HEAT SOURCE UNITS

1. SPECIFICATIONS

Model			PQRY-P72TGMU-A	PQRY-P96TGMU-A
Power source			3-phase 3-wire 208-230 V 60Hz	
Cooling capacity (Nominal)	*1	BTU / h	72,000	96,000
	*1	kW	21.1	28.1
	Power input	kW	5.25	6.95
	Current input(208-230)	A	16.19 - 14.64	21.43 - 19.38
	COP (kW / kW)		4.01	4.04
Temp. range of cooling	Indoor		59 to 75 degFW.B. (15 to 24 degCW.B.)	
	Circulating water		50 to 113 degF (10 to 45 degC)	
Heating capacity (Nominal)	*2	BTU / h	85,000	107,000
	*2	kW	24.9	31.4
	Power input	kW	5.44	6.84
	Current input(208-230)	A	16.77 - 15.17	21.09 - 19.07
	COP (kW / kW)		4.57	4.59
Temp. range of heating	Indoor		59 to 81 degFD.B. (15 to 27 degCD.B.)	
	Circulating water		50 to 113 degF (10 to 45 degC) 59 to 113 degF (15 to 45degC) when total indoor unit capacity exceeds 130% of the heat source uint.	
Indoor unit connectable	Total capacity		50-150% of outdoor unit capacity	50-150% of outdoor unit capacity
	Model / Quantity		P06-P96 / 1-15	P06-P96 / 1-19
Sound pressure level (measured in anechoic room)		dB <A>	46	47
Diameter of refrigerant pipe (O.D.)	Liquid (High press.)	in. (mm)	5/8 (15.88) Brazed	3/4 (19.05) Brazed
	Gas (Low press.)	in. (mm)	3/4 (19.05) Brazed	7/8 (22.2) Brazed
External finish			Steel plate -	
External dimension H x W x D		in.	70-7/8 x 39 x 21-21/32	70-7/8 x 39 x 21-21/32
		mm	1,800 x 990 x 550	1,800 x 990 x 550
Net weight		lbs(kg)	567 (257)	574 (260)
Heat exchanger			Tube-in-tube coil	Tube-in-tube coil
	Water volume in coil	G	2.51	2.77
		L	9.5	10.5
	Water pressure Max.	psi	145	145
		MPa	1.0	1.0
Compressor	Type		Inverter scroll hermetic comp.	Inverter scroll hermetic comp.
	Manufacturer		AC&R Works,MITSUBISHI ELECTRIC CORPORATION	
	Starting method		Inverter	Inverter
	Motor output	kW	5.0	6.0
	Case heater	kW	0.057(230V)	0.057(230V)
	Lubricant		MEL32	MEL32
Circulating Water	Water flow rate	G/h	1,204	1,521
		G/min	20.1	25.4
		m3 / h	4.56	5.76
		L/min	76	96
		cfm	2.7	3.4
	Pressure drop	kPa	16.5	19.5
		psi	2	3
	Operation volume range	G/h	1,030-1,795	1,188-1,901
		G/min	17.2-29.9	19.8-31.7
		m3 / h	3.9-6.8	4.5-7.2
HIC circuit (HIC: Heat Inter-Changer)			-	
Protection	High pressure protection		High pressure sensor, High pressure switch 601 psi (4.15 MPa)	
	Inverter circuit (COMP.)		Over-current protection,Over-heat protection	
	Compressor		Over-current protection,Over-heat protection	
Refrigerant	Type x Original charge	lbs + oz (kg)	R410A x (16 lbs + 9 oz) (7.5kg)	R410A x (18 lbs + 12 oz) (8.5kg)
	Control		indoor LEV and BC controller	
Drawing	External		W663170	
	Wiring		W274673	
	Refrigerant circuit		-	
Standard attachment	Document		Installation Manual	
	Accessory			
Optional parts			Joint : CMY-Y102S-G,CMY-R160-J BC controller: CMB-P104,105,106,108,1010,1013,1016-G Main BC controller:CMB-P108,1010,1013,1016-GA Sub BC controller: CMP-P104,108V-GB	
Remark			Details on foundation work,duct work,insulation work,electrical wiring,power source switch,and other items shall be re-ferred to the Installation Manual.	

Note :	*1 Nominal cooling conditions	*2 Nominal heating conditions	Unit converter
Indoor :	80degF D.B. / 67degF W.B.	70degF D.B.	kcal/h = kW x 860
	(26.7degC D.B. / 19.4degC W.B.)	(21.1degC D.B.)	BTU/h = kW x 3,412
Water temperature :	85degF	70degF	cfm = m3/min x 35.31
	(29.4degC)	(21.1degC)	lbs = kg / 0.4536
Pipe length :	25 ft. (7.6 m)	25 ft. (7.6 m)	psi=MPa x 145.038
Level difference :	0 ft. (0 m)	0 ft. (0 m)	G(us)=L x 0.2642
			*Above specification data is subject to rounding variation.

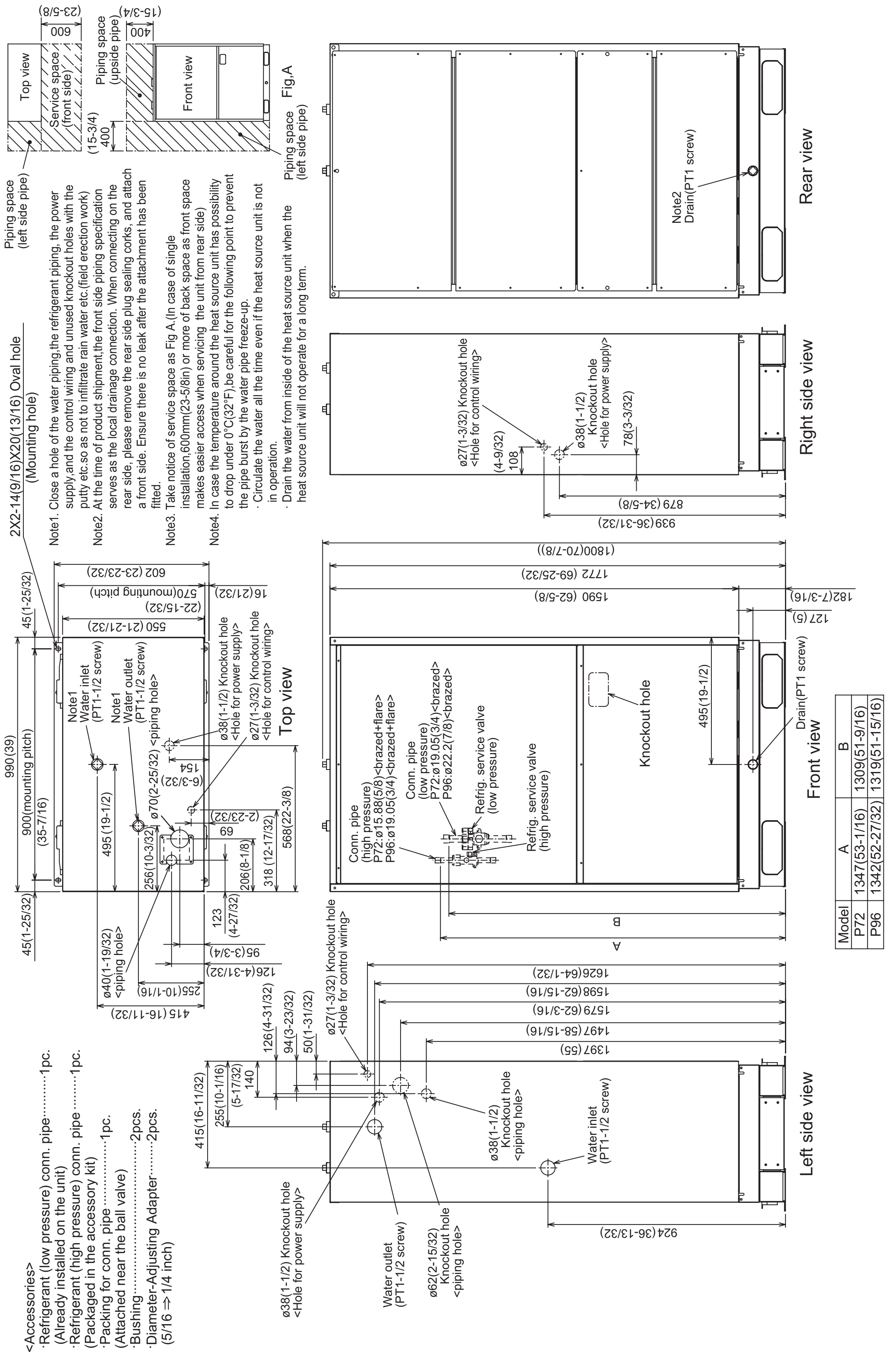
*Due to continuing improvement, above specification may be subject to change without notice.

Ref.: Spec_PQRY-P72-96TGMU

WR2

PQRY-P72,96TGMU-A

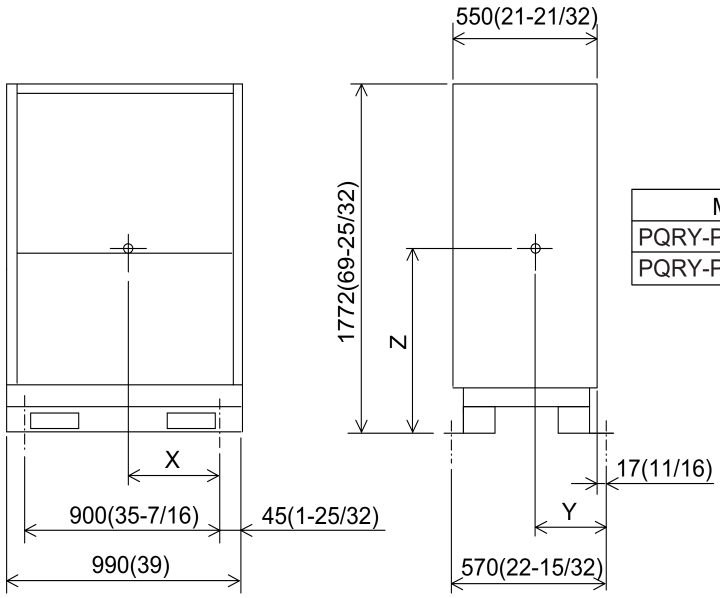
Drw. : PQRY-TGMU_W663170
Unit : mm(in)



WR2

PQRY-P72, 96TGMU-A

Unit : mm[in.]



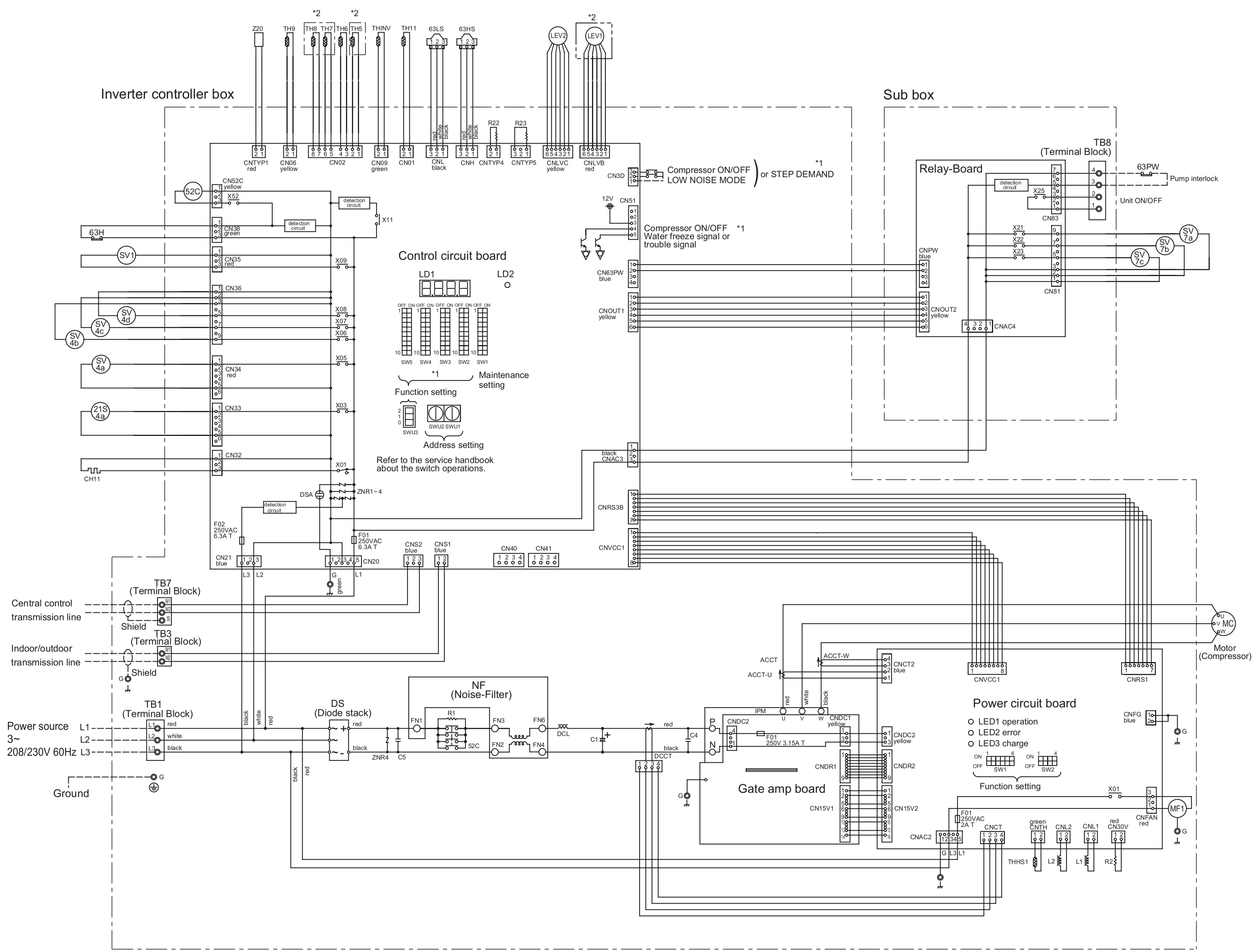
Model	X	Y	Z
PQRY-P72TGMU-A	535(21-1/8)	215(8-1/2)	735(28-15/16)
PQRY-P96TGMU-A	535(21-1/8)	215(8-1/2)	745(29-3/8)

Ref. : PQRY_TGMU_COG_USDB_ALL

WR2

PQRY-P72,96TGMU-A

Drw. :PQRY-TGMU_W274673



< Symbol explanation >

Symbol		Name
ACCT		AC Current Sensor
DCCT		DC Current Sensor
DCL		DC reactor (Power factor improvement)
52C		Magnetic contactor (Inverter main circuit)
MF1		Fan motor (Radiator panel)
CH11		Crank case heater (Compressor)
21S4a		4-way valve
SV1		Solenoid valve (Discharge-suction bypass)
SV4a,b,c,d		Solenoid valve (Heat exchanger capacity control)
SV7a,b,c		Solenoid valve (Heat exchanger capacity control)
LEV1		Electronic expansion valve (Sub-cool coil bypass)
LEV2		Electronic expansion valve (Heat exchanger for inverter)
TH11	Thermistor	Discharge pipe temp. detect
TH5	Thermistor	Pipe temp.detect
TH6	Thermistor	Water temp.detect
TH7	Thermistor	Liquid outlet temp.detect at sub-coolcoil
TH8	Thermistor	Bypass outlet temp.detect at sub-coolcoil
TH9	Thermistor	Freeze prevention sensor
THINV	Thermistor	Outlet temp.detect of heat exchanger for inverter
THHS1	Thermistor	Radiator panel temp. detect
63H		High pressure switch
63HS		High pressure sensor
63LS		Low pressure sensor
L1,L2		Choke coil (Transmission)
Z20		Function device
⏚		Ground terminal

< Difference of appliance >

○:exist X:not exist

Model name	*2
PQRY-P72/P96TGMU-A	×
PQHY-P72/P96TGMU-A	○

*1: Function according to switch operation. (SW4-7,CN3D 1-2P,and CN3D 1-3P, SW3-3:CN51 3-5P)

SW4-7:OFF (Compressor ON/OFF and LOW NOISE MODE)

CN3D 1-3P	Compressor ON/OFF
OPEN	ON
SHORT	OFF

CN3D 1-2P	LOW NOISE MODE
OPEN	OFF
SHORT	ON

SW4-7:ON (STEP DEMAND)

