with feet (option) to be directly mounted on the floor. This accessory is supplied spare, in a separate carton box.



Slide the unit out of the pallet and fix the first feet with the supplied screws.



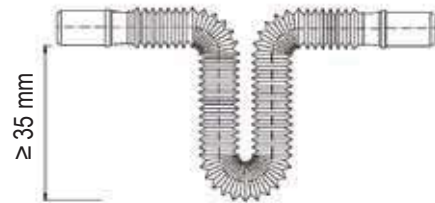
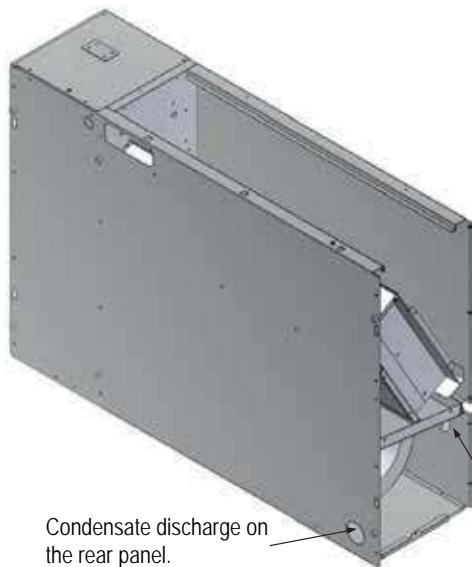
Remove the pallet and fix the second feet



The metallic feet (ZOCC) can't be installed if its installed the inlet plenum (PMBH).

### 4.15 Condensate draining connections

Condensate draining should be done using flexible rubber pipe (about 1mt. long, not supplied). The pipe will pass through the condensate drain hole located either on the rear panel of the unit or on the base frame. On the condensate discharge pipe it must be installed a syphon with a minimum height equal to the suction pressure of the fan.



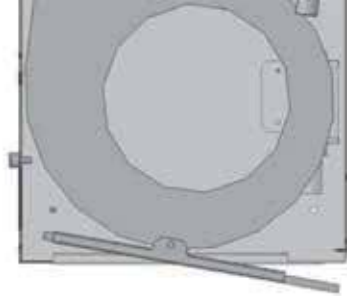
Discharge pipe  
 ø 20 mm mod. 75÷200  
 ø 16 mm mod. 50



The condensate drain line should have a water trap which may have minimum flying height equal to the suction of the fan, in any case never less than 35 mm.

### 4.16 How to remove filters

The air filter is positioned on the inferior part of the unit to be removed both from the unit with cabinet and from the unit without cabinet. You need to flow the filter towards left (towards the wall where the unit is fixed) as showed in the picture below. Afterwards it has to be inclined forward and removed.

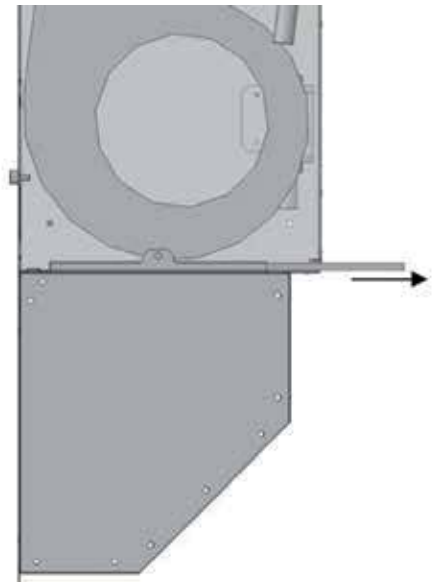
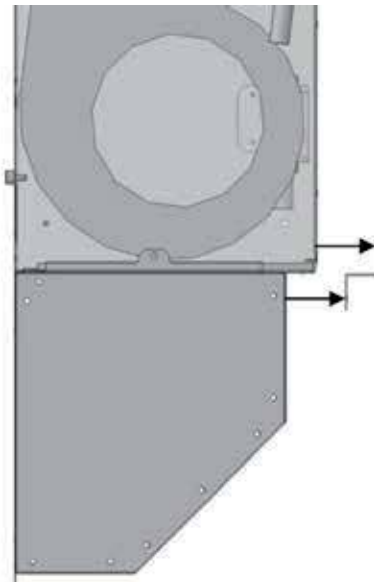
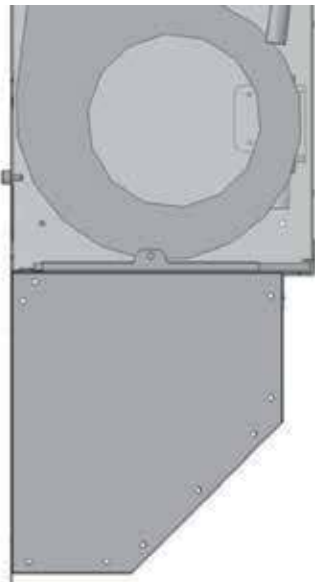


How to remove the filter from A/P units.

Turn the filter holder as shown.

Remove the filter.

### 4.14.1 How to remove the air filter in the units supplied with 90° return plenum



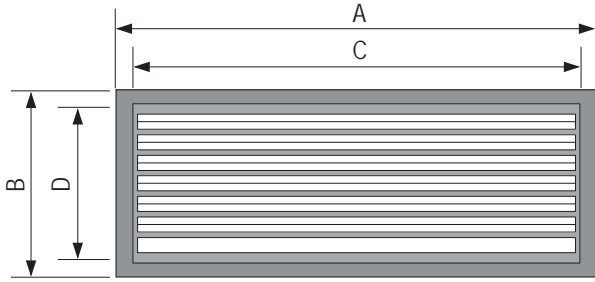
How to remove the filter from units with plenum.

Remove the bracket that locks the filter.

Remove the filter.

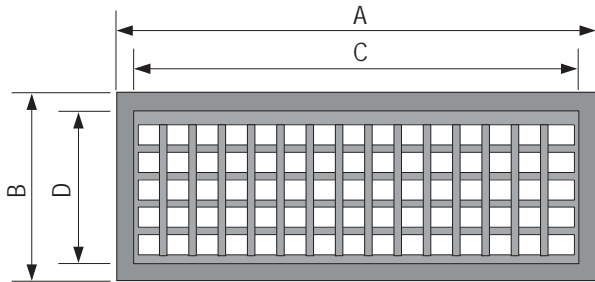
4.17 Grille kit and case for ducted version (KGBH)

4.17.1 Supply air grille



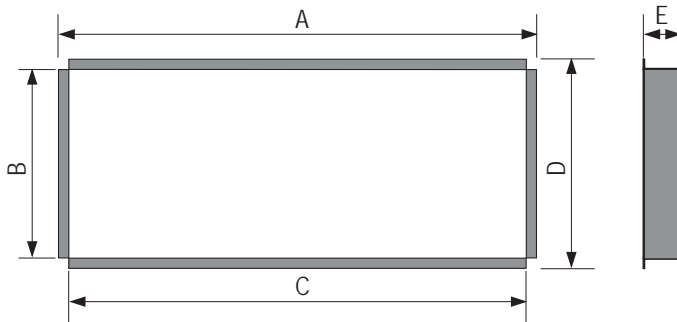
Mod.	A	B	C	D
50	452	248	420	215
75 - 100	753	253	720	220
150 - 200	957	253	918	220

4.17.2 Return air grille



Mod.	A	B	C	D
50	452	248	420	215
75 - 100	753	253	720	220
150 - 200	957	253	918	220

4.17.2 Case



Mod.	A	B	C	D	E
50	455	215	420	238	44
75 - 100	744	220	720	244	44
150 - 200	945	220	918	244	44

### 4.18 Electric connections: preliminary safety information

The electric panel is located inside the unit at the top of the technical compartment where the various components of the refrigerant circuit are also to be found. To access the electrical board, remove the front panel of the unit:



Power connections must be made in accordance to the wiring diagram enclosed with the unit and in accordance to the norms in force.



