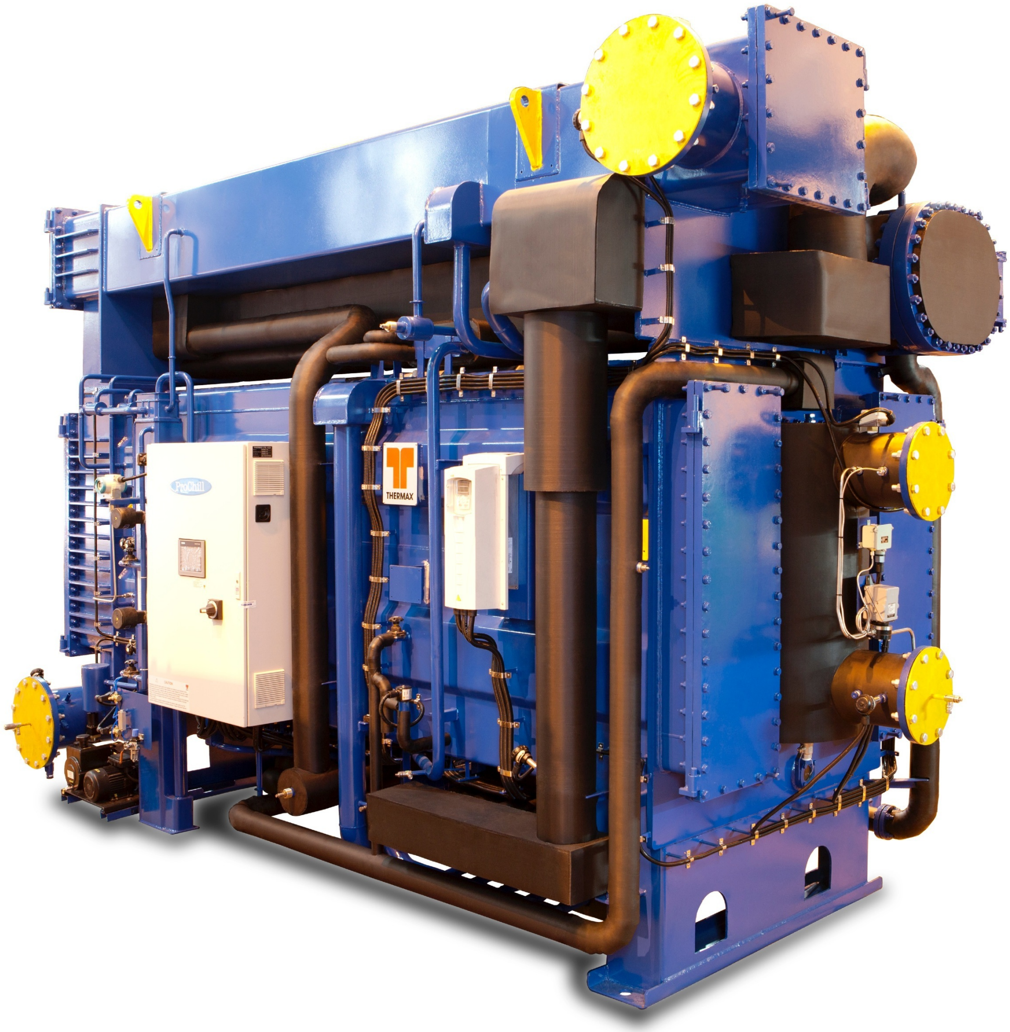
2B series

Absorption chillers

Steam fired - Double effect

750-4.500 kW



THERMAX

INTRODUCTION

WORKING PRINCIPLE

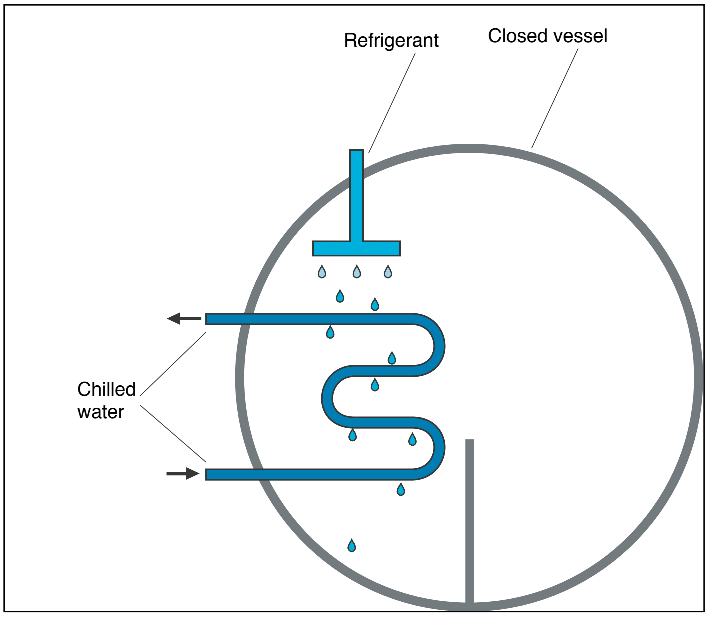
Absorption chillers operate on the basis of three well known physical phenomena:

a) When a liquid evaporates (or boils) it absorbs heat, and when it condenses it gives up heat.
b) The evaporating temperature of a liquid is a function of the pressure. I.e. as the pressure decreases so does the boiling point.
c) Some chemicals that have a strong affinity to absorb another.

