Summary

1. Introduction

Conventional, mechanical compression refrigeration is used in many different ways and is well proven, with a good support network of suppliers and maintenance companies. It is unlikely that absorption cooling will replace conventional systems on a large scale, but there are many applications where it can offer an environmentally and economically superior alternative. Generally speaking, absorption cooling is worth considering if one of the following factors apply:

• There is a cogeneration plant and it is not possible to use all the available heat, or there is a new cogeneration plant under design.

• Waste heat is available

• A low cost source of fuel is available (for example gas)

• Plant boiler efficiency is low due to a poor load factor (particularly in summer)

• It is not possible to satisfy the electrical load of the plant

• The site is particularly sensitive to noise and vibrations.

• The site needs more cooling but has an electrical load limitation that is expensive to overcome, and there is an adequate supply of heat.

In short, absorption cooling will find its application when a source of free or low cost heat is available, and/or if there are objections to the use of conventional refrigeration.

TYPES OF ABSORPTION CHILLERS

There are several types of absorption chillers; the two basic ones are:

1. Lithium bromide/water systems

2. Ammonia/water systems

THERMAX absorption chillers belong to the first category: water is the refrigerant and lithium bromide is the absorbent.

WORKING PRINCIPLE

Absorption chillers operate on the basis of three well known physical phenomena:

A. When a liquid evaporates (or boils) it absorbs heat, and when it condenses it gives up heat.

B. Boiling temperature of a liquid is a function of the pressure: as pressure decreases, boiling temperature decreases.

C. There are some pairs of chemicals that have a strong affinity to dissolve in one another.

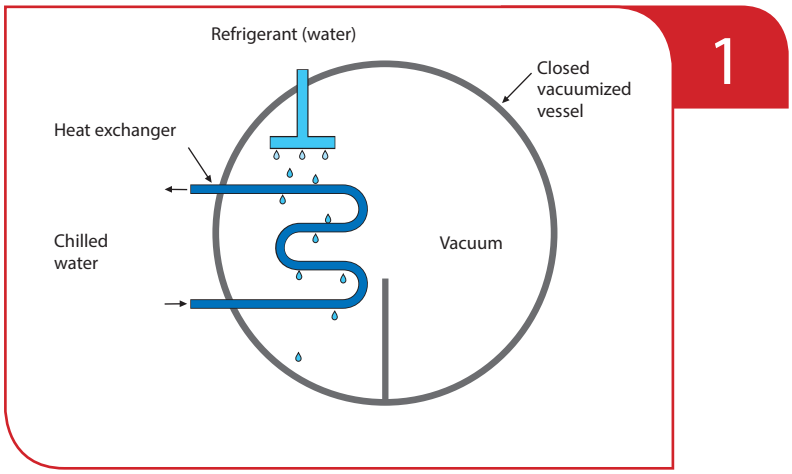
In a conventional mechanical vapour compression cycle; the refrigerant evaporates at a low pressure producing cooling. This is then compressed in a mechanical compressor to a higher pressure, where it condenses. In most machines on the market the compressor is powered by an electric motor.

In an absorption chiller the evaporator and condenser are essentially the same, but a chemical absorber and a thermal generator replace the compressor but with a pump to provide pressure change. As a pump requires much less power than a compressor; electrical power consumption is much lower.

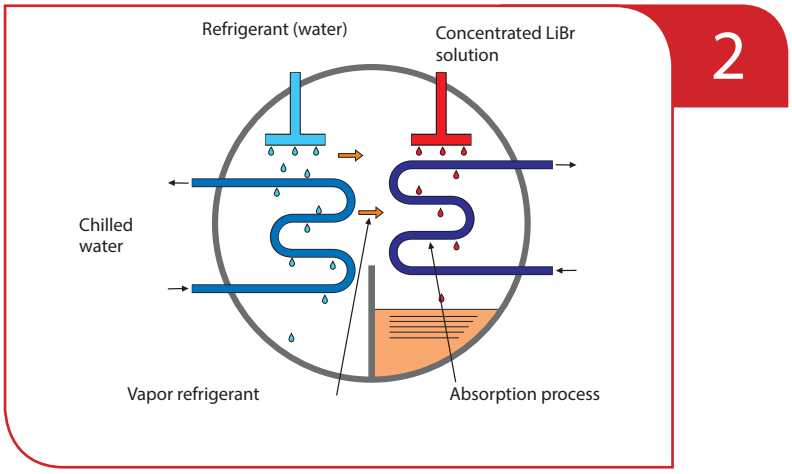
Let's see how the physical basics illustrated above are used in an absorption chiller.

1. Introduction

1. Assume a tube bundle within a closed vessel. In these tubes there is water flowing that needs to be chilled. In the vessel surrounding the tube bundle there is a vacuum. As mentioned previously; as the pressure decreases the boiling point of water also decreases. If the vacuum inside the vessel is 0.8kPa then water will boil at approximately 3,7°C. If we spray water onto the outside of the tube bundles then this spray of water will evaporate on contact, as long as the water in the tube is above 3,7°C. When this water spray evaporates it removes heat from the water flowing inside the tubes. This produces a cooling effect. This section of the vessel is called the EVAPORATOR



2. In reality, the above process will stop working very quickly if this vessel fills with water vapor. As more of the spray begins to evaporate then the vapor will linger in the vessel which increases the overall pressure. As this pressure builds, the boiling temperature also increases. This is until this spray is no longer evaporating on contact with the tube bundle. Once the spray stops evaporating you will lose the cooling effect. This issue is solved using lithium bromide. Lithium bromide has a great affinity to water as it is a hydroscopic compound (it attracts water). If there is another spray of lithium bromide within the same vessel then this lithium bromide will absorb water vapour building up inside the shell. This means that the pressure inside the vessel will stay constant and allows the cooling process to continue. The reaction between lithium bromide and water is exothermic which means heat is generated. This heat must be removed from the system, so there is a second tube bundle in the vessel which has a cooling water flow inside. This keeps the temperature inside the vessel constant. The section of the vessel with this second tube bundle is called the ABSORBER.



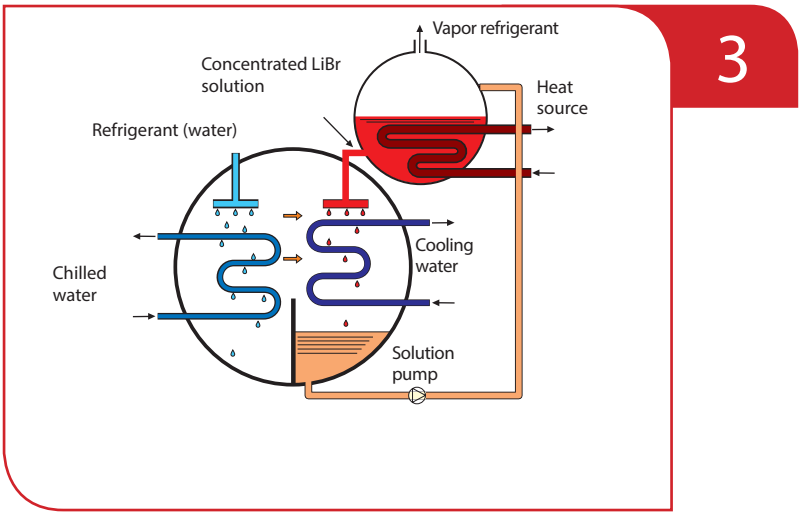
3. The hygroscopic properties of lithium bromide are not constant. It depends on two factors.

a) Temperature –the affinity between lithium bromide and water increases as the temperature decreases.

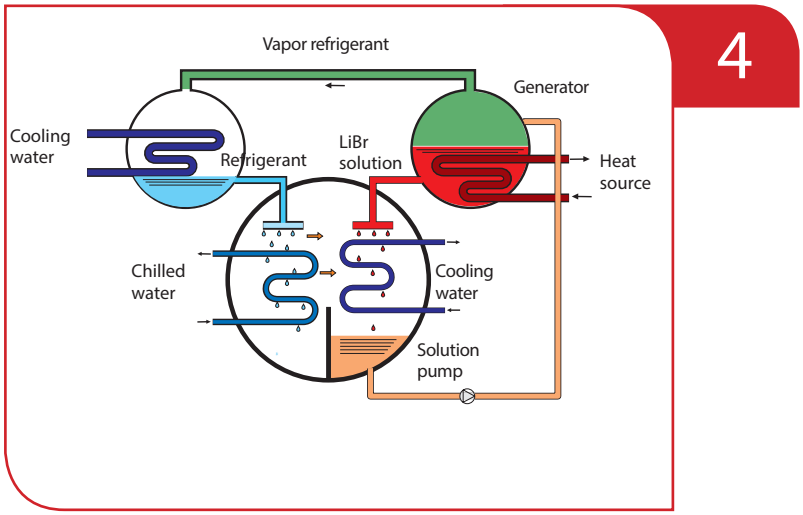
b) Concentration – when the quantity of the salt in the solution decreases the hydroscopic strength also decreases.

In the vessel, the temperature is kept low by the cooling water flowing through the absorber, this takes care of point a. For point b it becomes more complex. When the lithium bromide solution becomes more dilute as it absorbs more water vapor then it becomes less effective. To regain this strong hydroscopic effect, we need to increase the concentration of the lithium bromide solution. This is done with the heat source used to drive the chiller - it will boil the water vapour out of the solution which leads to an increase in the concentration. The vessel where this takes place is called the GENERATOR. The generator has a tube bundle inside where the heat source flows through (hot water, steam, exhaust gas etc). The dilute lithium bromide solution is then sprayed onto these tubes, once the spray hits the bundle it will evaporate the water which leaves the concentrated solution to sit at the bottom of the vessel. This concentrated solution is then sent to the ABSORBER to be used again.

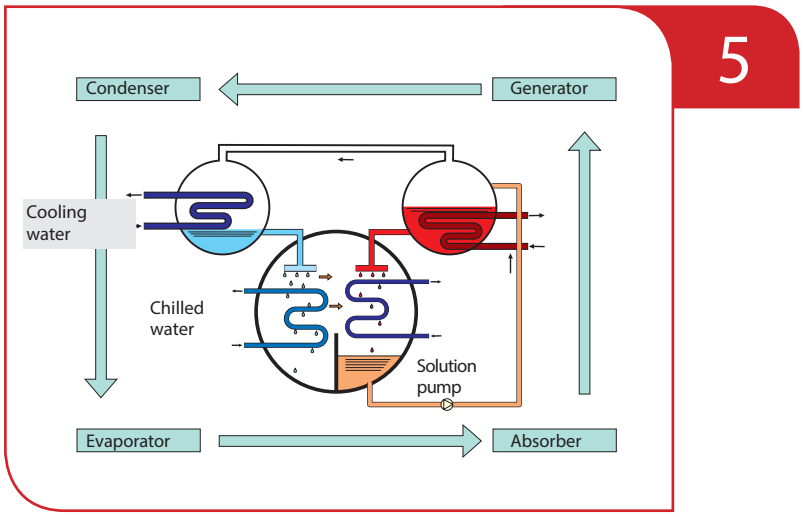
3



4. In the generator; as the water is being boiled out of the dilute solution it becomes water vapor in the vessel. This water needs to be condensed back to a liquid so it can be reused as refrigerant. This is done in another heat exchanger called the CONDENSER. The water vapor comes into contact with a tube bundle with the cooling water flowing inside (same cooling water used in absorber). The water vapor then condenses and flows back into the evaporator to be used as the refrigerant.This means that machines two working liquids are both closed loop systems.



5. Basic working cycle for a single effect absorption chiller.



WATER/LITHIUM BROMIDE TYPE ABSORPTION CHILLERS CLASSIFICATION

It is useful and common practice to divide absorption chillers into categories in different ways: by the type of heat source and by the number of effects.

Type of heat source

Heat is generally supplied to the absorption unit as one of the following:

- hot water
- steam
- directly burning fuel (direct fired)
- exhaust gases

Single, Double and Triple effect machines.

In the market it is possible to purchase single and double effect machines. Triple effect units have been launced recently. Double effect machines are more efficient than single effect, but also cost more.

The choice between triple, double and single effect chillers is based on the temperature of the heat source.

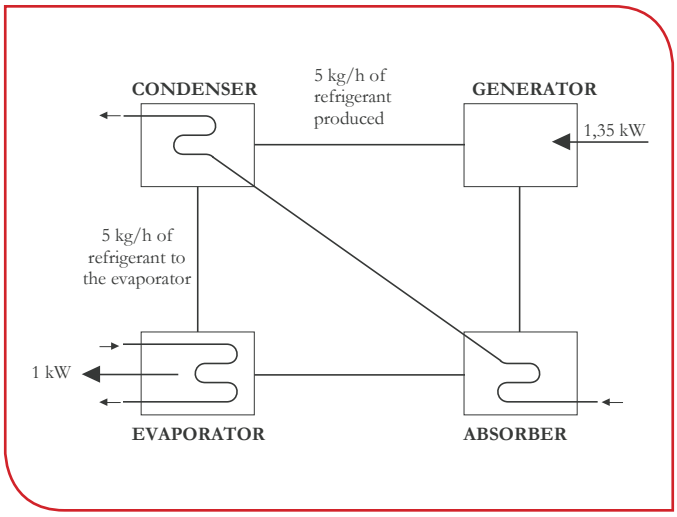
Also, for each type of machine you can have single or twin stage evaporatior/absorber. This isn't to be confused with single and double effect.

Below is a simplified scheme showing the different heat sources (and their temperatures) with the number of effects.

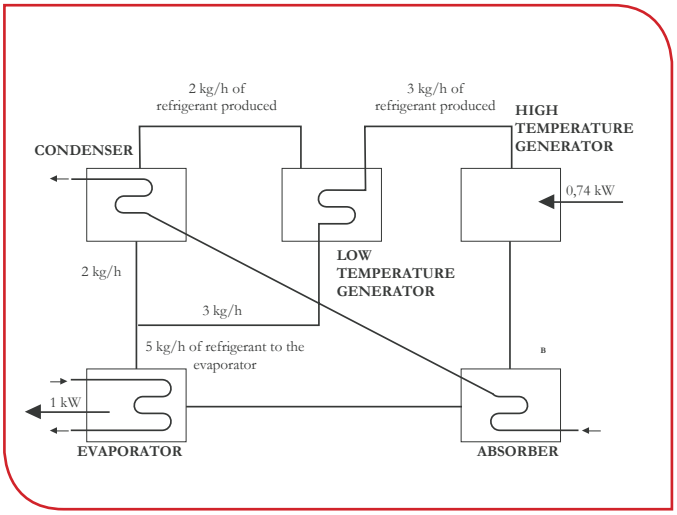
Hot water	from 75°C to 150°C single effect, from 150°C a 185°C double effect, from 185°C to 240°C triple effect
Steam	from 50 to 350 kPa (g) single effect, from 400 to 1000 kPa (g) double effect, from 1200 to 2500 kPa (g) triple effect
Direct fired	double effect
Exhaust gases	double effect/ triple effect

DOUBLE EFFECT CYCLE

The cycle shown in the previous segment refers to a single effect machine. It can be well illustrated by the following scheme:



In a hot water fired single effect machine you need approximately 5kg/h of refrigerant to evaporate in the evaporator to produce 1kW of cooling. This means the generator should recieve enough heat to boil 5kg/h of refrigerant to supply the evaporator. When this available heat source is very hot it causes the refrigerant water vapor to also be extremely hot. This temperature can be so high that the vapor can be used to boil the dilute solution a second time. This is what happens in a double effect chiller - there are two generators boiling the dilute solution. In one generator it is the heat source flowing through the tube bundle and in the second it is the water vapour from the first generator flowing through the tube bundle.



In the above diagram you will see that in the first generator (high temperature) there is only 3kg/h of refrigerant generated. The remaining 2kg/h of refrigerant are generated by the waste heat inside the unit from the high temperature generator. So a double effect machine requires less primary energy to produce the same chilled water capacity. So its efficiency is higher than the single effect chiller.

In double effect machines; the generator makes it possible to design different working cycles as it is possible to modify the flow direction from one generator to the other. We have parallel, series or reverse cycles. The main features of each cycle are described in the description of each model series.

CHEMICALS

- Lithium Bromide (LiBr)

Lithium bromide is a salt with similar properties of sodium chloride (NaCl), the common salt. When salt is left in a high humidity atmosphere it becomes sticky because it is absorbing water from the air. Lithium bromide has the same properties but its absorption power is 17 times stronger than sodium chloride. For salt solutions the higher the concentration and lower the temperature the stronger its absorbing power.

- Lithium molybdate

Lithium bromide is corrosive to metal in the presence of oxygen. As the absorption chiller is under vacuum there is almost no oxygen present inside the vessel. However it is possible, through maintenance works or operator error, for oxygen to enter the machine. So corrosion inhibitor is added to the internal solution, this inhibitor forms a hard productive layer on the internal metallic surfaces which protects against corrosion. When the layer is created it reduces the concentration of the inhibitor, so it is important to periodically analyse the internal solution to check the concentration of inhibitor present. Based on this analysis more corrosion inhibitor is added to keep the concentration at an optimal level. Excessive levels of molybdate are also to be avoided as it can affect the chillers performance.

- Water

The refrigerant used in the absorption machines is water. The water has to be pure and without contaminants so we use distilled water.

- Octyl alcohol

To increase the efficiency of the refrigerant a small amount of octyl alcohol is added to the internal solution. This increases the surface tension of the solution. This means the solution will stick to the tube bundles; increasing the heat and mass transfer and also reducing the splashing effect. Too much octyl alcohol will cause choking of the heat exchangers which reduces the capacity of the unit.

GENERAL CONSIDERATIONS

Temperature limitation

Lithium bromide/water units have a limitation on the chilled water temperature they can produce. For practical purposes, this is limited to 3,5-4°C. This limitation is due to water being used as refrigerant. As of now, THERMAX can offer a line of special designed machines where chilled water temperature can be reduced as low as -5°C under certain circumstances.

Heat rejection

Absorption chillers reject more heat into the atmosphere than conventional electrical chillers. This means that cooling towers/dry coolers will be larger. As a rule of thumb the heat that has to be dissipated is approximately 2,4 times the cooling capacity in single effect machines and 1,7 times in double effect machines.

The temperature of the cooling water circuit is very important. This is because the cooling water is used in the absorber to cool down the process, and then used in the condenser to condense the refrigerant. This means the absorption chillers are much more susceptible to changes in the cooling water flow and temperature. The lower the cooling water temperature the better, but there is a limitation as if it becomes too low we run the risk of crystallisation.

Crystallisation

Crystallisation has always been considered to be one of the major issues with the lithium bromide/water cycle. Advancements in PLC based control systems over the past 10 years have greatly reduced this phenomenon. However the reputation is still lingering so we should look at what crystallisation is.

What is crystallization?

In an absorption chiller we have a solution of water and salt. In a fixed temperature situation, if the water (solvent) is continuously removed from a solution, the solution becomes saturated. This means the solvent has reached its capacity to keep the salt in its dilute state. If we then continue to remove the water then the solution will begin to form particles. These particles are crystals which leads to the term crystallisation. So crystallisation is the appearance of the salt as a solid in its solution. It is formed based on the following:

• Temperature of the solution.

• Concentration of the solution.

For a particular solution, it is possible to draw a graph of temperature-vapour pressure at different concentrations. An example is shown below. In this graph a particular line called the “crystallisation line” is underlined: it shows the highest concentration that can be reached for every temperature: anything to the right of this line means the salt is in a solid state.

This graph shows a double effect machine internal cycle. As temperatures inside the machine changes the cycle moves around the graph: the temperatures and the concentration levels inside the machine have to stay behind the crystallisation line.

In an absorption chiller, crystallisation of the solution can occur due to one of these reasons or to a combination of them:

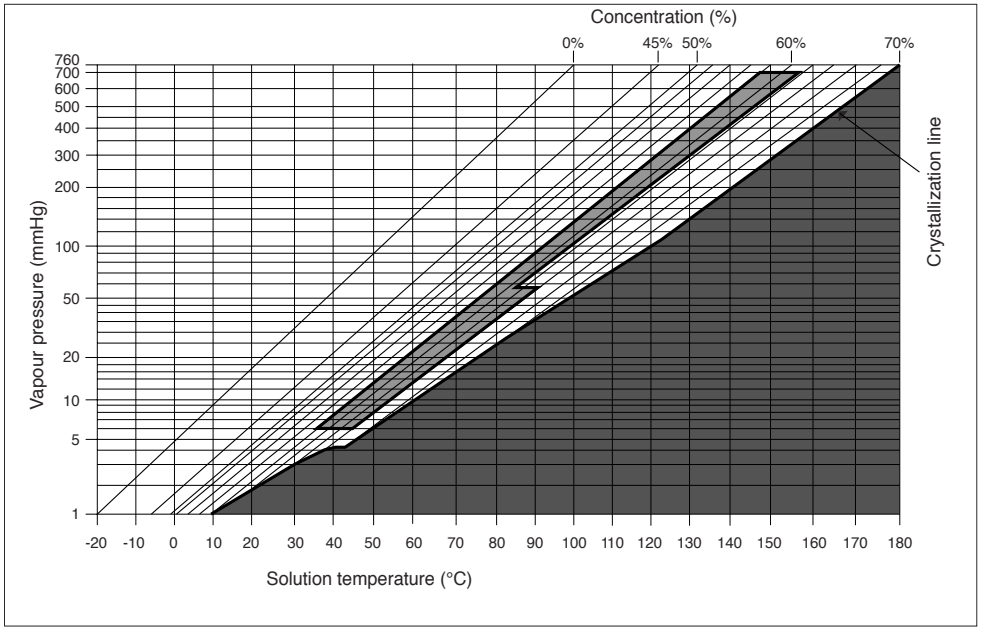
a) Low cooling water inlet temperature.

b) Insufficient vacuum inside the machine.

c) Insufficient solution flow.

d) Excessive generator heating.

Each machine is provided with several safeties in order to prevent the appearing of the crystallisation: all these applications are illustrated in each chiller series description.



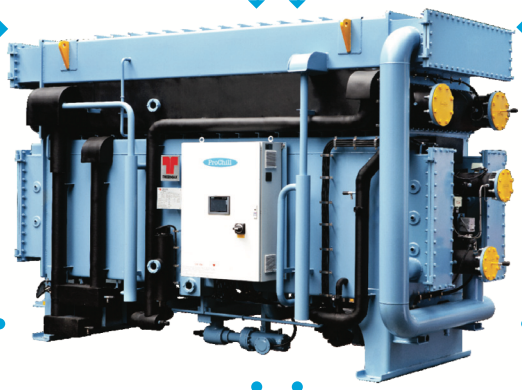
ENERGY SOURCE

STEAM
(0,1 bar-28 bar)

HOT WATER
(75°C-220°C)

GAS FIRING
(Natural gas/Biogas)

EXHAUST GASES
(From gas engines / Turbines)



Chilling: Primary
Heating: Secondary
SIMULTANEOUS
CHILLER HEATER
Chilled water down to 0°C &
Hot water up to 90°C

Heating: Primary
Chilling: Secondary
CHILLER
HEAT PUMP
Hot water up to 90°C &
chilled water down to 5°C

Heating only
HEAT PUMP
From 500 to 40.000 kW
Hot water up to 180°C

Chilling only
CHILLER
From 45 to 12.300 kW
Chilled water down to -5°C

UTILITY

3. Product range - General overview

SS/HS Series
Capacity: from 350 to 12.300 kW
Heat source: Steam (SS)/Superheated water (HS)
Steam pressure: 0-3,5 bar g
Superheated water temperature: 120-150°C
COP: 0,7-0,75

2B series
Capacity: from 176 to 12.300 kW
Heat source: Steam
Steam pressure: 4-10 bar g
COP: 1,4

3B Series
Capacity: from 176 to 5.300 kW
Heat source: Steam
Steam pressure: 12-25 bar g
COP: 1,6-1,9

5G Series
Capacity: from 45 to 5.800 kW
Heat source: Hot water
Hot water temperature: 75-120°C
COP: 0,75-0,8

2G Series
Capacity: from 176 to 12.300 kW
Heat source: Superheated water
Superheated water temperature: 140-180°C
COP: 1,4

3G Series
Capacity: from 176 to 5.300 kW
Heat source: Superheated water
Superheated water temperature: 180-240°C
COP: 1,6-1,9

2V Series
Capacity: from 176 to 10.500 kW
Heat source: Natural gas/Biogas)
COP: 1,4

2D Series
Capacity: from 176 to 12.300 kW
Heat source: Exhaust gases
Exhaust gases temperature: 250-600°C
COP: 1,4

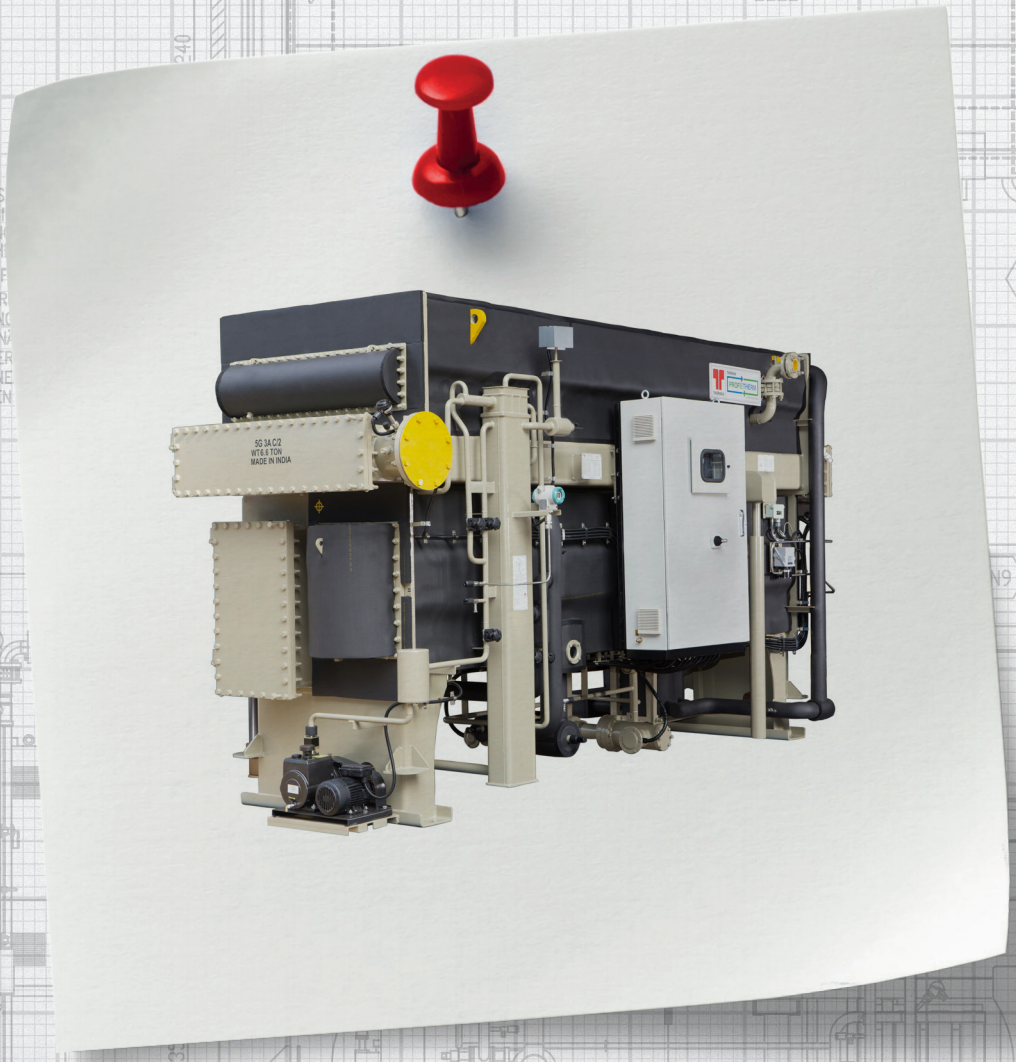
EJ Multi Energy Series
Capacity: from 350 to 12.300 kW
Heat source: Exhaust gases+Hot water
Exhaust gases temperature: 250-600°C
Hot water temperature: 80-120°C
COP: 1-1,1

Heat pump - TYPE I
Capacity: from 500 to 40.000 kW
Heat source: Steam/Hot water/
Natural Gas/Exhaust gases
COP: 1,7-1,85

Heta pump - TYPE II
Capacity: from 500 to 15.000 kW
Hea source: Steam/Hot water
COP: 0,45-0,47

High Efficiency Chiller/Heater
Cooling capacity: from 176 to 10.500 kW
Heating capacity: from 100 to 9250 kW
Heat source: Steam
Steam pressure: 3-10,5 bar g

5G Small



4. – 5G SMALL

Latest generation of single effect low temperature hot water fired absorption chillers.

The machines are specifically designed to be used with low temperature hot water, to maximize the efficiency and they are suitable to be used with high DT in water circuits.

This new generation of machines features compact dimensions, easy to use, easy to maintain and a high efficiency.

Cooling capacity from 45 kW to 780 kW.

Hot water inlet temperature between 75 °C and 120 °C.

COP: between 0,70 and 0,76

STANDARD FEATURES:

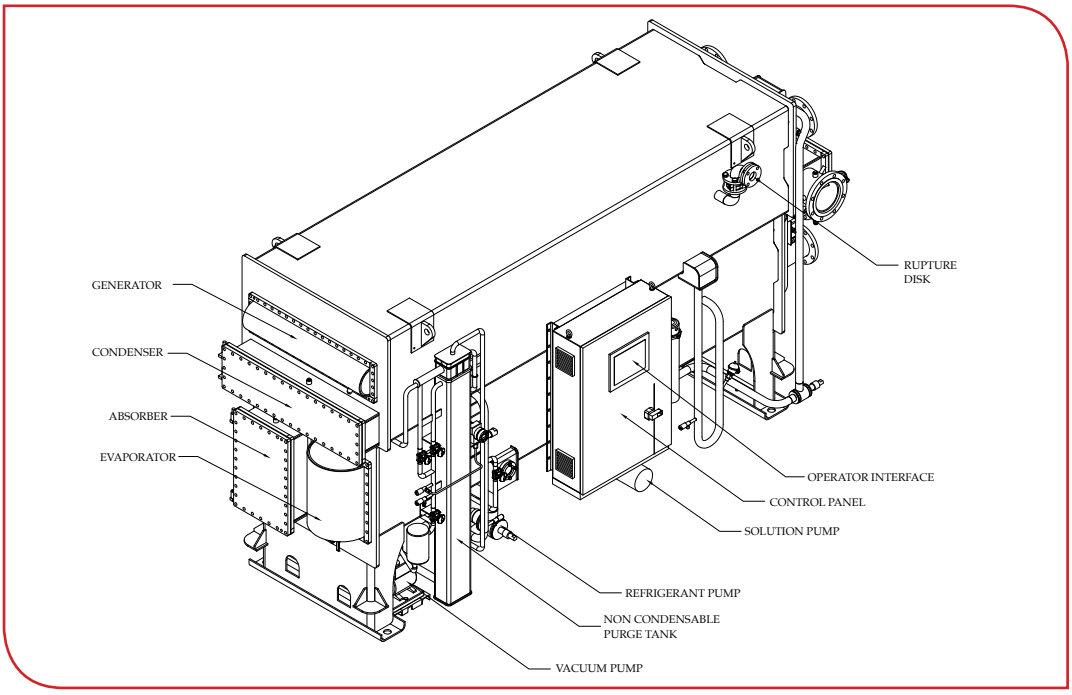
- Double shell design: the upper shell (including condenser and generator), the lower shell (including evaporator and the absorber).
- Compact design.
- Straight tubes in the generators for easy maintenance.
- Gravity feed spraying technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Marine type headers in absorber and condenser.
- Crystallization control and prevention based on on-line determination of actual measured concentration.
- Refrigerant autoblowdown solenoid valve controlled by solution concentration
- Level electrodes for refrigerant level monitoring in the evaporator. (excluding model 5G 1A C)
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state announced through an audio signal and appropriate messages display on the operator interface terminal.
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- Mini-finned SS 430 Ti tubes in generator
- DLP copper tubes in evaporator, absorber and condenser.
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, hot water control valve PLC control based on generator temperature.
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.
- Regenerative heat exchanger to increase the efficiency of the cycle. The heat exchanger is plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger ensures a compact design of the unit.
- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller (excluded model 5G 1A C)

- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch (starting from model 5G 2A C) and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled, cooling and hot water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip, remote setpoint.
- Rupture disk
- Digital vacuum transmitter
- Insulation of cold surfaces.
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel, starting from model 5G 2A C)

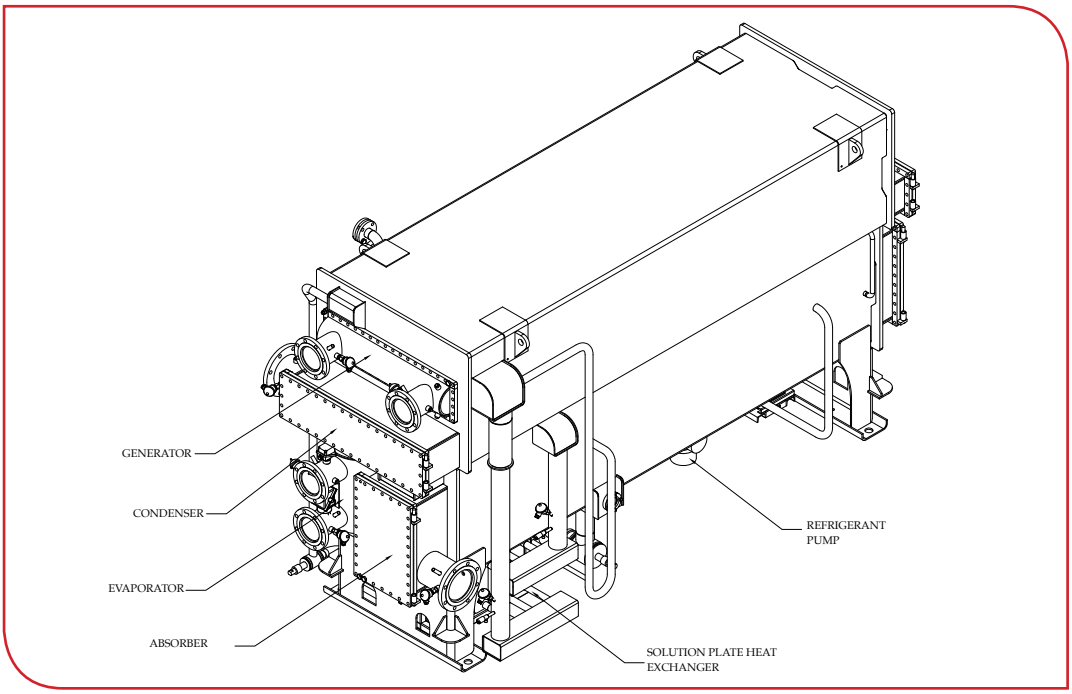
OPTIONAL:

- Stand by refrigerant and solution pumps (only for models from 5G 2E C to 5G 3B C).
- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG, starting from model 5G 2A C).
- Insulation of hot surfaces.
- Two pieces shipment: unit can be shipped in two pieces to be reassembled on site.
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Palladium cell for automatic and static removal of hydrogen from purge tank.
- Autopurge system for automatic purging of purge tank (electric or pneumatic, starting from model 5G 2A C). Alternative to palladium cell.