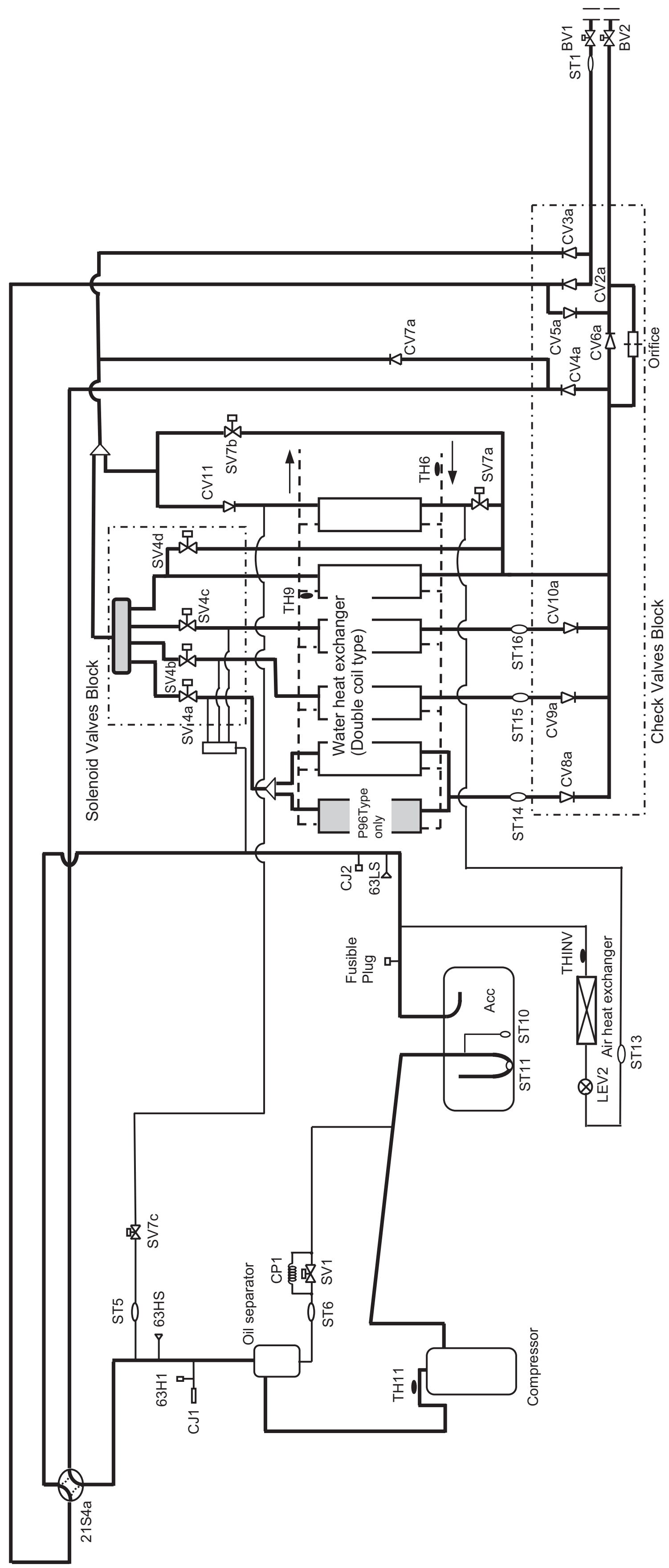
CN3D 1-3P \ CN3D 1-2P	OPEN	SHORT
OPEN	100%	75%
SHORT	0%	50%

SW3-3	CN51 3-5P
ON	water freeze signal
OFF	trouble signal

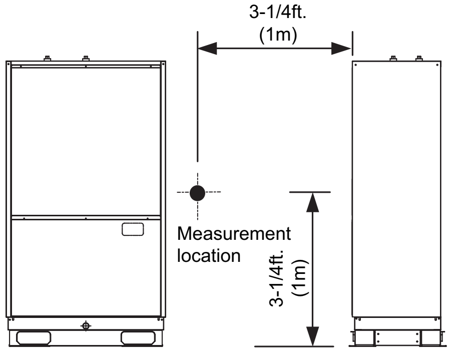
NOTE:The broken lines indicate field wiring.

5. REFRIGERANT CIRCUIT DIAGRAMS

(1) PQRY-P72, P96 TGMU-A

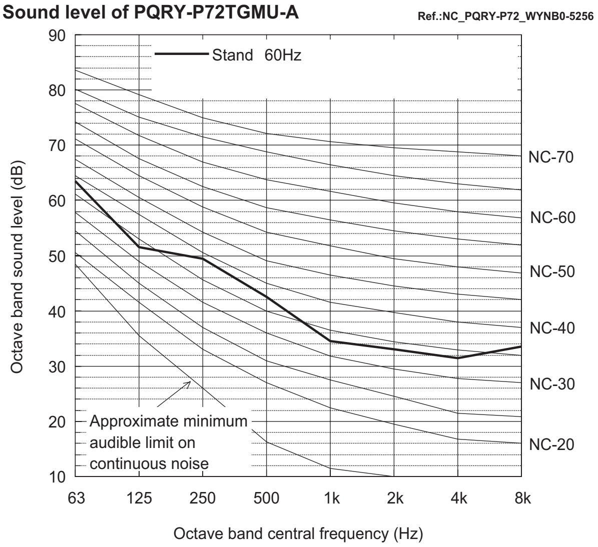


Measurement condition
PQRY-P72,96TGMU-A



Sound level of PQRY-P72TGMU-A

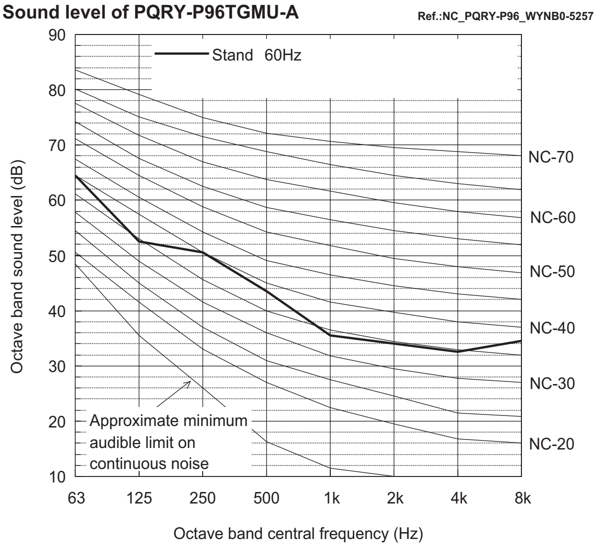
Ref.:NC_PQRY-P72_WYNB0-5256



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	60Hz	63.5	51.5	49.5	42.5	34.5	33.0	31.5	33.5	46.0

Sound level of PQRY-P96TGMU-A

Ref.:NC_PQRY-P96_WYNB0-5257



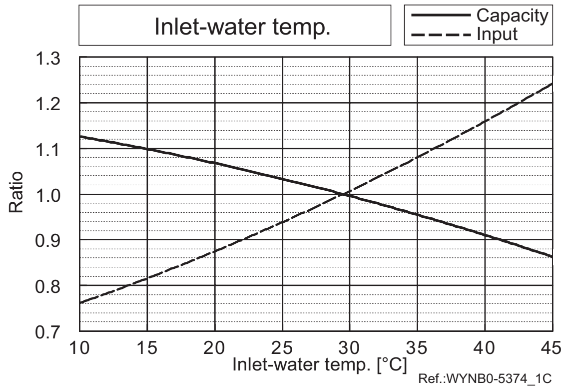
		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	60Hz	64.5	52.5	50.5	43.5	35.5	34.0	32.5	34.5	47.0

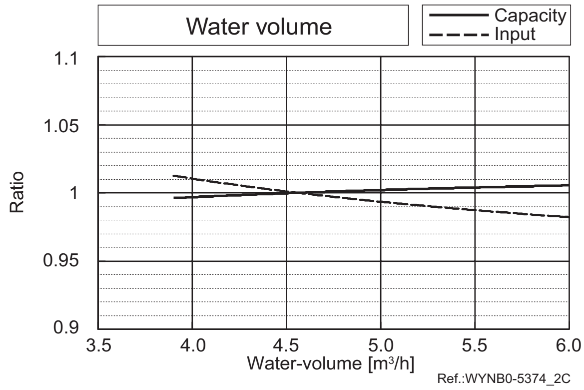
WR2

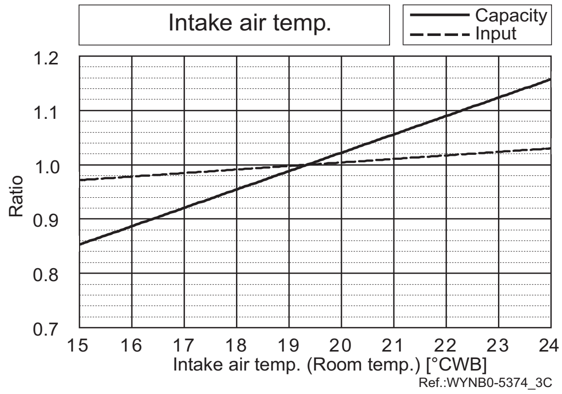
7-1. Correction by temperature

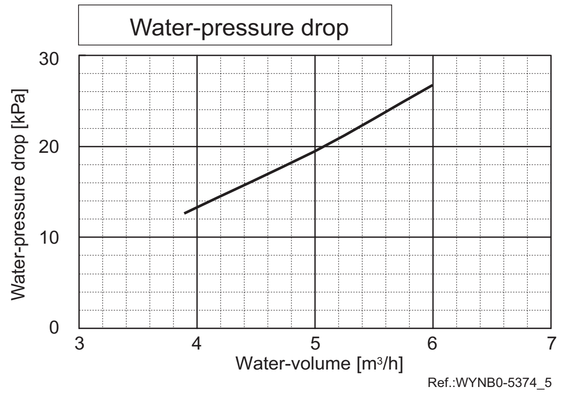
CITY MULTI could have various capacities at different designing temperatures. Using the nominal cooling/heating capacity values and the ratios below, the capacity can be found for various temperatures.