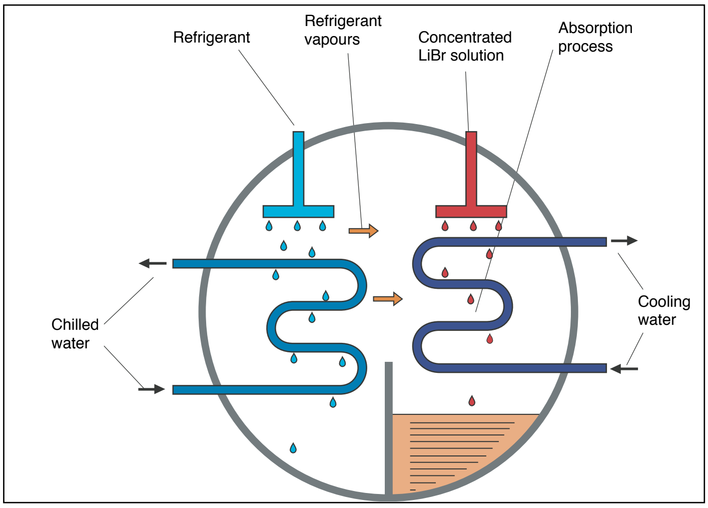
In a conventional, mechanical vapor compression cycle, the refrigerant evaporates at low temperature producing cooling. It is then compressed mechanically to an elevated pressure, then it is cooled and condensed. Most of the machines have a compressor powered by an electric motor. In an absorption chiller the evaporator and condenser are essentially the same, but a chemical absorber and a thermal generator replace the compressor, with a small pump to provide pressure change. As a pump requires much less power than a compressor.

The functions described operate in an absorption chiller as follows:

1. Refrigerant water evaporates in a deep vacuum “6 mmHg absolute” to a lower sealed shell at a temperature of 3,7°C. The chilled water circuit tube bundle is thereby cooled. The left hand side section in which the tube bundle is located is called the EVAPORATOR.

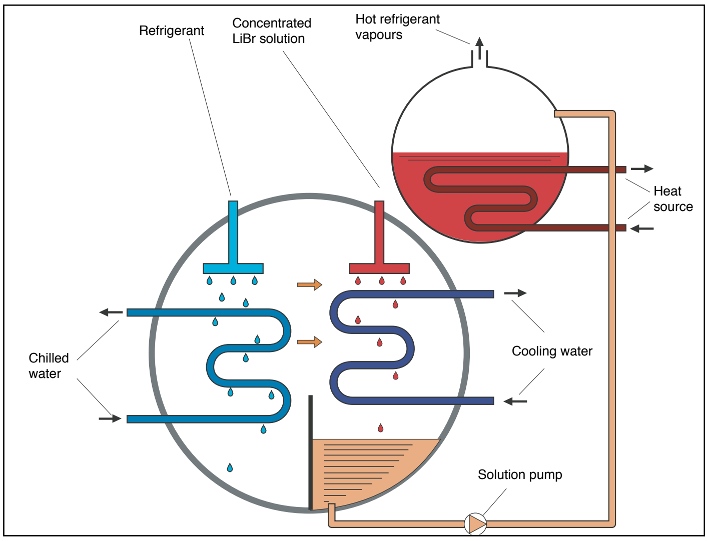


2. The right hand side location houses the ABSORBER section. In this section an aqueous concentrated solution of lithium bromide is sprayed. The solution is hygroscopic, maintaining the shell vacuum and the weak solution of lithium bromide is collected in the base. The process of absorption produces heat and this is removed by the cooling water tube bundle.

