

APCD Series Air Cooled Packaged Chillers

Range 4 TR to 386 TR
(14 kW to 1358 kW)



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R-22



ISO 9001
BUREAU VERITAS
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SKM Air Cooled Packaged Chillers

APCD Series - R22

Contents

Introduction	2	Capacity Control Steps	27
Legend.....	2	Compressor Start Up Method	28
Nomenclature	2	Power Entry Connection	28
General Features	3	Typical Control Panel	29
Main Component Features	3	Electrical Data	30-34
Optional Features	5	Typical Wiring Diagram	36
Microprocessor Control	5	Optional Features	38
Engineering Specifications	10	Electrical Schematic.....	38
Capacity Ratings	14	Dimensional Data.....	39
Capacity Correction & Limits	24	Location/Space Requirements.....	45
Water Pressure Drop	25	Application/Installation	46
Selection Procedure	26	Water Piping Practices	46
		Unit Sizing	47
		Guide Specifications.....	48

Legend

The following legends are used throughout this manual:

AMB.....	Ambient Temperature	kW	Kilowatt
ARI.....	Air Conditioning & Refrigeration Institute	lbs.....	Pounds
BTU	British Thermal Unit	LCWT	Leaving Chilled Water Temperature
C.CAP.....	Cooling Capacity in TR (kW refrigeration)	L/S	Liter per second
cfm.....	Cubic feet per minute	mm.....	Millimeters
ECWT.....	Entering Chilled Water Temperature	PI	Compressor Power Input in kW
EER	Energy Efficiency Ratio	Qty	Quantity
GPM	Gallons Per Minute	Range	ECWT-LCWT
kg.....	Kilogram	TR	Tons of Refrigeration
kPa	Kilo pascals	WFR	Water flow rate
		WPD	Water Pressure Drop

Nomenclature

A P C D - 5 100 B Y

Air Cooled
Packaged Chillers

D : Discus Compressor
H : Hermetic Compressor

Power Supply 5 : 50 Hz
Frequency 6 : 60 Hz

Nominal Tonnage Code

Power Supply Code

Y : 380-415V/3Ph/50Hz
P : 440V/3Ph/50Hz
R : 380V/3Ph/60Hz
E : 460V/3Ph/60Hz
T : 220V/3Ph/60Hz

Vintage

SKM Airconditioning Equipment,



Built in the Gulf...for the World

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General Features

High Energy Efficiency Ratio (EER)

APCD chillers use high efficiency semi-hermetic compressors having the unique Discus® valve design. The EER of **APCD** is substantially higher compared to units using equivalent conventional compressors. EER ratings for **APCD** chillers at ARI conditions are listed in Capacity Ratings.

Parallel Compressor Operation

APCD chillers are equipped with single compressor models, multi compressors with independent refrigeration circuits and multiple compressors with parallel operation.

APCD chillers equipped with multiple compressors connected in parallel in order to achieve greater operating flexibility. By cycling individual compressors the system capacity can be modulated with full power savings for the compressors in operation.

By using the system of parallel compressors operation, uncomplicated unload start is achieved by a simple time delay starting of single compressors as opposed to a compressor start with the total capacity.

Wide Operating Range

APCD chillers are designed, as standard, to operate at a wide range of ambient temperatures from 50°F (10°C), or lower if optional low ambient operation kit is included, to 125°F (52°C) or higher to 131°F (55°C) if optional high ambient operation kit is included.

Main Component Features

Compressors

Compressors used in **APCH** models are hermetically sealed, high efficiency, low noise, reciprocating while compressors used in **APCD** series are fully accessible, semi-hermetic, reciprocating type. Semi hermetic compressors are equipped with an oil sight glass, suction and discharge service valves and crankcase heater.

Semihermetic compressors are refrigerant gas cooled and equipped with an oil pressure lubrication system. The oil pump working in either direction is protected by an oil screen and a valve provided for the fitting of an oil pressure gauge. For protection, all compressors are equipped with preset internal relief valve between suction and discharge sides. The compressors are provided with vibration isolator mounting under the compressors skid and therefore, external to **APCD** chillers, AVM's may be necessary only for critical applications.

Figure 1: Compressor



The compressor motors have inherent thermal protection. This is in addition to other standard safety and protection controls. Compressors conform to DIN standards.

Condensers

Condenser coils are manufactured from seamless copper tubes mechanically bonded to aluminium fins to ensure optimum heat transfer. All coils are tested against leakage by air pressure of 450 psig (3100 kPa) under water. All standard coils are 3 or 4 rows/12 FPI, (2.1 mm fin spacing), 3/8" (9.5mm) O.D. tubes. An integral subcooling circuit is provided to increase the chiller cooling capacity, without additional operating costs.

Figure 2: Condenser Coil



For different application requirements, other optional condenser fin materials are available:

- Copper fins
- Copper fins only electrotinned
- Copper finned coil electro-tinned after manufacturing
- Precoated Aluminum fins



SKM Air Cooled Packaged Chillers

APCD Series - R22

The pre-coated is hydrophobic polyurethane resin. This option provides substantial corrosion protection beyond standard coil construction.

- Aeris Guard Coil Coating

The Aeris Guard Coil coat is a self etching high performance modified epoxy finish that is specifically designed to coat and protect Aluminum and Copper surfaces. In addition, the coating is ideal for the protection of ferrous and non ferrous materials.

Condenser Fans

Figure 3: Fan

The condenser fans are propeller type, aluminium alloy blades, directly driven by electric motors. Motors are Totally Enclosed Air Over (TEAO) six pole with class 'F' insulation and IP55 protection. The TEAO and class 'F' insulation features ensure long life and are unique to SKM.



The motors are factory wired to chiller unit control panel where the motor starters are located to control the operation of these motors.

The condenser fans are individually statically and dynamically balanced at the factory. Complete fan assembly is provided with suitable acrylic coated fan guard.

Evaporator

All models of APCH and APCD-5009A/6011A evaporators are Brazed Plate Heat Exchangers (BPHE). Channel plates, refrigerant and water connections are constructed from stainless steel with pure copper as brazing material. BPHE design and assembly process are in compliance with Europe, Pressure Equipment Directive (PED 97/23/EC). Maximum working pressure of water side is 363 psig ([2500 kPa](#)) and refrigerant side is 392 psig ([2700 kPa](#)).

All other APCD models with larger capacity, the evaporators are shell and tube, direct expansion, removable head and having 1, 2, and 3 refrigerant circuits. Evaporator shell, header, tubesheet, refrigerant and water connections are made of carbon steel. Baffles are provided in the waterflow to increase the heat transfer efficiency. High efficiency tubes are in copper. Evaporators are provided with drain and vent plugs.

Maximum working pressure of waterside is 145 psig ([1000 kPa](#)) and for refrigerant side is 363 psig ([2500 kPa](#)).

All evaporators are insulated with 1" ([25mm](#)) thick flexible closed cell insulation, having K factor of 0.26 Btu.in/ft².hr.^oF ([0.038 W/m.^oK](#)).

Figure 4: [Evaporator](#)



The Casing / Structure Frame

The unit casing in **APCD** series chillers is made of zinc coated galvanized steel sheets conforming to JIS-G 3302 and ASTM A653 which is phosphatized and baked after an electrostatic powder coat of approximately 60 microns.

This finish and coating can pass a 1000 hour in 5% salt spray testing at 95°F ([35°C](#)) and 95% RH as per ASTM B117. Unit casing is provided with access doors for easy servicing/maintenance.

APCD chillers are assembled on rigid structural steel skid channels painted with one coat galvanized primer and one coat black enamel. The package is assembled for easy handling during transportation and robust support during installation and operation.

Refrigerant Piping

The refrigeration circuit piping is fabricated from ACR grade copper piping. Each refrigeration circuit includes filter drier, liquid line solenoid valve, thermostatic expansion valve, sight glass, shut off valve and hot gas muffler. For single compressor circuits, additional vibration eliminators are provided. After fabrication the refrigeration circuit suction line is insulated with ½" ([13mm](#)) wall thickness closed cell pipe insulation.

Control Panel

The unit mounted Control Panel enclosure is fabricated out of heavy gauge sheet steel, which is phosphatized and baked after an electrostatic powder coat finish. The enclosure conforms to IP-54 as per guidelines in IEC-529. Control Panel for all APCH models and APCD-5009A and 6011A are with dead front panel cover screwed on to the enclosure. All other APCD model are with external panels with hinged doors and key fastener provided for easy access and security. These panels are ventilated through louvers and filters. The panel is factory wired in accordance with NEC-430 & 440 labeled, tagged and feature 220V/240V single, phase controls and the following as standard.

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- Individual compressor and condenser fan motor contactors.
- Circuit breakers for compressors.
- Condenser fan motor protector circuit breaker.
- Anti-recycle timer to prevent rapid cycling and short cycling of compressors.
- Compressor low pressure safety switch, factory set for each circuit.
- Compressor oil failure and high pressure safety switch, one each per compressor, factory set.
- Head pressure control, by fan cycling, for low ambient operation.
- Freeze protection thermostat.
- Multi-step temperature controller to control chiller capacity.
- Control ON / OFF toggle switch for each circuit.
- Control circuit fuses.
- Manual pump-down switch for each circuit.
- Run/Trip and control ON indication lights.
- Power and control circuit terminal blocks.

Note : Standard Items are for general information and guidance. The actual supplied item may vary depending on machine size and / or series H or D.

Optional Features

SKM Microprocessor Controller - MAGNUM

The Magnum Microprocessor Control System is available for APCD Series chiller as an **optional** feature. Our high energy efficient Chiller has a full function microprocessor control unit designed to keep the chiller running at its most Energy Efficient Level. The Magnum is a rugged microprocessor based controller that is designed for the hostile environment of HVAC/R industry.

Magnum provides flexibility with set points and control options that can be selected prior to commissioning a system or when the unit is live and functioning. Displays, alarms and other interfaces are accomplished in a clear and simple language that informs the user as to the status of the system. It is designed to safeguard the system that is being controlled, eliminate the need for manual intervention and to provide a simple but meaningful man-machine-interface.

This microprocessor provides complete operational control for the chiller and has built-in auto diagnostic capability that can signal off normal operation or alarm conditions as well as shutting down the chiller or system, if necessary.

The Main Features of the controller are as follows:

- A large graphical LCD Display (2.8" diagonal) with back-lit that can be seen in bright or dim lighting.
- A nine button generic keypad that is so user friendly, it is rarely requires a reference manual.
- Battery backed up Built in Real time clock to program the chiller for 2 starts and 2 stops daily to provide the information about the Running hours of the compressors.
- The multiple authorization levels to provide tight security of the control system.
- The system provides 'last time' enabled & disabled, number of cycles, and total run hours.
- Automatic Lead/Lag changeover of the compressors.
- Pump-down at the beginning and end of every circuit cycle (for DX type evaporator).
- Capacity control based on leaving chilled water temperature. A special control zone based on leaving water temperature that reduces compressor cycling, and improved unit part load efficiency.
- START/STOP Facility from remote through Volt Free Contact (VFC) is a standard feature.
- Common Run, Fault and remote mode operation status volt free contacts provided for remote signaling.

Display Information

SKM APCD chillers offer a graphics LCD display which allows the operator to access different parameters of the chiller. Operator can view and change the setpoint of chiller parameters. The graphical display has lot of features, trending is one of the key features of graphical display, which shows last 25 samples with an appropriate scale to allow it to fit on the display.

The well designed keypad with three function keys, four direction keys and two selection keys allows the operator to navigate through different Menu, such as:

- Status
- Outputs
- Inputs
- Alarms
- Graphs
- Setpoint



SKM Air Cooled Packaged Chillers

APCD Series - R22

- Service tools
- Lockout Reset
- Lockout Alarm
- Password

System Control Philosophy

The unit may be enabled or disabled manually or through the use of an external signal from a building automation system.

Control is based upon Leaving chilled water temperature. How fast the temperature changes is calculated and capacity decisions are based upon the rate, the current temperature, and the control temperature zone. Capacity is never added if the system is moving toward the temperature target at an acceptable rate. The unit will monitor all control functions and stage the compressor to maintain the required operating capacity.

(Remote adjustment of the leaving chilled water set point is accomplished through an external Building Automation System supplying a simple 0-5Vdc. signal) Specify during enquiry/order for this facility.

