



Maglev Chiller with Danfoss Turbocor Centrifugal Compressor

BROAD CENTRAL AIR CONDITIONING & MAGNETIC BEARING OIL FREE CHILLER

BROAD PACKAGED POWER-EFFICIENT CHILLER

MODEL SELECTION & DESIGN MANUAL

Refrigerant 513A



Application

- Provide chilled water for central air conditioning system
- Produce chilled water over 37.4°F

Cooling capacity

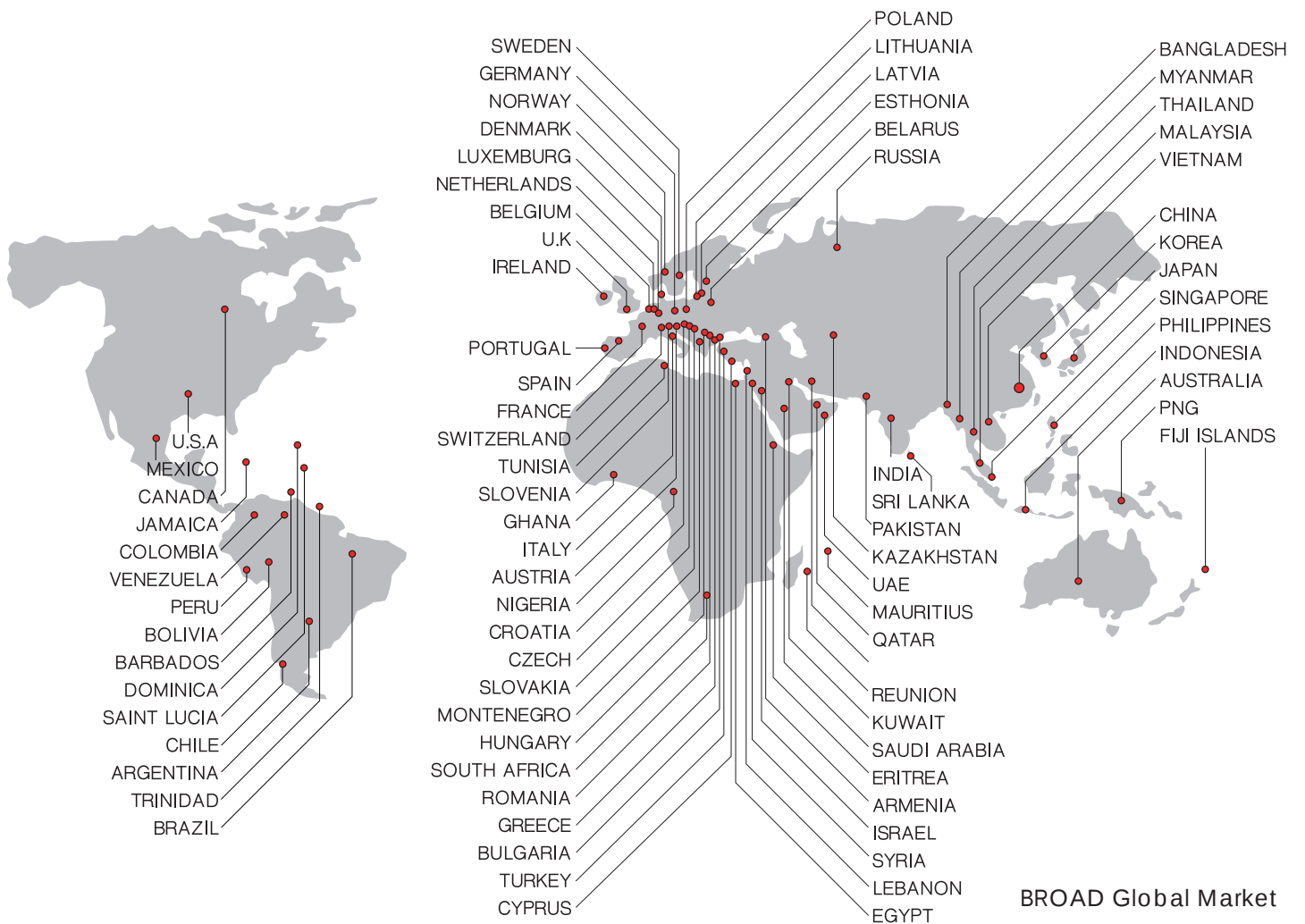
520 ~ 4200 kW
(150 ~ 1,200 RT)



(CY90 Packaged Chiller)



Global Internet Monitoring Center for BROAD central air conditioning. It has been operating since 1996, known as the pioneer of "internet +".



AS THE GLOBAL LEADER OF NON-ELECTRIC CHILLER, WHY BROAD ALSO MAKES ELECTRIC CHILLER ?

BROAD non-electric chiller is the world's most efficient equipment when evaluating the efficiency of "primary energy", also it is the only central air conditioning that can generate chilled water, heating water and sanitary hot water with the highest reliability, the longest life span and the quietest operation. However, the following reasons determine that we are manufacturing power-efficient chiller now.

1. Many areas have no access to natural gas or waste energy sources.
2. Some inquiries need cooling only, or the yearly operation time is too short to use multi-function air conditioning.
3. Specific locations powered by wind, hydro or solar PV has great potential to reduce CO₂ emissions.
4. BROAD Power-efficient Chiller is more efficient than traditional electric chillers.
5. BROAD Packaged Water Distribution System is more efficient than traditional distribution systems.
6. BROAD Power-efficient Chiller can be combined with BROAD non-electric chiller and BROAD CHP system, which has higher efficiency and energy flexibility than single energy source equipment.

VALUES OF BROAD POWER-EFFICIENT

ENERGY SAVING

The Integrated Part Load Value (IPLV) of the chiller can reach 10. This high IPLV can reduce energy consumption by 40% when compared to traditional electric chillers. BROAD Packaged Water Distribution System can reduce electricity consumption up to 76% when compared to conventional field-built systems.

ADDITIONAL COST SAVING

The magnetic oil free and zero friction technology can save up to 40% energy cost and 90% of maintenance cost when compared with traditional electric chillers. BROAD PLC "Smart anti-surge control" module insures the chiller always operate in a safe range.

The integrated design of the BROAD chiller, water distribution system and stainless steel metal enclosure reduce design cost and field installation costs for customers.

SPACE SAVING

Compared with the traditional electric chillers, BROAD packaged chiller reduces volume by 30~50% and weight by 30%.

BROAD Packaged Water Distribution System and stainless steel metal enclosures can be installed outside which reduces mechanical room footprint requirements.

WORRY-FREE

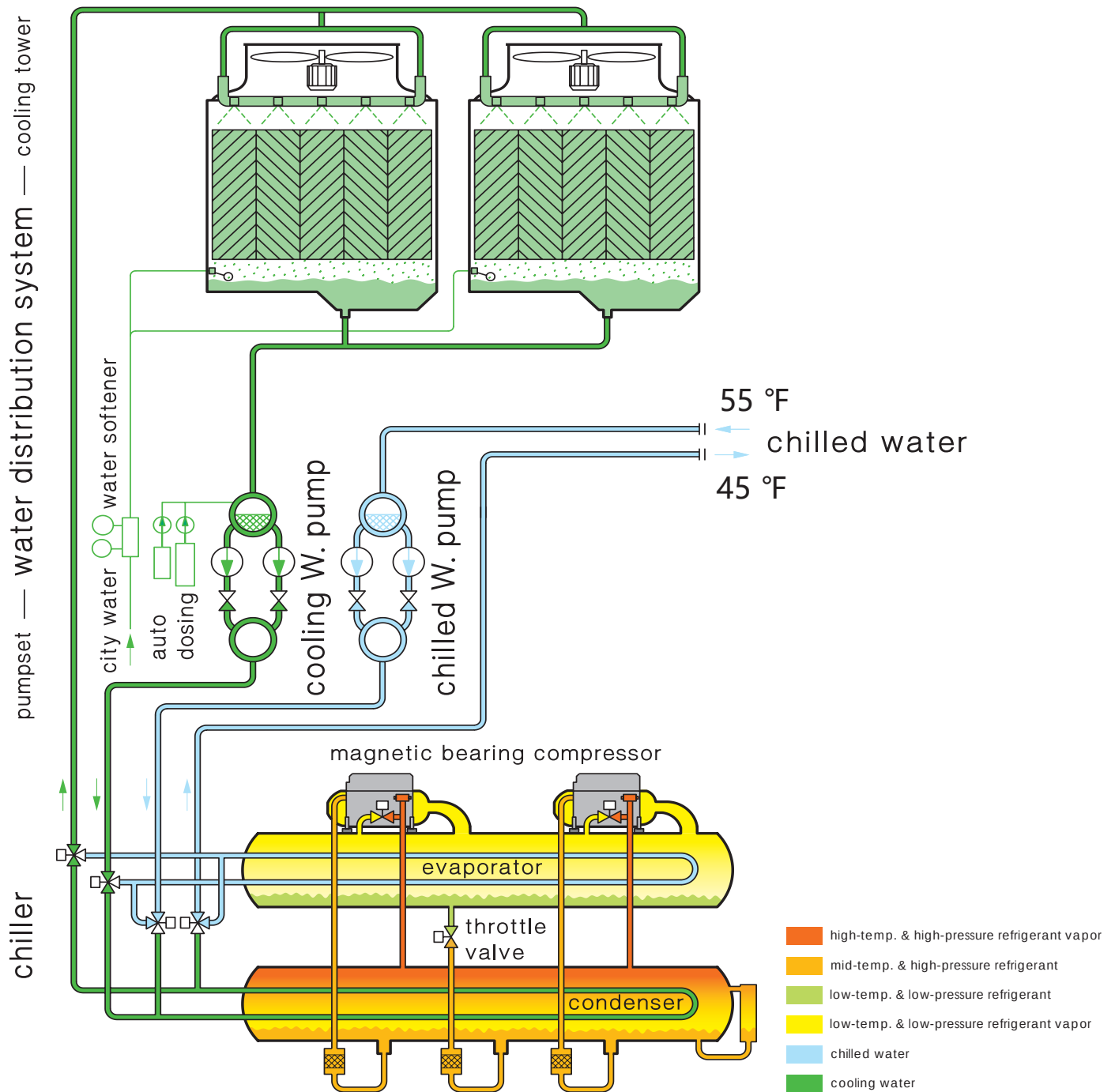
BROAD Packaged Water Distribution System and stainless steel metal enclosure eliminate risk and reduce system design, procurement and installation errors. BROAD Intelligent Control System (ICS) can be automated for free operation of the chiller and water distribution system.

