World Energy

Product Data

Double Effect
Direct Fired
Absorption Machine

DWHH Series

50 ~ 1,500 usRT (176 ~ 5,274 kW)

World Energy

DWHH-Series, Double Effect Direct Fired Absorption Machine burning GAS or OIL, provides the best solution for most efficient cooling and heating.

- No CFC's and environmentally safe
- Direct Cooling & Heating with GAS or OIL
- Low Noise & Low vibration operation
- Cost-Effective Cooling & Heating
- Low Maintenance Cost
- Simple Chiller System Configuration
- High Reliability

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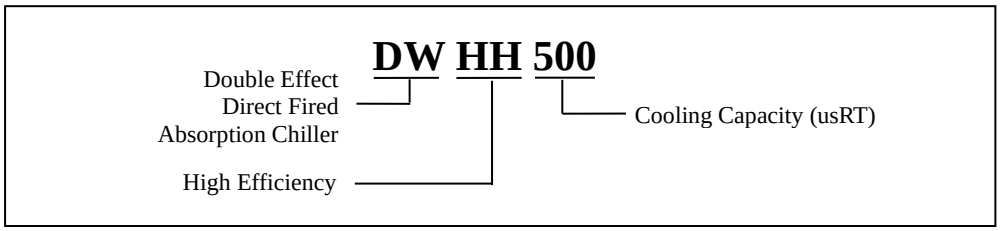
Model Name Nomenclature



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Features

DWHH Series Double Effect Direct Fired Absorption Machine is an excellent solution for maximizing an energy efficiency for all buildings and hotels where demand both cooling and heating.

EFFICIENT AIR-CONDITIONING DWHH Series Double Effect Direct Fired Absorption Machine produces both of cooling & heating energy by direct burning of fossil fuel without additional heat recovery devices.

EXCELLENT PART LOAD PERFORMANCE Unit controller allows stable, part load operation at cooling water temperatures as low as 20°C (68°F) without a cooling water bypass. For maximum efficiency, a variable frequency drive pump automatically maintains optimum solution flow to Low-Temp Generator and also High-Temp Generator during whole operation.

SIMPLE CONNECTION Unit-mounted electrical items are factory-wired to the chiller microprocessor control panel. Only a single-point electrical connection to the chiller from the building's electrical service is required. A multi-tap transformer, mounted in the chiller control panel, provides secondary, single-phase power for the machine controls.

LOW NOISE & VIBRATION The overall sound level of the machine is less than 75dBA from 1 meter distance from the machine. This allows the machines to be installed near occupies spaces or in areas with strict sound requirements. Low vibration levels also make it possible to install the chiller on upper floors without special consideration for vibration dampening systems.

COST-EFFECTIVE COOLING AND HEATING The Machine is designed to have double-effect cycle providing more efficient usage of the same energy input. The Machine operates with LNG, LPG or OIL and generates cooling and heating energy. Cooling operation produces chilled water, while heating operation produces hot water up to 60°C (140°F) as a standard and 79°C (175°F) as an option. Utilizing fossil fuel, full load cooling operation results in a machine COP (coefficient of performance) of maximum 1.36 at standard ARI operating conditions.

PRECISE & OPTIMIZED OPERATION Factory mounted, wired and tested microprocessor-based controller monitors and controls the machine operation continuously and automatically. A touch screen display identifies operational status and fault indication. All components meet internally acceptable codes like UL or CE or KS or the equivalents.
During the start-up sequence, the controller initiates a self-diagnostic system check to verify that all sensors are in range. Remote start/stop switch and a key-locked control panel door that protects against unauthorized access.

RELIABILITY & EASY MAINTENANCE Hermetical designed refrigerant and solution pumps which are only moving parts provide reliability and they are field serviceable through pumps isolation valves. Also marine-type water box cover on both of the absorber and condenser allows easy tube-cleaning and water-box-inspection.

And factory performance test, which is provided as an optional basis, ensure the performance and function of chiller before shipment.

Test of Absorption Chiller

UNIFORM DISTRIBUTION OF REFRIGERANT & SOLUTION The refrigerant and solution distribution system in evaporator and absorber is performed based on gravity and siphon phenomenon. This gravitational dropping distribution system adopts stainless steel tray and allows uniform solution spray and continuous heat transfer. Different from nozzle spray type of distribution system, this system eliminates an external pump to spray the solutions with nozzles and prevents nozzles from clogging.

ANTI-CRYSTALLIZATION CONTROLS PROPER SOLUTION CONCENTRATION Solution concentration is limited in several ways to avoid both of crystallization and over-dilution, providing dependable, trouble-free operation. The concentration control system automatically monitors the refrigerant water level in the evaporator in conjunction with the solution temperature returning to the absorber.

The Machine also incorporates a simple, passive method of control to correct any crystallization that would typically start to occur on the shell side of the low temperature solution heat exchanger under abnormal conditions.

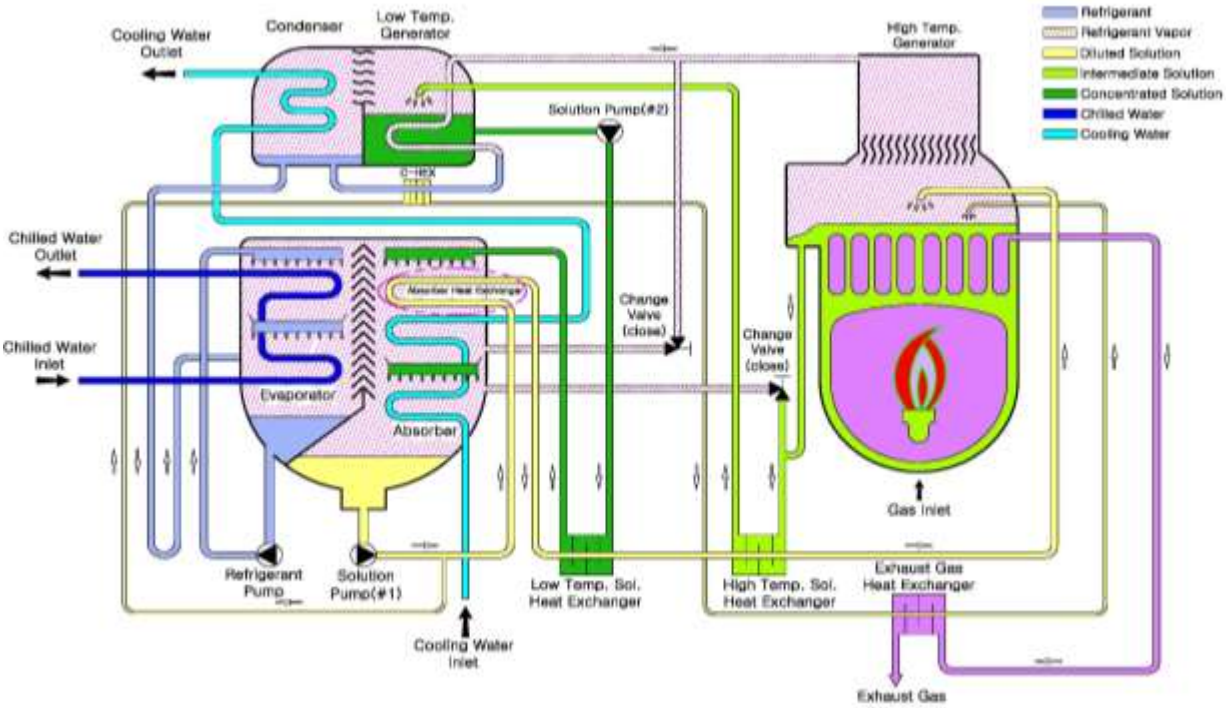
RELIABLE PURGE SYSTEM Non-condensable gases are periodically exhausted from the storage tank by a simple procedure performed while the machine is running. Evacuation is performed by a unit-mounted vacuum pump that is connected to the purge evacuation valve.

Installation of DWHH100 (2016. 11)

Absorption Cycle

Cooling Cycle (Cooling Mode)

The high efficiency double –effect, Direct fired absorption machine(DWHH) consists of an evaporator, absorber, condenser, high-temperature and low-temperature generator, solution heat exchangers, exhaust gas heat exchanger, condensation refrigerant heat exchanger, refrigerant and solution pumps(#1,#2), purge system, controls and accessories. During the cooling mode, the machine operates at the conditions that under vacuum, water boils at a low temperature. Under typical operating conditions, this occurs at approximately 4.4℃(40℉) , thereby cooling the chilled water that circulates through the evaporator tubes.
A refrigerant pump is used to transfer the refrigerant (water) over the evaporator tubes to improve heat transfer. To make the cooling process continuous, the refrigerant (water) vapor must be removed as it is produced. To accomplish this, a lithium bromide solution (which has a high affinity for water) is used to absorb the water vapor. As this process continues, the lithium bromide becomes diluted, reducing its absorption capacity. Before flow to low temp. generator, diluted solution pass through the absorber heat exchanger located top of absorber tube. A solution pump(#1) then transfers this diluted solution to the generators where it is re-concentrated in two stages (double-effect) to boil off the previously absorbed water and A solution pump(#1) transfers this diluted solution to the pipe connected to low temp. and high temp. sol. heat exchanger. A variable frequency drive on the solution pump automatically maintains optimum solution flow to the high temp. generators at all operating conditions for maximum efficiency. The diluted solution is pumped to the high-temperature generator where it is heated and re-concentrated to a medium concentration solution by the burner. The medium concentration solution from the high-temperature generator and diluted solution through condensation refrigerant heat exchanger flow to the low-temperature generator where it is heated and re-concentrated to a strong solution by the high temperature water vapor released from the solution in the high-temperature generator. Since the low temp. generator acts as the condenser for the high temp. generator, the heat energy first applied in the high temp. generator is used again in the low temp. generator, thus reducing the heat input by approximately 45% as compared to an absorption chiller with a single-stage of re-concentration. The water vapor released in the shell side of the low temp. generator, in addition to the condensed water vapor from the tube side of the low temp. generator, enters the condenser to be cooled and returned to a liquid state. The condensed water vapor from the tube side of the low temp. generator flows to the condensation refrigerant heat exchanger. Then it raise temperature diluted solution which flow through the condensation refrigerant heat exchanger. The refrigerant water then returns to the evaporator to begin a new cycle. To remove heat from the machine, cooling water from a cooling tower is first circulated through the tubes of the absorber to remove the heat of vaporization. The water is then circulated through the tubes of the condenser. The re-concentrated (strong) solution from the low temp. generator flows back to the absorber to begin a new cycle. For efficiency purposes, the medium concentration solution from the high temp. generator is passed through the high-temperature solution heat exchanger to pre-heat the diluted (weak) solution, while pre-cooling the medium concentration solution. The re-concentrated (strong) solution from the low temp. generator is passed through the low-temperature solution heat exchanger to pre-heat/pre-cool the solution before being returned to the absorber.