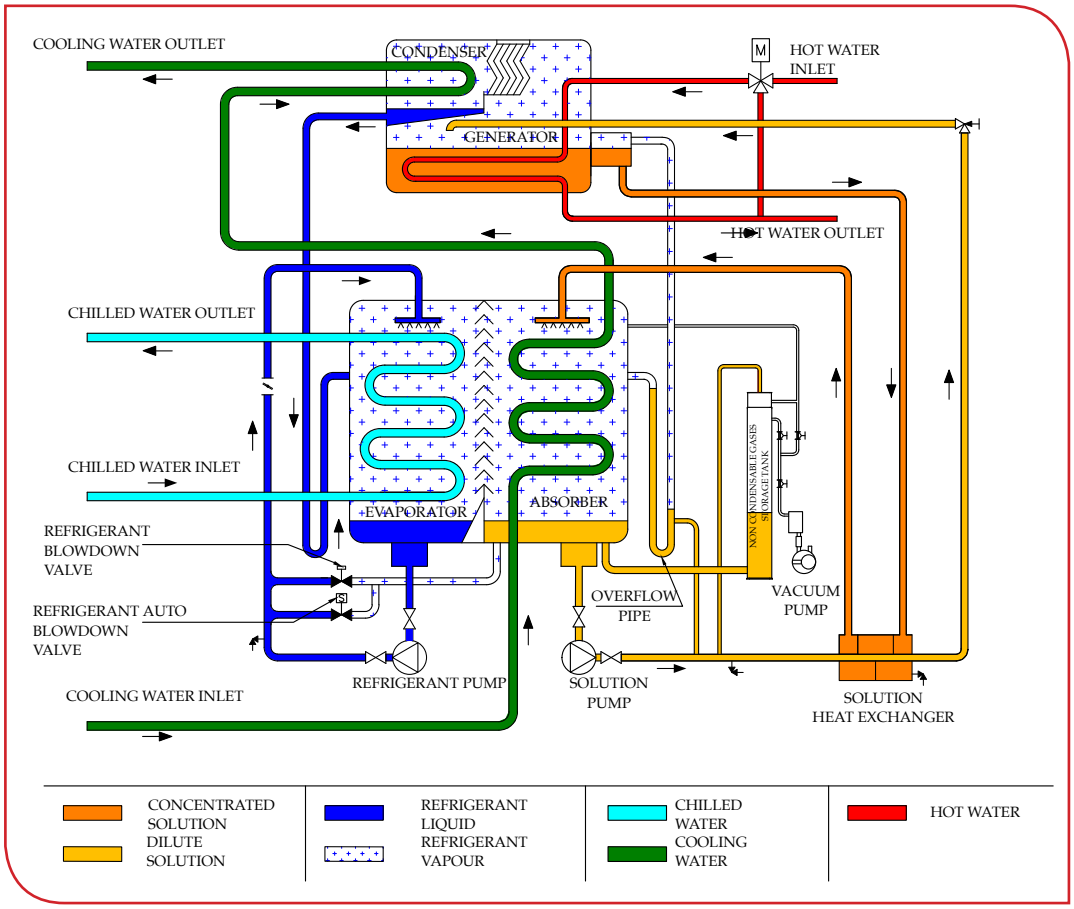
Absorption chiller of 5G Small series



3D view of a 5G Small machine with main components - Control panel side view



3D view of a 5G Small machine with main components - Rear view

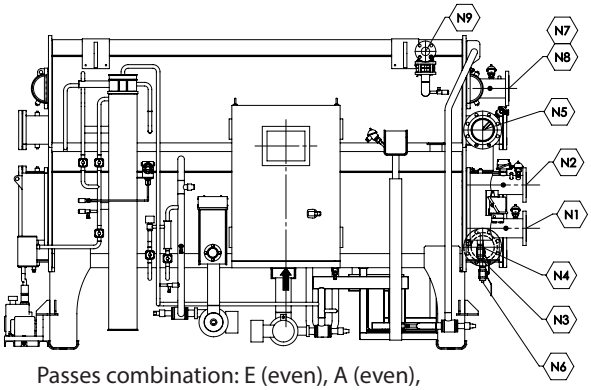


5G Small series working cycle

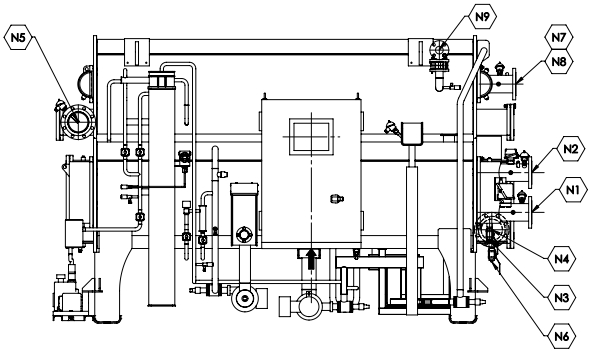
		UNITS	5G 1A C	5G 1B C	5G 1C C	5G2A C	5G 2B C	5G 2C C	5G 2D C	5G 2E C	5G3A C	5G 3B C
Cooling capacity		kW	61	122	182	238	324	395	470	568	692	792
Chilled water	Flow	m³/h	10,5	21	31,3	40,9	55,7	67,9	80,8	97,6	119	136,2
	Connection diameter	DN	50	80		100		125			150	
Cooling water	Flow	m³/h	26	48,5	75,9	93,6	135	160	190	230	282	321
	Connection diameter	DN	80	100		125		150			200	
Hot water	Flow	m³/h	7,9	15,4	22,8	29,7	40,2	47	56	67,6	82,3	94,2
	Connection diameter	DN	50	80		100		125			150	
Dimensions	Length (L)	mm	1670	2535		2840		3755		4360	4415	
	Width (W)	mm	1400	1635		1575		1655			1870	
	Height (H)	mm	1820	2200				2310			2420	
Weights	Shipping weight	x1000kg	2,0	3,6	3,8	4,4	4,6	5,7	5,9	6,6	7,7	8,0
	Working weight	x1000kg	2,2	3,9	4,2	5,0	5,2	6,5	6,8	7,7	9,1	9,5
Clearance	Clearance for tube removal	mm	1250	2110		2350		3390		4000	4060	
Electrical data	Solution pump	kW(A)	1,1 (3,4)			1,5 (5)						
	Refrigerant pump	kW(A)	0,1 (0,55)			0,3 (1,4)						
	Vacuum pump	kW(A)	0.75 (1.8)									
	Power consumption	kVA	5,1			6,9						
	Power supply		415 V (±10 %), 50 Hz (±5 %), 3 Phase+N									

1) Model code: 5G XX - C low temperatue hot water fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29/34 °C (29/34,3°C for models 5G 1B C and 5G 2A C), 4) Inlet/Outlet hot water temperature = 90°C/80°C, 5.a) Fouling factors: chilled water and hot water - 0,018 m²·K/kW, b) Fouling factor cooling water - 0,044m²·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 18 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

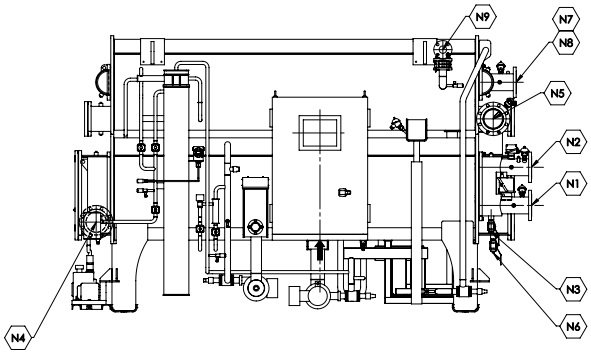
NOZZLES ORIENTATION DEPENDING ON NUMBER OF PASSES:



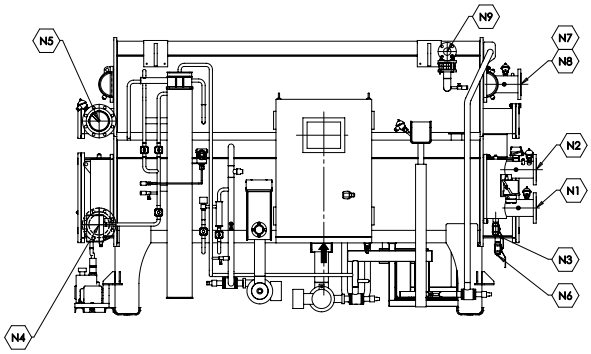
Passes combination: E (even), A (even),
C (even), G (even)



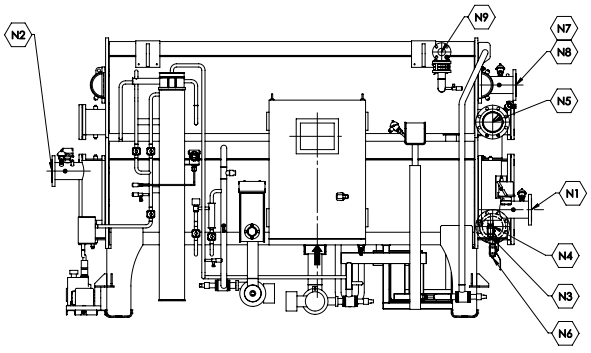
Passes combination: E (even), A (even),
C (odd), G (even)



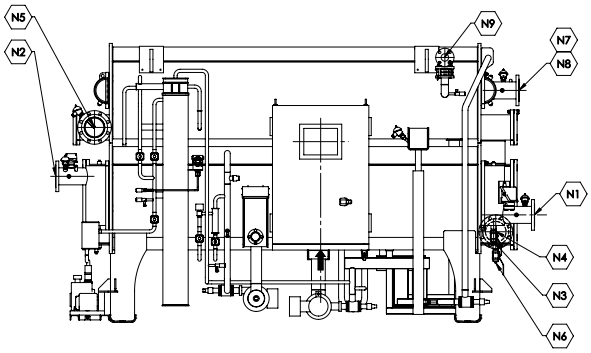
Passes combination: E (even), A (odd),
C (even), G (even)



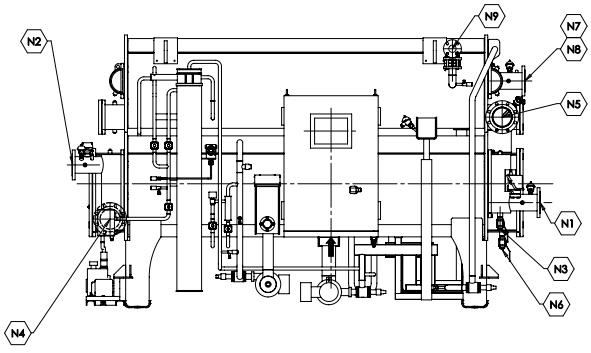
Passes combination: E (even), A (odd),
C (odd), G (even)



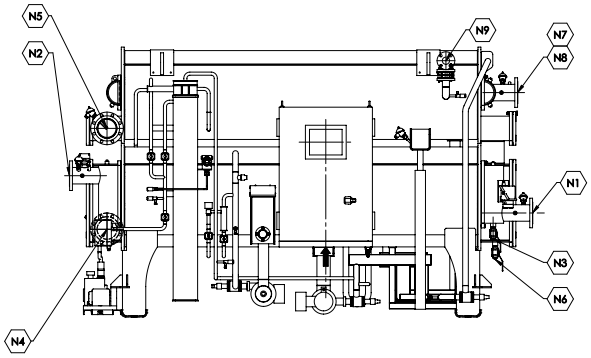
Passes combination: E (odd), A (even),
C (even), G (even)



Passes combination: E (odd), A (even),
C (odd), G (even)



Passes combination: E (odd), A (odd),
C (even), G (even)

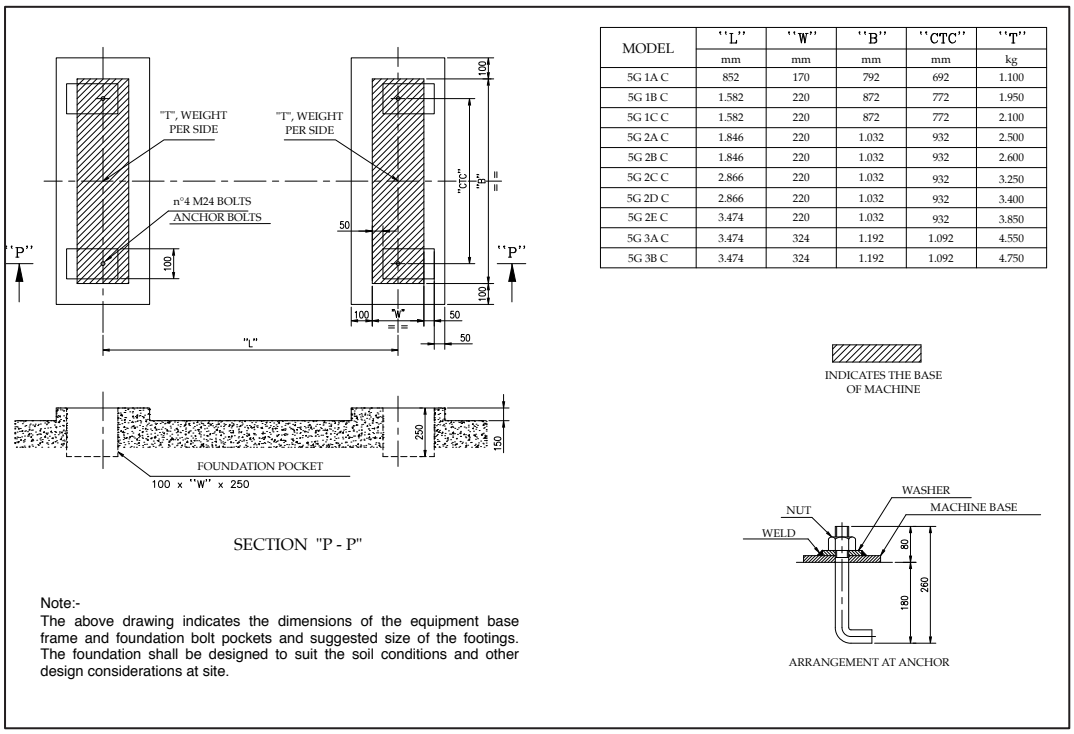


Passes combination: E (odd), A (odd),
C (odd), G (even)

4. 5G Small series

E = Evaporator, A = Absorber, C = Condenser, G = Generator

N1 = Chilled water inlet
N2 = Chilled water outlet
N3 = Chilled water drain
N4 =Cooling water inlet
N5 = Cooling water outlet
N6 = Cooling water drain
N7 = Hot water inlet
N8 = Hot water outlet
N9 = Rupture disk connection



MODEL	"L"	"W"	"B"	"CTC"	"T"
	mm	mm	mm	mm	kg
5G 1A C	852	170	792	692	1.100
5G 1B C	1.582	220	872	772	1.950
5G 1C C	1.582	220	872	772	2.100
5G 2A C	1.846	220	1.032	932	2.500
5G 2B C	1.846	220	1.032	932	2.600
5G 2C C	2.866	220	1.032	932	3.250
5G 2D C	2.866	220	1.032	932	3.400
5G 2E C	3.474	220	1.032	932	3.850
5G 3A C	3.474	324	1.192	1.092	4.550
5G 3B C	3.474	324	1.192	1.092	4.750

Note:-
The above drawing indicates the dimensions of the equipment base frame and foundation bolt pockets and suggested size of the footings. The foundation shall be designed to suit the soil conditions and other design considerations at site.

Foundation details

5G SMALL POSSIBLE APPLICATIONS:

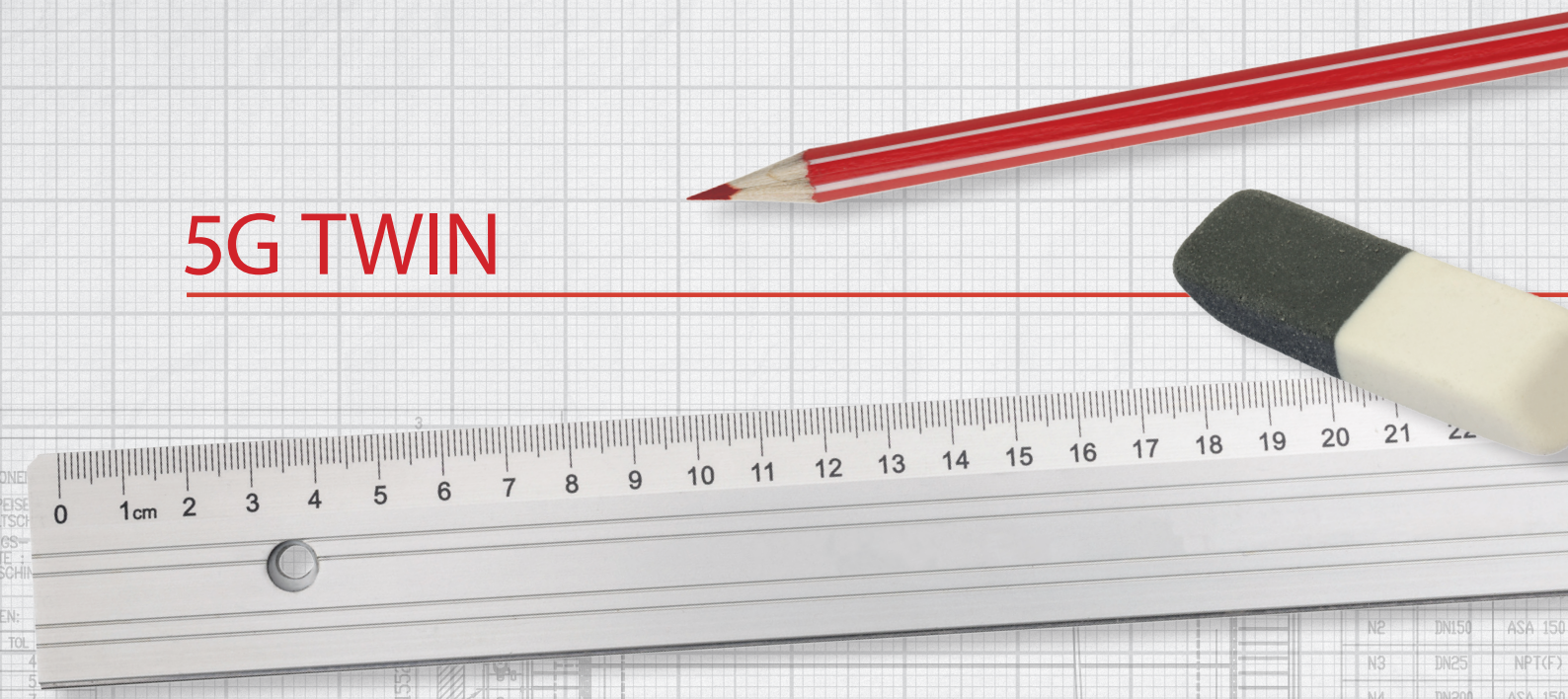
- District heating/cooling
- Cogeneration/Trigeneration
- Food industry
- Automotive industry
- Solar cooling

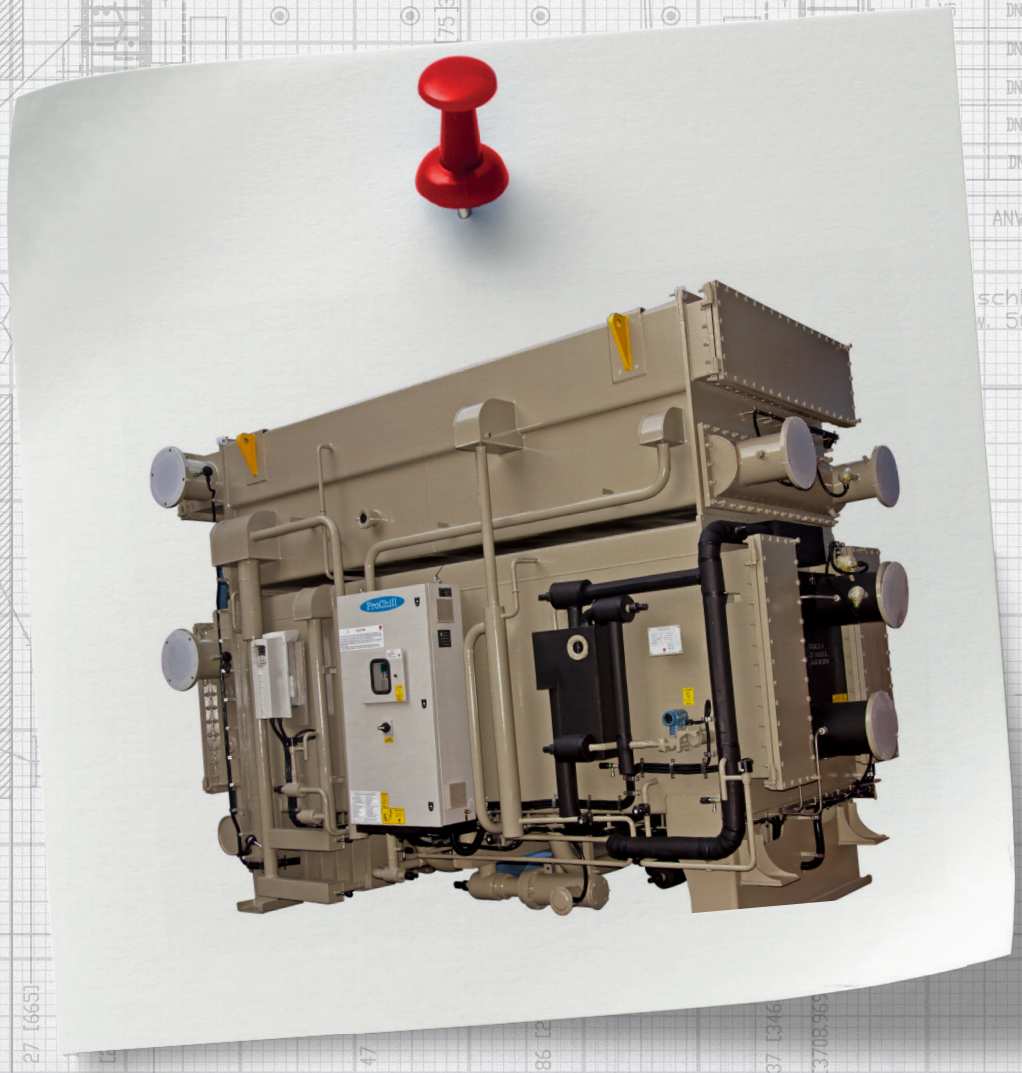
NECESSARY DATA TO PREPARE AN OFFER

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Hot water inlet/outlet temperatures

Notes

5G TWIN





5. – 5G TWIN

Latest generation of single effect low temperature hot water fired absorption chillers. This series features a double stage evaporation/absorption technology.

The machines are specifically designed to be used with low temperature hot water, to maximize the efficiency and they are suitable to be used with high DT in water circuits.

This new generation of machines feature compact dimensions, easy to use, easy to maintain and one of the highest efficiencies in the market.

Cooling capacity from 780 kW to 5.500 kW.

Hot water inlet between 75 °C and 120 °C.

COP: between 0,75 and 0,80

In a normal absorption chiller, overall chilled water capacity is limited by the achievable capacity at a maximum concentration of Lithium Bromide. Above this concentration there is a danger of crystallisation and therefore the machine is not stable. So in this scenario the absorber is the limiting heat exchanger in the machine. For low temperature hot water, overall chilled water capacity is decided by the maximum concentration the generator can achieve. This is because with low grade heat the LiBr concentration cannot get near to crystallisation levels, so for hot water the generator is the most important section of the chiller.

As the lithium bromide concentration increases at lower pressure, it is important to keep the generator at a lower pressure which can be done either through increasing the volume of the generator or increasing cooling water flow. These are both expensive ideas so we use TWIN machines to try and find a solution.

WORKING CYCLE.

Twin units are created by installing vertical plates in the lower and upper shell, this allows two machines to fit in a single unit.

Lithium bromide flows in both machines in parallel and the three water circuits flow in series. Low temperature-low pressure generator (LTG) supplies Lithium Bromide to high pressure absorber and high pressure-high temperature generator (HTG) supplies lithium bromide to the low pressure absorber. This is because the HTG can produce a higher concentration of lithium bromide which can produce a low pressure in the absorber. The lower absorber pressure allows a lower temperature chilled water production. The LTG will supply the high pressure absorber, the LTG produces a lower concentration of LiBr but this is less important as the chilled water temperatures are higher. In a twin unit the chilled water runs from high pressure evaporator to low pressure evaporator, this gives you an effective use of the concentrations and pressures so you can produce a higher capacity with the same heat transfer area.

STANDARD FEATURES:

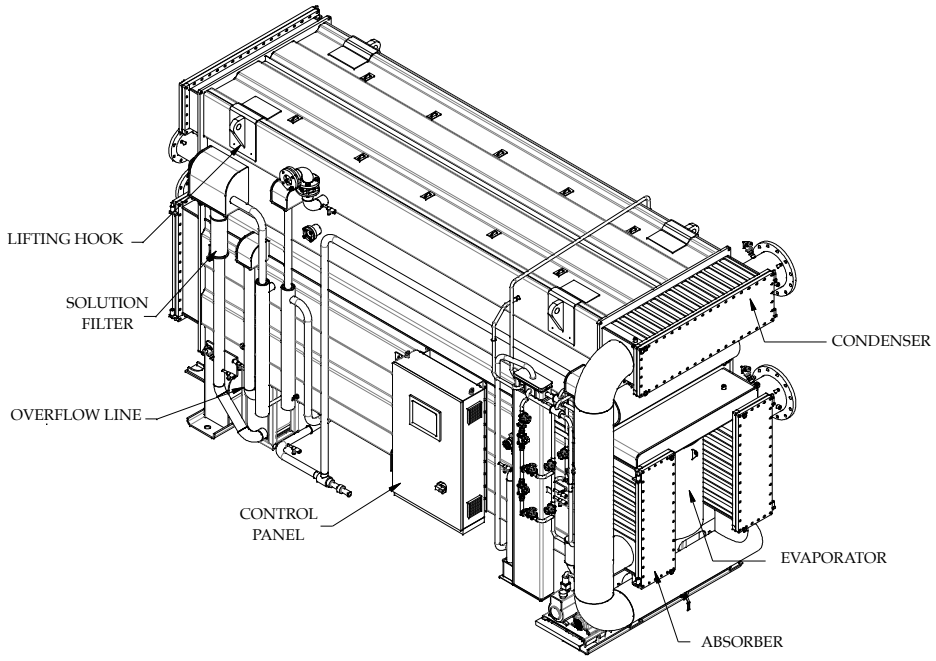
- Double shell design: the upper shell (including the condensers and the generators) and the lower shell (including the evaporators and the absorbers).
- The unique TWIN design feature helps to deliver high efficiencies with low hot water temperatures and can take higher temperature differentials (DT). The TWIN design encompasses 2 separate cycles, each working at different lithium bromide concentrations and pressures, in order to optimise the heat and mass transfer and maximize the efficiency.

- Split absorber construction, with evaporator sandwiched between absorbers. This reduces the area to be insulated.
- Straight tubes in the generators for easy maintenance.
- Gravity feed spray technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Marine type headers in absorber and condenser.
- Crystallization control and prevention based on calculation of actual measured concentration.
- Refrigerant autoblowdown solenoid valve which is controlled by solution concentration
- Level electrodes for refrigerant level monitoring in the evaporator. (excluded model 5G 1A C)
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state annunciation through an audio signal and appropriate message display on the operator interface terminal.
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- Mini-finned SS 430 Ti tubes in generator
- DLP copper tubes in evaporator, absorber and condenser.
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, hot water control valve PLC control based on generator temperature.
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.
- Two regenerative heat exchangers to increase the efficiency of the cycle. The heat exchangers are plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger leads to a compact design of the unit.
- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller.
- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled, cooling and hot water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip, remote setpoint.
- Rupture disk
- Digital vacuum transmitter
- Insulation of cold surfaces.
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel).
- Inverter on solution pump

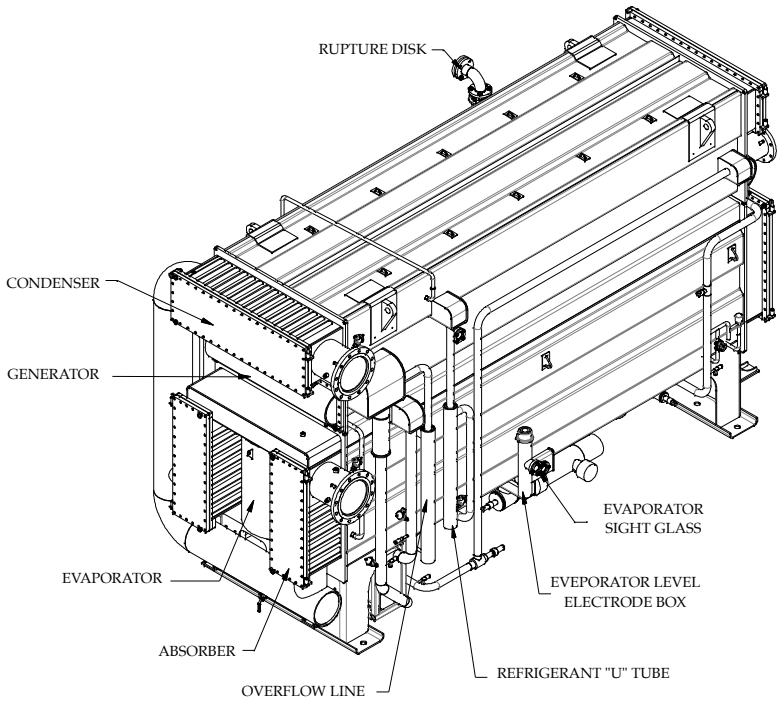
OPTIONAL:

- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG).
- Insulation of hot surfaces.
- Two pieces shipment: unit can be shipped in two pieces to be reassembled on site.
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Autopurge system for automatic purging of purge tank (electric or pneumatic.

