Ferroli

RHA

AIR COOLED WATER CHILLERS WITH HELICAL FANS

343 ÷ 622 kW

OZONE SAVED R407C

EUROVENT CERTIFIED PERFORMANCE

TECHNICAL MANUAL

TABLE OF CONTENTS

THIS MANUAL IS DIVIDED INTO SECTIONS. THEIR NAMES APPEAR IN THE HEADING OF EACH PAGE.

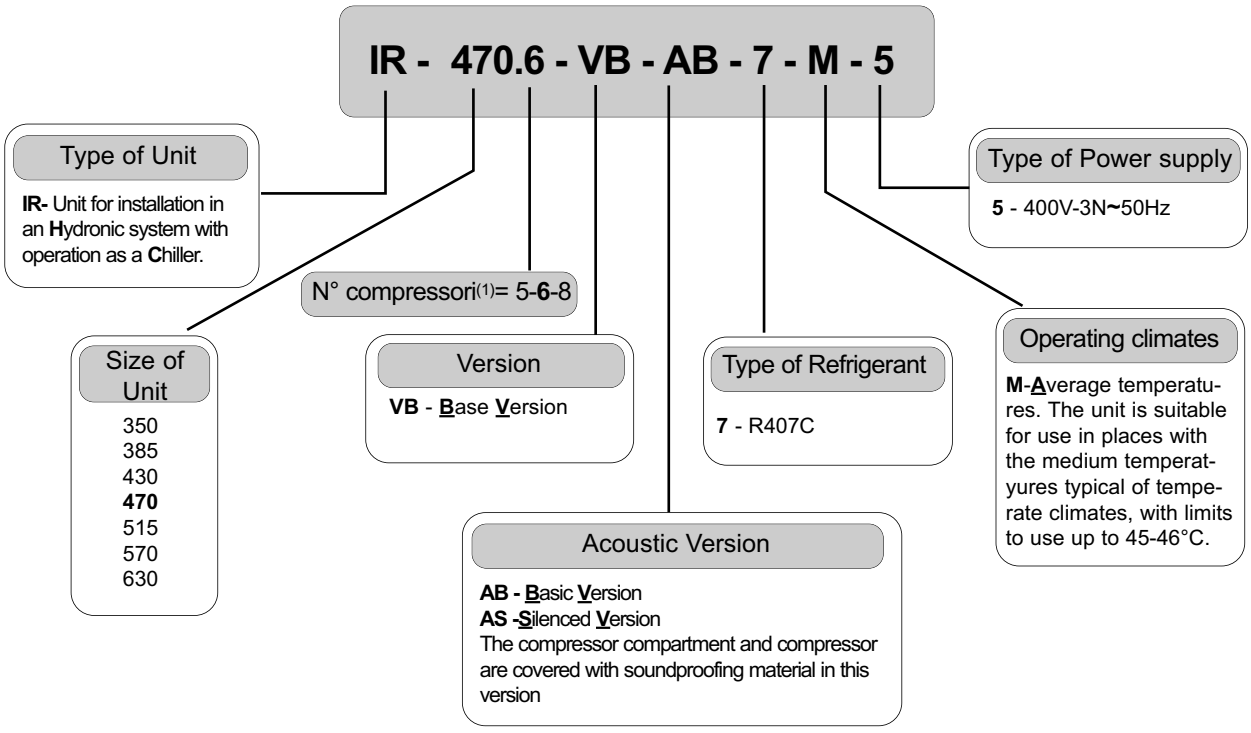
GENERAL SPECIFICATIONS

Presentation of the unit

This new series of industrial chillers has been designed to meet the air conditioning requirements of medium-high powered hydronic systems in the industrial, service and business sectors.
The appliances in question are air-cooled water chillers with helical fans suitable for installation outdoors: the bearing structure and panelling are made of adequately thick, coated and galvanized sheet metal. All the fastening components are made of stainless and/or galvanized steel. The cabinet that houses the electrical components and all the parts exposed to outdoor weather conditions (fans, pressure switches, valves, etc.) have a protection degree of at least **IP54.**
The complete series includes 7 sizes with refrigerating power ratings ranging from **343 to 622 kW** , available in the **Basic Version** or **Silenced version**, to choose depending on the noise level required. The chillers have been designed for use with **R407C ENVIRONMENT-FRIENDLY** refrigerant gas.
All the units can produce cold water at a temperature between 5 and 10°C and are also pre-engineered for operation at low outdoor air temperatures thanks to use of a monitoring system through control of the fans by steps.
All the units are equipped with hermetic scroll compressors: 5 compressors for mod. 350, 6 compressors for mod. 385-430-470 in two independent chilling circuits and 8 compressors in mod. 515-570-630 in four independent chilling circuits. This allows the power generated by the unit to be modulated, and to thus adapt to the heat load of the system supplied.
Standard supply also includes plate type evaporator/s (one for mod. 350-385-430-470, 2 for mod. 515-570-630) with alternate water/refrigerant circuits, thermally insulated and protected by means of a differential water pressure switch and electric antifreeze heater, coils with extended surfaces and extensive heat exchanging areas formed by copper pipes and notched aluminium fins, electric fans with scythe-shaped vanes to reduce the sound emission, electric panel for adjustments and controls, controller with microprocessor featuring split display with 4 lines and 20 characters.
The standard supply can also be integrated with a vast range of electrical and mechanical accessories. The **Water Storage Tank** and **Pumping Module** with 1 or 2 Pumps are particularly important accessories. If both are chosen, the tank is configured for storage on the delivery to the system or for storage on the return part of the system, or for storage pre-engineered for the primary and secondary circuit, depending on the type of **Pumping Module** selected.
All the units are accurately built and tested individually, thus only the electrical and wet connections need be made for installation.

Identification code of the unit

The codes that identify the units are listed below and include the sequences of letters that determine the meanings for the various versions and set-ups.



(1): The number of compressors varies depending on the Model of the Unit

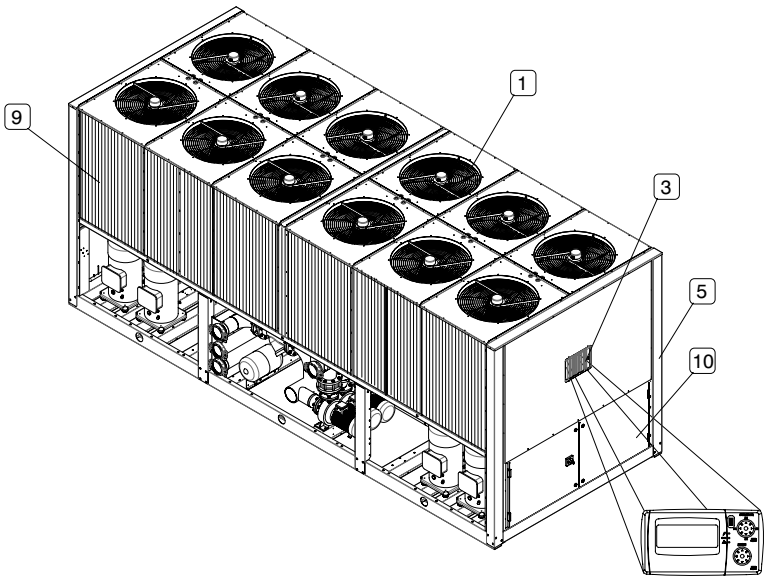
GENERAL SPECIFICATIONS

Description of the components

1. Fans. These are the helical type with scythe-shaped vanes to increase efficiency and reduce the sound emissions. The fans are directly coupled to the threephase motor by means of an external rotor. Thermal protection against operating faults is installed inside the winding.

2. Electric control and monitoring panel. It is housed in a cabinet made of adequately thick painted sheet metal suitable for outdoor installation (protection degree IP 54). The panel comprises the following main components:

- Main door-locking circuit-breaker.
- Control contactor for each compressor.
- Disconnectable fuse holders with protection fuses for each compressor.
- Disconnectable fuse holders with protection fuses for the oil heaters of the compressors.
- Disconnectable fuse holders with protection fuses for the antifreeze heater.
- Disconnectable fuse holders with fan protection fuses.
- Fan control contactors.
- Magnetothermic relay/s and contactor/s for the pump/s (if one of the pumping module accessories is installed).
- Fan speed monitoring board (not available for mod.300-345-390 in the **B**asic **V**ersion).
- Insulating and safety transformer to power the auxiliaries, protected with fuses.
- Basic monitoring board with microprocessor:



The main functions of the monitoring system are:
Temperature regulation of the water produced by the unit, operating hour counting for compressors and pump/s, balancing of operating hours for compressors, start-up timing, parameter entry digitized via the keyboard, alarm diagnosis.

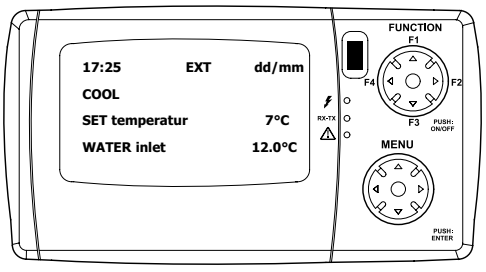
Functions associated with the digital inputs: low and high pressure, high discharge temperature, correct electric power phase presence-sequence, thermal protection for compressors, thermal protection for fans, thermal protection for pump, differential water pressure switch, remote controlled ON/OFF commands.

Functions associated with the digital outputs: compressor control, water pump/s control, electric antifreeze heater, ventilating step control to monitor condensing, general alarm (can be remote controlled).

Functions associated with the analog inputs: water inlet and outlet temperatures, coil temperature. Low pressure (accessory), high pressure (accessory).

3.User interfacing terminal with display. Housed inside a special module, and positioned in the front part of the unit: for mod. 300-345-390 above the Electric Panel, for mod. 430-470-510, on panel at the far left, viewing the Electric panel from the front. The interface consists of:

- FUNCTION/ON-OFF multifunction joystick key for quick access to the 4 main menus and for powering/switching off.
- MENU multifunction joystick key to access all the menus for controlling and configuring the unit.
- Power-on **LED**.
- RX-TX **LED** to indicate that the user interface and monitoring module are communicating.
- Alarm indicator **LED**.
- Check-control with alarm display.



4. Compressors. These are the **SCROLL** type with orbiting coil equipped with built-in thermal protection and oil heater. As part of the standard supply, they are positioned on rubber vibration dampers to reduce the vibrations transmitted to the base of the unit.
To lower the sound emission of silenced version **AS**, they are installed in a soundproofed booth made of galvanized sheet metal coated with polyurethane powder painbts and covered in soundproofing material.
5. Bearing structure made of galvanized sheet metal coated with polyurethane powder paint to ensure good protection against adverse weather conditions.

6. Water storage tank. (Accessory) Made of adequately thick painted sheet metal, this reduces the number of compressor start-ups and fluctuations in the temperature of the water conveyed to the users. It is insulated with thermalbarrier material to prevent the formation of condensation and heat exchanges towards the outside. In conjunction with the Pumping Module accessory, it can be supplied in 3 different configurations: Storage on the Delivery, Storage on the Return, Storage pre-engineered for the Primary and Secondary circuit. When the Pipe Kit accessory is used, the only configuration possible is with Storage on the Delivery.

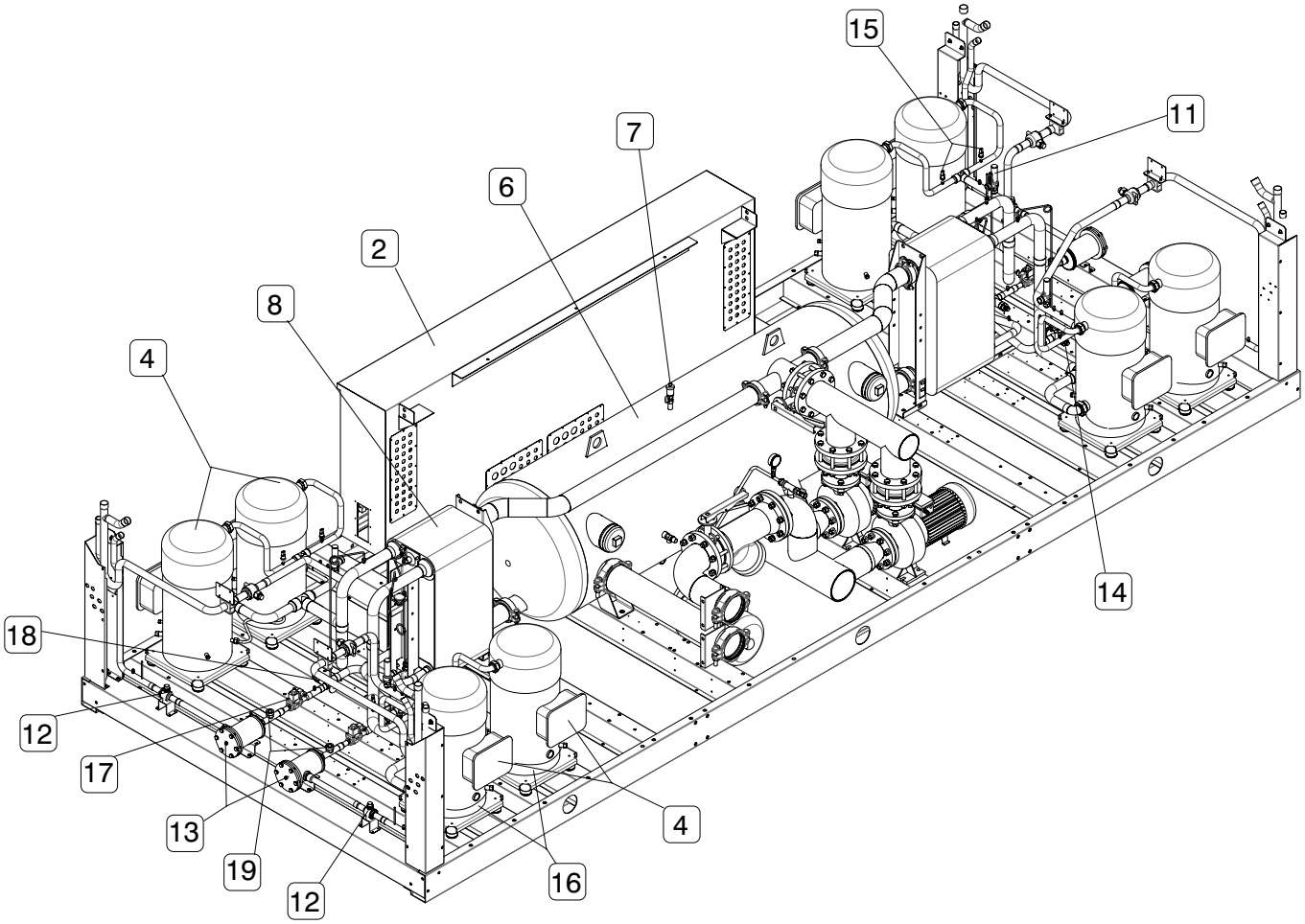
The water drain is installed under the tank as part of the standard supply. The water is turned on and off by a cock that allows the water in the unit to be drained off.