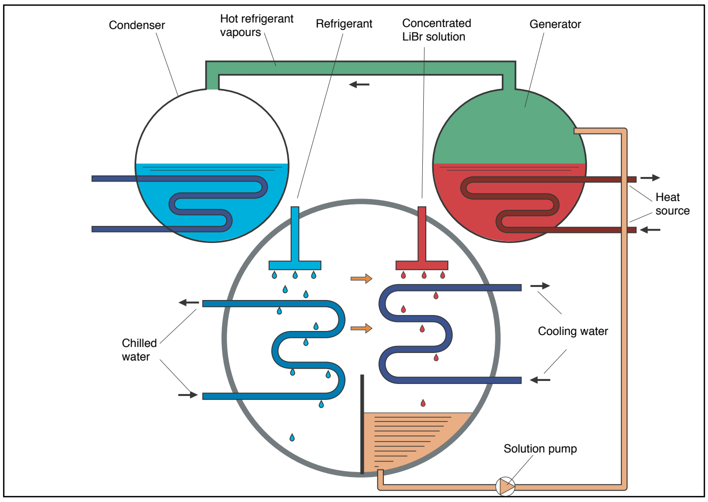


3. Hygroscopic properties of the aqueous solution of lithium bromide depend on two factors:
   i) Temperature: the affinity between lithium bromide and water increases as temperature decreases.
   ii) Concentration: as this reduces its hygroscopic effect decreases.

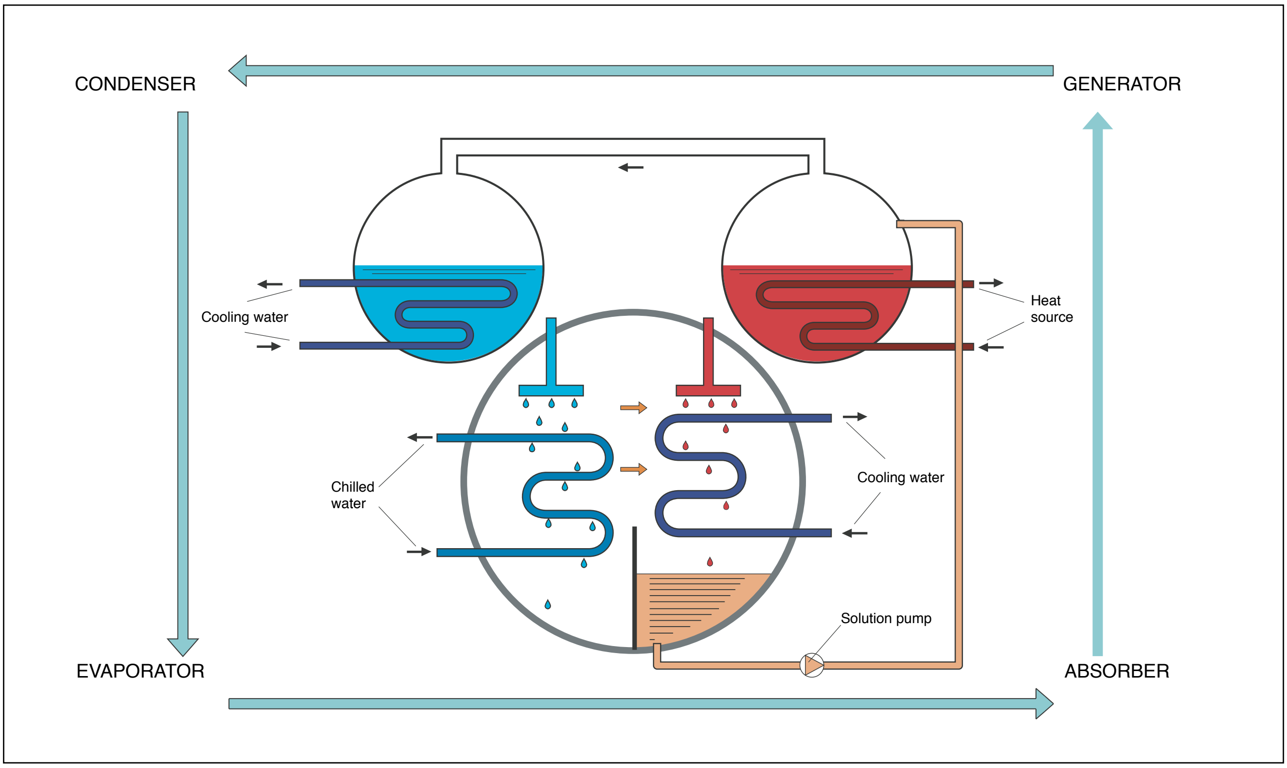
   The collected diluted solution of lithium bromide has to be re-concentrated. It is pumped to a dedicated vessel called GENERATOR. Heat is applied through a tube bundle to vaporize the water from the diluted solution. Hot water, steam or the direct combustion of fuel is used depending on type of machine.



4. The water vapours are pumped to another heat exchanger called CONDENSER where they are condensed by a cooling water flow (the same water that is flowing in the absorber). This condensed water is used as refrigerant to be sprayed in the evaporator to generate the cooling effect. Therefore, the working cycle of the machine is completely closed.