PQRY-		P72TGMU
Nominal Cooling Capacity	kW	21.1
	BTU/h	72,000
Input	kW	5.25



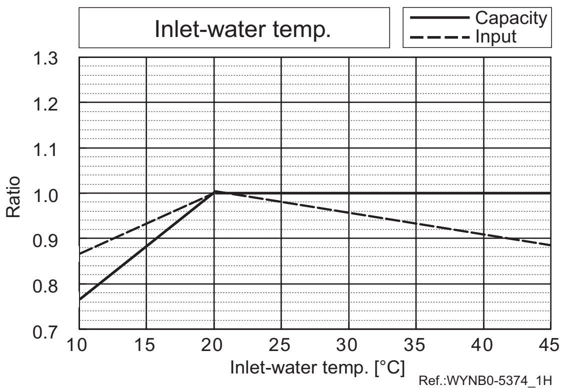


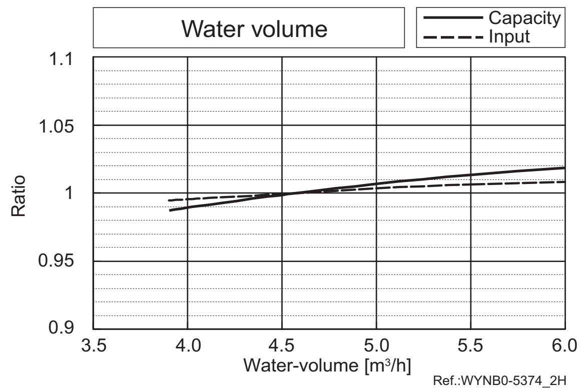


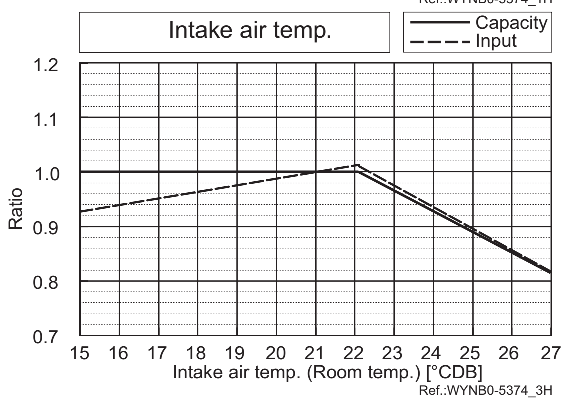


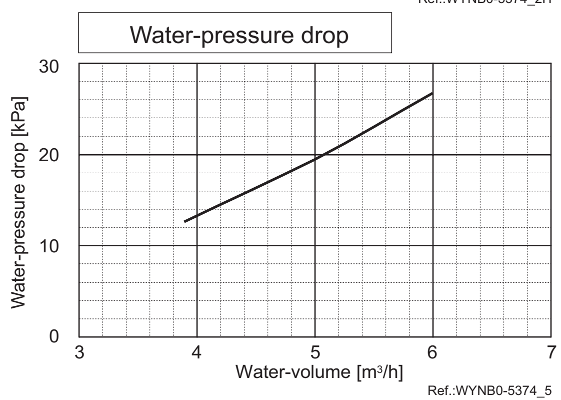
WR2

PQRY-		P72TGMU
Nominal Heating Capacity	kW	24.9
	BTU/h	85,000
Input	kW	5.44

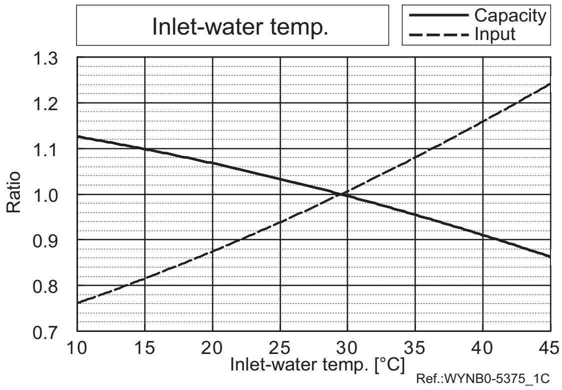


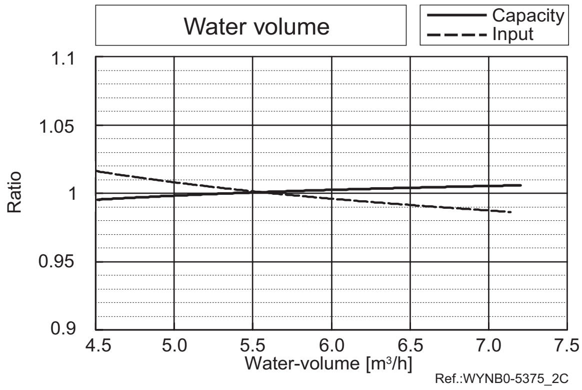


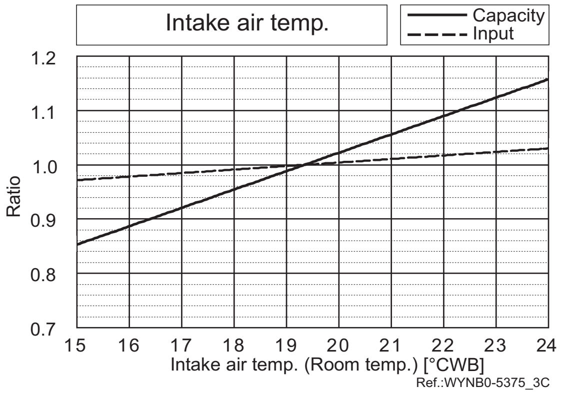


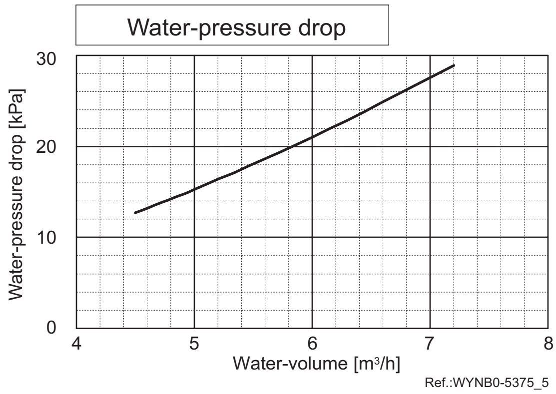


PQRY-		P96TGMU
Nominal Cooling Capacity	kW	28.1
	BTU/h	96,000
Input	kW	6.95



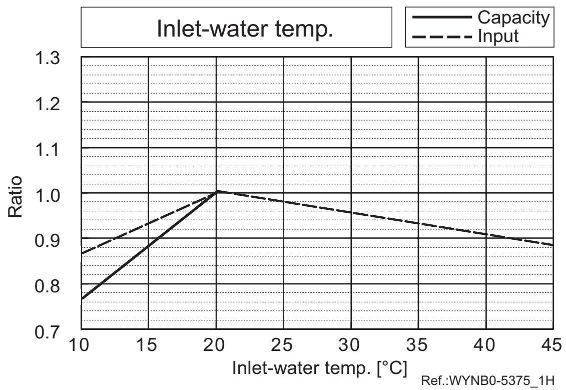


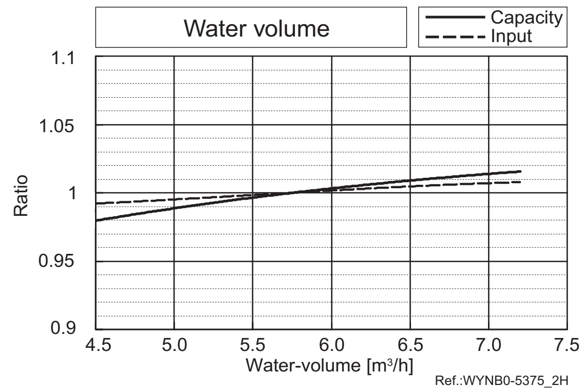


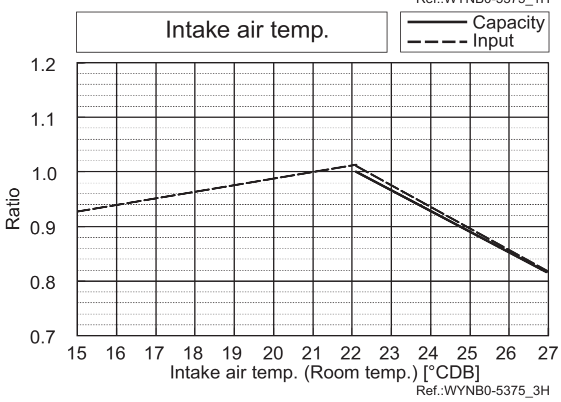


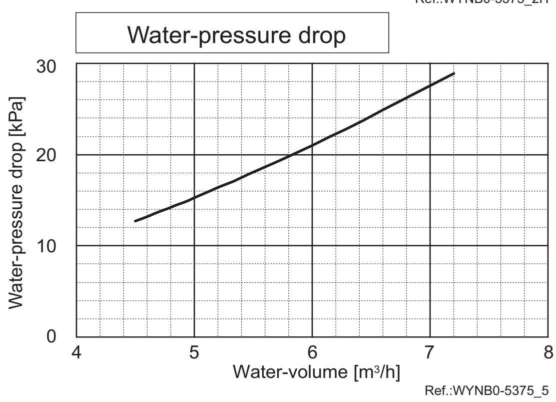
WR2

PQRY-		P96TGMU
Nominal Heating Capacity	kW	31.4
	BTU/h	107,000
Input	kW	6.84

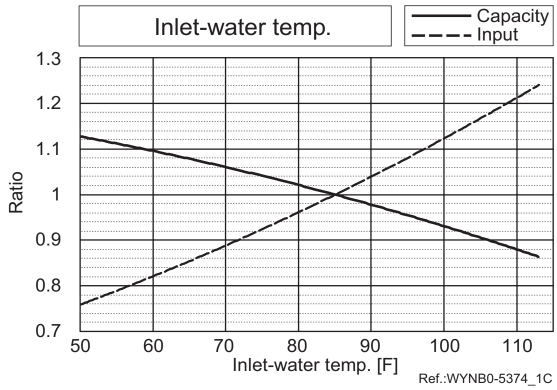


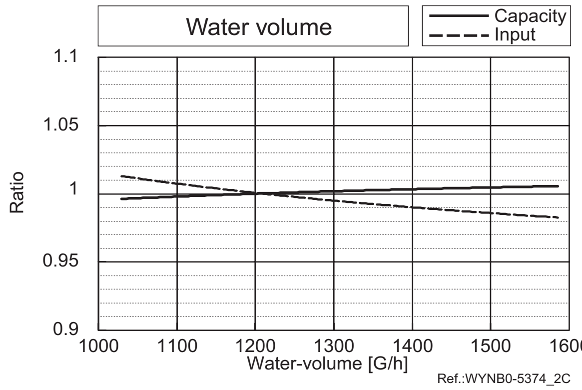


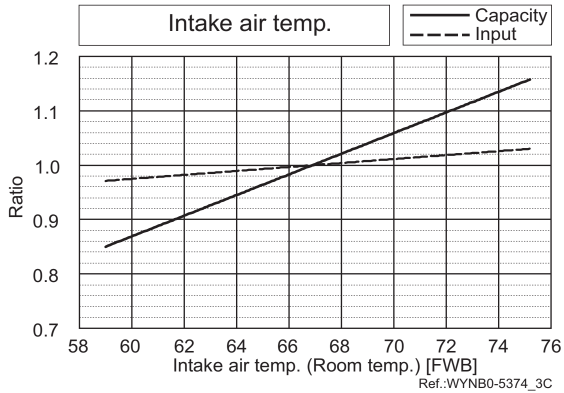


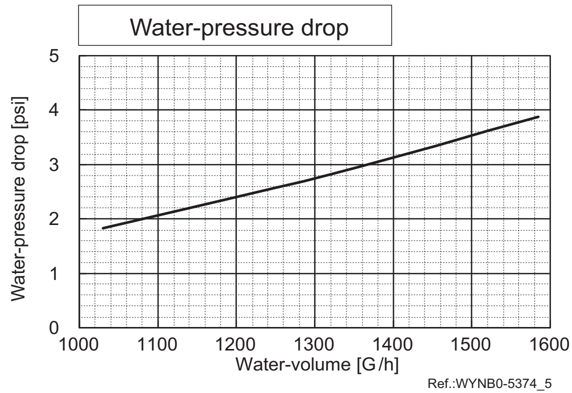


PQRY-		P72TGMU
Nominal Cooling Capacity	kW	21.1
	BTU/h	72,000
Input	kW	5.25



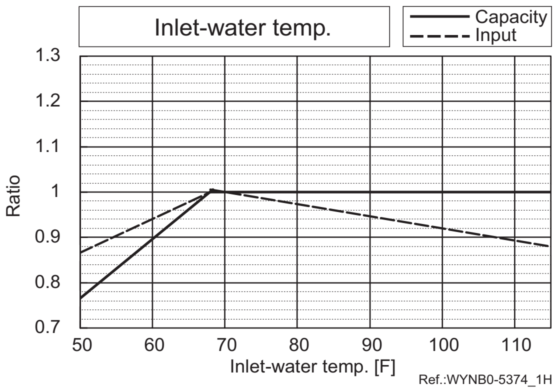


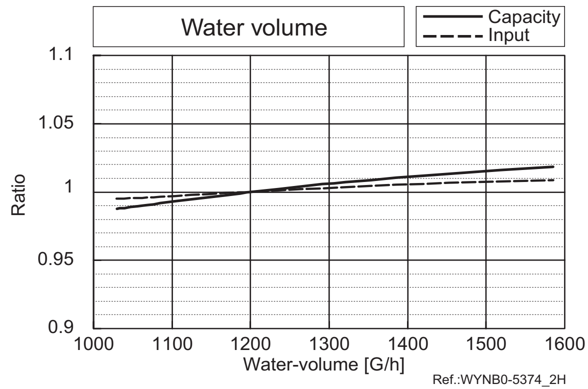


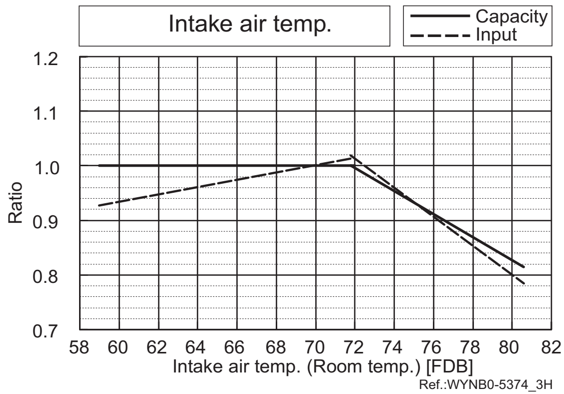


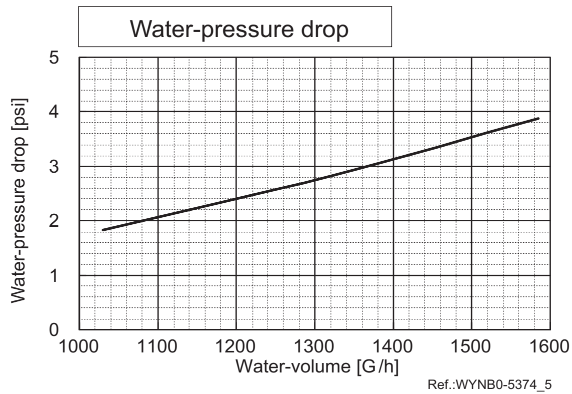
WR2

PQRY-		P72TGMU
Nominal Heating Capacity	kW	24.9
	BTU/h	85,000
Input	kW	5.44

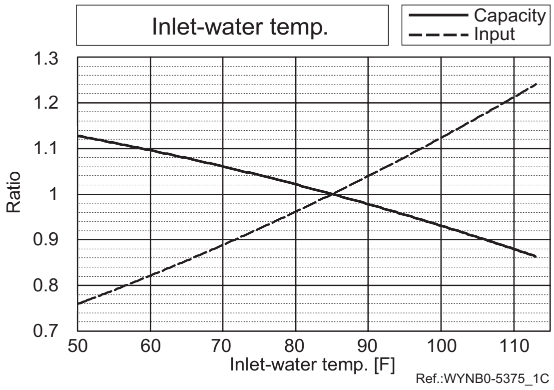


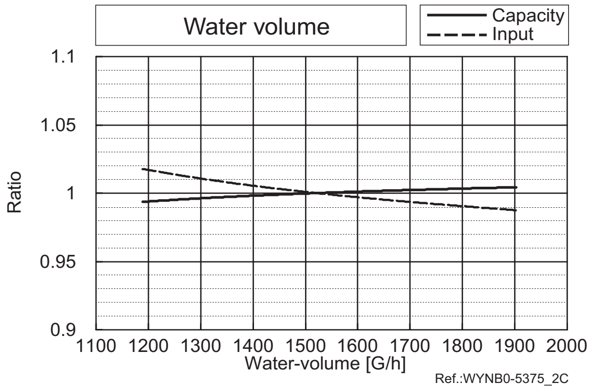


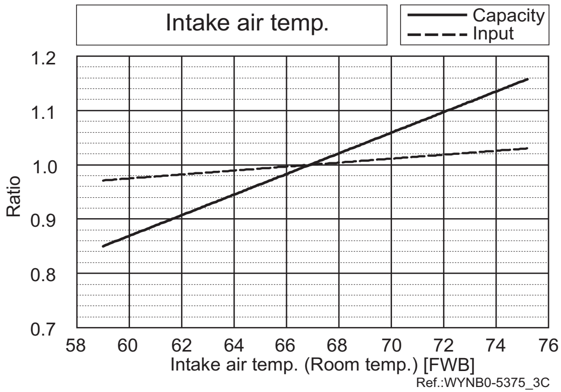


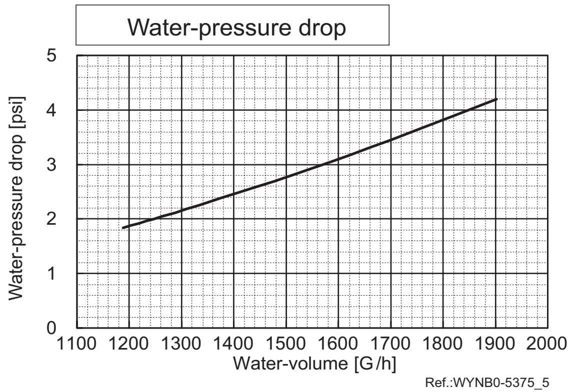


PQRY-		P96TGMU
Nominal Cooling Capacity	kW	28.1
	BTU/h	96,000
Input	kW	6.95

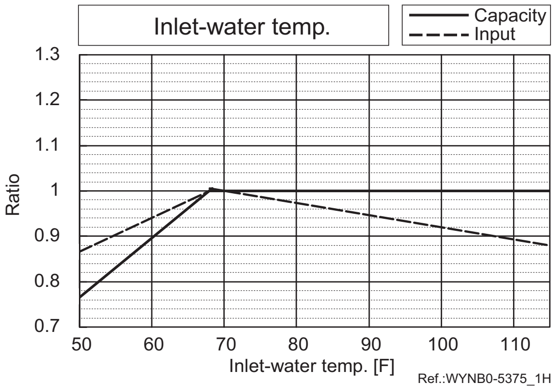


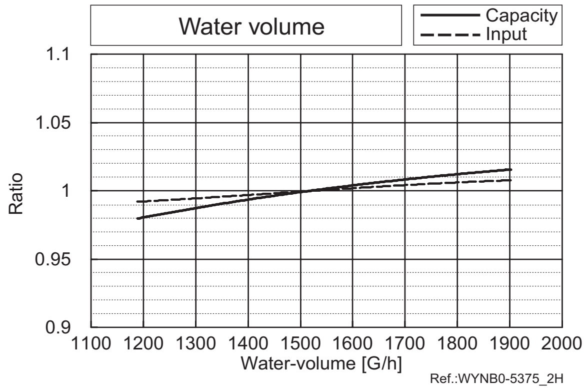


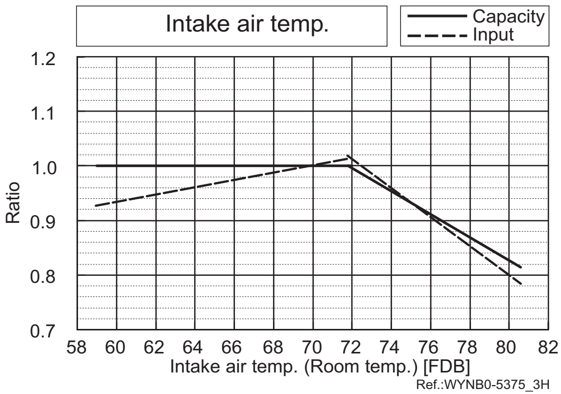


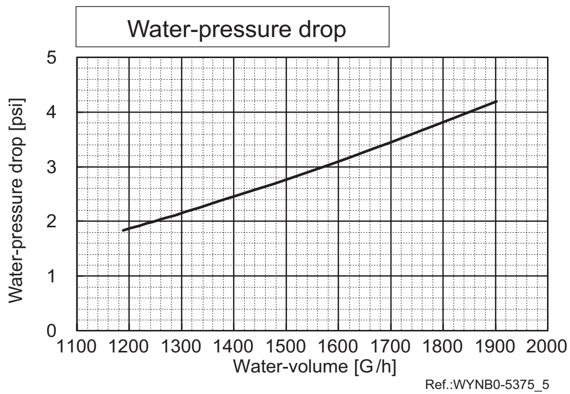


PQRY-		P96TGMU
Nominal Heating Capacity	kW	31.4
	BTU/h	107,000
Input	kW	6.84





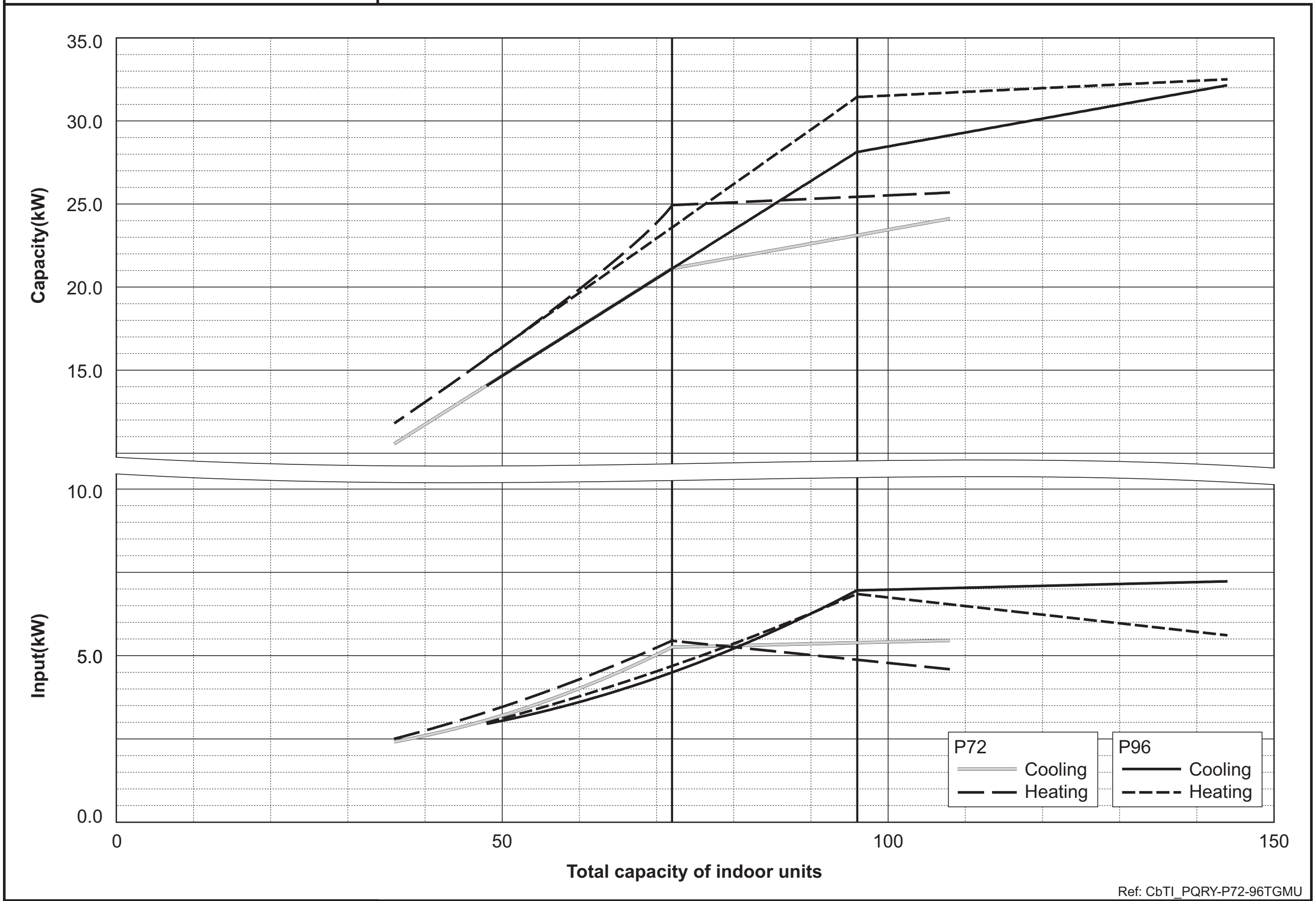




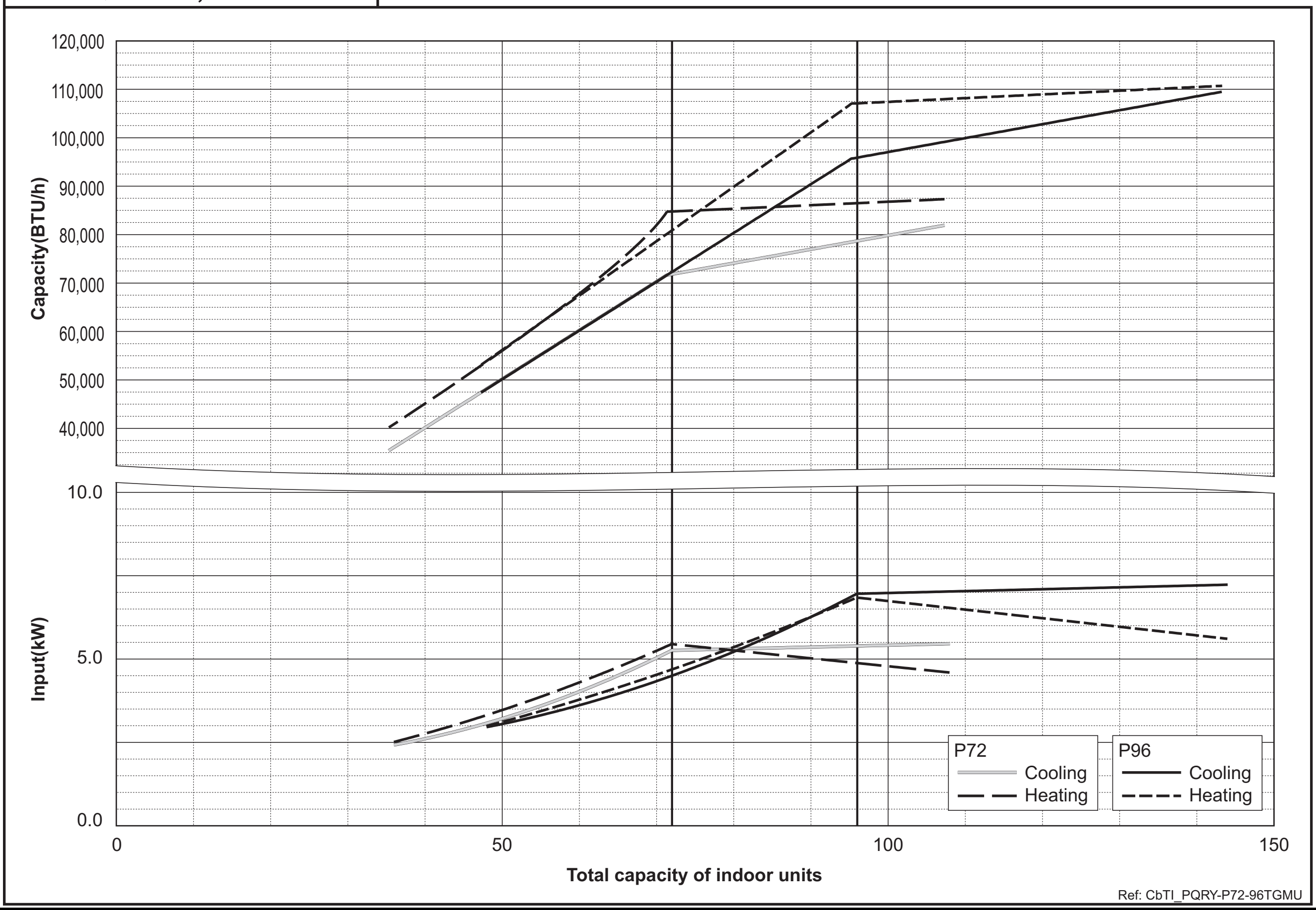
7-2. Correction by total indoor

CITY MULTI system have different capacities and inputs when many combinations of indoor units with different total capacities are connected. Using following tables, the maximum capacity can be found to ensure the system is installed with enough capacity for a particular application.

PQRY-P72,96TGMU



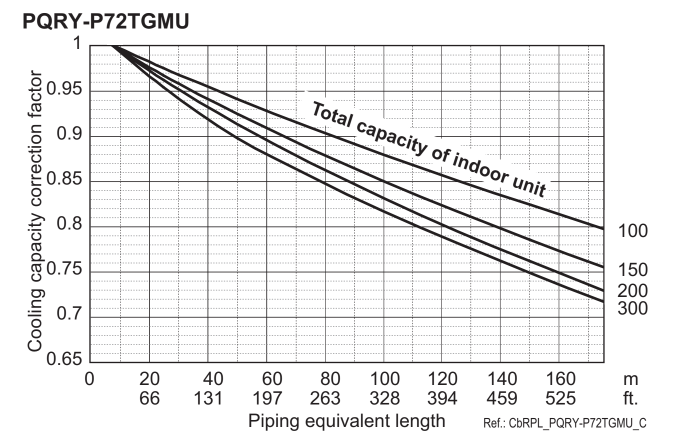
PQRY-P72,96TGMU

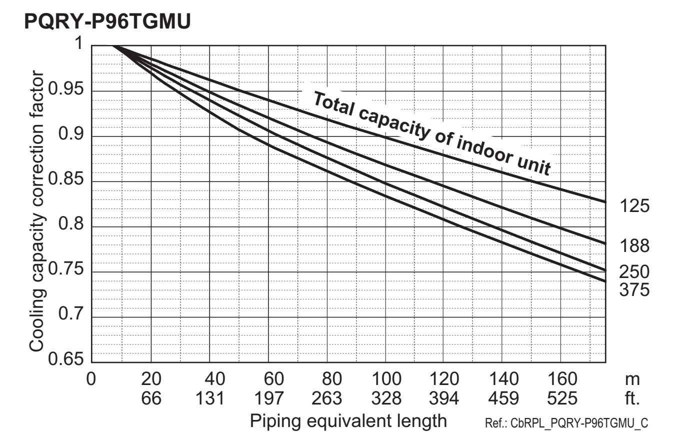


7-3. Correction by refrigerant piping length

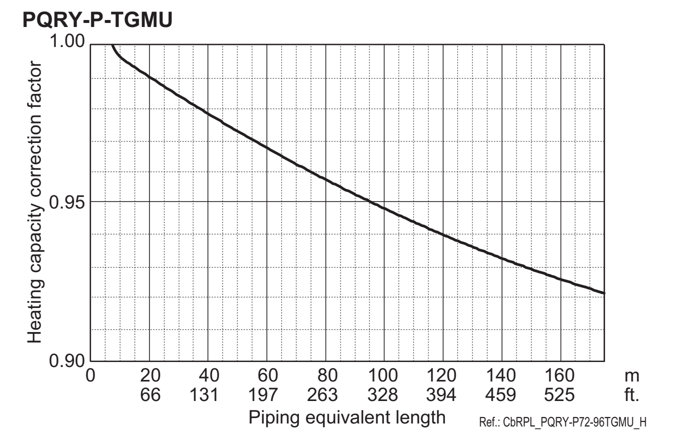
CITY MULTI systems can have extended piping lengths if certain limitations are followed, but cooling/heating capacity could be reduced. Using following correction factor by equivalent piping length shown at 7-3-1 and 7-3-2, capacity can be found. 7-3-3 shows how to obtain the equivalent piping length.

7-3-1. Cooling capacity correction





7-3-2. Heating capacity correction



7-3-3. How to obtain the equivalent piping length

1 PQHY, PQRY-P72TGMU

Equivalent length = (Actual piping length to the farthest indoor unit) + (0.35 x number of bends in the piping) m
+ (1.15 x number of bends in the piping) ft.

2 PQHY, PQRY-P96TGMU

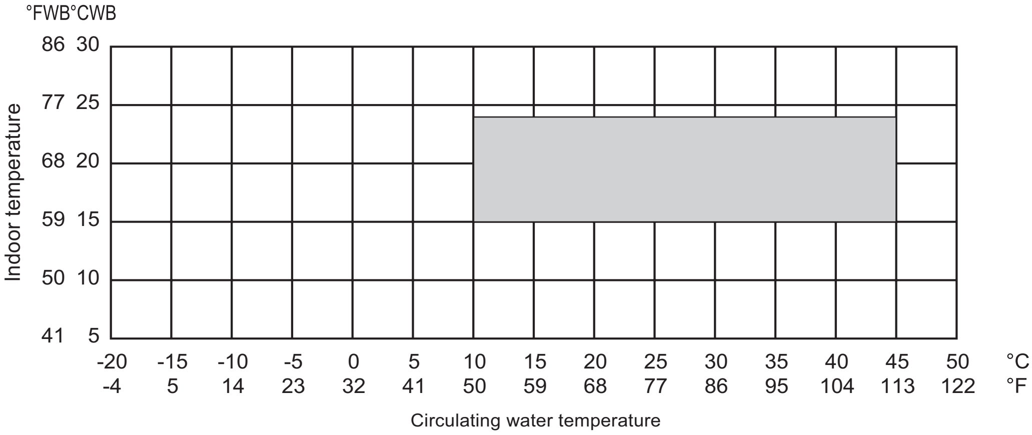