BROAD Global Internet Monitoring System provides customers with 24/7/365 fault prediction, analysis and energy-saving management tools.

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BROAD PACKAGED POWER-EFFICIENT CHILLER



The cooling principle

The compressor compresses 45°F low-temp. & low-pressure refrigerant vapor to 113°F high temp. & high pressure vapor then flows into condenser. In condenser cooling water absorbs the heat from refrigerant vapor condensation process and its temperature raises from 86°F to 95°F. Then the heat will be discharged to air through cooling tower. After condensation, 91.4°F refrigerant becomes into 42.8°F low-temp. & low-pressure liquid after throttle valve. The refrigerant enters evaporator and evaporates immediately. It absorbs heat from the chilled water and makes chilled water drop from 54°F to 45°F. After evaporation, the refrigerant gasifies into 45°F vapor and sucked into compressor. Then next cycle begins.

BROAD Maglev chiller, Danfoss Turbocor Centrifugal Compressor

Power-efficient Chiller Rated Parameters R513A

Model	C	45	60	90	120	180	240	360
Cooling capacity	kW	520	700	1045	1400	2090	2800	4200
	10 ⁴ kcal/h	45	60	90	120	180	240	360
	RT	150	200	300	400	600	800	1200
Input power	kW	95.5	125.0	185.0	238.0	360.0	445.5	665.0
Rated COP		5.45	5.60	5.65	5.88	5.81	6.30	6.32
COP (IPLV)		9.69	9.35	9.88	9.76	9.68	10.36	10.18
Starting current	A	2	2	2	2	2	2	2
Maximum operation current	A	180	230	360	460	740	920	1380
Power demand	kW	105	130	200	260	380	520	750
Evaporator								
Flow rate	gpm	396	528	793	1057	1585	2113	3170
Pressure drop	ftH ₂ O	9.4	10.0	20.1	23.4	31.8	23.4	36.8
Connection nozzle	NPS	6	6	8	8	10	12	14
Condenser								
Flow rate	gpm	493	660	991	1321	1981	2642	3963
Pressure drop	ftH ₂ O	9.4	11.7	21.7	25.1	30.1	25.1	35.1
Connection nozzle	NPS	6	6	8	8	12	12	14
Refrigerant wt.	lb	500	700	1100	1450	2100	2900	4200
Shipment wt.	lb	5750	7700	10150	12600	22050	25150	44100
Operation wt.	lb	6600	8800	11500	14800	24700	29550	49400

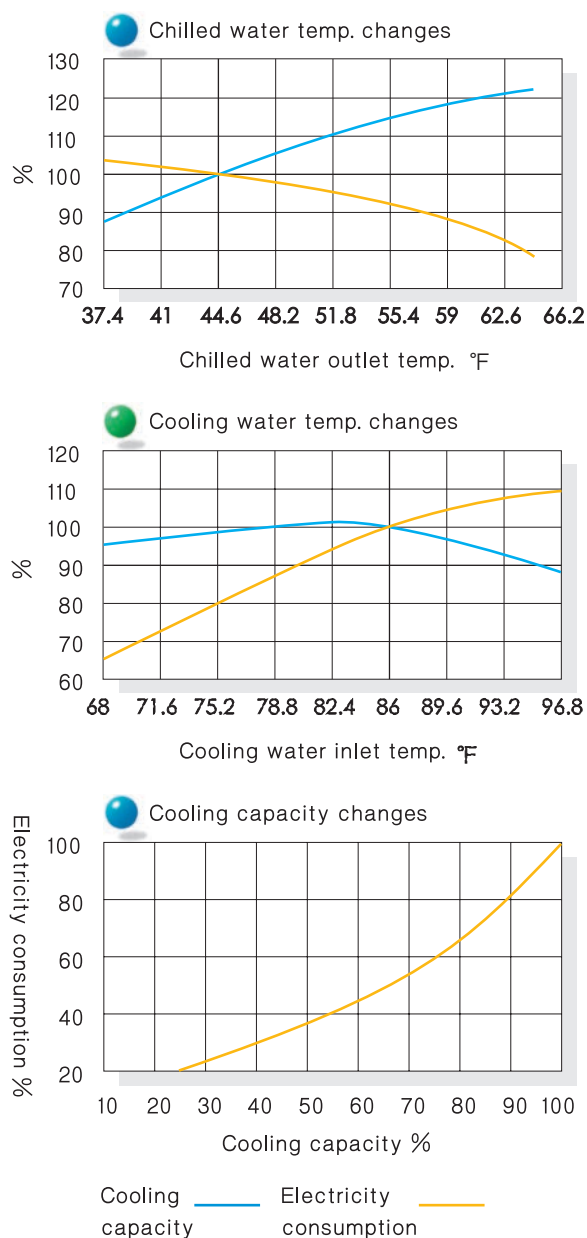
Packaged Power-efficient Chiller Rated Parameters

Model		CY	45	60	90	120	180	240	360
Pumpset	Chilled water pump								
	External head	ftH ₂ O	62	69	69	66	64	69	59
	Power demand	kW	11	15	22	37	44	60	90
	Rated power	kW	9.4	12.8	18.7	31.5	37.4	51.0	76.5
	Cooling water pump								
	External head	ftH ₂ O	38	38	28	25	20	28	21
	Power demand	kW	8	11	15	22	37	44	60
	Rated power	kW	6.8	9.4	12.8	18.7	31.5	37.4	51.0
	Total power	kW	19	26	37	59	81	104	150
	Shipment wt.	lb	2900	3500	4000	4650	7300	7300	11000
	Operation wt.	lb	5500	6850	7700	8400	13900	15000	18750

General Conditions

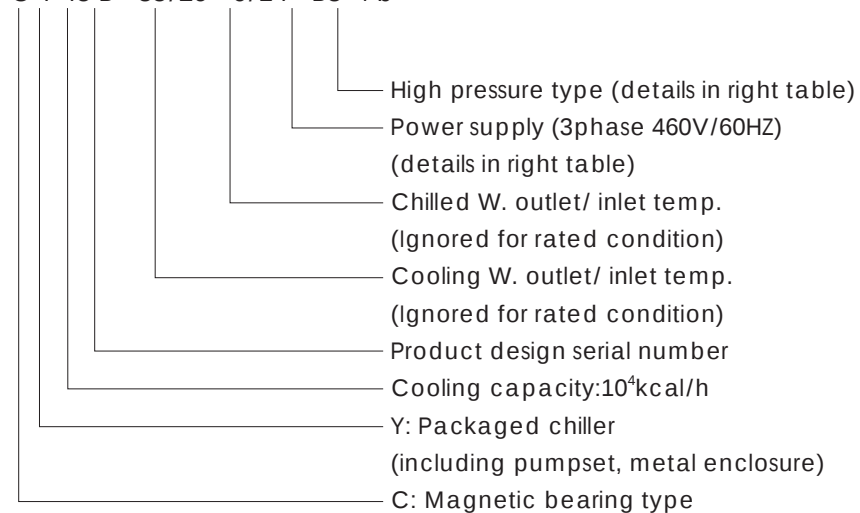
1. Rated chilled W. outlet/inlet temp: 45/54°F
2. Rated cooling W. outlet/inlet temp: 95/86°F
3. Lowest permitted outlet temp. for chilled water: 37.4°F
4. Lowest permitted inlet temp. for cooling water: 50°F
5. Adjustable chilled water flowrate: 50~120%
6. Adjustable cooling water flowrate: 20~130%
7. Pressure limit for chilled W. and cooling W.: ≤150 psig (high pressure model available)
8. Adjustable load: 10~100%
9. Fouling factor for chilled W: 0.0001 hr • ft²°F/Btu
Fouling factor for cooling W: 0.00025 hr • ft²°F/Btu
10. Refrigerant: R134a
11. Machine room ambient temperature: 41~110°F, humidity ≤85%
12. Life design: 30 years
13. Operation noise: ≤65dB (A)
14. Operation vibration: ≤0.012 inch