Make sure the power supply upstream of the unit is (blocked with a switch). Check that the main switch handle is padlocked and it is applied on the handle a visible sign of warning not to operate.



It must be verified that electric supply is corresponding to the unit electric nominal data (tension, phases, frequency) reported on the label in the front panel of the unit.



Power cable and line protection must be sized according to the specification reported on the form of the wiring diagram enclosed with the unit.



The cable section must be commensurate with the calibration of the system-side protection and must take into account all the factors that may influence (temperature, type of insulation, length, etc.).



Power supply must respect the reported tolerances and limits: If those tolerances should not be respected, the warranty will be invalidated.



Flow switches must be connected following the indication reported in the wiring diagram. Never bridge flow switches connections in the terminal board. Guarantee will be invalidated if connections are altered or not properly made.



Make all connections to ground provided by law and legislation.



Before any service operation on the unit, be sure that the electric supply is disconnected.



**FROST PROTECTION**

If opened, the main switch cuts the power off to any electric heater and antifreeze device supplied with the unit, including the compressor crankcase heaters. The main switch should only be disconnected for cleaning, maintenance or unit reparation.

### 4.19 Electrical data



The electrical data reported below refer to the standard unit without accessories. In all other cases refer to the data reported in the attached electrical wiring diagrams.



The line voltage fluctuations can not be more than  $\pm 10\%$  of the nominal value, while the voltage unbalance between one phase and another can not exceed 1%, according to EN60204. If those tolerances should not be respected, please contact our Company.

Model		50	75	100	150	200
Power supply	V/~/Hz	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50
Control board	V/~/Hz	24 V	24 V	24 V	24 V	24 V
Auxiliary circuit	V/~/Hz	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50
Fans power supply	V/~/Hz	230/1/50	230/1/50	230/1/50	230/1/50	230/1/50
Line section	mm <sup>2</sup>	1,5	1,5	1,5	4	4
PE section	mm <sup>2</sup>	1,5	1,5	1,5	4	4
Line section <sup>(1)</sup>	mm <sup>2</sup>	4	6	6	16	16
PE section <sup>(1)</sup>	mm <sup>2</sup>	4	6	6	16	16

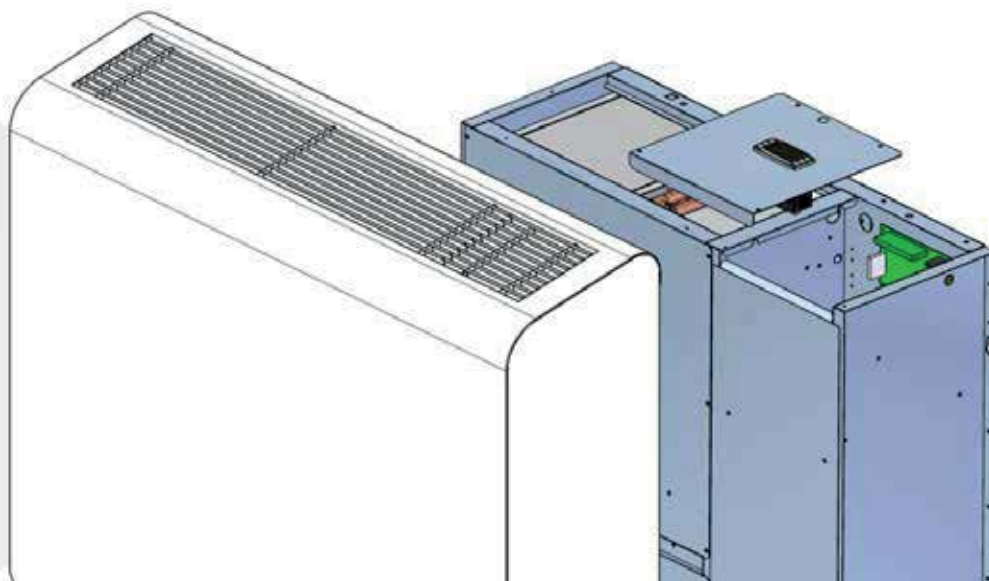
(1) The data refer to the unit with electric heaters (HOEL)



Electric data may change for updating without notice. It is therefore necessary to refer always to the wiring diagram present in the units.

### 4.20 How to connect the power supply

Remove the cabinet; use the appropriate conduit present in the electric panel to connect the power cable directly to the main switch.



## 4.21 Electric connections



The numbering of the terminals may change without notice. For their connection is mandatory to refer to the wiring diagram supplied along with the unit.

### 4.21.1 Remote wiring connections (compulsory)

All terminals referred to in the explanations below will be found on the terminal board inside the electrical box. All electric connections mentioned below have to be made by the installer, on site.



#### REMOTE ON / OFF

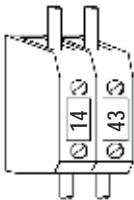
To switch the unit on or off from remote control.

Contacts are voltage free.

Le unità sono fornite di serie dalla fabbrica con morsetti ponticellati.

Contact closed, unit ON,

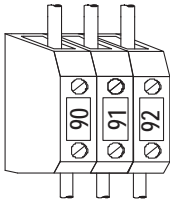
Contact open, unit OFF.



#### ROOM HYGROSTAT (UA)

Contact UA open: unit off.

Contact UA closed: unit in operation.



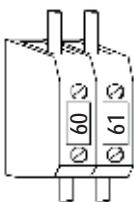
#### REMOTE GENERAL ALARM

For remote display of a general alarm, connect the visual or audible device between terminals 90-91-92.

Contacts 90/91 NC (Normally closed)

Contacts 91/92 NO (Normally opened)

### 4.21.2 Remote wiring connections (optional)



#### REMOTE CONTROL PANEL

The remote control panel replicates all of the functions on the main controller panel and can be connected up to a maximum distance of 50 meters from the unit. The panel has to be connected to the unit by 2 wires having diameter 0.75 mm<sup>2</sup>. The power supply cables must be separated from the remote control panel wires, in order to avoid interference. The control panel has to be connected to the terminals 60 and 61. The control panel cannot be installed in an area subject to excessive vibration, corrosive gases, is a dirty environment or has a high humidity level. The ventilation openings must not be blocked.

## 5. UNIT START UP

### 5.1 Preliminary checks

Before starting the unit the checks detailed in this manual of the electric supply and connections, the hydraulic system and the refrigerant circuit, should be performed.



Start-up operations must be performed in accordance with the instructions detailed in the previous paragraphs.