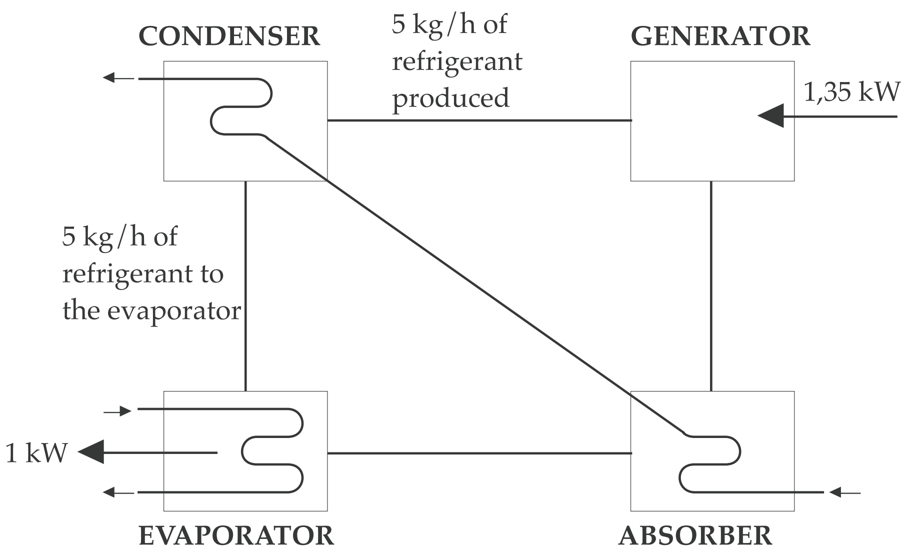


5. Basic working cycle for a single effect absorption chiller.



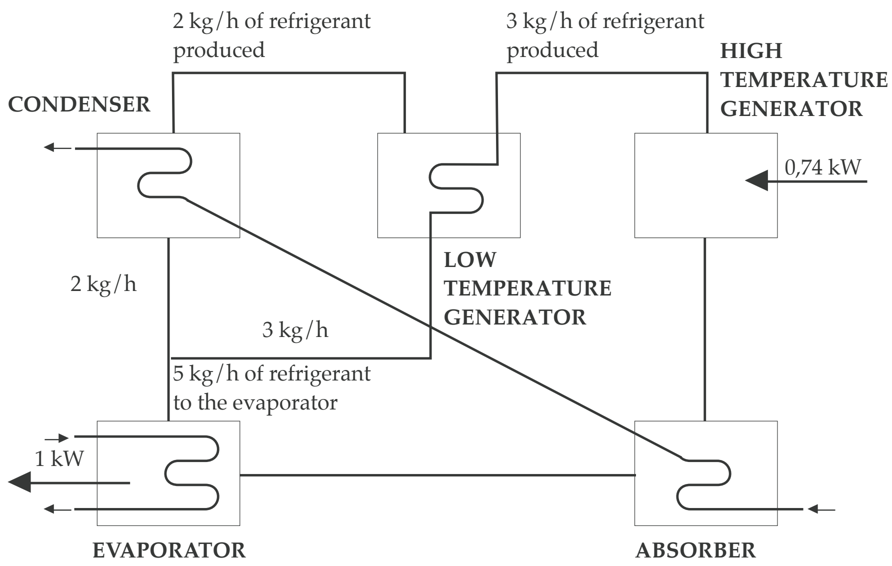
THE DOUBLE EFFECT CYCLE

The cycle described in the above pages refer to a single effect machine. It can be well illustrated by the above scheme. In a single effect machine approximately 5 kg/h of refrigerant have to evaporate in the evaporator to produce 1 kW of cooling: it means that the generator should receive enough heat to boil 5 kg/h of refrigerant out from the solution that will be sent to the evaporator once condensed.