Performance Curves

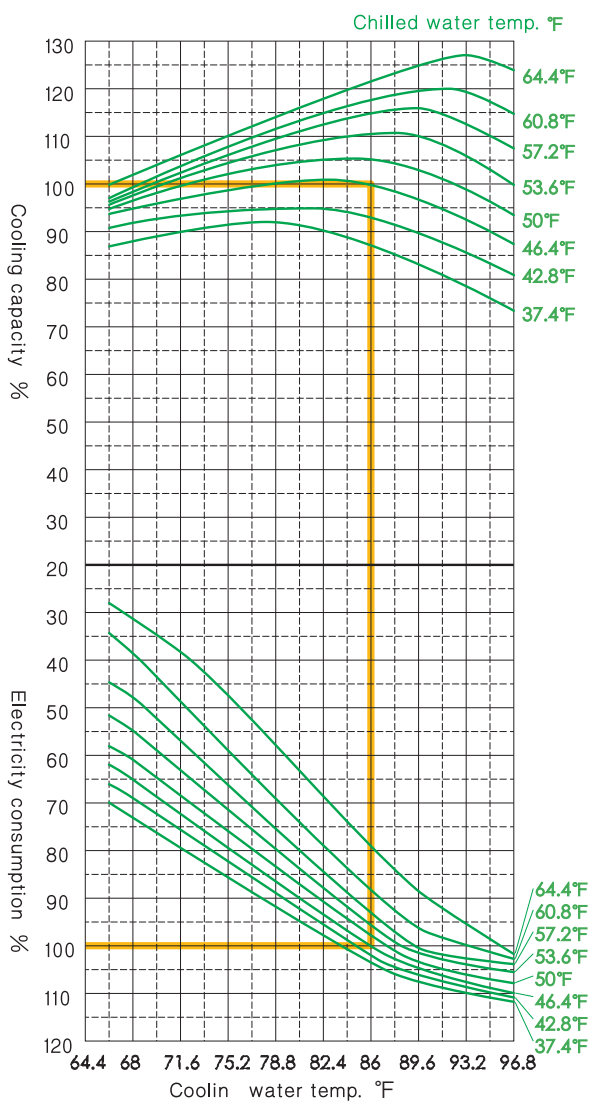


Nomenclature

C Y 45 B - 35/29 - 6/14 - B3 - Fb



Model Selection Curves



Notes: Calculation method of COP
 $COP = \text{cooling capacity} \% / \text{electricity consumption} \% \times \text{rated COP}$
 e.g. C90 rated COP is 6.05, chilled water temp. is 45°F, cooling water temp. is 79°F, then cooling capacity is 100%, electricity consumption is 87%, $COP = 100\% / 87\% \times 6.05 = 6.95$

Codes for high pressure type:

Pressure limit psig	Chilled W.	Cooling W.
150~232	Fb	Mb
233~290	Fc	Mc
291~348	Fd	Md

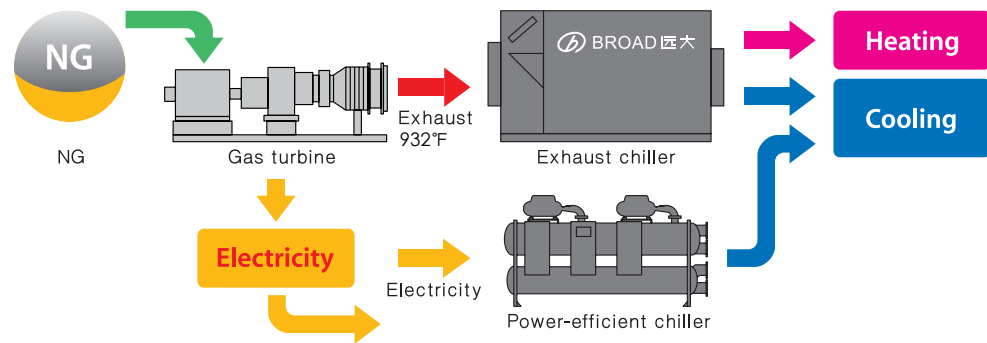
Codes for power supply:

Power supply	Voltage	Frequency
B1	380V	50Hz
B2	400~415V	
B3	460V	60Hz
B5	380V	
B6	400~415V	
B7	575V	

Combination of Non-electric Chiller and Power-efficient Chiller

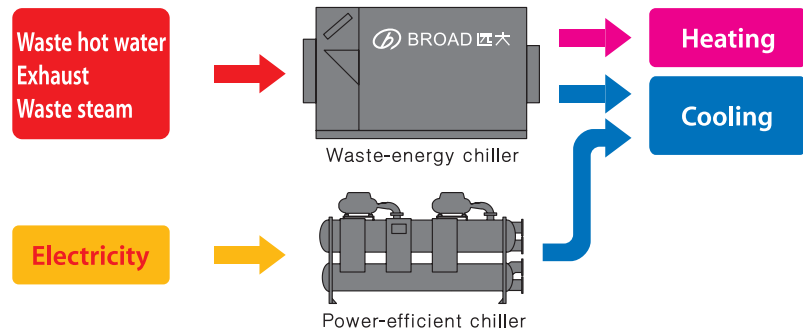
Combination of CHP and power-efficient chiller

Energy self-sufficient system



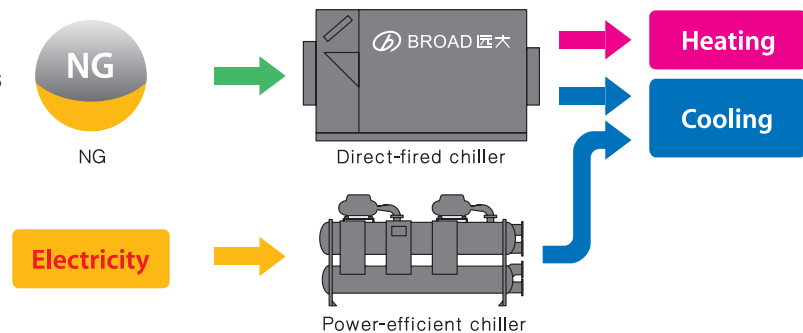
Combination of waste heat chiller and power-efficient chiller

Waste heat is priority
power-efficient
chiller used as
supplementary



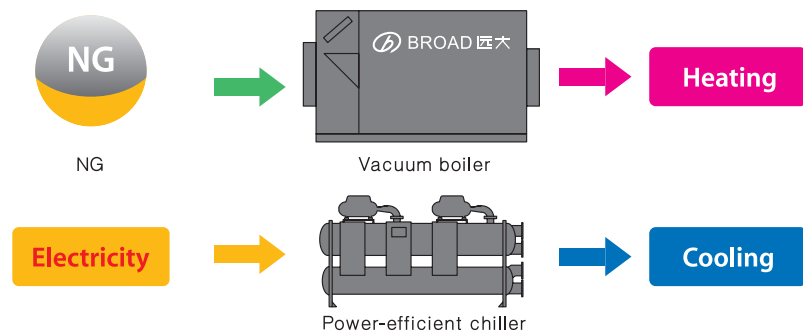
Combination of direct-fired chiller and power-efficient chiller

Daily shift or seasonal
shift according to
different energy prices



Combination of vacuum boiler and power-efficient chiller

Most applicable to
places with huge
heating and cooling
load difference



Model Selection & Ordering

Function selection

- Cooling only type
- Combination of CHP and power-efficient chiller, Combination of waste heat chiller and power-efficient chiller, combination of direct-fired chiller and power-efficient chiller, combination of vacuum boiler and power-efficient chiller

Load selection

- Any building cooling load cannot be estimated according to the building area, as it is more closely related to building insulation and room function
- 0.8 ~1.3 tons per 1,000 square foot is recommended for energy-efficiency building, 1.6~2.4 tons per 1,000 square foot for normal building, 2.7~4 tons per 1000 square foot for high occupancy and high space building

Flowrate selection

- BROAD designs the distribution system head according to its profound experiences
- BROAD is open for special head design

Pressure selection

- The standard pressure limit for chilled/heating/cooling water is 150 psig. Information about high pressure type please see Code for high pressure type
- >290 psig system: secondary heat exchange recommended

Control

- BROAD power-efficient chillers are equipped with complete control function including internet monitoring
- If customers have a building management system (BMS), the BMS control interface can be selected as an optional supply. If the BMS interface is not ordered along with the chiller, it can be purchased later
- BROAD BMS is recommended to customers (for the whole building)

Machine room location

- On the floor or on building rooftop
- Chiller can also be installed in the basement
- Cooling tower should be installed on the floor, on stilt or on building rooftop

Packaged selection

- Packaged power-efficient chiller includes chiller, water distribution system, metal enclosure as machine room, etc.
- If the packaged system is installed in the building, metal enclosure can be selected as an option
- Cooling tower is an option for international

Lead time

- ≤CY90: 3~6 months
- ≥CY180: 6~9 months

Warranty

Free warranty is to cover 24 months from commissioning or 30 months from shipment, whichever comes earlier

Warranty conditions:

- The Chiller should be installed as per BROAD Power-efficient Chiller Model Selection & Design Manual catalogue, and be commissioning by BROAD service engineer
- The chiller should be well connected with Internet
- The Buyers must operate and conduct regular maintenance as per Service Form of maintenance
- The Chiller service & maintenance record should be uploaded to BROAD Service Management APP with 24 hours after the procedure is done
- Solution sample should be sent to BROAD once/ year. Any service abnormal should be reported to BROAD International Service Center within 4 hours when it occurs