7 Air vent. The automatic type, turned on and off by a cock and positioned on the highest part of the tank.

8. Evaporator, plate type made of braze-welded stainless steel (**AISI 316**), double chilling circuit and alternate water/refrigerant circuits. It is installed within a shell of thermal barrier insulating material to prevent the formation of condensation and heat exchanges towards the outside. Standard supply also includes a differential pressure switch on the water supply circuit to avoid the risk of freezing if the water flow is shut off for some reason.

9. Condensing banks, the aluminium finned pack type with shaped profile to increase the heat exchange coefficient and with copper pipes arranged in staggered rows. A sub-cooling section is integrated into the lower part.

10. Covering panels, made of galvanized sheet metal coated with polyurethane powder paints to ensure the utmost ability to withstand adverse weather conditions.



The figure refer to **mod. 515.8÷630.8** IR Cooling Mode units.

GENERAL SPECIFICATIONS

Hydraulic and chilling circuit components

11.Coolant safety valve. (Conforms to the Directive governing pressurized vessels -**PED**). Installed on the delivery pipe of the compressors. It acts if critical service faults should occur.

12.Fluid cock - Gas cock. Allows all the refrigerant in the coils to be pumped and then stored so as to carry out servicing work or to replace all the components of the chilling circuit without having to drain it.

13.Dehydrator filter. Of the **removable cartridge** type. Retains impurities and traces of moisture in the circuit.

14.Low pressure switch With fixed setting. It is installed on the intake pipe and blocks the compressors of the circuit if the operating pressures drop below the tolerated values. It automatically resets as the pressure increases. If it activates frequently, the circuit will block and can only be restarted by resetting via the user interface terminal.

15.High pressure switch With fixed setting. It is installed on the delivery pipe and blocks the compressors of the circuit if the operating pressures exceed the tolerated values. If it activates, the circuit will block and can only be restarted by resetting via the user interface terminal.

16.Electrical heating elements to heat the compressor oil. One per compressor, “belt” type. It activates when the compressor switches off. Their task is to keep the temperature of the oil sufficiently high so as to prevent refrigerant from migrating during these pauses.

17.Fluid solenoid valve. One per circuit. They shut off when both the compressors of the circuit switch off, preventing liquid refrigerant from flowing towards the evaporator during periods at a standstill.

18.Thermostatic valve. With external equalizer. It’s task is to supply the evaporator correctly, keeping the selected degree of superheat at a steady levelon equalizzatore esterno.

19.Fluid and humidity indicator. Signals when fluid passes through the circuit, indicating that the refrigerant charge is correct. The fluid indicator also changes colour to show the amount of moisture in the refrigerant.

High temperature thermostat (accessory). One per compressor, installed on the delivery pipe to protect the individual compressor if the end of compression temperature exceeds **130° C**.

Differential water pressure switch. This is standard supply and is installed on the connections between the exchanger’s water inlet and outlet. It blocks the unit if it activates.

Pressure taps: 1/4 “ SAE (7/16” UNF) type with air pump. Allow the operating pressure of both the circuits to be measured in 3 main points: compressor delivery, flow-restricting component inlet, compressor intake.

Water safety valve, on the tank. It acts whenever faulty service leads to an operating pressure in the plumbing system that exceeds the valve opening value.

Antifreeze heater connection.1”1/4 female threaded connection pre-engineered for installation of the tank’s antifreeze heater.

ACCESSORIES AND OPTIONAL EQUIPMENT

Mechanical accessories

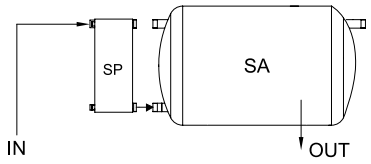
GM (M) Pressure gauge unit. Comprising a low and high pressure gauge for each chilling circuit (2+2 for mod. 350÷470, 4+4 for mod. 515÷630).

GP (M) Protective grilles. Consisting of metal grilles that protect the coils with extended surfaces.

AVM (F) Spring vibration dampers. Consisting of 6 spring vibration dampers to install under the unit. They reduce the mechanical vibrations generated by the compressor and fans during their normal operation, that are then transmitted to the bearing surface of the machine. The insulation degree provided by the vibration dampers is about 90%.

KT (M): Pipe kit. Obligatory if the MP - Pumping Module accessory is not installed. The picture on the right shows the water circulation diagram.

With storage tank
without pumping module

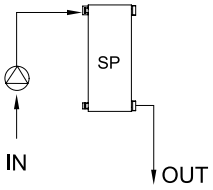


SAA (M) Water storage tank. Made of adequately thick painted sheet metal, this reduces the number of compressor start-ups and fluctuations in the temperature of the water conveyed to the users. It is insulated with thermal barrier material to prevent the formation of condensation and heat exchanges towards the outside. The accessory is inclusive of water safety valve, air vent, water drain and antifreeze heater connection. In conjunction with the Pumping Module accessory, it can be supplied in 3 different configurations: Storage on the Delivery, Storage on the Return, Storage pre-engineered for the Primary and Secondary circuit.
Picture on the right show the water circulation diagram according to different configurations.

MP: Pumping Modules with 1 or 2 Pumps (M):
This accessory is available in 2 configurations:
· **with 1 single pump**
· **with 2 pumps**: the second pump operates if the first one becomes faulty.
Also available for units without the water Storage Tank accessory.

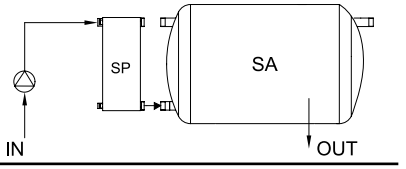
Besides the pumps, this accessory is equipped with all the plumbing components (water filter, surge chamber, on-off valves) required for a complete and easily serviced installation.
Various tank configurations are available if the Storage Tank accessory has also been chosen:

Without storage tank
with pumping module (1 pump)



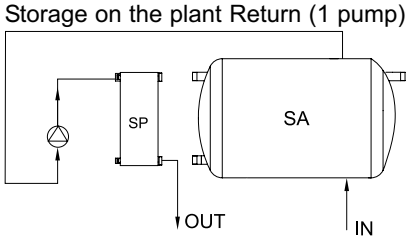
MP-AM : Storage on the plant Delivery : The pump draws water from the supply plant, sends it to the plate type heat exchanger and then to the inertial storage tank. When the pump operates in its nominal conditions, it is able to supply the circulating water with a residual head of about 120 to 170 kPa (from 12 to 17 m.w.c.)(1) in this configuration.

Storage on the plant Delivery (1 pump)



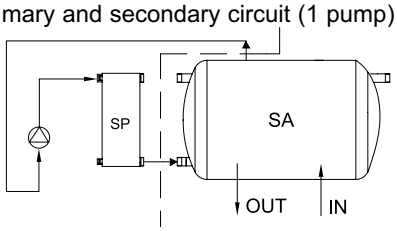
MP-AR Storage on the plant Return: The pump draws water from the inertial storage tank, sends it to the plate type heat exchanger and then to the system. When the pump operates in its nominal conditions, it is able to supply the circulating water with a residual head of about 120 to 170 kPa (from 12 to 17 m.w.c.)(1) in this configuration.

Storage on the plant Return (1 pump)



MP-PS Storage pre-engineered for the primary and secondary circuit. The pump's sole task is to allow water to circulate around the primary circuit: this circuit includes the storage tank and plate type heat exchanger (chiller's water circuit). Assembly of the pumping section for the secondary circuit is at the installer's charge and includes the storage tank (with pre-engineered wet connections) and the system to be supplied.

Storage pre-engineered for the primary and secondary circuit (1 pump)



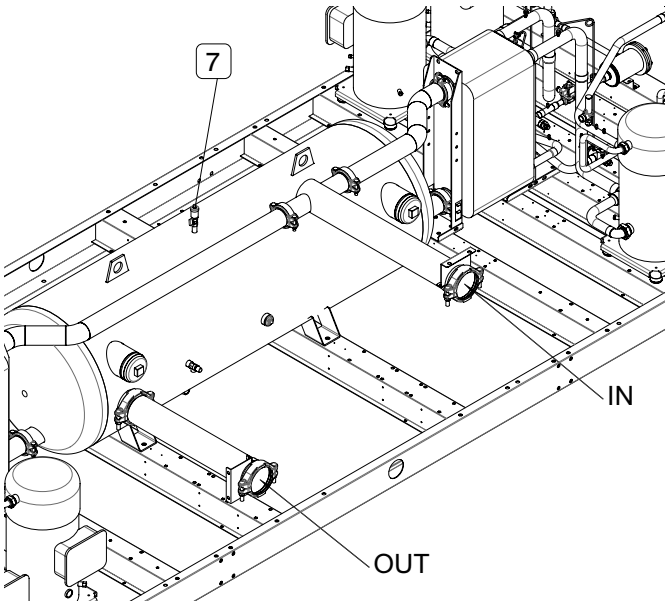
(1): Refer to the respective values given for each unit in the "Technical data" section.

ACCESSORIES AND OPTIONAL EQUIPMENT

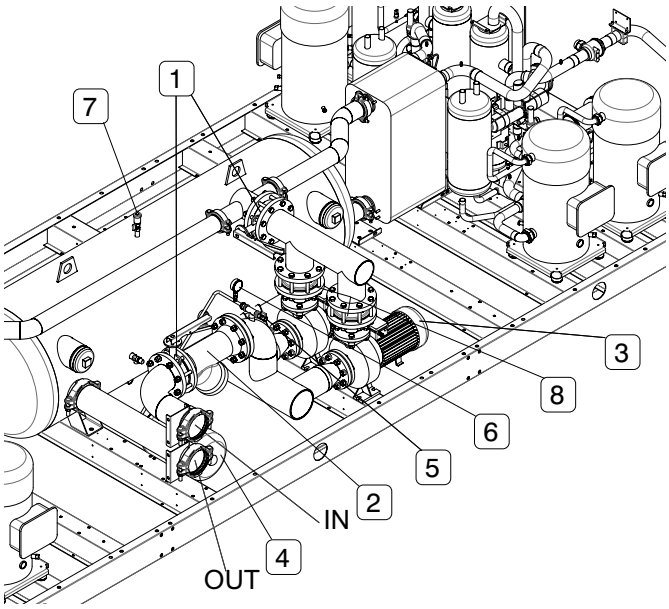
Description of the Pumping Module accessory configurations

Unit with Water Storage Tank

KT

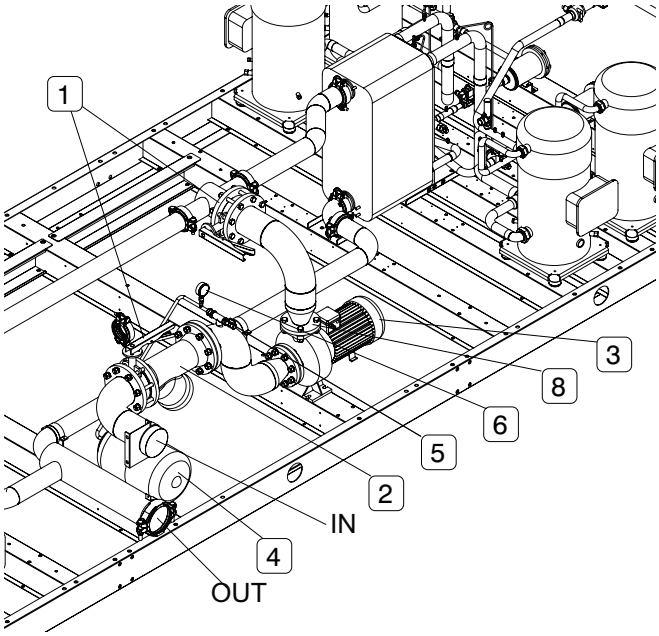


MP - AM with 2 Pumps



Unit without Water Storage Tank

MP with 1 Pump



• **MP.** Pumping module. It consists of:

1 On-off throttle valves. Turn components such as the water filter, surge chamber and pump on and off when they require routine or supplementary maintenance.

2 Metal gauze water filter. Can be turned on and off and inspected. It is installed on the pump suction side. Prevents any machining residues (dust, swarf, etc.) that may be in the water pipes from entering the pump impeller or plate-type heat exchanger.

