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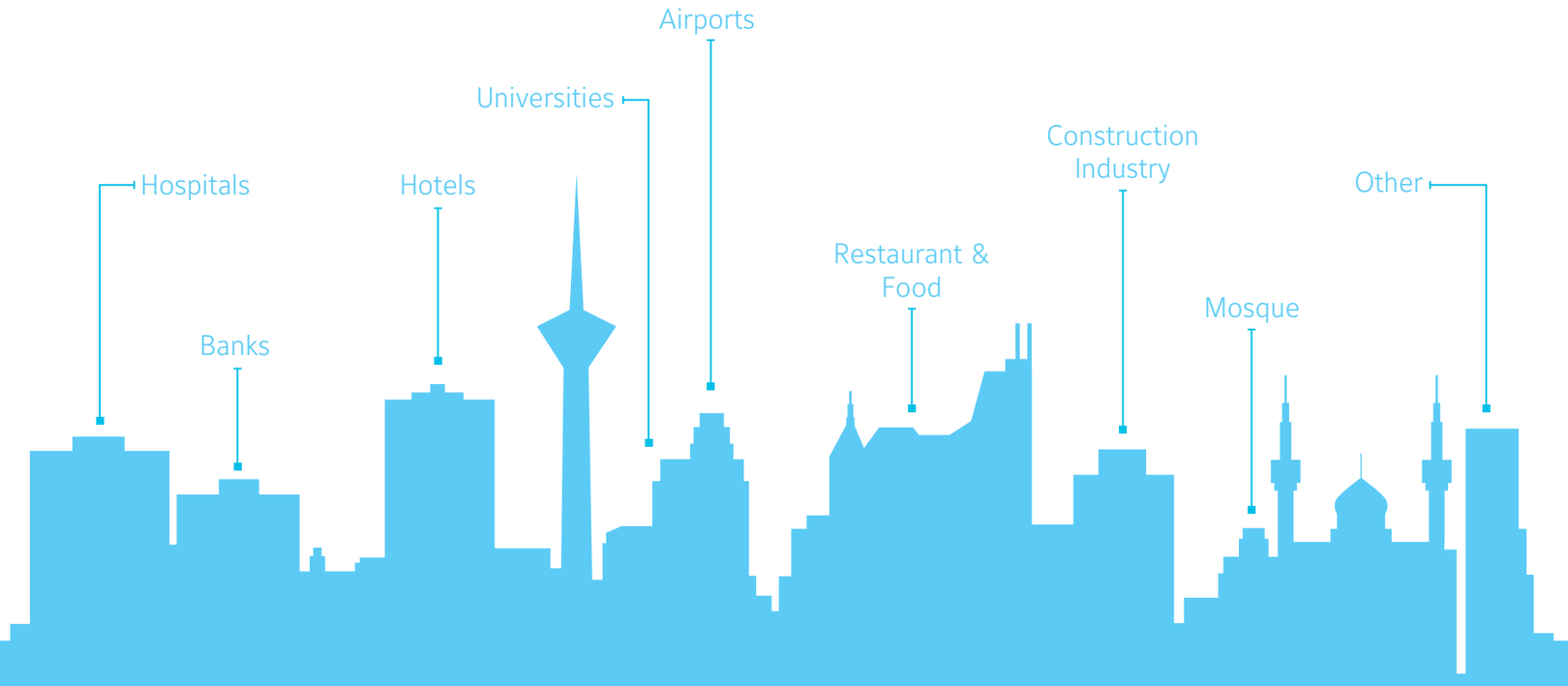
MODULAR
AIR COOLED CHILLER

Saran
Life's Pleasant Breeze



AIR CONDITIONING MFG.GROUP

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Contents

NOMENCLATURE

2 SR LC M – 32 A

- A — Air Cooled
- 32 — Nominal Cooling Capacity (T.R)
- M — Modular
- LC — Liquid Chiller
- SR — SARAN
- 2 — No. of Comperessor

Introdution

Saran modular air-cooled chillers are a premium solution for commercial and industrial applications where installers, consultants and building owner require optimal performances and maximum quality. Saran modular air-cooled chillers are available in nominal cooling capacity of 16, 24 and 32 tons of refrigeration with availability of many accessories, including advanced control and safety devices.