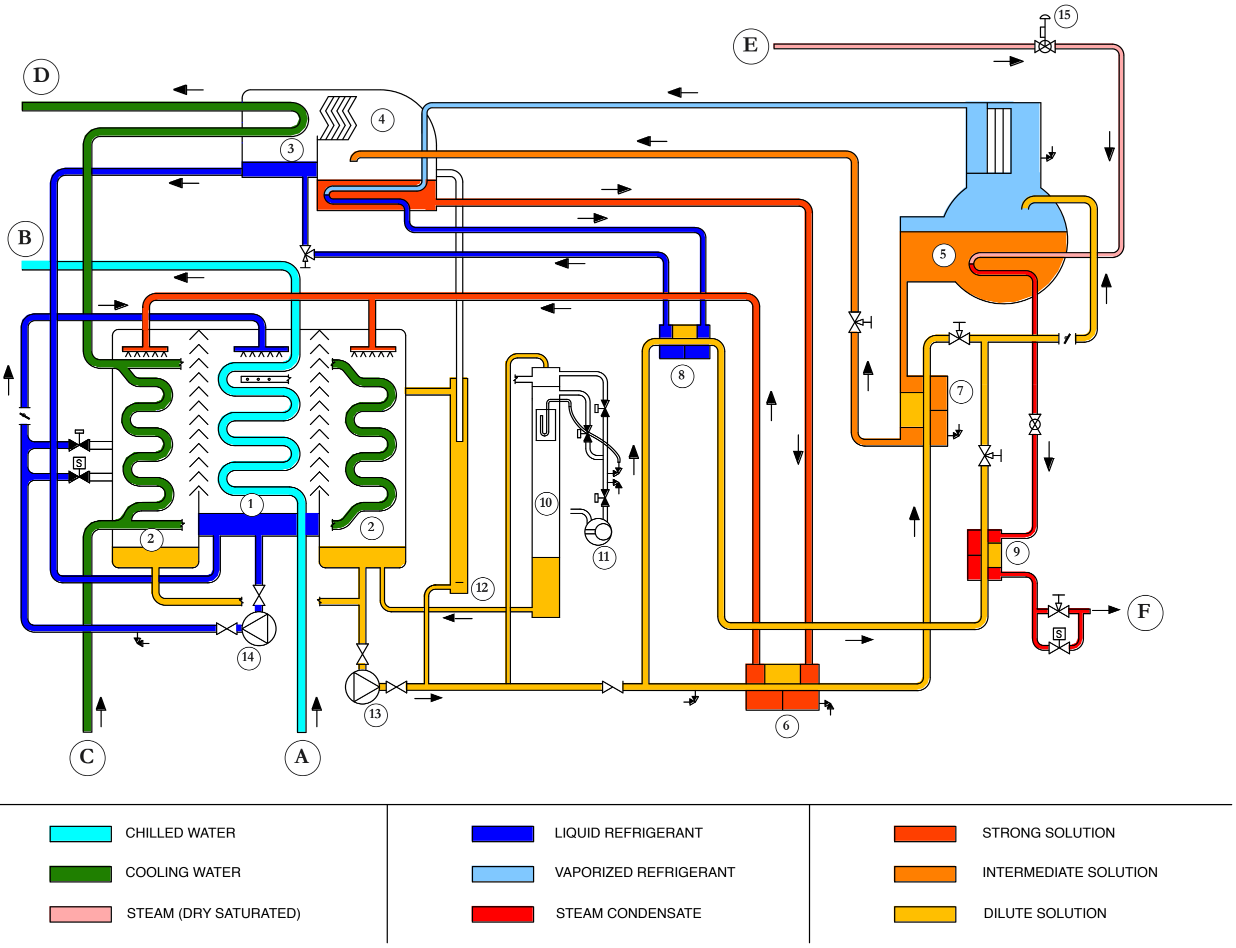


When the available heat source is very hot, the refrigerant vapours coming out from the generator and going to the condenser are also very hot. Their temperature is so high that they can be used to boil the solution a second time, so that an extra quantity of refrigerant is available to be sprayed in the evaporator. For this purpose a second generator is added to the machine (it is called low temperature generator, while the main one is called high temperature generator): in this one the heat source is the refrigerant vapour coming from the first generator.

The above scheme is modified as shown below. In this scheme HTG is the high temperature generator, while LTG is the low temperature generator. Analysing this scheme it is possible to notice that in this case only 3 kg/h of refrigerant are generated in the high temperature generator. It means that to produce 1 kW of cooling the machine has to be fired with less heat than a single effect one: in fact 2 kg/h of refrigerant are generated by waste heat inside the machine that otherwise would have been dissipated. So a double effect machine requires less quantity of primary energy to produce the same cooling capacity, or in other words its efficiency is greater than the one of a single effect machine.



CYCLE DIAGRAM



1. Evaporator	9. Heat Reclaimer (HR)	A. Chilled water inlet
2. Absorbers	10. Purge unit	B. Chilled water outlet
3. Condenser	11. Vacuum pump	C. Cooling water inlet
4. Low Temperature Generator (LTG)	12. Overflow pipe	D. Cooling water outlet
5. High Temperature Generator (HTG)	13. Solution pump	E. Steam inlet (dry saturated)
6. Low Temperature Heat Exchanger	14. Refrigerant pump	F. Condensate outlet
7. High Temperature Heat Exchanger	15. Steam control valve	
8. Drain Heat Exchanger (DHE)		

CYCLE DESCRIPTION

High Temperature Generator (HTG)

The high temperature generator (HTG) consists of a tube bundle, an outer shell and a set of eliminators. Steam passes through the tubes. The diluted absorbent flows around these tubes and is heated. The temperature of the solution increases until it reaches it's boiling point. The absorbed refrigerant boils out of the solution. The solution concentration increases. This increased concentration is referred to as the intermediate concentration. The vaporized refrigerant generated passes through the eliminators and goes to the low temperature generator.