Equivalent length = (Actual piping length to the farthest indoor unit) + (0.42 x number of bends in the piping) m
+ (1.38 x number of bends in the piping) ft.

Ref.: EPL_TGMU

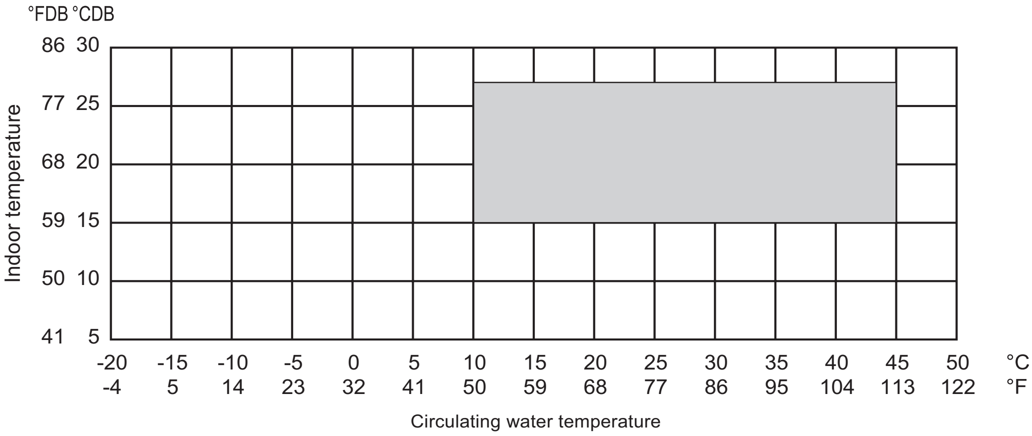
WR2

7-4. Operation temperature range

• Cooling



• Heating



59 to 113 degF (15 to 45degC) when total indoor unit capacity exceeds 130% of the heat source uint.

Ref.: tr-ygm-w

8-1. Designing of water circuit system

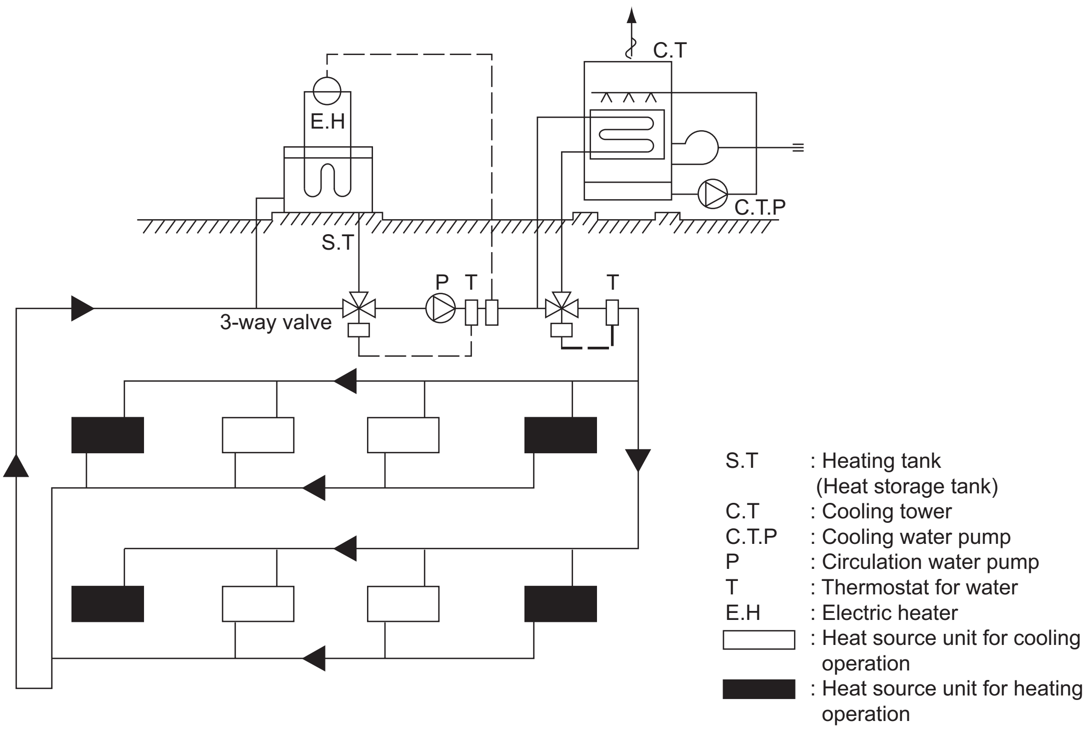
1) Example of basic water circuit

The water circuit of the water heat source CITY MULTI connects the heat source unit with the cooling tower/auxiliary heat source/heat storage tank/circulation pump with a single system water piping as shown in the figure below. The selector valve automatically controls to circulate water toward the cooling tower in the cooling season, while toward the heat storage tank in the heating season. If the circulation water temperature is kept in a range of 10~45°C[50~113°F]* regardless of the building load, the water heat source CITY MULTI can be operated for either cooling or heating. Therefore in the summer when only cooling load exists, the temperature rise of circulation water will be suppressed by operating the cooling tower. While in the winter when heating load increases, the temperature of circulation water may be dropped below 10°C[50°F]. Under such situation, the circulation water will be heated with the auxiliary heat source if it drops below a certain temperature.
When the thermal balance between cooling and heating operation is in a correct proportion, the operation of the auxiliary heat source and cooling tower is not required.
In order to control the above thermal balance properly and use thermal energy effectively, utilizing of heat storage tanks, and night-time discounted electric power as a auxiliary heat source will be economical.
Meantime as this system uses plural sets of heat source unit equipped with water heat exchangers, water quality control is important. Therefore it is recommended to use closed type cooling towers as much as possible to prevent the circulation water from being contaminated.
When open type cooling towers are used, it is essential to provide proper maintenance control such as that to install water treatment system to prevent troubles caused by contaminated circulation water.

*15~45°C[59~113°F] : 50%~150% of indoor units can be connected
*10~40°C[50~113°F] : 50%~130% of indoor units can be connected

WR2

Example of basic water circuit for water heat source CITY MULTI



The indoor unit and refrigerant piping system are excluded in this figure.

2) Cooling tower

a) Types of cooling tower

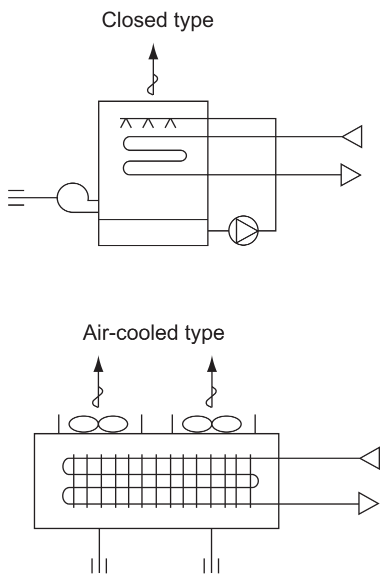
The cooling towers presently used include the open type cooling tower, open type cooling tower + heat exchanger, closed type cooling tower, and air-cooled type cooling tower. However, as the quality control of circulation water is essential when units are installed in decentralized state inside a building, the closed type cooling tower is generally employed in such case.