Technical specification is based upon

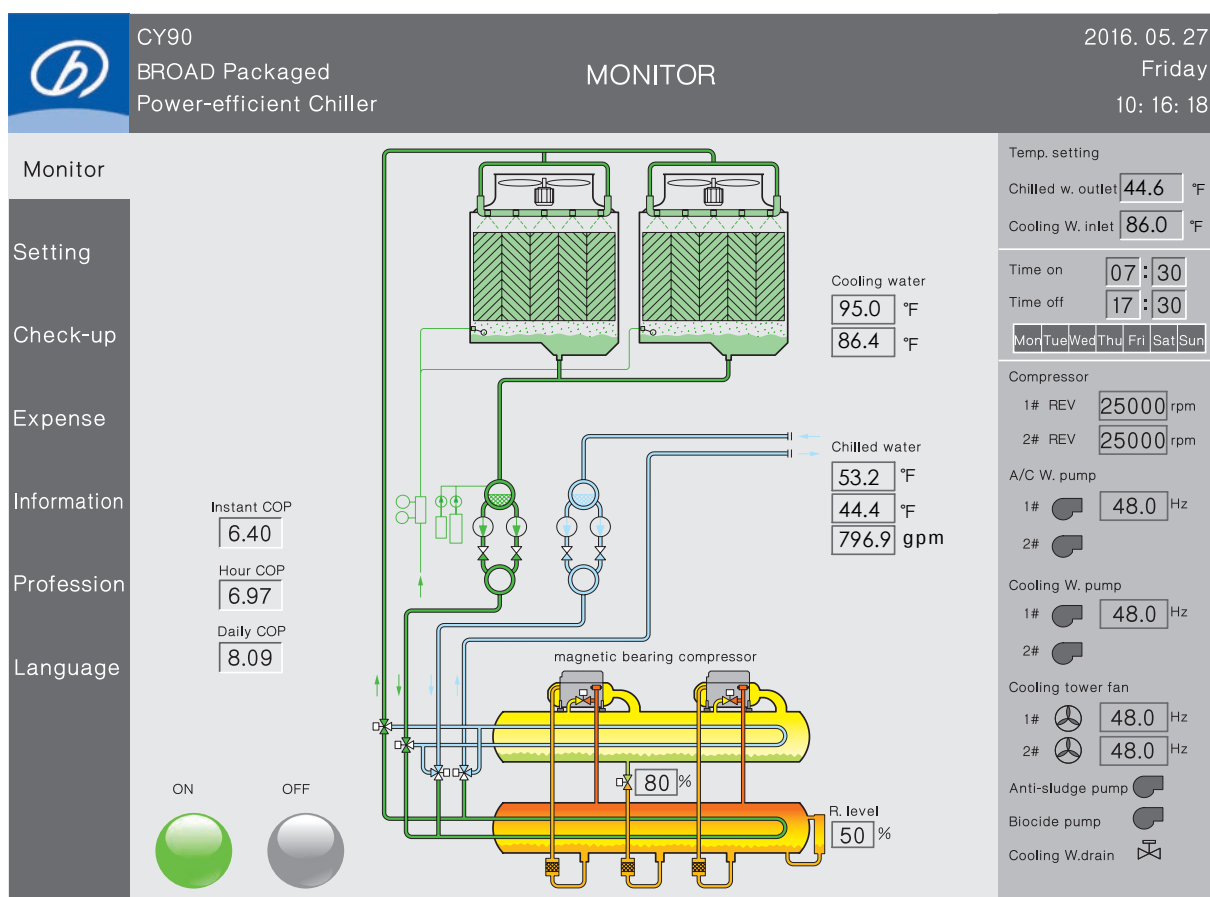
- GB/T18430 Water Chilling (Heat Pump) Packages Using The Vapor Compression Cycle. Part 1: Water Chilling (Heat Pump) Packages For Industrial & Commercial And Similar Application
- GB 25131 Safety Requirements For Water Chillers (Heat Pump) Using The Vapor Compression Cycle
- GB 19577 Minimum Allowable Values Of Energy Efficiency And Energy Efficiency Grades For Water Chillers
- ANSI with Addendum Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle

Supply Scope

Products	Category	Item	Remarks
Chiller	Chiller	Heat exchanger	Include condenser, evaporator (cold insulation included)
		Compressor	Magnetic bearing, VFD centrifugal type ,oil free operation
		Throttling valve set	Include electronic expansion valve, drying filter, shut-off valve, regulating valve
		Check valve	Prevent refrigerant vapor flow-back to protect compressor
		Motor cooling device	Include drying filter, control valve set etc
	Control system	Low voltage control cabinet	Include low voltage electric parts, control board, PLC, etc
		Power control cabinet	Includes switch gear, instant, reactor etc
		Touch screen	For operation
		External control elements	Include temperature & pressure sensors, flow switches, solution level probes and actuators
		BMS interface (optional)	Connect to BMS system through dry contact or serial communication
Pumpset system	Pumpset	Refrigerant	R134a
		A/C water pump	Two units
		Cooling water pump	Two units
		Accessories	Include zero resistance filter, check valve, soft connectors, valves and vibration isolator etc
		Piping *	Include all piping between pumpset and chiller
		Piping accessories	Include flow switches, auto air vent & its socket, soft connectors
		Motor drain valve	When water quality becomes poor, this valve automatically drains the cooling water. It also drains cooling water automatically in winter to avoid freeze
		A/C W. flowmeter	For precise management of chiller load and efficiency
		Water softener	Improve A/C water and cooling water quality
		Auto dosing device	Automatically charge biocide corrosion inhibitor and anti-sludge to the cooling water
		Pumpset control cabinet	Include inverters for A/C W. pump, cooling W. pump, cooling fan soft starter, low voltage electric parts, etc
		Electric wiring *	Include wires, cables, cable conduit, cable supporters, etc.
Option	Enclosure	Enclosure	Include stainless steel panel, roof cover, structural frame, baseframe, as well as accessories

Notes:

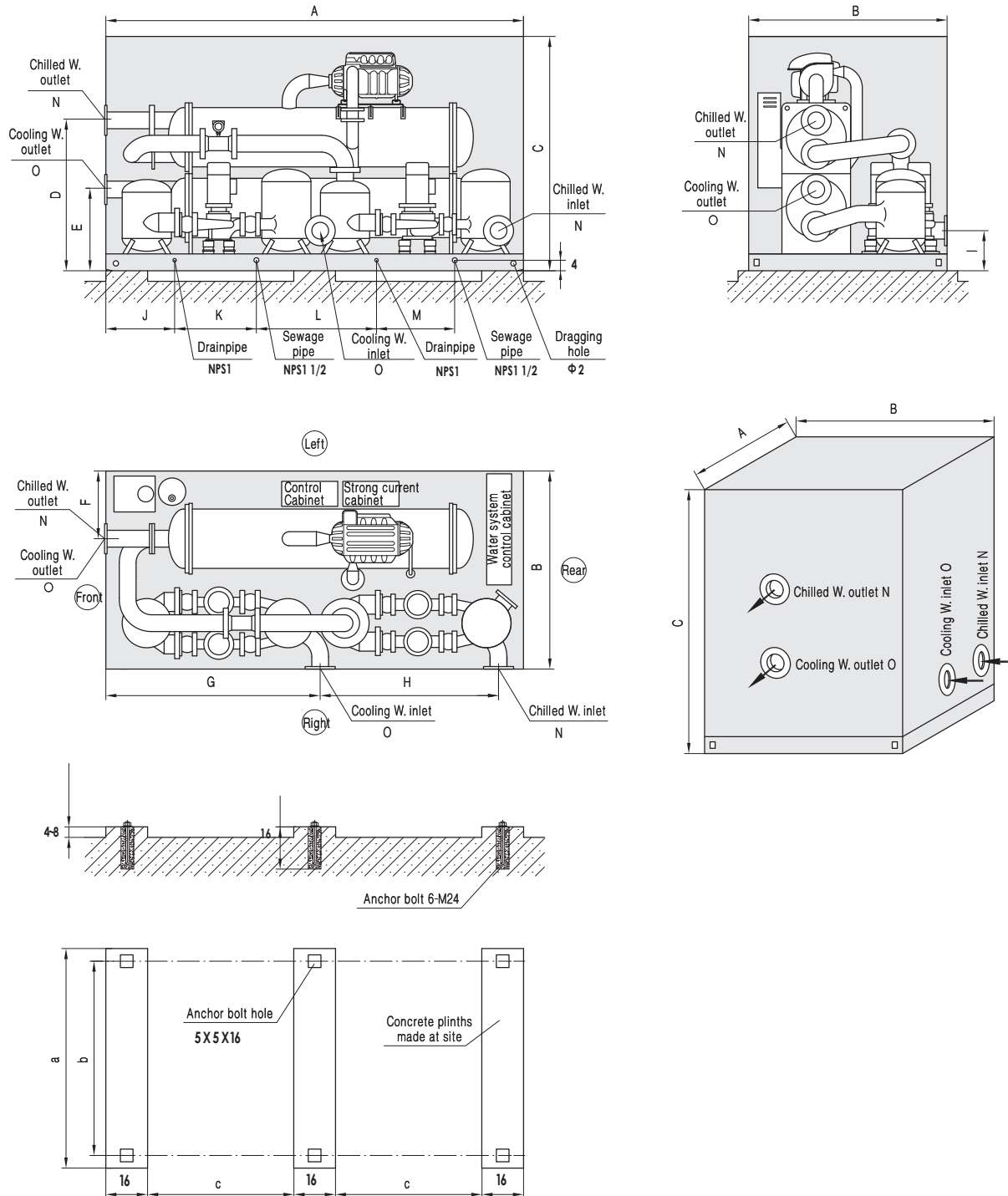
- * only for standard size. Special offer is available
- If the customer does not order cooling tower, a control signal linkage to cooling fan will be provided