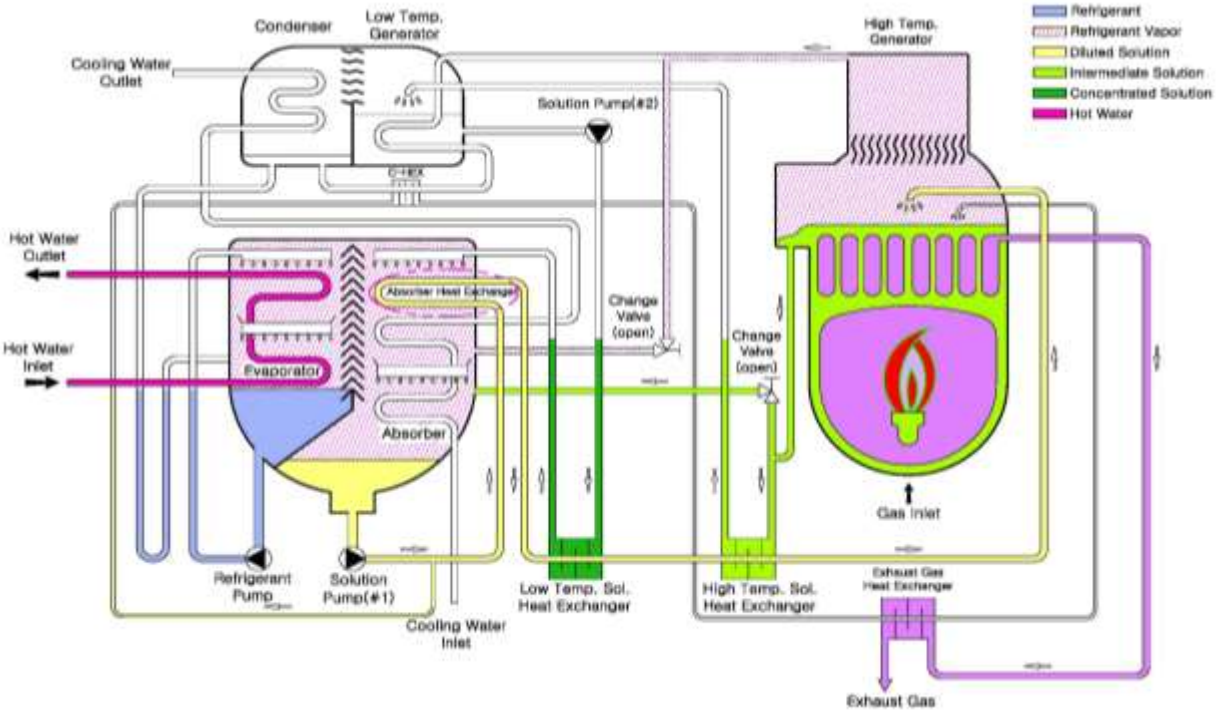


Heating Cycle (Heating Mode)

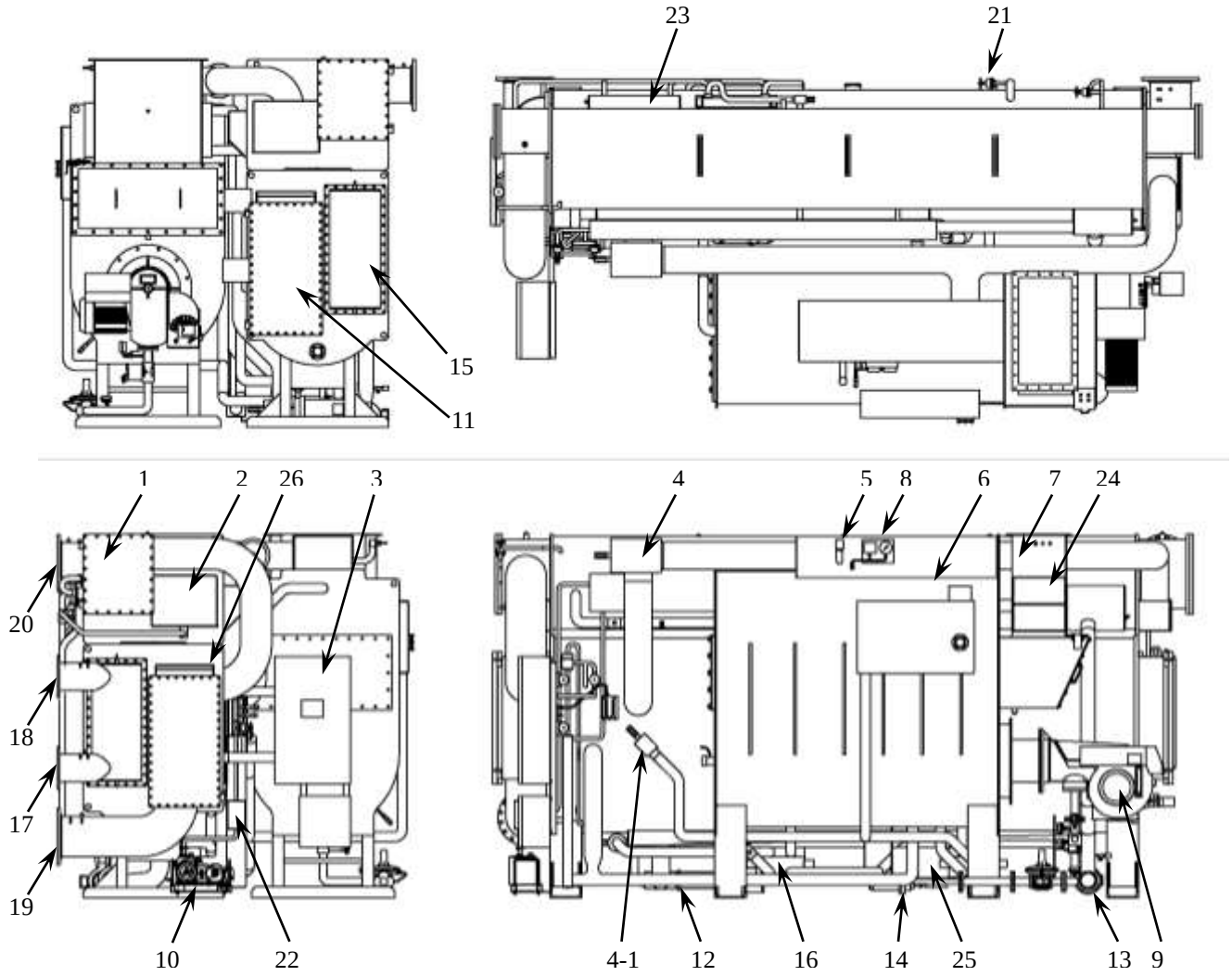
During the heating mode, the cycle follows a different vapor flow path than that undertaken for cooling and does not use the typical absorption process. In addition, the absorber-condenser cooling water circuit is drained and thus not operated, since all heat rejection from the machine is designed to take place through the evaporator (now the heating bundle) in a classic two-pipe system that utilizes only the evaporator nozzles.

High temperature water vapor produced in the high-temperature generator section is passed directly to the evaporator via the absorber where it condenses and transfers its heat to the water circulating through the evaporator tubes. This condensed water then flows to the absorber section where it mixes with the concentrated solution returning from the high-temperature generator. The diluted solution is then pumped back to the high-temperature generator to repeat the vapor generation phase for the heating function. Quick changeover from cooling to heating is accomplished by switching the positions of two hand valves, draining the absorber-condenser water circuit and putting the machine into heating mode by changing the position of a switch in the control panel.

The hot water temperatures is 60°C (140°F) as a standard without additional components and 79°C (175°F) as an option with the additional heat exchanger.



Components Arrangement



1 – Condenser
2 – Low temp. Generator (G2)
3 – Control panel
4 – Changeover Valve_ A
4_ 1 Changeover Valve_B
5 – Fusible Plug
6 – High temp. Generator (G1)
7 – Exhaust gas duct
8 – Pressure gage & switch
9 – Gas burner
10 – Purge (Vacuum) Pump
11 – Absorber
12 – Solution Pump(#1)
13 – Solution Pump(#2)
14 – Refrigerant Pump
15 – Evaporator
16 – Solution Heat Exchanger (Low Temp. Hex)
17 – Chilled Water Inlet
18 – Chilled Water Outlet
19 – Cooling Water Inlet
20 – Cooling Water Outlet
21 – Blow down Valve
22 – Check Valve (Oil Separator)
23 – Condensation Refrigerant Heat Exchanger
24 – Exhaust gas Heat Exchanger
25 – Solution Heat Exchanger (High Temp. Hex)
26 – Absorption Heat Exchanger

Product Specification

Electronically controlled DWHH Series Absorption Machine completely factory-packaged including evaporator, absorber, condenser, hermetic refrigerant pump & solution pump(#1,#2), vacuum pump, unit control panel, 1st generator, 2nd generator, low temperature heat exchanger, high temperature heat exchanger, exhaust gas heat exchanger, condensation refrigerant heat exchanger, absorption heat exchanger, Burner and all inter-connecting piping and wiring. Fuel train is delivered loose for site installation, and initial charge of absorbent(lithium bromide) and refrigerant(distilled water) is supplied with factory charged or separate-packaged for on-site charging.

EVAPORATOR
consists of a shell & tube heat-exchanger with Nozzle-in-head (NIH) type water boxes. And for a uniform and continuous distribution of refrigerant, non-clogging designed stainless steel tray is adopted.

The inside of water boxes is epoxy coated before the shipment. Each inlet and outlet is equipped with 150psig flanged connection, PT 1/2″ of drain nozzle and temperature sensor hole.

The heat-exchangers are inclusive of gaskets fitted on each header. The tubes are made of copper and are of notched floral type to increase the heat-transfer efficiency. All tubes are individually replaceable and straightly expanded on steel plates without welding. The standard outer diameter and thickness of the tubes are respectively 16 and 0.75 mm.

ABSORBER
consists of a shell & tube heat-exchanger with marine type hinged water boxes that can be opened from both sides of the chiller for easy inspection and maintenance. And for a uniform and continuous distribution of solutions, non-clogging designed stainless steel tray is adopted.

The inside of water boxes is epoxy coated before the shipment. Each inlet and outlet is equipped with 150psig flanged connection, PT 1/2″ of drain nozzle and temperature sensor hole.

The heat-exchangers are inclusive of gaskets fitted on each header. The tubes are made of copper and are of floral type to increase the heat-transfer efficiency. All tubes are individually replaceable and straightly expanded on steel plates without welding. The standard outer diameter and thickness of the tubes are respectively 16 and 0.6 mm.


Tray Performance Test

CONDENSER
consists of a shell & tube heat-exchanger with marine type hinged water boxes that can be opened from both sides of the chiller for easy inspection and maintenance.

The inside of water boxes is epoxy coated before the shipment. Each inlet and outlet is equipped with 150psig flanged connection, PT 1/2″ of drain nozzle and temperature sensor hole.

The heat-exchangers are inclusive of gaskets fitted on each header. The tubes are made of copper and are of prime type to increase the heat-transfer efficiency. All tubes are individually replaceable and straightly expanded on steel plates without welding. The standard outer diameter and thickness of the tubes are respectively 16~25 and 0.5~0.7 mm.

1ST GENERATOR (HIGH TEMP. GENERATOR)
consists of a liquid tube type heat-exchanger. The tubes are made of carbon steel(SPPS38) and 4.5 mm thick as a standard. The generator is supplied with level relays to constantly check the level of the absorbent solution and fusible plug & pressure switch as safety devices.

And for an inspection of flame condition and cleaning purpose, sight glass and inspection door is furnished.

2ND GENERATOR (LOW TEMP. GENERATOR)
consists of a shell & tube heat-exchanger with welded headers. The tubes are made of copper and are of low finned type to increase the heat-transfer efficiency. The standard outer diameter and thickness of the tubes are respectively 19.05 and 1.30 mm.