#### 5.1.1 Before start-up



Damage can occur during shipment or installation. It is recommended that a detailed check is made, before the installation of the unit, for possible refrigerant leakages caused by breakage of capillaries, pressure switch connections, tampering of the refrigerant pipework, vibration during transport or general abuse suffered by the unit.

- Verify that the unit is installed in a workmanlike manner and in accordance with the guidelines in this manual.
- Check that all power cables are properly connected and all terminals are correctly fixed.
- The operating voltage the one shown on the unit labels.
- Check that the unit is connected to the system earth.
- Check that there is no refrigerant leakage.
- Check for oil stains, sign of a possible leak.
- Check that the refrigerant circuit shows the correct standing pressure on the pressure gauges (if present) otherwise use external ones.
- Check that the Schrader port caps are the correct type and are tightly closed.
- Check that crankcase heaters are powered correctly (if present).
- Check that all water connections are properly installed and all indications on unit labels are observed.
- **The system must be flushed, filled and vented in order to eliminate any air.**
- Check that the water temperatures are within the operation limits reported in the manual.
- Before start up check that all panels are replaced in the proper position and locked with fastening screws.



Do not modify internal wiring of the unit as this will immediately invalidate the warranty.

## 5.2 Description of the control panel



### 5.2.1 Display icons

The instrument display is divided into three zones:

**Left Zone:** the display shows the icons,

**Top right zone:** the display shows room temperature.

**Bottom right zone:** the display shows room humidity.

Icon	Meaning	Icon	Meaning
	Not used.		Not used.
	Compressors 1 and 2.	<b>LP</b>	Not used.
	Dehumidification.	<b>HP</b>	High Pressure.
	Not used.		General Alarm.
	Unit fan.	<b>Vset</b>	Not used.
	On if the unit is turned on.	<b>menu</b>	Function menu active.
	Electric heater or water valve activated.	<b>Flow!</b>	Not used.

### 5.2.2 Key function



**M Press and release:** makes it possible to enter the functions menu.



**SET Press and release in the main display:**

makes it possible to display the set points;

Humidity set, in the bottom line will appear the label **SETI**.

Temperature set, in the bottom line will appear the label **SETH**.

**Press for 3 seconds and release in the main display:**

makes it possible to modify the set points;



In standard mode, with electronic sensor installed, allows the display of the following icons:

1 click: The bottom line displays **Tamb**: room temperature.

2 clicks: The bottom line displays **rH**: room humidity.

In standard mode with mechanical hygrostat, allows the display of the following icons:

the top line displays the label **TOn** (room temperature request) or **TOff** (room temperature in set).

the bottom line displays the label **UOn** (room humidity request) or **UOff** (room humidity in set).

In programming mode it allows the user to scroll through parameter codes or to change values.



In standard mode allows the display of the different temperatures in opposite way of the above arrow.

In programming mode allows to scroll through the parameter codes or increases the values



If pressed down for 5 seconds, it makes it possible to switch the unit on or off.



### 5.3 Remote control panel



#### 5.3.1 Display icons

The instrument display is divided into three zones:

**Left Zone:** the display shows the icons,

**Top right zone:** the display shows ambient temperature.

**Bottom right zone:** the display shows ambient humidity.

Icon	Meaning	Icon	Meaning
	Not used.		Not used.
	Compressors 1 and 2.	<b>LP</b>	Not used.
	Dehumidification.	<b>HP</b>	High Pressure.
	Unit fan.		General Alarm.
	On if the unit is turned on.	<b>Vset</b>	Not used.
	Electric heater or water valve activated.	<b>menu</b>	Function menu active.
		<b>Flow!</b>	Not used.

#### 5.3.2 Key functions



**M Press and release:** makes it possible to enter the functions menu



**SET Press and release in the main display:**

makes it possible to display the set points;

Humidity set, in the bottom line will appear the label SETI.

Temperature set, in the bottom line will appear the label SETH.

**Press for 3 seconds and release in the main display:**

makes it possible to modify the set points;

In standard mode, with electronic sensor installed, allows the display of the following icons:



1 click: The bottom line displays **Tamb**: room temperature.

2 clicks: The bottom line displays **rH**: room humidity.

In standard mode with mechanical hygrostat, allows the display of the following icons:

the top line displays the label **TON** (room temperature request) or **TOff** (room temperature in set).

the bottom line displays the label **UOn** (room humidity request) or **UOff** (room humidity in set).

In programming mode it allows the user to scroll through parameter codes or to change values.



In standard mode allows the display of the different temperatures in opposite way of the above arrow.

In programming mode allows to scroll through the parameter codes or increases the values

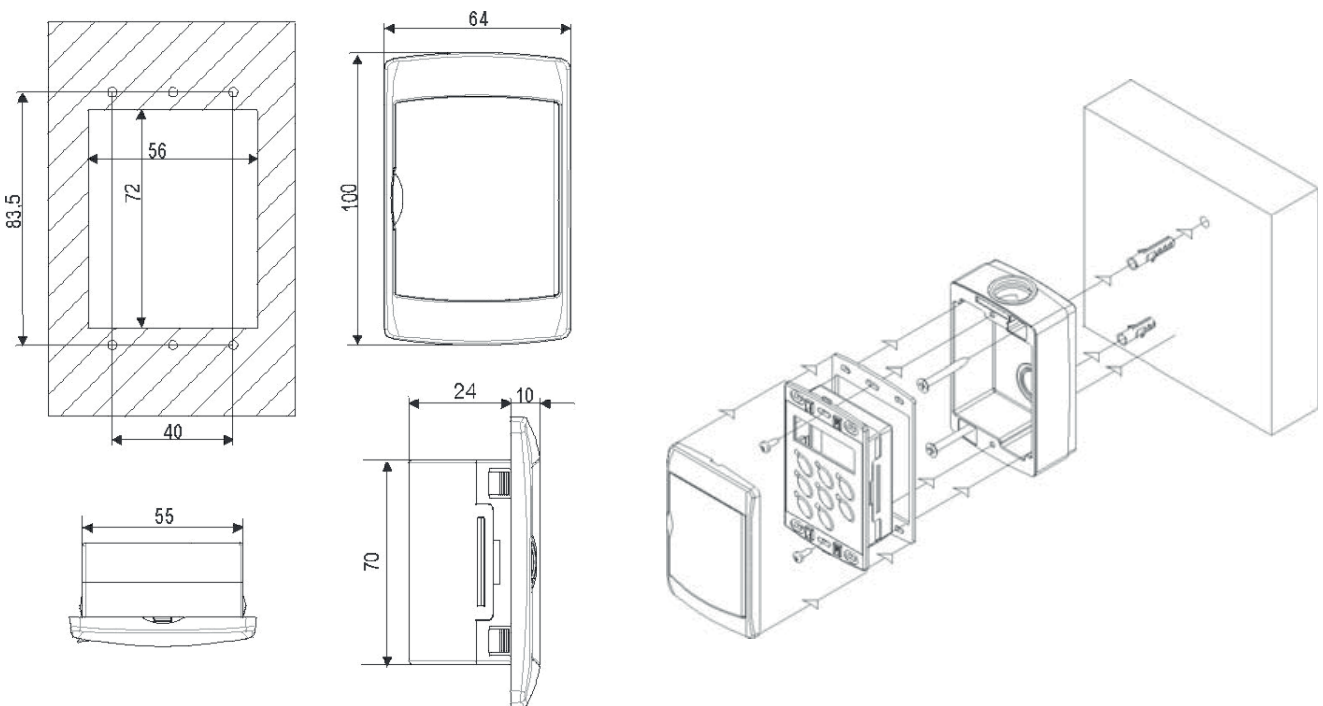


If pressed down for 5 seconds, it makes it possible to switch the unit on or off.