Although the circulation water will not be contaminated by atmospheric air, it is recommended to periodically blow water inside the system and replenish fresh water instead.

In a district where the coil may be frozen in the winter, it is necessary to apply antifreeze solution to the circulation water, or take freeze protection measures such as to automatically discharge water inside the cooling coil at the stopping of the pump.

When the open type cooling tower is used, be sure to install a water quality control device in addition to the freeze protection measures, as the water may be deteriorated by atmospheric contaminants entered into the cooling tower and dissolved into the circulation water.

Types of cooling towers



b) Calculation method of cooling tower capacity

All units of the water heat source CITY MULTI may possibly be in cooling operation temporarily (at pulling down) in the summer, however, it is not necessary to determine the capacity according to the total cooling capacity of all CITY MULTI units as this system has a wide operating water temperature range

(15~45°C[59~113°F] : 130% over
10~45°C[50~113°F] : 130% or less).

It is determined in accordance with the value obtained by adding the maximum cooling load of an actual building, the input heat equivalent value of all CITY MULTI units, and the cooling load of the circulating pumps. Please check for the values of the cooling water volume and circulation water volume.

$$\text{Cooling tower capacity} = \frac{Qc + 860 \times (\Sigma Qw + Pw)}{3{,}900} \text{ (Refrigeration ton)}$$

Qc : Maximum cooling load under actual state (kcal/h)
Qw : Total input of water heat source CITY MULTI at simultaneous operation under maximum state (kW)
Pw : Shaft power of circulation pumps (kW)

$$\text{Cooling tower capacity} = \frac{Qc + 3{,}412 \times (\Sigma Qw + Pw)}{15{,}500} \text{ (Refrigeration ton)}$$

Qc : Maximum cooling load under actual state (BTU/h)
Qw : Total input of water heat source CITY MULTI at simultaneous operation under maximum state (kW)
Pw : Shaft power of circulation pumps (kW)

* 1 Refrigerant ton of cooling tower capacity ≈ US refrigerant ton x (1+0.3)
= 3,900 kcal/h = 15,500 BTU/h

3) Auxiliary heat source and heat storage tank

When the heating load is larger than the cooling load, When the heating load is larger than the cooling load, the circulation water temperature lowers in accordance with the heat balance of the system. It should be heated by the auxiliary heat source in order to keep the inlet water temperature within the operating range

(15°C[59°F] or more : 130% over
10°C[50°F] or more : 130% or less)

of the water heat source CITY MULTI.

Further in order to operate the water heat source CITY MULTI effectively, it is recommended to utilize the heat storage tank to cover the warming up load in the morning and the insufficient heat amount.

Effective heat utilization can be expected to cover insufficient heat at the warming up in the next morning or peak load time by storing heat by installing a heat storage tank or operating a low load auxiliary heat source at the stopping of the water heat source CITY MULTI. As it can also be possible to reduce the running cost through the heat storage by using the discounted night-time electric power, using both auxiliary heat source and heat storage tank together is recommended.

The effective temperature difference of an ordinary heat storage tank shows about 5deg. even with the storing temperature at 45°C[113°F].

However with the water heat source CITY MULTI, it can be utilized as heating heat source up to 15°C[59°F] with an effective temperature of a high 30deg°C[54deg°F]. approximately, thus the capacity of the heat storage tank can be minimized.

a) Auxiliary heat source

The following can be used as the auxiliary heat source.

- Boiler (Heavy oil, kerosine, gas, electricity)
- Electric heat (Insertion of electric heater into heat storage tank)
- Outdoor air (Air-heat source heat pump chiller)
- Warm discharge water (Exhaust water heat from machines inside building and hot water supply)
- Utilization of night-time lighting
- Solar heat

Please note that the auxiliary heat source should be selected after studying your operating environment and economical feasibility.

WR2

Determining the auxiliary heat source capacity

For the CITY MULTI water heat source system, a heat storage tank is recommended to use. When employment of the heat storage tank is difficult, the warming up operation should be arranged to cover the starting up heating load. Since the holding water inside the piping circuit owns heat capacity and the warming up operation can be assumed for about one hour except that in a cold region, the heat storage tank capacity is required to be that at the maximum daily heating load including the warming up load at the next morning of the holiday. However the auxiliary heat source capacity should be determined by the daily heating load including warming up load on the week day.

For the load at the next morning of the holiday, heat storage is required by operating the auxiliary heat source even outside of the ordinary working hour.

When heat storage tank is not used

$$QH = HC_T \left(1 - \frac{1}{COP_h}\right) - 1000 \times Vw \times \Delta T - 860 \times Pw$$

QH	: Auxiliary heat source capacity	(kcal/h)
HC_T	: Total heating capacity of each water heat source CITY MULTI	(kcal/h)
COP_H	: COP of water heat source CITY MULTI at heating	
V_W	: Holding water volume inside piping	(m^3)
ΔT	: Allowable water temperature drop = $T_{WH} - T_{WL}$	(°C)
T_{WH}	: Heat source water temperature at high temperature side	(°C)
T_{WL}	: Heat source water temperature at low temperature side	(°C)
P_W	: Heat source water pump shaft power	(kW)

$$QH = HC_T \left(1 - \frac{1}{COP_h}\right) - 8.343 \times Vw \times \Delta T - 3412 \times Pw$$

QH	: Auxiliary heat source capacity	(BTU/h)
HC_T	: Total heating capacity of each water heat source CITY MULTI	(BTU/h)
COP_H	: COP of water heat source CITY MULTI at heating	
V_W	: Holding water volume inside piping	(G)
ΔT	: Allowable water temperature drop = $T_{WH} - T_{WL}$	(°F)
T_{WH}	: Heat source water temperature at high temperature side	(°F)
T_{WL}	: Heat source water temperature at low temperature side	(°F)
P_W	: Heat source water pump shaft power	(kW)

When heat storage tank is not used

$$QH = \frac{HQ_{1T} \cdot \left(1 - \frac{1}{COP_h}\right) - 860 \times Pw \times T_2}{T1} \times K \qquad \text{(kcal)}$$

QH_{1T}	: Total of heating load on weekday including warming up	(kcal/day)
T_1	: Operating hour of auxiliary heat source	(h)
T_2	: Operating hour of heat source water pump	(h)
K	: Allowance factor (Heat storage tank, piping loss, etc.)	1.05~1.10

HQ_{1T} is calculated from the result of steady state load calculation similarly by using the equation below.

$$HQ_{1T} = 1.15 \times (\Sigma Q'a + \Sigma Q'b + \Sigma Q'c + \Sigma Q'd + \Sigma Q'f)\, T_2 - \psi\, (\Sigma Qe_1 + \Sigma Qe_2 + \Sigma Qe_3)\, (T2 - 1)$$

Q'a	: Thermal load from external wall/roof in each zone	(kcal/h)
Q'b	: Thermal load from glass window in each zone	(kcal/h)
Q'c	: Thermal load from partition/ceiling/floor in each zone	(kcal/h)
Q'd	: Thermal load by infiltration in each zone	(kcal/h)
Q'f	: Fresh outdoor air load in each zone	(kcal/h)
$Q'e_1$	: Thermal load from human body in each zone	(kcal/h)
$Q'e_2$	: Thermal load from lighting fixture in each zone	(kcal/h)
$Q'e_3$	: Thermal load from equipment in each zone	(kcal/h)
ψ	: Radiation load rate	0.6~0.8
T2	: Air conditioning hour	

WR2

$$QH = \frac{HQ_{1T} \cdot \left(1 - \frac{1}{COP_h}\right) - 3{,}412 \times Pw \times T_2}{T1} \times K \qquad \text{(BTU)}$$

QH_{1T}	: Total of heating load on weekday including warming up	(BTU/day)
T_1	: Operating hour of auxiliary heat source	(h)
T_2	: Operating hour of heat source water pump	(h)
K	: Allowance factor (Heat storage tank, piping loss, etc.)	1.05~1.10

HQ_{1T} is calculated from the result of steady state load calculation similarly by using the equation below.

$$HQ_{1T} = 1.15 \times (\Sigma Q'a + \Sigma Q'b + \Sigma Q'c + \Sigma Q'd + \Sigma Q'f)\, T_2 - \psi\, (\Sigma Qe_1 + \Sigma Qe_2 + \Sigma Qe_3)\, (T2 - 1)$$

Q'a	: Thermal load from external wall/roof in each zone	(BTU/h)
Q'b	: Thermal load from glass window in each zone	(BTU/h)
Q'c	: Thermal load from partition/ceiling/floor in each zone	(BTU/h)
Q'd	: Thermal load by infiltration in each zone	(BTU/h)
Q'f	: Fresh outdoor air load in each zone	(BTU/h)
$Q'e_1$	: Thermal load from human body in each zone	(BTU/h)
$Q'e_2$	: Thermal load from lighting fixture in each zone	(BTU/h)
$Q'e_3$	: Thermal load from equipment in each zone	(BTU/h)
ψ	: Radiation load rate	0.6~0.8
T2	: Air conditioning hour	

b) Heat storage tank

Heat storage tank can be classified by types into the open type heat storage tank exposed to atmosphere, and the closed type heat storage tank with structure separated from atmosphere. Although the size of the tank and its installation place should be taken into account, the closed type tank is being usually employed by considering corrosion problems.
The capacity of heat storage tanks is determined in accordance with the daily maximum heating load that includes warming up load to be applied for the day after the holiday.

When auxiliary heat source is operated during operation and even after stopping of water heat source CITY MULTI unit

$$V = \frac{HQ_{2T}\left(1 - \frac{1}{COP_h}\right) - 860 \times Pw \times T_2 - QH \times T_2}{\Delta T \times 1{,}000 \times \eta V} \quad \text{(ton)}$$

HQ_{2T} : Maximum heating load including load required for the day after the holiday (kcal/day)
ΔT : Temperature difference utilized by heat storage tank (deg°C)
ηV : Heat storage tank efficiency

HQ_{2T} : $1.3 \times (\Sigma Q'a + \Sigma Q'c + \Sigma Q'd + \Sigma Q'f)\ T2 - \psi(\Sigma Qe2 + \Sigma Qe3)\ (T2 - 1)$

$$V = \frac{HQ_{2T}\left(1 - \frac{1}{COP_h}\right) - 3{,}412 \times Pw \times T_2 - QH \times T_2}{\Delta T \times \eta V} \quad \text{(lbs)}$$

HQ_{2T} : Maximum heating load including load required for the day after the holiday (BTU/day)
ΔT : Temperature difference utilized by heat storage tank (deg°F)
ηV : Heat storage tank efficiency

HQ_{2T} : $1.3 \times (\Sigma Q'a + \Sigma Q'c + \Sigma Q'd + \Sigma Q'f)\ T2 - \psi(\Sigma Qe2 + \Sigma Qe3)\ (T2 - 1)$

When auxiliary heat source is operated after stopping of water heat source CITY MULTI unit

$$V = \frac{HQ_{2T}\left(1 - \frac{1}{COP_h}\right) - 860 \times Pw \times T_2}{\Delta T \times 1{,}000 \times \eta V} \quad \text{(ton)}$$

HQ_{2T} : Maximum heating load including load required for the day after the holiday (kcal/day)
ΔT : Temperature difference utilized by heat storage tank (deg°C)
ηV : Heat storage tank efficiency

HQ_{2T} : $1.3 \times (\Sigma Q'a + \Sigma Q'c + \Sigma Q'd + \Sigma Q'f)\ T2 - \psi(\Sigma Qe2 + \Sigma Qe3)\ (T2 - 1)$

$$V = \frac{HQ_{2T}\left(1 - \frac{1}{COP_h}\right) - 3{,}412 \times Pw \times T_2}{\Delta T \times \eta V} \quad \text{(lbs)}$$

HQ_{2T} : Maximum heating load including load required for the day after the holiday (BTU/day)
ΔT : Temperature difference utilized by heat storage tank (deg°F)
ηV : Heat storage tank efficiency

HQ_{2T} : $1.3 \times (\Sigma Q'a + \Sigma Q'c + \Sigma Q'd + \Sigma Q'f)\ T2 - \psi(\Sigma Qe2 + \Sigma Qe3)\ (T2 - 1)$

4) Piping system

The following items should be kept in your mind in planning / designing water circuits.

a) All units should be constituted in a single circuit in principle.

b) When plural numbers of the water heat source CITY MULTI unit are installed, the rated circulating water flow rate should be kept by making the piping resistance to each unit almost same value. As an example, the reverse return system as shown below may be employed.

c) Depending on the structure of a building, the water circuit may be prefabricated by making the layout uniform.

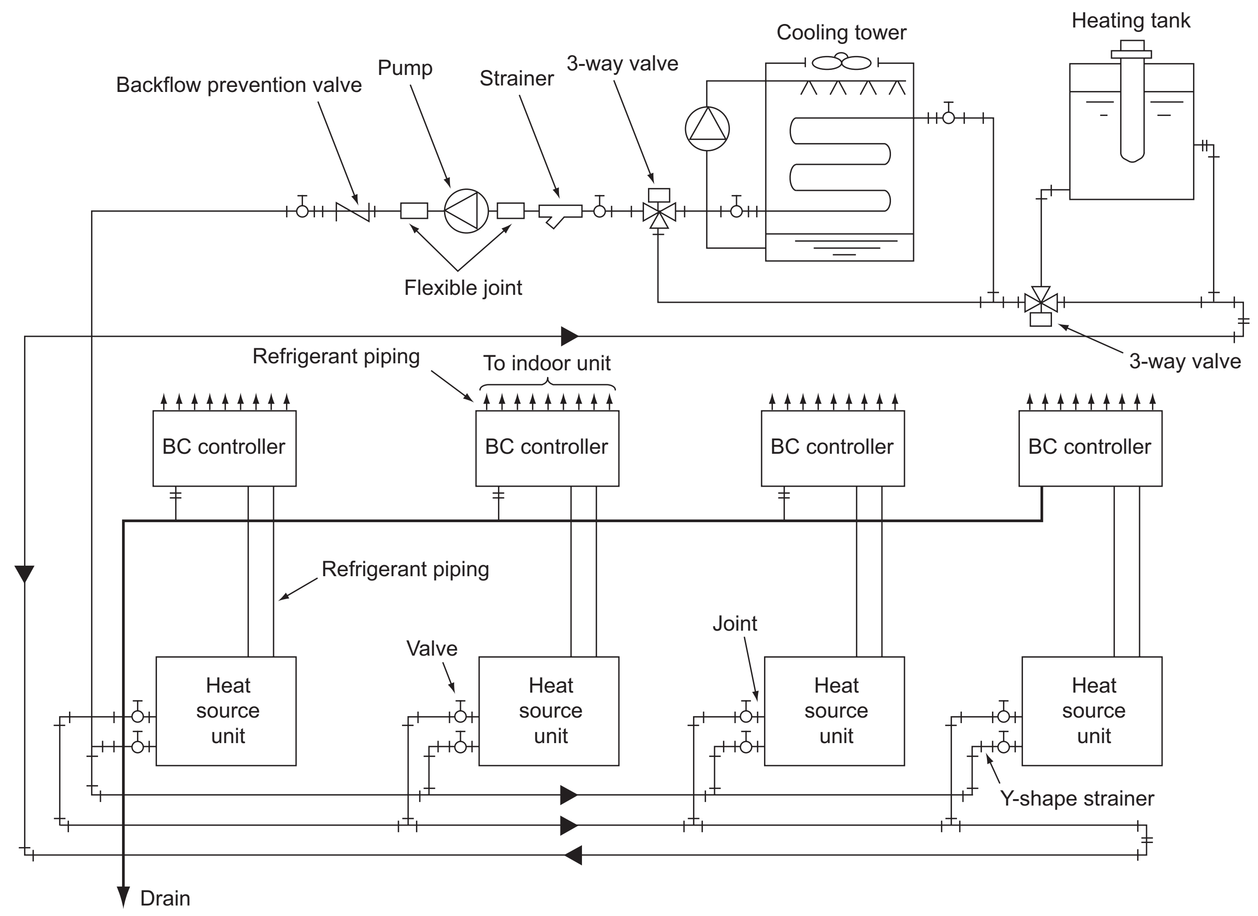
d) When a closed type piping circuit is constructed, install an expansion tank usable commonly for a make-up water tank to absorb the expansion/contraction of water caused by temperature fluctuation.

e) If the operating temperature range of circulation water stays within the temperature near the normal temperature (summer : 29.4°C[85°F], winter : 21.1°C[70°F]), thermal insulation or anti-sweating work is not required for the piping inside buildings.

In case of the conditions below, however, thermal insulation is required.

- When well water is used for heat source water.
- When piped to outdoor or a place where freezing may be caused.
- When vapor condensation may be generated on piping due to an increase in dry bulb temperature caused by the entry of fresh outdoor air.