Easy Accessible Measurements Include:

- Current capacity status.
- Current circuit/compressor status.
- Leaving and Entering chilled water temperature.
- Evaporator pressure of each refrigerant circuit.
- Condenser pressure of each refrigerant circuit.
- Compressor elapsed run time.
- Number of compressor starts.
- Ambient temperature.
- Lockout and alarm status with time stamped.
- Water flow switch status.
- Compressor amperage monitoring.
- Condenser fan ON/OFF status.
- Logging of Last 60 Alarms. These include:

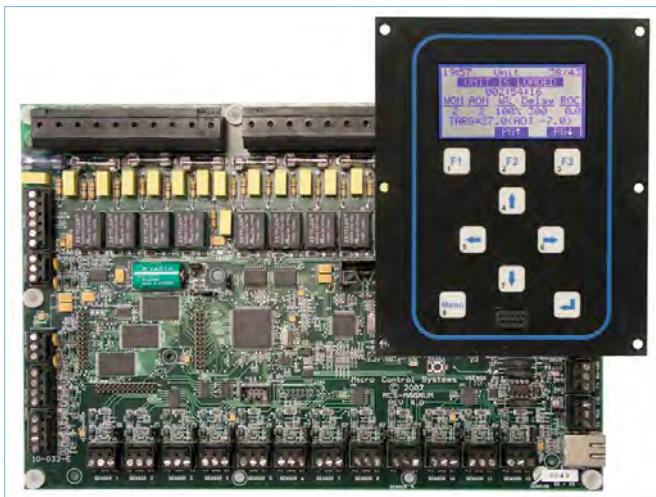
All the abnormal conditions of sensor inputs
Power Failure
Power returned
Battery failure
Clock setting modifications
CPU reset
Ram integrity
Changed set points
Failure of Input / Output cards

System Protection

The following system protection controls will automatically act to insure system reliability and protection of the unit.

- Low suction pressure limiting.
- High discharge pressure limiting.
- High motor temperature / over current.
- Freeze protection.
- Power loss.
- Chilled water flow loss.
- Sensor errors.
- Pump down.
- Anti-recycle.
- Time delay between stages.
- 4-Levels of PASSWORDS to restrict the intentional mishandling.

Microprocessor Controller-MAGNUM



MAGNUM Master micro controller board with twelve 0-5vdc sensor inputs, four 5vdc digital inputs, ten 230vac 6.3A relay outputs, four 0-10vdc analog outputs, keypad, 128x64 dot pixel STN monochrome graphics LCD with 2.8" diagonal viewing area, real time clock, MCD-I/O, RS-232, RS-485 and Ethernet communication ports. User selectable 115vac or 230vac operation.

SKM Air Cooled Packaged Chillers APCD Series - R22

Optional Features available for Magnum

PC Support Software for Magnum

[MCS-Connect](#) program provides both local and remote communications to the MAGNUM independent of the type of software. Through this program, the status of the controller can be viewed and proper authorization changes can be made to the system. Configuration files can be transmitted to or received from a Magnum unit. The Magnum automatically performs history logging; this program has complete graphic functions.

485 Network

The MCS 485 Network can support up to 20 Magnums and their associated I/O's. Access to this network can be local, via RS 232 connection, or remote via 14.4K Baud modem. When using the dial up through the modem, there will be no degradation in the performance of the network. Each Magnum in the network must be assigned to a unique address when the configuration file is build using [MCS-Config](#) program. This address will be the key in establishing communications with the appropriate Magnum system. This address can be changed from the LCD/keypad of the unit. The current address of Magnum can be viewed or changed with factory authorization. RS 232 transmission should not exceed 30 feet in length and RS 485 transmission should not exceed 1 mile without repeater.

Ethernet Port

Communications can be through the 100 MBPS Ethernet communications port on the Magnum. It is necessary to use a crossover cable when connected directly to this port from a PC.

Requirements for PC Software

To install and run the program, we suggest the following system requirements:

Front End System Requirements

- Windows 2000 or above.
- Pentium 166 MHz or above.
- 10 Gigabyte hard disk with at least 25 Megabytes free as minimum.
- CD Drive
- Super VGA display capable of displaying 256 colors
- 64 Megabytes of RAM or more is recommended
- 19.2k baud modem

BMS Communication Protocols

Magnum supports BACnet MSTP, BACnet IP, Modbus RTU, Modbus TCP/IP, Lonworks and Johnson N2. Each protocols are supported with various baud rates.

Since green buildings are the major issue in HVAC industry and building integration is one of the tools to save energy.

Complete control of the chillers along with the monitoring is possible if any of the above protocols are used to connect chillers to the BMS. The details of the parameters to be controlled, number of chillers in the building, the protocol, etc., are required before the order as costing of the BMS interface depends on these parameters.

Hard Wired of BMS Connection

Within the hard wire structure there are five options as follows:

1. Run / Stop – (BMS to Magnum)

A Run / Stop input is provided, by chiller, to allow the end user to provide an enable / disable signal from a building management system. This input allows for a normal shutdown of the chiller package.

2. Emergency Stop – (BMS to Magnum)

The EMER. STOP input is an input that allows for immediate shut down. This feature is used for safety, especially in explosion proof installations. The chiller bypasses the normal shutdown and shuts down immediately.

3. Chilled Water Reset – (BMS to Magnum) ‘Max Trg Reset’

Is a function of a signal from the building management system. This value is used to adjust the control LEV LIQ TARG set point #1. The amount of the actual adjustment is proportionally based upon the associated analog input value. The analog value can be between 0 and 5 volts.

4. Compressor Run – (Magnum to BMS)

This is a relay output (VFC) closure from the Chiller Controls to the BMS indicating the compressor/s is/are running.

5. Alarm – (Magnum to BMS)

This is a relay output (VFC) closure from the Magnum to the BMS indicating a problem. Communications to analysis the problem may be direct at the keypad, communications through PCconnection or direct from the BMS.



SKM Air Cooled Packaged Chillers

APCD Series - R22

Factory Installed Options

Low Ambient Operation Kit (LAO)

For operation down to 25°F (-4°C) ambient. Specify minimum design ambient temperature on order.

High Ambient Operation Kit (HAO)

For operation at reduced load at ambient temperature between 125°F (52°C) and 131°F (55°C) maximum.

Alternative Condenser Material

Made of copper tubes and alternative fin material and/or protective coats.

- For Copper Fins, specify (FC).
- For Copper Fins only electrotinned, specify (CFT).
- For Copper Finned Coils with electrotinned after manufacturing, specify (FCT).
- For Pre Coated aluminum fins, specify (FAP).
- For Aluminum Fins with Aeris Coat Protection, specify (FAA).
- For Copper Fins with Aeris Coat Protection, specify (FCA).

Galvanized Frame (GFB)

Hot dip galvanized after manufacture, steel frame and base.

IP55 Control Panel Enclosure (ICP)

Control Panel for special applications to meet IP55 requirements.

Evaporator Casing (ECA/ECG/ECS)

Shell and insulation casing enclosed in a jacket/casing of aluminium, galvanized or stainless steel as required, injected with polyurethane foam.

Condenser Coil Guard (CGP)

Coil wire mesh guard, in galvanized and painted finish for condensers.

Electronic Expansion Valve (EEV)

To provide energy saving benefits over mechanical thermostatic expansion valve (TXV).

Run Hour Meter(s)

To monitor operating hours of each compressor.

(RHM)

Main Isolator

With door interlock for main power isolation. (consult SKM)

(ISO)

Part Winding Start

Where specifically required by local codes compressors may be with Part Winding Start to reduce the high in rush current at starting.

(PWS)

Unload Start Kit

This option is required when the compressor needs a high starting torque such as when load is high. Not required for D50 and D60 compressors.

(USK)

Individual Refrigerant Circuit

For independent refrigeration circuits other than standard arrangement shown, consult SKM.

(IRC)

Load Limit Control Kit

To prevent nuisance trip-out when the entering chilled water temperature is above 76°F (24.4°C) at start up or where chillers may be subject to shut down for long periods during season.

(LCK)

Lead/Lag Control Switch

To manually reverse compressors operational sequence.

(LLS)

Voltage Monitoring Module

To prevent chiller operation in the event of phase burn-out, phase reversal, and under voltage/over voltage on the incoming line voltage.

(VMM)

Voltage Monitoring Module

To meet DEWA regulations. This option is available for Dubai, UAE only.

(DVM)

Evaporator Freeze Up Protection

Heating cable with thermostat to prevent evaporator freeze-up where low ambient temperatures below 32°F (0°C) are anticipated with/out chiller operation.

(EFP)

SKM Air Cooled Packaged Chillers

APCD Series - R22

Ammeter & Phase Selector Switch	(AMPC)	Options for Field Installation
To indicate running AMPS of each compressor.		Chilled Water Flow Switch (CWFS)
Ammeter & Phase Selector switch (AMPI)		Fault Status Indicator Panel (CSIP)
To indicate running AMPS on main incomer of a chiller.		Multi-chillers seq. panel (CSQP) with lead-lag capability for each chiller along with lead-lag option (factory installed) for compressors (Contact SKM for details)
Voltmeter & Selector Switch	(VSS)	Anti-vibration mounts, spring type (CAVM)
For incoming line voltage.		
Pressure Gauges	(SDG)	
Suction, discharge and oil pressure indication of each refrigerant circuit.		
Low Noise Fan & Motor	(LNF)	
Low noise Fan & Motor assembly can be provided for applications where minimal unit sound is required.		
Pressure Relief Valve	(PRV)	
To protect the chiller from hi-pressure in the event of primary high pressure safeties are failed.		
Marine Paint	(MP)	
To provide increased corrosion resistant in coastal environments and off-shore locations.		
Compressor Sound Enclosure	(CSE)	
To reduce compressor sound, compressor sound enclosure with insulated panels is mounted around the compressor.		
Vibration Eliminator	(DVE)	
For parallel compressor circuiting, vibration eliminators can be provided as an option.		
Capacity Control Steps	(CRS1/2)	
Where loads may vary greatly and finer capacity control is desired the standard control steps may not suffice. Additional capacity control steps are available as options CRS1 or CRS2.		



SKM Air Cooled Packaged Chillers

APCD Series - R22

Capacity Correction & Limits

ALTITUDE CORRECTION FACTORS			
Altitude		Capacity Multiplier	Power Multiplier
Feet	Meter		
0	0	1	1
2000	610	0.99	1.01
4000	1219	0.98	1.02
6000	1829	0.97	1.03
8000	2438	0.96	1.04
10000	3048	0.95	1.05

Table 5

COOLER FOULING FACTORS			
English	SI	Capacity Multiplier	Power Multiplier
0.0001	0.018	1.00	1.00
0.00025	0.044	0.99	1.00
0.00050	0.088	0.98	0.99
0.00100	0.176	0.95	0.98
0.00200	0.352	0.90	0.96

Table 6

RANGE CORRECTION FACTORS			
Range		Capacity Multiplier	Power Multiplier
°F	°C		
8	4.4	0.995	0.998
10	5.6	1.000	1.000
12	6.7	1.005	1.002
14	7.8	1.010	1.004
16	8.9	1.015	1.006

Table 7

FIN MATERIAL CORRECTION FACTORS		
Tube Material / Fin Material	Capacity Multiplier	Power Multiplier
Copper / Copper	1.010	0.992
Copper / Precoated	0.995	1.001

Table 8

Unit ratings are based on sea level altitude, copper tube/aluminum fins condenser, ARI 550-590 standard of 10°F (5.5°C) range and 0.0001 ft².h°F (0.018m².°C/kW) fouling factor. For higher altitude, the use of alternative condenser material, other range and fouling factor, apply the above factors.

Operation Limits

TEMPERATURE RANGE LIMITS			
LIMIT		°F	°C
Minimum Range Limit		8	4.4
Maximum Range Limit		16	8.9

Table 9

EVAPORATOR TEMPERATURE LIMITS			
LIMIT		°F	°C
Maximum leaving chilled water temperature		60	15.6
(1) Maximum entering chilled water tempreataure		76	24.4
(2) Minumum leaving chilled water temperature		40	4.4

Table 10

EVAPORATOR PRESSURE LIMITS					
PRESSURE		REFRIGERANT		WATER	
		psig	kPa	psig	kPa
Max Working Pressure	APCH 5004A / 6005A - APCD 5009A / 6011A	392	2700	363	2500
	APCD 5012A / 6014A - APCD 5340B / 6390B	363	2500	145	1000
Test Pressure	APCH 5004A / 6005A - APCD 5009A / 6011A	725	5000	725	5000
	APCD 5012A / 6014A - APCD 5340B / 6390B	399	2750	207	1430

Table 11

CONDENSER PRESSURE LIMITS			
REFRIGERANT PRESSURE		psig	kPa
Design Working Pressure		300	2068
Test Pressure		450	3100

Table 12

(1) For short periods.

(2) For lower temperatures, brine solutions to be used. Consult SKM.

SKM Air Cooled Packaged Chillers APCD Series - R22

Standard Compressor Startup Method

Models	Power Supply	Standard Compressor Starting
Using Compressor MH 6, MH10, M H12	380~415V / 3Ph / 50Hz 380V / 3Ph / 60Hz 460V / 3Ph / 60Hz 220V / 3Ph / 60Hz	DOL
Using Compressor D10, D15, D25, D35, D40, D35+D40 & D40+D50	380~415V / 3Ph / 50Hz 380V / 3Ph / 60Hz 440V / 3Ph / 50Hz	DOL
Using Compressor D50, D50+D60 & D60	460V / 3Ph / 60Hz	PWS
Using Compressor D35, D40, D50 & D60	220V / 3Ph / 60Hz	PWS

Table 15

Optional Part Winding Start

All chillers with standard DOL start compressors as shown, do not, generally require part winding start due to the use of multiple compressors allowing smaller electrical load increments. Maximum Instantaneous current flow (ICF) as shown on electrical specifications, page 27-31, must be used in determining the need of such part winding start.

In case of two values of ICF (DOL & PWS) shown in electrical data, pages 27-31, the unit must be supplied as in DOL as standard and PWS as optional. Specify PWS.