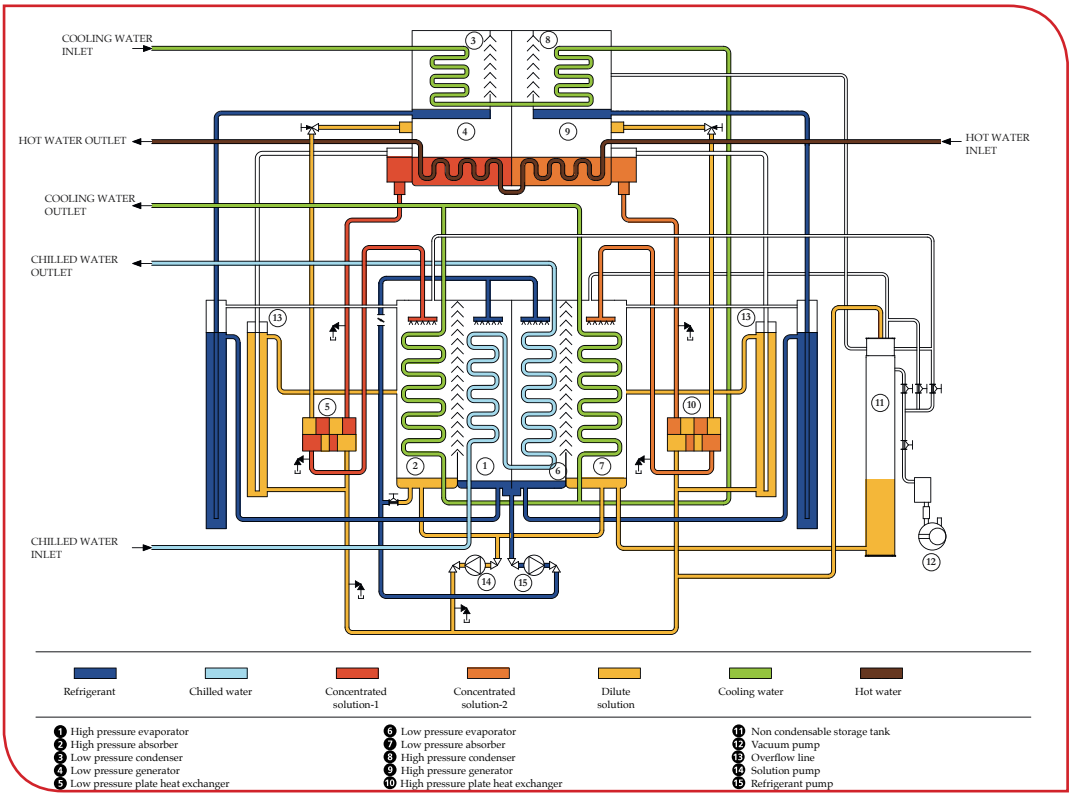
5G Twin series absorption chiller



3D view of a 5G Twin machine with main components - Control panel side view



3D view of a 5G Twin machine with main components - Rear view

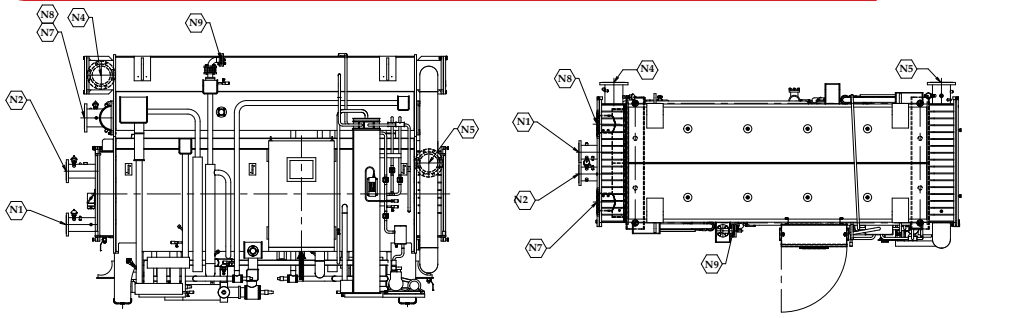


5G Twin working cycle

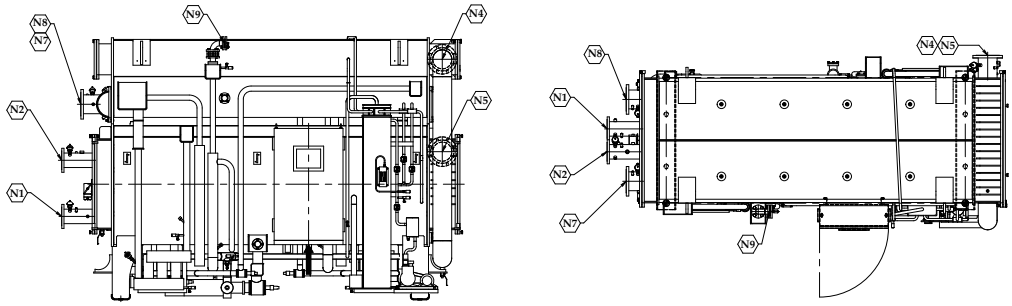
		UNITS	5G 3L C	5G3MC	5G 4K C	5G4LC	5G4MC	5G 5K C	5G 5L C	5G5MC	5G5NC	5G6KC	5G6LC	5G7KC	5G7LC	5G7MC	5G8KC	5G8LC	5G8MC	5G8NC
Cooling capacity		kW	790	940	1059	1205	1295	1475	1625	1785	1955	2395	2625	3070	3295	3610	4120	4440	4775	5135
Chilled water	Flow	m³/h	135,5	161,2	181,6	206,7	222,1	253	278,7	306,2	335,3	410,8	450,2	526,6	565,2	619,2	706,7	761,5	819	880,7
	Connectiondiameter	DN	150					200				250		300			350			
Coolingwater.	Flow	m³/h	310	358	402	463	464	556	612	556	612	940	1.038	1.040	1.117	1.232	1.516	1.603	1.516	1.603
	Temperature in/out	°C	29-34	29-34,2	29-34,2	29-34,1	29-34,5	29-34,2	29-34,2	29-35,3	29-35,3	29-34	29-34	29-34,8	29-34,8	29-34,8	29-34,4	29-34,5	29-35,2	29-35,3
	Connectiondiameter	DN	200					250		300				350			400			
Hot water	Flow	m³/h	89,5	107	120,8	137	147	167	184	203	223	271	299	346	372	408	465	501	540	582
	Connectiondiameter	DN	150		200									250			300			
Dimensions	Length (L)	mm	4010	4620	4670			4750		5930		7380		7390			7520		8770	
	Width (W)	mm	1920	1920	2040			2220		2290		2430		2850			3170		3170	
	Heigth (H)	mm	2860	2860	3060			3220		3330		3400		3660			3900		3900	
Weights	Shipping weight	x1000kg	10,1	11,2	12,9	13,3	13,6	15,4	15,8	18,5	19,1	24,5	25,2	32,2	32,9	33,9	39,7	40,9	45,3	46,6
	Working weight	x1000kg	11,9	13,3	15,4	16,0	16,5	18,9	19,6	22,9	23,7	29,9	30,9	40,1	41,2	42,7	50,6	52,2	57,4	59,4
Clearance	Clearance for tube removal	mm	3700			4300				5340		6700			6910				8220	
Electrical data	Solution pump	kW(A)	1,5 (5,0)			3,7 (11,0)		3,7 (11,0)		5,5 (14,0)		6,6 (17)		4,5 (13,0)			5,5 (17)			
	Refrigerant pump	kW(A)	0,3 (1,4)									1,5 (5,0)					1,5 (5,0)			
	Vacuum pump	kW(A)	0,75 (1,8)																	
	Power consumption	kVA	6,9			11,2		11,2		13,4		18,1		15,2			18,1			
	Power supply		415 V (±10 %), 50 Hz (±5 %), 3 Phase+N																	

1) Model code: 5G XX - C low temperatue hot water fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = see above table, 4) Inlet/Outlet hot water temperature = 90°C/80°C, 5.a) Fouling factors: chilled water and hot water - 0,018 m^2·K/kW, b) Fouling factor cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 18 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

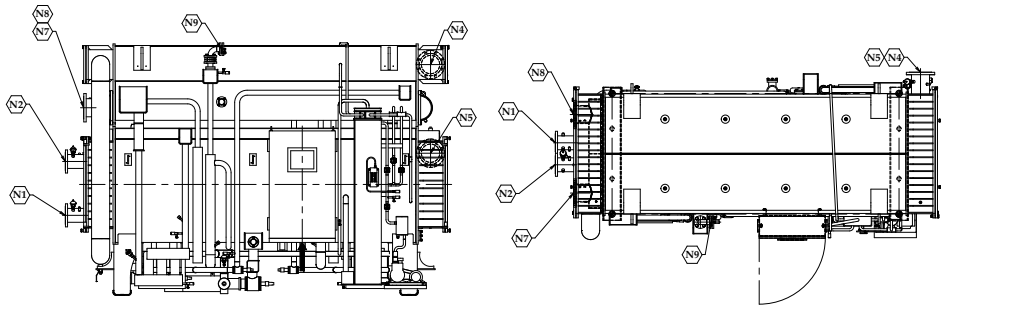
NOZZLES ORIENTATION DEPENDING ON NUMBER OF PASSES:



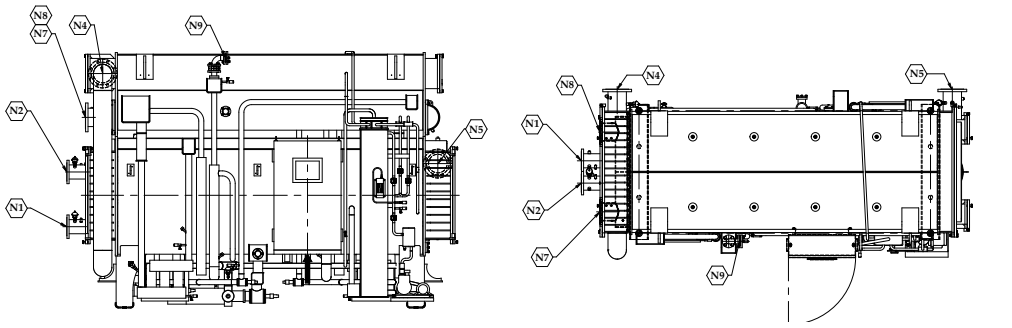
Passes combination: E (1+1), A (even,even), C (1,1), G (1+1)



Passes combination: E (1+1), A (even,even), C (1+1), G (1+1)



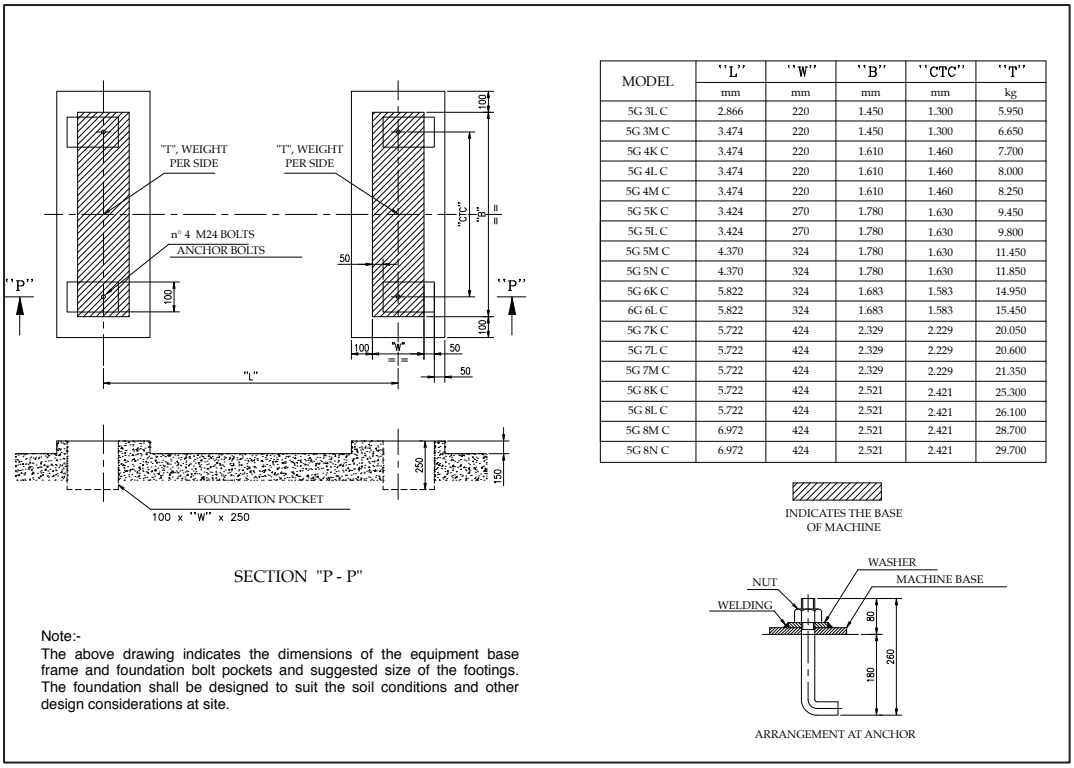
Passes combination: E (1+1), A (odd,odd), C (1,1), G (1+1)



Passes combination: E (1+1), A (odd,odd), C (1+1), G (1+1)

E=Evaporator, A=Absorber, C=Condenser, G=Generator

N1 = Chilled water inlet
N2 = Chilled water outlet
N3 = Chilled water drain
N4 =Cooling water inlet
N5 = Cooling water outlet
N6 = Cooling water drain
N7 = Hot water inlet
N8 = Hot water outlet
N9 = Rupture disk connection



MODEL	"L"	"W"	"B"	"CTC"	"T"
	mm	mm	mm	mm	kg
5G 3L C	2.866	220	1.450	1.300	5.950
5G 3M C	3.474	220	1.450	1.300	6.650
5G 4K C	3.474	220	1.610	1.460	7.700
5G 4L C	3.474	220	1.610	1.460	8.000
5G 4M C	3.474	220	1.610	1.460	8.250
5G 5K C	3.424	270	1.780	1.630	9.450
5G 5L C	3.424	270	1.780	1.630	9.800
5G 5M C	4.370	324	1.780	1.630	11.450
5G 5N C	4.370	324	1.780	1.630	11.850
5G 6K C	5.822	324	1.683	1.583	14.950
6G 6L C	5.822	324	1.683	1.583	15.450
5G 7K C	5.722	424	2.329	2.229	20.050
5G 7L C	5.722	424	2.329	2.229	20.600
5G 7M C	5.722	424	2.329	2.229	21.350
5G 8K C	5.722	424	2.521	2.421	25.300
5G 8L C	5.722	424	2.521	2.421	26.100
5G 8M C	6.972	424	2.521	2.421	28.700
5G 8N C	6.972	424	2.521	2.421	29.700

Foundation details

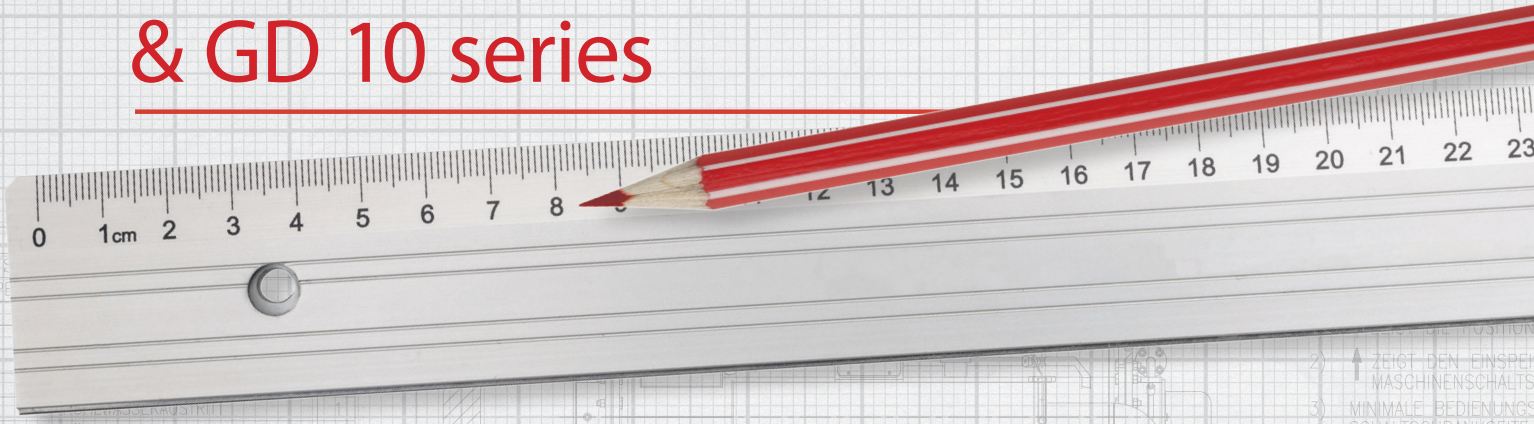
5G TWIN POSSIBILE APPLICATIONS:

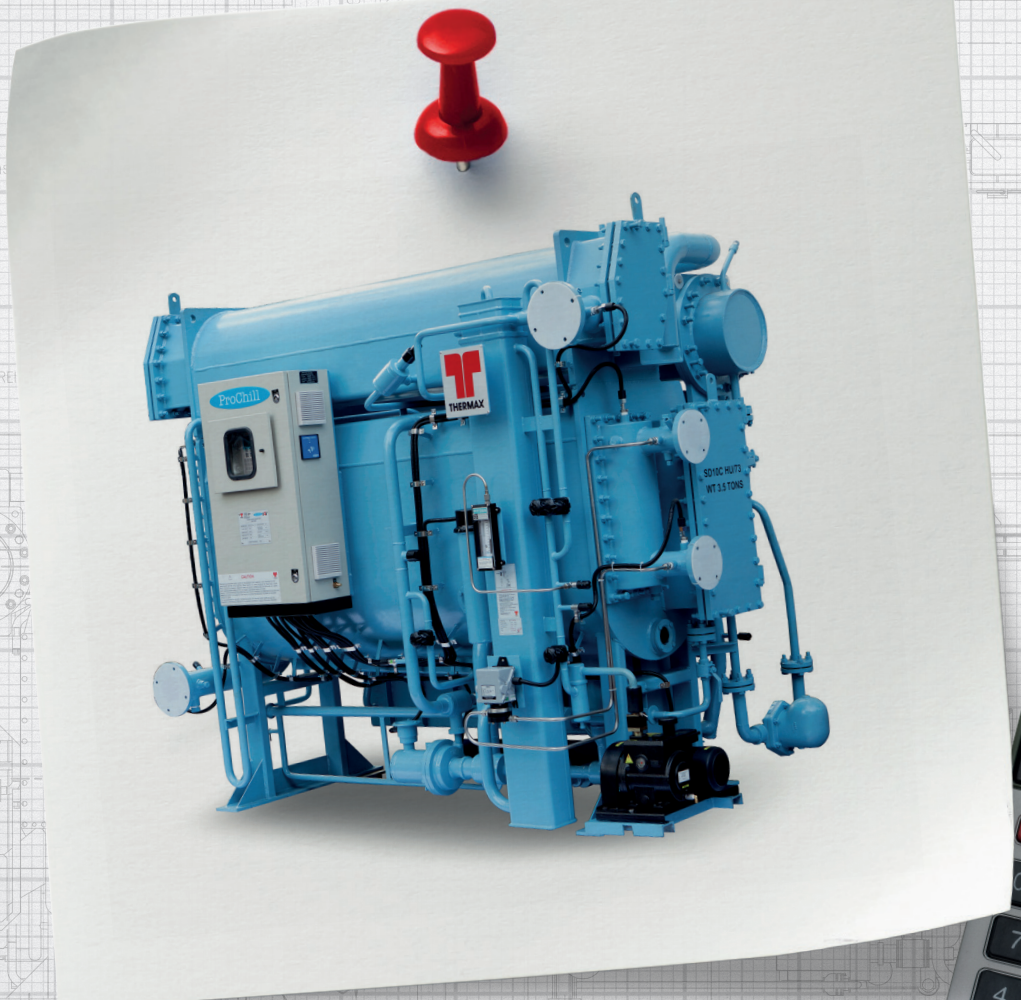
- District heating/cooling
- Cogeneration/Trigeneration
- Food industry
- Automotive industry
- Solar cooling

NECESSARY DATA TO PREPARE AN OFFER

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Hot water inlet/outlet temperatures

HD 10, SD 10, ED 10 & GD 10 series





6. HD 10, SD 10, ED 10 E GD 10:

Small size double effect absorption chillers, steam fired (SD 10), superheated water fired (HD 10), exhaust gases fired (ED 10) and natural gas fired (GD 10).

The steam and superheated water fired machines are specifically designed to be used with dry saturated steam at 8 bar(g) or high temperature superheated water (180°C is the design value).

This range of machines feature compact dimensions, easy to use, easy to maintenance and one of the highest efficiency of the market.

Cooling capacity from 165 kW to 355 kW.

Superheated water inlet temperature between 155 °C and 180 °C, steam pressure between 6 bar (g) and 10 bar (g), exhaust gases inlet temperature between 350°C and 600°C .

COP: between 1,25 and 1,35

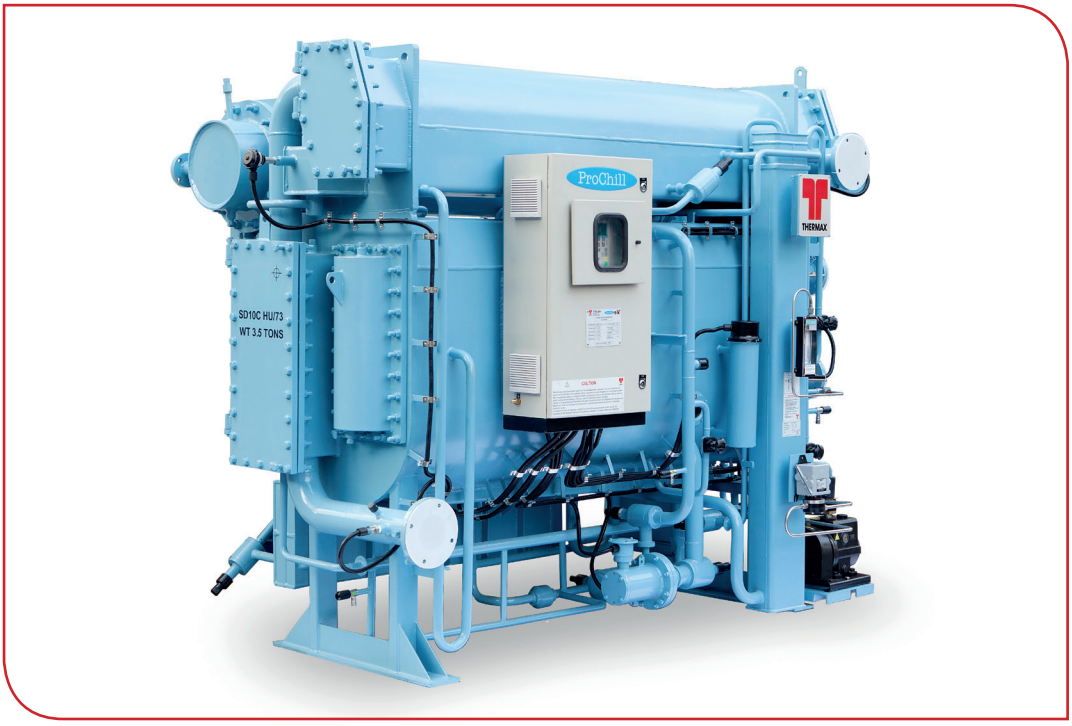
STANDARD FEATURES:

- Triple shell design: the upper shell (including condenser and low temperature generator(LTG)), the lower shell (including evaporator and the absorber) and High temperature Generator(HTG).
- Straight tubes in the HTG for easy maintenance
- Gravity feed spraying technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Crystallization control and prevention based on on-line determination of actual measured concentration.
- Refrigerant autoblowdown solenoid valve which controlled by solution concentration
- Level electrodes for refrigerant and solution level monitoring in the evaporator, absorber and high temperature generator.
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state annunciation through an audio signal and appropriate messages display on the operator interface terminal.
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- High temperature generator tubes in stainless steel SS430 (SD 10 and HD 10) or in boiler grade carbon steel (ED 10 and GD 10).
- DLP copper tubes in evaporator, absorber and condenser.
- All headers are Carbon steel (evaporator, absorber, condenser), fully removable from either side, for an easy access to the tube bundle. All water boxes have flanged connections.
- Hi-Low gas burner (GD 10).
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, steam/hot water control valve/exhaust damper PLC control based on generator temperature.
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.

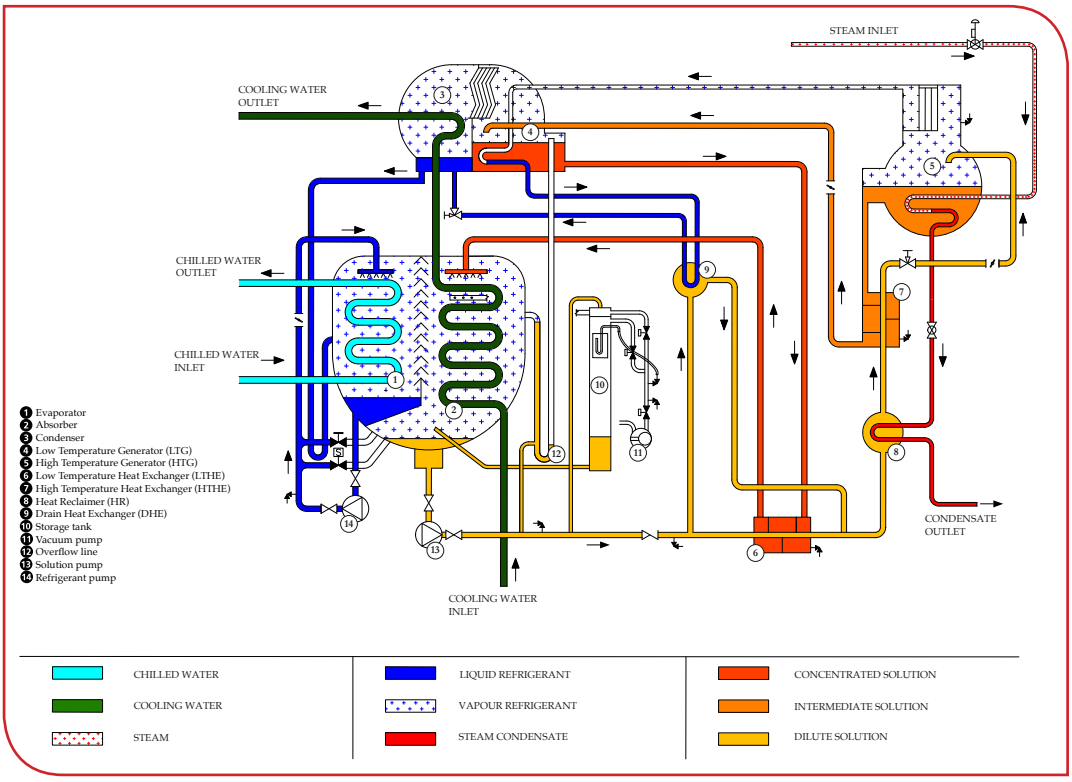
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.
- Three (HD 10, GD 10 or ED 10) or four (SD 10) regenerative heat exchanger to increase the efficiency of the cycle. The heat exchangers are plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger ensures compact design of the unit.
- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller.
- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled and cooling water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip, remote setpoint.
- Rupture disk
- Digital vacuum transmitter
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel)

OPTIONAL:

- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG).
- Insulation of cold and hot surfaces (excluded surfaces at T higher than 150°C).
- Three pieces shipment: unit can be shipped in three pieces to be reassembled on site: lower shell, upper shell and HTG.
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Autopurge system for automatic purging of purge tank (electric or pneumatic).
- Modulating burner (GD 10)



Double effect absorption chiller SD 10 series



Working cycle os SD 10 series

Working cycles of HD, ED and GD machines differ only for the HTG side, where heat source is varying. Heat reclaimer is present only in SD 10 machines.

		UNITS	SD10ACU	SD10BCU	SD10CCU
Cooling capacity		kW	172	267	366
Chilled water	Flow	m³/h	29,6	45,9	62,8
	Connection diameter	DN		80	
Coolingwater.	Flow	m³/h	53,5	83,0	112,4
	Connection diameter	DN		100	
Steam	Flow	kg/h	204,0	316,0	432,0
	Connection diameter (Steam)	DN		40	
	Connection diameter (Condensate)	DN		25	
Dimensions	Length (L)	mm	2550	2860	
	Width (W)	mm	1375	1595	
	Height (H)	mm	2020	2235	
Weights	Shipping weight	x1000 kg	3,4	3,9	4,1
	Working weight	x1000 kg	3,7	4,4	4,6
Clearance	Clearance for tube removal	mm	2200	2500	2500
Electrical data	Solution pump	kW(A)		1,1 (3,4)	
	Refrigerant pump	kW(A)		0,3 (1,4)	
	Vacuum pump	kW(A)		0,75 (1,8)	
	Power consumption	kVA		5,7	
	Power supply			415 V (±10 %), 50 Hz (±5 %), 3 Phase+N	

1) Model code: SD 10 X CU steam fired double effect absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29-34°C, 4) Steam pressure: 8 bar (g), 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factors: cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 20 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Maximum working pressure of steam circuit: 10,5 bar (g), 11) Please contact Thermax representative/office for customised specifications.