System example of water circuit



5) Cleaning of water heat exchanger

For the water heat exchanger, scale adheres in less amount generally in the case of closed type cooling towers. However in a long period of use, scale will adhere that may lower the heat exchange capacity and increase the water resistance.
In such case, conduct cleaning work under the procedure given below.
The cleaning work procedure generally used is as follows. However as the cleaning agents have various differences in their cleaning effect, corrosion characteristics, processing time, and condensation for use, conduct the work after consulting the relating manufacturer.

Acid washing → Water washing → Neutralization → Water washing → Applying inhibitor

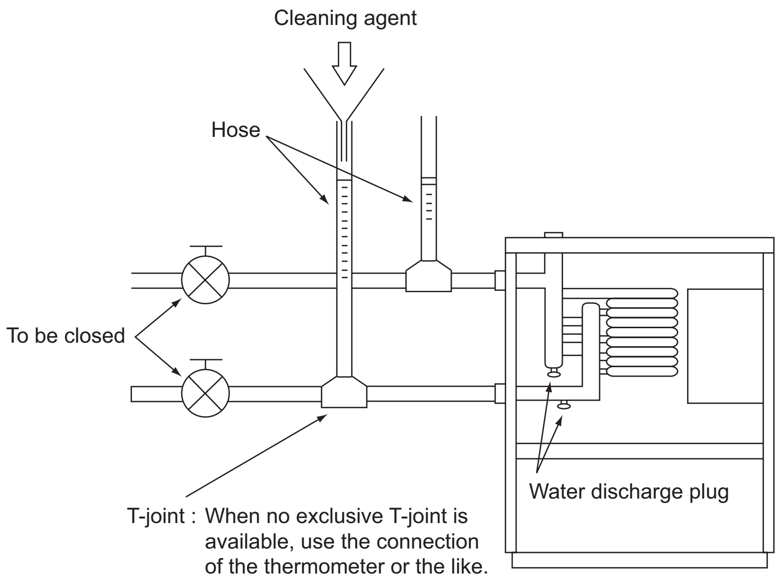
a) Still standing method

This method feeds the raw liquid or diluted solution of cleaning agent into the water circuit and leave it for a while, and requires only a simple device.

- Since the cleaning time required differs by the agent of each manufacturer, be sufficiently careful for the time and not to exceed the time specified.
- Fully recover the cleaning liquid through the water discharge plug of the heat exchanger, and then fully clean the water circuit with clean water. If the water washing can not be made sufficiently, neutralization processing will be effective.

WR2

Still standing cleaning device



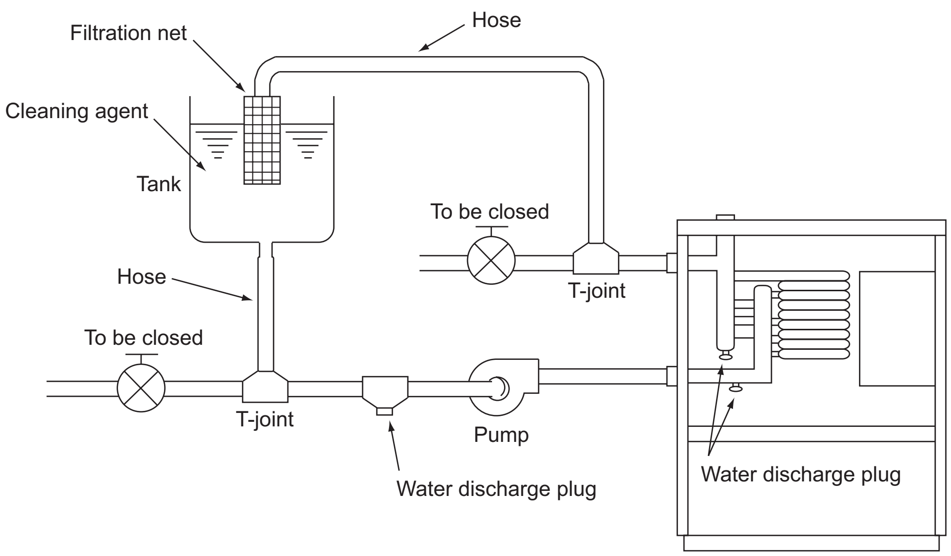
b) Circulation method

Although this method can clean in shorter time than that required by the still standing method, be careful that the circulation pump may be damaged if using cleaning agent with strong corrosive characteristics.

- After completing washing work, fully recover the washing liquid through the water discharge plug installed at the bottom of the piping and that at the heat exchanger.
- Conduct water washing for three times or more after removing cleaning agent. If this can not be made satisfactorily, apply neutralization treatment. Full replacement of water can be ascertained by measuring the PH of the water.
- Note that it may be required to control the cleaning time depending on the scale generation or water quality.
- At cleaning work, remove or shut down the instruments like water pressure gauges so that the cleaning liquid will not enter into them.
- Check for the connections of piping beforehand so that cleaning agent will not leak from the piping during cleaning work.
- Start cleaning operation after fully mixing the cleaning agent with water.
- Cleaning at the earlier timing is recommended as the removal of scale will be difficult if it has accumulated seriously. Periodical cleaning is necessary in a district with inferior water quality.
- Conduct water washing sufficiently with clear water after cleaning work as all cleaning agents own strong acidity.
- To verify the completion of cleaning, remove the hose and observe the inner wall of the piping whether it is clean.
- Be sufficiently careful for fire when using inflammable cleaning agent (GOSPEL R).

WR2

Circulation method cleaning device



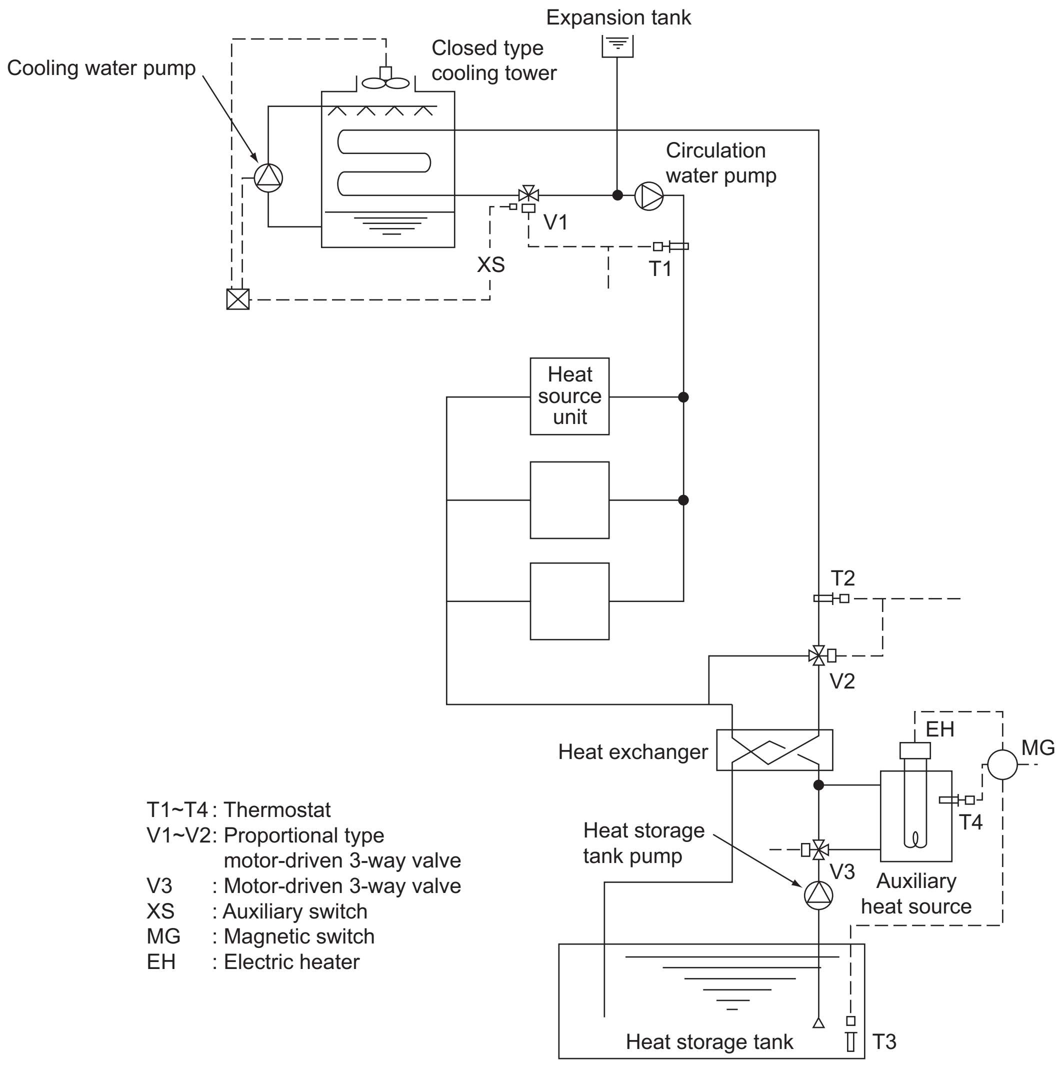
Example of cleaning agents

Name	Shape	Condensation	Time	Manufacturer
CLEARLITE RK	Powder/Liquid	10~20%	2~3Hr.	Koei Kagaku
CLEARLITE ACE	Powder/Liquid	3~5%	1~3Hr.	Koei Kagaku
GOSPEL R	Liquid	7% (Upper limit 10%, lower limit 5%)	1~4Hr.	Gospel Kako
GOSPEL SR	Powder			
ADDITION DR	Powder			Marusan
SS-100	Liquid			Seiwa kogyo
NEOLUX F	Powder			
DISCALER	Powder	4~7%		Saver Kagaku

6) Practical System Examples and Circulation Water Control

Since the water heat source CITY MULTI is of water heat source system, versatile systems can be constituted by combining it with various heat sources.
The practical system examples are given below.
Either cooling or heating operation can be performed if the circulation water temperature of the water heat source CITY MULTI stays within a range of 15~45°C [59~113°F]. However, the circulation water temperature near 32°C[90°F] for cooling and 20°C[68°F] for heating is recommended by taking the life, power consumption and capacity of the air conditioning units into consideration. The detail of the control is also shown below.

Example-1 Combination of closed type cooling tower and hot water heat storage tank (using underground hollow slab)



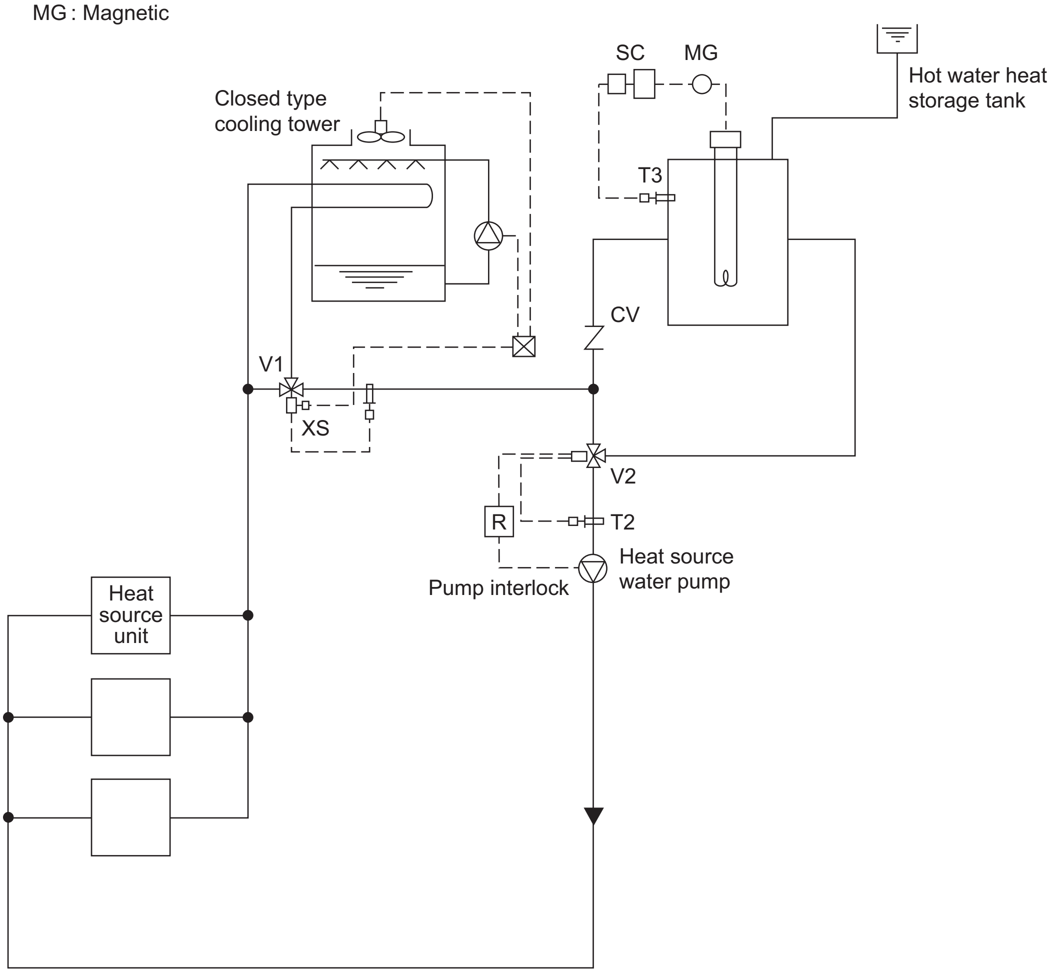
T1~T4 : Thermostat
V1~V2: Proportional type motor-driven 3-way valve
V3 : Motor-driven 3-way valve
XS : Auxiliary switch
MG : Magnetic switch
EH : Electric heater

By detecting the circulation water temperature of the water heat source CITY MULTI system with T1 (around 32°C[90°F]) and T2 (around 20°C[68°F]), the temperature will be controlled by opening/closing V1 in the summer and V2 in the winter.
In the summer, as the circulation water temperature rises exceeding the set temperature of T1, the bypass port of V1 will open to lower the circulation water temperature. While in the winter, as the circulation water temperature drops, V2 will open following the command of T2 to rise the circulation water temperature.
The water inside the heat storage tank will be heated by the auxiliary heat source by V3 being opened with timer operation in the night-time. The electric heater of the auxiliary heat source will be controlled by T3 and the timer. The start/stop control of the fan and pump of the closed type cooling tower is applied with the step control of the fan and pump following the command of the auxiliary switch XS of V1, that operates only the fan at the light load while the fan and pump at the maximum load thus controlling water temperature and saving motor power.

WR2

Example-2 Combination of closed type cooling tower and hot water heat storage tank

T1 : Proportional type, insertion system thermostat
T2 : Proportional type, insertion system thermostat
T3 : Proportional type, insertion system thermostat
V1 : Proportional type, motor-driven 3-way valve
V2 : Proportional type, motor-driven 3-way valve
XS : Auxiliary switch (Duplex switch type)
SC : Step controller
R : Relay
MG : Magnetic

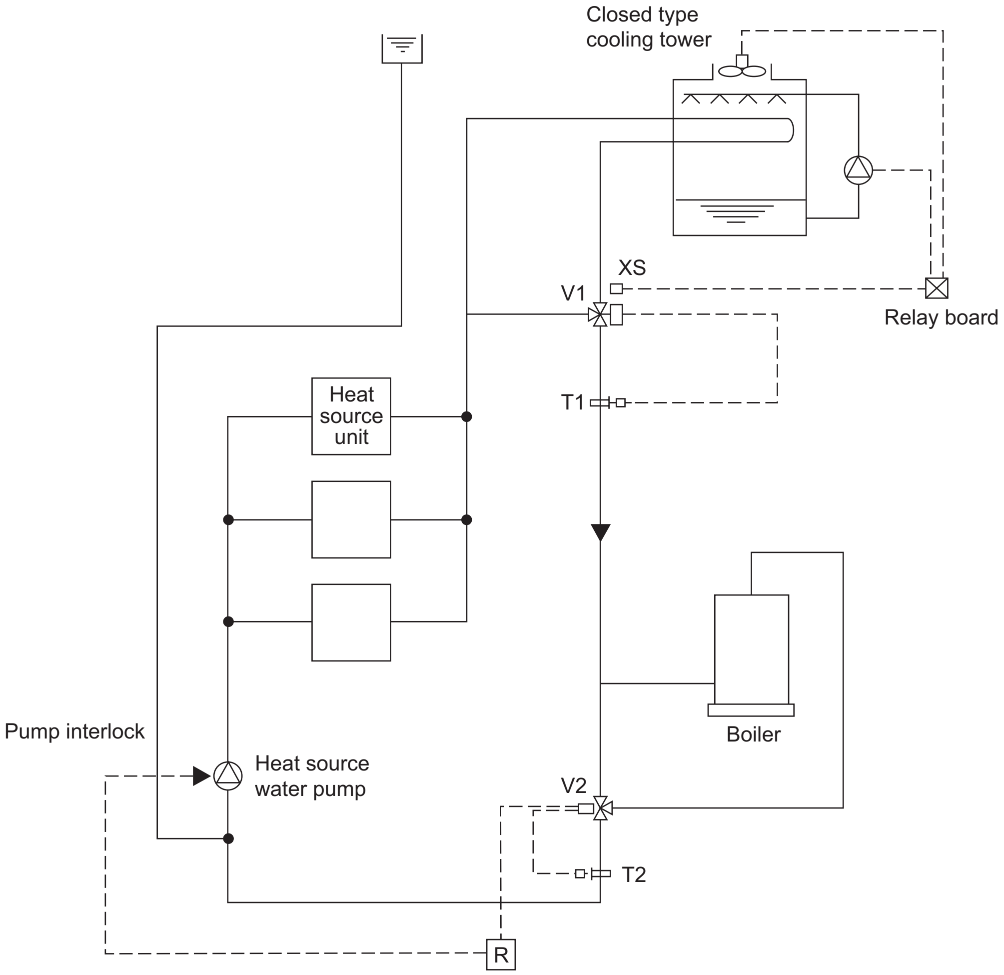


In the summer, as the circulation water temperature rises exceeding the set temperature of T1, the bypass port of V1 will open to lower the circulation water temperature. In the winter, if the circulation water temperature stays below 25°C[77°F], V2 will open/close by the command of T2 to keep the circulation water temperature constant.
The temperature of the hot water inside the heat storage tank will be controlled through the step control of the electric heater by step controller operation following the command of T3.
During the stopping of the heat source water pump, the bypass port of V2 will be closed fully by interlocking thus preventing the high temperature water from entering into the system at the starting of the pump.
The start/stop control of the fan and pump of the closed type cooling tower is applied with the step control of the fan and pump following the command of the auxiliary switch XS of V1, that operates only the fan at the light load while the fan and pump at the maximum load thus controlling water temperature and saving motor power.