3 Hydraulic pump. Circulates water around the system. The pumps have a high head and suit the majority of installation requirements. The pump is safeguarded by a motor protector installed in the chiller's electric panel.

4 Surge chamber. This is a closed, diaphragm type chamber. It absorbs the variations in the volumes of water in the system caused by temperature variations.

5 Water filling. Manual function with control positioned on the side of the unit opposite the electric panel and turned on and off by a cock that can be accessed by removing the rear panel.

6 Water pressure gauge. Connected to the water fill pipe. Displays the pressure of the water in the system.

7 Air vent. The automatic type, turned on and off by a cock and positioned on the highest part of the tank.

8 One-way check valves. Only installed if the Pumping Module accessory with 2 pumps is installed (one valve for each pump).

Water safety valve. On the tank. It acts whenever faulty service leads to an operating pressure in the plumbing system that exceeds the valve opening value.

Water drain. It is controlled by a cock that allows the water to be drained from the unit.

Antifreeze heater connection. Female threaded connection pre-engineered for installation of the tank's antifreeze heater.

KT. Pipe kit, consists of two steel pipes insulated with heat barrier material. Allows the water IN / OUT connections to be routed to the machine.

NOTE: it is OBLIGATORY to purchase the units with at least KT or MP accessory.
An MP accessory cannot be supplied if a KT accessory is chosen, and vice versa.

ACCESSORIES AND OPTIONAL EQUIPMENT

Electrical accessories

RAG (F) - Electric antifreeze heating element on the storage tank. Plug type. It activates in parallel with the evaporator's antifreeze heating element and keeps the water at a temperature able to prevent ice from forming during the winter, when the unit is not used.
TP(M) - High and low pressure transducers, two for each chilling circuit (4+4). Allow the delivery and intake pressure values of the compressors to be displayed.
CR (F) Remote Control Repeats the functions of the control system on the unit, thus allowing this latter to be controlled at a distance (up to 100 m) from the unit.

Mechanical options

Special finned heat exchangers
- Coils with copper fins
- Coils with tin-coated copper fins
- Coils with aluminium fins with acrylic coating

Electrical options

Power source voltage rating 230V-3-50Hz

TECHNICAL DATA AND STANDARD PERFORMANCES - R407C

Technical specifications of unit AB-7M5

Unit Size	350	385	430	470	515	570	630	UM
Net cooling capacity (1)	343	381	427	461	504	563	622	kW
Net total power input (1)	145	157	173	193	210	236	259	kW
Maximum pressure on wet side (*)	600/1000							kPa
Gross cooling capacity (1) (E)	345	383	430	464	507	567	627	kW
Gross total power input (1) (E)	143	155	169	190	206	232	253	kW

Compressor specifications

Type	SCROLL							
Quantity	5	6			8			N°
N° Throttling steps	0÷100							%
Power input	127	139	150	170	183	208	230	kW

Plate-type Heat Exchanger specifications

Quantity	1				2			N°
Total water capacity	37.4	42.8	50	50	60.3	65.7	74.7	l
Water flow rate(1)	16,4	18,2	20,4	22	24,1	26,9	29,7	l/s
Water pressure drop(1) (E)	37	40	46	44	39	43	46	kPa

Specifications of coils with extended surfaces

Number of coils	4		8	N°
Total area	19.1	24.4	28.7	m^2

Fan specifications

Number of fans	8	10		12		N°
Diameter [∅]	800					mm
Maximum speed	900					rpm
Total air flow rate(2)	50600	60912	60430	71646	70400	l/s
Motor rating	1.5					kW

Water Storage Tank specifications(

Quantity	1			N°
Water tank capacity	700	720	850	l

Pumping Module accessory specifications

Pump power rating	5.5	7.5						kW
Surge chamber volume	24							l
Service charge pressure of surge chamber	150							kPa
Water flow rate (1)	16,4	18,2	20,4	22	24,1	26,9	29,7	l/s
Working head (1) (MP)	169	138	138	117	150	124	98	kPa

Electrical specifications(3)(MP)

Power supply	400 / 3 / 50							V/ph/Hz
Total maximum power input [FLA]	323	355	396	426	478	518	558	A
Total maximum power input [FLI]	194	215	238	254	289	312	334	kW
Total maximum surge current [MIC]	581	575	654	684	698	776	816	A

(1) Inlet/outlet water temp. 12/7 °C. - Outdoor air temp. 35°C D.B.
(2) At fan's top speed
(3) At maximum operating conditions.
(E): Data dcertificated by **EUROVENT**
(MP) For units equipped with Pumping Module accessory MP-AM or MP-AR.
(*) Regarding unit WITH (600 kPa) or WITHOUT (1000 kPa) Storage Tank accessory.
(**) Regarding the Pumping Module accessory with 1 pump / 2 pumps.

TECHNICAL DATA AND STANDARD PERFORMANCES - R407C

Standard performances AB-7M5

MODEL	TW	OUTDOOR AIR TEMPERATURE (°C D.B.)											
		25		30		35		40		43		46	
		kWf	kWa	kWf	kWa	kWf	kWa	kWf	kWa	kWf	kWa	kWf	kWa
350	5	355	101	338	112	324	124	305	136	294	145	283	154
	6	366	103	349	114	333	125	306	138	293	147	291	156
	7	377	104	360	116	**343**	**127**	316	140	302	149	300	158
	8	388	106	370	117	353	128	326	141	312	151	-	-
	9	398	107	380	118	363	129	336	143	321	153	-	-
	10	409	109	389	119	374	130	352	145	339	154	-	-
385	5	394	111	375	122	360	135	339	149	327	159	314	169
	6	406	113	387	124	370	137	340	151	325	161	324	171
	7	418	114	400	127	**381**	**139**	351	153	336	163	333	173
	8	430	116	411	128	392	140	362	155	346	165	-	-
	9	443	118	422	129	404	141	373	157	357	167	-	-
	10	455	119	433	131	415	142	391	158	376	169	-	-
430	5	442	120	420	132	403	146	380	161	366	172	352	182
	6	455	122	434	134	415	148	381	163	364	174	363	185
	7	469	123	448	137	**427**	**150**	394	165	376	176	373	187
	8	482	125	460	138	440	151	406	167	388	178	-	-
	9	496	127	473	140	452	152	418	169	400	180	-	-
	10	510	129	485	141	465	153	438	171	422	182	-	-
470	5	477	136	454	149	435	165	410	182	395	195	380	207
	6	491	138	469	152	448	168	412	185	393	197	392	209
	7	506	140	484	155	**461**	**170**	425	187	406	199	403	212
	8	521	142	497	157	475	171	438	189	419	202	-	-
	9	536	144	510	158	488	173	452	191	432	204	-	-
	10	550	146	523	160	502	174	473	194	455	207	-	-
515	5	521	146	496	161	476	178	448	196	432	209	415	223
	6	537	148	512	164	490	181	450	199	430	212	428	225
	7	553	150	529	167	**504**	**183**	465	201	444	215	441	228
	8	569	153	543	169	519	184	479	204	458	217	-	-
	9	586	155	558	170	534	186	494	206	472	220	-	-
	10	602	157	572	172	549	187	517	209	498	223	-	-
570	5	582	166	554	183	532	202	501	223	482	238	464	253
	6	600	169	572	186	547	205	503	226	480	241	478	256
	7	618	171	591	190	**563**	**208**	519	229	496	244	492	259
	8	636	174	607	192	580	210	535	231	511	247	-	-
	9	654	176	623	194	596	211	551	234	527	250	-	-
	10	672	178	639	196	613	213	577	237	556	253	-	-
630	5	643	184	612	202	587	224	553	247	533	263	513	280
	6	663	186	632	206	605	227	555	250	531	267	528	283
	7	683	189	652	210	**622**	**230**	573	253	548	270	544	287
	8	703	192	670	212	640	232	591	256	565	273	-	-
	9	723	195	688	214	659	234	609	259	582	276	-	-
	10	742	197	706	216	677	235	638	262	614	280	-	-

Tw= Outlet water temperature °C **kWf =** Net refrigerating power (kW). **kWa =** Power input of compressors (kW)

The standard performances refer to a 5°C temperature difference between the water entering and leaving the plate-type heat exchanger and to operation of the unit with all fans at top speed. A 0.44 x 10^{-4} m^2 K/W fouling factor has also been considered with the unit installed at zero meters above sea level (Pb = 1013mbar).

Noise levels (E)

Mod.	SWL (dB)										SPL (dBA)
	Octave bands (Hz)								Total		
	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
350	101,8	98,2	96,8	95,7	93,3	89,8	83,6	76,0	105	98	**78**
385	102,8	99,2	97,8	96,7	94,3	90,8	84,6	77,0	106	99	**79**
430	104,8	101,2	99,8	98,7	96,3	92,8	86,6	79,0	108	101	**81**
470	105,8	102,2	100,8	99,7	97,3	93,8	87,6	80,0	109	102	**82**
515	105,8	102,5	101,5	100,5	98,3	94,8	89,9	82,1	110	103	**82**
570	105,8	102,5	101,5	100,5	98,3	94,8	89,9	82,1	110	103	**82**
630	105,8	102,5	101,5	100,5	98,3	94,8	89,9	82,1	110	103	**82**

SWL = Sound power levels, with reference to 1x10^{-12} W.
The **Total** sound power level in **dB(A)** measured in compliance with **ISO 9614** standards, is certified according to the **Eurovent** certification program.
Eurovent certification **(E)** exclusively refers to the **Total** Sound Power in **db(A)**, which is therefore the only binding acoustic specification (the values of the Octave bands in the table are indicative).

SPL = Sound pressure levels, with reference to 2x10^{-5} Pa.
The sound pressure levels are values calculated by applying the **ISO-3744 relation (Eurovent 8/1)** and refer to a distance of 1 meter away from the external surface of units operating in the open field with directivity factor 2 and the units operating in nominal conditions in the cooling mode.

TECHNICAL DATA AND STANDARD PERFORMANCES - R407C

Technical specifications of unit AS-7M5

Unit Size	350	385	430	470	515	570	630	UM
Net cooling capacity (1)	338	372	416	454	490	550	603	kW
Net total power input (1)	138	152	168	186	202	228	251	kW
Maximum pressure on wet side (*)	600/1000							kPa
Gross cooling capacity (1) (E)	340	374	419	457	493	554	607	kW
Gross total power input (1) (E)	136	150	164	182	198	224	246	kW

Compressor specifications

Type	SCROOL							
Quantity	5	6			8			N°
N° Throttling steps	0÷100							%
Power input	128	141	155	172	187	212	234	kW

Plate-type Heat Exchanger specifications

Quantity	1				2			N°
Total water capacity	37.4	42.8	50	50	60.3	65.7	74.7	l
Water flow rate(1)	16,1	17,8	19,9	21,7	23,4	26,3	28,8	l/s
Water pressure drop(1) (E)	36	38	44	43	37	41	43	kPa

Specifications of coils with extended surfaces

Number of coils	4		8	N°
Total area	19.1	24.2	28.7	m^2

Fan specifications

Number of fans	8		10		12			N°
Diameter [∅]	800							mm
Maximum speed	650							rpm
Total air flow rate(2)	36557	35980	46465		54885	53736	53354	l/s
Motor rating	0.75							kW

Water Storage Tank specifications(

Quantity	1			N°
Water tank capacity	700	720	850	l

Pumping Module accessory specifications

Pump power rating	5.5	7.5						kW
Surge chamber volume	24							l
Service charge pressure of surge chamber	150							kPa
Water flow rate (1)	16,1	17,8	19,9	21,7	23,4	26,3	28,8	l/s
Working head (1) (MP)	175	146	144	122	157	130	109	kPa

Electrical specifications (3)(MP)

Power supply	400 / 3 / 50							V/ph/Hz
Total maximum power input [FLA]	310	342	380	410	459	499	539	A
Total maximum power input [FLI]	186	207	228	245	278	300	323	kW
Total maximum surge current [MIC]	568	562	638	668	679	757	797	A

(1) Inlet/outlet water temp. 12/7 °C. - Outdoor air temp. 35°C D.B.
(2) At fan's top speed
(3) At maximum operating conditions.
(E): Data dcertificated by **EUROVENT**
(MP) For units equipped with Pumping Module accessory MP-AM or MP-AR.

(*) Regarding unit WITH (600 kPa) or WITHOUT (1000 kPa) Storage Tank accessory.
(**) Regarding the Pumping Module accessory with 1 pump / 2 pumps.