		UNITS	GD10ACU	GD10BCU	GD10CCU
Cooling capacity		kW	172	267	366
Chilled water	Flow	m³/h	29,6	45,9	62,8
	Connection diameter	DN		80	
Coolingwater.	Flow	m³/h	52,5	81,5	112
	Connection diameter	DN		100	
Gas circuit	Gas consumption	m_N^3/h	14,0	21,6	29,6
	Stack connection diameter	DN	100	125	
Dimensions	Length (L)	mm	2550	2860	
	Width (W)	mm	1800	1985	
	Height (H)	mm	2100	2300	
Weights	Shipping weight	x1000 kg	4,0	4,4	4,6
	Working weight	x1000 kg	4,4	4,9	5,1
Clearance	Clearance for tube removal	mm	2200	2500	2500
Electrical data	Solution pump	kW(A)		1,1 (3,4)	
	Refrigerant pump	kW(A)		0,3 (1,4)	
	Vacuum pump	kW(A)		0,75 (1,8)	
	Burner	kW(A)		0,4 (2,6)	
	Power consumption	kVA		7,5	
	Power supply			415V(±10%),50Hz(±5%), 3 Phase+N	

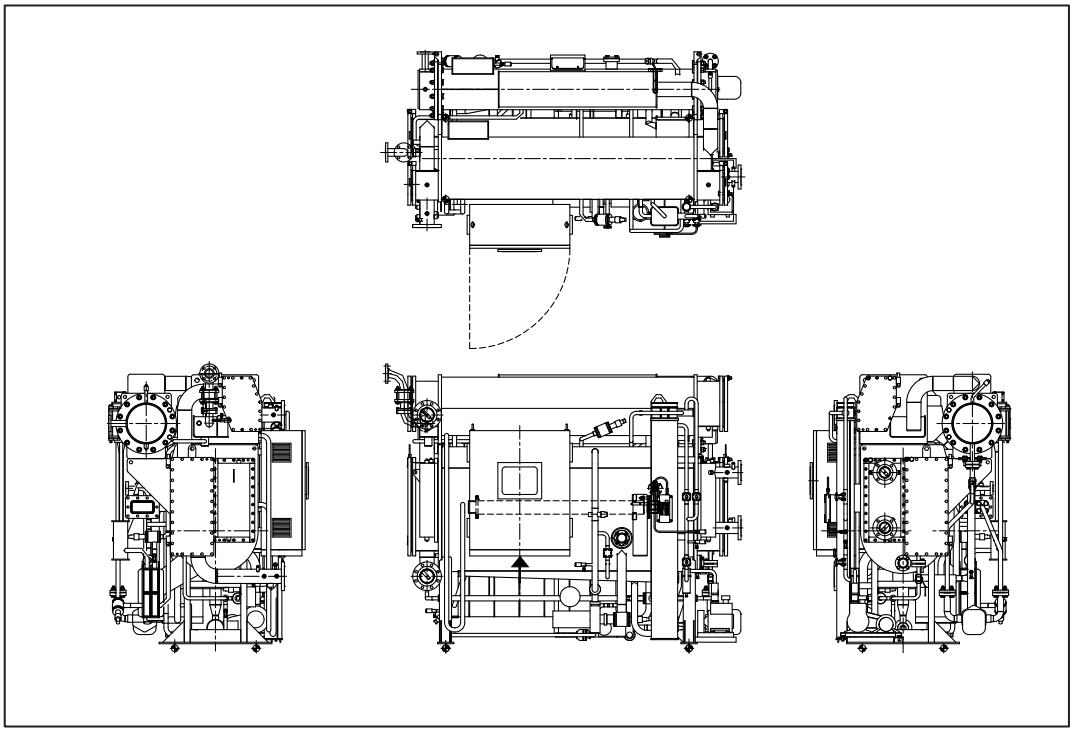
1) Model code: GD 10 X CU gas fired double effect absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29-34°C, 4) Gross calorific value of gas = 37.683 kJ/Nm3, 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factors: cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 20 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

		UNITS	ED10ACU	ED10BCU	ED10CCU
Cooling capacity		kW	172	267	366
Chilled water	Flow	m³/h	29,6	45,9	62,8
	Connection diameter	DN		80	
Coolingwater.	Flow	m³/h	52,5	81,5	112
	Connection diameter	DN		100	
Exhaust gases	Heat input	kW	146,1	226,4	310
Dimensions	Length (L)	mm	2600	2900	
	Width (W)	mm	1850	2025	
	Height (H)	mm	2100	2300	
Weights	Shipping weight	x1000 kg	4,1	4,5	4,7
	Working weight	x1000 kg	4,5	5,0	5,2
Clearance	Clearance for tube removal	mm	2200	2500	2500
Electrical data	Solution pump	kW(A)		1,1 (3,4)	
	Refrigerant pump	kW(A)		0,3 (1,4)	
	Vacuum pump	kW(A)		0,75 (1,8)	
	Power consumption	kVA		5,7	
	Power supply			415 V (±10%), 50 Hz (±5 %), 3 Phase+N	

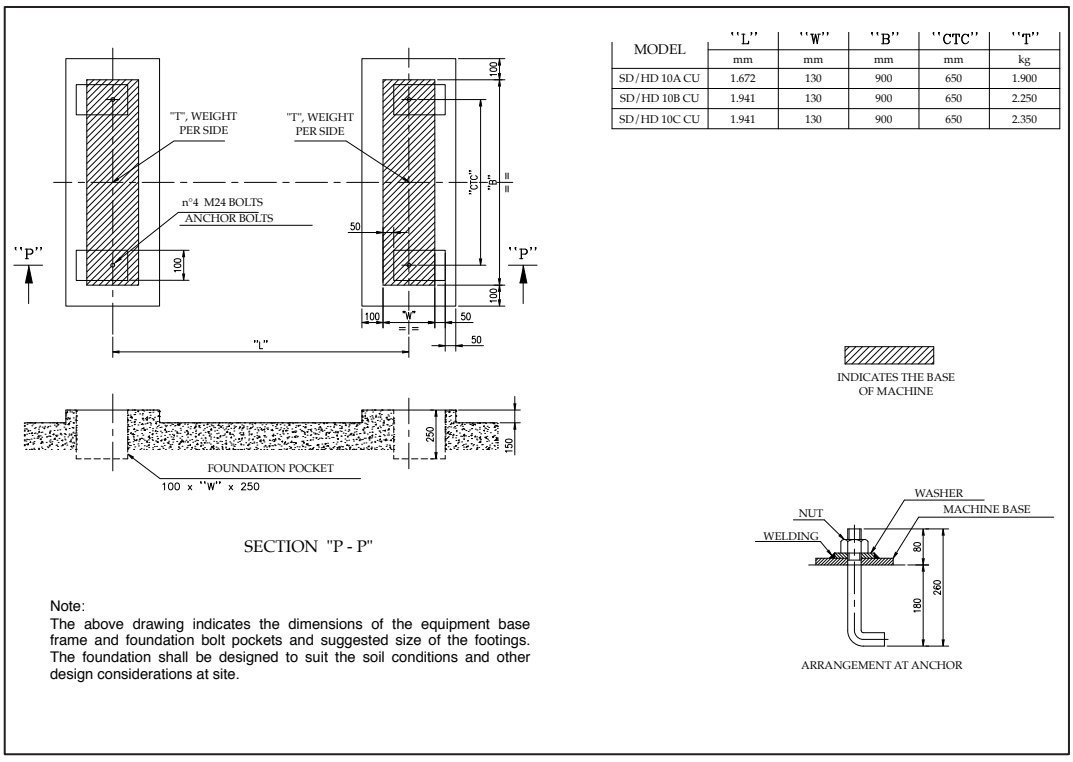
1) Model code: ED 10 X CU exhaust gases fired double effect absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29-34°C, 4) Exhaust gases inlet temperature between 350°C and 600°C; Minimum exhaust gases outlet temperature = 170°C, 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factors: cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 20 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

		UNITS	HD10ACU	HD10BCU	HD10CCU
Cooling capacity		kW	172	267	366
Chilled water	Flow	m³/h	29,6	4562	50,8
	Connection diameter	DN		80	
Coolingwater.	Flow	m³/h	52,5	81,5	112
	Connection diameter	DN		100	
Superheated water	Flow	m³/h	12,2	18,9	25,9
	Connection diameter	DN		50	
Dimensions	Length (L)	mm	2550	2860	
	Width (W)	mm	1375	1595	
	Height (H)	mm	2020	2235	
Weights	Shipping weight	x1000 kg	3,5	4,0	4,2
	Working weight	x1000 kg	3,8	4,5	4,7
Clearance	Clearance for tube removal	mm	2200	2500	2500
Electrical data	Solution pump	kW(A)		1,1 (3,4)	
	Refrigerant pump	kW(A)		0,3 (1,4)	
	Vacuum pump	kW(A)		0,75 (1,8)	
	Power consumption	kVA		5,7	
	Power supply			415V(±10%),50Hz(±5%), 3 Phase+N	

1) Model code: HD 10 X CU superheated water fired double effect absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29-34°C, 4) Inlet/Outlet superheated water = 175/165°C, 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factors: cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 20 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Maximum working pressure of superheated water circuit: 10,5 bar (g), 11) Please contact Thermax representative/office for customised specifications.



Typical layout of SD 10 machine



MODEL	"L"	"W"	"B"	"CTC"	"T"
	mm	mm	mm	mm	kg
SD/HD 10A CU	1.672	130	900	650	1.900
SD/HD 10B CU	1.941	130	900	650	2.250
SD/HD 10C CU	1.941	130	900	650	2.350

Note:
The above drawing indicates the dimensions of the equipment base frame and foundation bolt pockets and suggested size of the footings. The foundation shall be designed to suit the soil conditions and other design considerations at site.

Foundation details for SD10/HD 10 machines

6. HD10, SD10, ED10, GD10 series

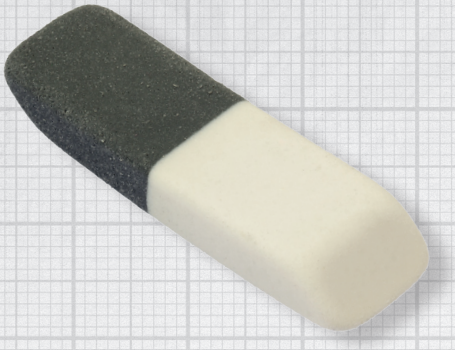
10 SERIES POSSIBLE APPLICATIONS:

- District heating/cooling
- Cogeneration/Trigeneration
- Food industry
- Automotive industry
- Solar cooling
- Steam from turbines discharge

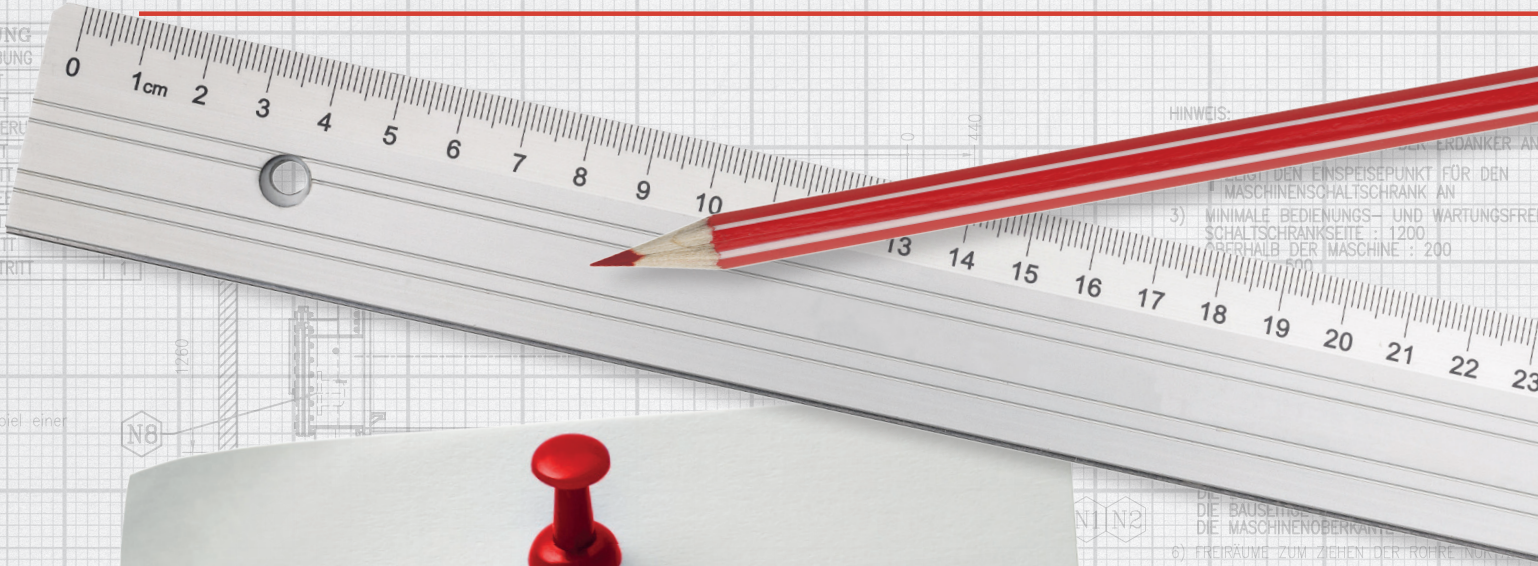
NECESSARY DATA TO PREPARE AN OFFER

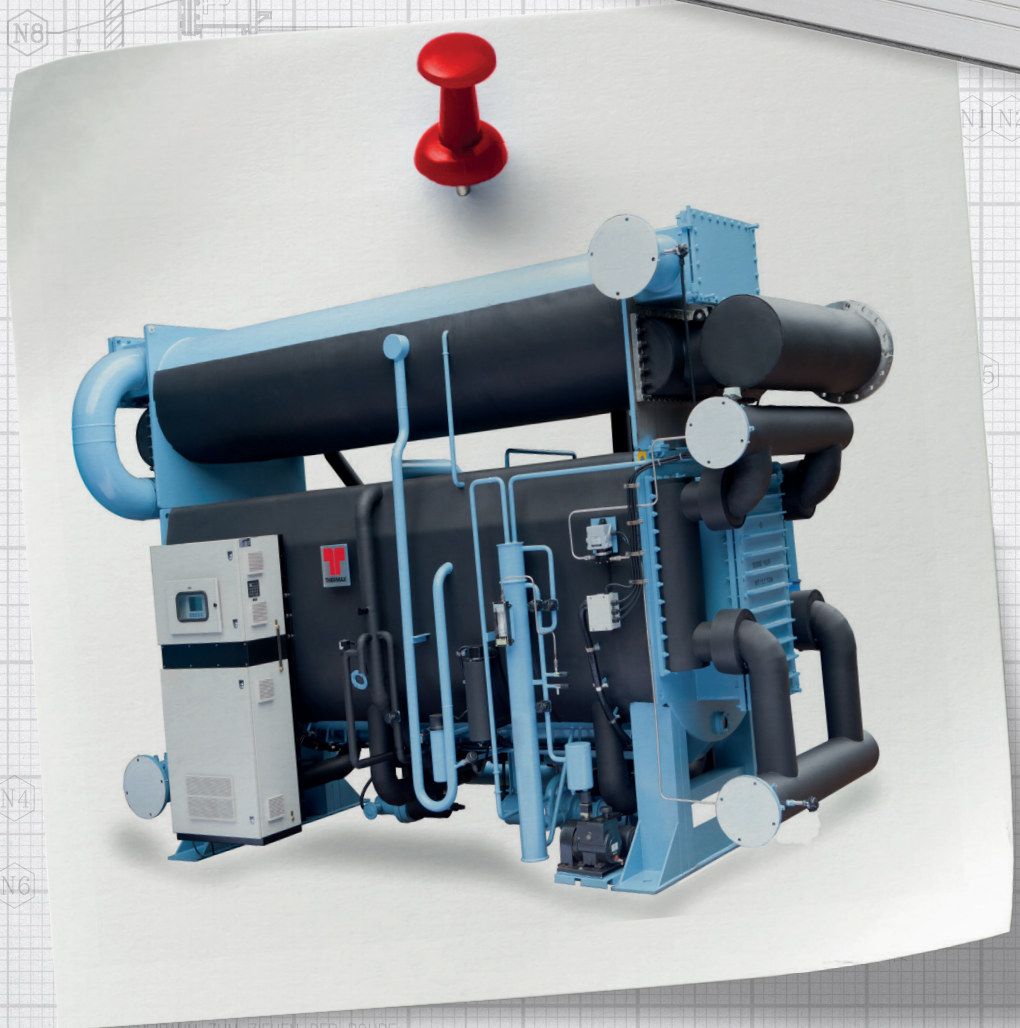
- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Superheated water inlet/outlet temperatures (HD 10)
- Available steam pressure (SD 10)
- Exhaust gases temperature and flow (ED 10)
- Allowable Pressure drop in exhaust furnace (ED 10)

Notes



HS/SS series





7. HS/SS SERIES:

Single effect medium temperature superheated water fired (HS) or steam fired (SS) absorption chillers.

The machines are specifically designed to be used with medium temperature superheated water or with low pressure steam.

Cooling capacity from 350 kW to 7.000 kW (higher capacities available upon request).

Superheated water inlet temperature between 115 °C and 150 °C.

Steam pressure between 0,5 bar (g) and 3,5 bar (g).

Steam pressure as low as 0,2 bar (g) for special applications available upon request

COP: between 0,7 and 0,72

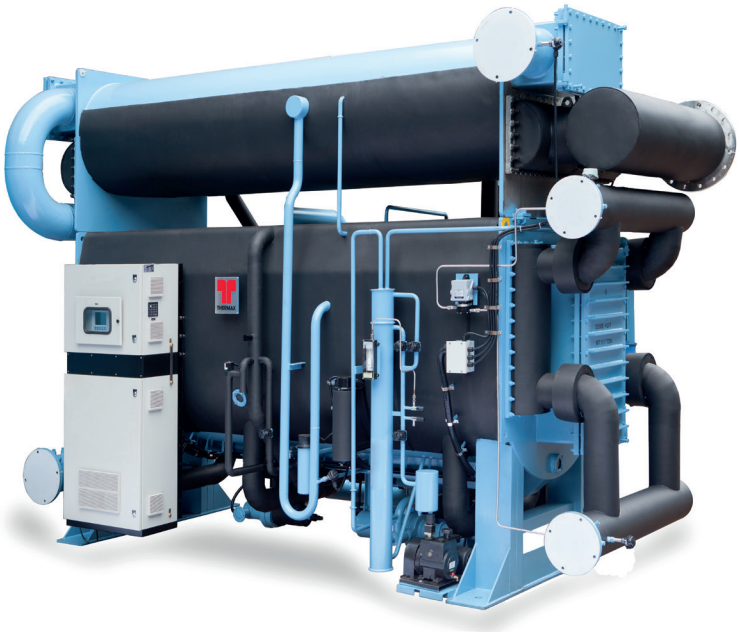
STANDARD FEATURES:

- Double shell design: the upper shell (including condenser and generator), the lower shell (including evaporator and the absorber).
- "Split" type evaporator: the evaporator is divided into two different tube bundles, placed on both sides of the absorber. This solution gives better efficiency at part load, optimizing the mass transfer inside the solution.
- Straight tubes in the generators for easy maintenance.
- Gravity feed spray technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Marine type headers on one side of absorber and condenser, for an easy access to the tube bundle without need of lifting systems to support the header. All water boxes have flanged connections. All water boxes are provided with drain and vent connections.
- Crystallization control and prevention based on internal calculation of actual measured concentration.
- Refrigerant autoblowdown solenoid valve controlled by solution level in absorber
- Level electrodes for refrigerant and solution level monitoring in the evaporator and absorber.
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state annunciation through an audio signal and appropriate messages display on the operator interface terminal.
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- Mini-finned SS 430 Ti tubes in generator
- DLP copper tubes in evaporator, absorber and condenser.
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, hot water/steam control valve PLC control based on generator temperature.

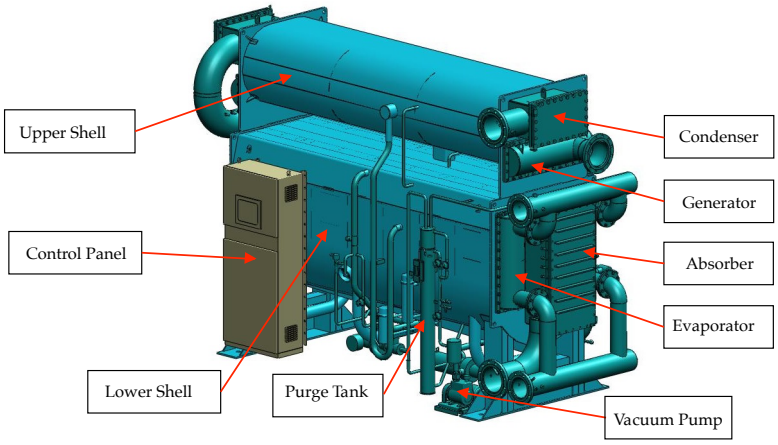
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.
- Regenerative heat exchanger to increase the efficiency of the cycle. The heat exchanger is plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger means a compact design of the unit.
- Heat reclaimer to recover heat from steam condensate (SS)
- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller.
- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled and cooling water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip.
- Rupture disk
- Digital vacuum transmitter
- Inverter on solution pump.
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel)

OPTIONAL:

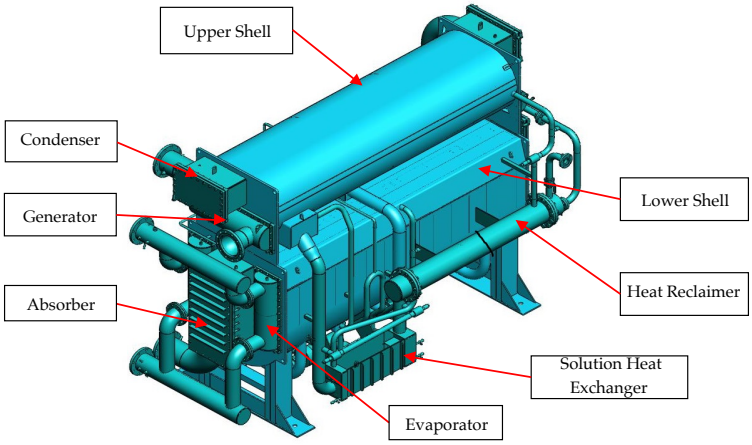
- Stand by refrigerant and solution pumps.
- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG).
- Insulation of cold and hot surfaces.
- Two pieces shipment: unit can be shipped in two pieces to be reassembled on site.
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Autopurge system for automatic purging of purge tank (electric or pneumatic).



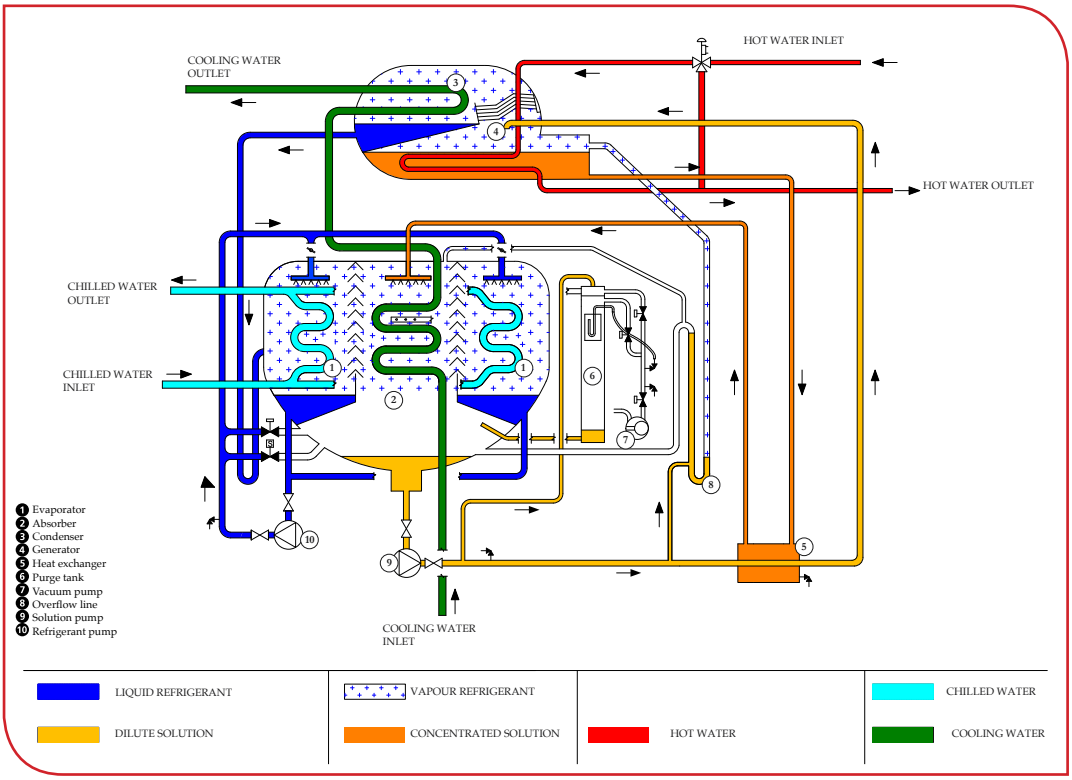
Steam fired chiller of SS series



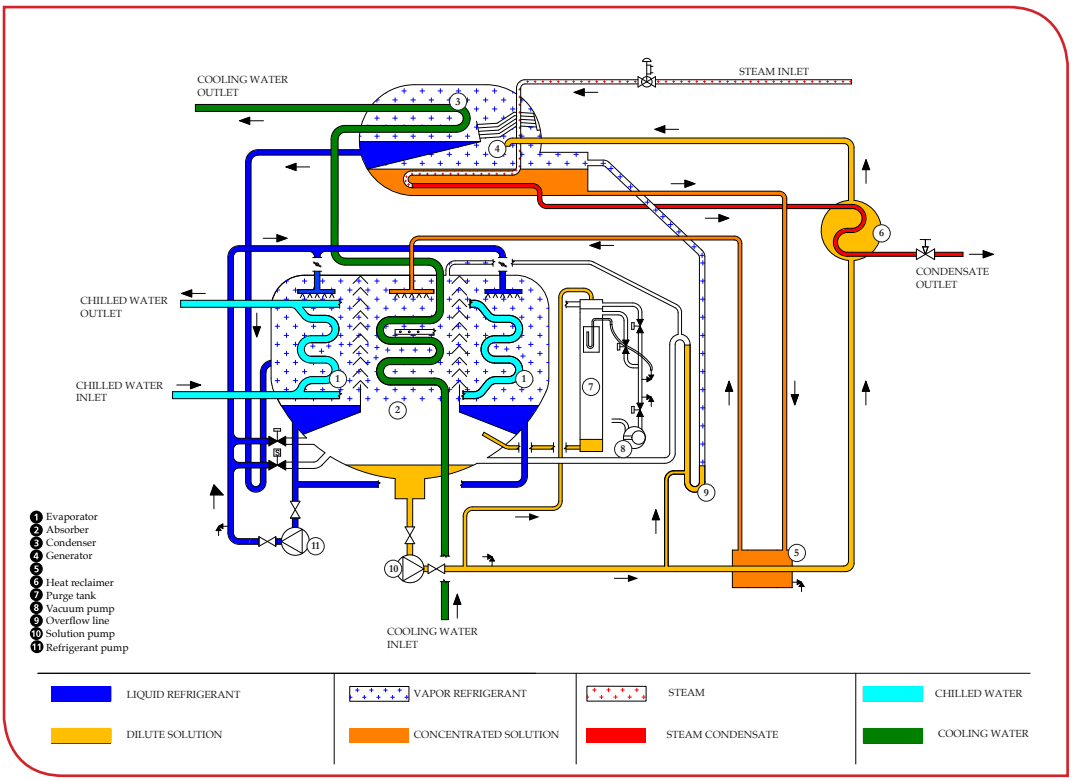
3D view of an SS machine with main components - Control panel side view



3D view of an SS machine with main components - Rear view



Working cycle of HS machine



Working cycle of SS machine

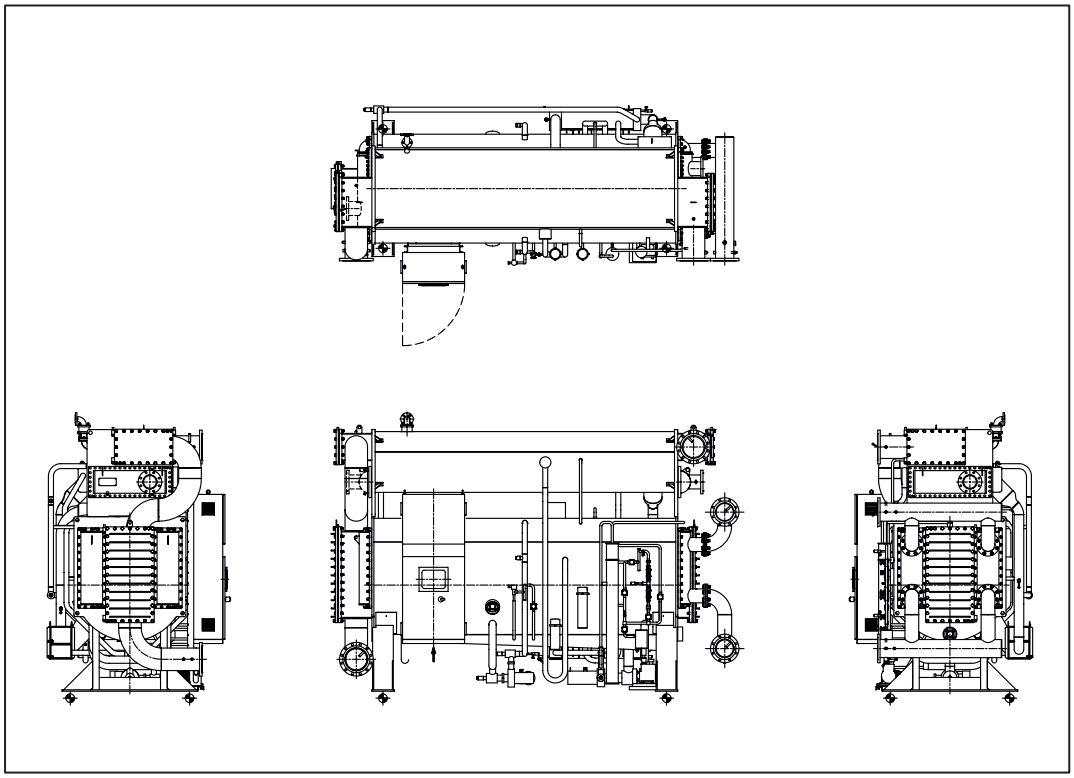
		UNITS	SS20ACU	SS20BCU	SS20CCU	SS20DCU	SS30ACU	SS30BCU	SS30CCU	SS40ACU	SS40BCU	SS40CCU	SS50ACU	SS50BCU	SS60ACU	SS60BCU	SS60CCU	SS60DCU	SS70ACU	SS70BCU	SS80ACU	SS80BCU	SS80CCU	SS80DCU
Cooling capacity		kW	469	563	710	850	1.025	1.150	1.370	1.550	1.755	1.920	2.180	2.280	2.705	2.995	3.305	3.660	4.192	4.670	5.195	5.690	6.680	7.200
Chilled water	Flow	m³/h	80,4	96,6	121,8	145,8	175,8	197,2	235	265,9	301	329,3	373,9	391,1	464	513,7	566,9	627,8	719	801	891	975,9	1.146	1.235
	Connectiondiameter	DN	125				150			200			200		250				300		350		400	
Cooling water.	Flow	m³/h	115	139	174	210	250	281	335	377	427	469	532	555	658	729	805	894	1.030	1.140	1.260	1.390	1.645	1.762
	Connectiondiameter	DN	150				200			250			250		300				350		400			
Steam	Flow	kg/hr	1.022	1.236	1.533	1.849	2.209	2.485	2.978	3.330	3.774	4.165	4.697	4.913	5.822	6.452	7.135	7.927	9.017	10028	11127	12203	14436	15481
	Connectiondiameter (Steam)	DN	150				200			250			250		300				350		400		450	
	Connectiondiameter (Condensate)	DN	40				50						65				80				100			
Dimensions	Length (L)	mm	2970		4000		4130		4740	4930			5050		6590		7880		7950		8630		9870	
	Width (W)	mm	1980		2020		2300		2325	2470			2670		2780		2730		2960		3600			
	Height (H)	mm	2830				2940			3325			3400		3825				4190		4690			
Weights	Shipping weight	x1000kg	4,9	5,0	5,9	6,1	7,6	7,8	8,6	10,8	11,1	11,4	13,1	13,3	19,4	19,8	22,2	22,9	29,2	29,8	38,6	39,0	43,3	43,8
	Working weight	x1000kg	5,4	5,6	6,6	6,8	8,6	8,9	9,8	12,5	12,9	13,2	15,3	15,7	22,5	23,1	25,8	26,7	34,0	34,9	45,6	46,3	51,2	52,0
Clearance	Clearance for tube removal	mm	2600		3600		3700		4200	4250			4400		5700		6900		6900		7000		8300	
Electrical data	Solution pump	kW(A)	1,1 (3,4)		1,5 (5,0)		3,0 (8,0)			3,7 (11,0)			3,7 (11,0)		5,5 (14,0)		6,6 (17,0)		4,5 (13,0)		4,5 (13,0)		5,5 (17,0)	
	Refrigerant pump	kW(A)	0,3 (1,4)														1,5 (5,0)							
	Vacuum pump	kW(A)	0,75 (1,8)																					
	Power consumption	kVA	5,7		6,9		9,1			11,2			11,2		13,4		18,1		15,2		15,2		18,1	
	Power supply		415 V(±10 %), 50 Hz (±5%), 3 Phase+N																					

1) Model code: SS XXX - CU single effect steam fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29/37,5°C 4) Steam pressure = 1,5 bar (g), 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factor cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 10 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

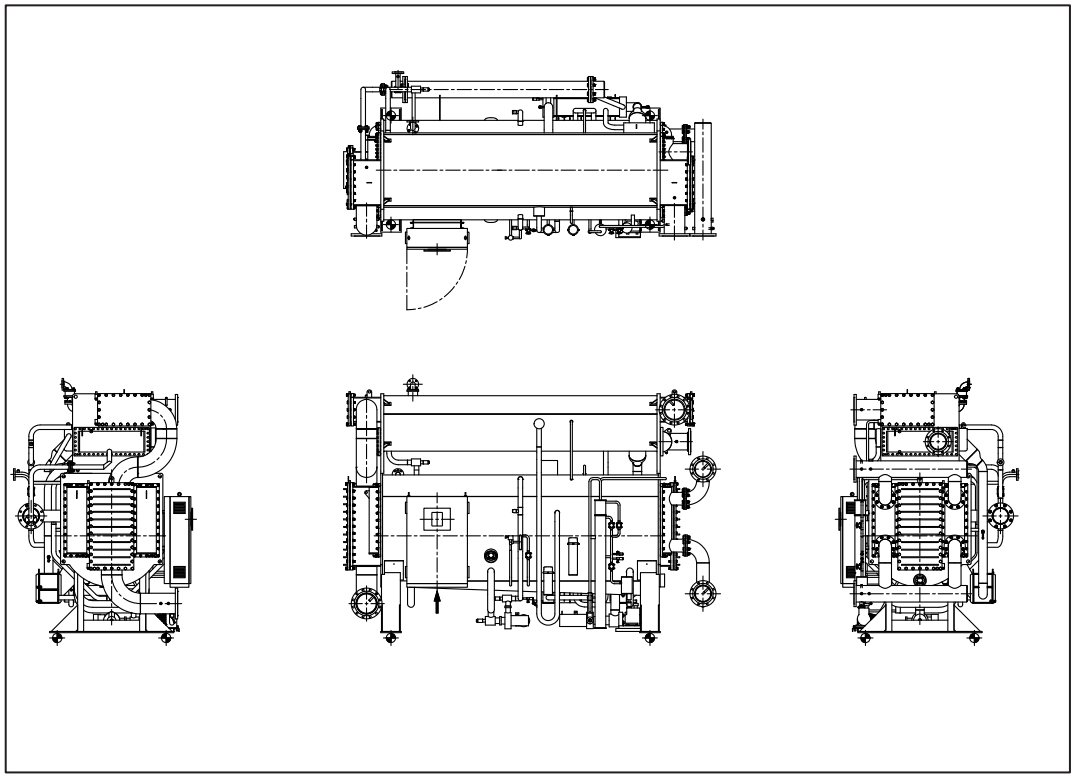
.