WR2

Example-3 Combination of closed type cooling tower and boiler

T1 : Proportional type, insertion system thermostat
T2 : Proportional type, insertion system thermostat
T3 : Proportional type, insertion system thermostat
V1 : Proportional type, motor-driven 3-way valve
S : Selector switch
R : Relay
XS : Auxiliary switch (Duplex switch type)

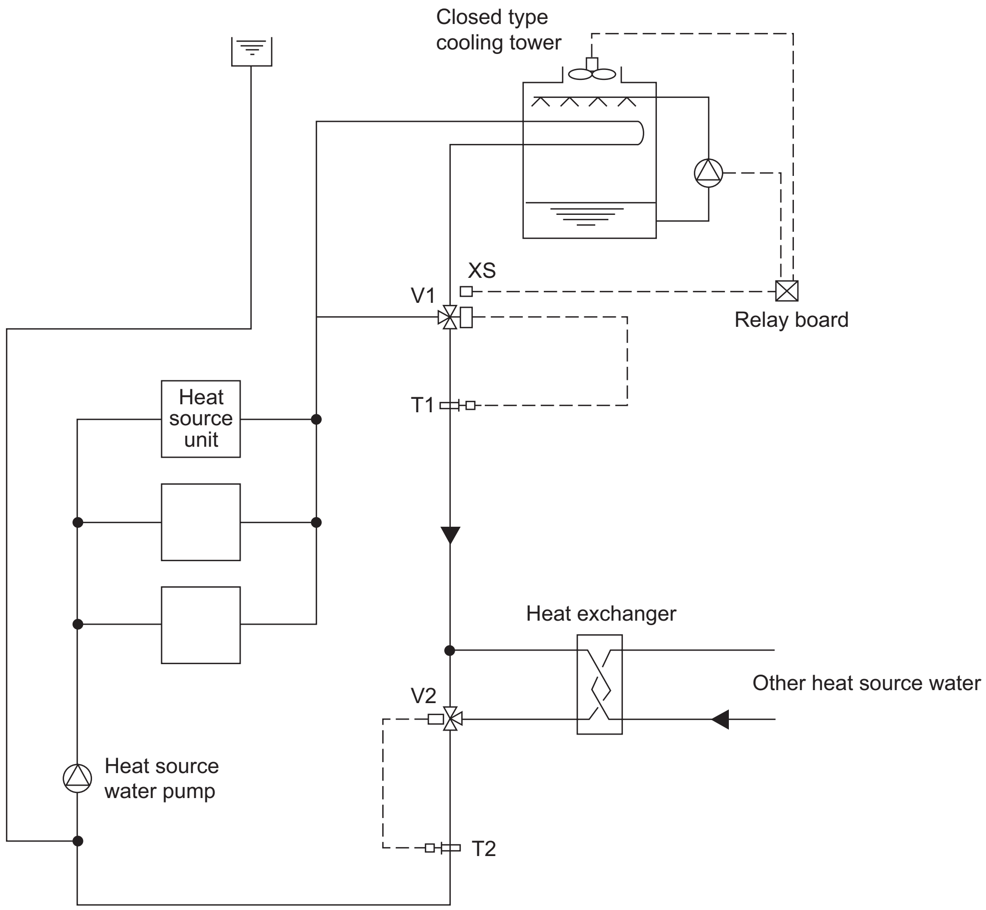


In the summer, as the circulation water temperature rises exceeding the set temperature of T1, the bypass port of V1 will close to lower the circulation water temperature. In the winter, if the circulation water temperature drops below 25°C[77°F], V2 will conduct water temperature control to keep the circulation water temperature constant.
During the stopping of the heat source water pump, the bypass port of V2 will be closed fully by interlocking.
The start/stop control of the fan and pump of the closed type cooling tower is applied with the step control following the command of the auxiliary switch XS of V1, thus controlling water temperature and saving motor power.

WR2

Example-4 Combination of closed type cooling tower and heat exchanger (of other heat source)

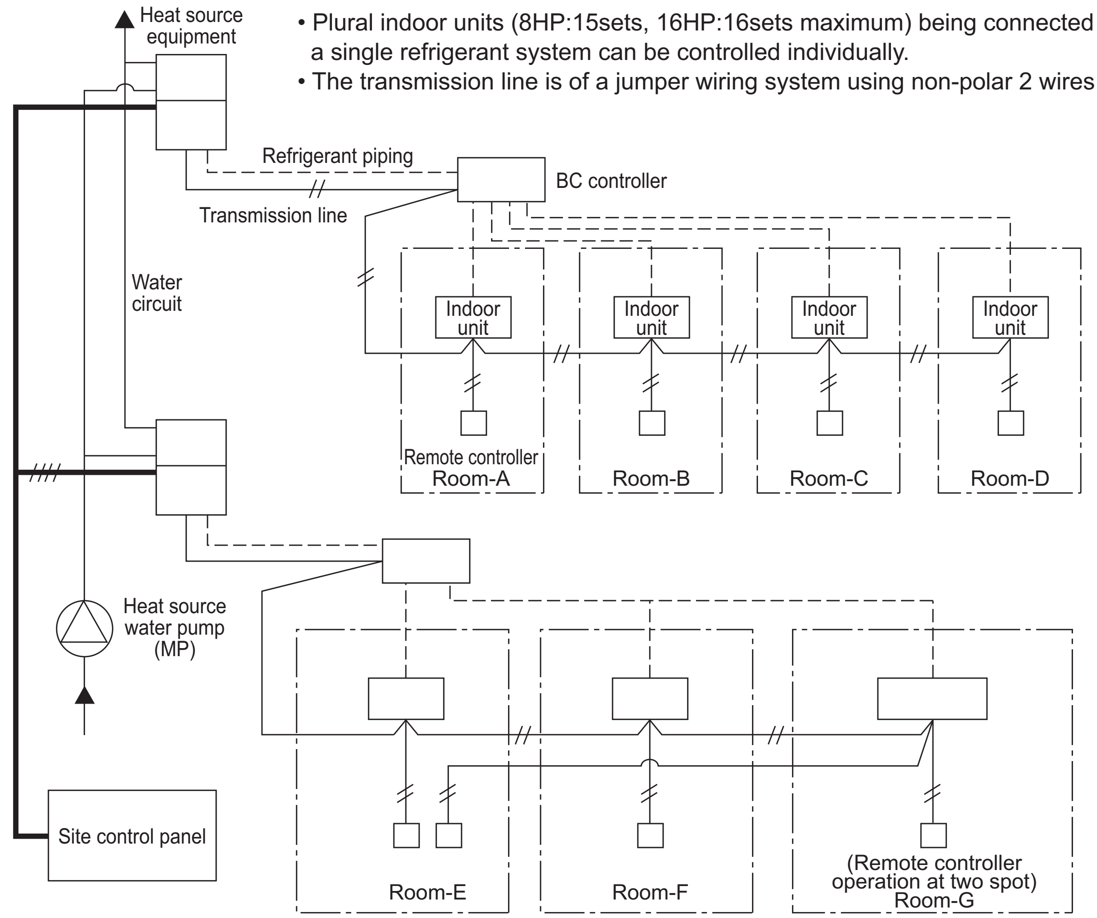
T1 : Proportional type, insertion system thermostat
T2 : Proportional type, insertion system thermostat
V1 : Proportional type, motor-driven 3-way valve
V2 : Proportional type, motor-driven 3-way valve
S : Selector switch
R : Relay
XS : Auxiliary switch (Duplex switch type)



In the summer, as the circulation water temperature rises exceeding the set temperature of T1, the bypass port of V1 will close to lower the circulation water temperature. In the winter, if the circulation water temperature drops below 26°C[79°F], V2 will conduct water temperature control to keep the circulation water temperature constant.
During the stopping of the heat source water pump, the bypass port of V2 will be closed fully by interlocking.
The start/stop control of the fan and pump of the closed type cooling tower is applied with the step control following the command of the auxiliary switch XS of V1, thus controlling water temperature and saving motor power.

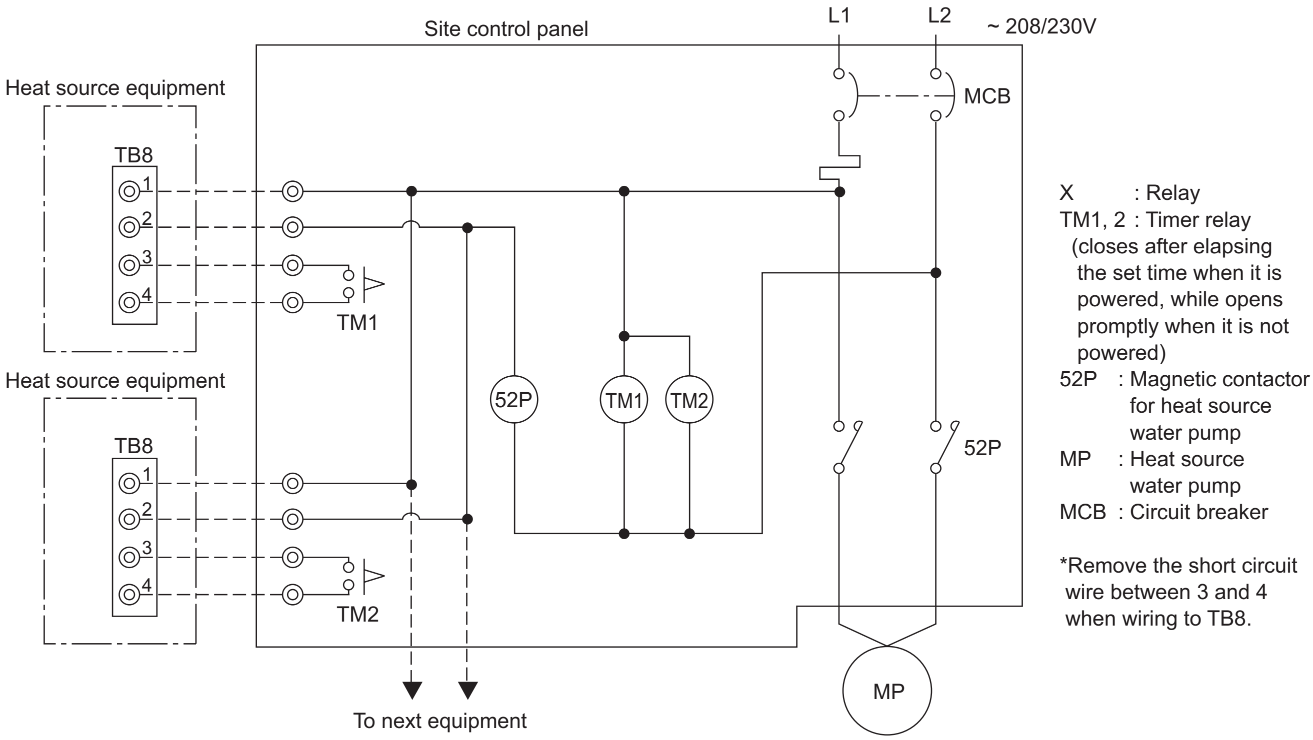
7) Pump interlock circuit

- Plural indoor units (8HP:15sets, 16HP:16sets maximum) being connected to a single refrigerant system can be controlled individually.
- The transmission line is of a jumper wiring system using non-polar 2 wires.



Wiring diagram

This circuit uses the “Terminal block for pump interlock (TB8)“ inside the electrical parts box of the heat source equipment.
This circuit is for interlocking of the heat source equipment operation and the heat source water pump.



WR2

Operation ON signal

Terminal No.	TB8-1, 2
Output	Relay contacts output Rated voltage : 3~ : 208/230V Rated load : 1A
Operation	• When Dip switch 2-7 is OFF The relay closes during compressor operation. • When DIP switch 2-7 is ON. The relay closes during reception of cooling or the heating operation signal from the controller. (Note : It is output even if the thermostat is OFF (when the compressor is stopped).)

Pump Interlock

Terminal No.	TB8-3, 4
Input	Level signal
Operation	If the circuit between TB8-3 and TB8-4 is open, compressor operation is prohibited.

8-2. Water piping work

Although the water piping for the CITY MULTI WR2 system does not differ from that for ordinary air conditioning systems, pay special attention to the items below in conducting the piping work.

1) Items to be observed on installation work

- In order to equalize piping resistance for each unit, adapt the reverse return system.
- Mount a joint and a valve onto the water outlet/inlet of the unit to allow for maintenance, inspection and replacement work. Be sure to mount a strainer at the water inlet piping of the unit. (The strainer is required at the circulation water inlet to protect the heat source unit.)

* The installation example of the heat source unit is shown right.

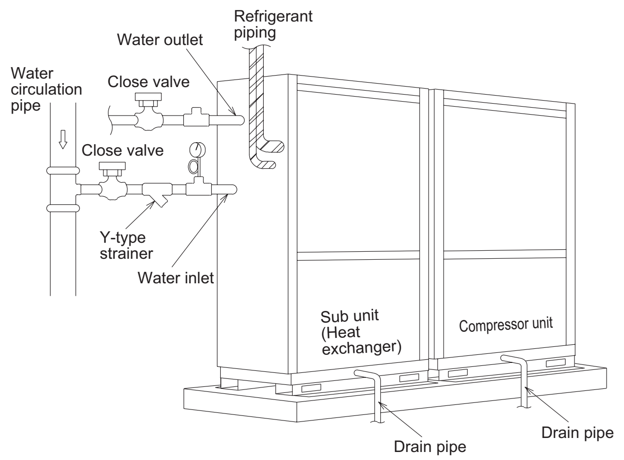
- Be sure to provide an air relief opening on the water piping properly, and purge air after feeding water to the piping system.
- Condensate will generate at the low temperature part inside the heat source equipment. Connect drain piping to the drain piping connection located at the bottom of the heat source equipment to discharge it outside the equipment.
- At the center of the header of the heat exchanger water inlet inside the unit, a plug for water discharge is being provided.
  Use it for maintenance work or the like.
- Mount a backflow prevention valve and a flexible joint for vibration control onto the pump.
- Provide a sleeve to the penetrating parts of the wall to prevent the piping.
- Fasten the piping with metal fitting, arrange the piping not to expose to cutting or bending force, and pay sufficient care for possible vibration.
- Be careful not to erroneously judge the position of the inlet and outlet of water.
  (Lower position : Inlet, Upper position : Outlet)

2) Thermal insulation work

Thermal insulation or anti sweating work is not required for the piping inside buildings in the case of the CITY MULTI WR2 system if the operating temperature range of circulation water stays within the temperature near the normal (summer : 29.4°C[85°F], winter : 21.1°C[70°F]). In case of the conditions below, however, thermal insulation is required.

- Use of well water for heat source water
- Outdoor piping portions
- Indoor piping portions where freezing may be caused in winter
- A place where vapor condensation may be generated on piping due to an increase in dry bulb temperature inside the ceiling caused by the entry of fresh outdoor air
- Drain piping portions

Installation example of heat source unit



3) Water treatment and water quality control

For the circulation water cooling tower of the CITY MULTI WR2 system, employment of the closed type is recommended to keep water quality. However, in the case that an open type cooling tower is employed or the circulating water quality is inferior, scale will adhere onto the water heat exchanger leading to the decreased heat exchange capacity or the corrosion of the heat exchanger. Be sufficiently careful for water quality control and water treatment at the installation of the circulation water system

- Removal of impurities inside piping

Be careful not to allow impurities such as welding fragment, remaining sealing material and rust from mixing into the piping during installation work.

- Water treatment

The water quality standards have been established by the industry (Japan Refrigeration, Air Conditioning Industry Association, in case of Japan) for water treatment to be applied.