In case only one value is shown, this means that the unit will be supplied, as standard, either DOL or PWS.

Standard Power Entry Connections

Power Supply	Model APCH/D	No. of Entry Points
380 440V / 3Ph / 50 Hz	5004A 5340B	One
380V / 3Ph / 60 Hz	6005A 6390B	
220V / 3Ph / 60 Hz	6005A 6240B	Two
	6250B 6390B	

Table 16

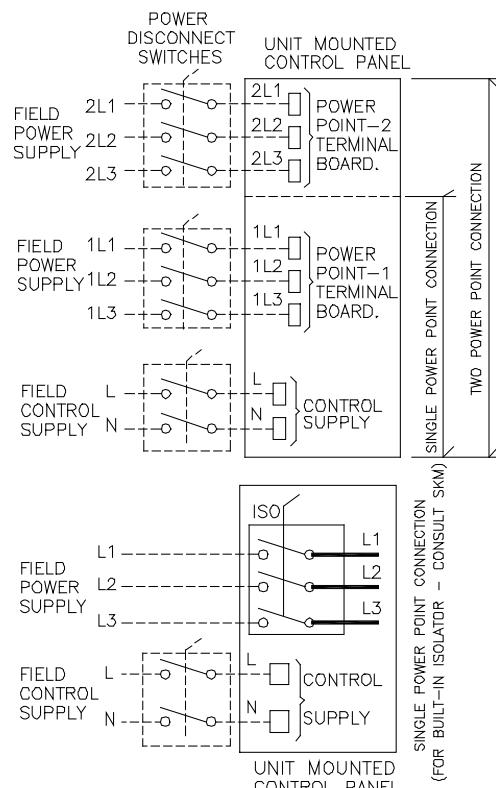
Notes :

All cable terminations are from the external isolator. Isolator is field supplied and field installed (by others) within close proximity of the chiller in accordance with local codes and regulations.

Voltages Range

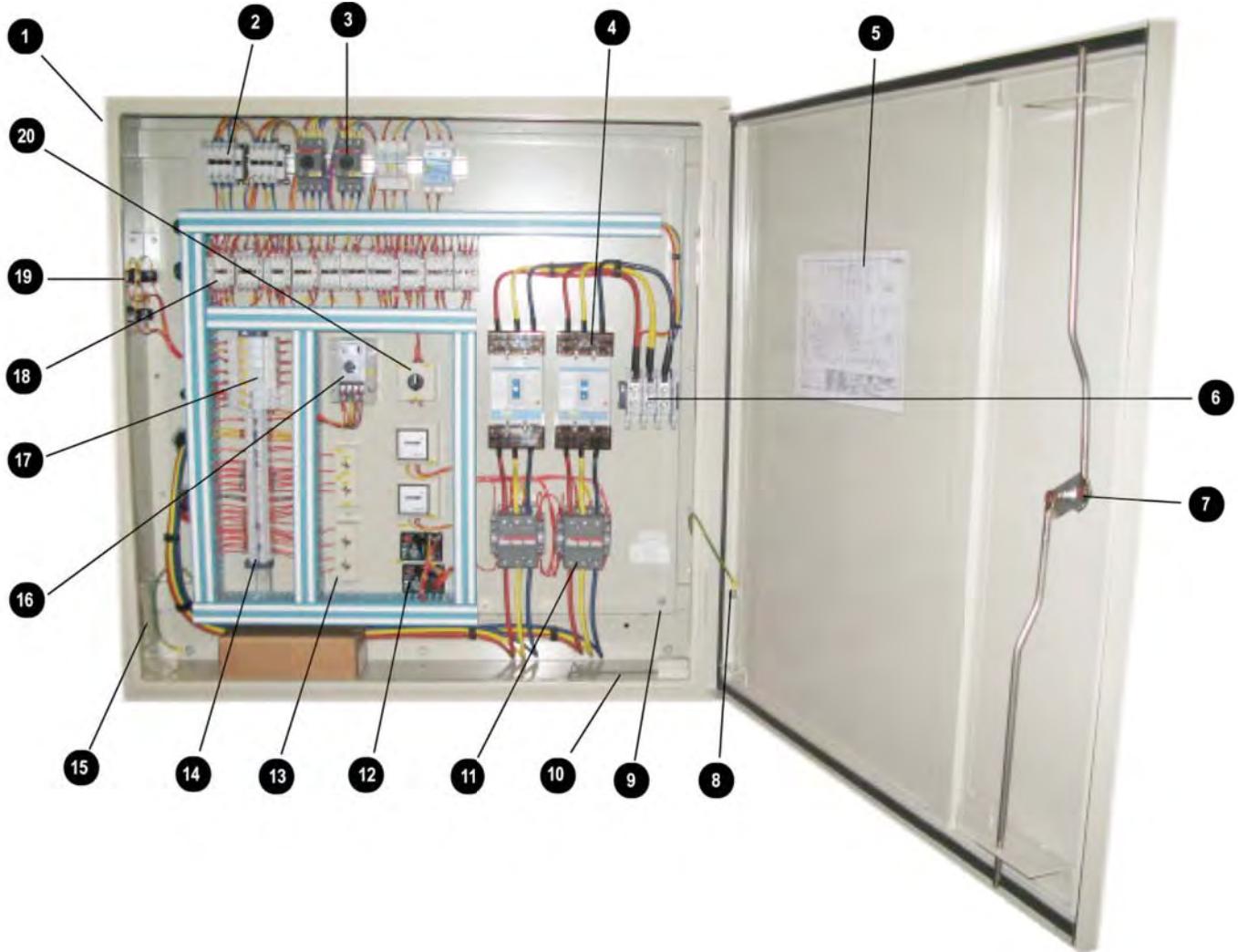
Unit Name Plate Power Supply (V / Ph / Hz)	Allowable Voltage Range	
	Minimum	Maximum
380 415 / 3 / 50	360	440
440 / 3 / 50	396	500
380 / 3 / 60	342	418
460 / 3 / 60	414	506
220 / 3 / 60	200	260

Table 17



SKM Air Cooled Packaged Chillers APCD Series - R22

Control Panel Components Layout (Typical)



Description:

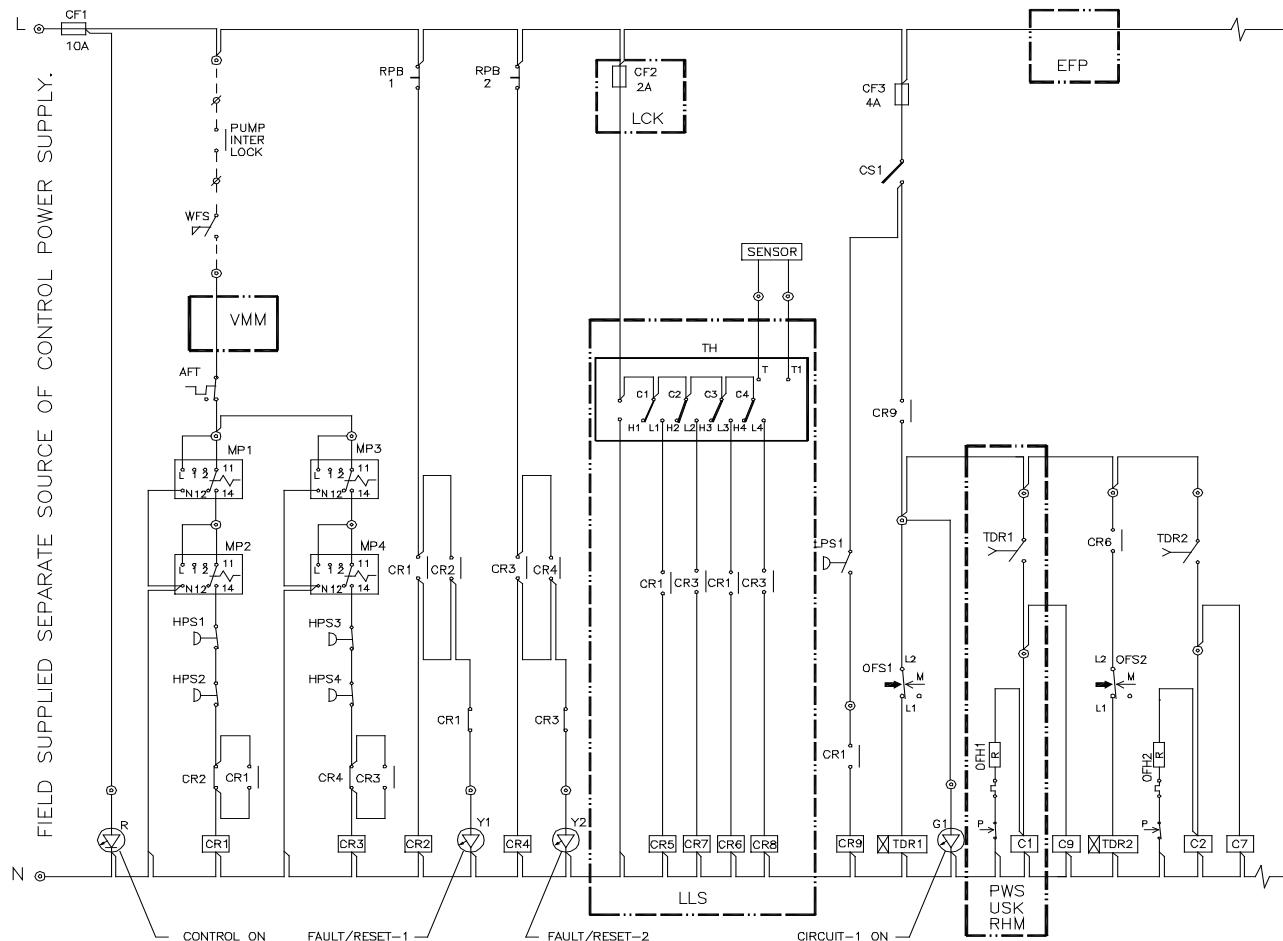
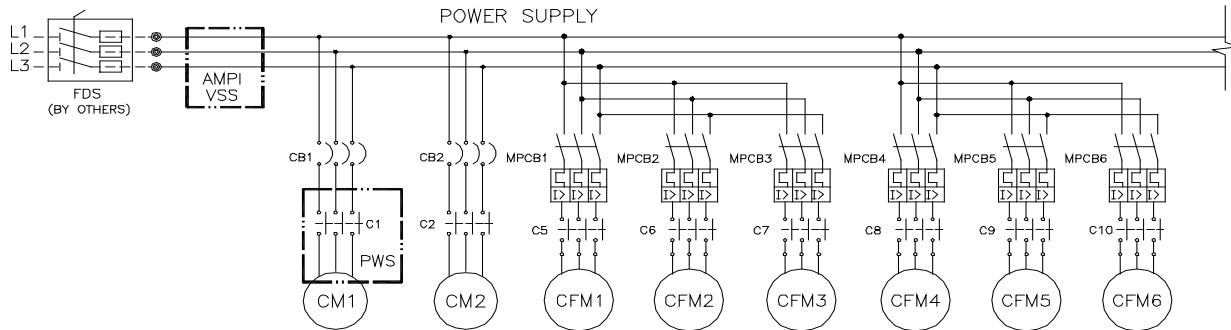
1. IP-54 Panel Enclosure with hinged door with key and lock.
2. Condenser Fan Motor Contactor.
3. Condenser Fan Motor Protection Circuit Breaker.
4. Compressor Circuit Breaker.
5. Wiring Diagram.
6. Incoming Supply Power Terminal / Busbars.
7. Lock & Key.
8. Door Earthing.
9. Earth Terminal.
10. Detachable plate for cable entry.
11. Compressor Contactor.
12. Anti- Recycling Time Delay Relays.
13. Control ON/OFF & Manual/Auto Pump Down switches.
14. Control Circuit Terminal Board.
15. Filtered Ventilation.
16. Electronic Temperature Controller.
17. Control Fuses & Reset Push Buttons.
18. Control Logic Relays.
19. Indication Lamps.
20. Selector Switch.

SKM Air Cooled Packaged Chillers

APCD Series - R22

Typical Wiring Diagram

The typical wiring diagram shown below is for Models APCD 5145B. For all other models, individual diagrams are available in drawing pocket located in the Control Panel.