LT & HT SOLUTION HEAT EXCHANGERS
STANDARD COP chiller is equipped with shell & tube type high efficiency heat-exchanger made of spiral type cu-pro nickel(90/10) tubes for HT generator and copper tubes for LT generator.

HIGH COP chiller is equipped with welding type higher efficiency plate heat-exchangers. Plates are made of 0.4 mm thick stainless steel.

CONDENSATION REFRIGERANT HEAT EXCHANGER
is located between 2nd generator and condenser to recover more heat from the high temperature condensed refrigerant in 2nd generator. It consists of brazed type high efficiency plate heat-exchangers and are of stainless steel.

EXHAUST GAS HEAT EXCHANGER
is connected to exhaust gas outlet of 1st generator to recover more heat from the exhaust gas and heat up the diluted solution from LT solution heat exchanger. The tubes are made of carbon steel pipe and are of high

finned type to increase the heat-transfer efficiency. The standard outer diameter and thickness of the tubes are respectively 27.2 and 2.9 mm.

ABSORBER HEAT EXCHANGER

Absorber heat exchanger is newly added in DWHH series absorber, so efficiency of DWHH series is much greater than the previous series.

Product Specification(Cont)

SOLUTION PUMPS
World energy chillers are equipped with VVVF inverter driven solution pump to control the diluted solution flow. And HIGH COP chiller is equipped with 1(one) more solution pump for the control of concentrated solution flow from 2nd generator to the LT heat exchanger. All pumps are low-power consumed, self-contained, leak-proof, hermetic motor driven canned type pumps cooled by the same pumped fluid. The pumps are factory fitted with isolating valves on both suction and discharge sides to avoid the drainage of the solution in case of pump repair or maintenance. 20,000 hours of normal operation is guaranteed.


Canned type pump & Isolating Valves (Angle valves)

REFRIGERANT PUMPS
Low-power consumed, self-contained, leak-proof, hermetic motor driven canned type pumps cooled by the same pumped fluid. The pumps are factory fitted with isolating valves on both suction and discharge sides to avoid the drainage of the solution in case of pump repair or maintenance. 20,000 hours of normal operation is guaranteed

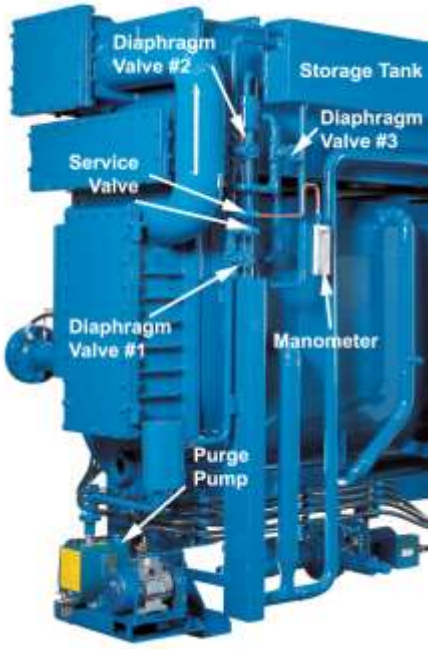
BURNER
It is low Direct ignition type, and automatically modulated according to load condition. The burner is delivered with factory-installed in high temp. generator and its fuel train is delivered in loose for preventing the damage during the transportation and can be simply installed and connected to fuel supply line at site. All burner-related components are properly installed and wired to the burner controller and alse chiller controller.


Burner Assembly

VACUUM PUMP (PURGE PUMP)
is equipped with belt-driven electrical motor. The pump is oil-lubricated and inclusive of oil level sight glass. First oil charge is included. The pump is also composed of air-intake valve for oil moisture removal and liquid trap on the suction line. The vacuum circuit is also composed of non-condensable gases storage tank, Ejector Device, pump liquid trap, diaphragm valves, vacuum Hg manometer, piping and service valve.

DIFFERENTIAL PRESSURE SWITCH
Chilled water differential pressure switch(or flow switch) shall be factory installed in the evaporator water nozzle chilled water flow detection. Cooling water flow switch shall be field installed or factory installed if customer requires and supplied by either the chiller manufacturer or the contractor/owner. And final adjustment must be done during the commissioning.

PURGE SYSTEM
An automatic purge system shall be provided to provide a continuous purging action whenever the chiller is in operation to assure long machine life and efficient performance. Non-condensable gas shall be removed from the absorber by a liquid eductor, which shall use flow from solution pump to create a suction. Non-condensable gas shall be stored external to the unit and shall be prevented from diffusing back into the machine when the unit is not operating. Evacuation of the external storage tank shall be accomplished by the use of a unit-mounted vacuum pump. The vacuum pump shall be factory mounted on the chiller and wired to the control panel by the chiller manufacturer.



Purging Unit

TEMPERATURE SENSORS
3(three) types of temperatures are used depending on the temperature levels: RTD_Low, RTD_Medium, RTD_High.

- Chilled water inlet & outlet temperature (RTD_Low)
- Cooling water inlet & outlet temperature (RTD_Low)
- Evaporator refrigerant outlet temperature (RTD_Low)
- Condenser refrigerant outlet temperature (RTD_Low)
- LT generator solution temperature (RTD_Low)
- HT generator solution temperature (RTD_Medium)
- Exhaust gas temperature (RTD_High)

Product Specification(Cont)

REFRIGERANT & ABSORBENT SOLUTION
The chiller is delivered together with lithium bromide solution(55wt% concentration) added with 300 ppm lithium molybdate as a corrosion inhibitor, demineralized water as a refrigerant and N-Octyl Alcohol(CH3(CH2)7OH) which will reduce surface tension and increase heat transfer. The refrigerant and absorbent solution is factory charged or supplied in 200liters plastic drums.

SIGHT GLASSES
Total 4(four) sight glasses are installed. One is installed on Evaporator to monitor refrigerant level and the other 2(two) are installed on Absorber and 1st generator to monitor solution levels.

DAMPERS
Total 3(three) dampers are provided for refrigerant and solution flow tuning at site. Different from STNADARD COP model, HIGH COP model 1(one) more damper is provided between concentrated heat exchanger and diluted discharge of diluted solution pump.

CHECK VALVES & SERVICE VALVES
are installed for service purpose such as solution sampling and etc.

QUALITY ASSURANCE
The chiller is designed and manufactured according to following codes:

- ARI Standard 560 (latest edition).
- ANSI/ASHRAE 15(latest edition)
- KS B 6271 (Korea Standard)
- JIS 8622 (Japanese Standard)
- UL (if required)
- CE/PED (if required)
  - 2006/42/EC (Machinery directive)
  - 2006/95/EC (Low Voltage directive)
  - 2004/108/EC (Electromagnetic Compatibility directive)
  - 97/23/EC (Pressure Equipment directive)

Each chiller shall undergo a series of standard factory tests to ensure that the unit is leak tight, that all electrical components operate as intended, and that every aspect of the unit fabrication meets stringent quality standards in accordance with good practice and the manufacturer's quality assurance requirements.

The shell side of each chiller shall be leak tested by pressurizing to 76kPa (11 psig) with nitrogen and then checked by spraying a soap/water mixture on all welds, tube joints, and/or gasket joints to identify any major leaks. Afterward, a mass spectrometer test shall be performed by evacuating the unit to 0.001mmHg absolute, covering the machine with a vinyl tent, and introducing helium gas under the tent. Any remaining leaks will allow the helium to be drawn into the shell side of the machine. The acceptable leak rate as measured by the mass spectrometer test shall not exceed 0.00001 cc/sec standard air.

The tube side of the evaporator, absorber, and condenser shall be hydrostatically tested at 1.5 times rated design pressure and held for one hour.

The refrigerant and solution pump/motors shall undergo standard factory tests to ensure proper head flow, and motor output characteristics.

All machine wiring shall undergo an insulation resistance test. The chiller control center and all electrical components shall also be functionally tested to verify continuity and proper electrical operation.

Final assembly inspection shall consist of verifying that all valves, controls, instrumentation, pumps, purge components, and all other machine components have been properly installed on the machine.

Each unit shall then be checked for overall appearance and dimensional accuracy.

Final inspection shall be performed on each unit to check that painting of the unit is as specified, name-plate data is correct, and that all accessories are furnished as required.

PRE-SHIPMENT FACTORY TEST
Leakage test with He(Helium) & N2(Nitrogen)
Hydraulic test
Electrical function test
Nitrogen gas charging

MACHINE SAFETY DEVICES
Machine safety and limit devices shall be included as follows:

- Chilled water temperature
- Chilled water flow
- Cooling water flow (optional)
- Fusible plug
- HT Generator temperature
- HT Generator pressure
- Motor winding temperature (refrigerant / solution pump)
- Motor amperage (refrigerant / solution pump)

ELECTRICAL REQUIREMENTS
Power supply to the unit shall be 3-ph, 60Hz with voltages of 380V, 400V, 440V, 460V or, 3-ph, 50Hz with 380V, 400V, 440V or 460V as specified on the equipment schedule. A multi-tap transformer shall provide single-phase and 24 DC secondary power for the control panel

Contractor shall supply and install the electrical power line and all auxiliary electrical protection devices per local code requirements and as indicated necessary by the chiller manufacturer.

POWER CONNECTION
A single point power connection is all that is required.

PIPING REQUIREMENTS
Piping and instrumentation for the chilled(hot) water, cooling water, burner's fuel inlet flange / generator's flue gas outlet flange, water discharge connections shall be supplied and installed by the contractor / owner.

THERMAL INSULATION (OPTION)
is provided optionally and shall be done with following materials:

- Hot Surfaces: Non-inflammable polymer sponge for high temp. usable up to max. 120°C
  Glass wool & Galvanized steel
- Cold Surfaces: Non inflammable polymer sponge.

SOUND LEVEL
The overall sound pressure level of the chiller shall not exceed 75dbA when measured per ARI Standard 575 (latest edition).

Product Specification(Cont)

START-UP (OPTION)

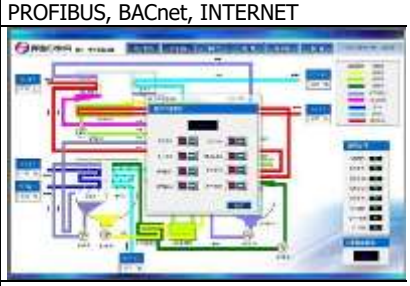
As an option with separate contract, a factory trained service engineer shall be dispatched to perform and/or supervise chiller pressure test (when required), charge chiller with refrigerant and lithium bromide solution, place unit into operation, and calibrate all controls in accordance with the manufacturer's written start-up, operating, and maintenance instructions.

After unit start-up has been performed, the operators shall be trained for proper start-up, operation, and maintenance procedures.