TECHNICAL DATA AND STANDARD PERFORMANCES - R407C

Standard performances AS-7M5

MODEL	TW	OUTDOOR AIR TEMPERATURE (°C D.B.)											
		25		30		35		40		43		46	
		kWf	kWa	kWf	kWa	kWf	kWa	kWf	kWa	kWf	kWa	kWf	kWa
350	5	348	103	332	113	319	125	301	137	290	146	279	155
	6	359	104	343	115	328	126	302	139	288	148	288	157
	7	370	105	354	117	**338**	**128**	312	141	298	150	296	159
	8	381	107	364	118	348	129	321	142	307	152	-	-
	9	392	108	374	119	358	130	331	144	316	154	-	-
	10	403	109	384	120	368	131	347	146	335	156	-	-
385	5	384	113	365	124	351	137	331	151	319	161	307	171
	6	396	115	378	126	361	139	332	153	317	163	317	173
	7	407	116	390	128	**372**	**141**	343	155	328	165	326	176
	8	419	117	401	130	383	142	354	157	338	167	-	-
	9	431	119	411	131	394	143	364	159	348	169	-	-
	10	443	120	422	132	405	144	382	160	368	171	-	-
430	5	429	124	409	136	392	151	370	166	357	177	344	188
	6	442	126	422	139	404	153	371	168	355	179	354	190
	7	456	127	436	141	**416**	**155**	383	170	366	182	365	193
	8	469	129	448	143	428	156	395	172	378	184	-	-
	9	482	131	460	144	441	157	407	174	389	186	-	-
	10	496	132	472	145	453	158	427	176	412	188	-	-
470	5	468	138	446	151	428	167	404	184	390	197	375	209
	6	483	140	461	154	441	170	405	187	387	199	387	211
	7	497	141	476	157	**454**	**172**	418	189	400	201	398	214
	8	512	143	489	158	467	173	432	191	412	204	-	-
	9	526	145	502	160	481	174	445	193	425	206	-	-
	10	541	147	515	161	494	176	466	196	449	209	-	-
515	5	505	150	481	165	462	182	436	200	421	214	405	227
	6	521	152	497	167	476	185	437	203	418	216	417	230
	7	537	154	513	170	**490**	**187**	452	205	432	219	430	233
	8	552	156	528	172	505	188	466	208	445	222	-	-
	9	568	158	542	174	519	190	480	210	459	224	-	-
	10	584	160	556	175	534	191	503	213	485	227	-	-
570	5	567	170	540	187	519	206	490	227	472	242	454	257
	6	585	172	558	190	534	209	491	230	469	245	468	261
	7	602	174	576	193	**550**	**212**	507	233	484	248	482	264
	8	620	177	592	195	566	213	523	236	500	251	-	-
	9	638	179	608	197	583	215	539	238	515	254	-	-
	10	655	181	624	199	599	216	565	241	544	258	-	-
630	5	622	188	592	206	569	228	537	251	517	267	498	284
	6	641	190	612	210	586	231	538	254	514	271	513	288
	7	660	192	632	213	**603**	**234**	556	257	531	274	529	291
	8	680	195	649	215	621	236	573	260	548	278	-	-
	9	699	197	667	217	639	237	591	263	564	281	-	-
	10	719	200	684	219	657	239	619	266	597	284	-	-

Tw= Outlet water temperature °C **kWf =** Net refrigerating power (kW). **kWa =** Power input of compressors (kW)

The standard performances refer to a 5°C temperature difference between the water entering and leaving the plate-type heat exchanger and to operation of the unit with all fans at top speed. A 0.44 x 10^{-4} m^2 K/W fouling factor has also been considered with the unit installed at zero meters above sea level (Pb = 1013mbar).

Noise levels(E)

Mod.	SWL (dB)										SPL (dBA)
	Octave bands (Hz)								Total		
	63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
350	95,1	91,2	90,3	88,2	85,1	80,0	73,4	65,9	98	90	**70**
385	96,1	92,2	91,3	89,2	86,1	81,0	74,4	66,9	99	91	**71**
430	98,1	94,2	93,3	91,2	88,1	83,0	76,4	68,9	101	93	**73**
470	99,1	95,2	94,3	92,2	89,1	84,0	77,4	69,9	102	94	**74**
515	99,2	95,5	95,4	93,0	90,2	85,5	80,1	72,0	103	95	**74**
570	99,2	95,5	95,4	93,0	90,2	85,5	80,1	72,0	103	95	**74**
630	99,2	95,5	95,4	93,0	90,2	85,5	80,1	72,0	103	95	**74**

SWL = Sound power levels, with reference to 1x10^{-12} W.
The **Total** sound power level in **dB(A)** measured in compliance with **ISO 9614** standards, is certified according to the **Eurovent** certification program.
Eurovent certification **(E)** exclusively refers to the **Total** Sound Power in **db(A)**, which is therefore the only binding acoustic specification (the values of the Octave bands in the table are indicative).

SPL = Sound pressure levels, with reference to 2x10^{-5} Pa.
The sound pressure levels are values calculated by applying the **ISO-3744 relation (Eurovent 8/1)** and refer to a distance of 1 meter away from the external surface of units operating in the open field with directivity factor 2 and the units operating in nominal conditions in the cooling mode.

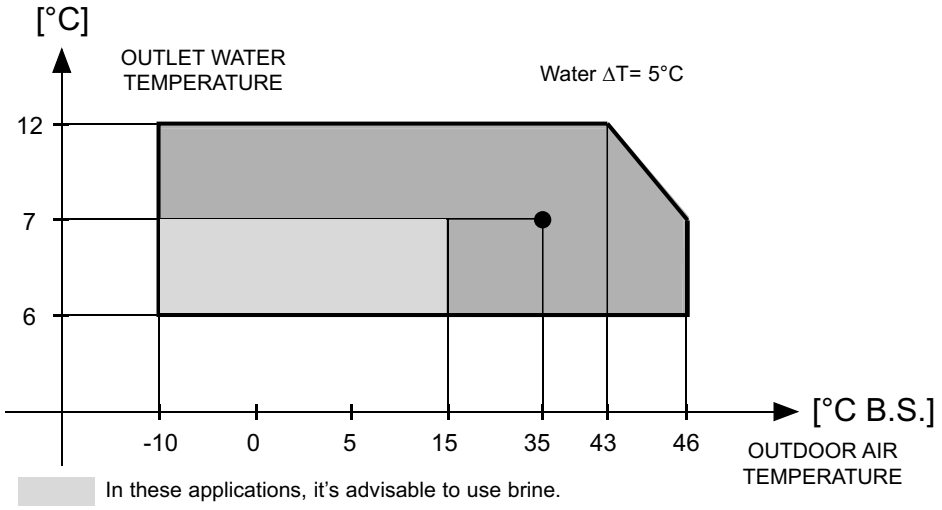
OPERATING RANGE

Operating range

The graphs below give the operating ranges within which correct operation of the units is guaranteed.
The use of the units in conditions differing from those indicated will void the warranty with which the product is supplied.
In the following table, there are the thermal water head limit values of the unit.

Thermal Water Head		Limit value
Minimun	°C	3
Maximus	°C	8

COOLING MODE



HOW TO SELECT THE UNIT

1) The "**Standard Performances**" tables in the "**Technical data and standard performances**" chapter give the useful output capacity values with the relative compressor input power values of the individual units in standard conditions, for each unit and for different outdoor air and outlet water temperature values. The data can be interpolated but not extrapolated.
2) The "**Technical data and standard performances**" tables in this technical handbook refer to use of **R407C** refrigerant.
3) The tables under the "**Standard Performances**" values give the operating temperature limits of the outdoor air that may enter the condenser.
4) The power input values in the "**Standard Performances**" tables refer to the compressors alone. Consult the "**Technical data of the unit**" tables for the power input of the fans at their top rate.
5) The "**Standard Performances**" values refer to 5° C of Δt of the water between the inlet and outlet of the evaporator. Use corrective factor F_{cD} in **Tab.3** for different values. To ensure the heat exchanger-evaporator operates in the correct way, comply with the limits to use given in the "**Loss of head**" and "**Useful head**" sections.
6) The " **Standard Performances**" values are based on a fouling factor of the heat exchanger on the wet side equal to $0.44 * 10^{-4}$ m^2 °C / W. If the values are different, consider correction factor F_{cP} given in **Tab. 1**.
7) The "**Standard Performances**" values refer to a unit installed in places at zero meters above sea level (Pb = 1013 mbar). Use "Performances" correction factor F_{cH} indicated in **Tab. 2** for operation at different altitudes.
8) Consult the "**Loss of head**" section to determine the loss of head on the wet side through the unit. If the units are equipped with the Pumping Module accessory with storage on the water supply plant delivery or storage on the return side, the useful head of the unit can be determined by means of the diagram in the "**Useful head**" section. Remember that the curves refer to the useful head calculated as difference between the pump head and the loss of head of the components (filter, on-off devices, pipes, tank, plate type heat exchanger) installed in the hydraulic circuit of the unit.
10) Use the "**Noise levels**" tables to check the acoustics.
11) If a unit equipped with one of the Pumping Module accessories is being evaluated, check in the "**Maximum volume of water**" section to make sure that the capacity of the surge chamber supplied with the accessory suits the volume of water actually in the system being supplied.

Example of how the unit is selected
Selection of a unit able to supply an **380 kW** refrigerating power in the following conditions:
- Outdoor air temperature = 30°C
- Temperature of the cold water outlet by the machine = 8°C
- Inlet/outlet temperature difference of the water Δt = 7°C

Also consider:
- a 0.88x10-4m^2°C/W fouling factor on the wet side of the heat exchanger
- unit installed in a place at 600 meters a.s.l.

The unit must also guarantee a sound pressure level of less than **75 dB(A)** measured one meter away from the machine.

Solution:
In view of the value imposed by the maximum sound level, the choice will be directed towards soundproofed units of the silenced type.
Beginning with the refrigerating power required at the given conditions of use and having checked the "Standard Performances" table, models **IR 385.6 VB AS7M5** can be selected as it provides a standard refrigerating power of **401 kW** and a sound pressure level of **71 dB(A)** one meter away from the machine.
The effective refrigerating power provided by the machine in the real conditions of use will be:

$$Pf = Pfs \cdot Fc_H \cdot Fc_D \cdot Fc_p$$

Where: P_f = refrigerating power provided in the real operating conditions (kW)
$P_{f\ s}$ = refrigerating power provided in standard conditions (kW)
F_{CH} = correction factor for the height above sea level
F_{CP} = correction factor for the fouling factor
F_{CD} = correction factor for the temperature difference

The available data and **tables 1, 2, 3** can be used to determine the values of correction factors F_{CH} = 0.98, F_{CP} = 0.98, F_{CD} = 1,027, after which the refrigerating power supplied in the real operating conditions can be calculated, i.e.:

$$Pf = (401)\,(0.98)\,(1.027)\,(0.98) = 396\ \text{kW}$$

In the given conditions of use, the selected unit provides a 396 kW refrigerating power, which meets the cooling requirements.
The flow rate of the water that passes through the evaporator will be:

$$Q = \frac{Pf}{c \cdot \Delta t} = \frac{396}{(4.186) \cdot 7} = 13.5\ \text{l/s}$$

with c = 4.186 kJ/kg °C specific heat of the water.
A 22 kPa loss of head is given in the "Loss of head" graph, on a level with the determined water flow rate of the selected model.

This value is acceptable since it is within the limit values given in “Limits to use”.
A 224 kPa useful head is given in the “Useful head” graph, on a level with the determined water flow rate and the curve of the selected model.

With reference to the “Maximum water volume” section drawing and supposing that the difference in level between the highest point in the circuit and the unit is 20 meters (case **B** of **table 5**), the chamber must be given a 226 kPa setting while the maximum amount of water in the system (including the volume of the tank of the pumping module) will be 1732 liters (V_{max}).

If the real volume of water in the system is less than 1732 liters, there will be no need to install an additional surge chamber. On the other hand, if the volume is greater, proceed as described below to size an additional surge chamber:
Volume of the system (V_i) = 2500 liters

$\Delta V = V_i - V_{max}$ = 768 liters

$E_{10\text{-}40°C}$ = 0.0074

P_i (Surge chamber service charge) = (H / 10.2 + 0.3) x 100 = 226 kPa (326 kPa absolute)

P_f (Fixed value) = 700 kPa (absolute value)

Volume of additional surge chamber = $(E \times \Delta V) / (1 - P_i / P_f)$ = (0.0074)(768)/(1-326/700) = 10.7 Liters

An additional surge chamber with a capacity of more than 10.7 liters and a 226 kPa setting must therefore be installed.

NOTE:
If brine is added to the water, the final checks must be made considering the correction due to the percentage of brine used.
The correct value of the additional surge chamber to be installed in the system is found with reference to the “Correction factors for the total volume of the system with brine” table in the “Maximum Volume of Water” section.
Considering the above example again, supposing that 30% brine is to be used:
the corresponding correction value for this percentage of brine used in the cooling mode is 0.652, with reference to the “Correction factors for the total volume of the system with brine” table.
The maximum amount of water in the system with brine added is as follows:
$V_{max,G} = V_{max} \times 0{,}652 = 1732 \times 0.652 = 1129$ liters

$\Delta V_G = Vi - V_{max,G} = 2500 - 1129 = 1371$ liters

E_G = Thermal expansion E /0,652= 0,0074/0,652= 0,0113

Thus, the volume of the surge chamber must be:
$(E_G \times \Delta V_G) / (1\text{-}Pi/Pf)$ = (0,0113 x 1371) / (1-326/700)= 29.1 liters

An additional surge chamber with a capacity of more than 29.1 liters and a 226 kPa setting must therefore be installed.

Tab.1

Correction factor F_{cP}	
Fs (m^2 °C/W)	**Fc - P**
Clean	1.02
0.44 x 10^{-4}	1.00
0.88 x 10^{-4}	0.98
1.76 x 10^{-4}	0.94

FS = Fouling factor
Fc - P = Refrigerating power correction factor

Tab.2

Correction factor F_{cH}		
Aslm (m)	**Pb** (mbar)	**Fc - H**
Sea level	1013	1
300	977	0.99
600	942	0.98
900	908	0.97
1200	875	0.96
1500	843	0.95
1800	812	0.94

Aslm = Height above sea level
Pb = Barometric pressure
Fc - H = Refrigerating power correction factor

Tab.3

Correction factor F_{cD}	
ΔT (°C)	**FC- D**
3	0.98
4	0.99
5	1
6	1.012
7	1.027
8	1.033

DT = Thermal gradient
Fc - D = Refrigerating power correction factor

If the system is not drained during winter, but is stopped and brine is used, it will be necessary to introduce multiplicative correction factors for the Refrigerating Power (F_{CPG}) and water flow rate (F_{CQG}).