DESIGN & CONSTRUCTION

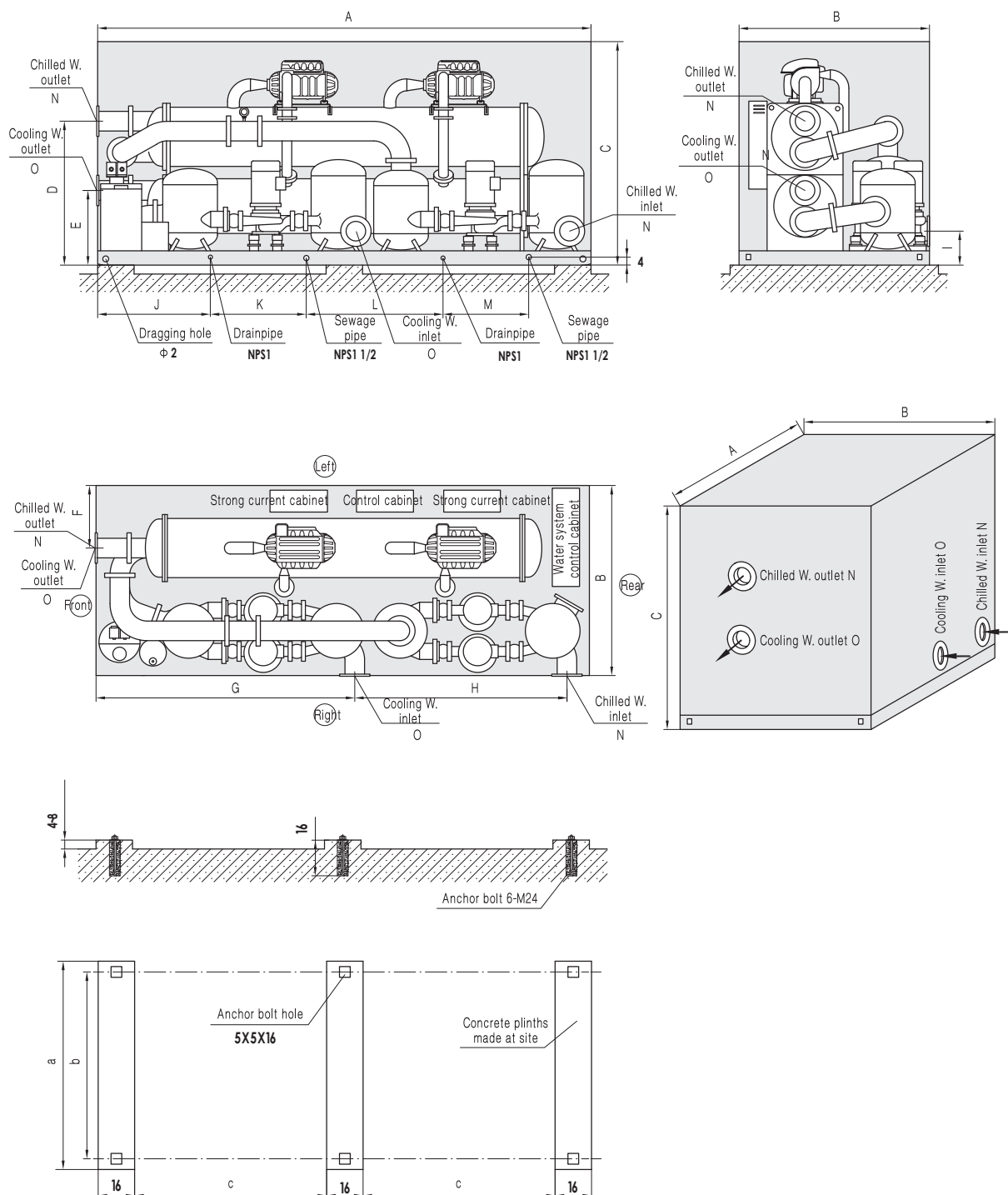
Dimensions

CY45 / CY60



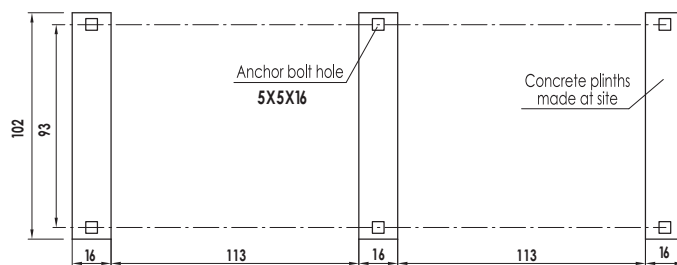
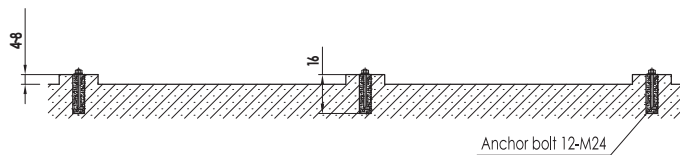
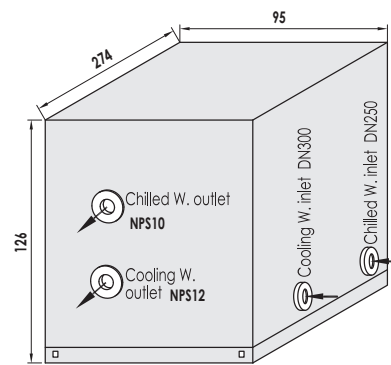
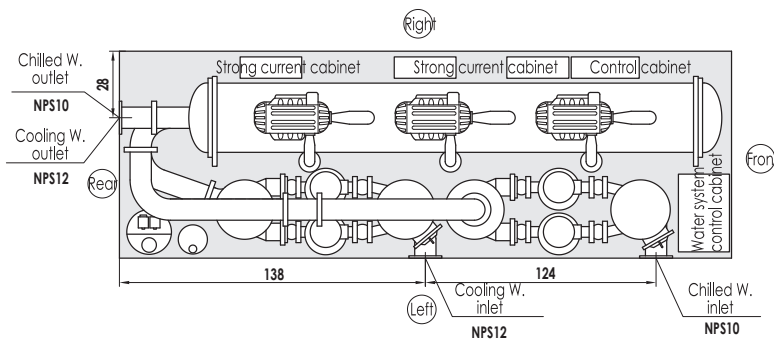
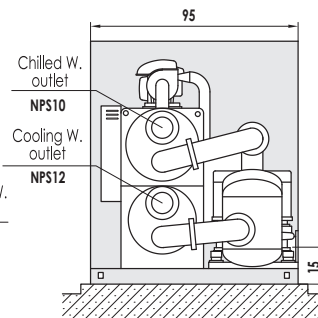
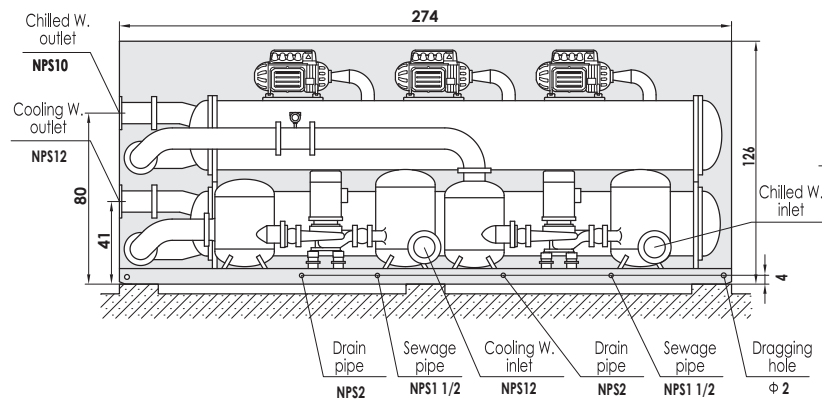
Model	A	B	C	D	E	F	G	H	I
CY45	156	74	93	56	31	25	72	75	15
CY60	166	84	105	67	31	28	74	83	17
Model	J	K	L	M	N	O	a	b	c
CY45	30	25	43	37	NPS6	NPS6	82	72	54
CY60	31	25	46	37	NPS6	NPS6	92	82	59