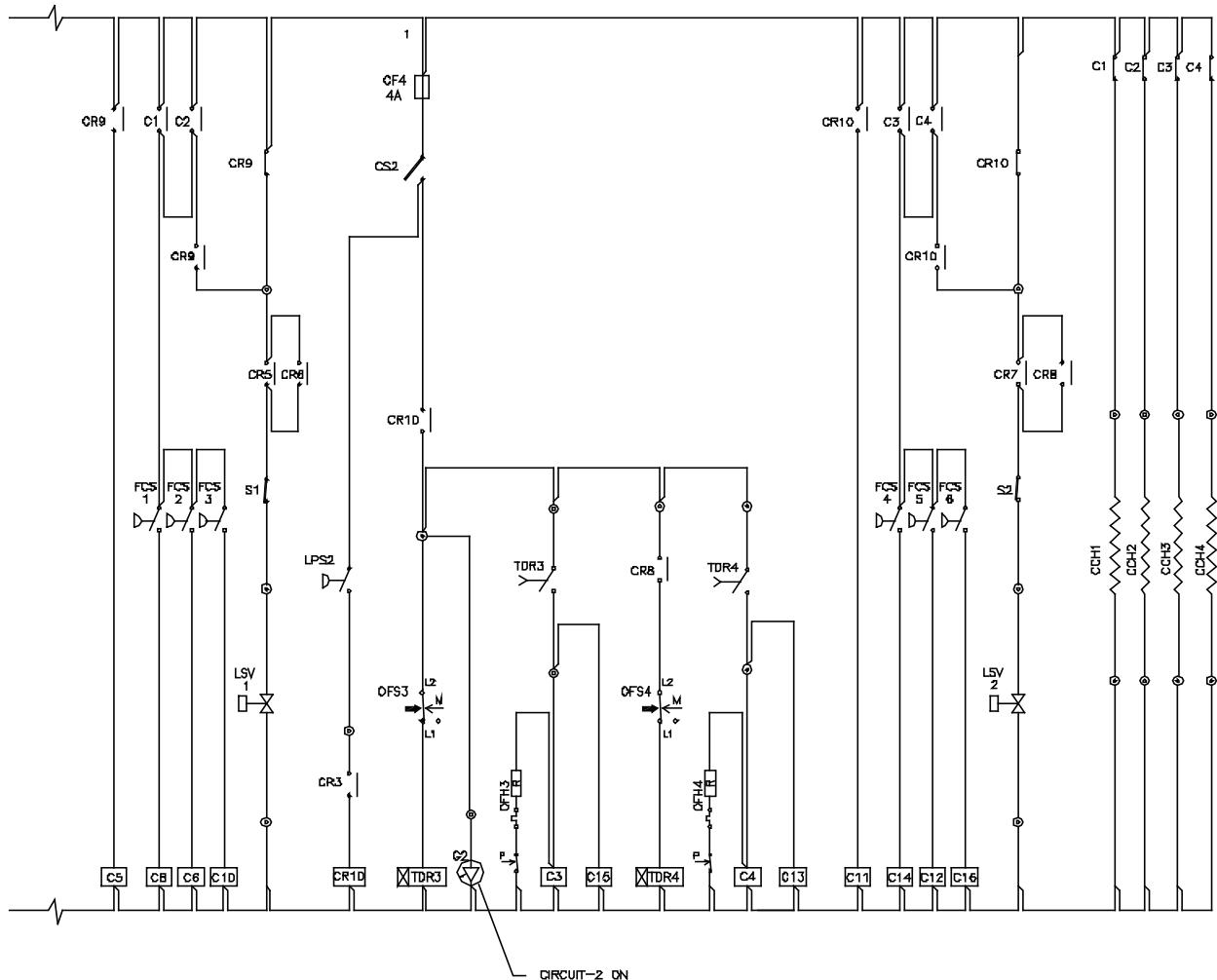
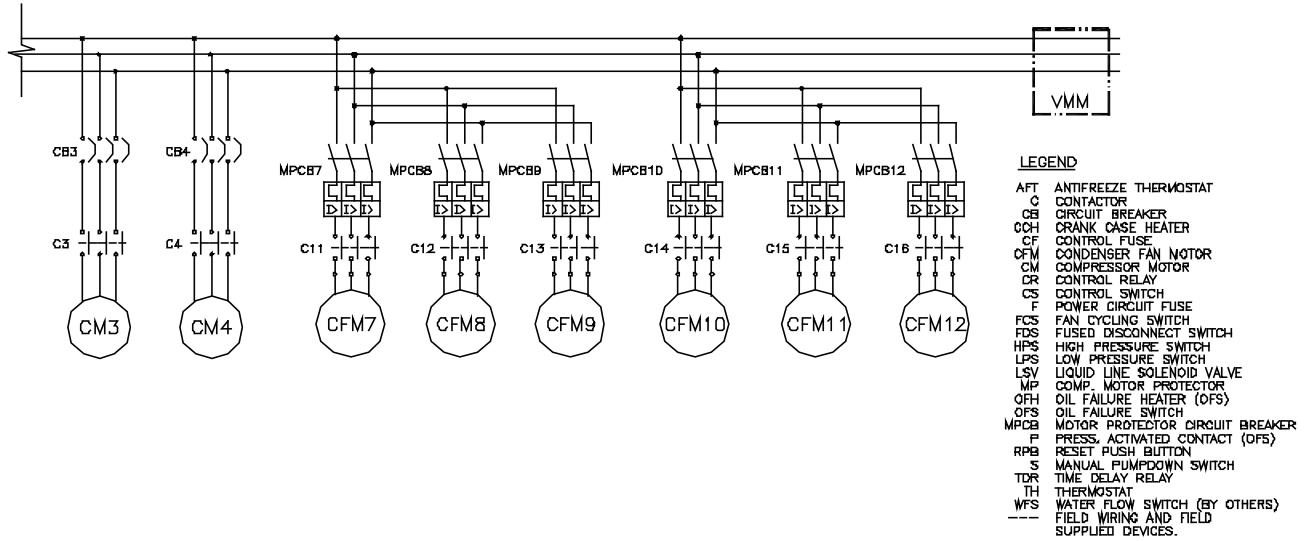


Note:

Shaded area indicate location / connection point for factory installed optional features.
Refer page # 38 for schematic representation of optional features.

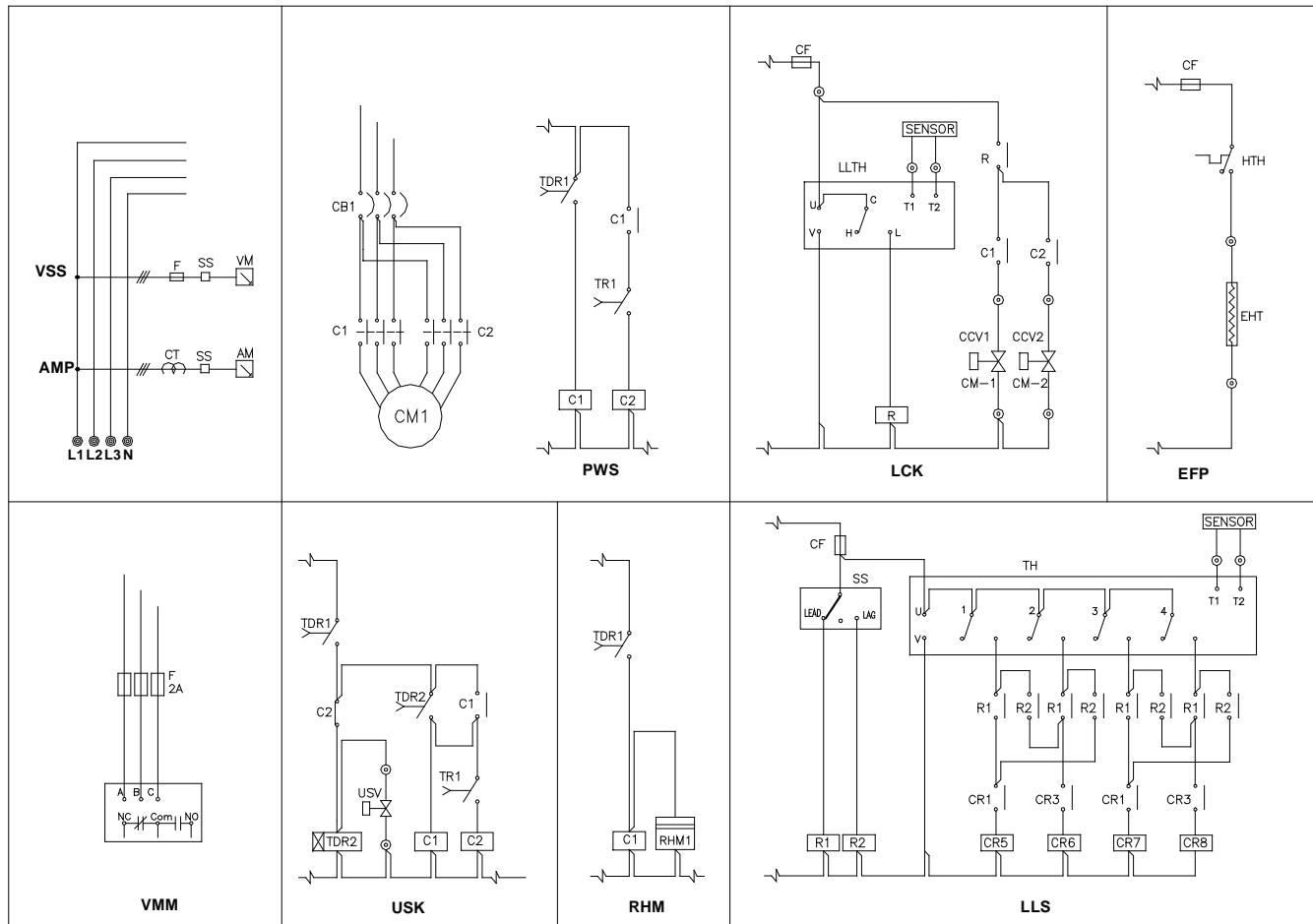
SKM Air Cooled Packaged Chillers APCD Series - R22

Typical Wiring Diagram



SKM Air Cooled Packaged Chillers APCD Series - R22

Optional Features Electrical Schematic



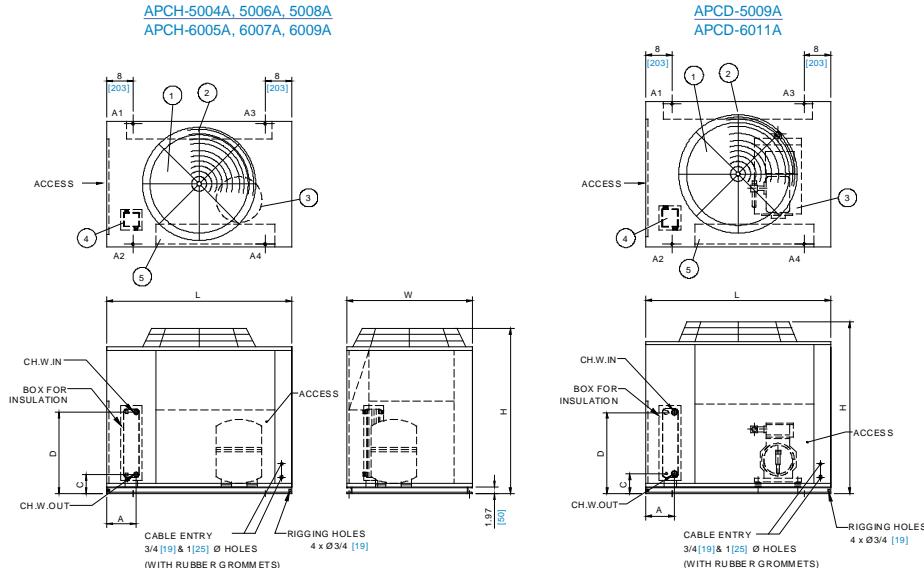
LEGEND	
C	CONTACTOR
CCV	CAPACITY CONTROL VALVE
CR/R	CONTROL RELAY
CT	CURRENT TRANSFORMER
EHT	EVAP. HEATER TAPE
HTH	HEATING THERMOSTAT
LLTH	LOAD LIMIT THERMOSTAT
SS	LEAD/LAG SELETOR SWITCH
TDR	TIME DELAY RELAY
TH	THERMOSTAT
TR	TIMER (PWS)
USV	UNLOAD SOLENOID VALVE

OPTION	
AMP	AMMETER & SELECTOR SWITCH
EFP	EVAP. FREEZE PROTECTION KIT
LCK	LOAD LIMIT CONTROL KIT
LLS	LEAD/LAG SWITCH
PWS	PART WINDING START
RHM	RUN HOUR METER
USK	UNLOAD START KIT
VMM	VOLTmeter & SELECTOR SWITCH
VSS	VOLTMETER & SELECTOR SWITCH