Main Features

Modular Design

Saran modular air-cooled chillers are designed as the three basic modules, different numbers of modules can be combined to satisfy different load. The largest combination is six modules, it convenient to transportation and installation.

Compressor

Saran modular air-cooled chillers is equipped with highly efficient, reliable and silent scroll compressor which features an internal overload protection. The compressor adopts hermetic type to further eliminate operating noise and vibration.

Condenser

All units have two air-cooled condenser coils in V-shape. Condenser coils are made of staggered rows of 3/8 inch diameter seamless inner grooved copper tube, mechanically expanded into slit aluminum fins to ensure optimum heat exchange capability.

Condenser Fan

To achieve best performance of chiller, the unit is equipped with the high airflow propeller fans. The fans are direct driven by weatherproof three-phase motor to ensure a reliable continuous operation. The condenser fans automatically controlled base on condensing temperature to obtain a satisfactory performance in different ambient conditions.

Evaporator

The evaporator of all units are designed and constructed base on the TEMA and ASME-Section VII code, respectively (Shell and tube, direct-expansion type evaporators used in all units, however other types of evaporators also available upon request).

Refrigerant Circuit

Saran modular air-cooled chillers have two separated refrigerant circuits which they are factory brazed and evacuated before accurately charged with R22, R407C or R134a (base on request) to ensure optimum operating requirement. To ensure flawless continuous operation, each refrigerant circuit is equipped with a carefully sized thermostatic expansion valve or electronic expansion valve (base on request).

Additional Safety Protection

The modular air-cooled chillers are equipped with intelligently designed safety control to ensure continuous safe operation. High and low pressure switch is provided to prevent the compressor damage resulting from both abnormal high discharge head pressure and low pressure due to insufficient gas. In addition, thermal and current overload protector are supplied with the units as well as phase sequencer protector.
Flow switch is provided in the unit to protect against damage to the water pump. The standard mechanical controller provides accurate water temperature control in the circuit by closely monitoring and reacting to the input from the water entering temperature, water leaving temperature and ambient air temperature.

Factory Testing

Each unit is pressure tested, vacuum tested, evacuated and charged with refrigerant requested then It tested at the factory's test bench under the design conditions specified by the customer. Before shipment, each unit is recheck for pressure and refrigerant charge control.

Selection Information

Cooling capacity of Saran modular air-cooled chillers presented in the "Performance Data" tables; cover the most frequently encountered leaving water temperatures.
The modular air-cooled chillers are rated over a range of leaving water temperatures of 42°F to 46°F and ambient temperatures of 95°F to 120°F.
To select a Saran modular air-cooled chiller, the following information is required:

1. Design system load (Btu/h)
2. Design leaving water temperature (°F)
3. Design chilled water range (°F)
4. Evaporator fouling factor (h.ft^2.°F/Btu)
5. Design ambient temperature (°F)
6. Altitude (ft)

Chilled Water Flow and Range:

Required cooling capacity and the desired chilled water range are two important factors in determining the amount of water to be circulate in the evaporator. The following formula used for determining chilled water flow:

$$\text{Chilled Water Flow (GPM)} = \frac{24 \times \text{Cooling Capacity (TR)}}{\text{Chilled Water Range (°F)}}$$

Performance tables in this catalogue are based on a 10°F temperature drop through the evaporator. In other conditions please using following correction factors for performance data:

Table 1: Chilled Water Range Correction Factors

Chilled Water Range (°F)	Correction Factor
6	0.992
8	0.995
10	1.000
12	1.005
14	1.010
16	1.014

Fouling Factor

The cooling capacity of the modular air-cooled chillers in this catalogue permit a fouling factor of 0.0001 h.ft^2.°F/Btu (ARI Standard 550/590-98) for the evaporators. In other conditions please using following correction factors for performance data:

Table 2: Fouling Factor Correction Factors

Fouling factor (h.ft^2.°F /Btu)	Correction Factor
0.00010	1
0.00025	0.992
0.00050	0.978
0.00075	0.965
0.00100	0.951

Altitude:

Performance tables of the modular air-cooled chillers in this catalogue are based on sea level altitude, so in other conditions, please using following correction factors for performance data:

Table 3: Altitude Correction Factor

Altitude (ft)	Correction Factor
0	1.00
2000	0.99
4000	0.98
6000	0.96

Selection Example

Given:

Chilled Water Flow Rate = 56 GPM
Design chilled water range = 10°F
Evaporator leaving water temperature = 45°F
Ambient temperature = 100°F
Evaporator fouling factor = 0.0001 $h.ft^2.°F/Btu$
Altitude = sea level
Refrigerant = R407C

Solution:

Step 1- Cooling capacity calculation

To calculate the required cooling capacity, we use the following formula:
Cooling Capacity (TR) = Chilled Water Flow (GPM) x Chilled Water Range (°F) / 24;
So in this problem, our required cooling capacity is 23.3 TR (280 MBH);

Step 2- Modular air-cooled chiller model selection

By referring to the performance data table of modular air-cooled chillers, we can see cooling capacity of 2SRLCM-32A in ambient temperature of 100°F and evaporator leaving water temperature of 45 °F is 281.8 MBH. So cooling capacity of 2SRLCM-32A satisfy our requirements.
In additional, we can see cooling capacity of 2SRLCM-16A in ambient temperature of 100°F and evaporator leaving water temperature of 45 °F is 152 MBH. So we can satisfy our requirement by combination of two 2SRLCM-16A.

Step 3- Chilled Fluid Pump Selection

By referring to evaporator pressure drop graph we can find selected modular air-cooled chiller's pressure drop, add the pressure drop through the chilled fluid loop piping, valves and equipment. This will be the foundation of your pump selection criteria.

Technical Data

Table 4: Technical Data

Models	2SRLCM-16A	2SRLCM-24A	2SRLCM-32A
Actual Cooling Capacity (MBH)	157	238	305
Actual Power Input (kW)	13.74	19.64	26.60
Compressor			
Type	Hermetic Scroll		
Capacity Control	Fixed Speed		
Quantity	2	2	2
Evaporator			
Type (Optional)	Shell and Tube (Brazed Plate)		
Water Connector (inches)	2	2 1/2	3
Water Flow Rate (GPM)	31.4	47.6	61.0
Water Pressure Drop (ft.wg)	1.2	2.0	3.2
Condenser			
Coil Rows Deep	3	4	4
Total Coils Face Area (Sq. ft)	32.7	37.6	45.7
Total Air Flow (CFM)	14000	16000	24000
Fan Quantity	2	2	2
Fan Diameter (inches)	28.0	28.0	31.5
Fan Power Inputs (kW)	0.9	0.9	1.2
Refrigerant			
Standard (Optional)	R22 (R407C , R134a)		
Flow Control (Optional)	Thermal Expansion Valve (Electronic Expansion Valve)		
Number Of Circuits	2	2	2
Refrigerant Charge (kg)	21	30	38
Electerical Data			
Power Supply	380V/3ϕ/50Hz		
Maximum Power Input (kW)	16.7	24.2	32.3
Maximum Current (A)	31.0	42.3	57.4
Overall Dimensions			
Length (mm)	1800	1800	2050
Width (mm)	1220	1220	1350
Overall Height (mm)	1950	2100	2270
Unit Weight			
Net Weight (kg)	850	1000	1300
Operating Weight (kg)	910	1070	1375

NOTE

- 1MBH=1000 Btu/hr
- Actual cooling capcities are based on entering / leaving water temperature of 56°F / 46°F , ambient temperature of 100°F and R22.
- The above data is subject to change without notice.