STANDARD SPARES

The following spares shall be delivered:

- Fuses
- Purge pump oils (2 Liters)
- Touch-up paint (2 Liters)

Item	Available
Special application design	Anti-freeze media on water circuits Low chilled water design (min. 4℃) Explosion-proof design Chemical plant heat recovery Outdoor installation design Marine application design
Certifications	CE, ISO(kmAR)
Water circuit connections	Flanged with ANSI or DIN or KS Victaulic connection
High pressure Water box	250psig, 300psig
Special tubing	Non-standard tube thickness, Material change (CuNi, Titanium)
BMS interface	MODBUS-RTU, MODBUS-TCP/IP PROFIBUS, BACnet, INTERNET
Remote monitoring & control s/w	
Cooling water flow detection	Differential pressure switch, Flow switch
Outdoor installation and/or Anti-freeze design	ENCLOSURE IP55 control cabinet Trace heater on EVA. 
Purge line back flow prevention valve	Solenoid valve on purge pump 
Control valve	Pneumatic * Motorized control valve
Safety device	Repture disc
Packing	Wooden boxing * Plastic cover packing is standard
Others	Dual fuel burner (GAS/OIL) Thermal insulation Foundation anchoring packages Vibration isolation package Sectional shipment (2~3 pieces) Warranty extension (Up to 3 yrs.) Installation supervision Commissioning & start-up

Performance Data

DWHH50~DWHH210

Model		Unit	DWHH 50	DWHH 60	DWHH 70	DWHH 80	DWHH 100	DWHH 120	DWHH 150	DWHH 180	DWHH 210
Cooling Capacity		kW	176	211	246	281	352	422	527	633	738
		usRT	50	60	70	80	100	120	150	180	210
Heating Capacity		kW	116	139	162	185	232	278	348	417	487
		Mcal/h	100	120	140	159	199	239	299	359	419
Chilled Water	Inlet/outlet Temp	℃	12 / 7								
	Flow rate	m^3/h	30.2	36.3	42.3	48.4	60.5	72.6	90.7	108.9	127.0
	Pressure Drop	mH_2O	7.5	6.9	6.3	6.9	5.9	6.1	8.0	8.2	7.6
	Connection	mm	80				100				125
Hot Water	Inlet/outlet Temp.	℃	56.8 / 60								
	Flow rate	m^3/h	30.2	36.3	42.3	48.4	60.5	72.6	90.7	108.9	127.0
	Pressure Drop	mH_2O	7.5	6.9	6.3	6.9	5.9	6.1	8.0	8.2	7.6
	Connection	mm	80				100				125
Cooling Water	Inlet/outlet Temp	℃	32 / 37.1								
	Flow rate	m^3/h	50	60	70	80	100	120	150	180	210
	Pressure Drop	mH_2O	7.3	6.1	8.0	7.6	7.3	7.7	9.9	10.4	11.5
	Connection	mm	100				125		150		
Gas	High Heating Value	$kcal/Nm^3$	10,400								
	Flow rate	Nm^3/h	11.0	13.2	15.4	17.6	22.0	26.4	33.0	39.7	46.3
	Inlet Pressure	mmH_2O	200			4000					
	Connection	mm	50 (200mmAq)			40 (4000mmAq)					
	Exhaust gas	mm	190x110	270x150		232 x 400				290x600	
Electric	Power source	-	3PH, 400V, 50Hz								
	Ref. Pump	kW(A)	0.2(1.2)								0.3(1.4)
	Abs.Pump1	kW(A)	1.2(3.8)				1.5(4.8)				2.0(5.7)
	Purge Pump	kW(A)	0.4(1.4)								
	Burner	kW(A)	0.37(1.4)		0.74(1.7)			1.5(4.6)			
	Control Panel	kW(A)	0.2(0.5)								
	Total kW	kW	2.4		2.7		3.0	3.8			4.4
	Total Ampere@400V	A	8.3		8.6		9.6	12.5			13.6
Size	Length (L)	mm	2,245	2,971					3,804		3,869
	Width (W)	mm	1,477		1,833		1,697		1,792		1,902
	Hight (H)	mm	1,901		1,997		2,202		2,202		2,460
Weight	Rigging	ton	2.7	2.9	3.4	3.6	4.5	4.8	5.7	6.2	7.2
	Operation	ton	2.9	3.1	3.7	3.9	5.0	5.3	6.3	6.8	8.0
Space tube Replacement		mm	1,900	2,400					3,400		

Note

1. HHV(Kcal/Nm³) : High heating value of driving gas
2. Working pressure of each water side is based on 1.0Mpa (150pisg)
3. Fouling factor 0.0001 m².hr.℃/Kcal for Absorber, Condenser and Evaporator.
4. Min. outlet temp. of chilled water: 5℃
5. Min. allowable inlet temp. of cooling water: 20℃.
6. Controllable range shall be 0~100%.
7. Available power sources (options): 220V, 380V, 440V and 460V with 50HZ or 60HZ.
8. Custom designed is available with modifications from the standard or redesign
   - Cooling capacity
   - Hating capacity & heating temperature
   - Dual fuel burner
   - Chilled and Cooling water circuit with anti-freezing additives
   - Higher working pressure
   - Special tubes and thicker shell material
   - Various operational temp. conditions
   - Higher delta t operation
   - Outdoor installation
9. The specifications above are subject to change without prior notice for an improvement of the chiller.

Performance Data

DWHH250~DWHH630

Model		Unit	DWHH240	DWHH 280	DWHH 320	DWHH 360	DWHH 400	DWHH 450	DWHH 500	DWHH 560	DWHH 630
Cooling Capacity		kW	844	985	1,125	1,266	1,407	1,582	1,758	1,969	2,215
		usRT	240	280	320	360	400	450	500	560	630
Heating Capacity		kW	556	649	742	834	927	1,043	1,159	1,298	1,460
		Mcal/h	478	558	638	718	797	897	997	1,116	1,256
Chilled Water	Inlet/outlet Temp	℃	12 / 7								
	Flow rate	m^3/h	145.2	169.3	193.5	217.7	241.9	272.2	302.4	338.7	381.0
	Pressure Drop	mH_2O	7.5	5.4	5.3	5.7	5.8	5.0	5.3	7.3	9.9
	Connection	mm	125	150				200			
Hot Water	Inlet/outlet Temp	℃	56.8 / 60								
	Flow rate	m^3/h	145.2	169.3	193.5	217.7	241.9	272.2	302.4	338.7	381.0
	Pressure Drop	mH_2O	7.5	5.4	5.3	5.7	5.8	5.0	5.3	7.3	9.9
	Connection	mm	125	150				200			
Cooling Water	Inlet/outlet Temp	℃	32 / 37.1								
	Flow rate	m^3/h	240	280	320	360	400	450	500	560	630
	Pressure Drop	mH_2O	10.2	8.3	7.9	8.1	8.2	8.2	8.3	11.3	15.3
	Connection	mm	150	200				250			
Gas	High Heating Value	kcal/Nm^3									
	Flow rate	Nm^3/h	52.9	61.7	70	79	88	99	110	123	139
	Inlet Pressure	mmH_2O									
	Connection	mm	50 (4000mmAq)								
	Exhaust gas	mm	290x600		360x310		410x310		412 x 670		
Electric	Power source	-									
	Ref. Pump	kW(A)	0.3(1.4)					0.4(1.4)			
	Abs.Pump1	kW(A)	2.0(5.7)			2.4(6.7)		3.0(8.6)			
	Purge Pump	kW(A)	0.4(1.4)								
	Burner	kW(A)	2.2(6.0)			5.5(13.0)					7.5 (15.8)
	Control Panel	kW(A)	0.2(0.5)								
	Total kW	kW	5.1			8.8		9.5			11.5
	Total Ampere@400V	A	15.0			23.0		24.9			27.7
Size	Length (L)	mm	3,869	4,919		5,077				5,739	6,219
	Width (W)	mm	1,902			2,200		2,510			
	Hight (H)	mm	2,460			2,557		2,723		2,793	
Weight	Rigging	ton	7.6	8.8	9.3	11.5	12.1	14.1	14.8	19.6	21.2
	Operation	ton	8.5	9.8	10.4	12.8	13.5	15.8	16.6	22.2	24.0
Space tube Replacement		mm	3,400	4,600						5,200	5,700

Note

1. HHV(Kcal/Nm^3) : High heating value of driving gas
2. Working pressure of each water side is based on 1.0Mpa (150pisg)
3. Fouling factor 0.0001 m^2.hr.℃/Kcal for Absorber, Condenser and Evaporator.
4. Min. outlet temp. of chilled water: 5 ℃
5. Min. allowable inlet temp. of cooling water: 20 ℃.
6. Controllable range shall be 0~100%.
7. Available power sources (options): 220V, 380V, 440V and 460V with 50HZ or 60HZ.
8. Custom designed is available with modifications from the standard or redesign
   - Cooling capacity
   - Hating capacity & heating temperature
   - Dual fuel burner
   - Chilled and Cooling water circuit with anti-freezing additives
   - Higher working pressure
   - Special tubes and thicker shell material
   - Various operational temp. conditions
   - Higher delta t operation
   - Outdoor installation
9. The specifications above are subject to change without prior notice for an improvement of the chiller.

Performance Data

DWHH700~DWHH1500

Model		Unit	DWHH 700	DWHH 770	DWHH 840	DWHH 900	DWHH 1000	DWHH 1100	DWHH 1200	DWHH 1300	DWHH 1400	DWHH 1500
Cooling Capacity		kW	2,461	2,708	2,954	3,165	3,516	3,868	4,220	4,571	4,923	5,274
		usRT	700	770	840	900	1,000	1,100	1,200	1,300	1,400	1,500
Heating Capacity		kW	1,622	1,785	1,947	2,086	2,318	2,549	2,781	3,013	3,245	3,476
		Mcal/h	1,395	1,535	1,674	1,794	1,993	2,192	2,392	2,591	2,790	2,990
Chilled Water	Inlet/outlet Temp.	℃	12 / 7									
	Flow rate	m^3/h	423.4	465.7	508.0	544.3	604.8	665.3	725.8	786.2	846.7	907.2
	Pressure Drop	mH_2O	9.4	12.0	15.1	9.0	11.9	15.1	11.4	14.3	8.6	10.6
	Connection	mm	200	250				300			350	
Hot Water	Inlet/outlet Temp.	℃	56.8 / 60									
	Flow rate	m^3/h	423.4	465.7	508.0	544.3	604.8	665.3	725.8	786.2	846.7	907.2
	Pressure Drop	mH_2O	9.4	12.0	15.1	9.0	11.9	15.1	11.4	14.3	8.6	10.6
	Connection	mm	200	250				300			350	
Cooling Water	Inlet/outlet Temp.	℃	32 / 37.1									
	Flow rate	m^3/h	700	770	840	900	1,000	1,100	1,200	1,300	1,400	1,500
	Pressure Drop	mH_2O	11.9	13.4	14.0	8.8	14.8	15.8	14.1	13.4	13.6	14.1
	Connection	mm	300				350		400		450	
Gas	High Heating Value	kcal/N m^3										
	Flow rate	Nm^3/h	154	170	185	198	220	242	264	286	308	330
	Inlet Pressure	mmH_2O										
	Connection	mm	50 (4000mmAq)				65 (4000mmAq)					
	Exhaust gas	mm	400x620				400x900					
Electric	Power source	-	3PH, 400V, 50Hz									
	Ref. Pump	kW(A)	0.4(1.4)			1.5(4.0)					1.8(6.0)	
	Abs.Pump1	kW(A)	4.5(12.4)			5.5(14.3)			4.5(15.2)		5.5(19.0)	
	Purge Pump	kW(A)	0.4(1.4)						0.75(2.2)			
	Burner	kW(A)	7.5(15.8)				11.0(22.0)				15.0(29.3)	
	Control Panel	kW(A)	0.2(0.5)									
	Total kW	kW	13.0			15.1	18.6		18.0		23.3	
	Total Ampere@400V	A	31.5			36.0	42.2		43.9		57.0	
Size	Length (L)	mm	6,231	6,836	7,230	6,230	6,829	7,449	6,920	7,420	7,197	7,697
	Width (W)	mm	2,760	3,281			3,290	3,880			4,420	
	Hight (H)	mm	3,020			3,171		3,940			4,000	
Weight	Rigging	ton	22.7	25.0	28.7	30.6	32.9	40.4	43.4	46.0	50.1	52.7
	Operation	ton	25.7	28.0	32.0	35.5	37.1	45.1	48.5	51.5	56.1	59.1
Space tube Replacement		mm	5,700	6,300	6,700	5,700	6,300	6,700	6,300	6,700	6,300	6,700