CY90 / CY120

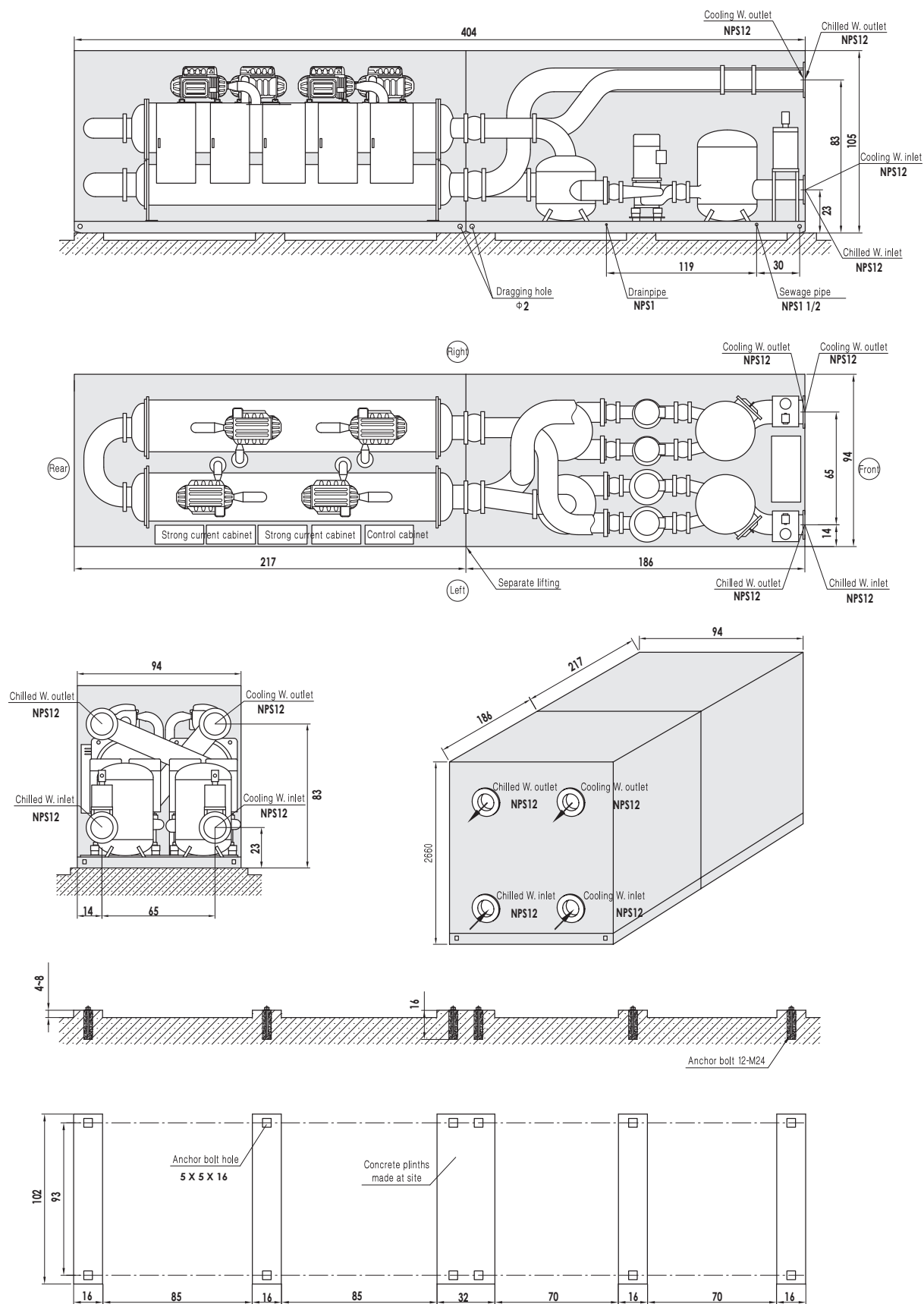


Model	A	B	C	D	E	F	G	H	I
CY90	217	84	105	63	33	28	113	102	15
CY120	228	84	105	65	31	26	115	100	15
Model	J	K	L	M	N	O	a	b	c
CY90	64	25	60	37	NPS8	NPS8	92	82	85
CY120	62	25	66	37	NPS8	NPS8	92	82	90

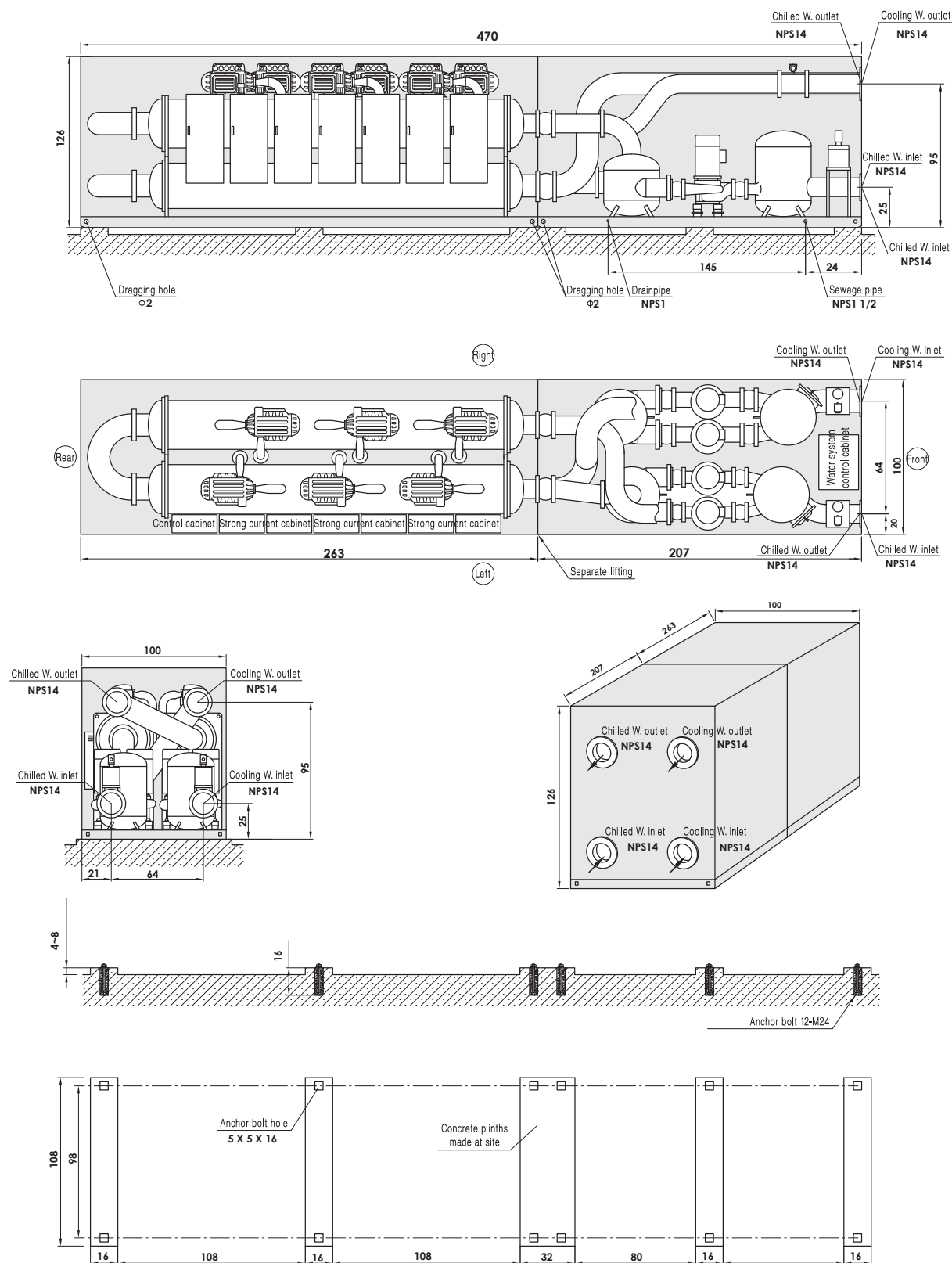
CY180



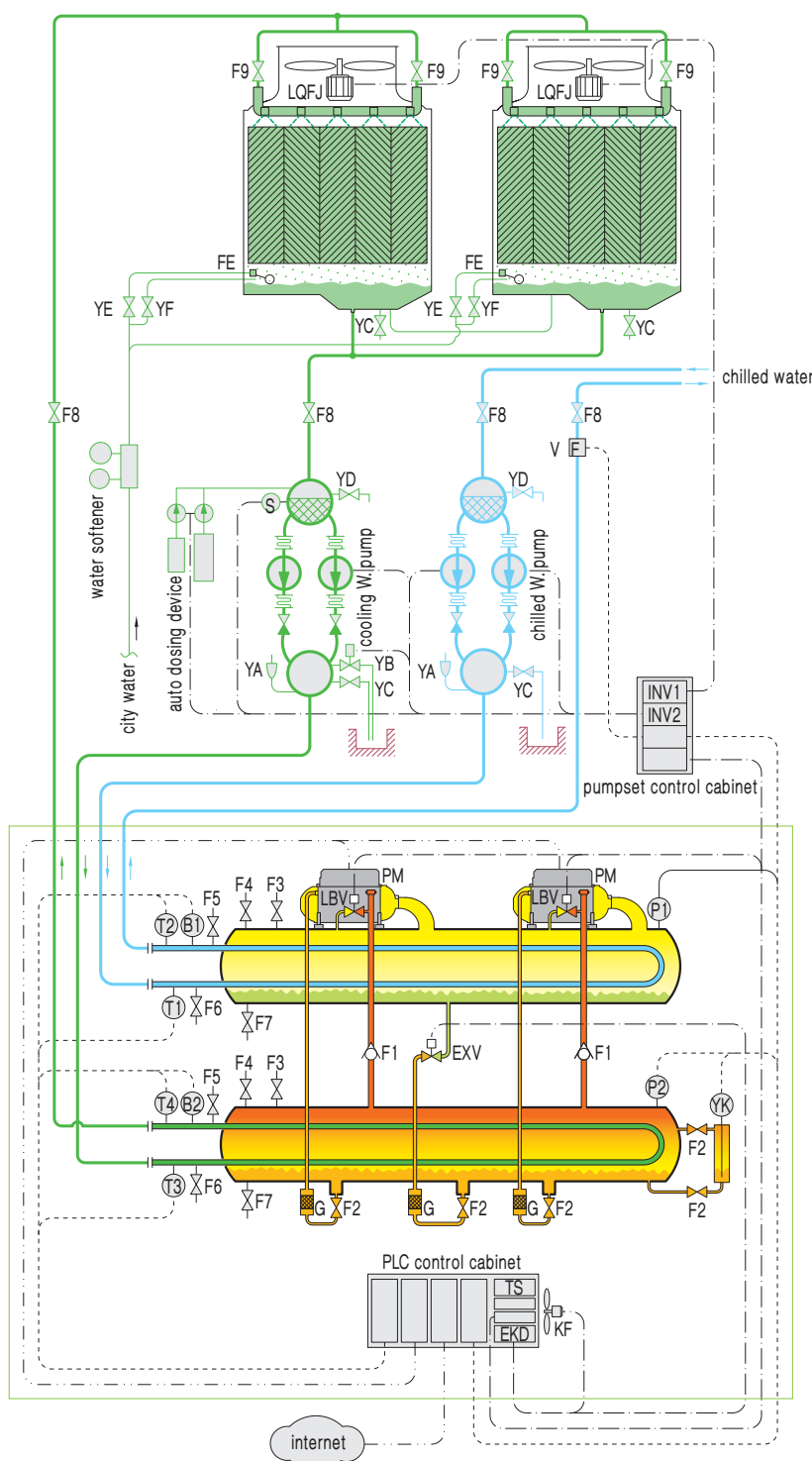
CY240



CY360



P&I Diagram



Control devices:

EKD electronic throttle valve controller
 INV1 cooling tower fan inverter
 INV2 cooling water pump inverter
 PLC Programmable Logic Controller
 TS Touch screen

Controlled objects:

EXV electronic throttle valve
 KF control cabinet fan
 LBV load balancing valve
 LQFJ cooling tower fan
 PM compressor
 YB motor drain valve