Performance Data

Table 5: Performance Data (2SRLCM-16A)

Cooling Capacity (MBH)						
Refrigerant: R-22	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	148.8	144.2	139.4	134.2	-	-
43 °F	152.0	147.4	142.4	137.2	-	-
44 °F	155.2	150.4	145.4	140.2	-	-
45 °F	158.4	153.6	148.6	143.4	-	-
46 °F	161.6	156.8	151.8	146.4	-	-

Cooling Capacity (MBH)						
Refrigerant: R-407C	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	147.4	142.2	136.8	130.8	-	-
43 °F	150.6	145.4	139.8	133.8	-	-
44 °F	154.0	148.6	143.0	137.0	-	-
45 °F	157.2	152.0	146.4	140.2	-	-
46 °F	160.6	155.2	149.6	143.4	-	-

Cooling Capacity (MBH)						
Refrigerant: R-134a	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	99.4	96.0	92.2	88.4	84.4	80.2
43 °F	101.8	98.2	94.6	90.8	86.6	82.4
44 °F	104.2	100.6	97.0	93.0	89.0	84.8
45 °F	106.6	103.0	99.4	95.4	91.2	87.0
46 °F	109.0	105.4	101.8	97.8	93.6	89.4

NOTE

- 1MBH = 1000 Btu/hr
- LWT = Leaving Water Temperature
- Cooling capcities are based on chilled water range of 10 °F and sea level altitude.
- The above data is subject to change without notice.

Performance Data (Cont.)

Table 6: Performance Data (2SRLCM-24A)

Cooling Capacity (MBH)						
Refrigerant: R-22	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	227.0	220.0	213.0	205.0	-	-
43 °F	232.0	224.0	217.0	209.0	-	-
44 °F	236.0	229.0	221.0	214.0	-	-
45 °F	241.0	233.0	226.0	218.0	-	-
46 °F	245.0	238.0	230.0	222.0	-	-

Cooling Capacity (MBH)						
Refrigerant: R-407C	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	221.0	213.0	205.0	196.4	-	-
43 °F	226.0	218.0	210.0	201.0	-	-
44 °F	231.0	223.0	215.0	206.0	-	-
45 °F	236.0	228.0	220.0	211.0	-	-
46 °F	241.0	233.0	224.0	215.0	-	-

Cooling Capacity (MBH)						
Refrigerant: R-134a	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	156.6	151.6	146.6	141.0	135.4	129.4
43 °F	159.6	154.6	149.4	144.0	138.2	132.0
44 °F	162.6	157.6	152.4	146.8	141.0	134.8
45 °F	165.8	160.8	155.4	149.8	143.8	137.6
46 °F	168.8	163.8	158.4	152.6	146.6	140.4

NOTE

- 1MBH = 1000 Btu/hr
- LWT = Leaving Water Temperature
- Cooling capcities are based on chilled water range of 10 °F and sea level altitude.
- The above data is subject to change without notice.

Performance Data (Cont.)

Table 7: Performance Data (2SRLCM-32A)

Cooling Capacity (MBH)						
Refrigerant: R-22	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	289.2	281.4	273.6	265.6	-	-
43 °F	295.0	287.2	279.2	271.0	-	-
44 °F	301.0	293.0	284.8	276.4	-	-
45 °F	307.2	299.0	290.6	282.0	-	-
46 °F	313.2	305.0	296.4	287.8	-	-