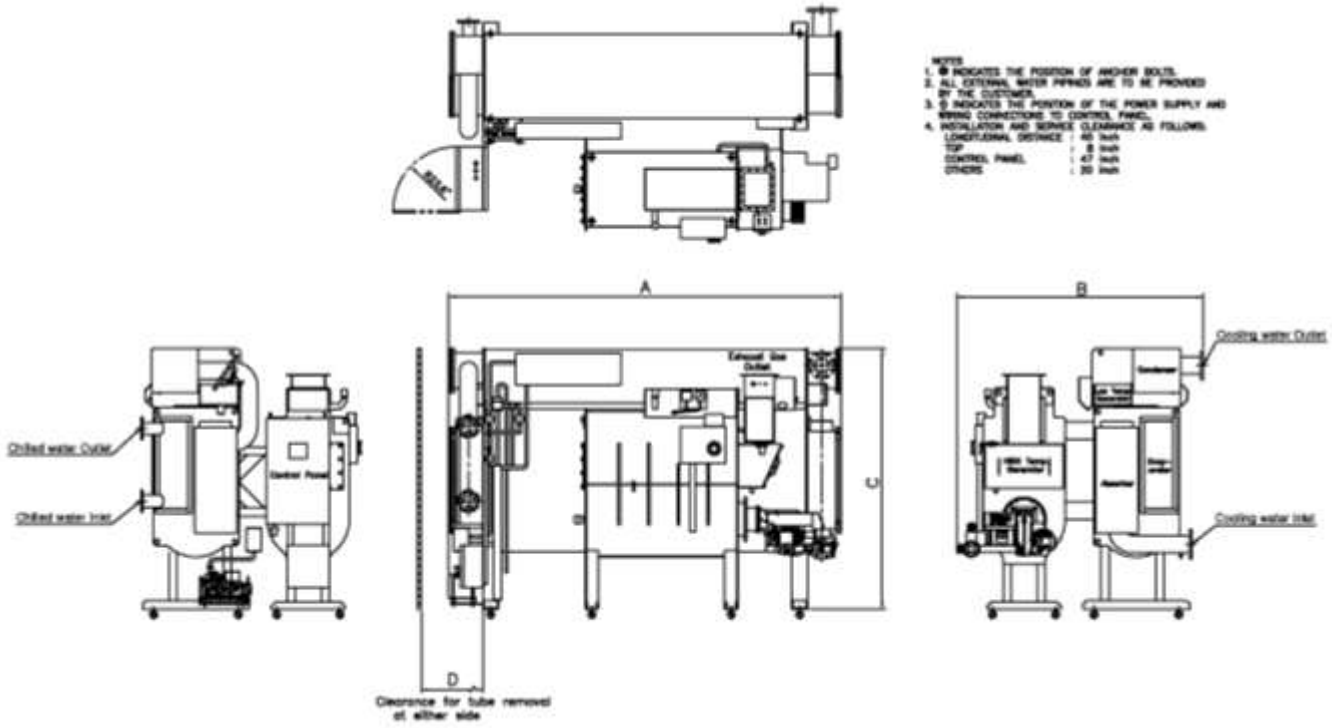
Note

1. HHV(Kcal/Nm³) : High heating value of driving gas
2. Working pressure of each water side is based on 1.0Mpa (150pisg)
3. Fouling factor 0.0001 m².hr.℃/Kcal for Absorber, Condenser and Evaporator.
4. Min. outlet temp. of chilled water: 5 ℃
5. Min. allowable inlet temp. of cooling water: 68 ℉.
6. Controllable range shall be 0~100%.
7. Available power sources (options): 220V, 380V, 440V and 460V with 50HZ or 60HZ.
8. Custom designed is available with modifications from the standard or redesign
   - Cooling capacity
   - Hating capacity & heating temperature
   - Dual fuel burner
   - Chilled and Cooling water circuit with anti-freezing additives
   - Higher working pressure
   - Special tubes and thicker shell material
   - Various operational temp. conditions
   - Higher delta t operation
   - Outdoor installation
9. The specifications above are subject to change without prior notice for an improvement of the chiller.

Dimensions

DWHH Series

Unit : mm



	DWHH 50	DWHH 60	DWHH 70	DWHH 80	DWHH 100	DWHH 120	DWHH 150	DWHH 180	DWHH 210	DWHH 240	DWHH 280	DWHH 320	DWHH 360	DWHH 400
A	2245	2971					3804		3869		4919		5077	
B	1477		1833		1697		1792		1902				2200	
C	1901		1997		2202				2460				2557	
D	1900	2400					3400				4600			

	DWHH 450	DWHH 500	DWHH 560	DWHH 630	DWHH 700	DWHH 770	DWHH 840	DWHH 900	DWHH 1000	DWHH 1100	DWHH 1200	DWHH 1300	DWHH 1400	DWHH 1500
A	5077		5739	6219	6231	6836	7230	6230	6829	7449	6920	7420	7197	7697
B	2510				2760	3281		3281	3290	3880			4420	
C	2723		2793		3020			3171		3940			4000	
D	4600		5200	5700		6300	6700	5700	6300	6700	6300	6700	6300	6700

Control System

Unit Controller is factory mounted, wired and tested to ensure a protection of the Machine, and efficient capacity control. The program logic provides proper Start/Stop of the Machine and also enables a communication interface with BMS.

A Programmable Logic controller monitors and controls all operations of the machine. The Programmable Logic controller system matches the cooling capacity of the machine to the cooling load while providing state of machine protection.

The control system controls the operation of the machine by monitoring all operating conditions. The Programmable Logic controller panel can diagnose a problem and let the operator know what the problem is and what to check. It can interface with auxiliary equipment such as pumps and cooling tower fans. It continually checks all safeties to prevent any unsafe operating condition.

- **» Component test and diagnostic check**
- **» Menu-driven touch keypad interface for status Status display, set-point control and system configuration**
- **» Primary and secondary status messages**
- **» Password protected**
- **» Recall of up to 200 alarm and warning messages**
- **» Extensive diagnostic and service capabilities**
- **» Advanced crystallization preventive algorithm**
- **» Improved solution flow control**

HARDWARE

- Programmable Logic controller
  - » SIEMENS PLC Controller
- Built-in Touch Screen LCD (7" Color)
- VVVF inverter with isolated cabinet
- IP52 Protection Grade Cabinets
- Step-down transformer
- Indication lamps for chiller & pumps status and alarm
- Selector Switch for purge pump operation, operation reset and emergency chiller stop
- Buzzer On/Off selector switch

USER INTERFACE

- Interlock with Chilled(hot) water pump and cooling water pump
- Chiller Start/Stop and chilled water temp. setting
- Cooling tower Fan ON/OFF or speed control
- MODBUS, PROFIBUS, BACnet, INTERNET (Option)

CAPACITY CONTROL

The cooling capacity is automatically controlled within the chilled (hot) water set point temperature plus the dead-band by sensing the leaving chilled water and regulating flow and direction of the driving exhaust gas via the diverter valve blades, which are mechanically linked with actuator,

REMOTE START/STOP CONTROL

A remote device, such as a time clock which uses a set of contacts, may be used to start and stop the chiller.

COOLING TOWER-FAN RELAY

The cooling tower-fan relay can be controlled when cooling water inlet temperature is low. The temperature setting point is adjustable in the range 15 ~ 30°C(60 ~ 85°F).

AUTO RESTART AFTER POWER FAILURE

If the control power is interrupted during operation, the chiller stops immediately without the normal shutdown sequence and dilution. Solution crystallization can occur if the concentration is high (chiller was operating with a relatively large load). The machine will start automatically when the power is back on.

SPARE SAFETY INPUTS

Normally closed (NC) digital inputs for additional field-supplied safeties may be wired to the spare protective limits input channel in place of the factory-installed jumper. (Wire multiple inputs in series.) The opening of any contact will result in a safety shutdown and controller display.

SAFETY CONTROL

The Control panel monitors all safety control inputs and if required shuts down the chiller or stops solution pump to protect the chiller from possible damage from any of the critical conditions. The controller screen displays the messages if the controller starts safety controls to stop, the alarm relay operates and alarm indicator is brink. The alarm is saved in the controller alarm table to correct the problems.

SIEMENS POL635 Controller

LCD Touch Screen

Control Panel

SAFETY CUTOUTS

- Solution pump(s) motor OVERLOAD/ temp. HIGH
- Refrigerant pump motor OVERLOA/ temp. HIGH
- Low Chilled water Outlet Temperature Cutout
- Low Refrigerant Temperature Cutout
- Low Cooling Water Inlet Temperature Cutout
- Low Chilled Water Flow Cutout
- Low Cooling Water flow Cutout (Option)
- High 1st generator solution outlet Temperature Cutout
- 1st generator pressure High
- 1st generator solution level Low
- High 2nd generator solution outlet Temperature Cutout
- High Exhaust gas outlet Temperature Cutout
- Burner ignition failure
- Burner Alarm
- Emergency Stop

PROTECTIVE LIMITS

- Max. Allowable Cooling Water Inlet Temperature
- Max. Allowable 1st generator Absorbent Temperature
- Max. Allowable Absorbent Concentration
- Low Chilled Water Temperature

TEMPERATURE SENSOR FAULTS

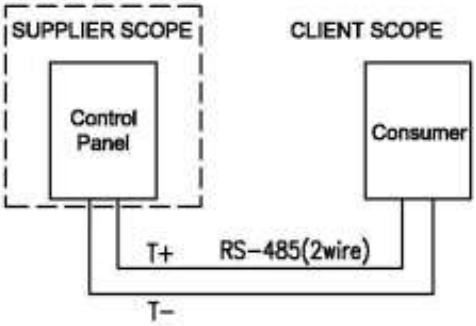
- Chilled water Outlet Temperature.
- Cooling water Inlet Temperature.
- Refrigerant Evaporator Temperature.
- Refrigerant Condenser Temperature.
- 1st generator solution Outlet Temperature
- 2en generator solution Outlet Temperature.
- Exhaust gas Outlet Temperature.