		UNITS	HS20ACU	HS20BCU	HS20CCU	HS20DCU	HS30ACU	HS30BCU	HS30CCU	HS40ACU	HS40BCU	HS40CCU	HS50ACU	HS50BCU	HS60ACU	HS60BCU	HS60CCU	HS60DCU	HS70ACU	HS70BCU	HS80ACU	HS80BCU	HS80CCU	HS80DCU
Cooling capacity		kW	469	563	710	850	1.025	1.150	1.370	1.550	1.755	1.920	2.180	2.280	2.705	2.995	3.305	3.660	4.192	4.670	5.195	5.690	6.680	7.200
Chilled water	Flow	m³/h	80,4	96,6	121,8	145,8	175,8	197,2	235	265,9	301	329,3	373,9	391,1	464	513,7	566,9	627,8	719	801	891	975,9	1.146	1.235
	Connectiondiameter	DN	125				150			200			200		250				300		350		400	
Cooling water.	Flow	m³/h	116	140	176	210	252	284	342	382	432	474	536	559	664	738	815	904	1.030	1.148	1.268	1.394	1.645	1.768
	Connectiondiameter	DN	150				200			250			250		300				350		400			
Superheated water	Flow	m³/h	31	37,2	46,8	56	67,1	75,2	90,4	101,3	114,4	126,2	142,4	149,3	176,4	196,1	217,4	240,8	273,3	304,4	337,8	370,1	436,4	469,5
	Connectiondiameter	DN	150				200			250			250		300				350		400		450	
Dimensions	Length (L)	mm	2970		4000		4130		4740	4930			5050		6590		7880		7950		8630		9870	
	Width (W)	mm	1980		2020		2300		2325	2470			2670		2780		2730		2960		3600			
	Height (H)	mm	2830				2940			3325			3400		3825				4190		4690			
Weights	Shipping weight	x1000kg	4,9	5,0	5,9	6,1	7,6	7,8	8,6	10,8	11,1	11,4	13,1	13,3	19,4	19,8	22,2	22,9	29,2	29,8	38,6	39,0	43,3	43,8
	Working weight	x1000kg	5,4	5,6	6,6	6,8	8,6	8,9	9,8	12,5	12,9	13,2	15,3	15,7	22,5	23,1	25,8	26,7	34,0	34,9	45,6	46,3	51,2	52,0
Clearance	Clearance for tube removal	mm	2600		3600		3700		4200	4250			4400		5700		6900		6900		7000		8300	
Electrical data	Solution pump	kW(A)	1,1 (3,4)		1,5 (5,0)		3,0 (8,0)			3,7 (11,0)			3,7 (11,0)		5,5 (14,0)		6,6 (17,0)		4,5 (13,0)		4,5 (13,0)		5,5 (17,0)	
	Refrigerant pump	kW(A)	0,3 (1,4)														1,5 (5,0)							
	Vacuum pump	kW(A)	0,75 (1,8)																					
	Power consumption	kVA	5,7		6,9		9,1			11,2			11,2		13,4		18,1		15,2		15,2		18,1	
	Power supply		415 V (±10 %), 50 Hz (±5 %), 3 Phase+N																					

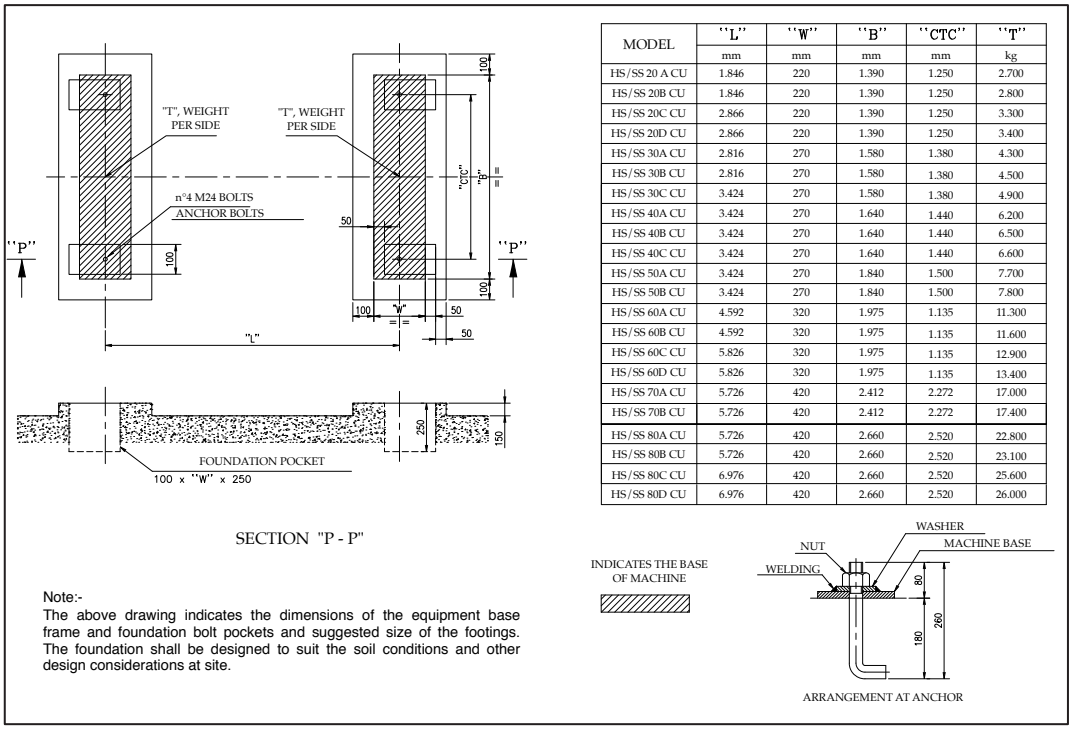
1) Model code: HS XXX - CU single effect superheated water fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29/37,5°C 4) Inlet/Outlet superheated water = 150/130°C, 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factor cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 10°C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.



Typical layout of HS machine



Typical layout of SS machine



MODEL	"L"	"W"	"B"	"CTC"	"T"
	mm	mm	mm	mm	kg
HS/SS 20 A CU	1.846	220	1.390	1.250	2.700
HS/SS 20B CU	1.846	220	1.390	1.250	2.800
HS/SS 20C CU	2.866	220	1.390	1.250	3.300
HS/SS 20D CU	2.866	220	1.390	1.250	3.400
HS/SS 30A CU	2.816	270	1.580	1.380	4.300
HS/SS 30B CU	2.816	270	1.580	1.380	4.500
HS/SS 30C CU	3.424	270	1.580	1.380	4.900
HS/SS 40A CU	3.424	270	1.640	1.440	6.200
HS/SS 40B CU	3.424	270	1.640	1.440	6.500
HS/SS 40C CU	3.424	270	1.640	1.440	6.600
HS/SS 50A CU	3.424	270	1.840	1.500	7.700
HS/SS 50B CU	3.424	270	1.840	1.500	7.800
HS/SS 60A CU	4.592	320	1.975	1.135	11.300
HS/SS 60B CU	4.592	320	1.975	1.135	11.600
HS/SS 60C CU	5.826	320	1.975	1.135	12.900
HS/SS 60D CU	5.826	320	1.975	1.135	13.400
HS/SS 70A CU	5.726	420	2.412	2.272	17.000
HS/SS 70B CU	5.726	420	2.412	2.272	17.400
HS/SS 80A CU	5.726	420	2.660	2.520	22.800
HS/SS 80B CU	5.726	420	2.660	2.520	23.100
HS/SS 80C CU	6.976	420	2.660	2.520	25.600
HS/SS 80D CU	6.976	420	2.660	2.520	26.000

Note:-
The above drawing indicates the dimensions of the equipment base frame and foundation bolt pockets and suggested size of the footings. The foundation shall be designed to suit the soil conditions and other design considerations at site.

Foundation details for SS/HS series

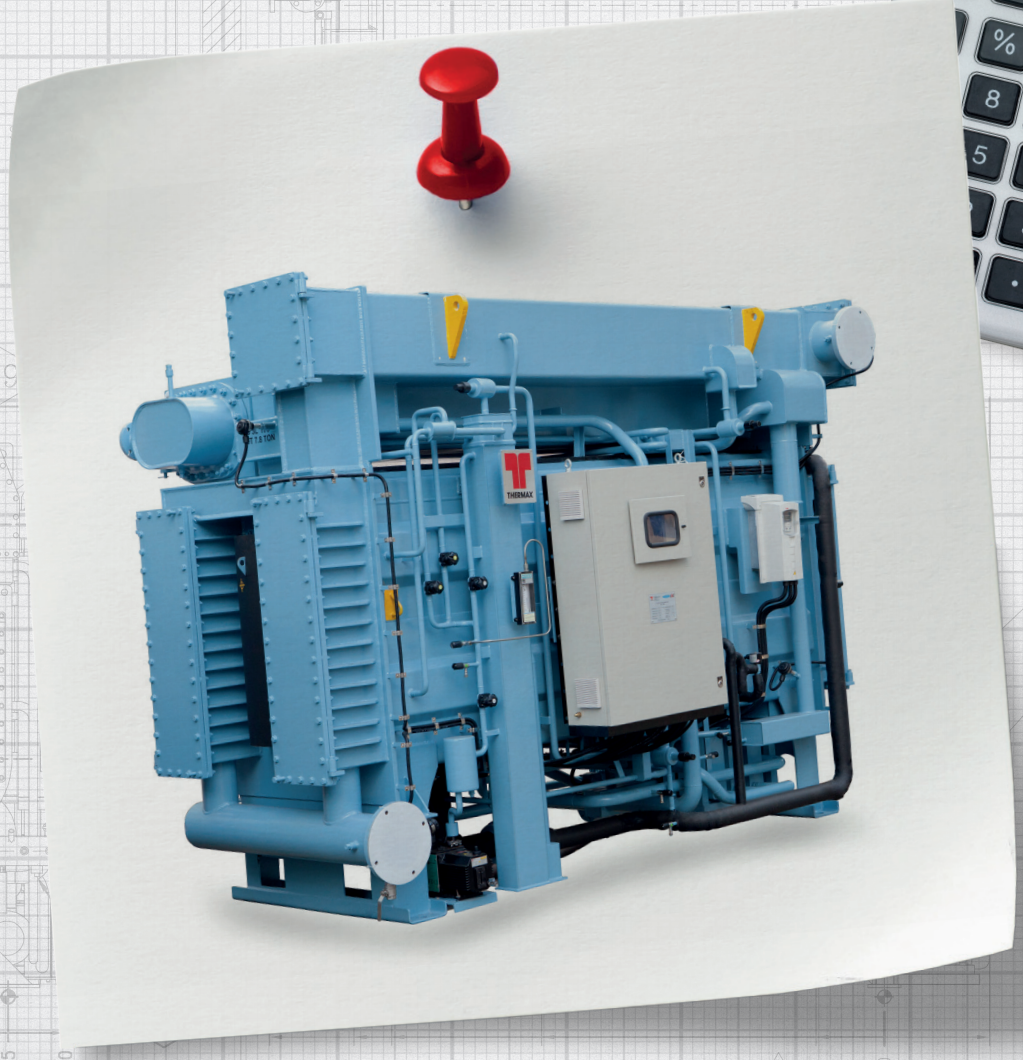
SS/HS SERIES POSSIBLE APPLICATIONS:

- District heating/cooling
- Cogeneration/Trigeneration
- Food industry
- Automotive industry
- Solar cooling
- Steam from turbines discharge

NECESSARY DATA TO PREPARE AN OFFER

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Superheated water inlet/outlet temperatures (HS)
- Steam pressure (SS)

2G/2B series



8. 2G/2B SERIES:

Latest generation of double effect high temperature superheated water fired (2G) or steam fired (2B) absorption chillers. This series features a double stage evaporation/absorption technology.

The machines are specifically designed to be used with high temperature superheated water or with steam.

This new generation of machines feature compact dimensions, easy to use, easy to maintenance and one of the highest efficiency of the market.

Cooling capacity from 350 kW to 8.500 kW (higher capacities available upon request).

Superheated water inlet temperature between 155 °C and 180 °C.

Steam pressure between 4 bar (g) and 10 bar (g)

COP: between 1,38 and 1,43

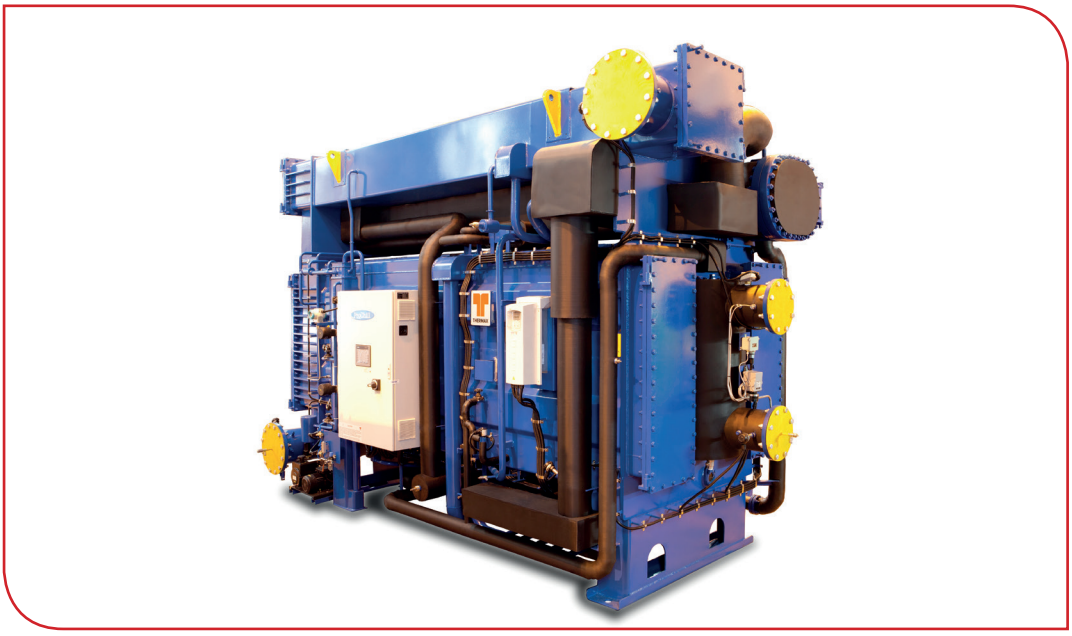
STANDARD FEATURES:

- Triple shell design: the upper shell (including condenser and generator (LTG), the lower shell (including evaporators and the absorbers) and High temperature Generator (HTG)
- The lower shell has a 2 Pressure level design, with 'split' type evaporator and 2 absorbers. This gives the advantage of higher efficiency of absorption (water vapour into sprayed LiBr solution).
- Straight tubes in the generators for easy maintenance.
- Gravity feed spray technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Marine type headers in absorber and condenser, for an easy access to the tube bundle without use of lifting systems to support the header. All water boxes have flanged connections. All water boxes are provided with drain and vent connections.
- Crystallization control and prevention based on on-line determination of actual measured concentration.
- Refrigerant autoblowdown solenoid valve controlled by solution concentration
- Level electrodes for refrigerant and solution level monitoring in the evaporator, absorber and HTG.
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state annunciation through an audio signal and appropriate messages display on the operator interface terminal.
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- SS 430 Ti tubes in generator.
- DLP copper tubes in evaporator, absorber and condenser.
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, hot water/steam control valve PLC control based on generator temperature.
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.

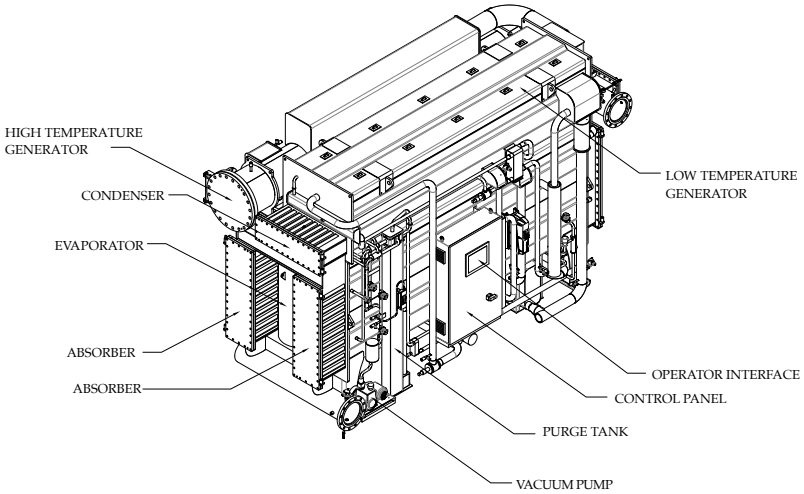
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.
- Three (2G) or four (2B) regenerative heat exchangers to increase the efficiency of the cycle. The heat exchangers are plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger ensures a compact design of the unit.
- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller.
- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled and cooling water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip, remote setpoint.
- Rupture disk
- Digital vacuum transmitter
- Inverter on solution pump.
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel)
- Generator pressure switch

OPTIONAL:

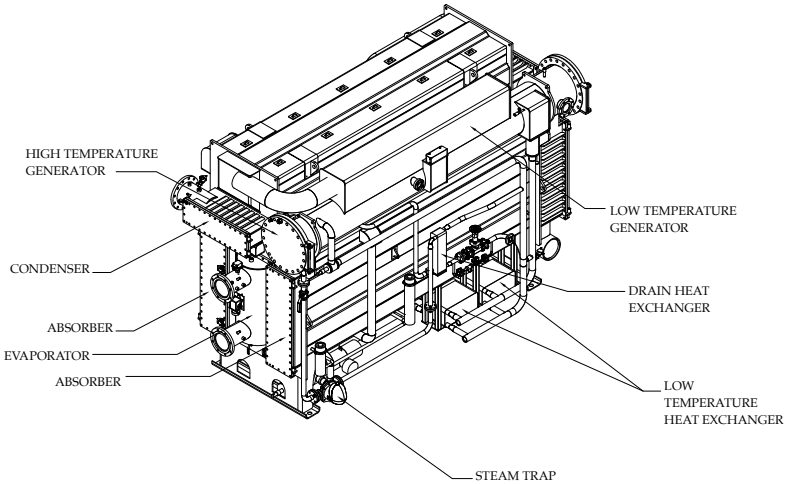
- Stand by refrigerant and solution pumps.
- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG).
- Insulation of cold and hot surfaces (excluded surfaces at T higher than 150°C).
- Three pieces shipment: unit can be shipped in three pieces to be reassembled on site (lower shell, upper shell and HTG).
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Autopurge system for automatic purging of purge tank (electric or pneumatic).



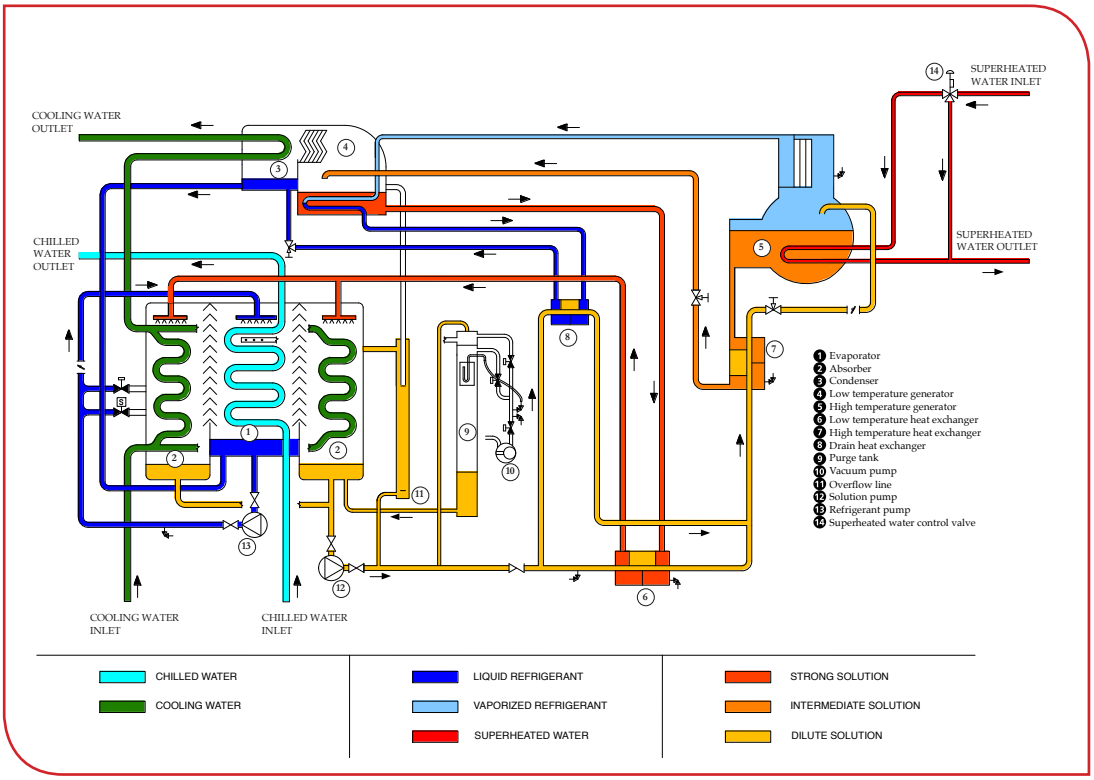
Double effect steam fired absorption chiller of 2B series



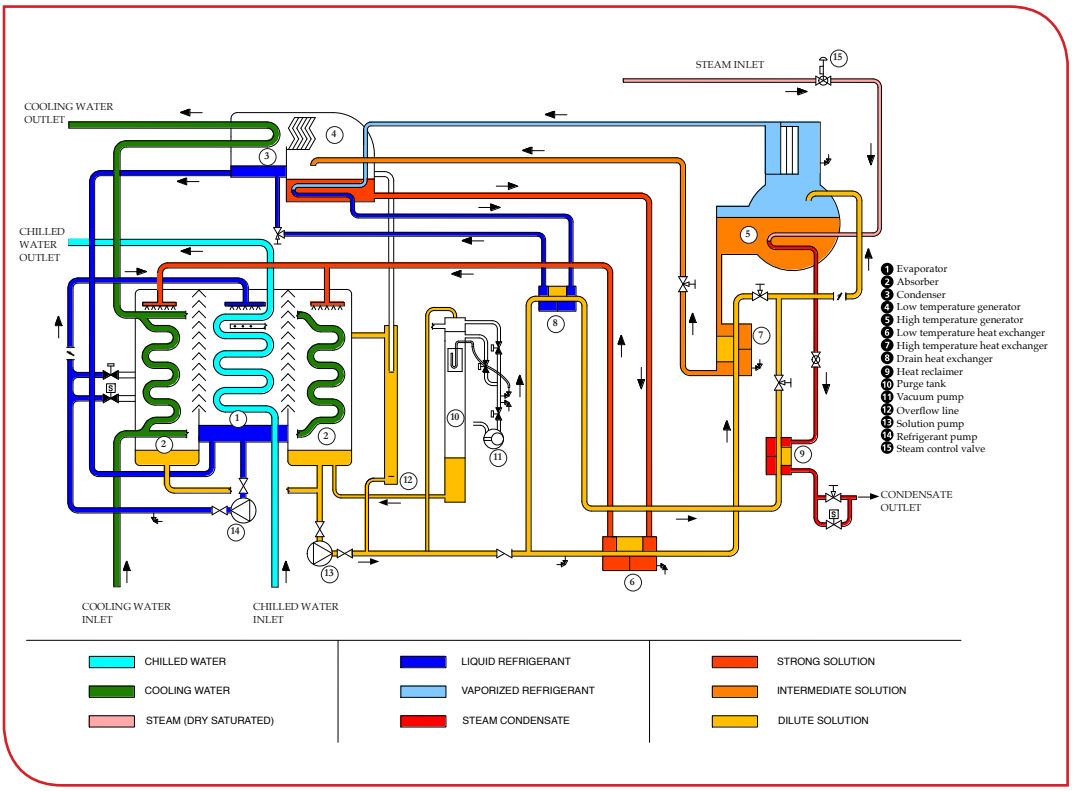
3D view of a 2B machine with main components - Control panel side view



3D view of a 2B machine with main components - Rear view



Working cycle of a 2G machine



Working cycle of a 2B machine

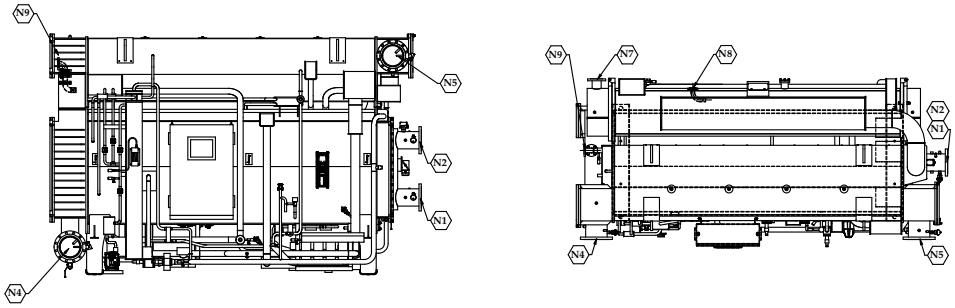
		UNITS	2B2KC	2B2LC	2B2MC	2B2NC	2B3KC	2B3LC	2B3MC	2B4KC	2B4LC	2B4MC	2B5KC	2B5LC	2B5MC	2B5NC	2B6KC	2B6LC	2B7KC	2B7LC	2B7MC	2B8KC	2B8LC	2B8MC	2B8NC
Cooling capacity		kW	476	568	704	840	1.005	1.130	1.354	1.515	1.705	1.885	2.086	2.302	2.654	2.965	3.280	3.655	4.665	5.160	5.680	6.580	7.110	7.940	8.490
Chilled water	Flow	m³/h	81,6	97,4	120,7	144,1	172,4	193,8	232,2	259,9	292,4	323,2	357,8	394,8	455,2	508,6	562,6	626,9	800,1	885	974,2	1.129	1.220	1.362	1.456
	Connectiondiameter	DN	125				150			200			200		250				350			400			
Cooling water	Flow	m³/h	142	170	210	252	300	335	404	450	500	562	622	688	792	882	970	1.094	1.380	1.530	1.641	1.960	2.100	2.337	2.337
	Connectiondiameter	DN	150				200			250			300		350				400			450			
Steam	Flow	kg/hr	511,6	610,5	757,7	903,2	1.072	1.205	1.449	1.616	1.819	2.013	2.225	2.455	2.829	3.161	3.535	3.938	5.015	5.545	6.109	7.071	7.641	8.534	9.129
	Connectiondiameter (Steam)	DN	65				80			100			100		125				150			200			
	Connectiondiameter (Condensate)	DN	40				40			40			50		50				65			65			
Dimensions	Length (L)	mm	2850		3870		3990		4590	4720			4810		5870		7340		7480			7580		8830	
	Width (W)	mm	2050		1890		1960		2010	2150			2470		2450		2450		2940			3180		3310	
	Height (H)	mm	2680		2680		2790		2790	3060			3250		3350		3430		3800			4200		4230	
Weights	Working weight	x1000kg	6,8	7,0	8,3	8,6	10,0	10,3	11,5	14,0	14,5	14,9	17,5	18,0	21,7	22,4	27,8	28,7	40,6	41,7	43,1	50,3	51,6	58,5	60,0
	Shipping weight	x1000kg	6,2	6,3	7,6	7,8	8,9	9,1	10,2	12,2	12,7	12,9	15,1	15,4	18,8	19,3	24,1	24,8	34,6	35,4	36,4	42,3	43,2	49,5	50,7
Clearance	Clearance for tube removal	mm	2500		3500		3600		4200	4250			4350		5400		6860		6910			6910		8220	
Electrical data	Solution pump	kW(A)	2,2 (6,0)				3,0 (8,0)			3,7 (11,0)			5,5 (14,0)		6,6 (17,0)		7,5 (20,0)				9,0 (27,0)			11,0 (28,0)	
	Refrigerant pump	kW(A)	0,3 (1,4)														1,5 (5,0)								
	Vacuum pump	kW(A)	0,75 (1,8)																						
	Power consumption	kVA	7,6				9,1			11,2			13,4		15,5		20,3				25,3			26,0	
	Power supply		415 V (±10 %), 50 Hz (±5 %), 3 Phase+N																						

1) Model code: 2B XX - C double effect steam fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29/34°C except for models 2B 7M C (29/34,1°C) and 2B 8N C (29/34,4°C) 4) Steam pressure = 8 bar (g), 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factor cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 10 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

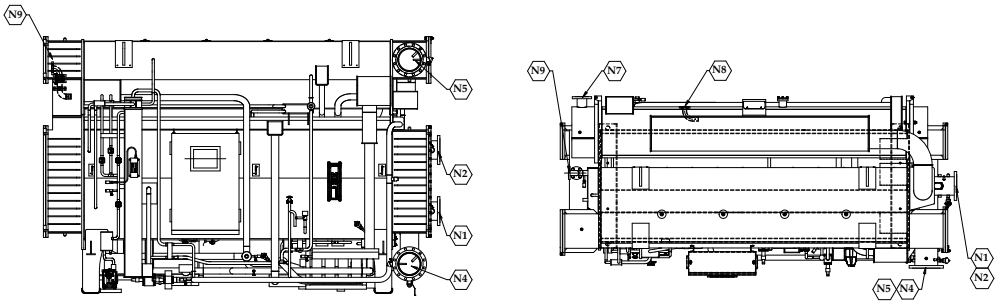
		UNITS	2G2KC	2G2LC	2G2MC	2G2NC	2G3KC	2G3LC	2G3MC	2G4KC	2G4LC	2G4MC	2G5KC	2G5LC	2G5MC	2G5NC	2G6KC	2G6LC	2G7KC	2G7LC	2G7MC	2G8KC	2G8LC	2G8MC	2G8NC
Cooling capacity		kW	476	568	704	840	1.005	1.130	1.354	1.515	1.705	1.885	2.086	2.302	2.654	2.965	3.280	3.655	4.665	5.160	5.680	6.580	7.110	7.940	8.490
Chilled water	Flow	m³/h	81,6	97,4	120,7	144,1	172,4	193,8	232,2	259,9	292,4	323,2	357,8	394,8	455,2	508,6	562,6	626,9	800,1	885	974,2	1.129	1.220	1.362	1.456
	Connectiondiameter	DN	125				150			200			200		250				300		350		400		
Cooling water	Flow	m³/h	142	170	210	252	300	335	404	450	500	562	622	688	792	882	970	1.094	1.380	1.530	1.641	1.960	2.100	2.337	2.377
	Connectiondiameter	DN	150				200			250			300		350				400			450			
Hot water	Flow	m³/h	20,8	24,7	30,8	36,5	43,7	48,9	59,0	66,0	74,0	81,9	90,6	100,0	115,2	128,6	144,2	160,6	203,1	225,1	247,6	286,6	309,6	345,6	369,6
	Connectiondiameter	DN	65		80		100						125				150				200			250	
Dimensions	Length (L)	mm	2850		3870		3990		4590	4720			4810		5870		7340		7480			7580		8830	
	Width (W)	mm	2050		1890		1960		2010	2150			2375		2470		2450		2940			3180		3310	
	Height (H)	mm	2680		2680		2790		2790	3060			3250		3350		3430		3800			4200		4230	
Weights	Working weight	x1000kg	6,8	7,0	8,3	8,6	10,0	10,3	11,5	14,0	14,5	14,9	17,5	18,0	21,7	22,4	27,8	28,7	40,6	41,7	43,1	50,3	51,6	58,5	60,0
	Shipping weight	x1000kg	6,2	6,3	7,6	7,8	8,9	9,1	10,2	12,2	12,7	12,9	15,1	15,4	18,8	19,3	24,1	24,8	34,6	35,4	36,4	42,3	43,2	49,5	50,7
Clearance	Clearance for tube removal	mm	2500		3500		3600		4200	4250			4350		5400		6860		6910			6910		8220	
Electrical data	Solution pump	kW(A)	2,2 (6,0)				3,0 (8,0)			3,7 (11,0)			5,5 (14,0)		6,6 (17,0)		7,5 (20,0)				9,0 (27,0)			11,0 (28,0)	
	Refrigerant pump	kW(A)	0,3 (1,4)														1,5 (5,0)								
	Vacuum pump	kW(A)	0,75 (1,8)																						
	Powerconsumption	kVA	7,6				9,1			11,2			13,4		15,5		20,3				25,3			26,0	
	Power supply		415 V (±10 %), 50 Hz (±5 %), 3 Phase+N																						

1) Model code: 2G XX - C double effect superheated water fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29/34°C except for models 2G 7M C (29/34,1°C) and 2G 8N C (29/34,4°C) 4) Inlet/Outlet superheated water = 180/165°C, 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factor cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 10°C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

NOZZLES ORIENTATION DEPENDING ON NUMBER OF PASSES:

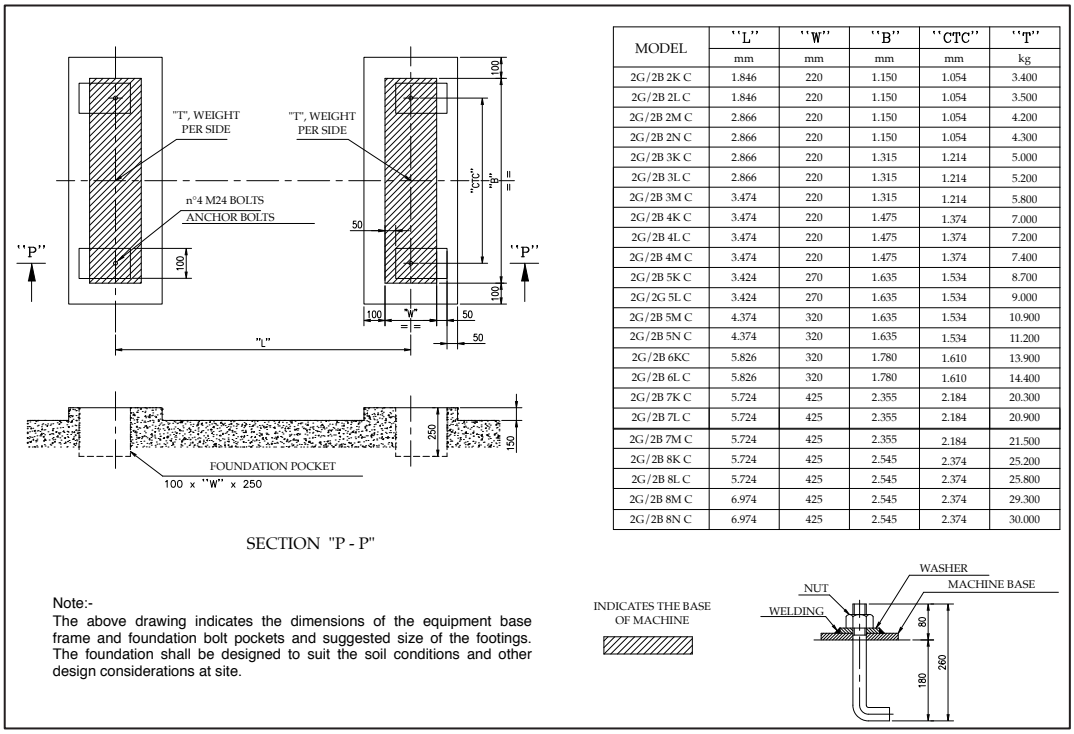


Passes combination: Evaporator (even), Absorber (even), Condenser (1)



Passes combination: Evaporator (even), Absorber (odd), Condenser (1)

N1 = Chilled water inlet
N2 = Chilled water outlet
N4 = Cooling water inlet
N5 = Cooling water outlet
N7 = Steam inlet
N8 = Condensate outlet
N9 = Rupture disk connection



MODEL	"L"	"W"	"B"	"CTC"	"T"
	mm	mm	mm	mm	kg
2G/2B 2K C	1.846	220	1.150	1.054	3.400
2G/2B 2L C	1.846	220	1.150	1.054	3.500
2G/2B 2M C	2.866	220	1.150	1.054	4.200
2G/2B 2N C	2.866	220	1.150	1.054	4.300
2G/2B 3K C	2.866	220	1.315	1.214	5.000
2G/2B 3L C	2.866	220	1.315	1.214	5.200
2G/2B 3M C	3.474	220	1.315	1.214	5.800
2G/2B 4K C	3.474	220	1.475	1.374	7.000
2G/2B 4L C	3.474	220	1.475	1.374	7.200
2G/2B 4M C	3.474	220	1.475	1.374	7.400
2G/2B 5K C	3.424	270	1.635	1.534	8.700
2G/2G 5L C	3.424	270	1.635	1.534	9.000
2G/2B 5M C	4.374	320	1.635	1.534	10.900
2G/2B 5N C	4.374	320	1.635	1.534	11.200
2G/2B 6KC	5.826	320	1.780	1.610	13.900
2G/2B 6L C	5.826	320	1.780	1.610	14.400
2G/2B 7K C	5.724	425	2.355	2.184	20.300
2G/2B 7L C	5.724	425	2.355	2.184	20.900
2G/2B 7M C	5.724	425	2.355	2.184	21.500
2G/2B 8K C	5.724	425	2.545	2.374	25.200
2G/2B 8L C	5.724	425	2.545	2.374	25.800
2G/2B 8M C	6.974	425	2.545	2.374	29.300
2G/2B 8N C	6.974	425	2.545	2.374	30.000

Note:-
The above drawing indicates the dimensions of the equipment base frame and foundation bolt pockets and suggested size of the footings. The foundation shall be designed to suit the soil conditions and other design considerations at site.