SKM Air Cooled Packaged Chillers APCD Series - R22

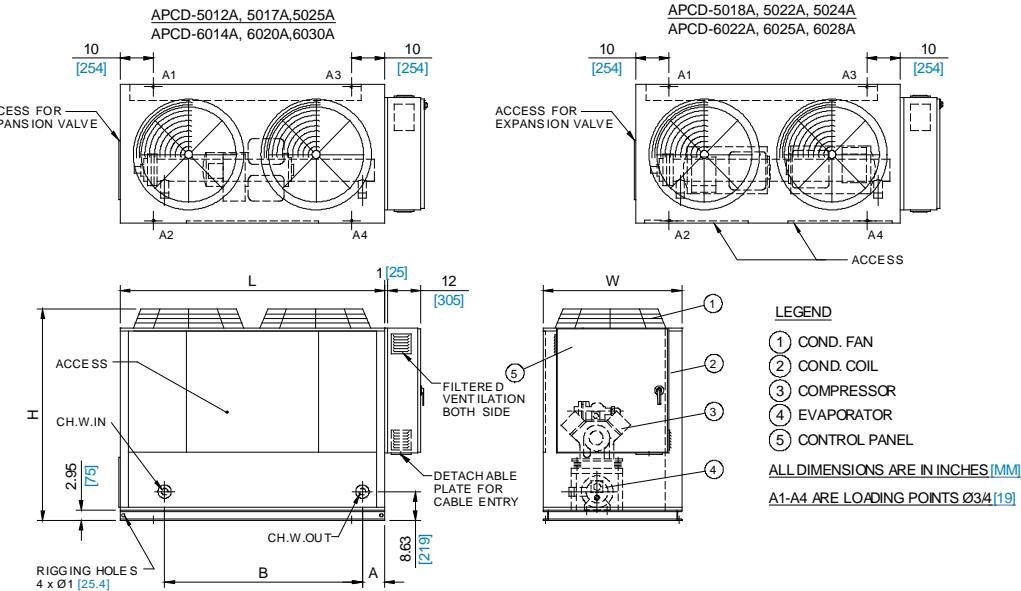
Dimensional Data

APCH Models - 5004A-5008A & 6005A-6009A
APCD Models - 5009A-5025A & 6011A-6030A



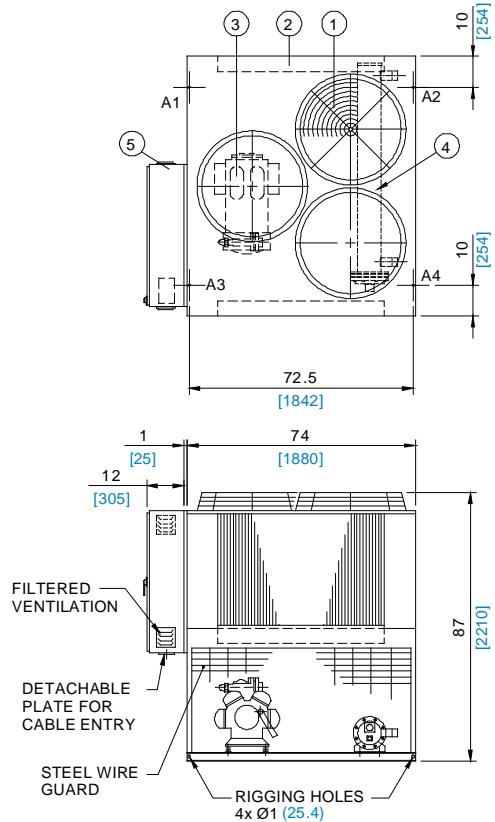
MODEL	L	W	H	A	B	C	D	CH.W. IN/OUT Ø	LOAD AT EACH POINT Lb/Kg				OPT.WT. Lb/Kg				
									A1	A2	A3	A4					
5004A 6005A	45 [1143]	34 [864]	51 [1295]	8.92	-	5.85 [148]	24.7 [627]	1 1/4MPT [32]	147 67	95 43	158 72	198 90	598 271				
5006A 6007A	56 [1422]	38 [965]	50 [1270]		-	6.02 [153]	24.53 [623]		162 73	159 72	181 82	210 95	712 323				
5008A 6009A	56 [1422]	44 [1118]	52 [1321]	8.73 [222]	-	40.55 [1030]	-	1 1/2MPT [38]	188 85	161 73	192 87	215 98	756 343				
5009A 6011A					-				229 104	201 91	305 138	299 136	1034 469				
5012A 6014A	68 [1727]	44 [1118]	65 [1651]	7 [178]	40.55 [1030]	-	-	2 1/2MPT [63]	325 147	290 132	390 177	375 170	1380 626				
5017A 6020A	80 [2032]	42 [1067]	65 [1651]	19.72 [501]					400 182	320 145	450 204	380 172	1550 703				
5018A 6022A	88 [2235]	48 [1219]	77 [1956]	8.66 [220]					440 199	381 173	539 244	460 209	1820 825				
5022A 6025A									550 249	515 234	640 290	625 284	2330 1057				
5024A 6028A									560 254	525 238	640 290	625 284	2350 1066				
5025A 6030A									525 238	450 204	600 272	566 257	2141 971				

Table 24



SKM Air Cooled Packaged Chillers APCD Series - R22

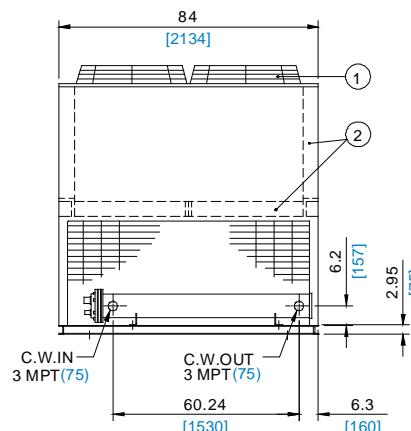
APCD Models - 5030A-5040A & 6035A-6050A



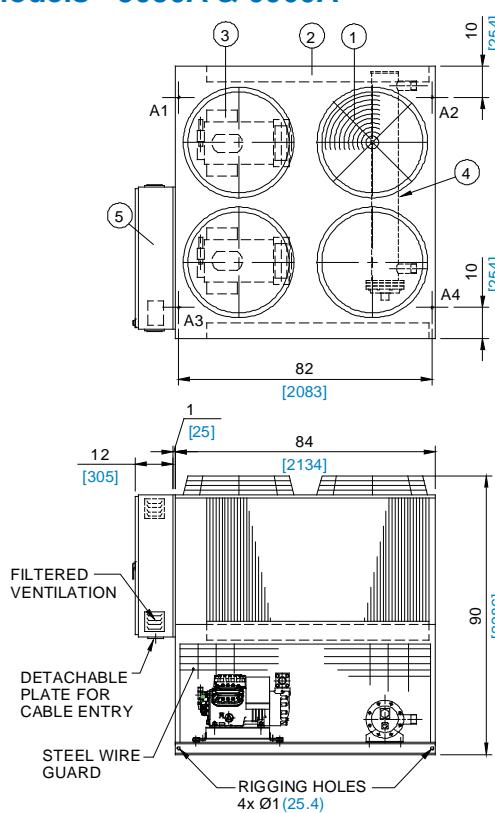
MODEL APCD-	LOAD AT EACH POINT Lb/Kg				OPT.WT. Lb/Kg
	A1	A2	A3	A4	
5030A 6035A	630 286	530 240	710 322	580 263	2450 1111
* 5032 A 6036A	755 342	635 288	815 370	630 286	2835 1286
* 5034 A 6039A	771 350	639 290	880 399	640 290	2930 1329
5035 A 6040A	719 326	591 268	800 363	630 286	2740 1243
* 5039A 6046A	781 354	649 294	910 413	670 304	3010 1365
5040 A 6050A	730 331	590 267	840 381	630 286	2790 1265

* MODEL WITH 2-COMPRESSORS

Table 25



APCD Models - 5050A & 6060A



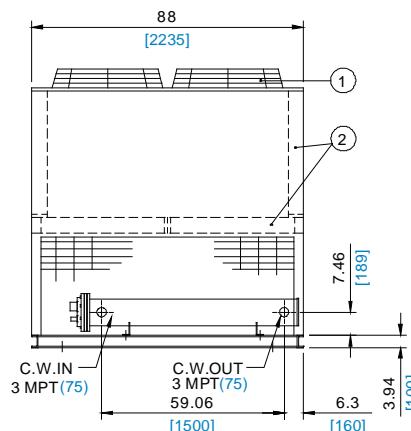
LEGEND

- (1) COND. FAN
- (2) COND. COIL
- (3) COMPRESSOR
- (4) EVAPO RATOR
- (5) CONTROL PANEL

ALL DIMENSIONS ARE IN INCHES (MM)
A1-A4 ARE LOADING POINTS Ø3/4 (19)

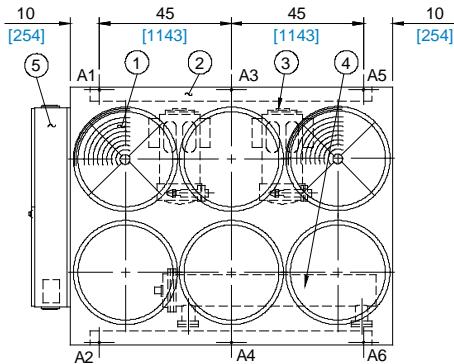
MODEL APCD-	LOAD AT EACH POINT Lb/Kg				OPT.WT. Lb/ Kg
	A1	A2	A3	A4	
5050A 6060A	1091 495	829 376	1180 535	880 399	3980 1805

Table 26



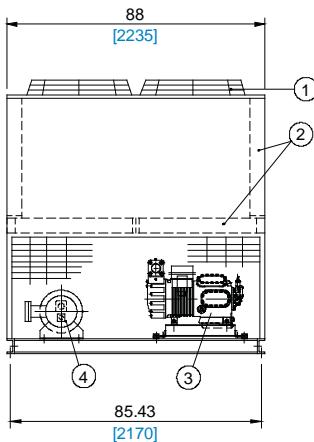
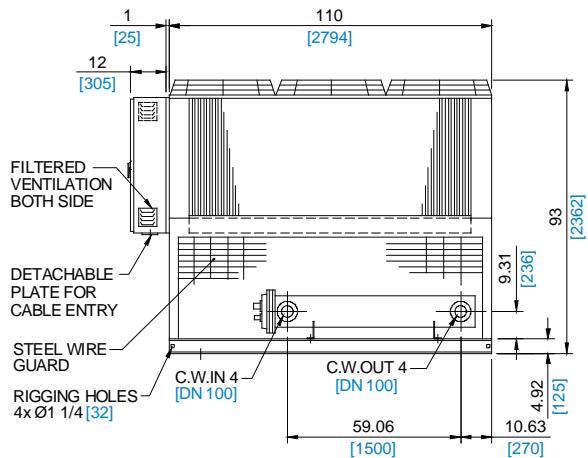
SKM Air Cooled Packaged Chillers APCD Series - R22

APCD Models - 5065A-5085A & 6075A-6095A



MODEL APCD-	LOAD AT EACH POINT Lb/Kg						OPT.WT. Lb/Kg
	A1	A2	A3	A4	A5	A6	
5065A 6075A	875 397	585 265	1020 463	960 435	740 336	640 290	4820 2186
5070A 6080A	950 431	630 286	1120 508	1010 458	770 349	670 304	5150 2336
5075A 6085A	1000 454	660 299	1170 531	1050 476	860 390	710 322	5450 2472
5080A 6090A	1010 458	670 304	1200 544	1060 481	860 390	710 322	5510 2499
5085A 6095A	1020 463	680 308	1230 558	1070 485	880 399	720 327	5600 2540

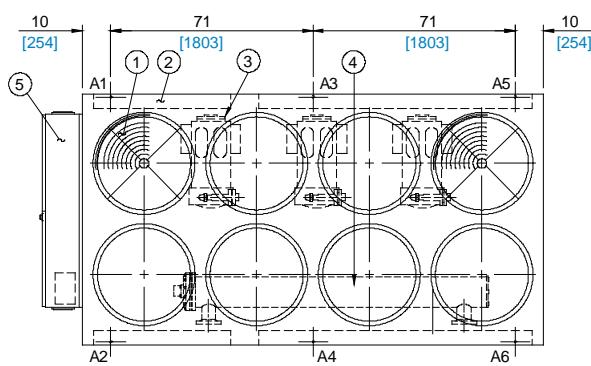
Table 27



- LEGEND**
- (1) COND. FAN
 - (2) COND. COIL
 - (3) COMPRESSOR
 - (4) EVAPORATOR
 - (5) CONTROL PANEL

ALL DIMENSIONS ARE IN INCHES [MM]
A1-A6 ARE LOADING POINTS Ø3/4 [19]

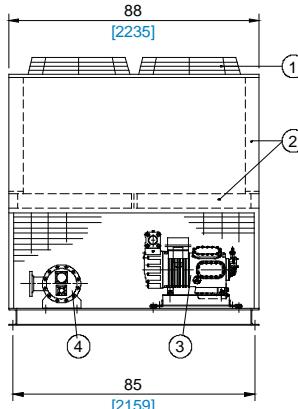
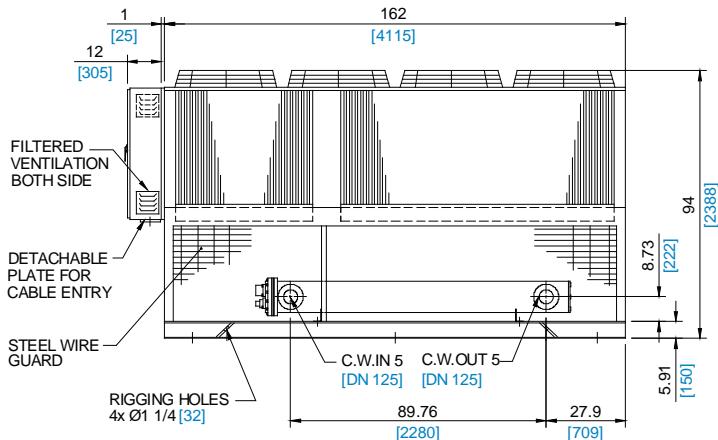
APCD Models - 5095B-5125B & 6110B-6145B