### 5.3.3 Installation

The remote control panel is mounted on a panel with 72x56 mm cut-out, fixed with screw.

To obtain IP65 protection for the panel, use the rubber gasket RGW-V (optional). For wall mounting use the V-KIT plastic adapter as illustrated in the picture.



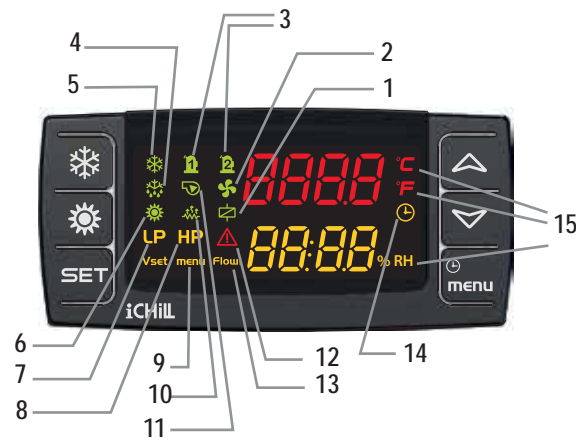
Electric data can be updated without notice. It is therefore necessary to always refer to the wiring diagram provided in the unit.



If there is damage to the remote control or there is a faulty connection, failure of communication will be indicated in the display with the message "noL" (no link).

6. USE

6.1 Switch the unit on



Legend

1	Not used.	9	Icon ON: function menu active.
2	Icon ON: if fans are running.	10	Icon ON: Electric heater or water valve activated.
3	Icon ON: if the compressor is turned on; Icon blinking: if the compressor is the ignition timing.	11	Not used.
4	Icon ON: Dehumidification cycle activated.	12	Icon blinking on alarm.
5	Not used.	13	Not used.
6	Icon ON: the unit is on.	14	Counter between two defrost cycles.
7	Not used.	15	Icon ON: the display shows the room temperature or humidity.
8	Icon blinking: high pressure alarm is active.		

In order to power the unit, turn the main switch to the ON position.

- a. In case of electronic sensor the display shows room temperature (in the top line) e room humidity (in the bottom line).
- b. In case of remote mechanical hygrostat the display shows tOFF/UOFF (temperature/humidity off, unit in set) or tOn/UOn (temperature/humidity on, unit running).



Push 5 seconds the key  to start the unit.

### 6.1.2 Display during operation

Defrost  
Unit equipped with electronic sensor



Defrost  
Unit equipped with mechanical hygrostat




Unit in drip time after defrost  
Unit equipped with electronic sensor



Unit in drip time after defrost  
Unit equipped with mechanical hygrostat



## 6.2 Stop

to stop the unit press the key  for 5 seconds. The unit goes into stand-by mode.

## 6.3 Stand-by

When the unit is switched off from keyboard or remote control panel, it goes into stand-by mode. In this mode the microprocessor control displays the sensor readings and is also able to manage alarm situations. The only visible labels on the display are the temperature and the humidity (in case of unit equipped with electronic sensor), or OFF (in case of unit equipped with mechanical hygrostat). In case the unit is switch off from the remote ON/OFF contact, the display shows OFF.

Display in stand-by mode.



Display in OFF from remote contact.



## 6.4 How to change the set points






When modifying or varying the machine's operating parameters, make sure that you do not create situations that conflict with the other set parameters.

Select the required set point pressing the  key. The label appears at the bottom of the display:

**SEtI** Room humidity set point;

**SEtH** Room temperature set point. Visible on the display only with the presence of HWC (Hot Water Coil) or electric heater fitted in the unit.

To set the required set-points press again the  for 3 seconds. The current value flashes at the top and can be modified using the  ,  keys we can modify the parameter. Then press the  key to memorise the parameter and exit.



All set points are intended as room conditions.

### 6.4.1 Adjustable parameters

The adjustable set points that can be modified by the end user are:

Label	Function	Adjustment limit	Default value
SEt I	Room humidity set point	40÷90%	50%
SEt H	Room temperature set point	18÷30°C	26°C
PAS	Password	(Contact the Company)	



The units are supplied with a very sophisticated control system with many other parameters that are not adjustable by the end user; these parameters are protected by a manufacturer password.

## 6.5 Acoustic signal silencing

Pressing and releasing one of the keys; the buzzer is switched off, even if the alarm condition remains in place.

## 6.6 Display during alarm



In case of alarm the display shows:

-  + alarm code in the bottom line, (the bottom line of the display shows the alarm code in alternatively to the standard label).

## 6.7 Alarm reset

Press the  key (the menu **AlrM** appears at the bottom right of the display). Press the  key to display the alarm event.

In case of multiple alarms, use the ,  keys to scroll the list of the active alarms.  
There are two types of alarms:

### Reset alarms:

RST label appears on the upper part of the display. In this case press the  key to reset.

### Non reset alarms:

The nO label appears on the upper part of the display. In this case the alarm is permanent; contact the Company.

## 7. MAINTENANCE OF THE UNIT

### 7.1 General warnings

Maintenance can:

- Keep the equipment operating efficiently
- Prevent failures
- Increase the equipment life



It is advisable to maintain a record book for the unit which details all operations performed on the unit as this will facilitate troubleshooting.



Maintenance must be performed in compliance with all requirements of the previous paragraphs.



Use personal protective equipment required by regulations as compressor casings and discharge pipes are at high temperatures. Coil fins are sharp and present a cutting hazard.

### 7.2 Drive access

Access to the unit once installed, should only be possible to authorized operators and technicians. The owner of the equipment is the company legal representative, entity or person owns the property where the machine is installed. They are fully responsible for all safety rules given in this manual and regulations.

### 7.3 Periodical checks



The start-up operations should be performed in compliance with all requirements of the previous paragraphs.



All of the operations described in this chapter **MUST BE PERFORMED BY TRAINED PERSONNEL ONLY**. Before commencing service work on the unit ensure that the electric supply is disconnected. The top case and discharge line of compressor are usually at high temperature. Care must be taken when working in their surroundings. Aluminium coil fins are very sharp and can cause serious wounds. Care must be taken when working in their surroundings. After servicing, replace the cover panels, fixing them with locking screws.

#### 7.3.1 Every 6 months:

It is advisable to perform periodic checks in order to verify the correct working of the unit.

- Check that safety and control devices work correctly as previously described.
- Check all the terminals on the electric board and on the compressor are properly fixed.
- Check and clean the sliding terminals of the contactors.
- Check for water leaks in the hydraulic system.
- Check the filters and if its necessary, replace them.
- Check mounting of fan blades and their balancing.

#### 7.3.2 End of seasons or unit switched off:

If the unit is to be left out of commission for a long period, the hydraulic circuit should be drained down. This operation is compulsory if the ambient temperature is expected to drop below the freezing point of the fluid in the circuit (water or Glycol mix).