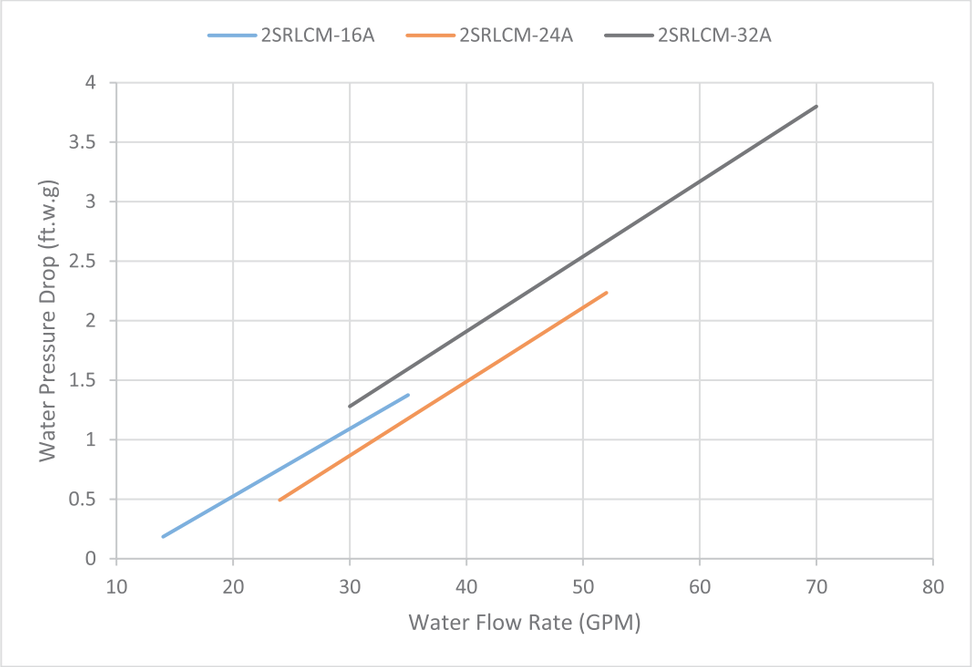
Cooling Capacity (MBH)						
Refrigerant: R-407C	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	272.6	263.8	254.6	245.0	-	-
43 °F	278.8	269.6	260.2	250.6	-	-
44 °F	285.0	275.6	266.0	256.2	-	-
45 °F	291.2	281.8	272.0	262.0	-	-
46 °F	297.6	288.0	278.0	267.8	-	-

Cooling Capacity (MBH)						
Refrigerant: R-134a	Ambient Temperature					
LWT (°F)	95 °F	100 °F	105 °F	110 °F	115 °F	120 °F
42 °F	199.8	193.6	187.0	180.4	173.4	166.2
43 °F	204.0	198.0	191.4	184.6	177.6	170.2
44 °F	209.0	202.0	195.8	189.0	181.8	174.4
45 °F	214.0	207.0	200.0	193.2	186.0	178.6
46 °F	218.0	212.0	205.0	197.8	190.4	182.8

NOTE

- 1MBH = 1000 Btu/hr
- LWT = Leaving Water Temperature
- Cooling capcities are based on chilled water range of 10 °F and sea level altitude.
- The above data is subject to change without notice.

Evaporator Pressure Drop



NOTE

- All above data subject to change without notice.

Electrical Data

Table 8: Electrical Data

Model	Refrigerant	Compressor							Fan			Total Power			Cable Size (mm^2)
		Starting Type	RLA	FLA	MOC	LRA	MPI	QTY	MPI	FLA	QTY	RLA	FLA	MPI	
2SRLCM-16A	R22	D.O.L	11.55	13.60	15.9	95	7.45	2	0.9	1.9	2	26.9	31.0	16.7	4x10
	R407C	D.O.L	12.00	13.70	15.9	95	7.65	2	0.9	1.9	2	27.8	31.2	17.1	4x10
	R134a	D.O.L	9.75	10.65	15.9	95	5.10	2	0.9	1.9	2	23.3	25.1	12.0	4x6
2SRLCM-24A	R22	D.O.L	16.20	19.25	22.3	118	11.20	2	0.9	1.9	2	36.2	42.3	24.2	4x16
	R407C	D.O.L	16.30	19.20	22.3	118	11.25	2	0.9	1.9	2	36.4	42.2	24.3	4x16
	R134a	D.O.L	11.75	13.65	22.3	118	7.55	2	0.9	1.9	2	27.3	31.1	16.9	4x10
2SRLCM-32A	R22	D.O.L	22.70	25.85	35.0	174	14.95	2	1.2	2.85	2	51.1	57.4	32.3	3x25/16
	R407C	D.O.L	22.25	26.50	35.0	174	15.20	2	1.2	2.85	2	50.2	58.7	32.8	3x25/16
	R134a	D.O.L	21.40	22.85	35.0	174	10.35	2	1.2	2.85	2	48.5	51.4	23.1	4x16