OPERATION STATUS DISPLAY

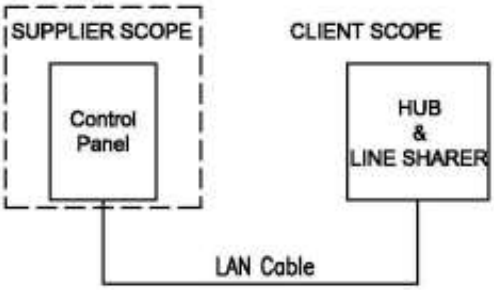
- Chilled water inlet & outlet Temperature.
- Cooling water inlet & outlet Temperature.
- Driving exhaust gas outlet Temperature.
- 1st Generator Temperature.
- 2nd Generator Temperature.
- Condenser Temperature.
- Evaporator Temperature.
- Temperature setting
- Various status of chiller operation
- Status of Burner capacity control mode
- Concentration percentage
- Diluted solution pump inverter frequency
- Opening percentage of the Burner capacity
- Status of the chiller's auxiliaries
- User's auxiliaries status (if available from the user)
- Date and time
- Absorption chiller's dilution cycle at shutdown
- No. of operating hours
- No. of starts
- Alarm ranges settings
- Alarm data log
- Graphical display of chilled water temp. trend
- PID logic and other service-related parameters
- Operation Schedule
- Safety shutdown message
- Display language selection
- Diluted solution pump inverter frequency

Communication

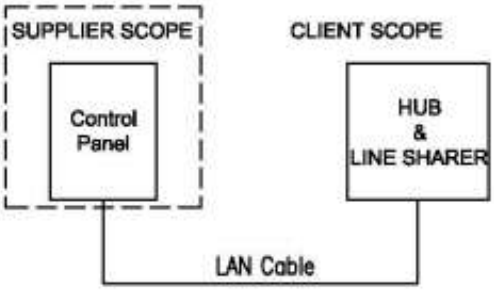
1.MODBUS-RTU



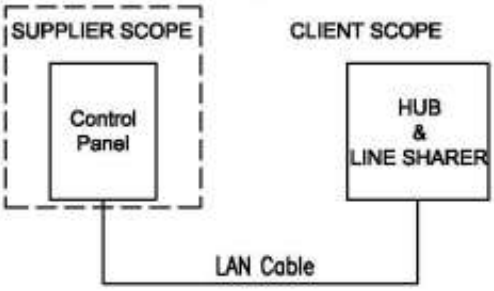
4.BACnet



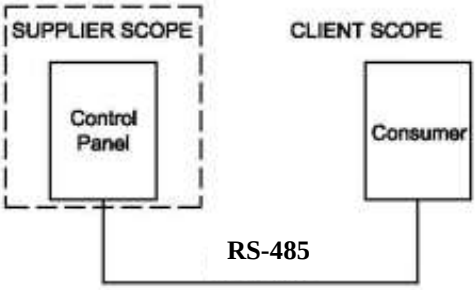
2.MODBUS-TCP



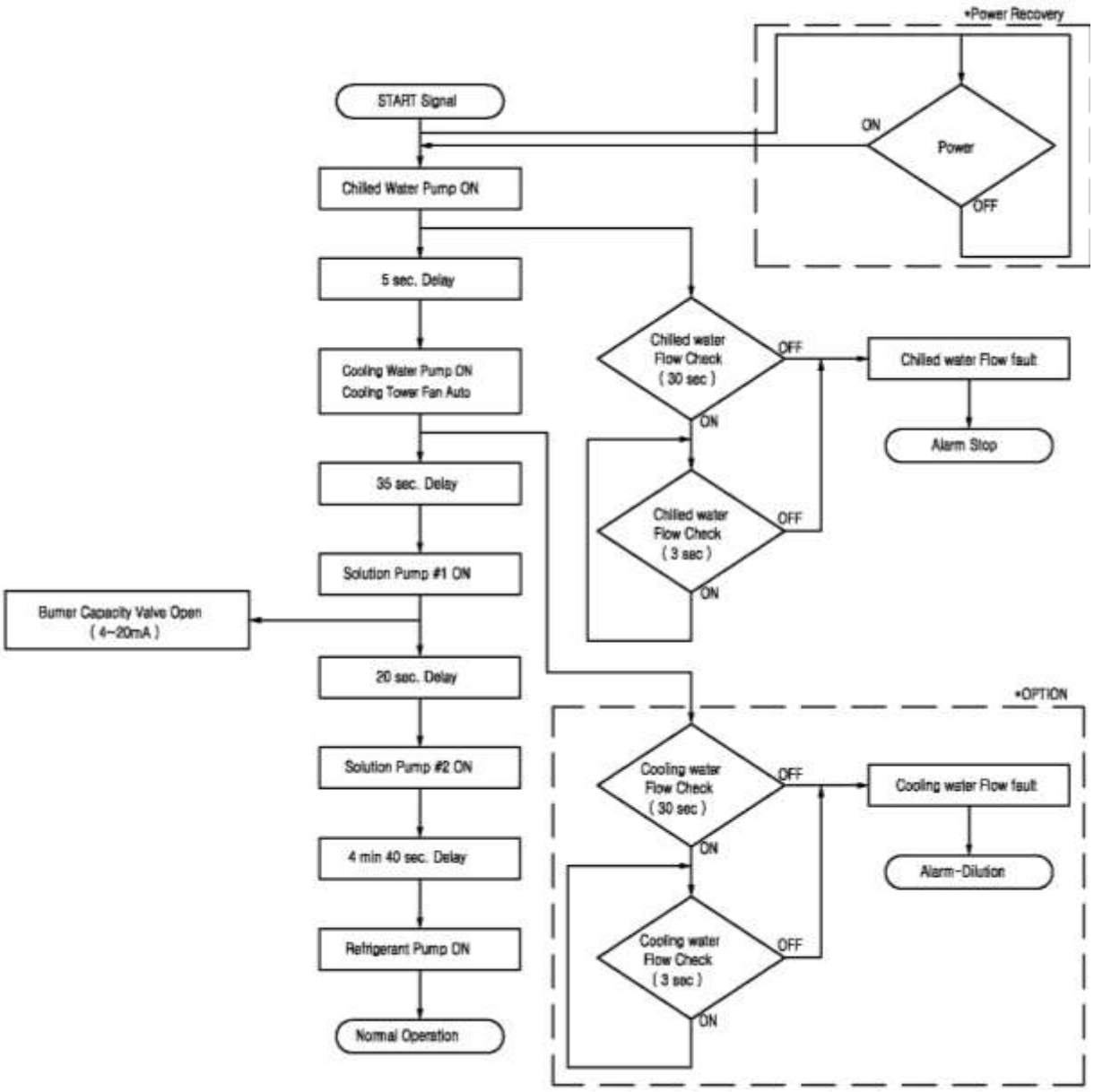
5.INTERNET KIT(PLC)



3.PROFIBUS

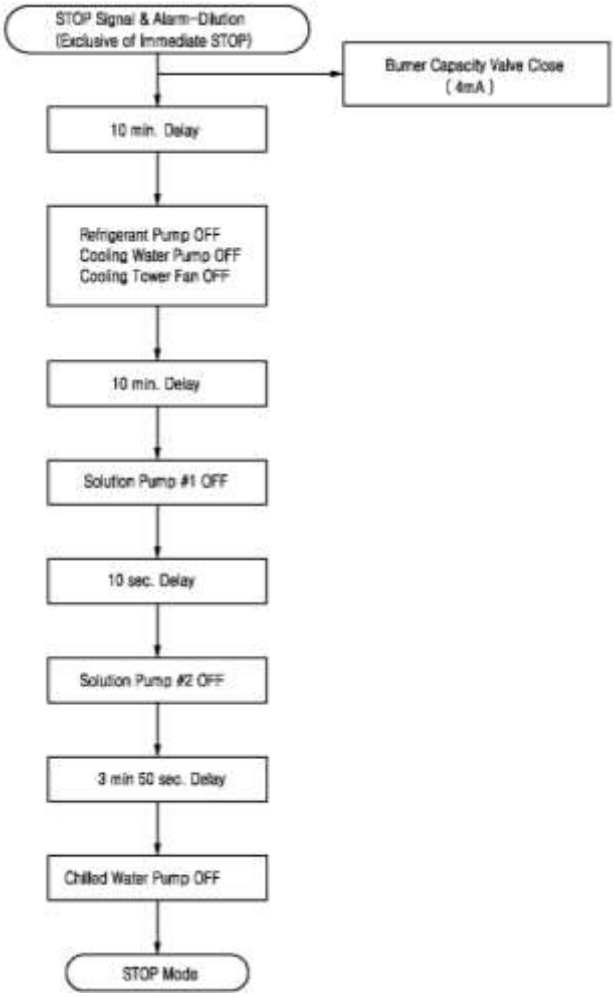


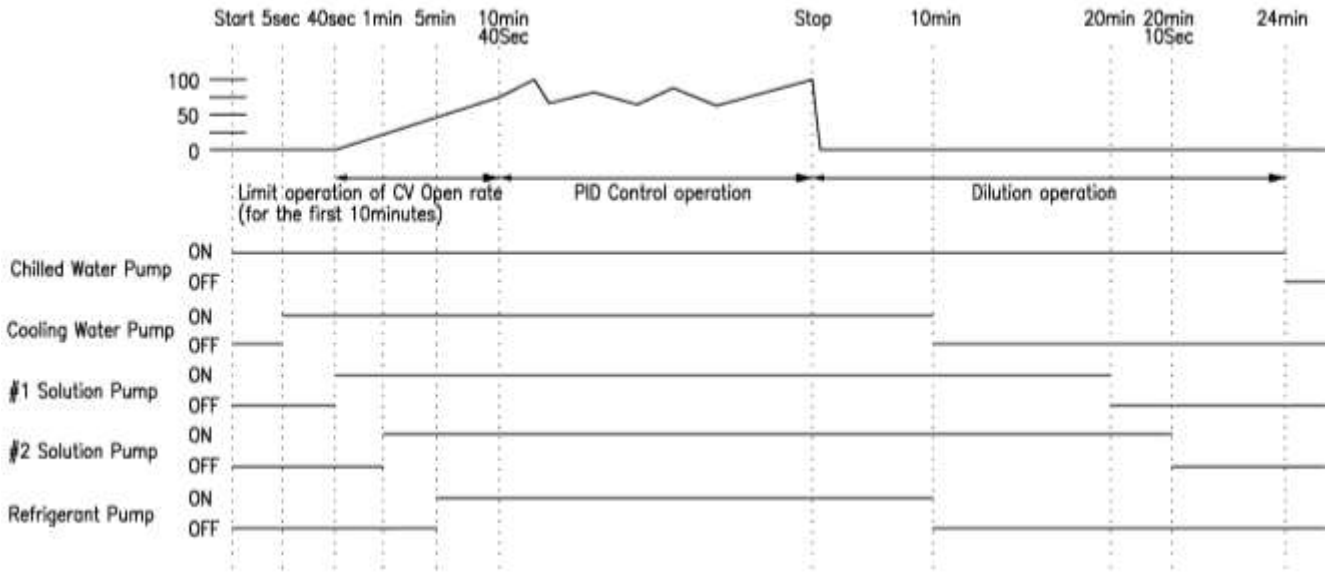
Start-up Sequence



* The time delay above depends on the relevant time setting which is decided during start-up.