## 7.4 Refrigerant circuit repair



If the refrigerant circuit is to be emptied, all the refrigerant must be recovered using the correct equipment.

For leak detection, the system should be charged with nitrogen using a gas bottle with a pressure reducing valve, until 15 bar pressure is reached. Any leakage is detected using a bubble leak finder. If bubbles appear discharge the nitrogen from the circuit before brazing using the proper alloys.



Never use oxygen instead of nitrogen: explosions may occur.

Site assembled refrigerant circuits must be assembled and maintained carefully, in order to prevent malfunctions.

Therefore:

- Avoid oil replenishment with products that are different from that specified and that are pre-loaded into the compressor.
- In the event of a gas leakage on machines using refrigerant R134A, R410A even if it is only a partial leak, do not top up. The entire charge must be recovered, the leak repaired and a new refrigerant charge weighed in to the circuit.
- When replacing any part of the refrigerant circuit, do not leave it exposed for more than 15 minutes.
- It is important when replacing a compressor that the task be completed within the time specified above after removing the rubber sealing caps.
- When replacing the compressor following a burn out, it is advisable to wash the cooling system with appropriate products including a filter for acid.
- When under vacuum do not switch on the compressor.

## 8. DECOMMISSIONING

### 8.1 Disconnect the unit



All decommissioning operations must be performed by authorized personnel in accordance with the national legislation in force in the country where the unit is located.

- Avoid spills or leaks into the environment.
- Before disconnecting the machine please recover:
  - the refrigerant gas;
  - Glycol mixture in the hydraulic circuit;
  - the compressor lubricating oil.

Before decommissioning the machine can be stored outdoors, providing that it has the electrical box, refrigerant circuit and hydraulic circuit intact and closed.

### 8.2 Disposal, recovery and recycling

The frame and components, if unusable, should be taken apart and sorted by type, especially copper and aluminum that are present in large quantities in the machine.

All materials must be recovered or disposed in accordance with national regulations.



### 8.3 RAEE Directive (only UE)



- The RAEE Directive requires that the disposal and recycling of electrical and electronic equipment must be handled through a special collection, in appropriate centers, separate from that used for the disposal of mixed urban waste.
- The user has the obligation not to dispose of the equipment at the end of the useful life as municipal waste, but to send it to a special collection center.
- The units covered by the RAEE Directive are marked with the symbol shown above.
- The potential effects on the environment and human health are detailed in this manual.
- Additional information can be obtained from the manufacturer.

## 9. DIAGNOSIS AND TROUBLESHOOTING

### 9.1 Fault finding

All units are checked and tested at the factory before shipment, however, during operation an anomaly or failure can occur.

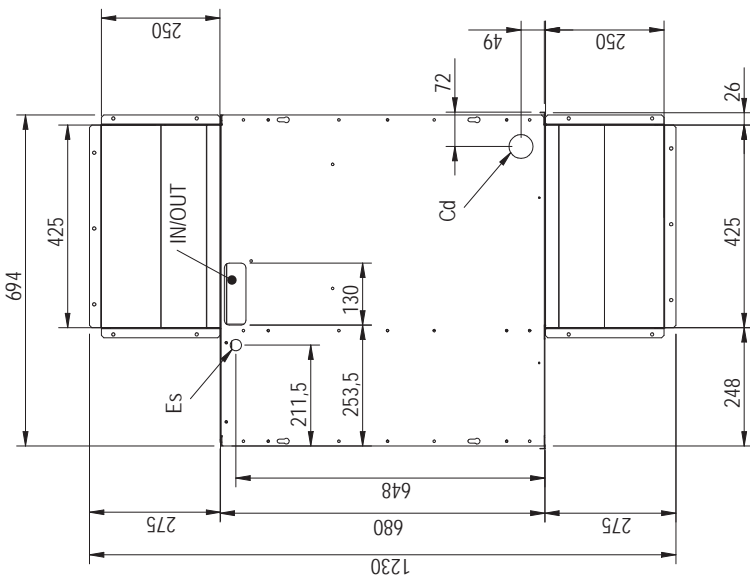
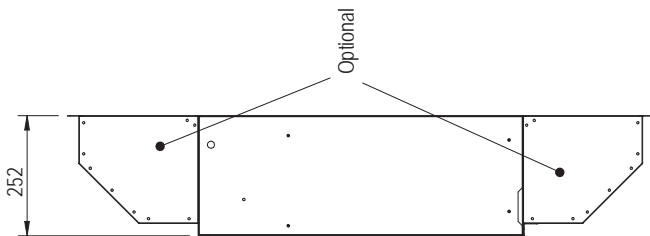
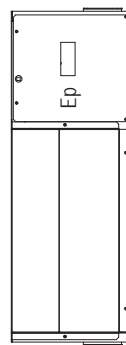
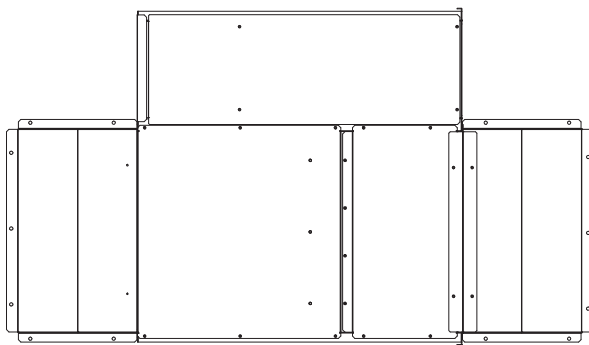
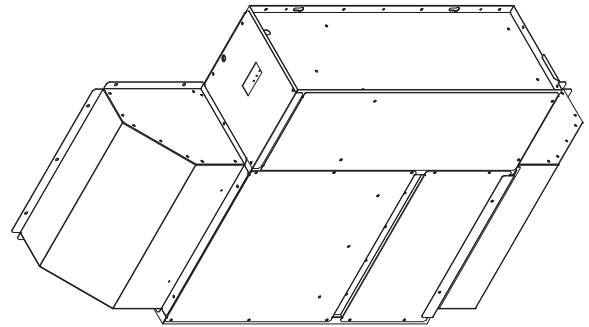
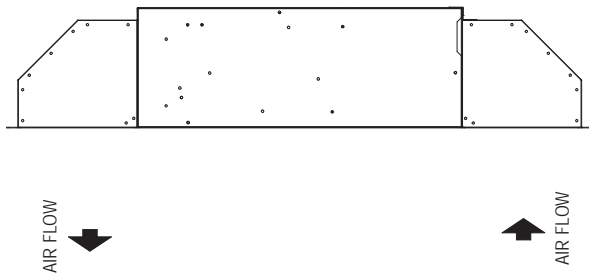


BE SURE TO RESET AN ALARM ONLY AFTER YOU HAVE REMOVED THE CAUSE OF THE FAULT; REPEATED RESET MAY RESULT IN IRREVOCABLE DAMAGE TO THE UNIT.