Sensors:

T1 chilled W. inlet temp. sensor
 T2 chilled W. outlet temp. sensor
 T3 cooling W. inlet temp. sensor
 T4 cooling W. outlet temp. sensor
 B1 chilled W. flow switch
 B2 cooling W. flow switch
 P1 evaporation pressure sensor
 P2 condensation pressure sensor
 S conductivity sensor
 V A/C W. flowmeter

Others:

F1 check valve
 F2 shutoff valve
 F3 safety valve
 F4 purge valve
 F5 vent valve
 F6 drain valve
 F7 refrigerant discharge valve
 F8 shutoff valve
 F9 balance valve
 FE auto water makeup valve
 YA auto vent valve
 YC manual drain valve
 YD pollution discharge valve
 YE water makeup valve
 YF manual water makeup valve
 YK level probe
 G dry filter

Notes:

1. Chiller scope

2. Line type:

actuator signal output

sensor signal input

communication

Scope of Supply / Work

Category	Item	BROAD	Customer	Remarks
Transportation & Location	Factory to port		√	BROAD can arrange transportation upon request
	Jobsite settlement (eg. positioning)		√	BROAD provides guidance
Electric engineering	Power supply to enclosure		√	3 phase, 4 wires
	Internet connection	√		Network cable to the enclosure is to be provided by customer
	Grounding		√	
Construction & Installation	Foundation		√	
	Pipe connection between chiller and pumpset for order with pumpset	√		A crane must be provided by customer
	External piping installation		√	Include chilled water pipes, water make-up and drain pipes
	Chiller cold insulation and chilled water pumps cold insulation	√		Factory-mounted
	Piping cold insulation in enclosure	√		For order with pumpset
	Pipeline cold insulation		√	
	Anti-freezing		√	Water anti-freeze treatment is recommended when the ambient temp. is below 32°F
Commissioning	Jobsite chiller commissioning	√		Customer provides energy and air conditioning load
Operation & Maintenance	Operator training on site	√	√	BROAD provides free professional site training; the customer pays the accommodations and transportation for BROAD engineer
	Regular maintenance	√		Service contract can be signed after the warranty period

Machine Room Construction

Machine Room

BROAD Packaged Power-efficient Chiller can be placed outdoor directly, no additional construction of machine room. Make the foundation in accordance with the drawings

Foundation

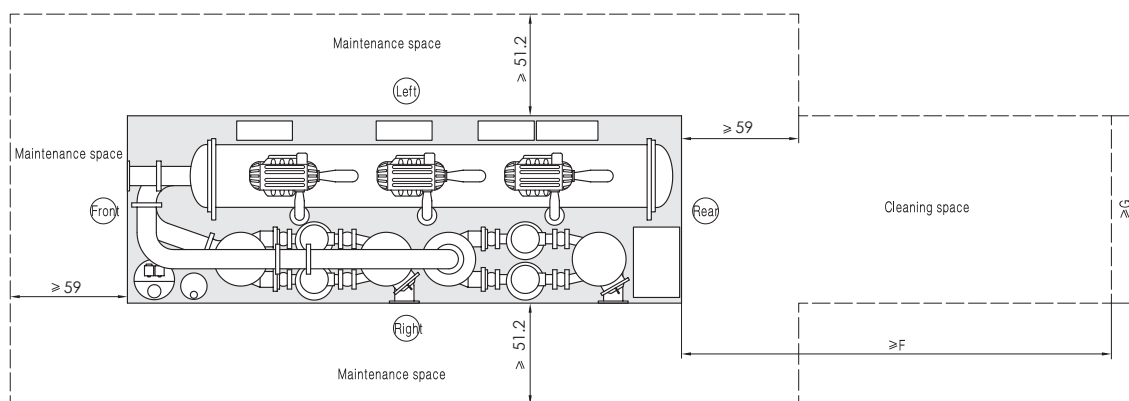
- Please refer to dimension drawings for plinth dimensions
- Load capacity:
 - ① The machine room foundation load is recommended as 1.5 times of the operation weight
 - ② Make sure that the foundation is level without sinking or overload (for rooftop installation)
 - ③ Chiller load should be evenly distributed on the contact surface between the frame base rolling steel and the plinth
- Anchor bolts:
 - ① Anchor bolts must be pre-installed in foundation per dimension drawings
 - ② Place the chiller on the foundation directly and fix it with anchor bolts

Machine room built by customer

- Ventilation: poor ventilation leads to high humidity in the machine room, which may erode the unit. Please ventilate 3 times machine rooms every hour
- Drainage:
 - ① Chiller foundation must be on a high level in the machine room
 - ② All discharge pipes and drainpipes must be visible above the drainage
 - ③ Machine room in basement must be built above a water ditch, which is equipped with an auto level-controlled submerged pump
- Temperature:

Machine room temperature must be controlled within 41~110°F. Lower temperature may crack heat exchange tubes and water box when the chiller is shut off. Higher temperature may damage electrical components. Thermometer and over temperature alarm must be installed in machine room
- Humidity:

Machine room humidity must be lower than 85%. Higher humidity may impair insulation of electrical components
- See maintenance space requirements as below:

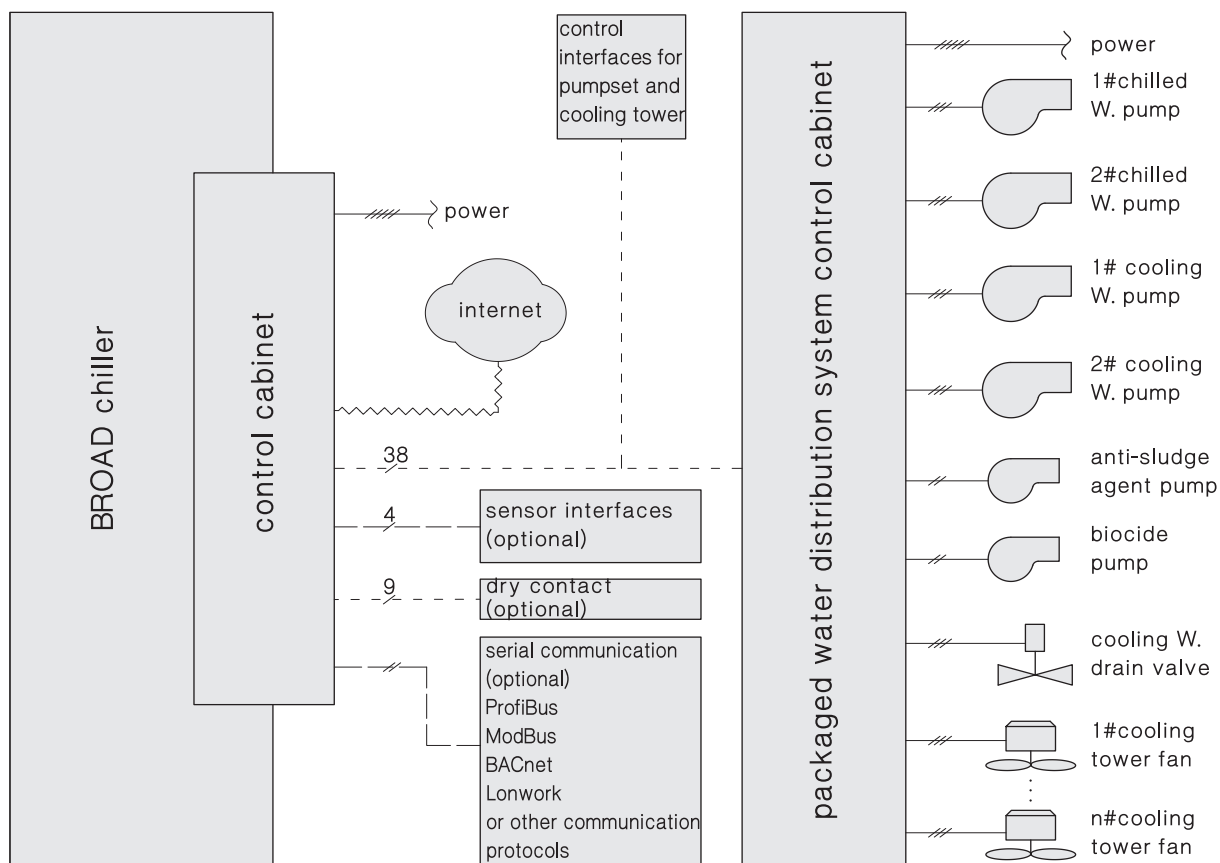


Model	CY45	CY60	CY90	CY120	CY180	CY240	CY360
F	118	118	177	177	217	177	217
G	74	84	84	84	94	89	94

Notes:

1. F, G is the space for tube service clearance. It could be the space of water pumps, doors or windows and also can be shared by two chillers.
2. The checking and washing work can be done by removing flexible joint and water cover in the front of chiller without dismantling pipeline system.
3. If the machine room is smaller than the above size, please contact with BROAD for a solution.
4. It is recommended that the height of the machine room be 1.7 ft higher than that of chillers.