Table 4 also gives the reference multiplication factors for the Compressor power input and Loss of head values.
Supposing that brine with 30% ethylene glycol is used, the Refrigerating Power, Water Flow Rate and Loss of Head values previously found for the selected unit become:

$P^*_f = P_f (F_{CPG}) = (396) (0.97) = 384$ kW

$Q^* = Q (F_{CQG}) = (13.5) (1.12) = 15.1$ l/s

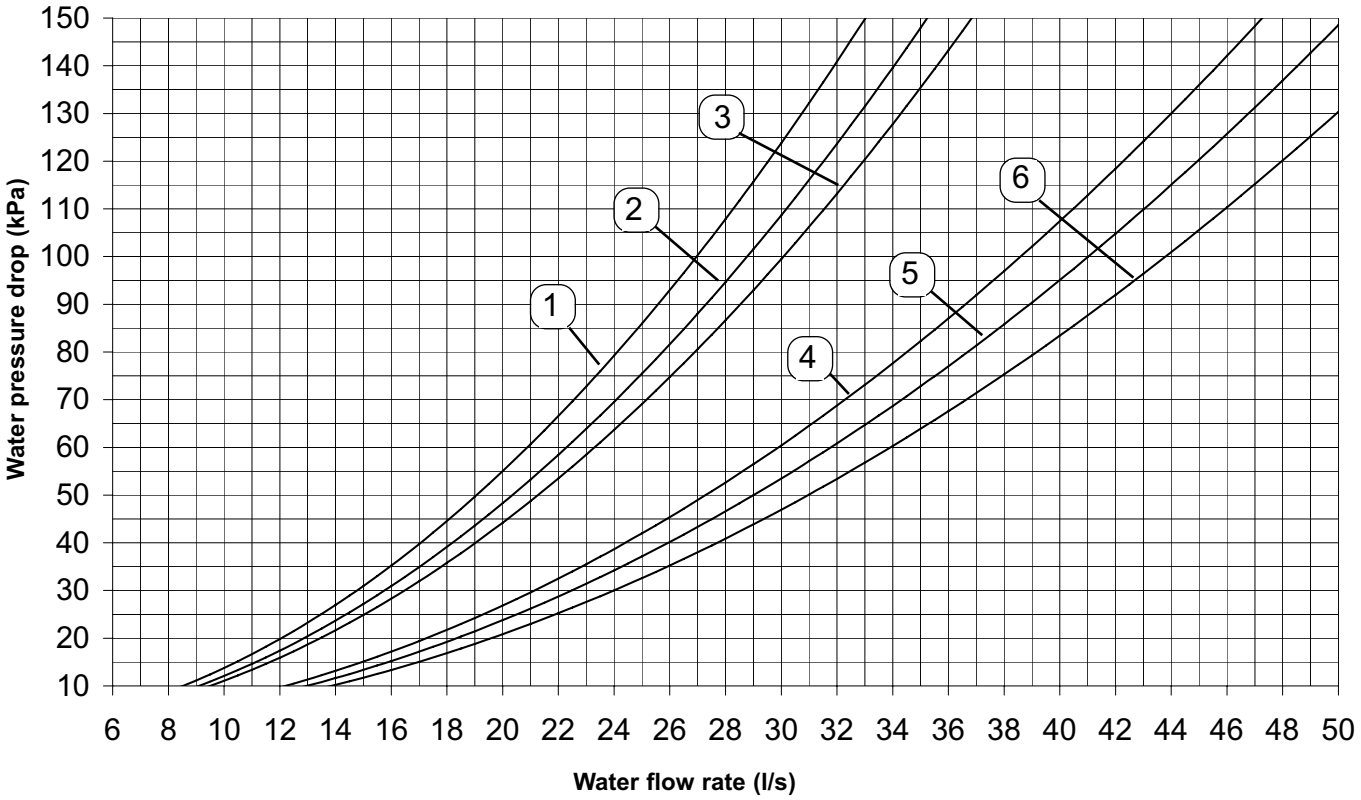
Loss of Head = (22) (1.25) = 27 kPa

Tab.4

% of brine in weight	0	10%	20%	30%	40%
Freezing temperature	0	-3.9	-8.9	-15.6	-23.4
Refrigerating power multiplier (FCPG)	1	0.99	0.98	0.97	0.95
Power input multiplier	1	1	0.99	0.99	0.98
Water flow rate multiplier (FCQG)	1	1.04	1.08	1.12	1.16
Loss of head multiplier	1	1.08	1.16	1.25	1.35

WATER PRESSURE DROP

The graph below illustrates the water pressure drop values in **kPa** depending on the flow rate in **liters/second**. The operating range is delimited by the minimum and maximum values given in the next table.

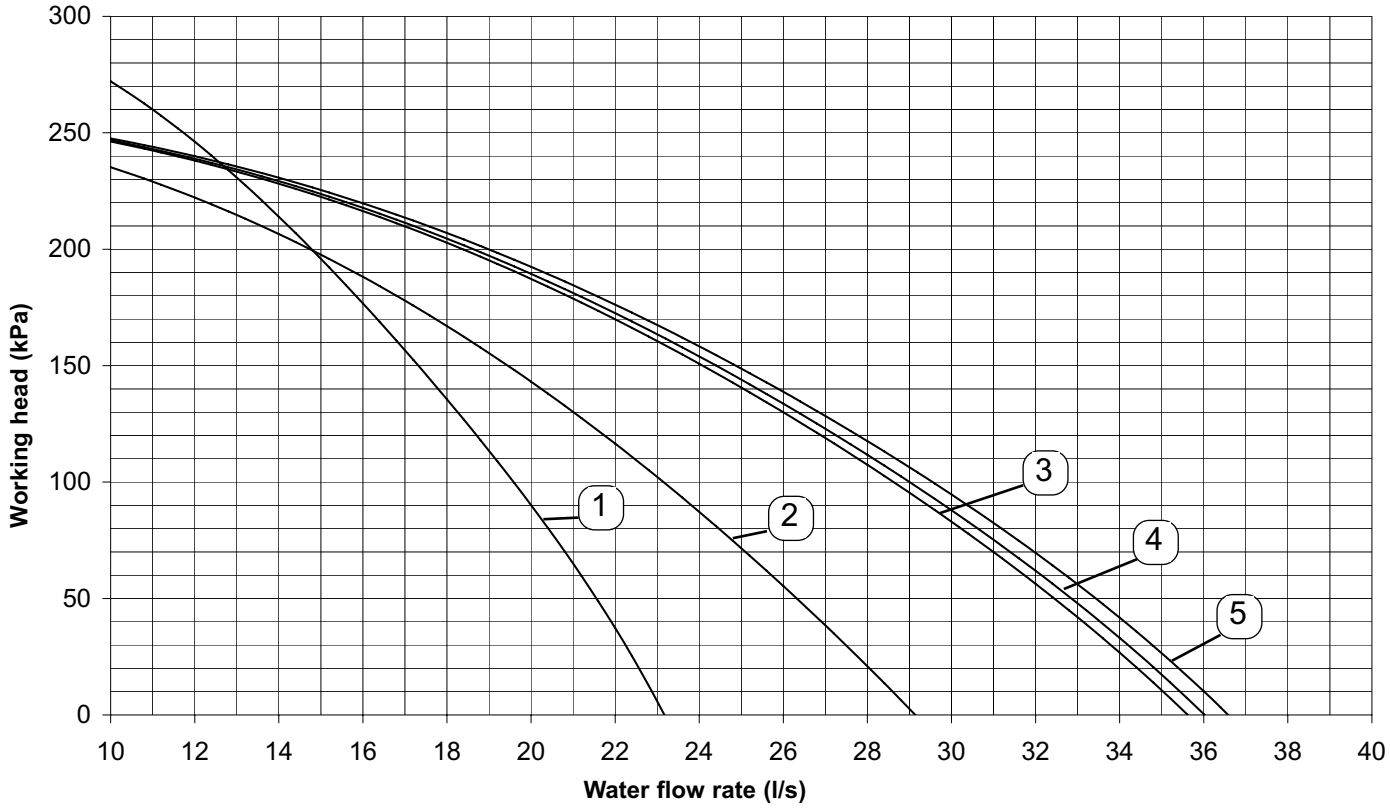


Limits to operation

Unit Size		350	385	430	470	515	570	630	UM	NOTES
Graph reference		1	2	3		4	5	6		**Q=**Water flow rate
Lower limit value	**Q**	8.5	9.1	9.5		12.2	13	14	l\s	
	Δp	10							kPa	**Δp=**Water pressure drop
Upper limit value	**Q**	33	35.2	36.8		47.2	50	50	l\s	
	Δp	150						130	kPa	

WORKING HEAD

The following graph gives the head values (**kPa**) depending on the water flow rate (**liters/second**). The operating range is delimited by the minimum and maximum values given in the next table.
Working head is the one on the wet module outlet minus all the load losses of the unit.



Limits to operation

Unit Size		350	385	430	470	515	570	630	UM	NOTES
Graph reference		1		2		3	4	5		**Q=**Water flow rate
Upper limit value	**Q**	23.2		29.1		35.6	36	36.6	l\s	

MAXIMUM VOLUME OF WATER

Maximum volume of water of the system with wet module

Before filling the water supply system, it is advisable to consider the type of installation in question, i.e. check the difference in level between the wet module and user. The following table gives the maximum water content of the water supply system in liters, depending on the capacity of the standard surge chamber supplied and the pressure at which it should be charged. The surge chamber setting must be regulated to suit the maximum positive difference in level of the user.
Maximum setting value **600 kPa**.
With a positive H of more than 12.25 meters, calculate the surge chamber's service charge value in kPa using the formula below:

Surge chamber service charge= [H/10.2+0.3]x100 = [kPa]

NOTE. In case **A**, make sure that the user's lowest point is able to withstand the global pressure.

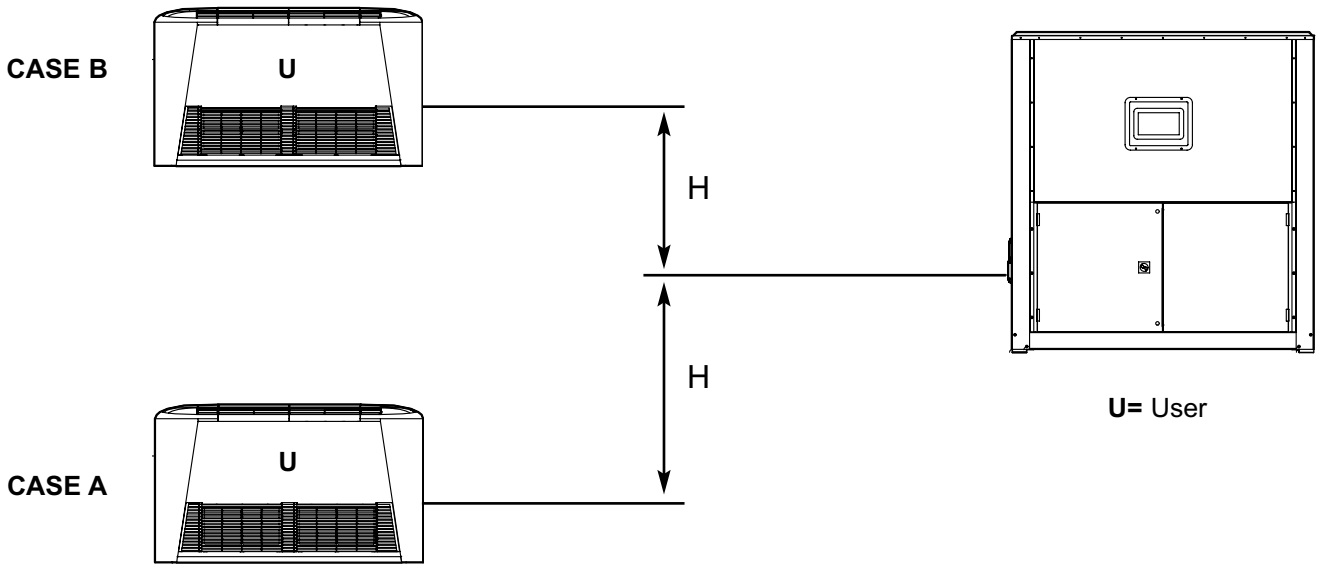
Tab.1

Model			**350 - 385 - 430 - 470 - 515 - 570 - 630**
Surge chamber volume (liters)			24
Thermal expension of water (10-40°C)			0.0074
H (meters)		Surge chamber pressure (kPa)	Maximum total volume of water supply system (liters)
Case A	H <0	150 (standard)	2085
Case B	0 < H < 12.25	150 (standard)	2085
	15	177	1960
	20	226	1732
	25	275	1505
	30	324	1279

NOTE: If the unit operates with brine, calculate the real volume of the system by taking into account the corrective factors for the volume of the system given in the table below.