MODEL APCD-	LOAD ON EACH POINT Lb/Kg						OPT. WT. Lb/Kg
	A1	A2	A3	A4	A5	A6	
5095B 6110B	1133 514	977 443	1746 792	1296 588	1002 454	951 431	7105 3222
5100B 6115B	1220 553	1016 461	1831 830	1335 606	1020 463	969 439	7391 3352
* 5105B 6125B	1233 559	1030 467	1979 898	1392 631	1036 470	983 446	7653 3471
5110B 6130B	1249 566	1046 474	2059 934	1428 648	1125 510	1022 464	7929 3596
5115B 6135B	1251 567	1046 474	2059 934	1428 648	1125 510	1022 464	7931 3597
* 5120B 6140B	1251 567	1046 474	2061 935	1428 648	1125 510	1022 464	7933 3598
5125B 6145B	1251 567	1046 474	2061 935	1428 648	1125 510	1024 465	7935 3599

* DIFFERENT COIL ARRANGEMENT

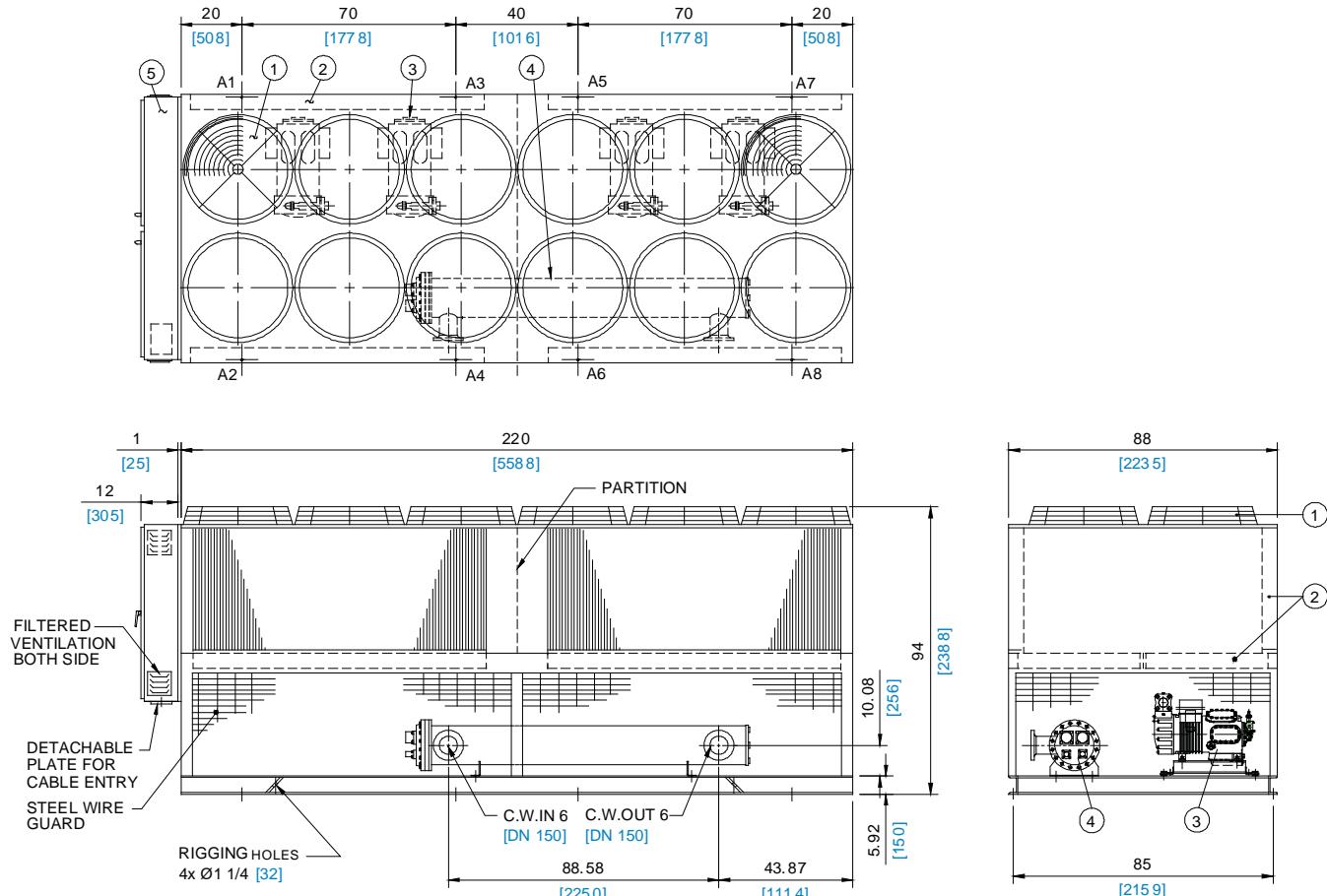
Table 28



Air Conditioning Equipment · Built in the Gulf... for the World

SKM Air Cooled Packaged Chillers APCD Series - R22

APCD Models - 5135B-5170B & 6155B-6195B



MODEL APCD-	LOAD ON EACH POINT Lb/Kg								OPT. WT. Lb/Kg
	A1	A2	A3	A4	A5	A6	A7	A8	
513 5B 615 5B	1415 642	1050 476	1311 595	1195 542	1215 551	1081 490	1222 554	1046 474	9535 4324
514 0B 616 5B	1464 664	1082 491	1434 650	1251 567	1238 561	1104 501	1245 565	1069 485	9887 4484
514 5B 617 0B	1484 673	1102 500	1454 659	1272 577	1354 614	1156 524	1297 588	1100 499	10219 4634
515 0B 617 5B	1495 677	1111 504	1464 664	1281 581	1393 632	1175 533	1405 637	1142 518	10466 4746
515 5B 618 0B	1496 678	1111 504	1465 664	1281 581	1393 632	1175 533	1405 637	1142 518	10468 4747
516 0B 618 5B	1496 678	1111 504	1465 664	1281 581	1394 632	1175 533	1406 638	1142 518	10470 4748
516 5B 619 0B	1497 679	1111 504	1466 665	1281 581	1394 632	1175 533	1406 637	1142 518	10472 4749
517 0B 619 5B	1497 679	1111 504	1466 665	1281 581	1395 632	1175 533	1407 638	1142 518	10474 4750

Table 29

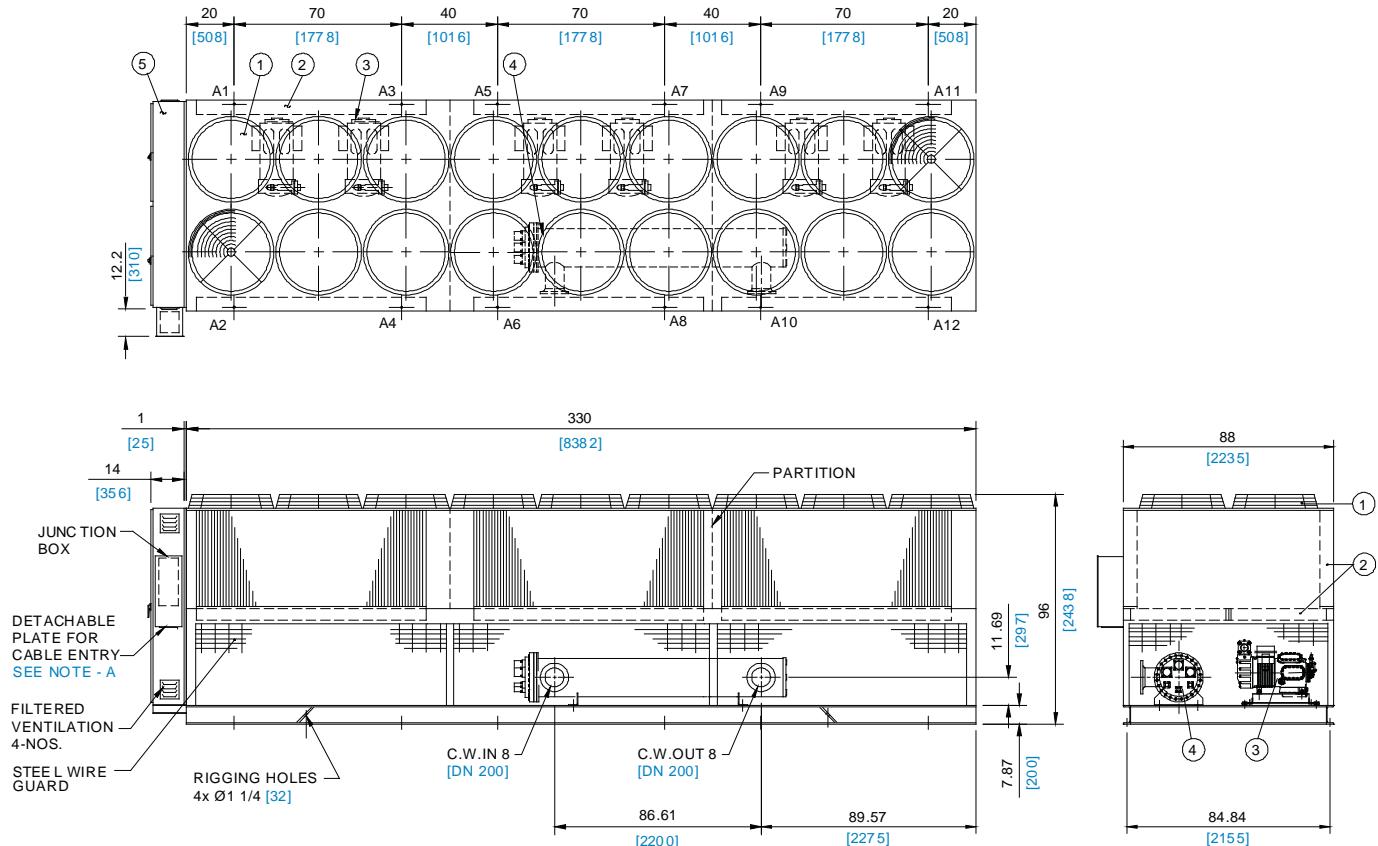
LEGEND

- (1) COND. FAN
- (2) COND. COIL
- (3) COMPRESSOR
- (4) EVAPORATOR
- (5) CONTROL PANEL

ALL DIMENSIONS ARE IN INCHES [MM]
A1-A8 ARE LOADING POINTS Ø3/4 [19]

SKM Air Cooled Packaged Chillers APCD Series - R22

APCD Models - 5180B-5250B & 6210B-6290B



LEGEND

- (1) COND. FAN
- (2) COND. COIL
- (3) COMPRESSOR
- (4) EVAPORATOR
- (5) CONTROL PANEL

NOTE - A

2 POINT CABLE ENTRY FOR MODEL # 6270,6280 & 6290 WITH POWER SUPPLY 220V / 3Ph / 60 Hz - ONE EACH SIDE. CERTIFIED DRGS. ARE AVAILABLE ON REQUEST.

ALL DIMENSIONS ARE IN INCHES [MM]

A1-A12 ARE LOADING POINTS Ø3/4 [19]

MODEL APCD-	LOAD ON EACH POINT Lb/Kg												OPT. WT. Lb/Kg
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	
5180B 6210B	1486 674	1166 529	1164 528	840 381	1260 571	1190 540	1286 583	1257 570	1337 606	1457 661	1164 528	840 381	14447 6552
5190B 6230B	1486 674	1166 529	1187 538	850 386	1260 571	1190 540	1307 593	1269 575	1337 606	1457 661	1187 538	850 386	14546 6597
5200B 6240B	1629 739	1224 555	1338 607	910 413	1276 579	1206 547	1323 600	1286 583	1353 614	1474 668	1204 546	867 393	15090 6844
5210B 6250B	1642 745	1237 561	1351 613	923 418	1416 642	1260 571	1470 667	1342 609	1367 620	1488 675	1218 552	880 399	15594 7072
5220B 6260B	1657 752	1252 568	1366 618	938 425	1431 649	1276 579	1485 674	1357 616	1508 684	1543 700	1366 619	938 425	16117 7309
5230B 6270B	1658 752	1253 568	1367 620	939 426	1431 649	1276 579	1485 674	1357 615	1508 684	1543 700	1366 619	938 425	16121 7311
5240B 6280B	1658 752	1253 568	1367 620	939 426	1433 650	1276 579	1487 674	1358 616	1508 684	1543 700	1366 619	938 425	16125 7313
5250B 6290B	1658 752	1253 568	1367 620	939 426	1433 650	1276 579	1487 674	1358 616	1510 685	1543 700	1367 620	939 426	16130 7315