Code	Alarm description	Electronic sensor	mechanical hygrostat	Cause	Solution
AhiP	High pressure	Yes	Yes	Too low airflow or high room temperature.	Check the filters, if necessary replace them. In P versions, check the pressure drop of the ducts.
AloP	Low pressure	Yes	Yes	Refrigerant charge leakage.	Contact the Company
APBa/ APBi	Room temperature probe sensor alarm PBa	Yes	No	Replace faulty sensor	Contact the Company
APBu	Room humidity probe sensor alarm P Bu	Yes	No		
Atdf	Defrost time too long.	Yes	Yes	Warning	(Reporting only)
Atlo	Low room temperature.	Yes	No	Replace faulty sensor	Contact the Company
Athi	High room temperature.	Yes	No	Replace faulty sensor	Contact the Company

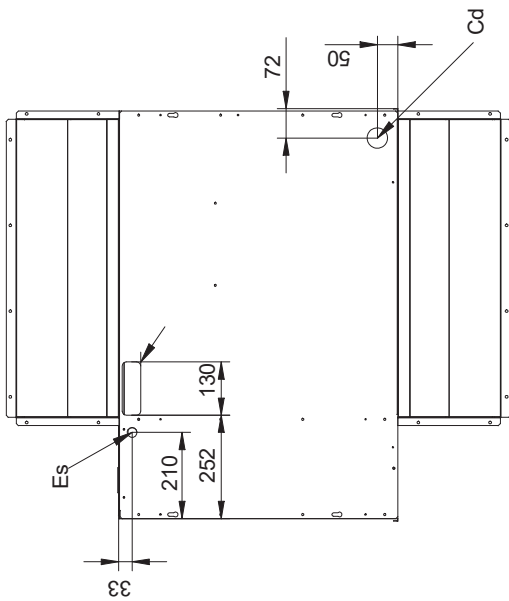
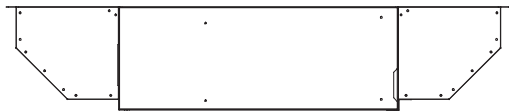
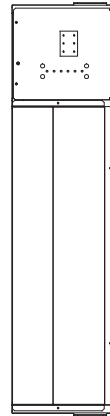
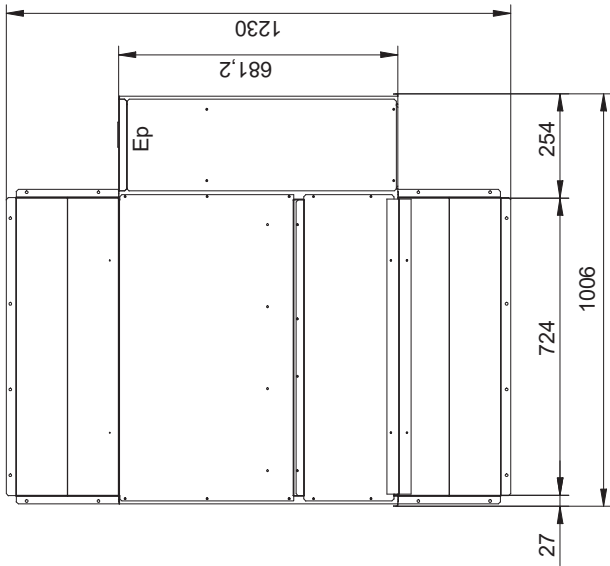
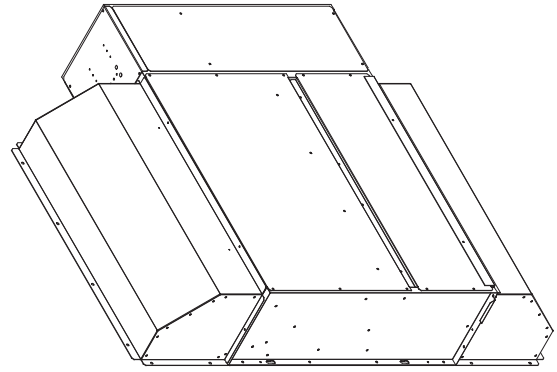
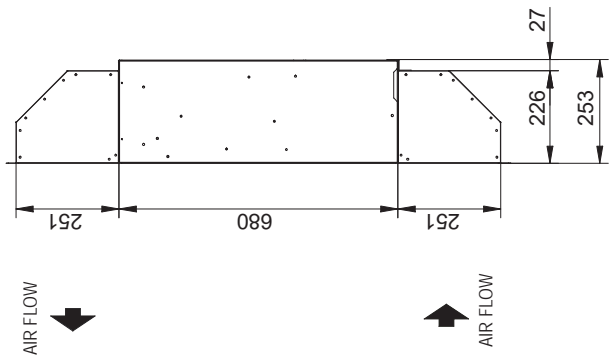
10. DIMENSIONAL DRAWINGS

Dimensional drawing DC 50-R



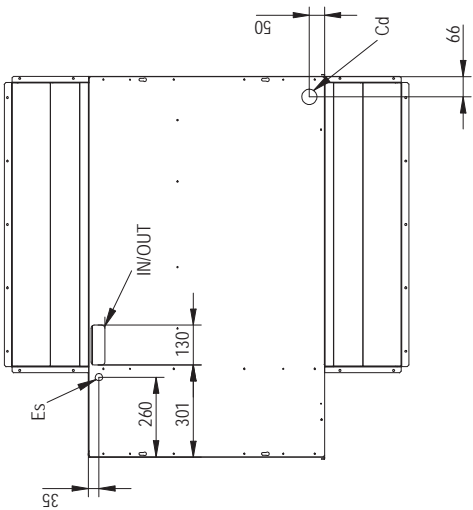
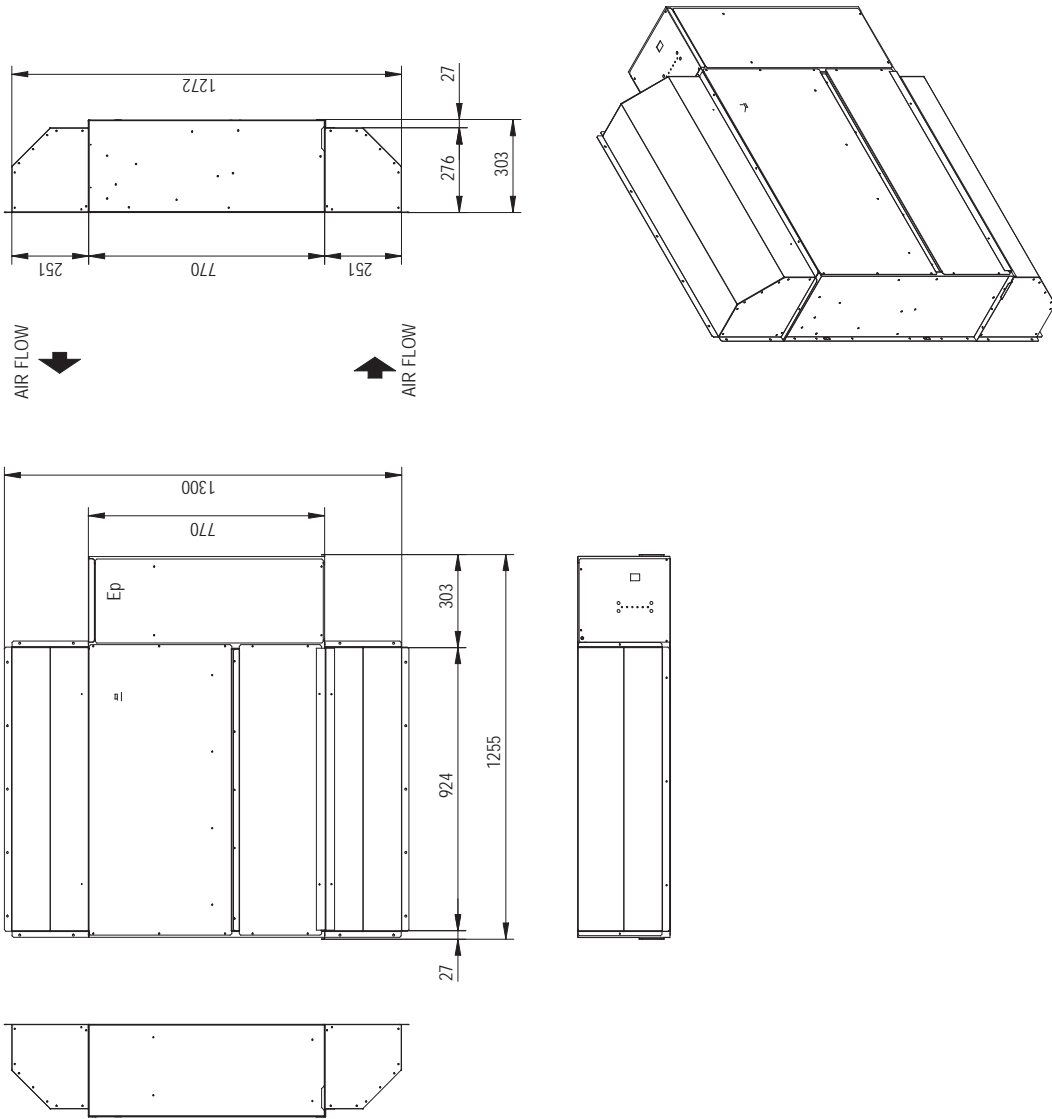
Ep	ELECTRICAL PANEL
Es	INPUT POWER
Cd	DRAIN