Low Temperature Generator (LTG) and Condenser

The low temperature generator (LTG) and condensor tube bundles are enclosed in a shell and are separated by an insulation plate. The vaporized refrigerant passes through the LTG tubes. It heats the intermediate absorbent, flowing outside the tubes, and condenses. The condensed refrigerant flows into the condenser. Refrigerant vaporized from the intermediate absorbent passes through the eliminators to the condenser. Here it is cooled by cooling water being circulated inside the condenser tubes. The refrigerant vapour condenses on the outside of the condenser tubes and collects in the bottom of the condenser. The condensed refrigerant from the LTG and the condensor mix and flows to the evaporator. The absorbent which has become concentrated in the LTG drains to the absorber to begin a new absorbent cycle.

Regenerative Heat exchangers

The diluted absorbent is pumped to the high temperature generator by the absorbent pump. It flows parallel through the low/high temperature heat exchanger an heat reclaimer/drain heat exchanger. In low temperature heat exchanger where it absorbs heat from the concentrated absorbent. Then the diluted absorbent flows through the high temperature heat exchanger where it absorbs heat from the intermediate absorbent solution. In the drain heat exchanger where it absorbs heat from refrigerant condensed in LTG and in heat reclaimer where it absorbs heat from the steam condensate. The solution then enters the high temperature generator. The heat exchangers serve to heat up the cool absorbent solution before it enters the high temperature generator for reheating. This reduces the heat input required in the high temperature generator. This increases the efficiency of the cycle.

Absorber

The absorber consists of a tube bundle, an outer shell (common with the evaporator), distribution trays and an absorbent collection sump. Concentrated absorbent solution from the generator is fed into the distribution trays. This solution falls on the absorber tubes. Concentrated absorbent has an affinity to water. Hence the vaporized refrigerant from the evaporator section is absorbed. Due to this absorption the vacuum in the shell is maintained at a low pressure and ensures the correct chilled water temperature. The concentrated absorbent becomes diluted. During this dilution the 'Heat of Dilution' is generated. The cooling water being circulated in the absorber tubes removes this heat. The diluted absorbent collects in the bottom of the shell.

Evaporator

The evaporator consists of a tube bundle, an outer shell, distribution trays, and a refrigerant pan. The chilled water flows inside the tubes. A refrigerant pump circulates the refrigerant from the refrigerant pan into the distribution trays. From the trays the refrigerant falls on the evaporator tubes. The shell pressure is very low (about 6.8mmHg). At this pressure the refrigerant evaporates at a low temperature (about 3.7°C) and extracts latent heat of evaporation from the water being circulated through the evaporator tubes. Thus the water being circulated through the tubes becomes chilled.

The above described cycle is a type of series cycle: main feature of this cycle is that maximum temperature and maximum concentration of the solution never occur in the same place. In HTG temperature is highest, but concentration is intermediate. In LTG concentration is the highest, but temperature is lower. Corrosion rates inside the machine are high when concentrations or temperatures are high. If highest temperature and highest concentration peaks at one place, corrosion rates increase exponentially. Series flow arrangement ensures not such occurrence.

DESIGN PHILOSOPHY

The design philosophy of Thermax 2B series machines are spread over four categories:

Reliability	➡ SS 430 Ti tubes in generators and solution heat recovery heat exchanger of plate type with SS plates.
	➡ Gravity feed distribution system for LiBr and refrigerant.
	➡ Advanced state of the art series cycle
	➡ Real time concentration control
Efficiency	➡ Two stage evaporation
	➡ Inverter on solution pump
	➡ Split absorber design
Monitoring	➡ PLC based monitoring and control
	➡ Modbus, Profibus and Ehernet connectivity available on request
Maintenance	➡ Vaccum seal isolation valves on solution and refrigerant pump
	➡ Marine water boxes for cooling water
	➡ Non toxic corrosion inhibitor

MAIN FEATURES

- New modified series cycle, with great optimization of the heat transfer. Thanks to these modifications it is possible to achieve higher efficiencies.
- For controlling the corrosion rate and increasing the life, chiller cycle has been designed in such a way that maximum absorbent concentration and maximum temperature shall not occur simultaneously in the generators (series cycle).
- Two stage evaporation concept design is used for superior performance: by creating two pressure levels in the same shell, dilute LiBr is made to absorb more refrigerant vapour.
- Triple shell design: the upper shell (including the condenser and the low temperature generator), the lower shell (including the evaporators and the absorber) and the high temperature generator. In case of single shell design, the evaporator is on top of the absorber. Any non condensable gas released in the absorber section will rise up and there is a possibility that these gases are trapped below the bottom of the separation trap, and they can given time corrode the separation plate. Whereas in case of a double shell design, the evaporator and the absorber are located side by side, and therefore the possibility of the separation plate corrosion is eliminated. This shell design type calls

also for higher chances of internal short circuiting as when the water level in the evaporator is very high (and consequently the solution concentration is very high) the refrigerant can directly flow into the absorber and the concentration of the solution is reduced.