Foundation details for 2G/2B series

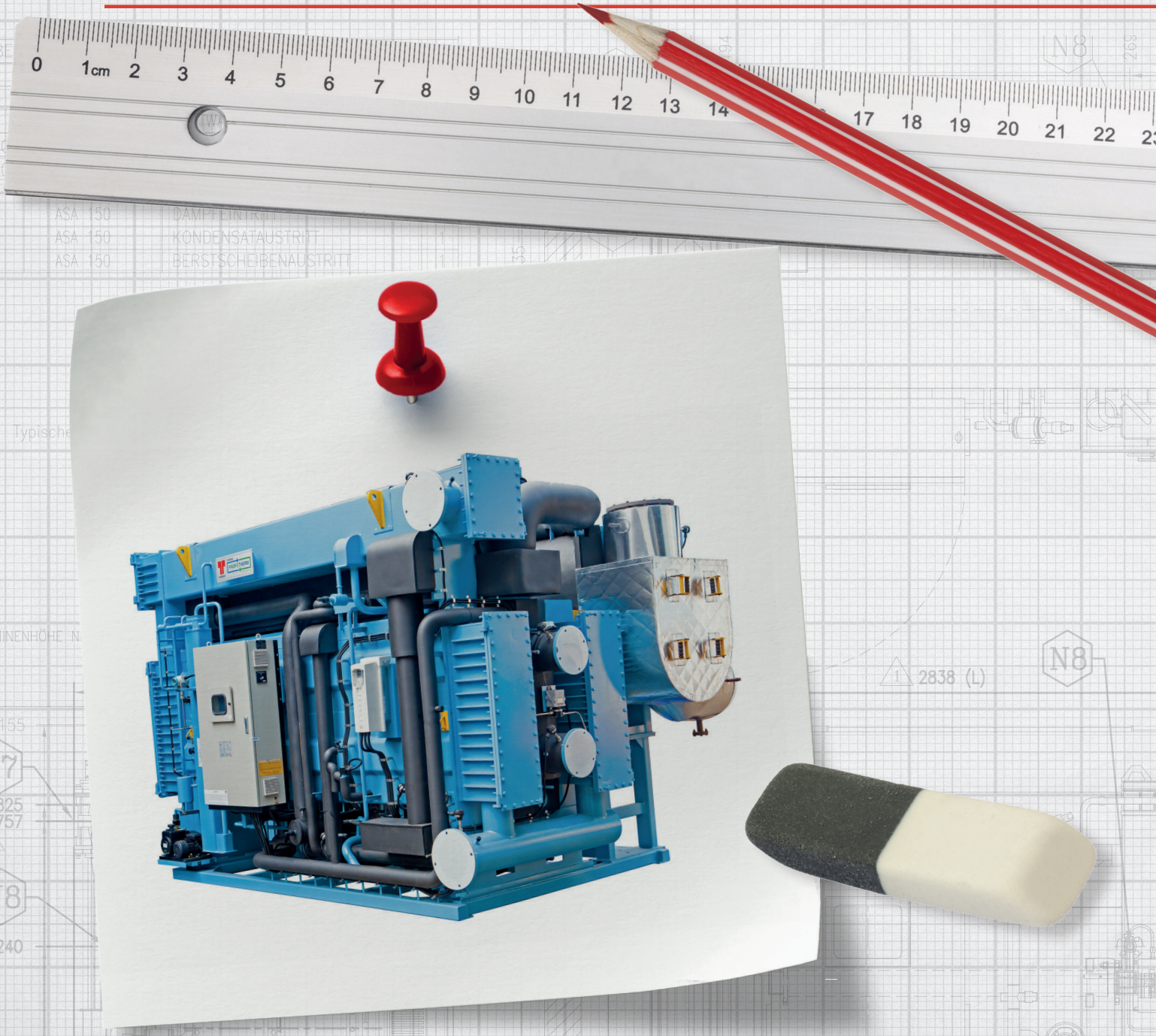
SS/HS SERIES POSSIBLE APPLICATIONS:

- District heating/cooling
- Cogeneration/Trigeneration
- Food industry
- Automotive industry
- Solar cooling

NECESSARY DATA TO PREPARE AN OFFER

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Superheated water inlet/outlet temperatures (2G)
- Steam pressure (2B)

2D series



9. 2D SERIES:

Latest generation of double effect exhaust gases fired absorption chillers. This series features a double stage evaporation/absorption technology.

The machines are specifically designed to be used with exhaust gases coming from a gas engine or a gas turbine.

This new generation of machines feature compact dimensions, easy to use, easy to maintenance and one of the highest efficiency of the market.

Cooling capacity from 350 kW to 8.500 kW (higher capacities available upon request).

Exhaust gases temperature between 350 °C and 600 °C (lower temperatures upon request).

COP: between 1,38 and 1,43

STANDARD FEATURES:

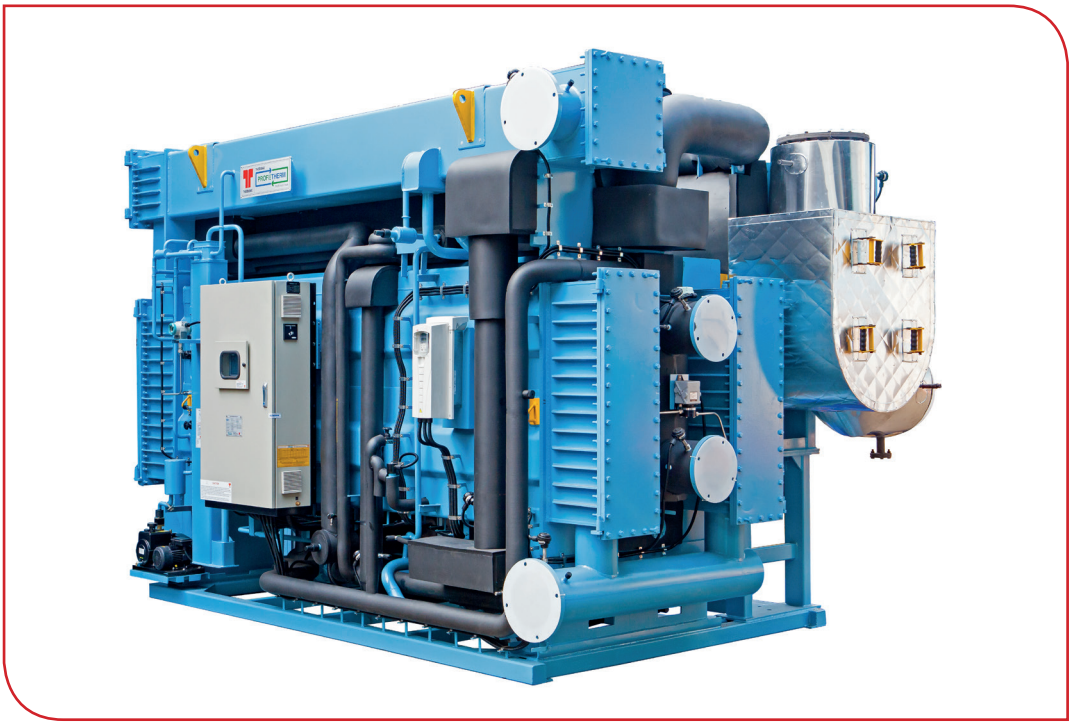
- Triple shell design: the upper shell (including condenser and generator (LTG), the lower shell (including evaporators and the absorbers) and High temperature Generator (HTG)
- The lower shell has a 2 Pressure level design, with 'split' type evaporator and 2 absorbers. This gives the advantage of higher efficiency of absorption (water vapour into sprayed LiBr solution).
- Straight tubes in the generators for easy maintenance.
- Gravity feed spraying technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Marine type headers in absorber and condenser, for an easy access to the tube bundle without need of lifting systems to support the header. All water boxes have flanged connections. All water boxes are provided with drain and vent connections.
- Crystallization control and prevention based on on-line determination of actual measured concentration.
- Refrigerant autoblowdown solenoid valve controlled by solution concentration
- Level electrodes for refrigerant and solution level monitoring in the evaporator, absorber and HTG.
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state annunciation through an audio signal and appropriate messages display on the operator interface terminal.
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- Boiler grade carbon steel tubes in high temperature generator.
- DLP copper tubes in evaporator, absorber and condenser.
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, exhaust damper PLC control based on generator temperature.
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.
- Three regenerative heat exchangers to increase the efficiency of the cycle. The heat exchangers are

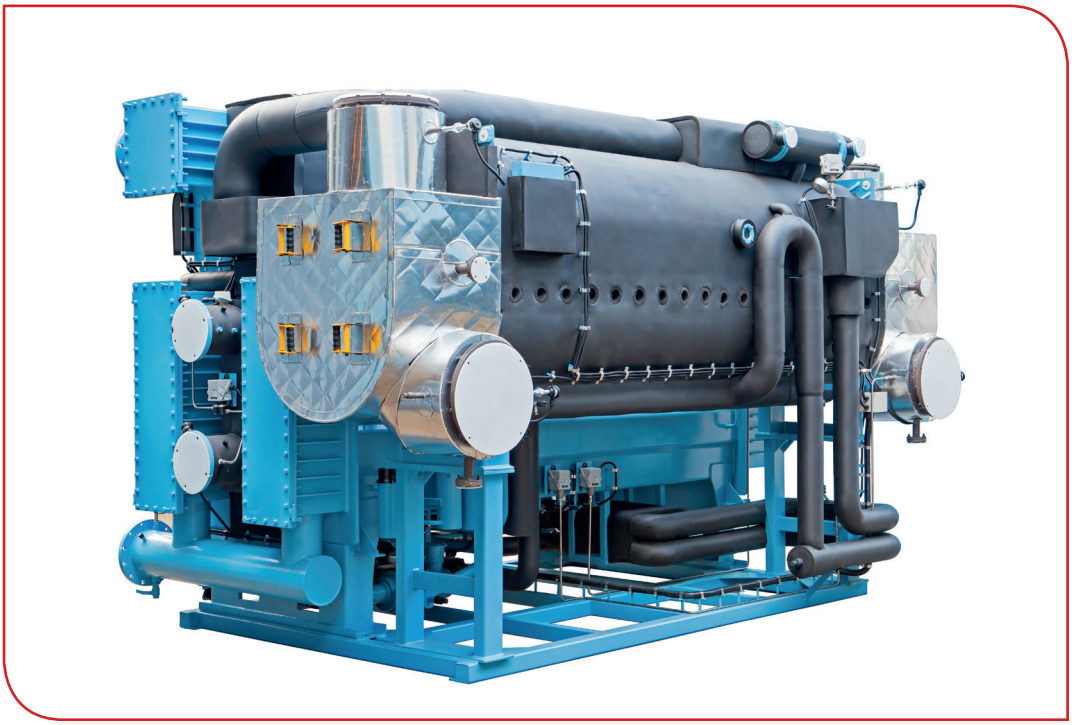
plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger ensures a compact design of the unit.

- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller.
- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled and cooling water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip, remote setpoint.
- Rupture disk
- Digital vacuum transmitter
- Inverter on solution pump.
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel)
- Generator pressure switch.

OPTIONAL:

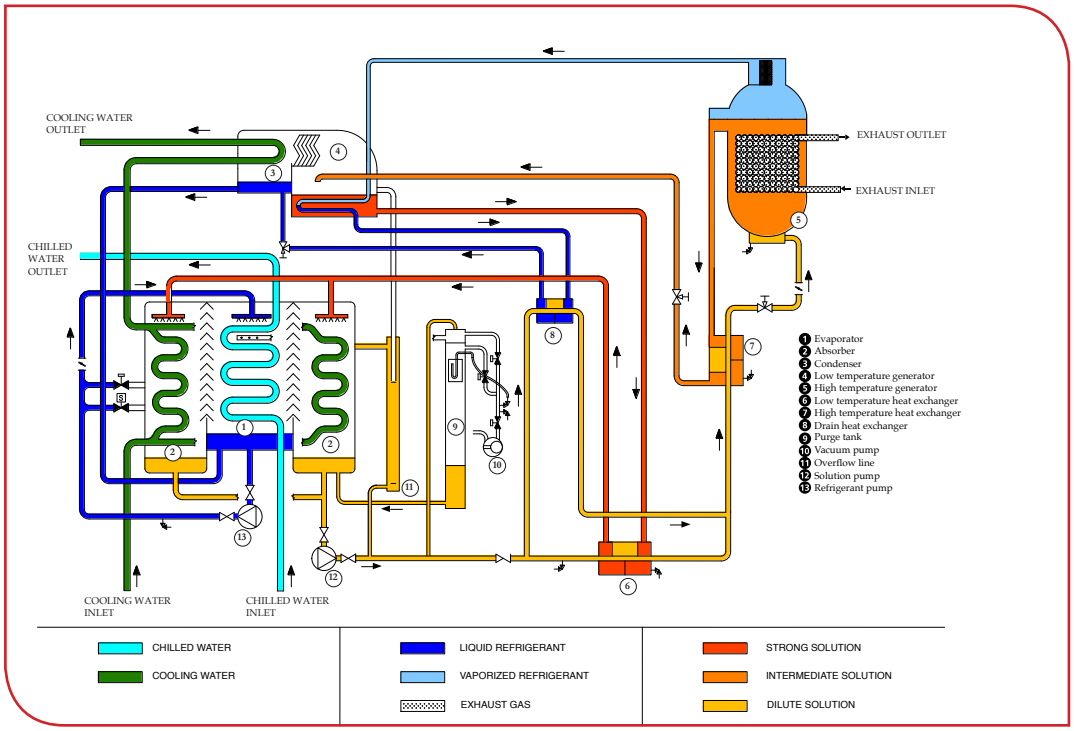
- Stand by refrigerant and solution pumps.
- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG).
- Insulation of cold and hot surfaces (excluded surfaces at T higher than 150°C).
- Three pieces shipment: unit can be shipped in three pieces to be reassembled on site (lower shell, upper shell and HTG).
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Autopurge system for automatic purging of purge tank (electric or pneumatic).





Double effect exhaust fired absorption chiller of 2D series

9. 2D series



Working cycle of 2D series

		UNITS	2D 2KC	2D 2LC	2D 2MC	2D 2NC	2D 3KC	2D 3LC	2D 3MC	2D 4KC	2D 4LC	2D 4MC	2D 5KC	2D 5LC	2D 5MC	2D 5NC	2D 6KC	2D 6LC	2D 7KC	2D 7LC	2D 7MC	2D 8KC	2D 8LC	2D 8MC	2D 8NC
Cooling capacity		kW	476	568	704	840	1.005	1.130	1.354	1.515	1.705	1.885	2.086	2.302	2.654	2.965	3.280	3.655	4.665	5.160	5.680	6.580	7.110	7.940	8.490
Chilled water	Flow	m³/h	81,6	97,4	120,7	144,1	172,4	193,8	232,2	259,9	292,4	323,2	357,8	394,8	455,2	508,6	562,6	626,9	800,1	885	974,2	1.129	1.220	1.362	1.456
	Connection diameter	DN	125				150			200			200		250				350			400			
Cooling water	Flow	m³/h	142	170	210	252	300	335	404	450	500	562	622	688	792	882	970	1.094	1.380	1.530	1.641	1.960	2.100	2.337	2.337
	Connection diameter	DN	150				200			250			300		350				400			450			
Exhaust	Heat input	kW	338	401	500	592	707	792	955	1.069	1.200	1.327	1.468	1.620	1.865	2.083	2.336	2.602	3.291	3.647	4.012	4.643	5.016	5.598	5.988
Dimensions	Length (L)	mm	3350		4400		4450		5075	5150			5200		6200		7675		7825			7850		9150	
	Width (W)	mm	2675		2600		2825		2875	3150			3400		3550		3750		4450			4800		5000	
	Height (H)	mm	2790		2790		2890		2890	3160			3350		3450		3530		3900			4350		4380	
Weights	Working weight	x1000kg	9,2	9,2	10,9	11,5	13,1	13,5	15,2	18,3	19,0	19,4	22,0	22,7	28,0	28,9	34,6	35,8	48,7	50,1	52,4	59,8	61,6	69,3	71,5
	Shipping weight	x1000kg	8,6	8,8	10,4	10,9	12,3	12,7	14,3	17,3	17,9	18,3	20,6	21,1	26,4	27,1	32,4	33,5	44,8	46,0	48,0	54,4	55,9	63,3	65,3
Clearance	Clearancefortube removal	mm	2500		3500		3600		4200	4250			4350		5400		6860		6910			6910		8220	
Electrical data	Solution pump	kW(A)	2,2 (6,0)				3,0 (8,0)			3,7 (11,0)			5,5 (14,0)		6,6 (17,0)		7,5 (20,0)				9,0 (27,0)			11,0 (28,0)	
	Refrigerantpump	kW(A)	0,3 (1,4)																1,5 (5,0)						
	Vacuum pump	kW(A)	0,75 (1,8)																						
	Power consumption	kVA	7,6				9,1			11,2			13,4		15,5		20,3				25,3			26,0	
	Power supply		415 V (±10 %), 50 Hz (±5 %), 3 Phase+N																						

1) Model code: 2D XX - C double effect exhaust fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29/34°C except for models 2D 7M C (29/34,1°C) and 2D 8N C (29/34,4°C) 4) Inlet/Outlet exhaust gases temperature = 450/170°C with specific heat of exaust of 1,128 kJ/kg °C, 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factor cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 10 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.

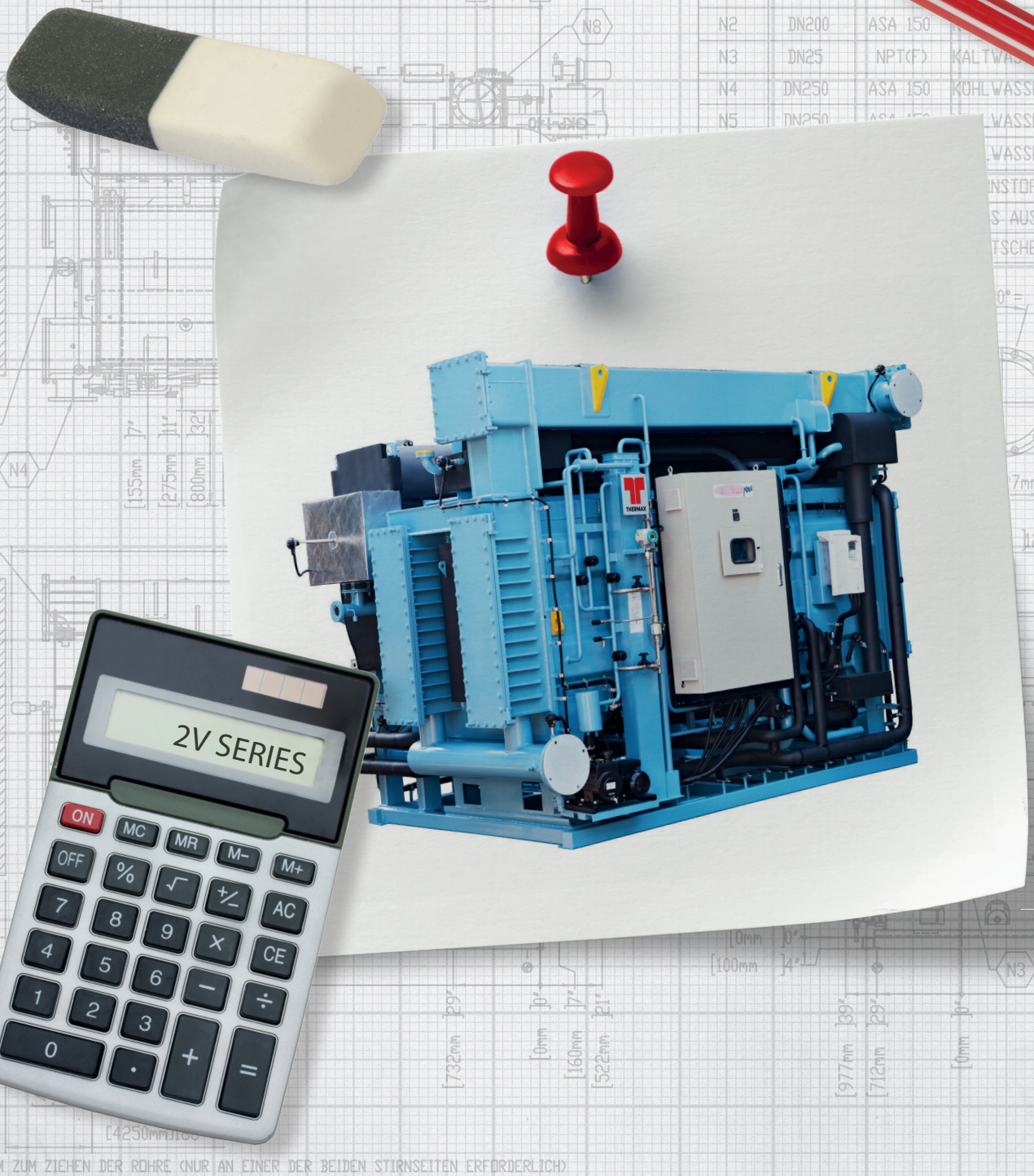
2D SERIES POSSIBLE APPLICATIONS:

- Cogeneration/Trigeneration
- Paper industry
- Automotive industry

NECESSARY DATA TO PREPARE AN OFFER:

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Exhaust flow (in kg/h)
- Exhaust temperature
- Allowable Pressure drop in exhaust furnace

2V series



10. 2V SERIES:

Latest generation of double effect direct fired absorption chillers. This series features a double stage evaporation/absorption technology.

The machines are specifically designed to be used with natural gas.

This new generation of machines feature compact dimensions, easy to use, easy to maintenance and one of the highest efficiency of the market.

Cooling capacity from 350 kW to 5.700 kW (higher capacities available upon request).

COP: between 1,38 and 1,43

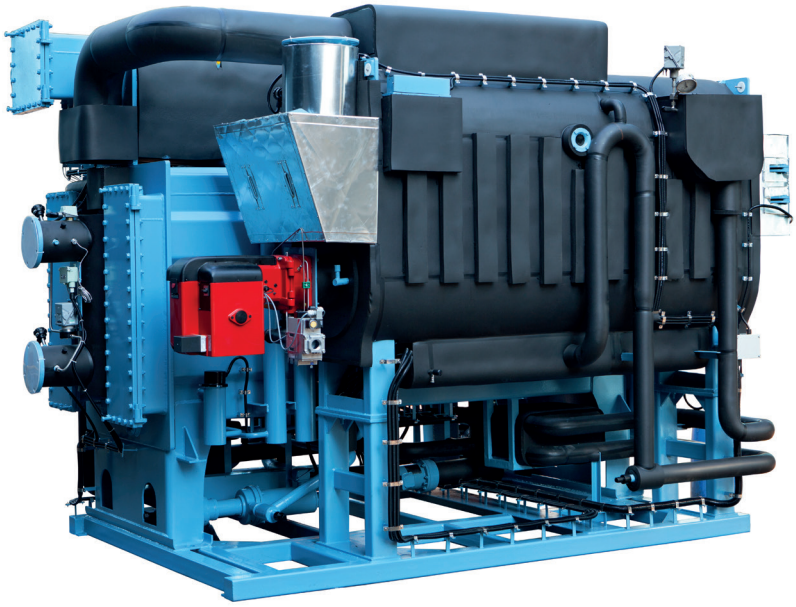
STANDARD FEATURES:

- Triple shell design: the upper shell (including condenser and generator (LTG), the lower shell (including evaporators and the absorbers) and High temperature Generator (HTG)
- The lower shell has a 2 Pressure level design, with 'split' type evaporator and 2 absorbers. This gives the advantage of higher efficiency of absorption (water vapour into sprayed LiBr solution).
- Straight tubes in the generators for easy maintenance.
- Gravity feed spraying technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Marine type headers in absorber and condenser, for an easy access to the tube bundle without need of lifting systems to support the header. All water boxes have flanged connections. All water boxes are provided with drain and vent connections.
- Crystallization control and prevention based on on-line determination of actual measured concentration.
- Refrigerant autoblowdown solenoid valve controlled by solution concentration
- Level electrodes for refrigerant and solution level monitoring in the evaporator, absorber and HTG.
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state annunciation through an audio signal and appropriate messages display on the operator interface terminal.
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- Boiler grade carbon steel tubes in high temperature generator.
- DLP copper tubes in evaporator, absorber and condenser.
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, gas burner PLC control based on generator temperature.
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.

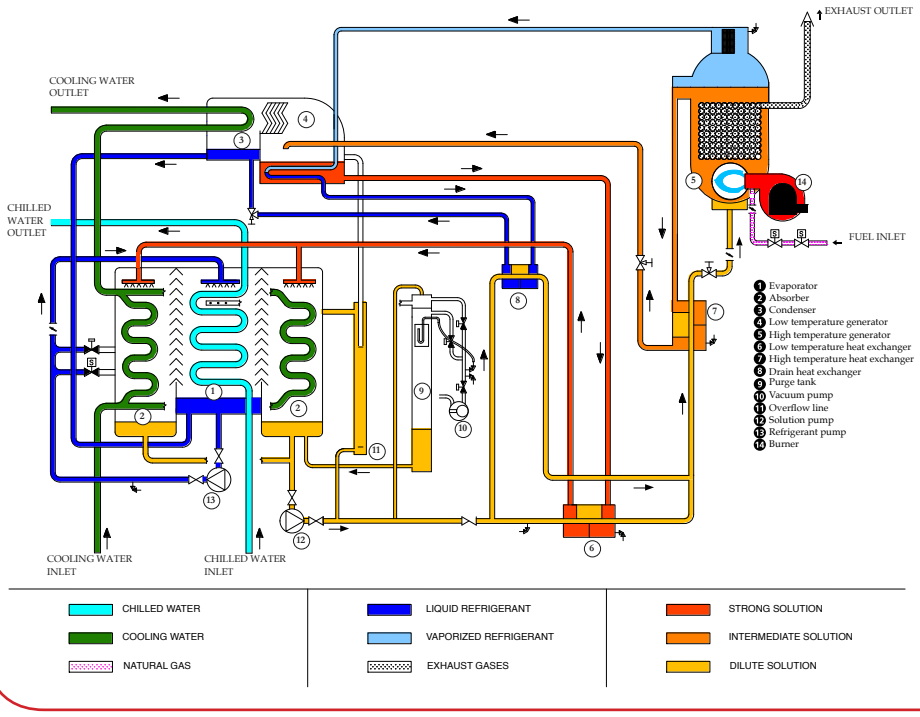
- Three regenerative heat exchangers to increase the efficiency of the cycle. The heat exchangers are plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger ensures a compact design of the unit.
- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller.
- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled and cooling water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip, remote setpoint.
- Rupture disk
- Digital vacuum transmitter
- Inverter on solution pump.
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel)
- Generator pressure switch.
- Hi-low or modulating burner, depending on models.

OPTIONAL:

- Stand by refrigerant and solution pumps.
- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG).
- Insulation of cold and hot surfaces (excluded surfaces at T higher than 150°C).
- Three pieces shipment: unit can be shipped in three pieces to be reassembled on site (lower shell, upper shell and HTG).
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Autopurge system for automatic purging of purge tank (electric or pneumatic).
- Special version with reverse cycle valve to generate hot water up to 60°C
- Special version with additional heat exchanger to generate hot water up to 90°C
- Special version with additional heat exchanger to generate simultaneously chilled water and hot water.