Items		Lower mid-range temperature water system		Tendency	
		Recirculating water [20<T<60°C] [68<T<140°F]	Make-up water	Corrosive	Scale-forming
Standard items	pH (25°C[77°F])	7.0 ~ 8.0	7.0 ~ 8.0	○	○
	Electric conductivity (mS/m) (25°C[77°F]) (μS/cm) (25°C[77°F])	30 or less [300 or less]	30 or less [300 or less]	○	○
	Chloride ion (mg Cl^-/ℓ)	50 or less	50 or less	○	
	Sulfate ion (mg SO_4^{2-}/ℓ)	50 or less	50 or less	○	
	Acid consumption (pH4.8) (mg $CaCO_3$/ℓ)	50 or less	50 or less		○
	Total hardness (mg $CaCO_3$/ℓ)	70 or less	70 or less		○
	Calcium hardness (mg $CaCO_3$/ℓ)	50 or less	50 or less		○
	Ionic silica (mg SiO_2/ℓ)	30 or less	30 or less		○
Reference items	Iron (mg Fe/ℓ)	1.0 or less	0.3 or less	○	○
	Copper (mg Cu/ℓ)	1.0 or less	0.1 or less	○	
	Sulfide ion (mg S^{2-}/ℓ)	not to be detected	not to be detected	○	
	Ammonium ion (mg NH_4^+/ℓ)	0.3 or less	0.1 or less	○	
	Residual chlorine (mg Cl/ℓ)	0.25 or less	0.3 or less	○	
	Free carbon dioxide (mg CO_2/ℓ)	0.4 or less	4.0 or less	○	
	Ryzner stability index	–	–	○	○

Reference : Guideline of Water Quality for Refrigeration and Air Conditioning Equipment. (JRA GL02E-1994)

In order to keep the water quality within such standards, you are kindly requested to conduct bleeding-off by overflow and periodical water quality tests, and use inhibitors to suppress condensation or corrosion. Since piping may be corroded by some kinds of inhibitor, consult an appropriate water treatment expert for proper water treatment.

(4) Pump interlock

Operating the heat source unit without circulation water inside the water piping can cause a trouble. Be sure to provide interlocking for the unit operation and water circuit. Since the terminal block is being provided inside the unit, use it as required.

HEAT SOURCE UNITS

1. JOINT

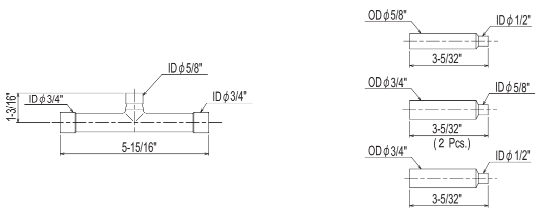
CITY MULTI piping can be installed easily with joints and headers provided by MITSUBISHI ELECTRIC CORP.
Two sets of joints are available. Details for installing the joint sets are found in System Design 5-1, or their own Installation Manual.

CMY-Y102S-G

Ref.: W901632
in.

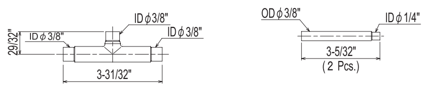
For gas pipe:

<Reducer(Accessory)>



For liquid pipe:

<Reducer(Accessory)>



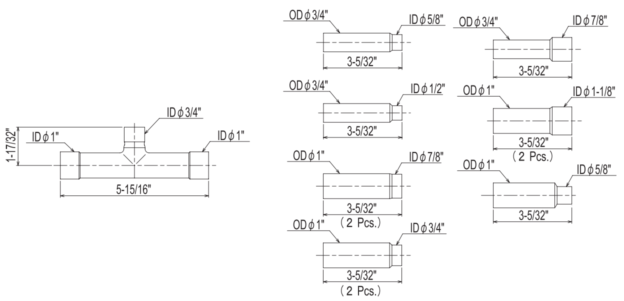
ID: Inner Diameter OD: Outer Diameter

CMY-Y102L-G1

Ref.: W901633
in.

For gas pipe:

<Reducer(Accessory)>



For liquid pipe:

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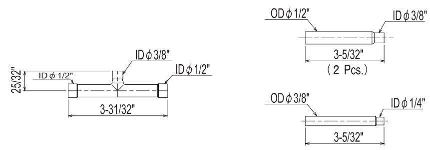


ID: Inner Diameter OD: Outer Diameter

Option

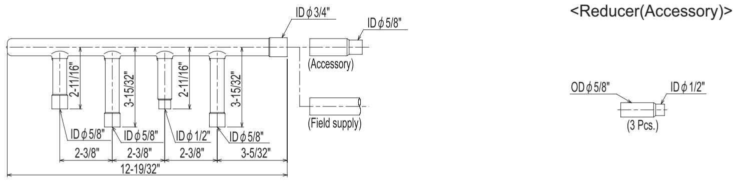
2. HEADER

CITY MULTI piping can be installed easily with joints and headers provided by MITSUBISHI ELECTRIC CORP.
Three sets of headers are available. Details for installing the header sets are found in System Design 5-2, or their own Installation Manual.

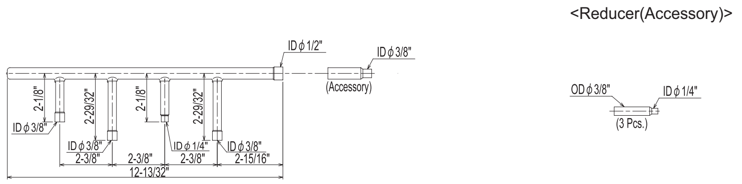
CMY-Y104-G

Ref.: W901636
in.

For gas pipe:



For liquid pipe:

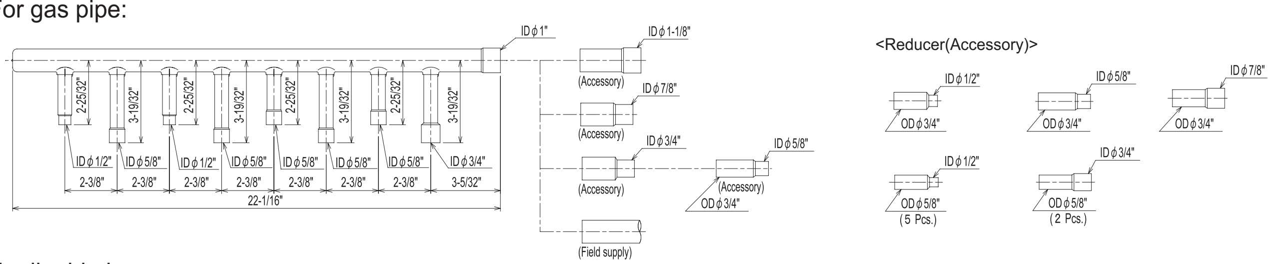


ID: Inner Diameter OD: Outer Diameter
NOTE: Besides above mentioned accessories, caps for ϕ1/4", ϕ3/8", ϕ1/2", ϕ5/8" pipes (each diameter 1 piece) are included in the Header set.

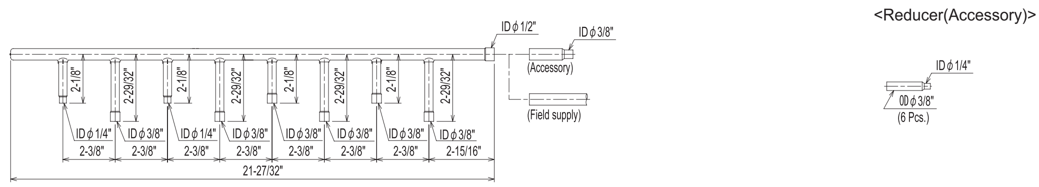
CMY-Y108-G

Ref.: W901637
in.

For gas pipe:



For liquid pipe:

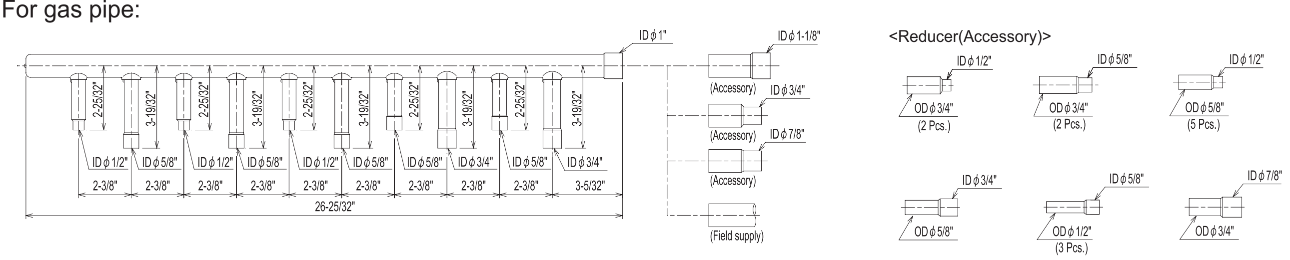


ID: Inner Diameter OD: Outer Diameter
NOTE: Besides above mentioned accessories, caps for ϕ1/4", ϕ3/8", ϕ1/2", ϕ5/8" pipes (each diameter 2 pieces) and 1 cap for ϕ3/4" pipe are included in the Header set.

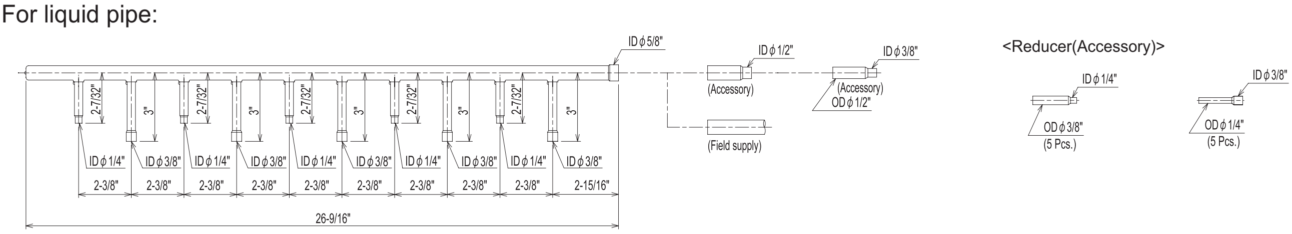
CMY-Y1010-G

Ref.: W901638
in.

For gas pipe:



For liquid pipe:



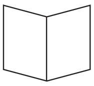
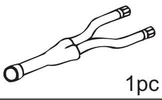
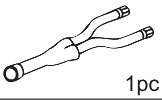
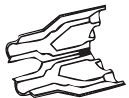
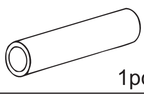
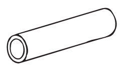
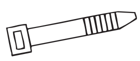
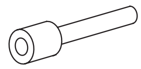
ID: Inner Diameter OD: Outer Diameter
NOTE: Besides above mentioned accessories, caps for ϕ1/4", ϕ3/8", ϕ1/2", ϕ5/8" pipes (each diameter 2 pieces) and 1 cap for ϕ3/4" pipe are included in the Header set.

Option

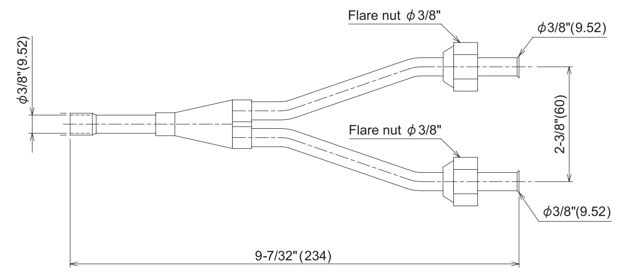
3. JOINT KIT "CMY-R160-J" FOR BC CONTROLLER

Joint kit "CMY-R160-J" is used to combine two ports of the BC controller for a PQRY-P-TGMU system to enable Indoor capacity above P55 as shown in Fig. 1.

The Joint kit include following items:

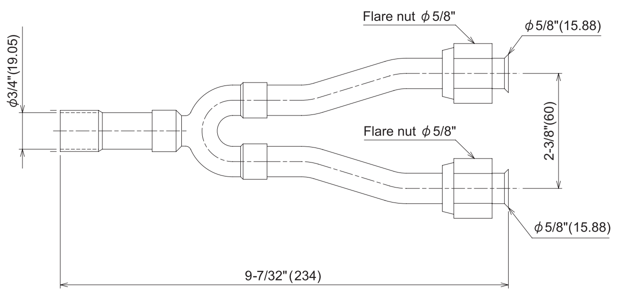
①Instructions	②Joint pipe	③Joint pipe	④Cover 1	⑤Cover 2	⑥Cover 3	⑦Band	⑧Reducer
 1pc	(for liquid side)  1pc	(for gas side)  1pc	 2pcs	(for gas side)  1pc	(for liquid side)  1pc	 8pcs	 1pc

②Joint pipe (for liquid side)



③Joint pipe (for gas side)

in.(mm)



1. Designing CMY-R160-J to a PQRY-P-TGMU system

The maximum of Indoor capacity for one port of BC controller is P54. When the Indoor capacity is above P54, Joint kit CMY-R160-J is needed to combine two ports of BC controller to enlarge the capacity, like Groups 2 and 3 in Fig. 1.

A maximum of three Indoor units are allowed to connect to one port of BC controller or two combined ports of BC controller using CMY-R160-J.

When connecting Indoor units to one port of BC controller or two combined ports of BC controller using CMY-R160-J, CMY-Y102S-G2 or CMY-Y104-G is applicable, like Groups 1 and 2 in Fig. 1

Caution: Simultaneous operation of cooling and heating modes for Indoor units connecting to the same BC ports is not available.

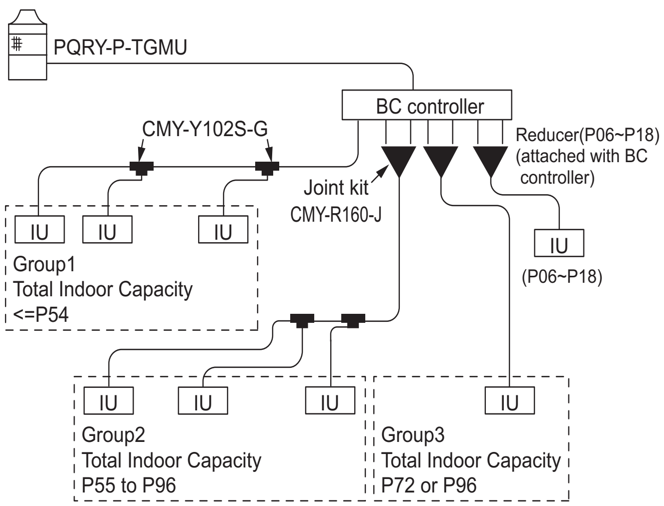


Fig.1. CMY-R160-J applying scheme

2. Piping at the installation site

Refer to Fig. 2 for connecting the CMY-R160-J to the BC controller and the pipe leading to the Indoor units. Non-oxidized brazing is necessary. Avoid getting foreign material inside the piping.

After piping and air-tight testing, insulate the joint and pipe. Details are available in the Installation Manual.

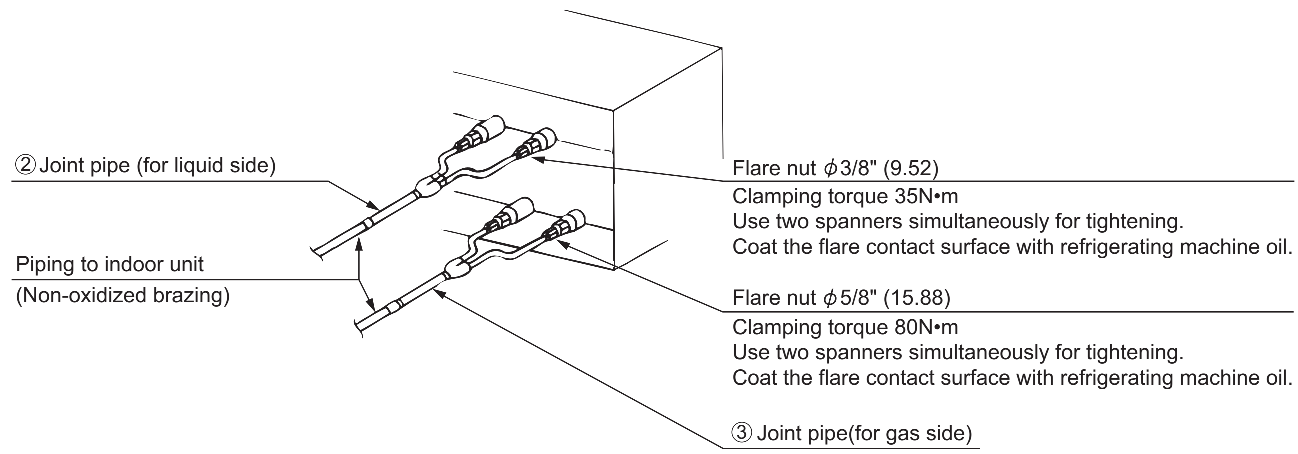


Fig.2. Connecting CMY-R160-J