- Completely factory assembled and wired. For transport facility bigger models may be shipped in three pieces. Always for transport facility control panel may be shipped loose.
- Leak tested in every part: upper and lower shells, high temperature generator, solution heat exchangers, solution and refrigerant canned pumps, vacuum pump and purge assembly.
- PLC based control.
- LiBr solution, refrigerant, corrosion inhibitor and octyl alcohol separately provided to be charged on site.
- Nitrogen is charged into the machine at a pressure slightly higher than atmospheric prior to shipping, in order to avoid air entering the machine and damaging the internals.
- Lifting lugs provided on each side of the machine.

MECHANICAL FEATURES

LOWER SHELL

The lower shell assembly houses the evaporator and the absorbers sections. They are shell and tube type heat exchangers, housed in a common fabricated carbon steel shell.

- Stainless steel eliminator plates between the evaporator and the absorber, in order to permit only to the refrigerant vapors to flow to the absorber, retaining the liquid in the evaporator.
- "Two stage evaporation" concept: lower shell is divided in two sections at different pressures. This feature grants a better efficiency, optimizing the mass transfer between refrigerant and LiBr solution.
- Finned (minifinned starting from model 2B 5M C) and thin wall DLP (Deoxidized Low Phosphorous) copper tubes in the evaporator. In DLP copper the oxygen is removed and the phosphorous content is less than 0,005 ppm. The presence of phosphorous greater than 0,005 ppm in the tubes of the absorption machines can result in "Stress Corrosion Cracking". At a microscopic level, stress corrosion cracking takes place on the external surface of the tubes by the attack of a salt (e.g. LiBr) on the grain boundary.

- ❖ Mini-finned and thin wall DLP (Deoxidized Low Phosphorous) copper tubes in the absorber. In DLP copper the oxygen is removed and the phosphorous content is less than 0,005 ppm. The presence of phosphorous greater than 0,005 ppm in the tubes of the absorption machines can result in "Stress Corrosion Cracking". At a microscopic level, stress corrosion cracking takes place on the external surface of the tubes by the attack of a salt (e.g. LiBr) on the grain boundary.
- ❖ All the tubes fitted in the respective tube sheets are duly expanded for the correct fit. All the tubes are individually accessible and replaceable from either end of the chiller.
- ❖ Carbon steel tube sheets.
- ❖ Carbon steel evaporator headers fully removable at either side of the machine, for easy access to the tube bundle. Headers are provided with flanged nozzles.
- ❖ Marine type absorber header on one side of the unit, for an easy access to the tube bundle without need of lifting systems to support the header.
- ❖ Counter flanges provided as a standard feature with the unit.
- ❖ Plugged vents and drain connections provided for the water boxes.
- ❖ Sight glasses respectively on the evaporator and the absorber shell. These glasses are used to monitor the refrigerant and the solution levels in the evaporator and the absorber for an easy and user friendly operation, since through them it is possible to monitor the correct working of the machine.

UPPER SHELL

The upper shell assembly houses the condenser and the low temperature generator sections. They are shell and tube type heat exchangers, housed in a common fabricated carbon steel shell.

- ❖ Stainless steel eliminator plates between the condenser and the low temperature generator, in order to permit only the refrigerant vapors to flow to the condenser; the retained solution drops to the bottom of the generator, thus reducing the chance for the solution contaminating the pure refrigerant.
- ❖ Enhanced and thin wall DLP (Deoxidized Low Phosphorous) copper tubes in the condenser. In DLP copper the oxygen is removed and the phosphorous content is less than 0,005 ppm. The presence of phosphorous greater than 0,005 ppm in the tubes of the absorption machines can result in "Stress Corrosion Cracking". At a microscopic level, stress corrosion cracking takes place on the external surface of the tubes by the attack of a salt (e.g. LiBr) on the grain boundary
- ❖ Enhanced stainless steel tubes SS 430F Ti in low temperature generator.

- ❖ All the tubes of the condenser fitted in their respective tube sheets are duly expanded for the correct fit. All the tubes of the condenser are individually accessible and replaceable from either end of the chiller.
- ❖ Carbon steel tube sheets.
- ❖ Marine type condenser header at one side, for an easy access to the tube bundle without need of lifting systems to support the header.
- ❖ Counter flanges provided as a standard feature with the unit.
- ❖ Plugged vents and drain connections provided for the water boxes.