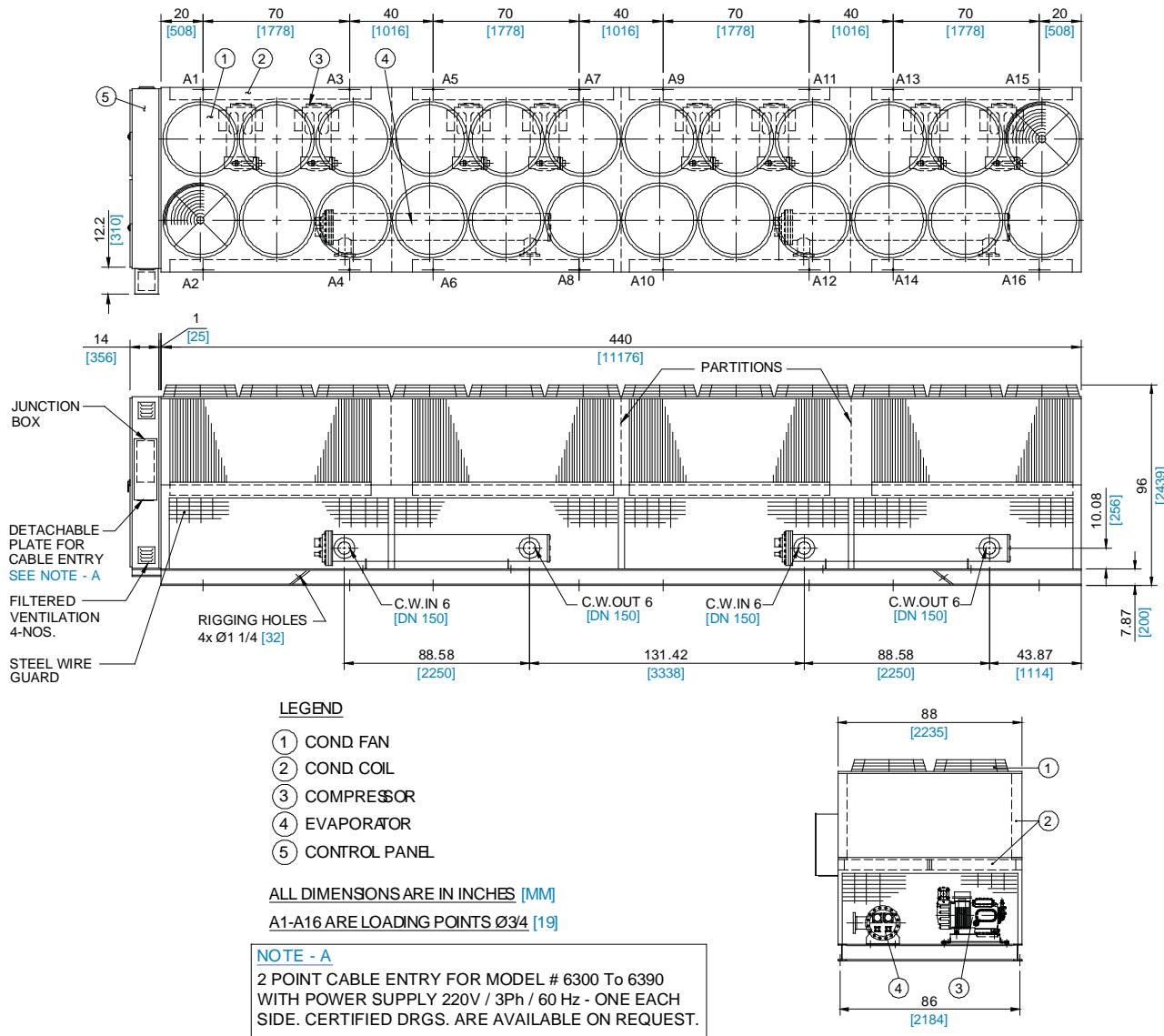
Table 30



Air Conditioning Equipment · Built in the Gulf... for the World

SKM Air Cooled Packaged Chillers APCD Series - R22

APCD Models - 5260B-5340B & 6300B-6390B



MODEL APCD-	LOAD ON EACH POINT Lb/Kg																OPT. WT. Lb/Kg
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	
5260B 6300B	1615 732	1301 590	1403 636	1330 603	1376 624	1241 563	1361 617	1201 545	1290 585	976 443	1403 636	1330 603	1376 624	1241 563	1361 617	1201 545	21006 9526
5270B 6310B	1712 776	1334 605	1433 650	1341 608	1376 624	1241 563	1361 617	1201 545	1387 545	1009 458	1433 629	1341 650	1376 624	1241 563	1361 617	1201 545	21348 9682
5280B 6330B	1734 786	1357 615	1457 661	1363 618	1495 678	1296 587	1415 642	1234 560	1409 639	1032 468	1457 661	1363 618	1495 678	1297 588	1415 642	1234 560	22053 10001
5290B 6340B	1785 810	1388 629	1573 723	1417 643	1515 687	1316 597	1435 651	1254 563	1460 662	1062 481	1573 713	1418 643	1515 687	1316 597	1435 651	1254 569	22716 10302
5300B 6350B	1786 810	1389 630	1575 714	1418 643	1547 702	1328 602	1533 695	1289 585	1461 662	1064 483	1575 714	1418 643	1547 702	1328 602	1533 695	1289 585	23080 10467
5310B 6360B	1788 811	1389 630	1575 714	1418 643	1547 702	1328 602	1533 695	1289 585	1463 663	1064 483	1575 714	1418 643	1547 702	1328 602	1533 695	1289 585	23084 10469
5320B 6370B	1788 811	1389 630	1575 714	1418 643	1548 702	1329 603	1533 695	1289 585	1463 663	1064 483	1575 714	1418 643	1548 702	1329 603	1533 695	1289 585	23088 10471
5330B 6380B	1788 811	1389 630	1576 715	1418 643	1549 702	1329 603	1533 695	1289 585	1463 663	1064 483	1576 715	1418 643	1549 702	1329 603	1533 695	1289 585	23092 10473
5340B 6390B	1788 811	1389 630	1576 715	1418 643	1550 703	1330 603	1533 695	1289 585	1463 663	1064 483	1576 715	1418 643	1550 703	1330 603	1533 695	1289 584	23096 10474

Table 31

SKM Air Cooled Packaged Chillers APCD Series - R22

Location/Space Requirements

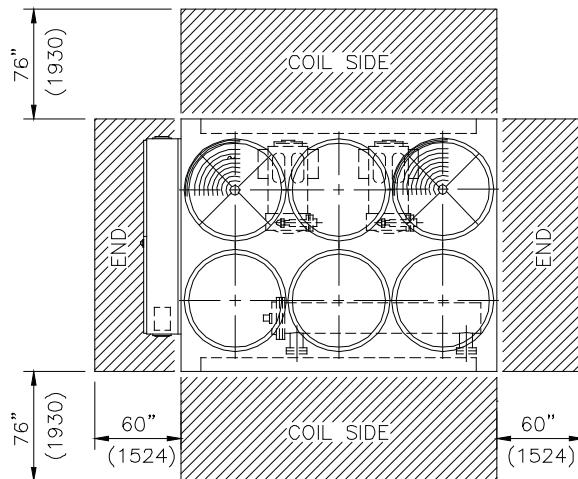
Due to the vertical air flow discharge condenser design, it is recommended that certain precautions are to be taken before installation. There should be no obstruction on the air flow.

Orient the unit so that prevailing winds blow parallel to the unit length thus minimizing the effects on condensing pressure. If it is not practical to orient the unit in this manner, a wind deflecting shield should be considered.

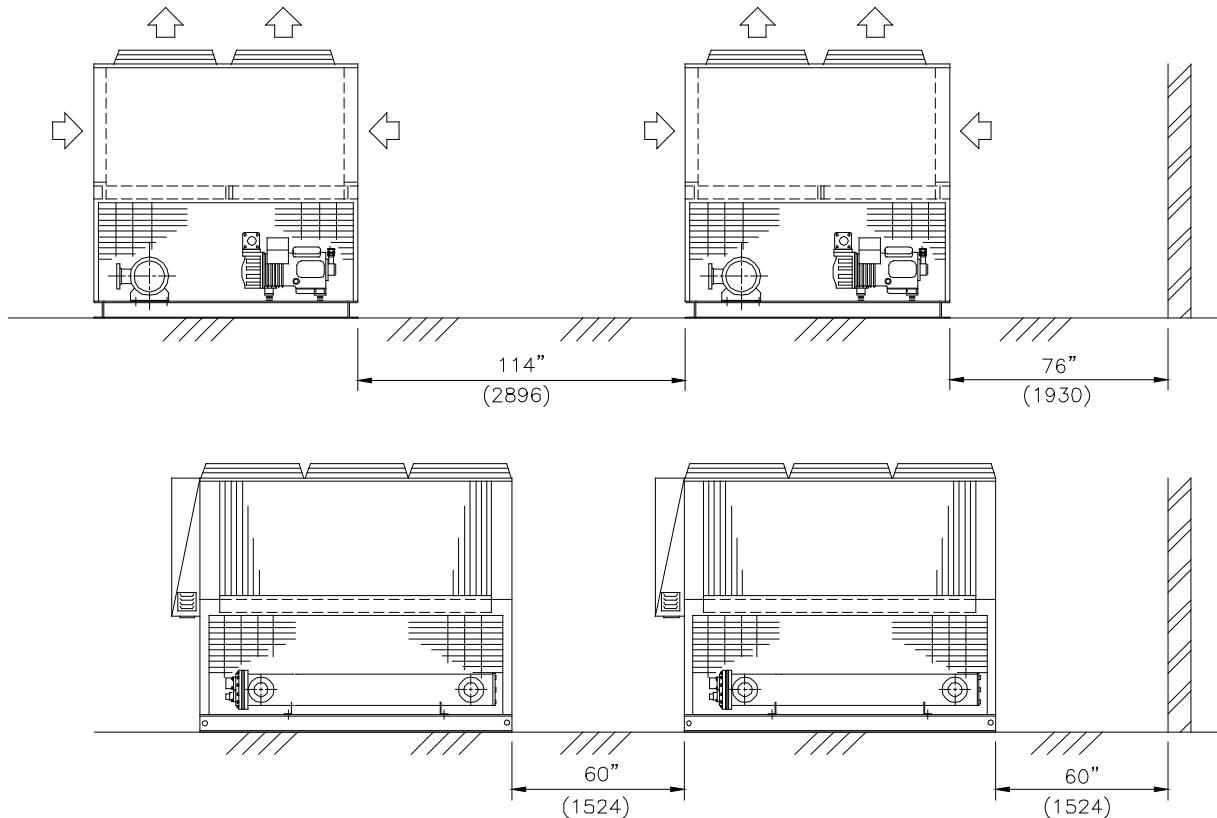
It is also necessary to provide adequate clearance on all sides of the unit for service access and satisfactory performance. This will prevent excessive condensing temperatures and enhance system performance and operating economy.

Refer to Figure A for recommended clearance around chillers to avoid warm air recirculation or coil starvation.

Single Unit Installation



Multiple Unit Installation



SKM Air Cooled Packaged Chillers APCD Series - R22

Application / Installation

Foundation

A flat concrete foundation or floor which can support the weight of the equipment must be provided as the unit must be level for proper operation and functioning of controls.

Vibration Isolation

Under certain critical conditions it is recommended that vibration isolators of rubber-in-shear or spring type be installed under the base.

The isolators must be designed for the operating weight of the unit. For operating load points refer to the Dimensional Data. Correct selection of types of isolators depends upon application and structure.

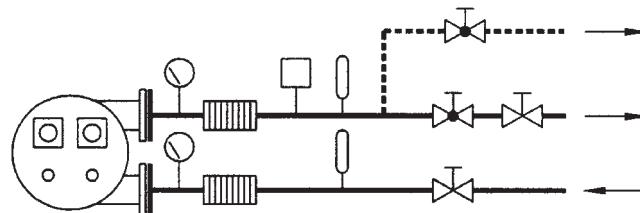
To further reduce the transmission of vibration, it is recommended that flexible water connections suitable for the system pressure be installed on the water inlet and outlet connections of the chiller. For critical applications or locations, services of a noise and vibration expert is recommended.

Water Piping Practices

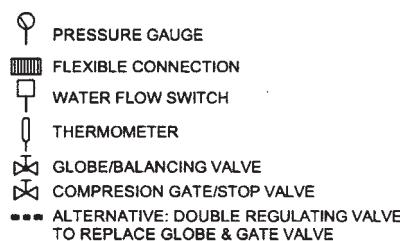
Due to the variety of piping practices, it is advisable to follow the recommendations of local authorities. They can supply the installer with the proper building and safety codes required for a safe and proper installation. Basically the piping should be designed with a minimum number of bends and changes in elevation to keep the system cost down and performance up. It should contain :

1. Vibration eliminators to reduce vibration and noise transmission to the building.

2. Shut-off valves to isolate the unit from the piping system during unit servicing.
3. Manual or automatic air vent valves at the high points of the system so that the air can be vented.
4. An expansion tank to control system pressure allowing water to expand on increase of water temperature.
5. Make necessary arrangements to install a water flow switch on the leaving water connection to ensure adequate waterflow and wire it with the terminals provided in the unit control panel. This will safeguard against slugging the compressor on start-up and shut down the unit should the water flow be interrupted. Refer to the Installation instruction sheet furnished with the water flow switch.
6. Temperature and pressure indicators located at the unit to aid in unit servicing.
7. A strainer or some means of removing foreign matter from the water before it enters the pump. It should be placed far enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer will prolong pump life and thus keep system performance up. All building water piping must be flushed prior to making final connection to the chiller.
8. Prior to insulating the piping and filling the system a preliminary leak check should be made.
9. Piping insulation should include a vapor barrier to prevent moisture condensation and possible damage to the building structure. It is important to have the vapor barrier on the outside of the insulation to prevent condensation within the insulation on the cold surface of the pipe.