Double effect direct fired absorption chiller of 2V series

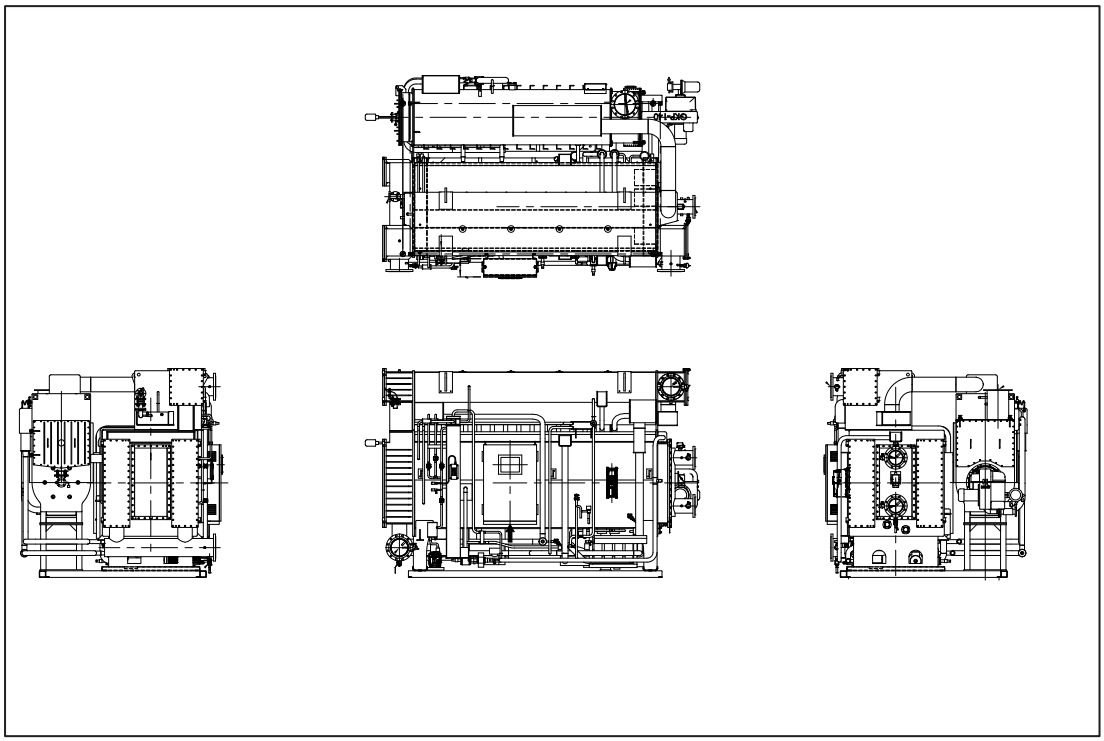


Working cycle of 2V series

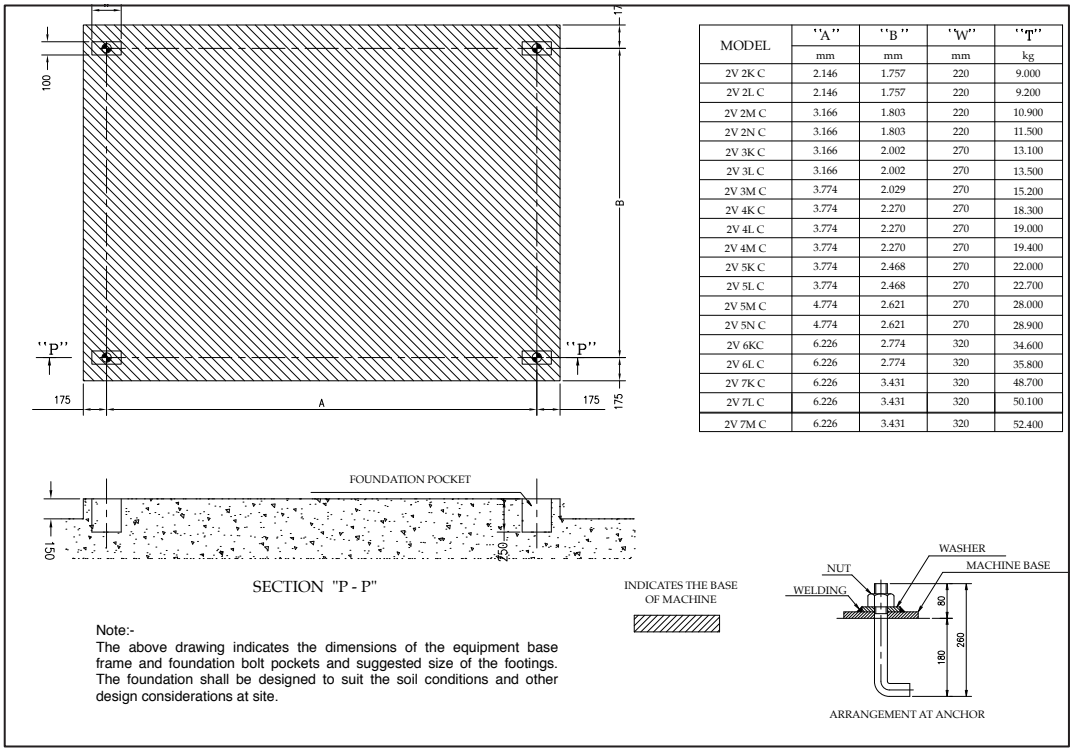
10. 2V series

		UNITS	2V2KC	2V2LC	2V2MC	2V2NC	2V3KC	2V3LC	2V3MC	2V4KC	2V4LC	2V4MC	2V5KC	2V5LC	2V5MC	2V5NC	2V6KC	2V6LC	2V7KC	2V7LC	2V7MC
Cooling capacity		kW	476	568	704	840	1.005	1.130	1.354	1.515	1.705	1.885	2.086	2.302	2.654	2.965	3.280	3.655	4.665	5.160	5.452
Chilled water	Flow	m^3/h	81,6	97,4	120,7	144,1	172,4	193,8	232,2	259,9	292,4	323,2	357,8	394,8	455,2	508,6	562,6	626,9	800,1	885	935,1
	Connection diameter	DN	125				150			200			200		250				350		
Cooling water	Flow	m^3/h	142	170	210	252	300	335	404	450	500	562	622	688	792	882	970	1.094	1.380	1.530	1.620
	Connection diameter	DN	150				200			250			300		350				400		
Gas circuit																					
	Gas consumption	m_N^3/h	34,8	41,3	51,5	61	72,9	81,7	98,5	110,2	123,7	136,9	151,4	167	192,4	214,7	240,8	268,3	339,3	376	396,7
	Stack connection diameter	DN	150		200		250			300			350		150		500		550		
Dimensions	Length (L)	mm	3270		4285		4325		4930	4975			5010		6010		7465		7595		
	Width (W)	mm	2640		2550		2550		2800	3070			3300		3450		3640		4310		
	Height (H)	mm	2790		2790		2890		2890	3160			3350		3450		3530		3900		
Weights	Working weight	x1000kg	9,0	9,2	10,9	11,5	13,1	13,5	15,2	18,3	19,0	19,4	22,0	22,7	28,0	28,9	34,6	35,8	48,7	50,1	52,4
	Shipping weight	x1000kg	8,4	8,5	10,1	10,6	11,9	12,3	13,9	16,5	17,1	17,4	19,6	20,1	25,1	25,8	30,9	31,9	42,7	43,8	45,7
Clearance	Clearance for tube removal	mm	2500		3500		3600		4200	4250			4350		5400		6860		6910		
Electrical data	Solution pump	kW(A)	2,2 (6,0)				3,0 (8,0)			3,7 (11,0)			5,5 (14,0)		6,6 (17,0)		7,5 (20,0)				
	Refrigerant pump	kW(A)	0,3 (1,4)														1,5 (5,0)				
	Vacuum pump	kW(A)	0,75 (1,8)																		
	Power consumption	kVA	11,2				13,4	14,8	15,3	17,5			23,9		26,1	26,4	36,7			41,6	
	Power supply		415 V (±10 %), 50 Hz (±5 %), 3 Phase+N																		

1) Model code: 2V XX - C double effect direct fired absorption chiller, 2) Inlet/Outlet chilled water temperature = 12/7 °C, 3) Inlet/Outlet cooling water temperature = 29/34°C 4) Net calorific value of gas = 37.681 kJ/Nm3, 5.a) Fouling factors: chilled water - 0,018 m^2·K/kW, b) Fouling factor cooling water - 0,044m^2·K/kW, 6) Minimum chilled water outlet temperature 3,5°C; lower temperatures upon request, 7) Minimum cooling water inlet temperature 10 °C, 8) Plantroom minimum/maximum temperature 5-45 °C, 9) Maximum working pressure in water circuits = 8 bar(g); higher pressures available upon request at extra price, 10) Please contact Thermax representative/office for customised specifications.



Typical layout of 2V series



MODEL	''A''	''B''	''W''	''T''
	mm	mm	mm	kg
2V 2K C	2.146	1.757	220	9.000
2V 2L C	2.146	1.757	220	9.200
2V 2M C	3.166	1.803	220	10.900
2V 2N C	3.166	1.803	220	11.500
2V 3K C	3.166	2.002	270	13.100
2V 3L C	3.166	2.002	270	13.500
2V 3M C	3.774	2.029	270	15.200
2V 4K C	3.774	2.270	270	18.300
2V 4L C	3.774	2.270	270	19.000
2V 4M C	3.774	2.270	270	19.400
2V 5K C	3.774	2.468	270	22.000
2V 5L C	3.774	2.468	270	22.700
2V 5M C	4.774	2.621	270	28.000
2V 5N C	4.774	2.621	270	28.900
2V 6KC	6.226	2.774	320	34.600
2V 6L C	6.226	2.774	320	35.800
2V 7K C	6.226	3.431	320	48.700
2V 7L C	6.226	3.431	320	50.100
2V 7M C	6.226	3.431	320	52.400

Foundation details of 2V series

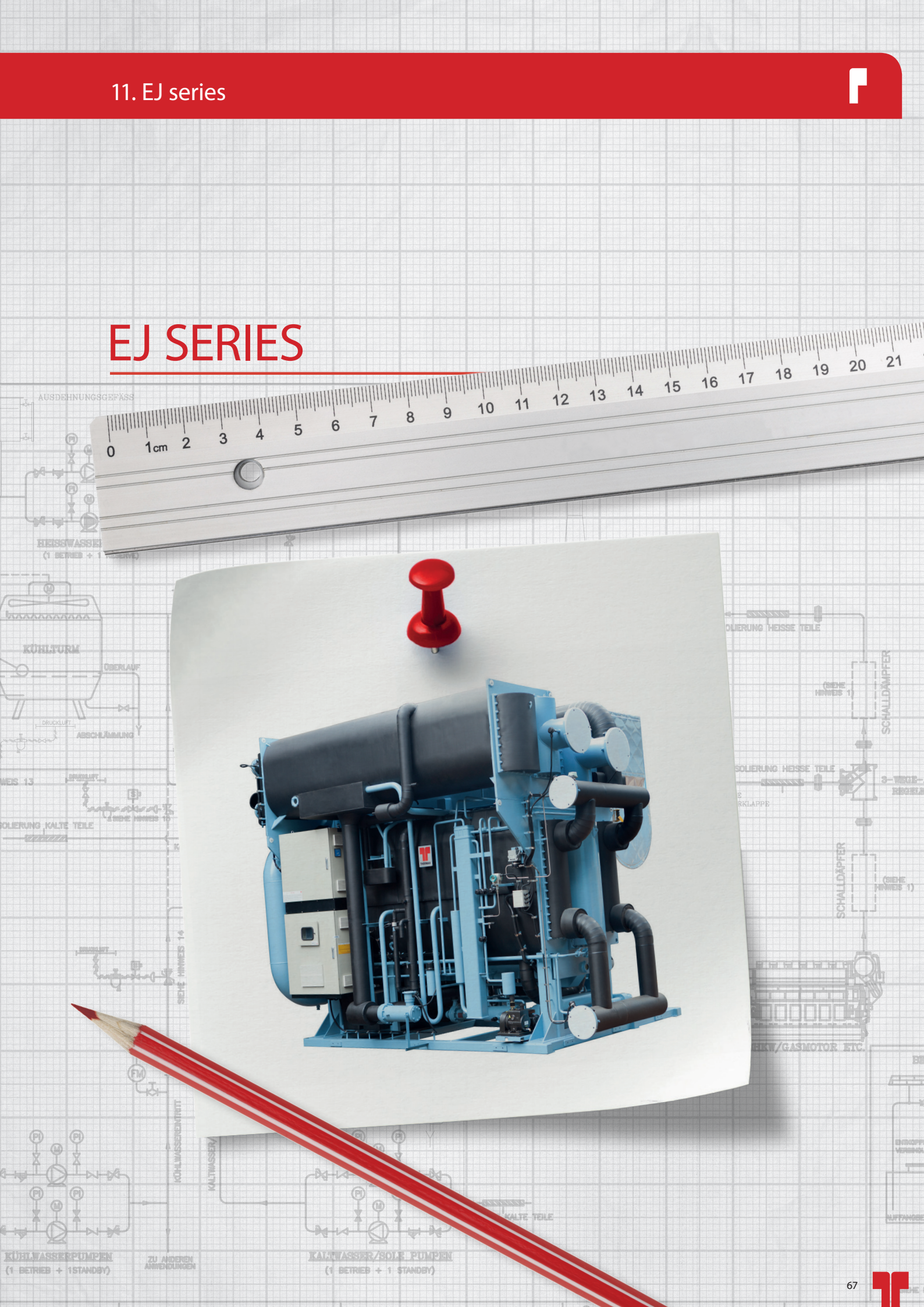
2V SERIES POSSIBLE APPLICATIONS:

- Installations with fiscal facilities on gas price
- Installations with low electrical power available
- Installations requiring cooling and heating generation

NECESSARY DATA TO PREPARE AN OFFER:

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Calorific value of gas

EJ SERIES



11. EJ SERIES:

"J" series machines can be fired with multiple heat sources simultaneously. The most common model of the series is the "EJ" series, that can be fired with hot water and exhaust gases at the same time. Other options are anyway available, like the steam + hot water (SJ) or the superheated water + hot water (HJ).

All machines in this series feature three different generators: one fired by the low temperature heat source (hot water) and two fired with the high temperature heat source. Basically it is as if the machine is running a single effect cycle and a double effect cycle at the same time.

With the "J" series it is possible to maximize the cooling output of the machine at same heat input, with much more compact dimensions respect to the use of two separate machines.

Cooling capacity 455 kW-7 MW.

HIGH TEMPERATURE HEAT SOURCE
Exhaust gases: 350 °C-600 °C
Steam: 4 bar(g)-10 bar(g)
Superheated water: 155 °C-180 °C

LOW TEMPERATURE HEAT SOURCE
Hot water: 85 °C-120 °C

BACK UP BURNER AVAILABLE IN OPTION

COP: between 0,95 and 1,1

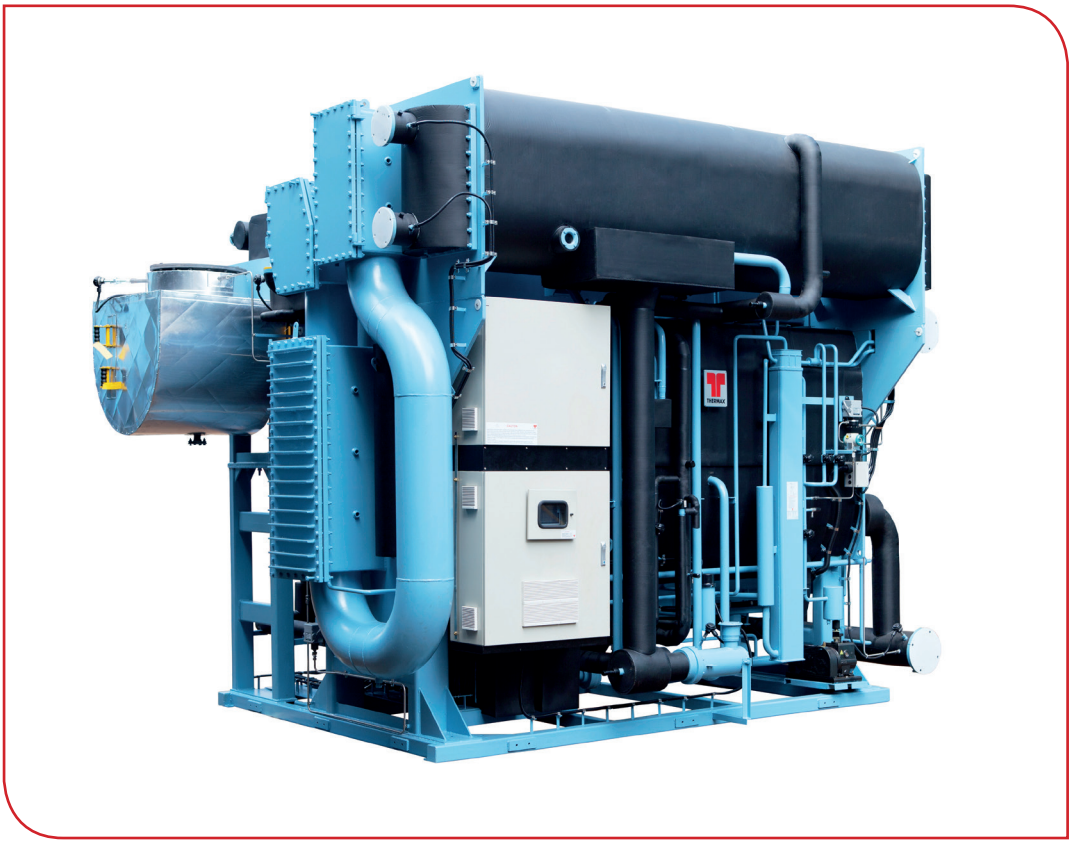
STANDARD FEATURES:

- Triple shell design: the upper shell (including the two condensers, the low temperature generator (LTG) and the hot water fired generator, the lower shell (including evaporators and the absorbers) and High temperature Generator (HTG).
- "Split" type evaporator: the evaporator is divided into two different tube bundles, placed on both sides of the absorber, that remains in the middle of the two evaporators. This solution grants a better efficiency at part load, optimizing the mass transfer inside the solution.
- Straight tubes in the generators for easy maintenance.
- Gravity feed spray technology in evaporator and absorber. Liquids are sprayed downwards on the tubes to ensure good film thickness and better heat transfer.
- Marine type headers in absorber and condenser, for an easy access to the tube bundle without need of lifting systems to support the header. All water boxes have flanged connections. All water boxes are provided with drain and vent connections.
- Crystallization control and prevention based on on-line determination of actual measured concentration.
- Refrigerant autoblowdown solenoid valve controlled by solution concentration
- Level electrodes for refrigerant and solution level monitoring in the evaporator, absorber and HTG.
- PLC based control panel SIEMENS SIMATIC S7-1200
- Alarm state annunciation through an audio signal and appropriate messages display on the operator interface terminal.

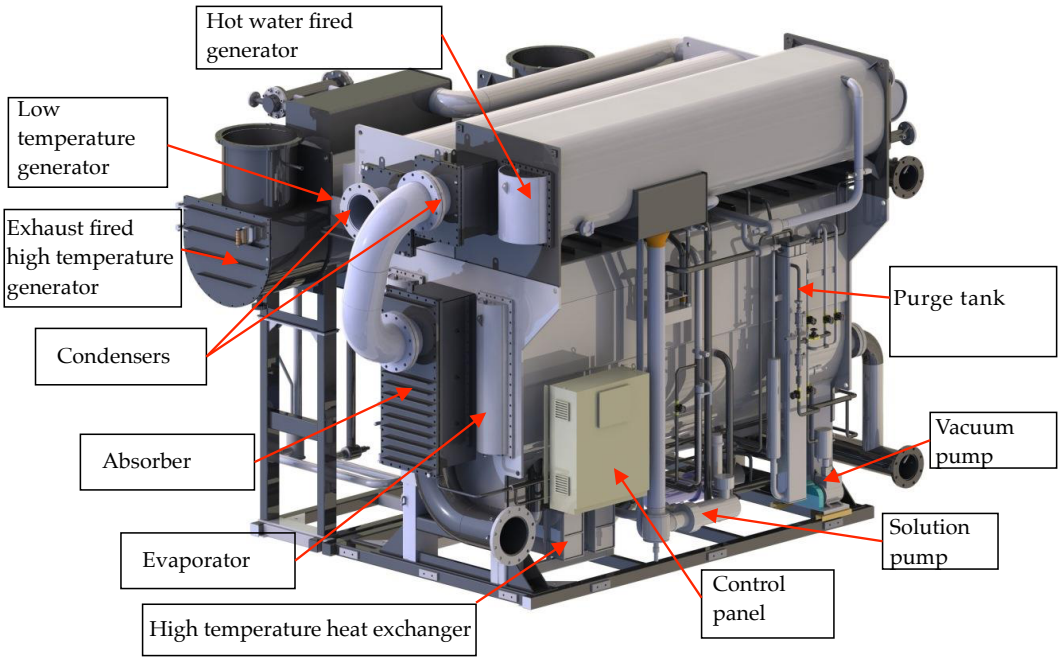
- Operator panel SIEMENS TP700, 7" touchscreen.
- MODBUS RTU connectivity as a standard feature.
- Several field interlocks available for plant automation.
- Boiler grade carbon steel tubes in high temperature generator (in case of exhasut fired firing). SS 430 Ti tubes in case of steam firing.
- DLP copper tubes in evaporator, absorber and condenser.
- Crystallization prevention safeties: overflow pipe for auto decrystallisation, low/high cooling water inlet temperature cut-out, high temperature control for generator, heat input PLC control based on generator temperature.
- PID algorithm capable of achieving part load operation from 10 to 100% stepless, based on chilled water outlet temperature.
- Purge system, which continuously and automatically removes non condensable gases from the shell side and stores them in a tank. A purge pump is provided as standard feature.
- Three regenerative heat exchangers to increase the efficiency of the cycle. The heat exchangers are plate type, with copper brazed stainless steel plates, designed for the maximum heat exchange with minimum pressure loss. The use of a plate heat exchanger ensures a compact design of the unit.
- Isolating valves for easy removal of the pumps for maintenance without breaking the vacuum inside the chiller.
- Antifreeze protection safeties: PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for refrigerant pump (L-cut), flow switch and D.P. switch for chilled water.
- Completely factory assembled and wired.
- Potential free contacts for remote and automatic operation of the machine: chilled and cooling water pumps start/stop, cooling tower fans start/stop, remote start/stop of the machine, remote indication of machine status (on/off) and machine trip, remote setpoint.
- Rupture disk
- Digital vacuum transmitter
- Inverter on solution pumps.
- TRG, a patented bearing monitoring system for monitoring the wear and tear of the bearings (through contacts inside control panel)
- Generator pressure switch.

OPTIONAL:

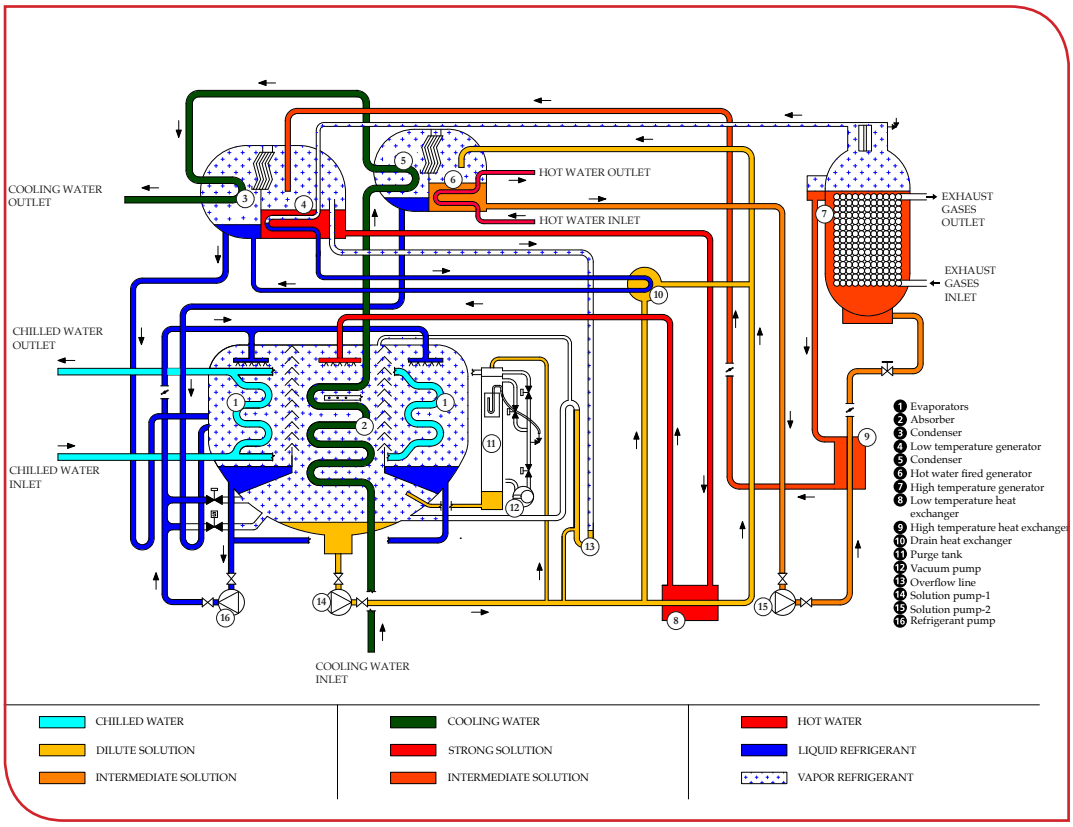
- Stand by refrigerant and solution pumps.
- Special metallurgy for tubes (CuNi 95/5, CuNi 90/10, Stainless steel, Titanium).
- Tubesheet and headers cladding in case of use of bad quality water not suitable for carbon steel
- On line indication of healthiness of bearings of refrigerant and solution pump (on line TRG).
- Insulation of cold and hot surfaces (excluded surfaces at T higher than 150°C).
- Multiple pieces shipment: unit can be shipped in multiple pieces to be reassembled on site.
- Profibus connection.
- Ethernet or Modbus TCP/IP connection.
- Autopurge system for automatic purging of purge tank (electric or pneumatic).
- Back up burner



EJ series absorption chiller fired with exhaust gases + hot water



3D view of an EJ machine



Working cycle of EJ series

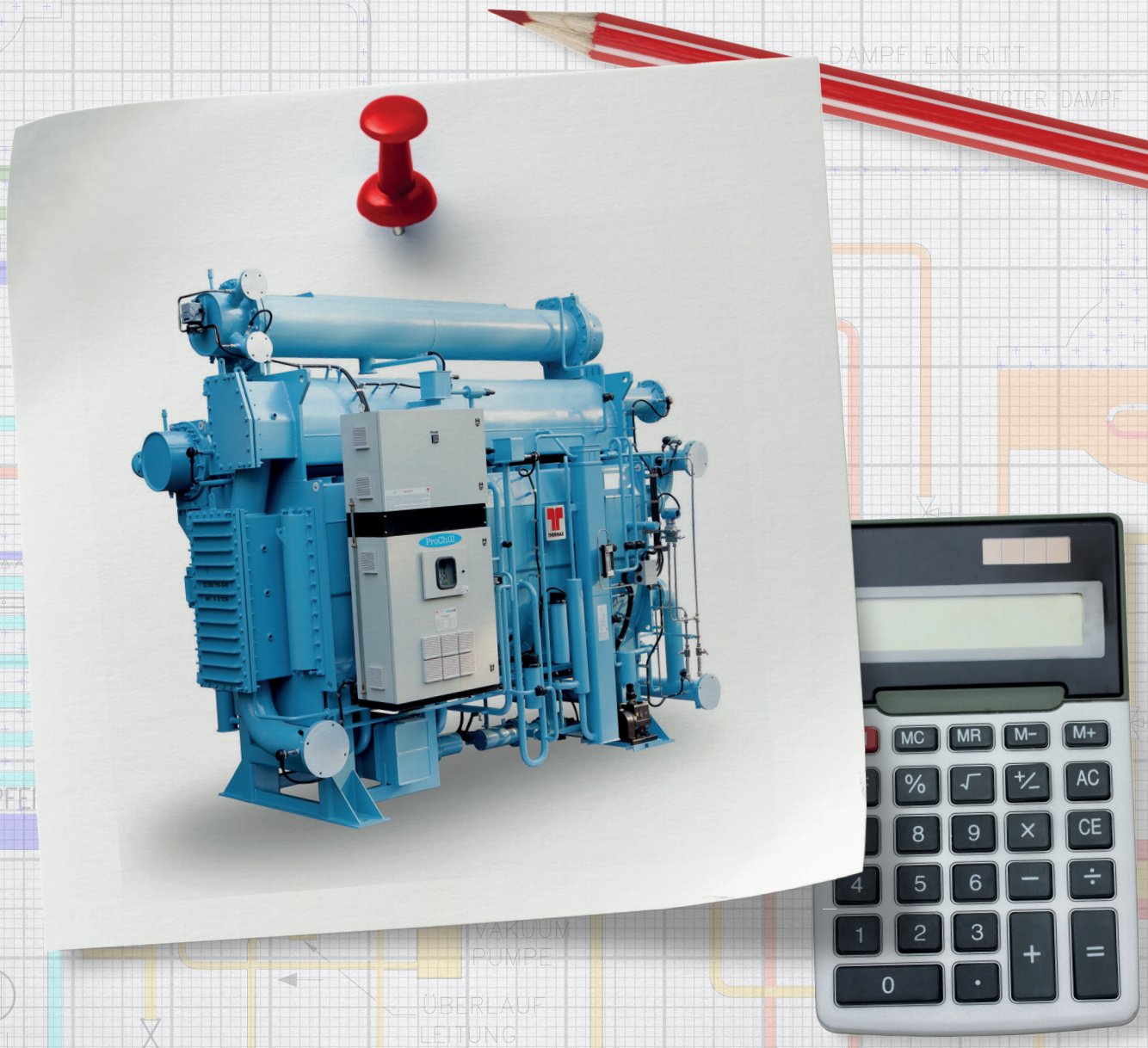
EJ SERIES POSSIBLE APPLICATIONS:

- Cogeneration/Trigeneration when it is important to maximize the cooling capacity with the smallest footprint: industries, hospitals, airports, etc

NECESSARY DATA TO PREPARE AN OFFER:

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Hot water inlet/outlet temperatures
- Exhaust gases temperature
- Exhaust gases flow (in kg/h)
- Allowable Pressure drop in exhaust furnace

High efficiency Chiller/Heater



12. HIGH EFFICIENCY CHILLER/HEATER (HEATING AND COOLING SIMULTANEOUSLY)

High efficiency Chiller/Heater is an absorption chiller capable to provide cooling and heating simultaneously in a very efficient way.

Traditionally boilers have been used to generate hot water, which are either gas or oil fired or steam fired, with the team being generated using fossil fuel fired boiler. So to produce ~90°C hot water, flue gases at 1000°C produced by combustion of fuels are used, i.e. high grade heat is used to produce low temperature hot water. These systems require around 115kW of fuel energy input to produce 100kW of hot water. 15kW loss is through energy loss in combustion.

There could also be applications in industry where both chilled water and hot water are required simultaneously. The chiller heater offers a single point solution for this dual purpose application. There are conventional chiller heaters available using absorption technology but these chiller heaters are consuming energy such as hot water plus absorption chillers. There is no energy saved. The only advantage of this is that it is a single piece of equipment.

Thermax have developed a product that can provide simultaneous chilling and heating using its vapour absorption technology with 40% saving in heating energy.

In this chiller heater product, 40% of heat required for generating hot water is recovered from low temperature chilled water. Remaining 60% is recovered from the external heat source. This means you save 40% of the energy coming from the direct heat source to heat the water, and chilled water is produced simultaneously.

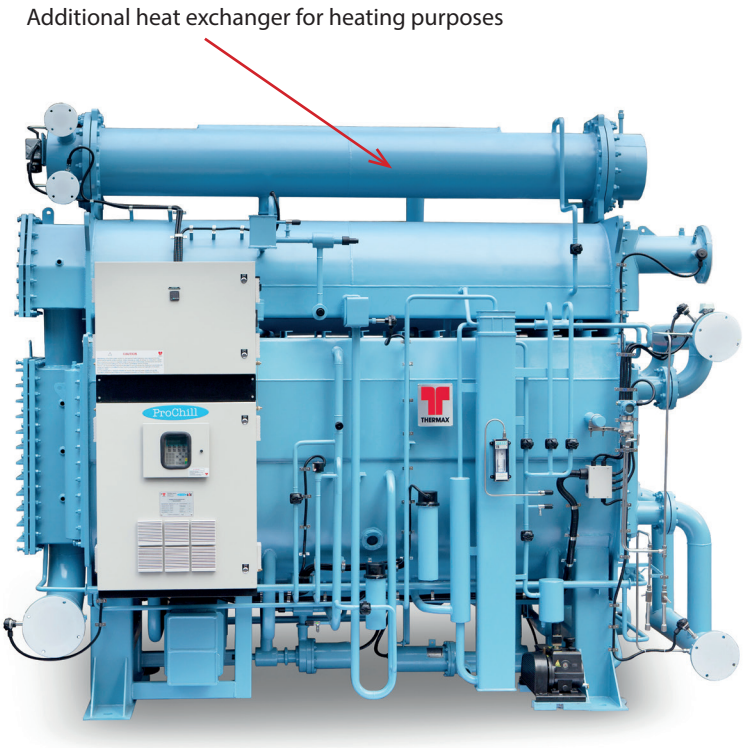
Thermax Vapour absorption chiller heater generates chilling and heating simultaneously in a single unit using Steam / Fuel firing / Exhaust gases / Hot water as heat source.

Product patent application has been filed for this product in India as well as major export markets.

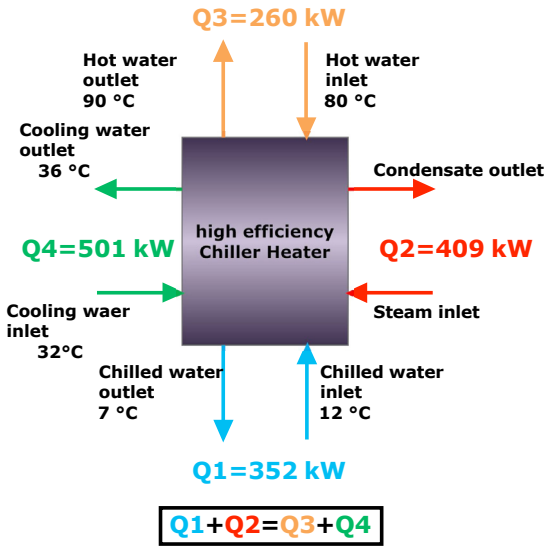
27/02/2018----------

12. High efficiency Chiller/Heater

High efficiency Chiller/Heater.