Dimensional drawing DC 75-R und DC 100-R



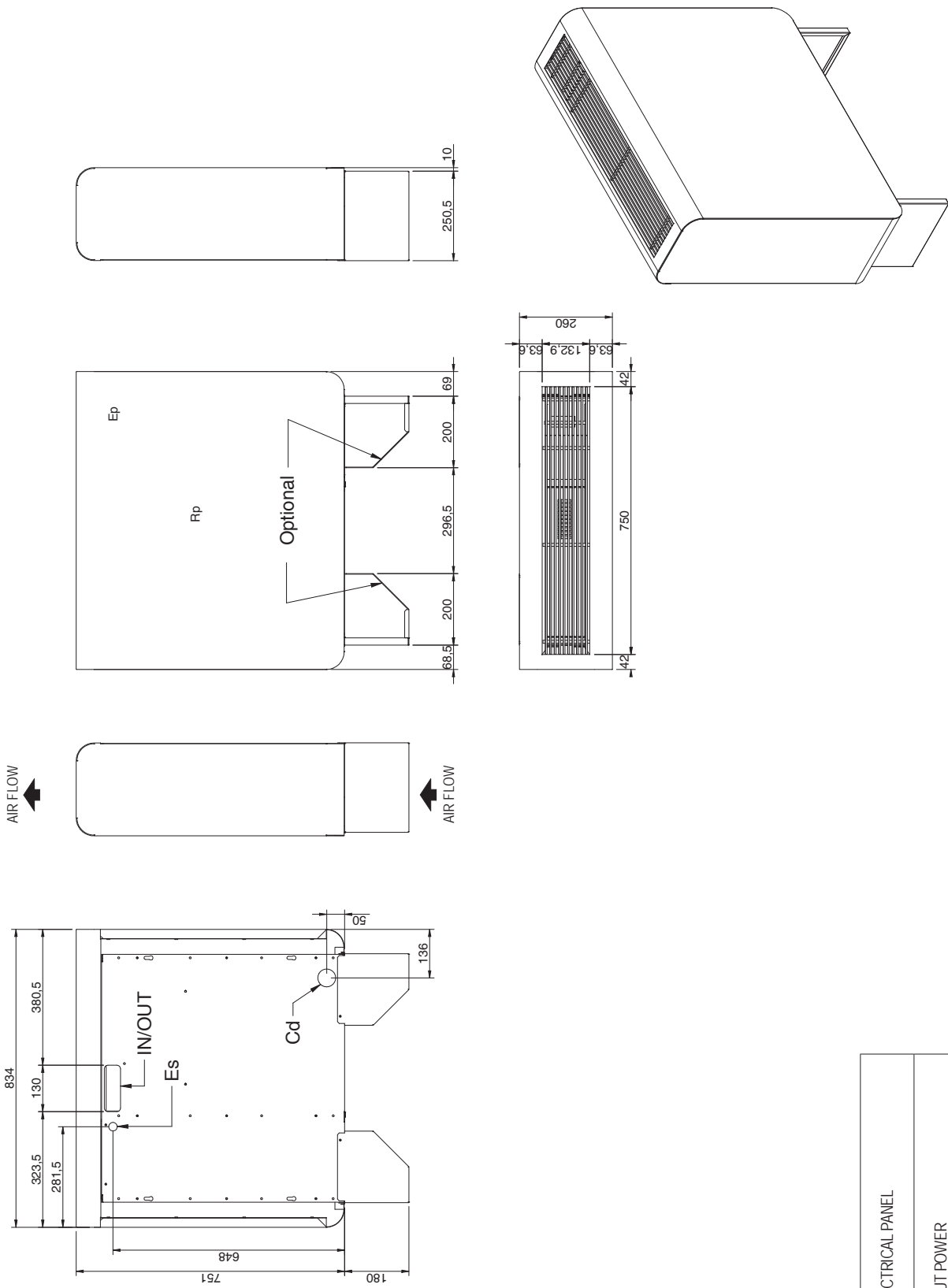
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Es	INPUT POWER
Cd	DRAIN