TYPICAL CHILLED WATER PIPING



SKM Air Cooled Packaged Chillers APCD Series - R22

Unit Sizing

It is strongly recommended to size the chiller for the present load. For future expansion, it is recommended to install another chiller to meet the additional load demand.

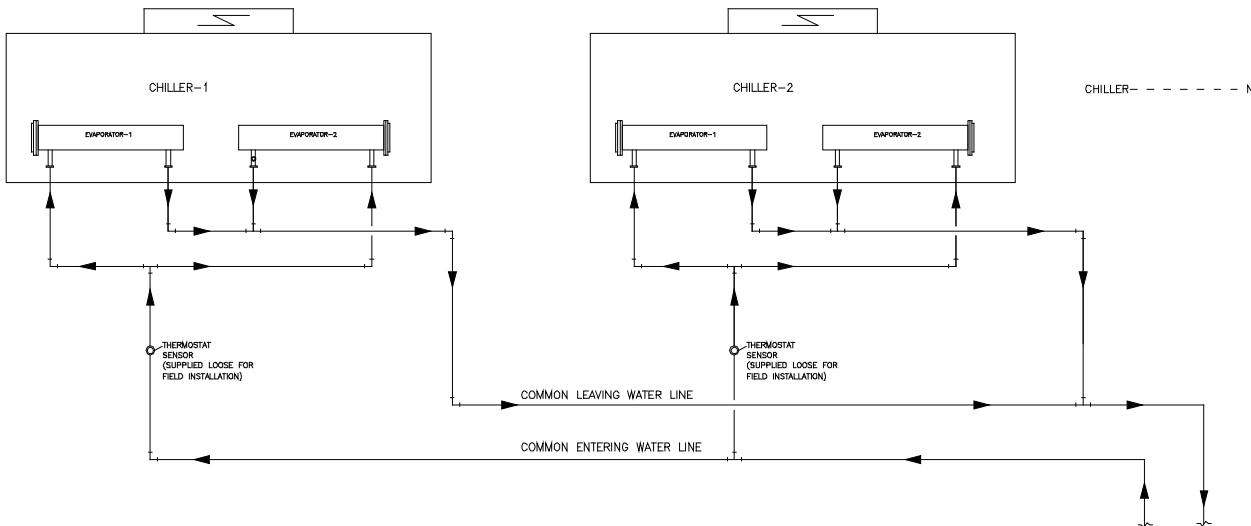
Over sizing of chillers by more than 10% at design conditions must be avoided. Over sizing causes energy inefficiency (more power consumption), erratic system operation and shortened compressor life due to excessive cycling of compressors.

Multiple Chiller Operation

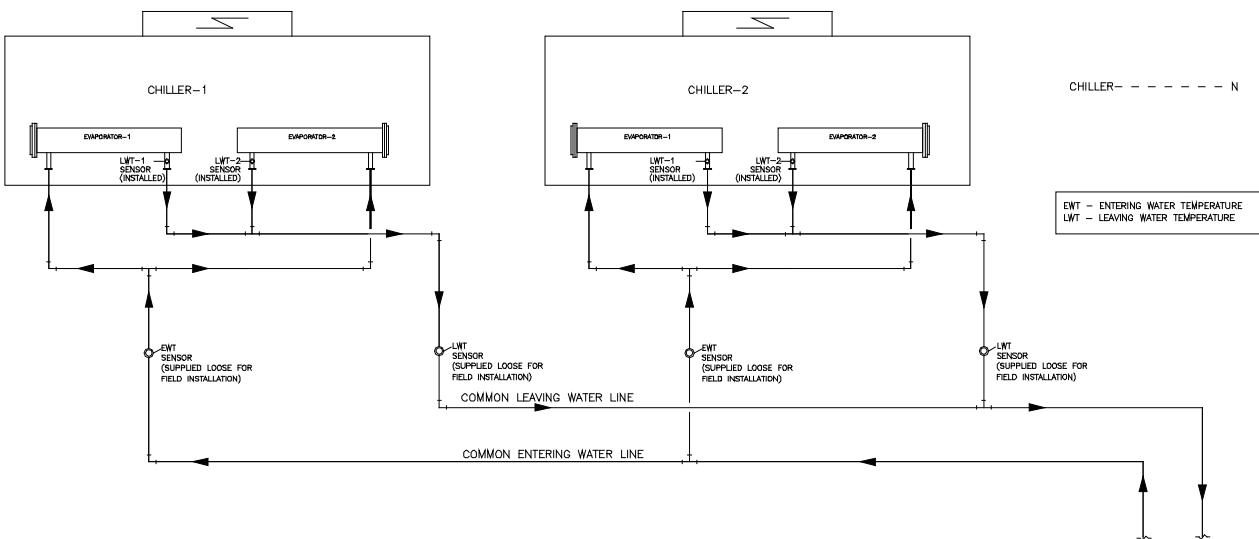
If the capacity requires installing more than one chiller unit or where standby units are desired, units should be of equal size (or near) to ensure balanced water flow.

SKM recommends that water flow supply & return are connected either parallel in case of range $< 16^{\circ}\text{F}$ (8.9°C) or in series if range $> 16^{\circ}\text{F}$ (8.9°C).

Chilled Water Piping for Multiple Chiller Installation (With Standard Controls)



Chilled Water Piping for Multiple Chiller Installation (With Microprocessor-Magnum Option)



For chillers with two evaporators, pipes for leaving and entering water, from one evaporator should be joined to the corresponding pipe from the other evaporator, before connecting to the main header of the installation.



SKM Air Cooled Packaged Chillers APCD Series - R22

GUIDE SPECIFICATIONS

GENERAL

The contractor shall supply and install factory assembled air-cooled packaged water chillers, the number and capacity of which shall be as indicated in the capacity schedule shown on the drawings.

Each machine shall consist of at least one refrigerating circuit comprising of hermetic/semi hermetic reciprocating high efficiency compressor(s), air-cooled condenser, evaporator, interconnecting refrigerant piping, controls, safety devices and accessories.

The machine shall be factory assembled, leak tested, evacuated and completely charged with refrigerant R - 22. All factory wiring and piping shall be contained within the machine enclosure. All electrical components shall be protected from the weather.

Air cooled chillers shall be rated in accordance with ARI - 550/590. Each machine shall be capable of operating satisfactorily in a wide range of ambient air temperatures ranging from 50°F (10°C) to 125°F (52°C).

Unless indicated otherwise on electrical wiring diagram, each unit shall be factory equipped to connect to only one electrical power feeder with the necessary circuit breakers, if so specified.

Each unit shall be mounted on anti vibration isolators flexible enough to dampen any vibrations.

COMPRESSOR

Compressors used in Air Cooled Packaged Chillers shall be hermetically sealed, high efficiency, low noise reciprocating/high efficiency and fully accessible semi hermetic reciprocating type with discus valve design. The compressors shall be equipped with crank case heater, refrigerant gas cooled electric motor, preset internal relief valves, oil sight glass, and inherent thermistor motor protection. Semi hermetic compressors shall be with a reversible oil pump. Compressors shall be mounted on anti-vibration mounts to minimize vibration transmission. All compressors shall be provided with an individual 3 pole MCCB for overcurrent, short circuit protection & Isolation in case it is required. Individual 3 pole contactors for switching of the compressors shall be rated for AC3 duty. To reduce the starting inrush on the power supply system, compressors shall be provided with part winding starting if so specified.

EVAPORATOR

Units with smaller capacity shall be with Brazed Plate Heat Exchanger (BPHE). Brazed plate heat exchanger's channel plates, refrigerant and water connections shall be constructed from stainless steel with pure copper as brazing material. The design and assembly process shall comply with Europe Pressure Equipment Directive PED 97/23/EC and maximum working pressure of water side shall be 363 psig (2500 kPa) and refrigerant side shall be 392 psig (2700 kPa).

Larger capacity evaporators shall be of shell and tube, direct expansion with removable head, having 1, 2, and 3 refrigerant circuits. Evaporator header, tube sheet, shell and water connections shall be made of carbon steel. Baffles shall be made of brass/carbon steel. High efficiency tubes shall be in copper.

The evaporator shall be provided with water drain, air vent and fittings for temperature sensors. The evaporator shall be designed for maximum working pressure of water side shall be 145 psig (1000 kPa) and for refrigerant side 363 psig (2500 kPa).

Shell and tube evaporator design, materials specifications and assembly process shall be in compliance with the following codes: CE, GOST, UDT, and ASME.

The shell shall be insulated with 1" (25mm) thick flexible closed cell insulation with a maximum K factor of 0.26 Btu.in/ft².hr.°F (0.038 W/m.°K).

CONDENSER COIL

Condenser coil shall be air cooled and shall be constructed of seamless copper tubes, maximum 4 rows deep, 3/8" (9.52 mm) O.D. and mechanically bonded to the wavy type aluminum fins. Fins spacing shall be maximum 12 FPI (2.1mm). Slit fins shall not be accepted.

Precoated fins shall be used for saline and corrosive environment (if so specified). Integral sub cooling circuit in each coil shall be provided to increase the chiller cooling capacity, without additional operating cost. The coils shall be tested against leakage by air pressure of 450 psig (3100 kPa) under water.

CONDENSER FANS & MOTORS

The machine shall be furnished with direct driven propeller type discharging air upward condenser fans. Fans shall be constructed of corrosion resistant blades such as heavy gauge aluminum. The fan and drive shall be held in proper alignment. Fan assemblies shall be provided with heavy gauge, rust resistant steel. The fan assembly shall be protected with an acrylic coated steel wire fan guard. All condenser fans shall be individually statically and dynamically balanced for vibration free operation.

Condenser fan motor shall be Totally Enclosed Air Over (TEAO), 3-phase type, 6 poles with Class F insulation, Class B temperature rise and IP55 protection. Also, Motor shall be with permanently lubricated bearings and inherent corrosion resistance shaft. Condenser fan motors shall be provided with individual 3 pole contactor rated for AC3 duty operation & motor protector circuit breaker for short circuit, over current protection & isolation.

REFRIGERATION CIRCUITS

Refrigeration circuits piping shall be fabricated from ACR grade copper pipes and each refrigeration circuit shall include a removable core filter drier, liquid line solenoid valve, thermostatic expansion valve, shut off valve, sight glass and hot gas muffler. For single compressor circuits, vibration absorbers on suction and discharge lines shall be provided.

Suction line shall be insulated with 1/2" (13mm) wall thickness closed cell pipe insulation with maximum k factor 0.26 Btu.in/ft².hr.°F (0.038 W/m.°K).

SKM Air Cooled Packaged Chillers APCD Series - R22

GUIDE SPECIFICATIONS

CASING

Machine casing shall be made of heavy gauge zinc coated galvanized steel sheets conforming to JIS-G 3302 and ASTM-A 635. To provide an extremely tough, scratch resistance, excellent anti-corrosive protection, fabricated steel shall be thoroughly de-greased and then phosphatized before application of an average 60 micron backed electrostatic polyester dry powder coating in RAL 7032 color scheme. This finish shall pass 1000-hour, 5% salt spray test at 95°F (35°C) and 95% relative humidity (ASTM B 117).

Machine casing shall be provided with access doors for easy service and maintenance and painted steel wire guard for compressors section.

The machine shall be fully assembled on welded rigid structural steel skid painted with one coat primer and minimum one coat of rust-preventing black enamel.

CONTROL PANEL & CONTROLS

The unit control panel enclosures shall be fabricated out of heavy gauge sheet steel. The enclosure shall be phosphatized and baked after an electrostatic dry powder coat finish and shall be conform to IP-54 protection as per guidelines in IEC-529. Control Panels shall be with dead front panel cover screwed on the enclosure or external panels with hinged doors and key fasteners shall be provided for easy access and security.

Panels shall be factory wired in accordance with NEC 430 & 440, labeled, tagged and shall feature 220/240V single phase controls and to include the following as minimum

- Individual compressor and condenser fan motor contactors.
- Circuit breakers for compressors. (if applicable)
- Condenser fan motor protector circuit breaker.
- Anti-recycle timer to prevent rapid cycling and short cycling of compressors.

- Compressor low pressure safety switch, factory set for each circuit.
- Compressor oil failure and high pressure safety switch, one per compressor, factory set.
- Head pressure control, by fan cycling, for low ambient operation.
- Freeze protection thermostat.
- Multi-step temperature controller to control chiller capacity.
- Control ON / OFF toggle switch for each circuit.
- Control circuit fuses.
- Manual pump-down switch for each circuit.
- Run/Trip indication lights.
- Power and control circuit terminal blocks.

MICROPROCESSOR CONTROL

Microprocessor Controls with transducers and sensors shall be provided for the chiller operation if so specified.

The main features of the controller includes graphical LCD with back-lit screen, a nine button generic keypad, battery backed -up real time clock to program the chiller for 2 starts and 2 stops daily to provide the information about the running hours of the compressors. The multiple authorization levels provides maximum security of the control system. Automatic lead/lag control for the compressors, pump down at the beginning and end of every circuit cycle, capacity control based on leaving chilled water temperature, remote start/stop facility and volt free contacts for common run, fault and remote mode operation for remote indication, etc.





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