Below scheme shows a typical example of the energy balance of the Chiller/Heater:



The scheme of operation of chiller heater as compared to conventional hot water generator has been explained using schematic diagrams as given above.

40% of fuel consumption required for hot water generation (Q3) is recovered from the refrigeration cycle. Hence not only does the fuel consumption for heating is reduced, the heat rejection in Cooling tower (Q4) also reduces.

High efficiency Chiller/Heater is flexible enough to be used for production of chilled water only, hot water only or chilled water and hot water simultaneously.

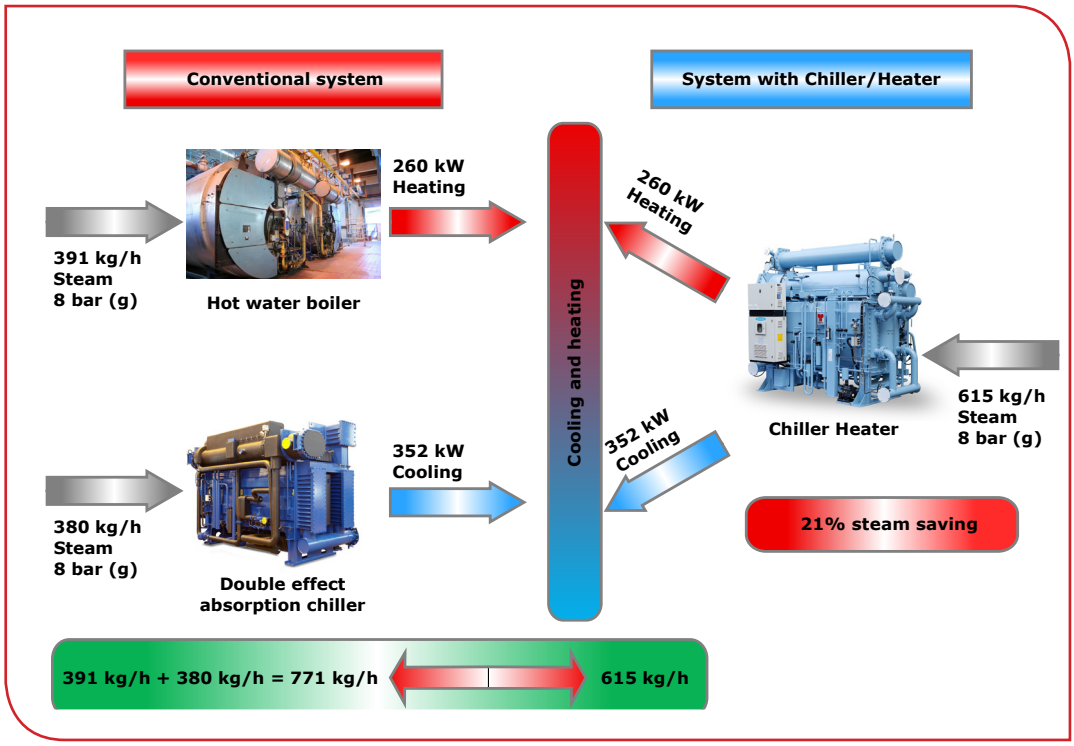
In the absence of heating load the chiller-heater can run with a turndown of 20-100 % cooling capacity. This doesn't require change over of mode of operation.

When the cooling load goes down, the heating capacity delivered will also reduce. The maximum heating capacity in simultaneous mode is 75-80% of the prevailing cooling load.

When the cooling load is in the range of 90-100% of rated, the chiller heater can deliver heating with a turn down of 20-100% of rated.

In the absence of cooling load (0%), chiller-heater can produce 100% heating capacity only after change over to heating mode.

Picture below shows schematically the advantages of the high efficiency Chiller/Heater

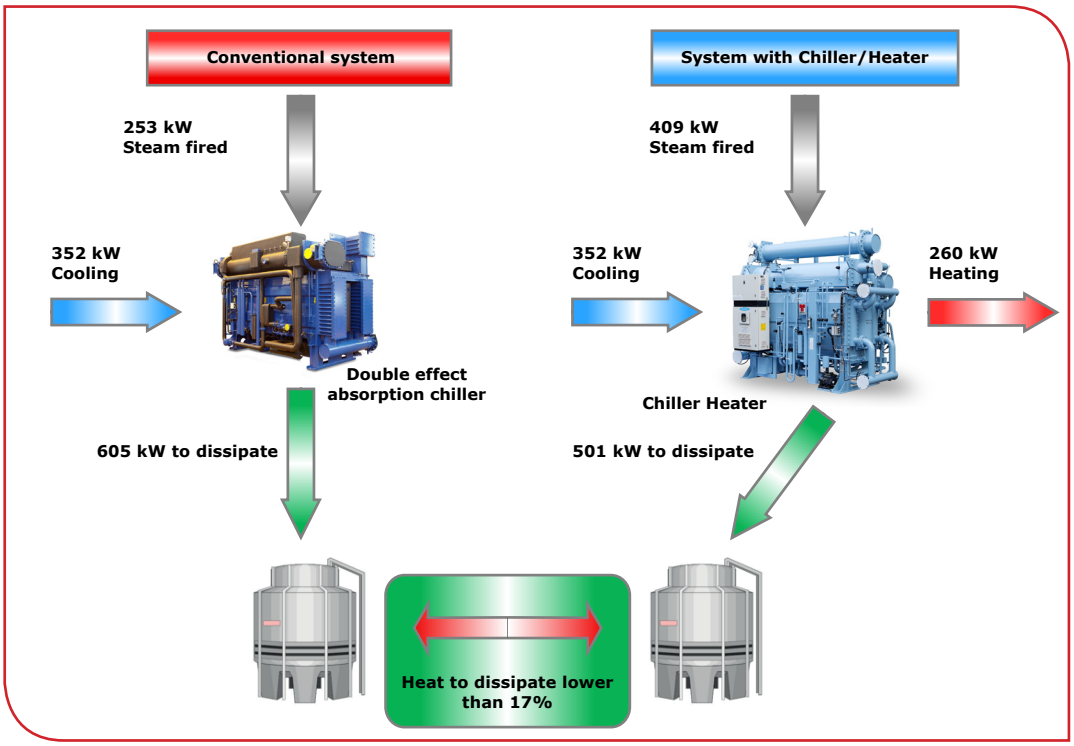


In the above example the solution utilizing a high efficiency Chiller/heater is achieving a steam saving of 21% respect to a conventional solution utilizing a boiler and a separate absorption chiller.

Other advantages of this type of machine are the small footprint, the simple hydraulic connection required and the extremely simplified regulation.

12. High efficiency Chiller/Heater

Also, as already mentioned, there is another important advantage on the cooling system of the machine, as illustrated in below scheme:



At same cooling capacity and same heating capacity, the high efficiency Chiller/heater dissipate a quantity of heat which is about 17% lower than the one dissipated by a conventional system. Hence this is reducing substantially the size of the cooling tower and of the entire cooling system.

POSSIBLE HEAT SOURCES:

Steam 3,0 bar(g)-10 bar(g)

Superheated water 145 °C-180 °C

Direct fired with gas burner

Exhaust gases 350 °C-600 °C

CAPACITY RANGE:

Cooling capacity between 350 kW and 12,3 MW

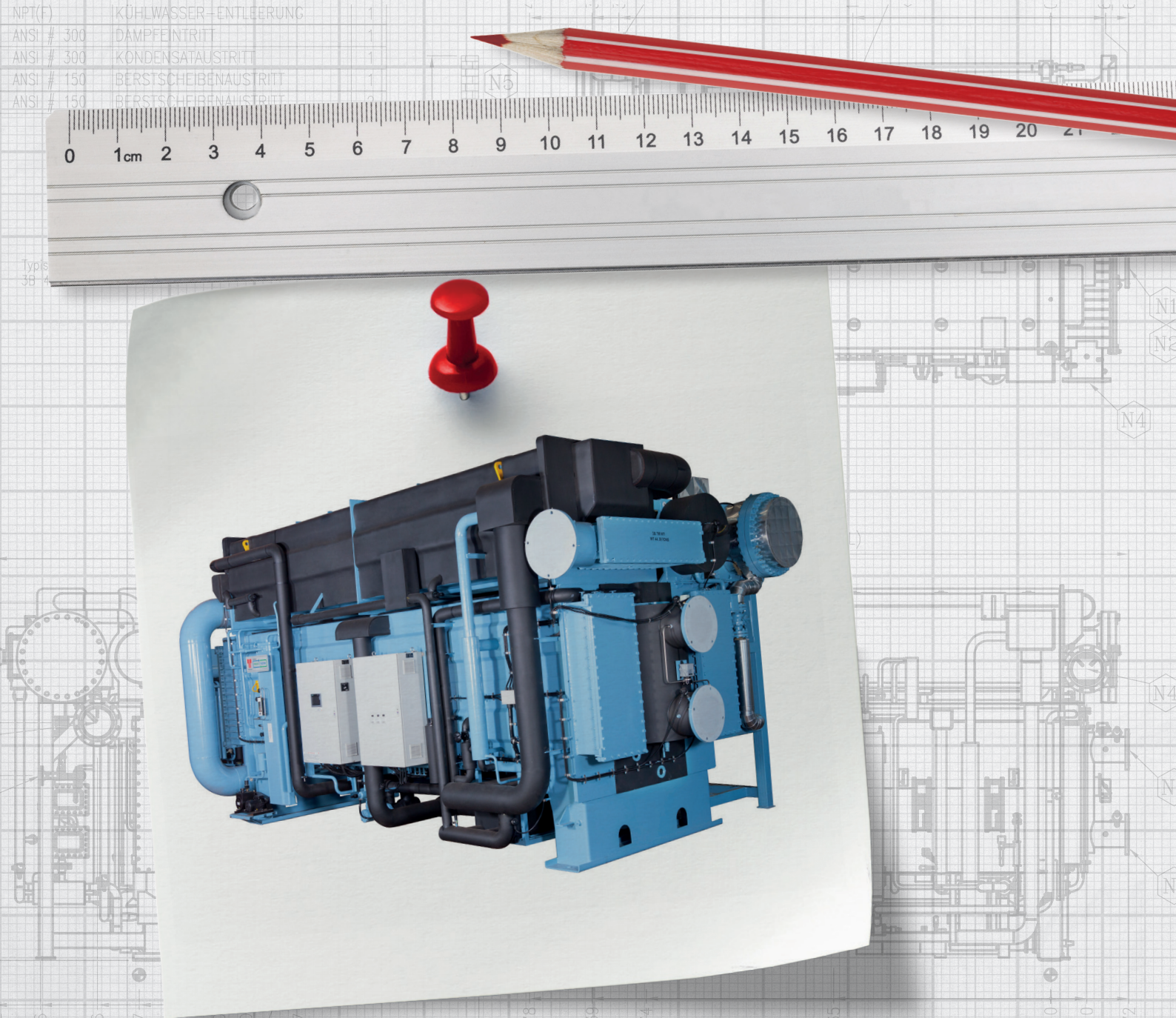
Heating capacity between 100 kW and 9 MW

TEMPERATURE RANGE:

Cooling 0-30 °C, ΔT=30 °C max.

Heating 30 °C-90 °C, ΔT=5-50 °C max.

3B/3D series Triple effect



NEW

13. 3B/3D SERIES:

Brand new series featuring a triple effect cycle, with three generators and low, medium and high temperature, fired with high grade heat sources like steam (3B) of exhaust gases (3D).

This series represents the highest development reached by an absorption chiller and it shows the highest values of efficiency in the market. Thermax has become the first manufacturer to have developed a triple effect machine and to have launched it in the market.

Triple effect machines have an average COP between 1,75 and 1,85. This means cooling capacities between 23 and 28% higher with same heat input respect to double effect machines.

Triple effect machines operate with high temperature generator temperatures between 180°C and 210°C. This make them the first LiBr absorption chillers running with a positive pressure, in a range between 2,5 and 4,5 bar (g).

As the number of effects increase, not only internal temperatures are raising, but at same concentration level also corrosion rate is increasing.

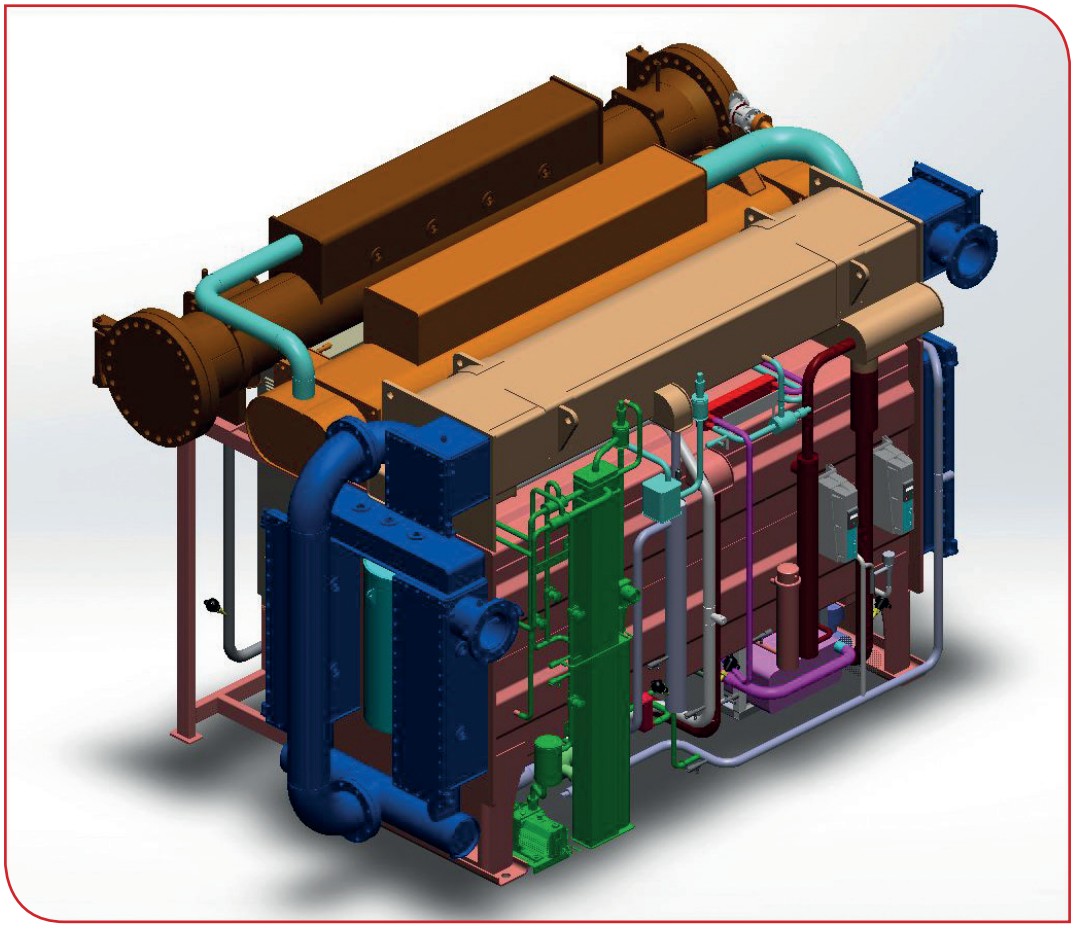
For such reasons the technical challenges given by a triple effect machine are extremely complex: the complexity of the working cycle (considering the presence of three generators and many other heat exchangers), the higher working pressures (more rugged construction required) and the higher corrosion potential of LiBr solution.

In order to give answer to all above challenges Thermax has further developed and refined the modified series cycle already used in its double effect machines. With this new cycle the couple temperature/concentration of the solution never shows both maximum values at the same time. In high temperature generator where the temperature is the highest, the concentration will be the lowest. At same time where concentration is higher in low temperature generator, temperature is lowest.

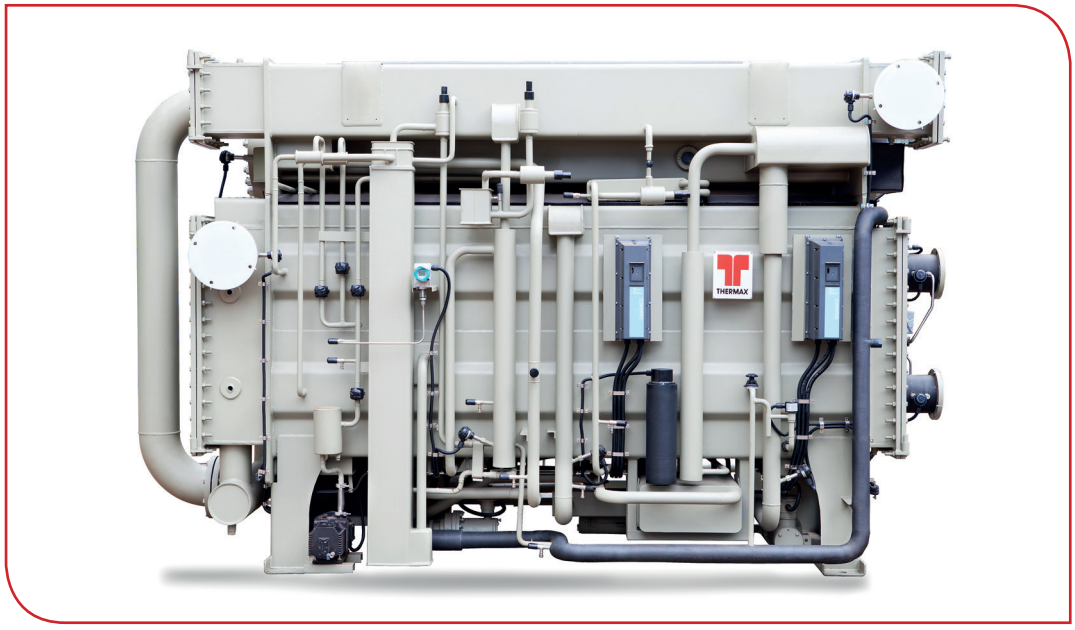
In a Thermax triple effect machine developed with this concept, solution concentration in high temperature generator is usually lower than the same one in a double effect machine.

Capacity range of steam fired machines: 175 kW-3,5 MW
Capacity range of exhaust gases fired machines: 175 kW-1,8 MW

Nominal steam pressure between 15 bar(g) and 25 bar(g)
Exhaust gases temperatures between 400 °C and 600 °C
COP: ca. 1,75-1,85



3D view of a triple effect machine of 3B series



Picture of a triple effect machine of the 3B series

Below pictures show two real triple effect machines of 3B series installed in a plant room.

13. 3B/3D series

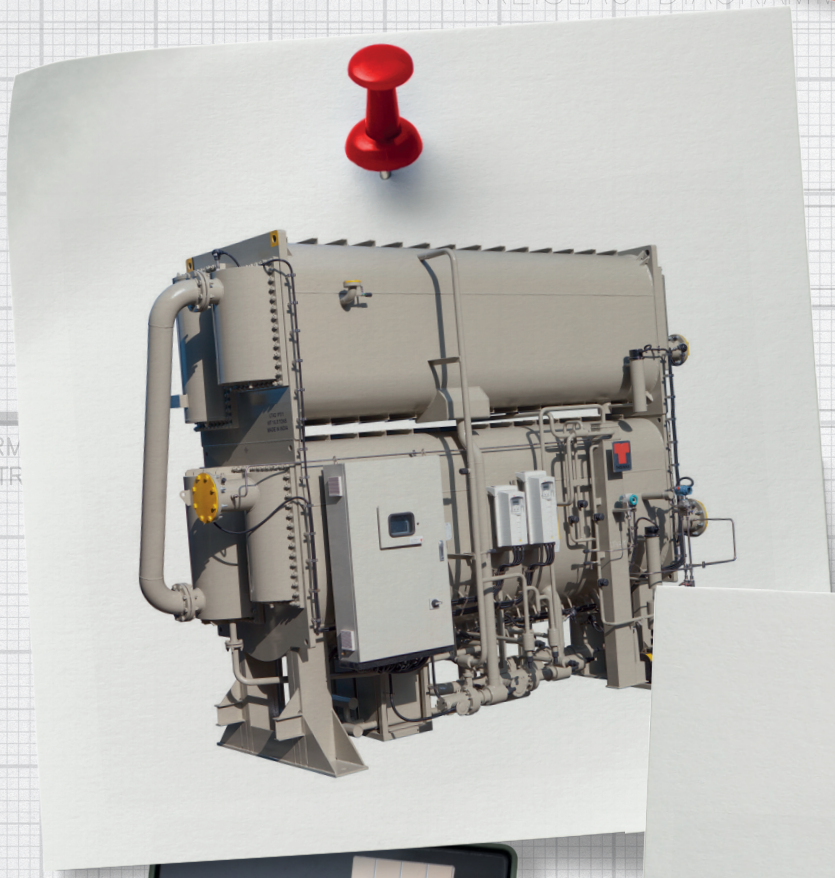
3B/3D POSSIBLE APPLICATIONS:

- Chemical industry
- Food industry
- Automotive industry
- Processes using steam discharge from turbine in cogeneration plants or in power plants
- Exhaust gases from gas engines in large cogeneration plants
- Industrial steam or waste heat available at the required temperature level

NECESSARY DATA TO PREPARE AN OFFER:

- Cooling capacity required (or alternatively the available heat capacity)
- Chilled water inlet/outlet temperatures
- Cooling water inlet/outlet temperatures
- Steam pressure (3B)
- Exhaust gases temperature (3D)
- Exhaust gases flow (in kg/h) (3D)
- Allowable Pressure drop in exhaust furnace (3D)

Heat pumps

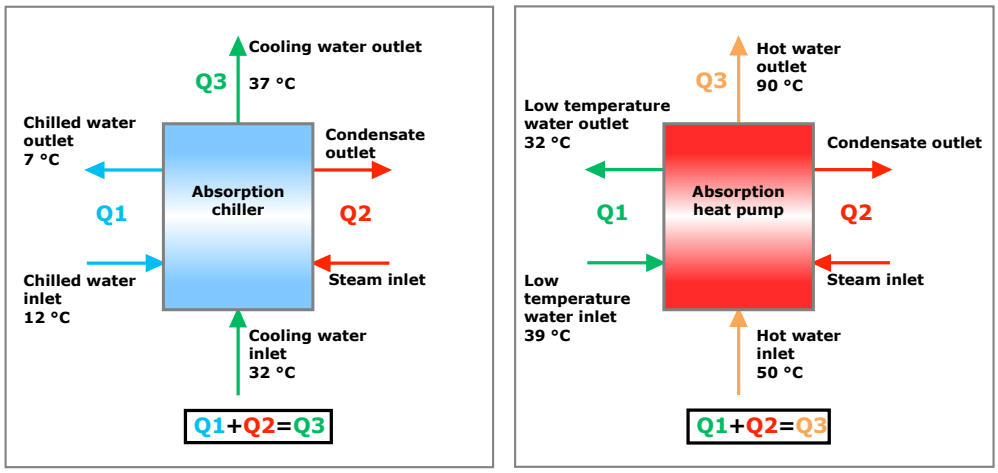


14. HEAT PUMPS

Further to absorption chillers for cooling and chilled water production, the absorption technology can be applied also on heat pumps, in order to achieve production of hot water.

TYPE I HEAT PUMPS

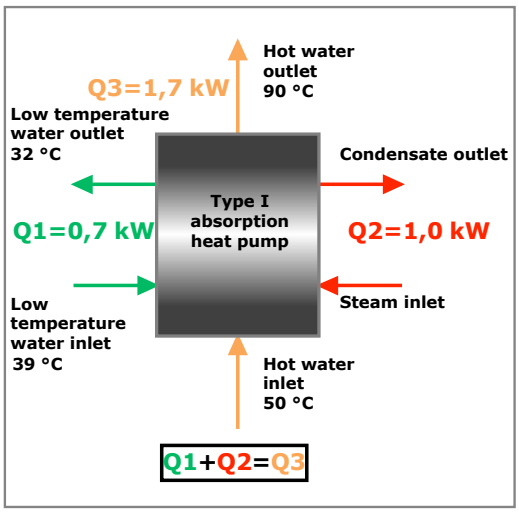
Below picture shows the different temperature levels at which typically an absorption chiller and an absorption heat pump work:



Type I heat pump is fired by high temperature heat source, it extracts heat from a low grade heat source, and it provides heat at an intermediate temperature between the two.

The schematic diagram shown in following picture illustrates a typical energy balance of a Type I absorption heat pump.

As you can see, for each 1,7 kW of hot water given to the final user, 0,7 kW are generated for free. This means a saving of 40% respect to the use of conventional hot water boilers.



For each 1,7 kW → **0,7 kW are provided free by the absorption heat pump**

40% saving

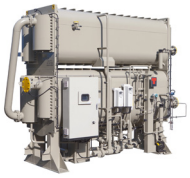
The higher is the temperature of the low temperature heat sink where the heat is extracted from, the higher is the hot water temperature that is possible to achieve.

Absorption heat pumps are designed on a case to case basis depending upon the specific request of the customers.

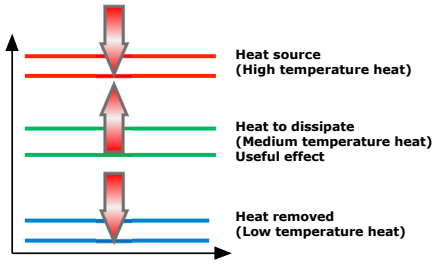
TYPE II HEAT PUMPS

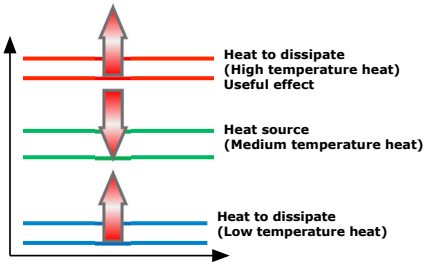
Below scheme illustrates the major differences between a Type I heat pump and a Type II heat pump:

Type I Heat pump



Type II Heat pump





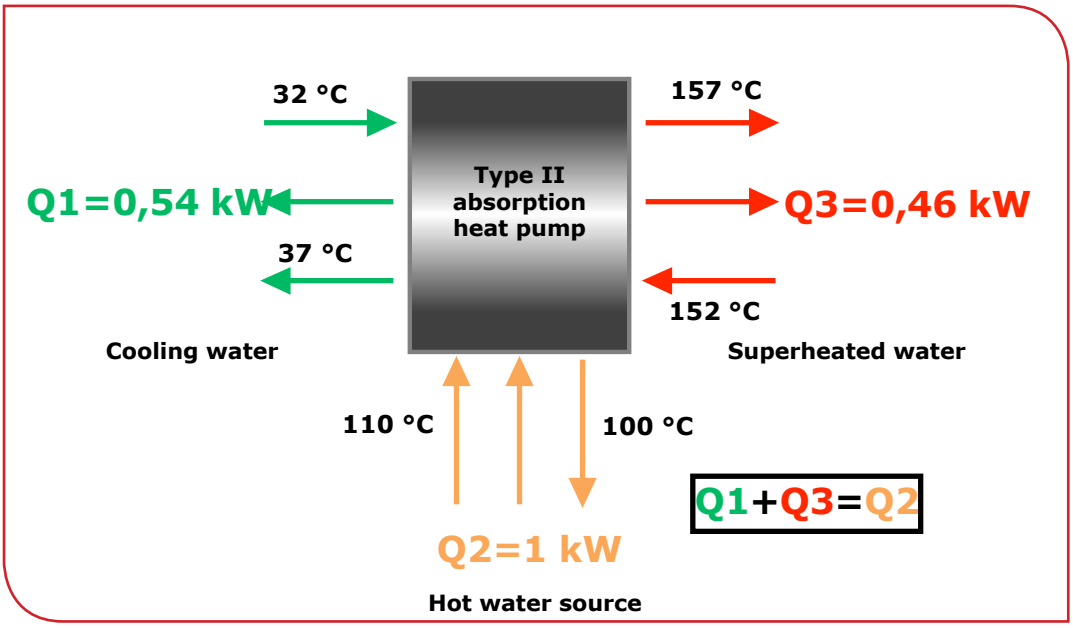
As it is shown, the position of the rejected heat (which represents the useful effect) is substantially different in the two cases. While in Type I heat pump the heat to be dissipated (hot water going to user) is at a medium temperature level, in Type II heat pump it is a the highest temperature level.

Similarly, heat source in Type I heat pump is at the highest level, while in Type II heat pump is at he medium level. Also Type II requires some heat to be dissipated at low temperature. It means Type II heat pump requires a cooling tower just like an absorption chiller.

Differences between the two heat pumps are summarized in below table:

Type I heat pump Vs Type II heat pump	
Type I heat pump	Type II heat pump
Machine is fired by an heat source at high temperature. Heat is extracted by a low temperature heat sink and heat at an intermediate temperature between the two is released to final users.	Machine is fired by an heat source at a medium temperature. Part of this heat is dissipated at low temperatures (cooling towers) while part of it is released to final users at higher temperatures.
Efficiency approx. 1,7	Efficiency approx. 0,48
Typical temperature profile: Low temperature heat sink: 40 °C-35 °C High temperature heat source: superheated water at 180 °C-160 °C or steam at 6-8 bar (g) Hot water available to users: 60 °C-90 °C	Typical temperature profile: Medium temperature heat source: hot water at 110 °C-100 °C Cooling water: 30 °C-36 °C Hot water available to users:150 °C-160 °C

In below scheme it is shown the typical energy balance of a Type II heat pump:



Picture below shows a Type II heat pump:

TYPE I HEAT PUMP

Low temperature heat sink (30 °C-60 °C)
- Water from cooling towers
- Condensate from industrial processes
- Geothermal water

High temperature heat source
- Dry saturated steam (1-10 bar(g))
- Superheated water (130 °C-180 °C)
- Exhaust gases (275 °C-600 °C)

Capacity range between 250 kW and 40 MW

COP 1,65-1,75

Hot water released to users:
- Hot water 35 °C-90 °C
- ΔT 55 °C max.

TYPE II HEAT PUMP

Medium temperature heat source (80 °C-120 °C)
- Hot water from process
- Geothermal water
- Condensate from steam turbines

High temperature heat released to users:
- Dry saturated steam (1,0 bar(a)-4,0 bar(g))
- Superheated water (110 °C-155 °C)

Capacity range between 500 kW and 10 MW

COP 0,45-0,5

Type I heat pump installed in Copenhagen (Denmark)

NEW

15. LOW TEMPERATURE MACHINES

All absorption chillers shown in the catalogue can be equipped with a special kit (called "Low Temperature kit") in order to achieve chilled water outlet temperatures between 3,5°C and -5°C .

In a traditional absorption chiller the minimum chilled water outlet temperature achievable is limited by the fact that the refrigerant used by machines is water. In order to avoid the freezing of refrigerant the minimum chilled water outlet temperature achievable by a traditional machine is 3,5°C.

Thanks by the technology developed by Thermax it is possible now to achieve lower temperatures of chilled water outlet: as of now the limit is set at -5°C.

A precise and sophisticated control system injects a small quantity of LiBr solution into refrigerant: in such a way the contaminated refrigerant doesn't freeze at 0°C anymore and it is possible to achieve lower chilled water temperatures. The system is capable to determine the concentration of LiBr solution in the refrigerant and it maintain this concentration between a narrow range: enough to avoid refrigerant freezing but also to avoid excessive heat transfer loss due to too much LiBr solution in refrigerant.

POSSIBLE APPLICATIONS:

- Food industry
- Cheese industry
- Milk industry
- Beer industry
- Refrigeration plants in order to reduce the consumption of ammonia chillers

Notes

Notes

Riportiamo di seguito un estratto di alcune installazioni in Italia eseguite in collaborazione con TRANE ITALIA srl. THERMAX può vantare circa duecento unità installate in Italia e quasi 500 in tutta Europa. Per l'elenco completo rivolgersi agli uffici di Thermax o Trane Italia.

- Ergom Melfi
- Fiat Sevel
- Università di Fisciano
- Università di Potenza
- Ferrero (stabilimenti di Alba, Balvano e S.Angelo Lodigiano)
- Ospedale di Merano
- Ospedale di Cittadella
- Ospedale di Camposanpiero
- Ospedale Este
- Humanitas Rozzano
- Policlinico di Milano
- AGAP Maserati
- Sanofi (stabilimenti di Brindisi e Scoppitto)
- Pasta Baronia
- Ospedale di Merate
- Ospedale di Feltre
- Ospedale Fatebenefratelli
- Ospedale S.Carlo Borromeo
- Ospedale Cardarelli
- Aeroporto Marco Polo Venezia
- Aeroporto G.Marconi Bologna
- Patheon
- Sigma Tau
- Eskigel
- Luxottica
- Albea Cosmetics
- Ospedale di Tricase
- Hexion
- Siemens
- Alpla
- Veritas
- Peroni