Stop Sequence

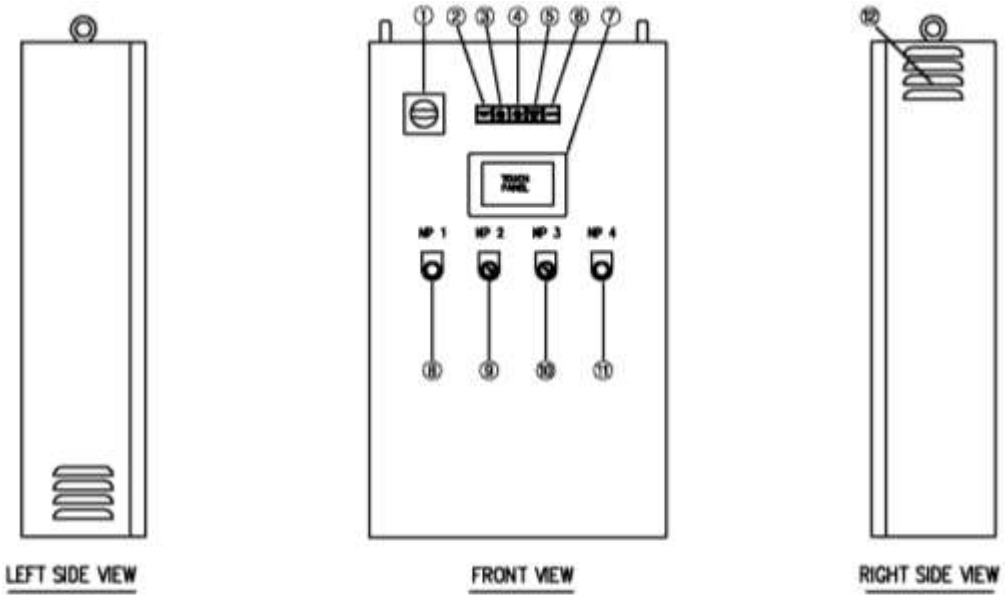


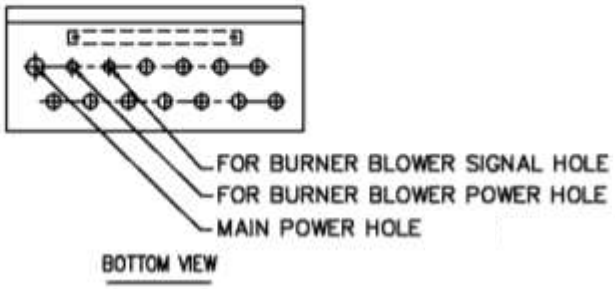


<Operation Graph>

Control Panel

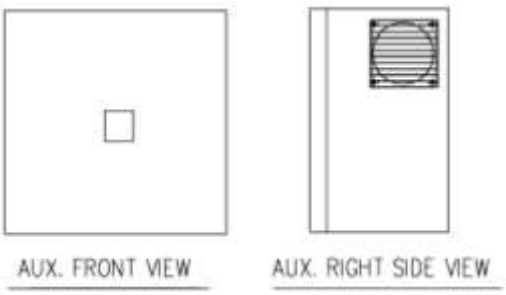
>> Main Control panel Cabinet



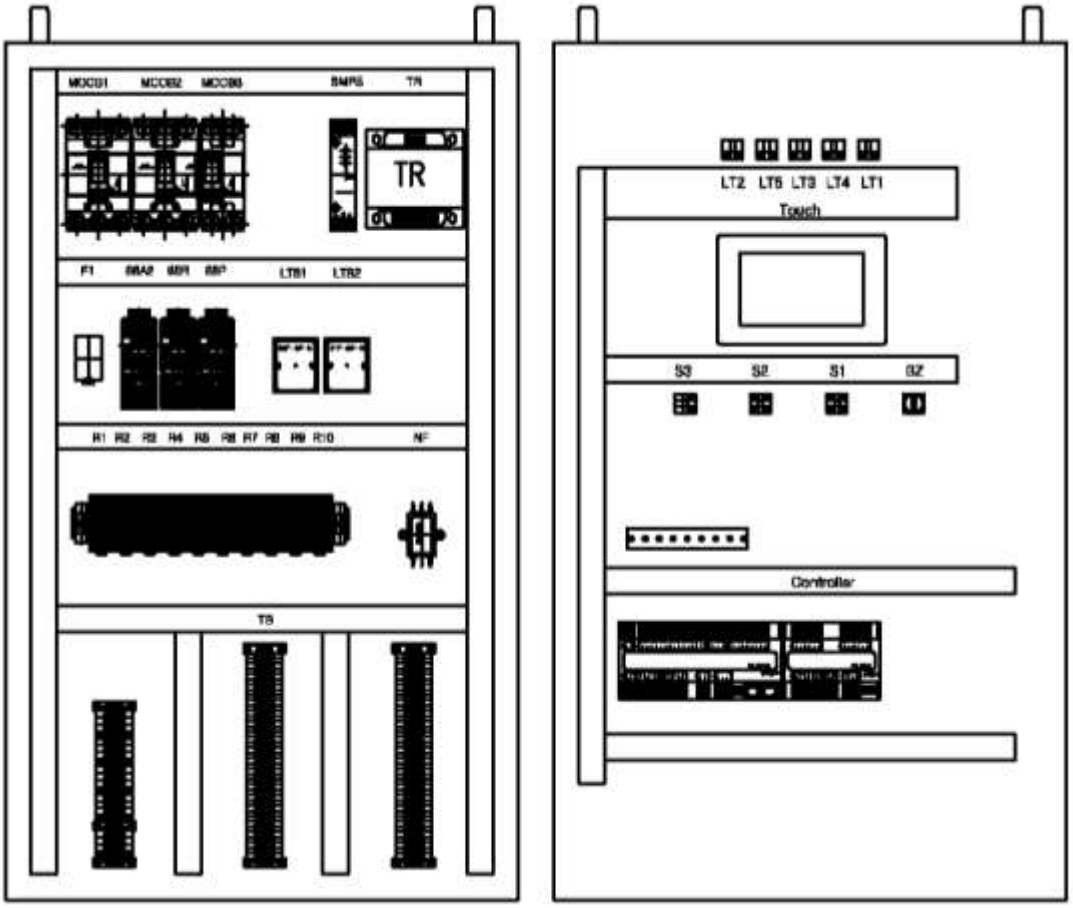


NO.	SYMBOL NAME	DESCRIPTION
1	Q1	DISCONNECT SWITCH
2	LT1	SYSTEM RUN LIGHT
3	LT4	SOLUTION PUMP LIGHT
4	LT3	REFRIGERANT PUMP LIGHT
5	LT5	PURGE PUMP LIGHT
6	LT2	TOTAL ALARM LIGHT
7	TOP	TOUCH OPERATION PANEL
8	BZ	BUZZER
9	S1	BUZZER ON/OFF SELECTOR SWITCH
10	S2	PURGE PUMP START/STOP SELECTOR SWITCH
11	S3	EMERGENCY STOP
12	CF	COOLING FAN

>> Inverter panel Cabinet



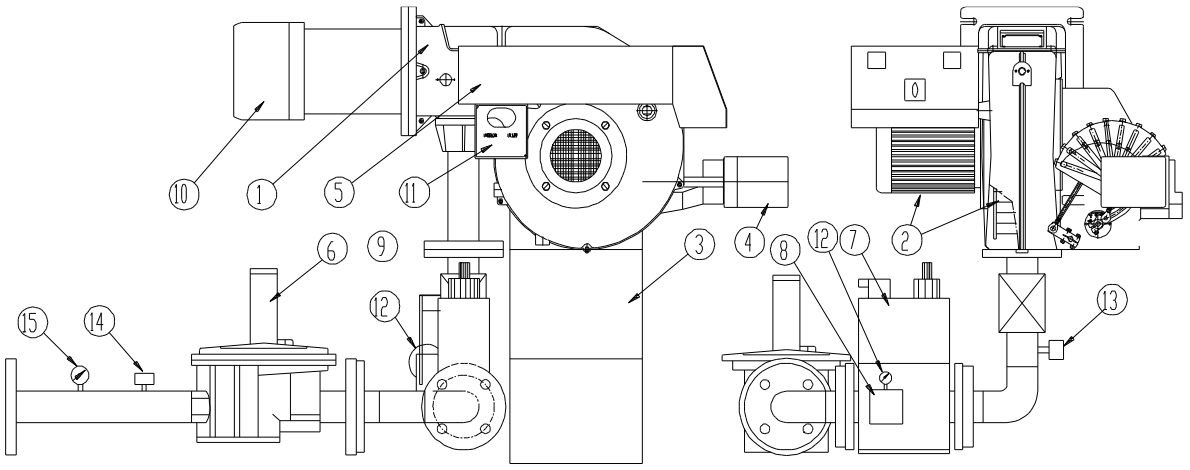
Control Panel – Inside View



NO.	SYMBOL NAME	NAME OF INSTRUMENT	Q'TY
1	MCCB1	MAIN POWER CIRCUIT BREAKER	1
2	MCCB2	BURNER POWER CIRCUIT BREAKER	1
3	MCCB3	CONTROL CIRCUIT BREAKER	1
4	TR	TRANSFORMER	1
5	88A2	SOLUTION PUMP2 CONTACTOR	1
6	88R	REFRIGERANT PUMP CONTACTOR	1
7	88P	PURGE PUMP CONTACTOR	1
8	51A2	SOLUTION PUMP2 OVERLOAD RELAY	1
9	51R	REFRIGERANT PUMP OVERLOAD RELAY	1
10	51P	PURGE PUMP OVERLOAD RELAY	1
11	F1	POWER FUSE	1
12	R1~R10	RELAY	10
13	NF	NOISE FILTER	1
14	SMPS	DC POWER SUPPLY	1
15	TB	TERMINAL BLOCK	
16	LTS1	G1 LEVEL CONTROL RELAY HIGH	1
17	LTS2	G1 LEVEL CONTROL RELAY LOW	1
18	PLC	CONTROLLER	1
19	LT1~5	PILOT LAMP	5
20	S1~S3	SELECTOR SWITCH	3
21	BZ	BUZZER	1
22	TOP	TOUCH SCREEN	1

Burner

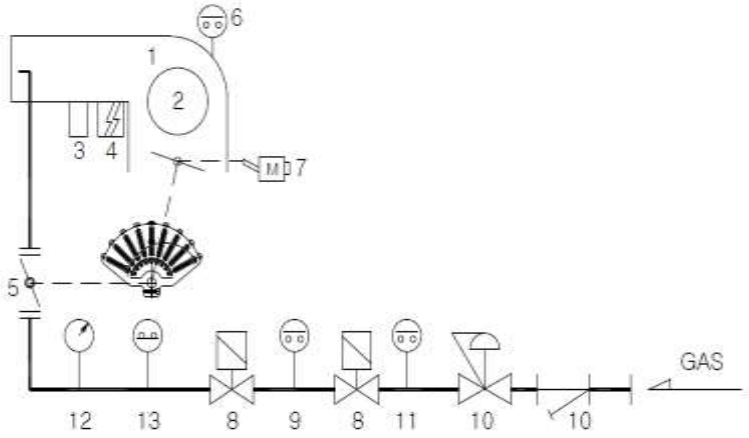
Burner Construction (with Gas Train)