Corrective factors per total maximum volume of the system with brine

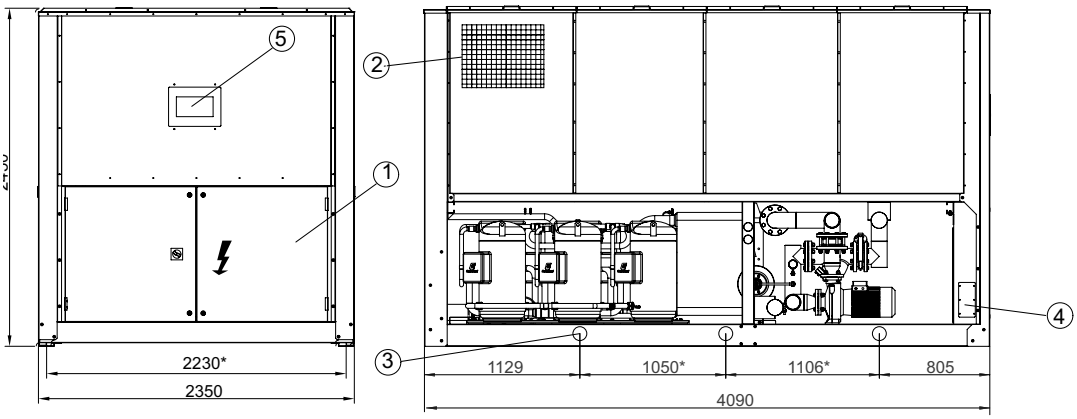
% of brine	**0%**	**10%**	**20%**	**30%**	**40%**
Cooling Mode	1.000	0.738	0.693	0.652	0.615
Heating Mode	1.000	0.855	0.811	0.769	0.731



OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

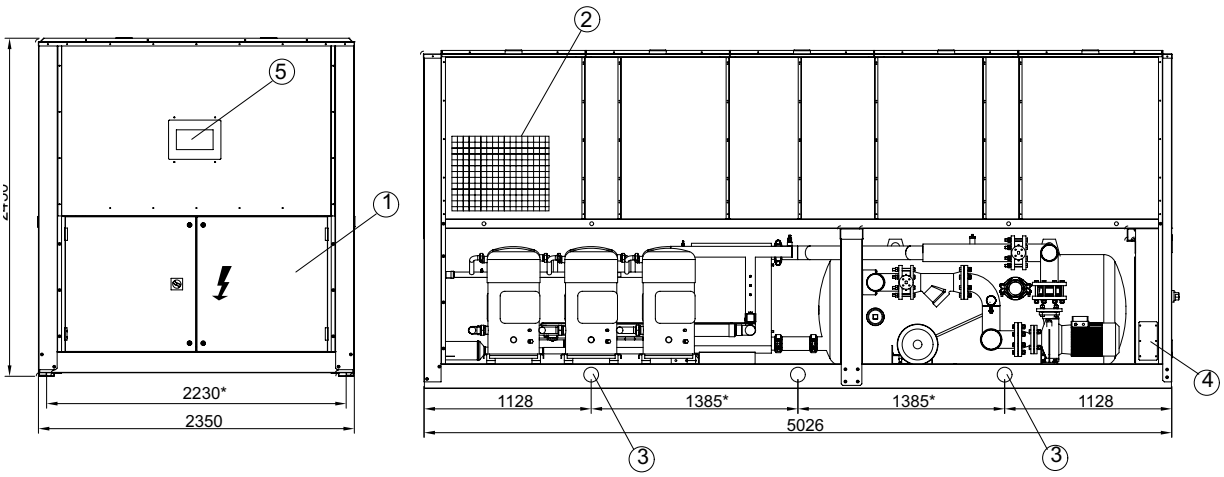
Overall dimensions

Mod. 350.5 ÷ 385.6



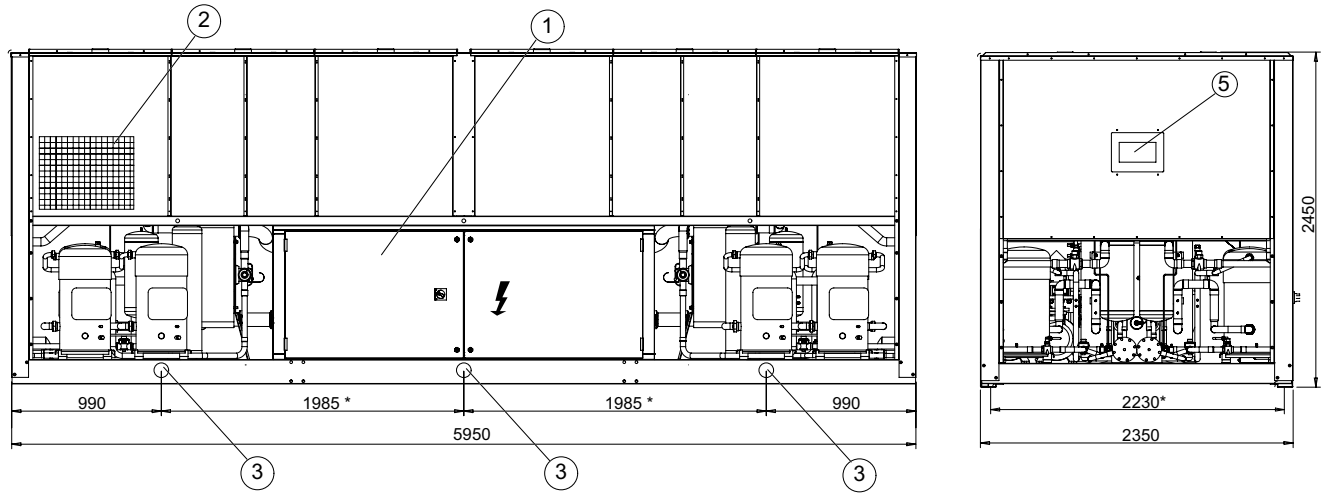
*Center distance for vibration damper holes f=18mm

Mod. 430.6 ÷ 470.6



*Center distance for vibration damper holes f=18mm

Mod. 515.8 ÷ 630.8



*Center distance for vibration damper holes f=18mm

Description of the components

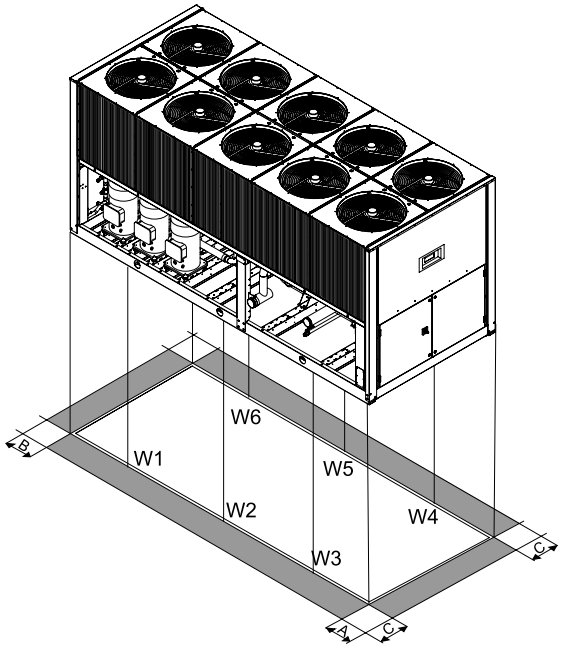
1 - Access panel to electric panel
2 - Coil protection grilles (accessory)
3 - Lifting holes
4 - Input plate for power supply cables, unit and electrical accessories type (F) (120x250 mm - useful hole in cabinet 73x200)
5 - Unit controller with display

OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

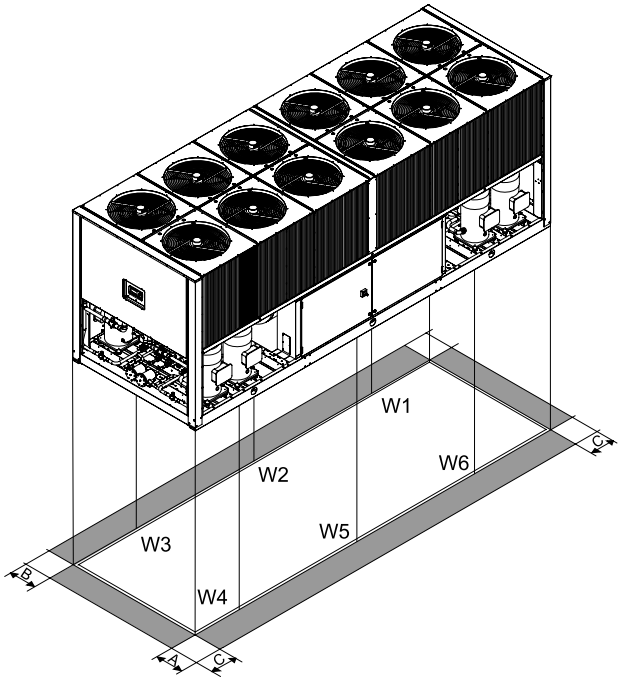
Minimum space required for operation

To correctly install the unit, comply with the measurements for the free area that must be left around the machine, as shown in the figure. This will ensure good air circulation, allow the unit to operate correctly and facilitate future maintenance work.

Mod. 350.5 ÷ 470.6



Mod. 515.8 ÷ 630.8



Model	350	385	430	470	515	570	630
Vacant space (mm)							
A	1100				1300		
B	600				1100		
C	1100				600		

The distances must be doubled if the unit is to be installed in a pit.
NOTE: Allow for an uncluttered area of not less than 2.5 meters above the unit.

The functional areas must be doubled if multiple units are installed.
NOTE: Consult the **"Weights and centers of gravity during operation"** section for how the loads are distributed amongst the supports.**".**

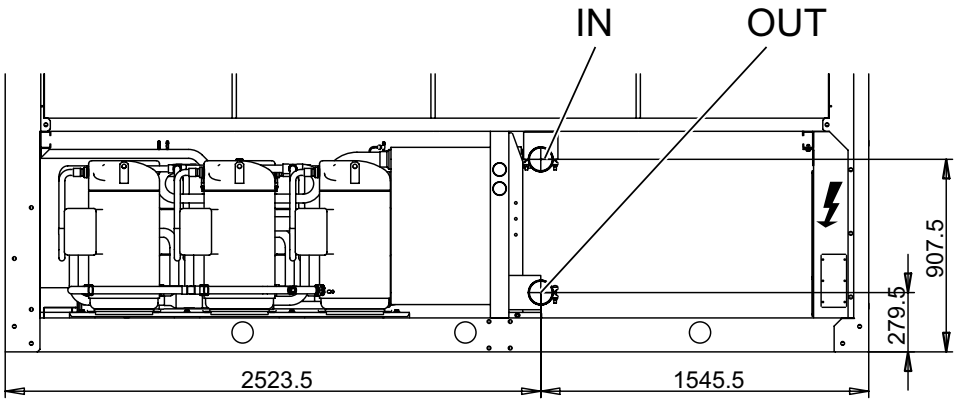
OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

Position of wet connections

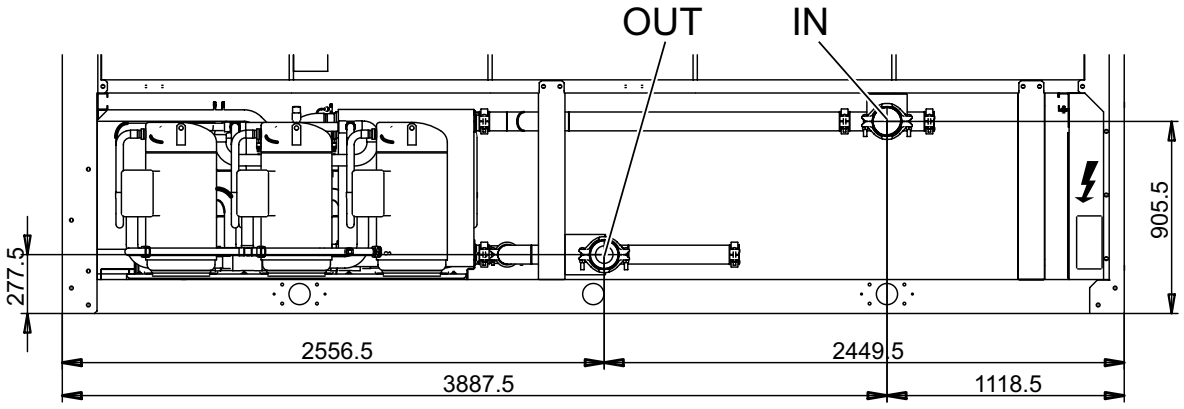
Unit WITHOUT Water Storage Tank

UNIT WITH PIPE KIT

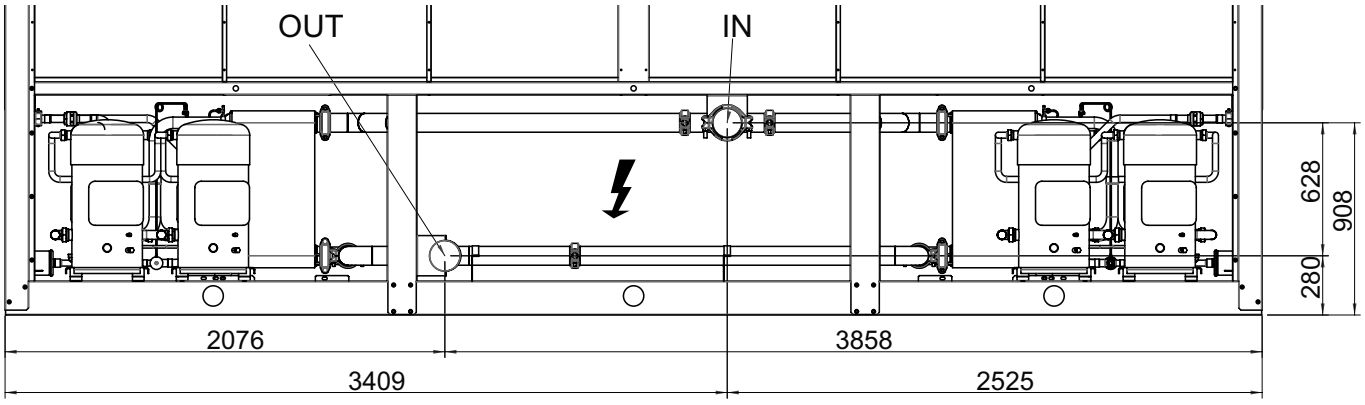
For **mod. 350-385**, the unit's water inlet (IN) and outlet (OUT) occur through **4"** flexible **Victaulic** couplings **(DN 100).**



For **mod. 430-470**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 120)**.