Dimensional drawing DC 150-R and DC 200-R



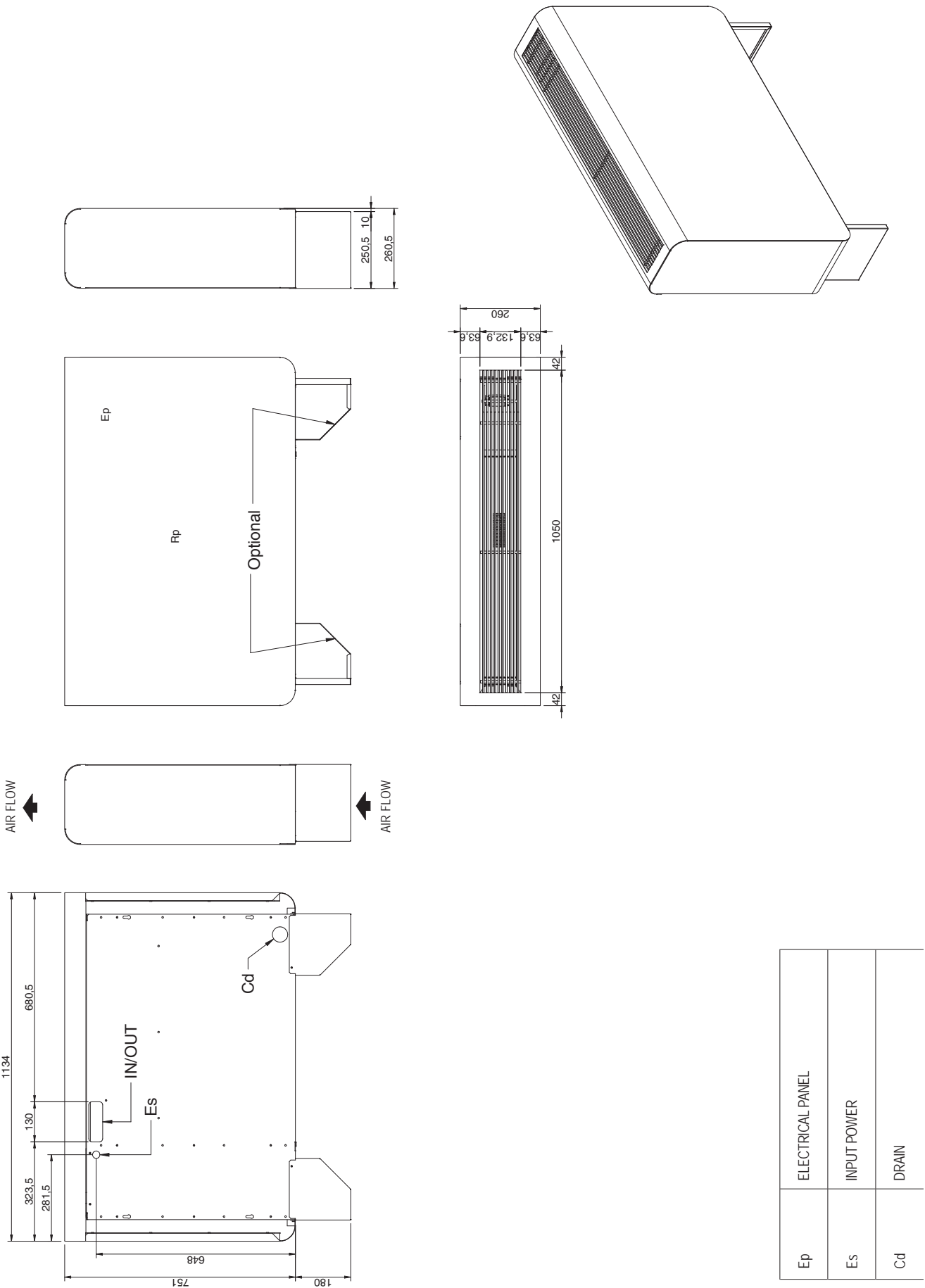
Ep	ELECTRICAL PANEL
Es	INPUT POWER
Cd	DRAIN

Dimensional drawing DC 50 W



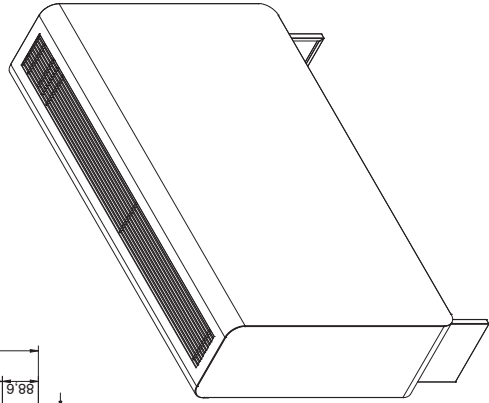
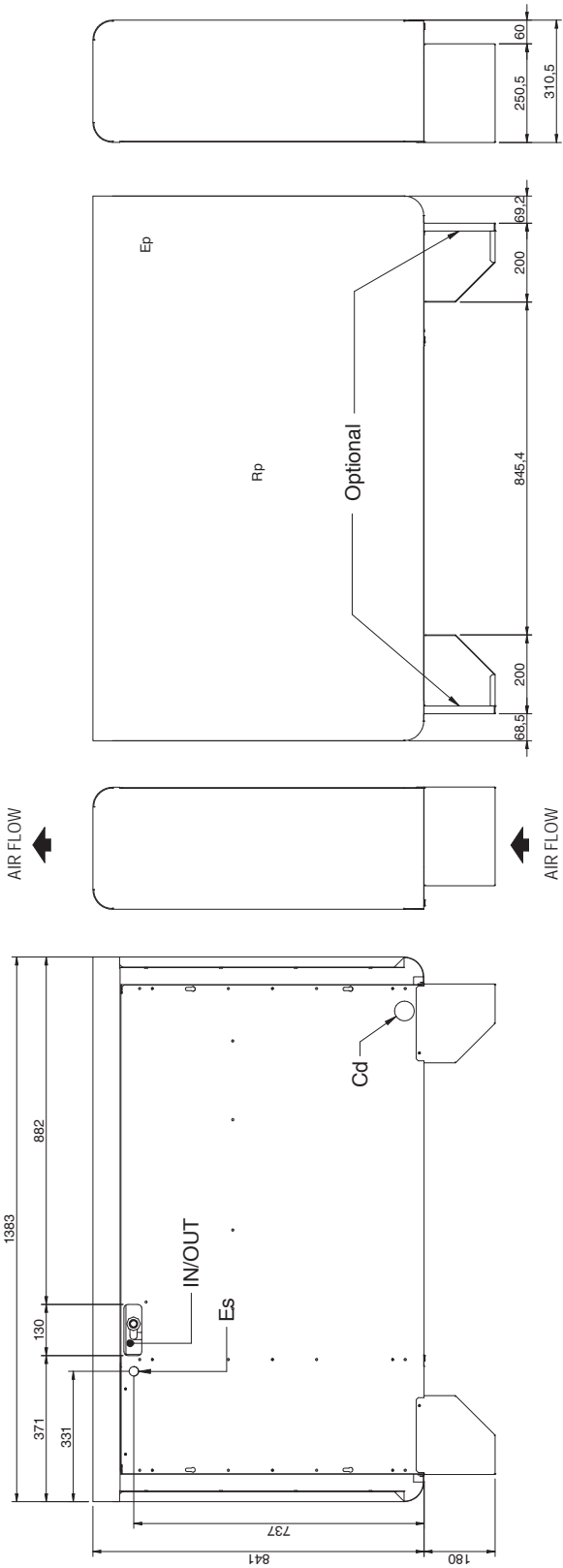
Ep	ELECTRICAL PANEL
Es	INPUT POWER
Cd	DRAIN

Dimensional drawing DC 75-100 W



Ep	ELECTRICAL PANEL
Es	INPUT POWER
Cd	DRAIN

Dimensional drawing DC 150-200 W



Ep	ELECTRICAL PANEL
Es	INPUT POWER
Cd	DRAIN











CONSULTING, SALES AND SERVICE:



CH94/0002.00

Condair Group AG  
Talstrasse 35-37, CH-8808 Pfäffikon (SZ)  
Phone +41 55 416 61 11, Fax +41 55 416 62 62  
info@condair.com, www.condair.com