Control System



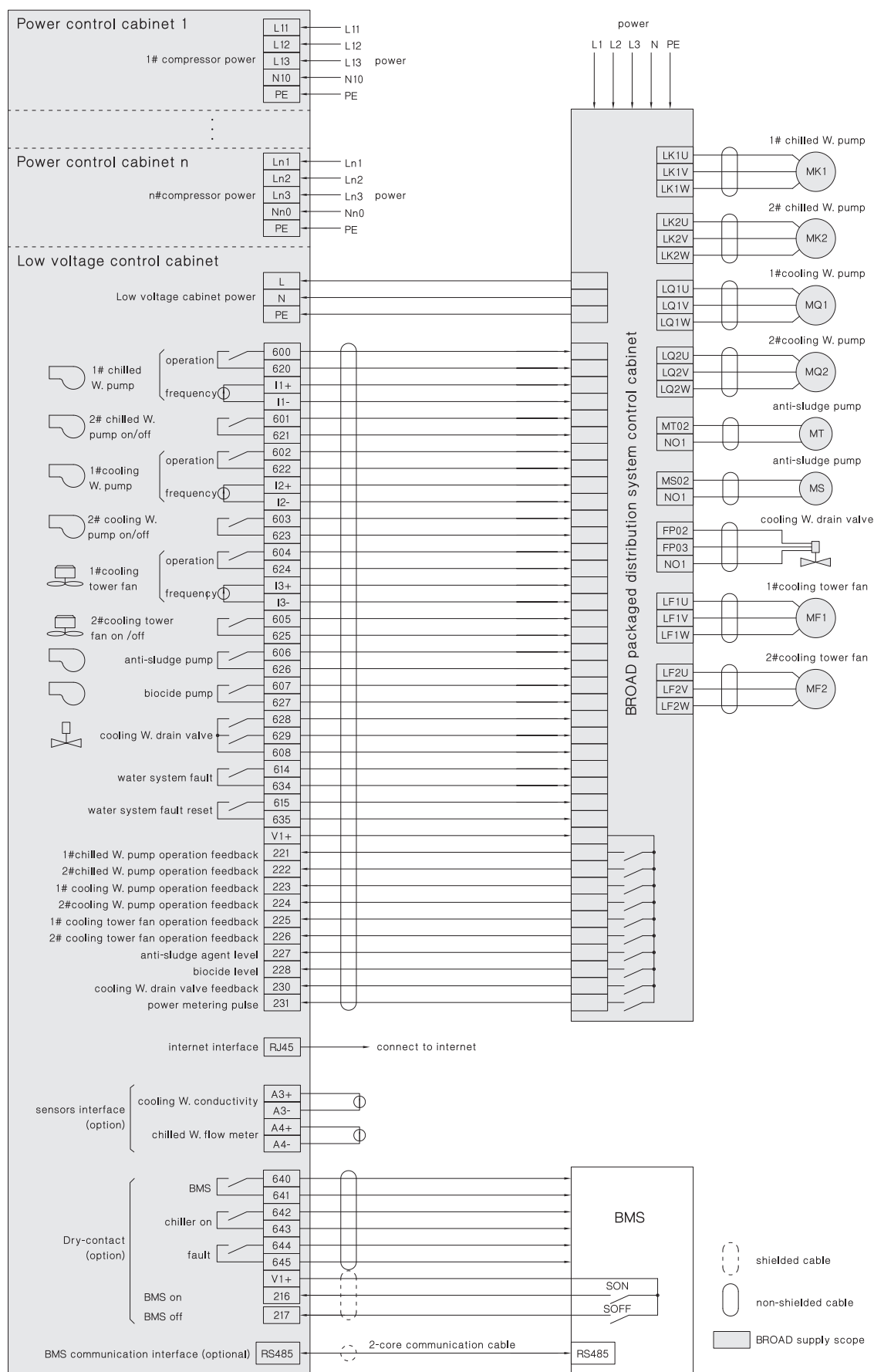
Notes:

1. BROAD packaged chiller control system includes interfaces for chiller / pumpset / cooling tower fan / internet / BMS etc
2. Pumpset and cooling tower control interface and water distribution system control cabinet are supplied with pumpset
3. BMS control interface includes Serial Communication and Dry Contact options. Serial Communication interface can be ModBus / ProfiBus / BACnet or Lonwork
4. Only control interfaces will be provided to customers who only order chiller without pumpset and cooling tower

cable:

power cable	—————
control wire	- - - - -
communication cable	—————
internet connection	~~~~~

Exterior Wiring Diagram



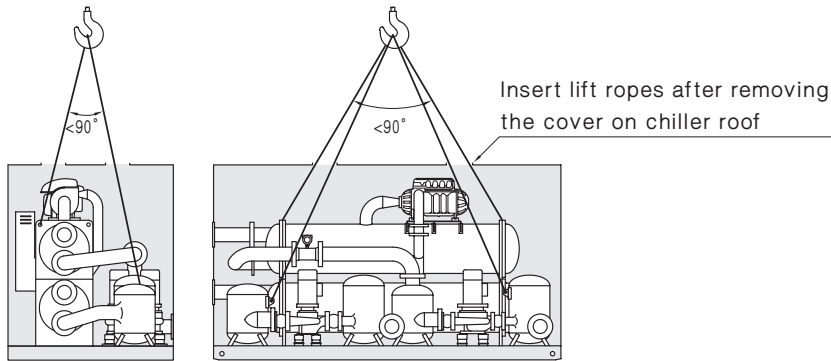
Notes:

1. Instead of a control cabinet, only control interfaces will be provided to customers who only order chiller without pumpset and cooling tower
2. DC4-20mA signal is provided for frequency control and sensors

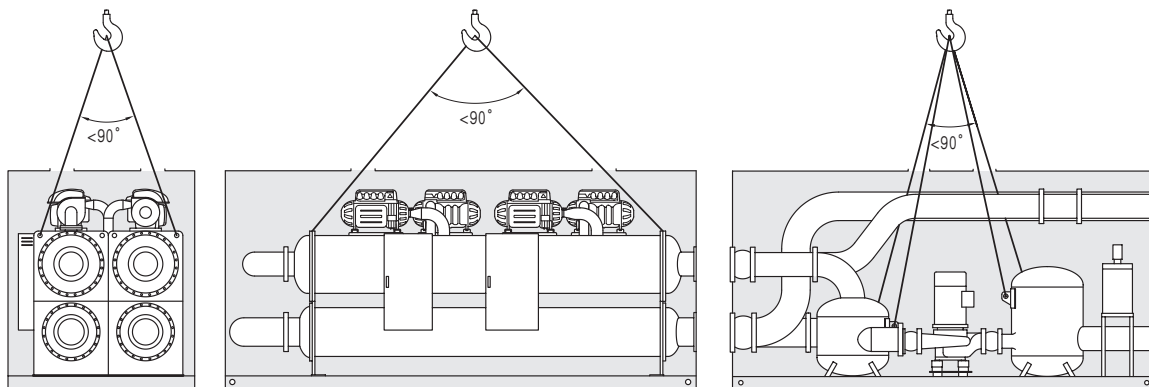
Lifting & Leveling Tips

1. Before the chiller is positioned, concrete foundation plinths must be molded and leveled. The level degree is $<1.5\%$, height of foundation is 4~8 inch. Then fix the chiller with anchor bolts on the foundation.
2. Lifting must be done by qualified lifting companies that are properly insured.
3. The crane must be supported by crossties and firm foundation to avoid sinking. Check the crane steel ropes and hooks before lifting to prevent any accident. The lifting intersection angle must be less than 90° . It is strictly prohibited to lift the chiller with a single steel rope. When the chiller is lifted 0.79 inch above the carriage or the ground, it should be kept for a little while. Lift the chiller slowly if everything is fine.
4. If limited by loading height, loading angle or machine room access, the professional lifting company must make special plan with BROAD team together to avoid any risk.
5. The landing of the chiller must be with care. Crash landing is strictly forbidden.
6. When moving the chiller, only round steels or thick steel tubes can be used as rollers instead of wooden sticks. Only drag the dragging hole on the rolling steel. Do not place forces on other part of the chiller. Lift the unit first with jacks under the rolling steel before rigging
7. After chiller positioning, please adjust leveling and lay thin steel plate where it is uneven to guarantee compact contact between the chiller and base. Take tube sheet as the leveling point and make front/rear and left/right leveling (check level height of every part by acrylic tube). It should be leveled within 1% both lengthwise and sidewise. Leveling must be done within 2 hours after locating the chiller; otherwise the chiller base will be damaged.
8. The chiller must be located levelly and its steel frame bases must match the plinth, the weight of the chiller must be evenly balanced on the plinth.
9. The chiller should be protected by full time personnel during transportation & installation. No access allowed for unauthorized persons. Valves of the chiller are forbidden to be screwed. If the machine room is still under construction, precautions are essential to avoid chiller get damaged or dirty. No scraping the paint or insulation layer.

Sketch of lifting



CY45/60/90/120/180 lifting sketch



CY240/360 chiller lifting sketch

CY240/360 pumpset lifting sketch

List of Control System Installation

Item	Object	Installation position and requirement	Material	Source	BROAD scope	Customer scope
Chiller	Chiller power	Chiller control cabinet and water system	5-core cable	Customer	/	Cable installation and wiring inside chiller control cabinet
	Touch screen	Built-in	/	BROAD	/	/
	Ambient temperature sensor	Ventilation and avoid direct sunlight	3-core shielded cable (33 ft standard supply)	BROAD	Wiring inside chiller control cabinet	Temperature sensor installation and cable installation
	Network monitor	Built-in	Network cable	Customer	Wiring inside chiller control cabinet	Cable installation Wiring at building side
	BMS interface (optional)	Chiller control cabinet	Communication cable (for serial communication), 11-core cable (for dry contact)	Customer	Wiring inside chiller control cabinet	Cable installation wiring at building side
	Chiller and pumpset grounding	Grounding resistance $\leq 4\Omega$	Grounding / wire	Customer	/	Grounding setup and wiring
Pumpset	Main power supply connection	Water distribution system control cabinet	5-core cable	Customer	Wiring inside chiller control cabinet	Cable installation
	Wire between chiller and water distribution system cabinet	Between chiller and water distribution system cabinet	Cable supply as per package chiller	BROAD	installation and wiring inside chiller control cabinet	/



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BROAD power-efficient chillers and packaged water distribution system are ISO, CE, ETL,



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