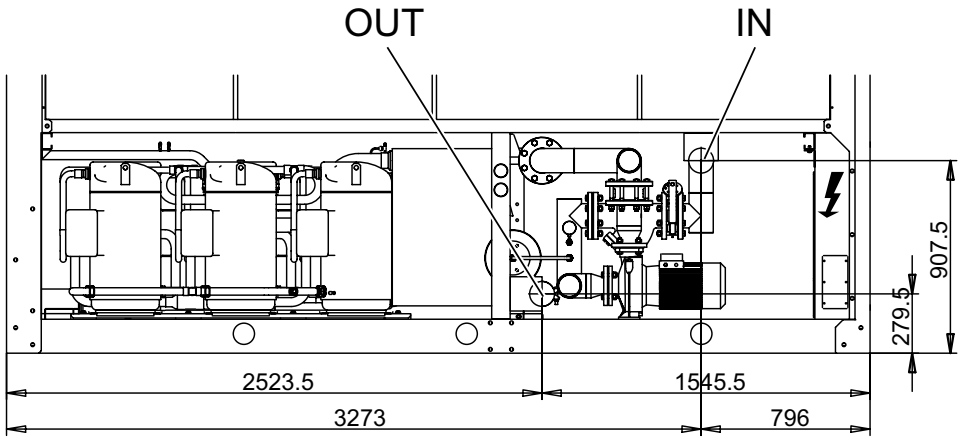
For **mod. 515÷630**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 125**).



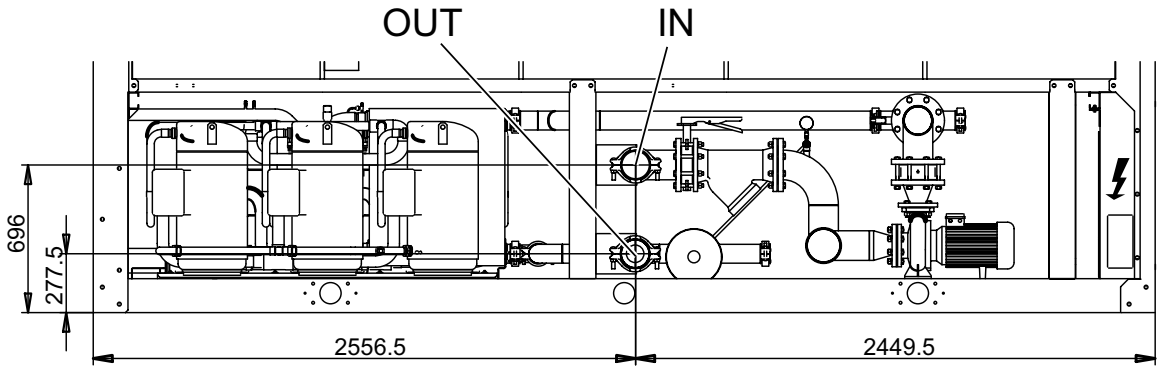
OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

UNIT WITH PUMPING MODULE WITH 1/2 PUMPS

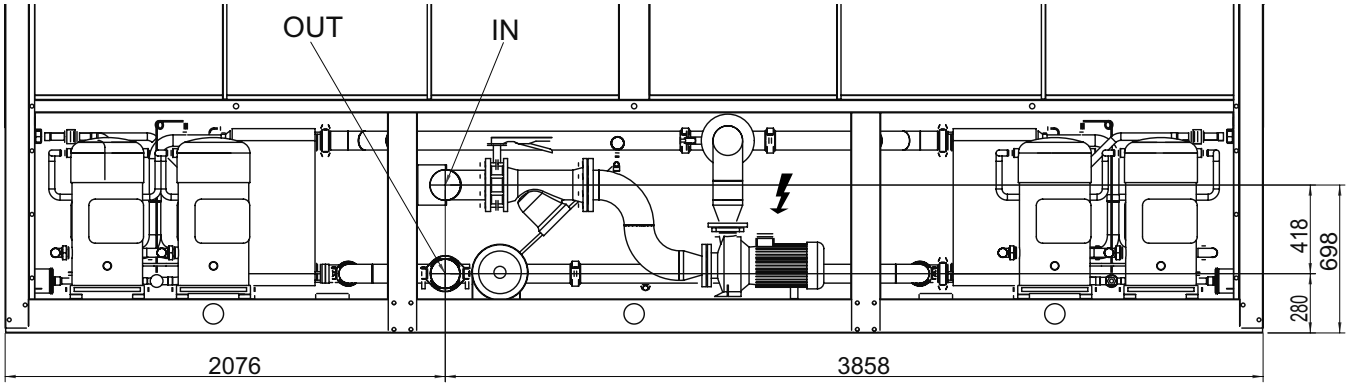
For **mod. 350-385**, the unit's water inlet (IN) and outlet (OUT) occur through **4"** flexible **Victaulic** couplings **(DN 100).**



For **mod. 430-470**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 120)**.



For **mod. 515÷630**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 125**).

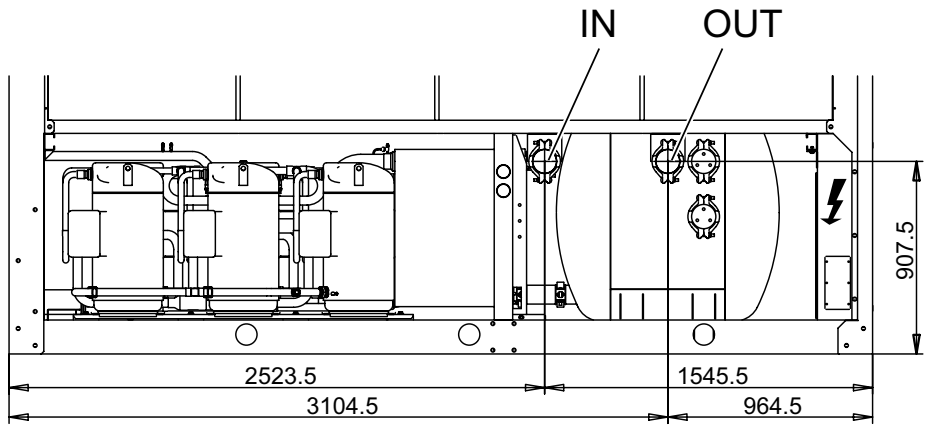


OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

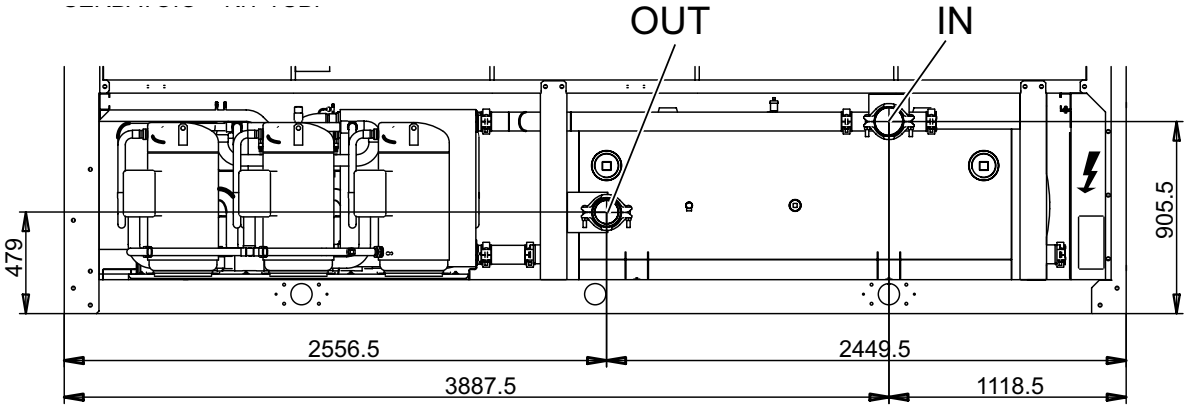
Unit WITH Water Storage Tank

UNIT WITH PIPE KIT

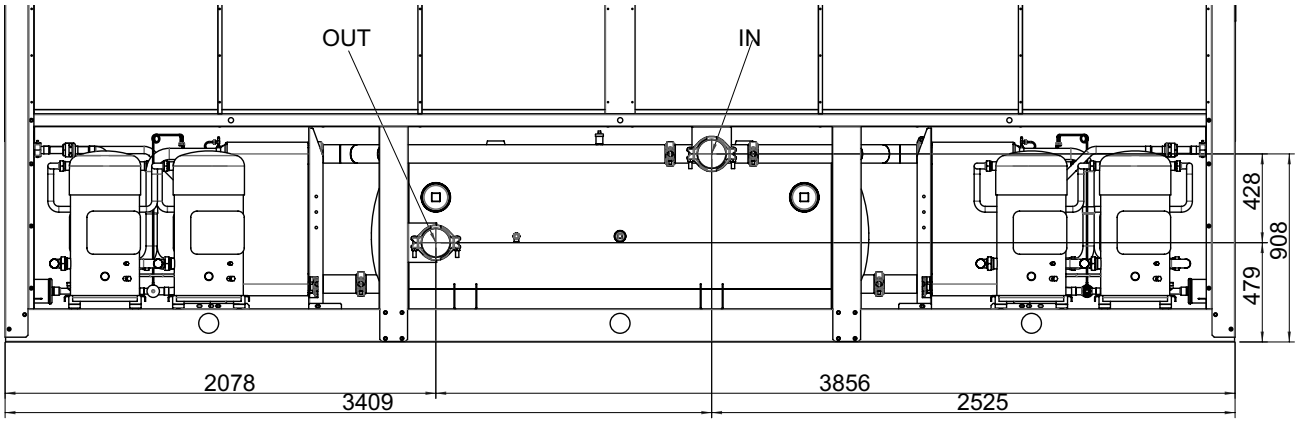
For **mod. 350-385**, the unit's water inlet (IN) and outlet (OUT) occur through **4"** flexible **Victaulic** couplings **(DN 100).**



For **mod. 430-470**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 120)**.



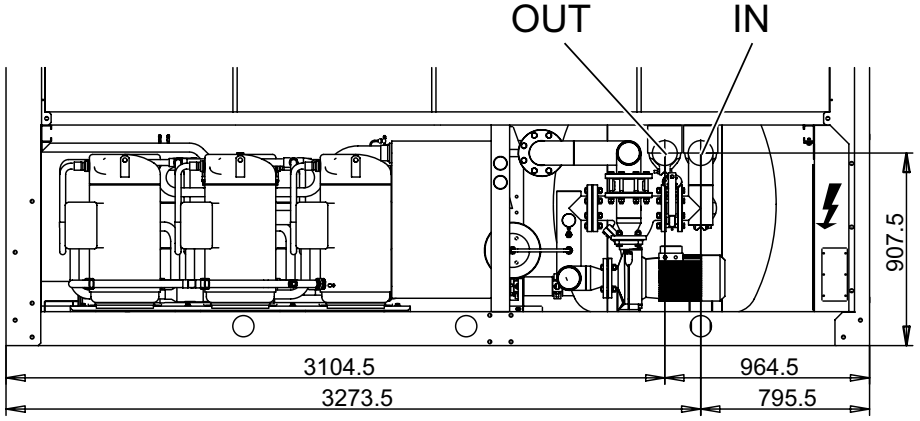
For **mod. 515÷630**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 125**).



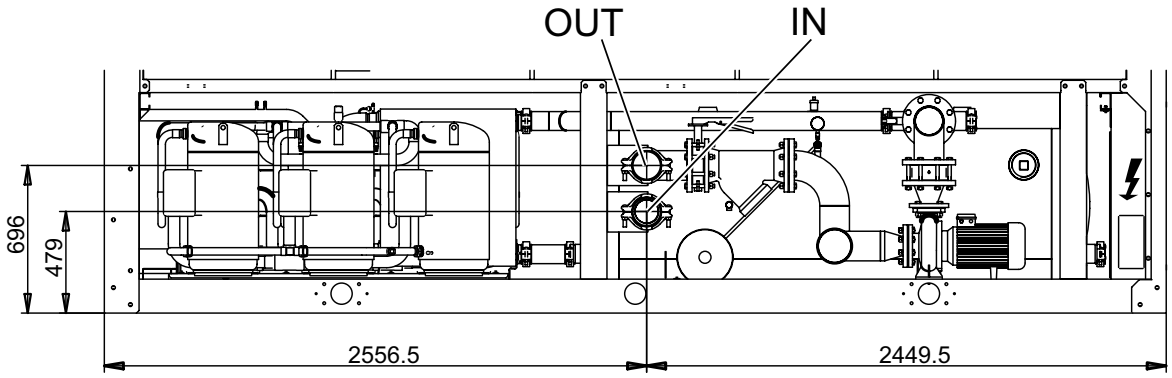
OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

UNIT WITH PUMPING MODULE STORAGE ON THE DELIVERY SIDE WITH 1/2 PUMPS

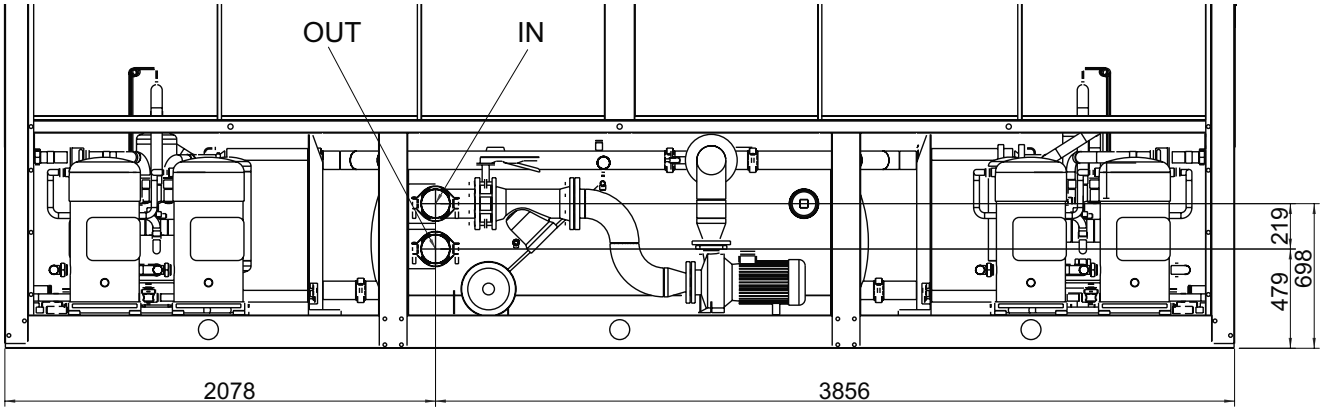
For **mod. 350-385**, the unit's water inlet (IN) and outlet (OUT) occur through **4"** flexible **Victaulic** couplings **(DN 100).**



For **mod. 430-470**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 120)**.