NOTE

- System Power Supply: 380~400V/3ϕ/ 50HZ
- RLA: Rated Load Ampere
- FLA: Full Load Ampere
- MOC: Maximum Operating Current
- LRA: Lock Rotor Ampere
- MPI: Maximum Power Input (kW)
- D.O.L: Direct On Line Start Type
- Cable size are based on copper conductor at maximum ambient temperature of 40°C and maximum distance of 70 meter.
- All above data subject to change without notice.

Installation

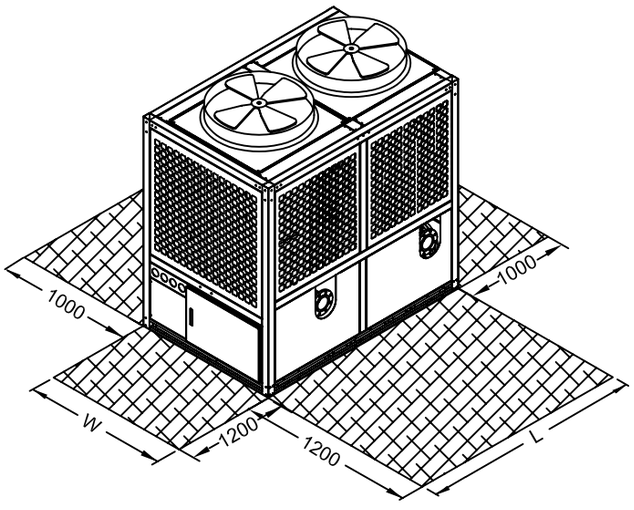
Please read this chapter carefully before installation, and you must install the machine according to the following procedures. Install the modular air-cooled chiller in places with good air flowing because air-cooled chiller needs a good heat releasing condition. If the modular air-cooled chiller is installed inside the factory, then the surrounding temperature should not be higher than 105°F and there must have fans to make air-flow flow fluently.

Installation Notice Items

1) Make sure that voltage of electricity matches with the nameplate.
2) Connect the electricity wire and earth wire according to local regulations.
3) Use independent electricity wire and power switch .The diameter of the wire should not be less than electric cabinet's wire.
4) The end of the electricity wire should be safe and firm.
5) Protect water chilling pipes with hear-insulating materials.
6) Make sure that the diameter of the recycling pump pipeline and collector of modules is appropriate.

Select Installation Site

In order to achieve maximum cooling capacity, the location selection should fulfill the following requirements:
1- Install the chiller in such a way that the hot air discharge cannot be drawn in again
2- Ensure that there is no obstruction to air flow into or out of the unit. Remove obstacles which blocking intake or discharge air.
3- The location must be well ventilated, so air can be drawn in and discharge out efficiently.
4- Choose a place which can rigidly support the weight of the unit, this will help to minimize vibration and noise.
5- The location must not be susceptible to dust or oil to avoid condenser coil being choke by the contaminant. As the general safety precaution, it is advised that no flammable danger gas should be located near to the unit.
6- Water source of the cooler must be clean and free from any contaminant such as rusted particles or any kind of oil. It is necessary to install a water filter in the returning water line.
7- Set apart some service space. Space ranges are recommended in following schematics:

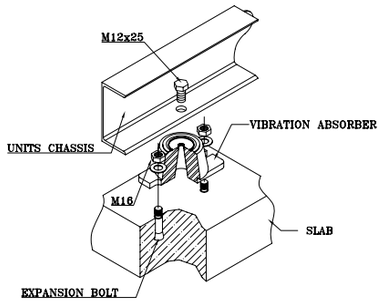


NOTE

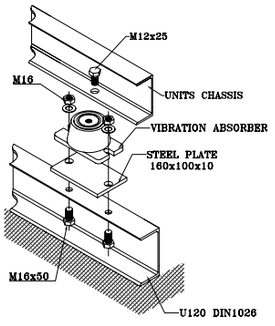
- L: Modular chiller length
- W: Modular chiller width
- All dimension are in millimeter

Bearing Platform

1- The unit should be installed on concrete or steel structure bearing platform that is firm and the surface of the baring platform should be smooth and flat. The intensity of the platform should hold the whole unit, if the intensity is not strong enough, it is easy to cause vibration and noise.
2- The surface of the concrete base platform normally has been plastered as horizontal ornament with waterproof treatment. the surrounding of it should have drainage sink placed, and the slope angle should be no less than 0.5% and the slope should lead to drainage outlet.
3- In order to maintain quiet operation and prevent the vibration and noise transmission from interfering the under floors, the absorber should be laid between the unit base and base platform. Please maintain horizontal when install the unit and mount anti vibration pad when it is necessary.
4- In order to keep connection pipe from being twisted to crack by earthquake, typhoon, or by long time running caused movement. The fixation method should be taken into consideration, refers to following examples for platform installation and fixation:



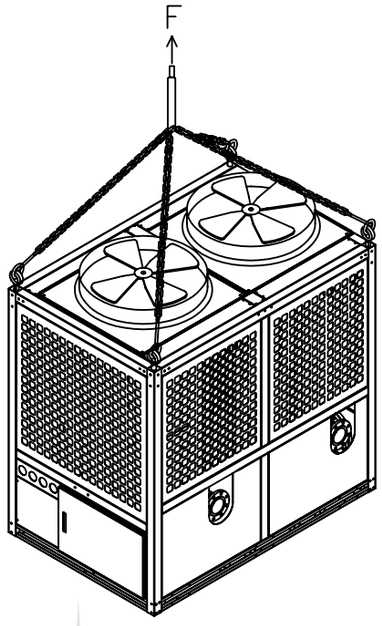
ARMOURED CEMENT FOUNDATION



STEEL FRAME FOUNDATION

Hanging and Transporting of the Unit

1- Each unit has been carefully tested and inspected at the factory where every precaution was taken to ensure that it reaches its destination in prefect condition. It is very important that the installers, movers, and riggers use the same care in handling the unit. Chains, cables, or other moving equipment should be placed to avoid damage to any part of the unit. For proper method of rigging consult the label on the unit.
2- To prevent any damage to the unit, at least 45 degree angle between the unit and the hosting chain should be maintained.



Dimensions

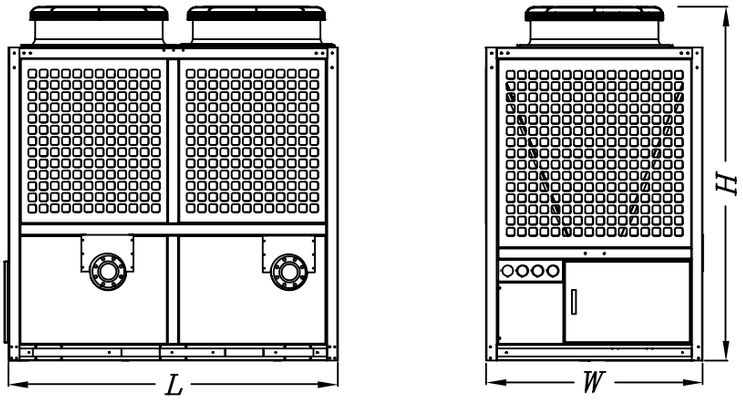


Table 9

Models	L	W	H
2SRLCM-16A	1800	1220	1950
2SRLCM-24A	1800	1220	2100
2SRLCM-32A	2050	1350	2270

NOTE

- All dimensions are in millimeter
- The above data is subject to change without notice.