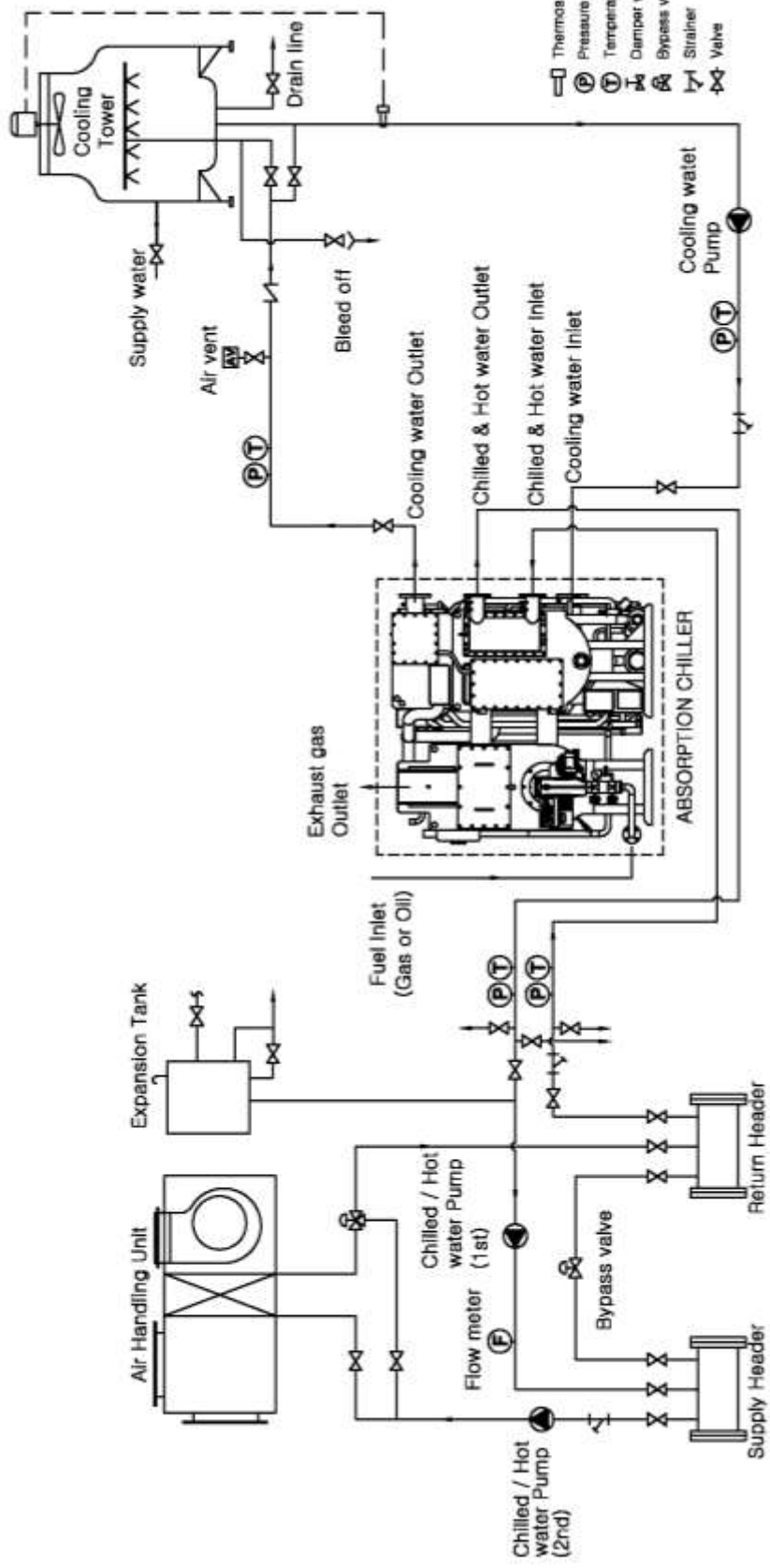
1. Burner Body
2. Blower
3. Silencer
4. Damper Motor
5. Control Panel
6. Governor & Filter
7. Gas Solenoid Valve
8. Gas Leak Check Switch
9. Blast Valve
10. Blast Tube
11. Protect Relay
12. Gas Pressure Gauge
13. Gas Pressure Switch
14. Gas Pressure Switch
15. Gas Pressure Gauge

Typical Piping Diagram of Gas Burner

NO.	DESCRIPTION
1	BURNER BODY
2	BLOWER
3	FLAME DETECTOR
4	IGNITION TRANS FORMER
5	BUTTERFLY VALVE
6	AIR PRESSURE S/W
7	DAMPER MOTOR
8	GAS SOLENOID VALVE
9	GAS LEAK CHECK S/W
10	GAS GOVERNOR & FILTER
11	GAS PRESSURE LOW S/W
12	GAS PRESSURE GAUGE
13	GAS PRE SSURE HIGH S/W
14	BURNER CONTROL
15	SIGNAL CONVERTOR

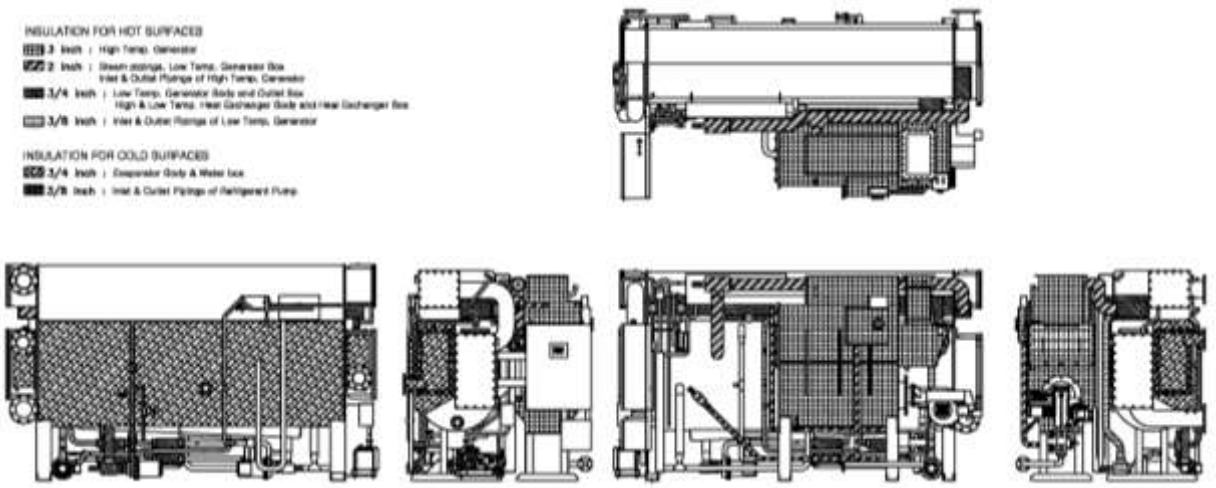


System Piping



1) All external equipment out of dotted line is scope of customer´s.
2) Refer to outline drawing and specification data sheet for the external dimensions of the machine, the location & the diameter of water pipe and Natural Gas pipe connections.
3) The locations of chilled water pump, cooling water pump are determined in consideration of the hydrostatic head of pumps and the height of building. And the Machine shall not be subject to a pressure higher than the designed pressure at any water header.
4) The stop valves at Natural Gas Pipes shall be installed.
5) For cooling water quality control, it is recommended to install cooling water bleed-off device on the inlet pipe line of cooling towers.
6) Around 10 meshes of strainers are recommended to be installed in the cooling water line.
7) For the maintenance and the inspection of the Machine, the following equipment shall be installed on each chilled water and cooling water inlet/outlet lines as well as stop valve.
8) Thermometers and pressure gauges shall be installed at chilled and cooling water inlet/outlet.
9) Air relief valves shall be installed on each chilled and cooling water lines at higher points than each water heaters.
10) Drain valves shall be installed at the lowest position between the stop valves of chilled and cooling water and the Machine and the drain valve shall be pipes to the drain ditch.
11) There shall be a sufficient clearance for access to the absorber, evaporator, condenser, and generator to facilitate inspection and cleaning work

Thermal Insulations



Notes

1. Use only non-inflammable or incombustible insulation materials.
2. Do not insulate motor of refrigerant pump and fusible plug
3. Total insulation are includes piping.
4. Do not cover all valves, dampers, sight glasses, temperature sensors and its wells.

Model	Hot Surface (ft^2)				Cold Surface (ft^2)	
	3inch	2inch	3/4inch	3/8inch	3/4inch	3/8inch
DWHH50	61.4	9.7	29.1	4.3	28.0	3.2
DWHH60	61.4	9.7	29.1	4.3	28.0	3.2
DWHH70	64.6	9.7	36.6	4.3	28.0	3.2
DWHH80	64.6	11.8	36.6	4.3	28.0	3.2
DWHH100	67.8	19.4	45.2	7.5	38.8	3.2
DWHH120	74.3	19.4	46.3	7.5	38.8	3.2
DWHH150	87.2	23.7	67.8	7.5	51.7	3.2
DWHH180	93.6	23.7	67.8	7.5	51.7	3.2
DWHH210	108.7	23.7	76.4	9.7	62.4	3.2
DWHH240	117.3	23.7	76.4	9.7	62.4	4.3
DWHH280	128.1	26.9	89.3	11.8	76.4	4.3
DWHH320	135.6	26.9	89.3	11.8	76.4	4.3
DWHH360	156.1	32.3	98.0	12.9	85.0	4.3
DWHH400	164.7	32.3	98.0	12.9	85.0	4.3
DWHH450	188.4	33.4	108.7	12.9	118.4	4.3
DWHH500	198	33.4	108.7	12.9	118.4	4.3
DWHH560	215.3	80.7	122.7	15.1	145.3	6.5
DWHH630	229.3	89.3	131.3	15.1	161.5	7.5
DWHH700	241.1	99.0	139.9	16.1	172.2	7.5
DWHH770	269.1	107.6	145.3	16.1	177.6	9.7
DWHH840	301.4	118.4	152.8	17.2	193.8	11.8
DWHH900	312.2	123.8	155.0	17.2	199.1	12.9
DWHH1000	331.5	139.9	160.4	18.3	215.3	12.9
DWHH1100	395.0	166.8	147.5	18.3	239	15.1
DWHH1200	416.6	180.8	150.7	18.3	242.2	15.1
DWHH1300	438.1	195.9	153.9	19.4	251.9	15.1
DWHH1400	489.8	194.8	157.1	19.4	286.3	16.1
DWHH1500	505.9	211	162.5	19.4	297.1	16.1

Water Quality

The cooling water which is recycled by cooling tower is exposed into atmosphere and polluted as it is vaporized. If the cooling water gets polluted, it develops corrosion and also scale inside the tubes and Absorption Machine performance drops.

Therefore, it is recommended to control the water quality; the following table shows guideline for cooling water and make-up water. The tube cleaning method and interval depends on each water quality.

Items		Cooling Water	Make-up Water	Tendency	
				Corrosion	Scale
Standard	PH(77 °F)	6.5 ~ 8.0	6.5 ~ 8.0	O	O
	Conductivity (77 °F, s/cm)	Max. 800	Max. 200	O	O
	Chloride ion Cl (mg / cl /liter)	Max. 200	Max. 50	O	
	Sulfuric acid ion $SO_4$2-(mg $CaCo_3$ /liter)	Max. 200	Max. 50	O	
	Alkalinity pH4.8 (mg $CaCo_3$ /liter)	Max. 100	Max. 50		O
	Total hardness (mg $CaCo_3$ /liter)	Max. 200	Max. 50		O
Reference	Iron Fe (77 °F)	Max. 1.0	Max. 0.3	O	
	Sulfides S^{2-} ion(ms S^{2-}/liter)	No trace	No trace	O	
	Ammonium ion NH_4+(mg NH_4+/liter)	Max. 1.0	Max. 0.2	O	
	Silica SiO (mg SiO_2 /liter)	Max. 50	Max. 30		O

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