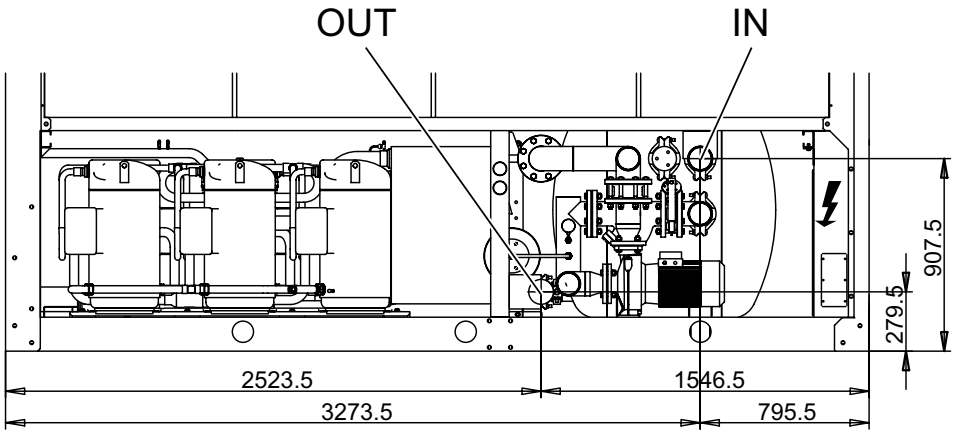
For **mod. 515÷630**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 125**).



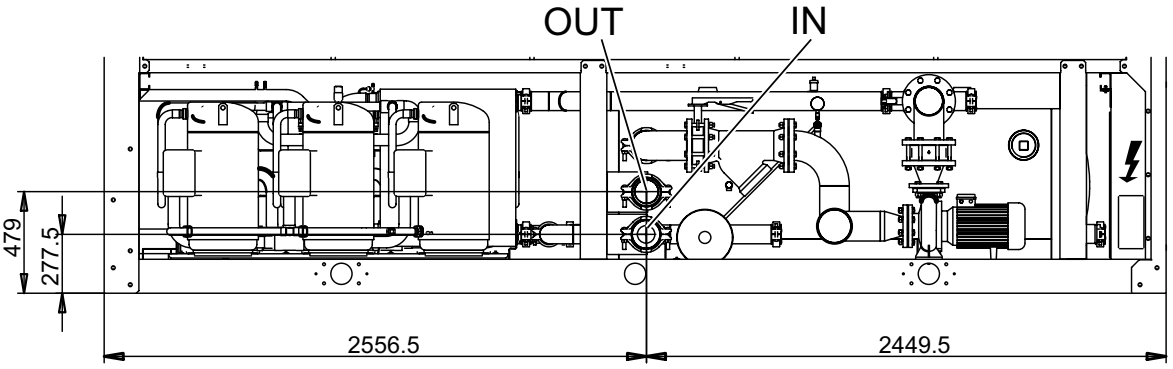
OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

UNIT WITH PUMPING MODULE STORAGE ON THE RETURN SIDE WITH 1/2 PUMPS

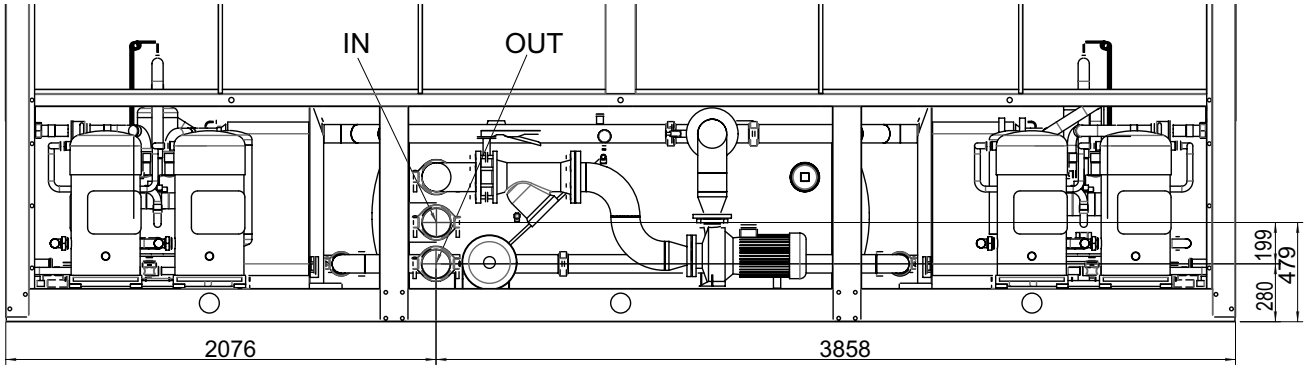
For **mod. 350-385**, the unit's water inlet (IN) and outlet (OUT) occur through **4"** flexible **Victaulic** couplings **(DN 100).**



For **mod. 430-470**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 120)**.



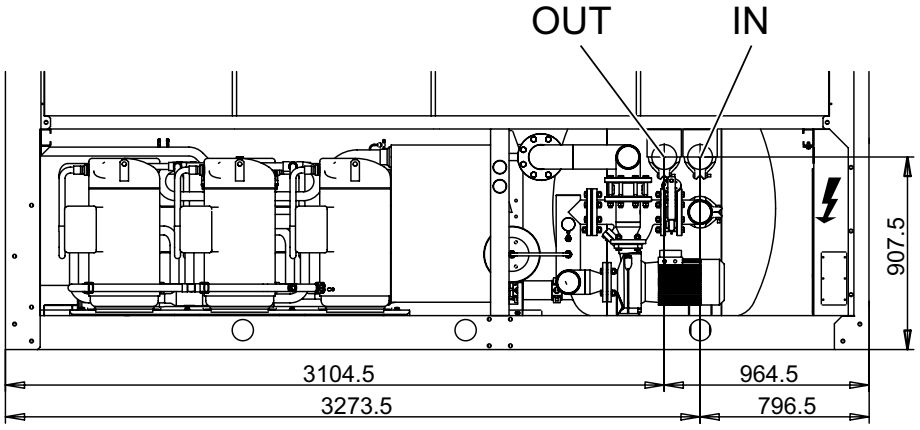
For **mod. 515÷630**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 125**).



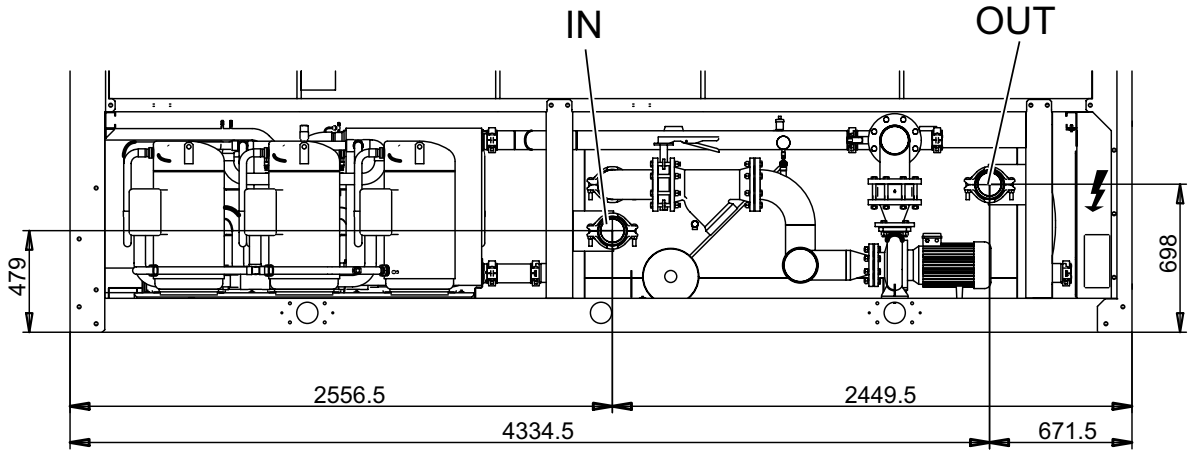
OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

UNIT WITH PRIMARY/SECONDARY PUMPING MODULE WITH 1/2 PUMPS

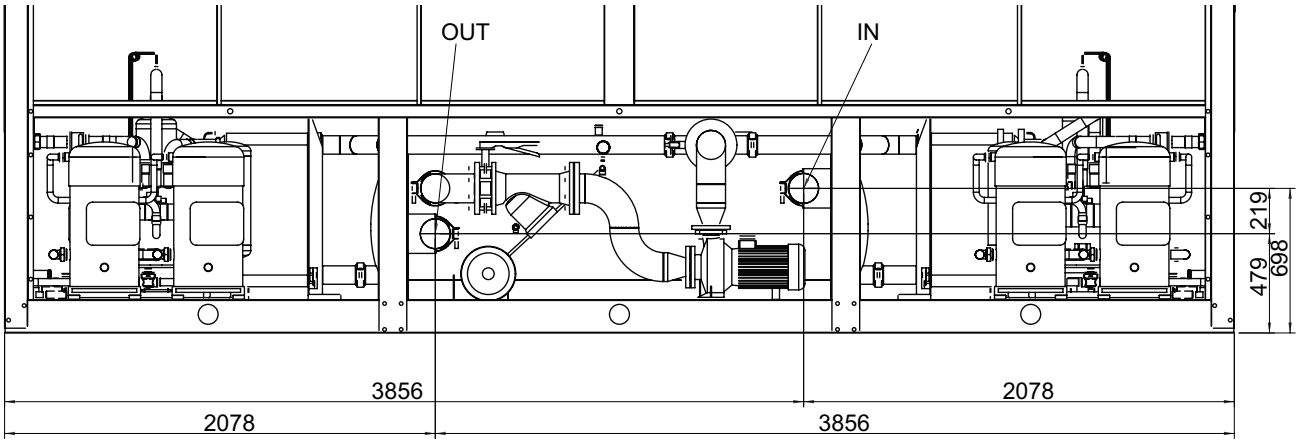
For **mod. 350-385**, the unit's water inlet (IN) and outlet (OUT) occur through **4"** flexible **Victaulic** couplings **(DN 100).**



For **mod. 430-470**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 120)**.



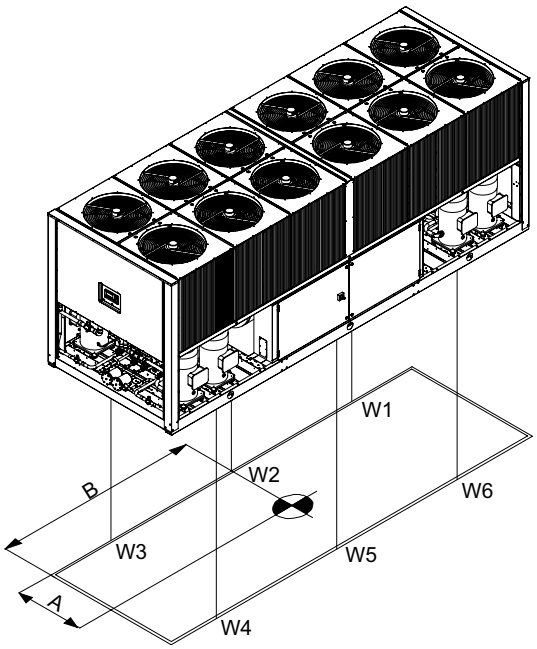
For **mod. 515÷630**, the unit's water inlet (IN) and outlet (OUT) occur through **5"** flexible **Victaulic** couplings **(DN 125**).



OVERALL DIMENSIONS - MINIMUM SPACE REQUIRED AND WEIGHTS

Weight distribution and center of gravity position during operation

Consider the following center of gravity position values and load on the bearing surfaces to correctly match the machine to the bearing structure, with reference to the figure:



Weights in kg (1)							
Model	**350**	**385**	**430**	**470**	**515**	**570**	**630**
Shipping weight	3900	4000	4450	4800	5347	5670	6021
Operating weight	4630	4740	5220	5570	6314	6637	6988

(1): Operating weight relative to the unit of the heaviest series (version with Pumping Module with 2 Pumps).

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Cod. 3QE19653

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