HIGH TEMPERATURE GENERATOR

- ❖ Minifinned stainless steel tubes SS 430 Ti in high temperature generator.
- ❖ Straight type tubes: expansion coefficients of the material of tube sheet and tubes are very similar, avoiding the rise of dangerous mechanical stress due to thermal expansion, without the use of "U" type tubes or mobile supports.
- ❖ All the tubes fitted in their respective tube sheets are duly expanded for the correct fit. All the tubes are individually accessible and replaceable from either end of the chiller.

HEAT EXCHANGERS

- ❖ The units are provided with four regenerative heat exchangers to increase the efficiency of the cycle.
    - A low-temperature solution heat exchanger is an integral part of the machine to increase efficiency by pre-heating the weak solution with the strong solution. This is a plate type heat exchanger. The plates are of stainless steel with copper brazing.
    - A high-temperature solution heat exchanger is an integral part of the machine to increase efficiency by pre-heating the weak solution. This is a plate type heat exchanger. The plates are of stainless steel with copper brazing.
    - A drain heat exchanger is an integral part of the machine to increase efficiency by pre-heating the weak solution with the condensed refrigerant from the LTG. This is a plate type heat exchanger. The plates are of stainless steel with copper brazing.
    - A heat reclaimer shall be an integral part of the machine to increase efficiency by pre-heating weak solution with steam condensate from high temperature generator. This is a plate type heat exchanger. The plates are of stainless steel with copper brazing.

PURGE ASSEMBLY

- The units are provided with a purge system which is able to continuously and automatically remove non condensable gases from the inside of the machine, storing them into the storage tank. This one is divided in two parts: a first chamber where gases coming from the inside of the machine enter, and a second chamber that is the real storage tank. A small pipe connected to the solution pump discharge sends a small quantity of solution in the first chamber. The discharge of this liquid is pinched to create a jet effect. Due to this jet effect the area surrounding the pipe connection has a negative pressure. Since this chamber is connected to the main shell of the machine, gases are sucked from the machine inside and sent to the purge device. Once the gases are inside, they are taken to the bottom of the chamber by the solution spray and they are then released in the storage tank. Here they are kept until the purge pump is not activated.
- The purge pump is provided as a standard feature on all machines. The storage tank has to be evacuated before it gets completely full.

SOLUTION AND REFRIGERANT PUMPS

- All the machines are provided with Japanese manufactured canned pumps,Teikoku made, self lubricating, factory mounted and wired. Teikoku is a world leader in the manufacturing of this type of pumps and it is well known all over the world for extremely high quality standards.
- All the pumps are provided with TRG, a patented bearing monitoring system for monitoring the consumption of the bearings. By simply connecting to a couple of free contacts in the terminal strip of the control panel it is possible to have an indication on the bearing status, without opening the canned motor pumps. The canned motor pumps are provided with over-current and high temperature protection safeties to prevent the motors from burnout.
- These pumps are of a bolted construction so that if required bearing and filters can be cleaned. In case of hermetically sealed pumps replacement of entire pump is the only solution. There is great difference in leak rates caused by moving seal joint and fix seal joint. Canning avoids moving seal joint as pump has no shaft seal. Back cover plate fitted for dismantling the pump does not come in contact with any moving parts. Such fixed sealing allows leak rate to be maintained within international standards without comprising the maintainability.

- The pumps are also provided with isolating valves at their suction and discharge ends to ease the removal of the pumps during maintenance without breaking the vacuum inside the chiller.
- Solution pump is also provided with A/C drive as standard feature, for smooth operation and superior part load performance.

CROSSOVER PIPING

- All the various sections of the machines are interconnected by suitably sized seamless carbon steel piping. All the piping is of welded construction complete with necessary valves and fittings. The absorber to the condenser crossover piping suitably welded is a standard feature of all the machines.

AUTOMATIC DECRYSTALLISATION SYSTEM

- The machines are provided with an auto-decrystallisation line, protecting themselves from crystallisation during operation. If crystallisation occurs, it starts inside the concentrated solution at the outlet of the heat exchanger, where the concentration is higher and the temperature is lower. Here the crystallisation would cause a partial blockage of this line that would reduce the outflow of the concentrated solution from the generator. For the automatic decrystallisation a U-tube is provided connecting the generator to the absorber, bypassing the heat exchanger. The accumulation of the concentrated solution in the generator causes the solution level to rise. The overflow of the hot concentrated solution from the generator to the absorber warms up the weak solution. This heated weak solution warms up the crystallised solution on the opposite side of the heat exchanger. Thus the crystals melt enabling the normal flow of LiBr solution through the heat exchanger.

ANTICRYSTALLISATION SYSTEM

- The machines are also provided with an advanced state of the art active concentration control. By means of a series of different sensors, machine's PLC is able to calculate in every moment the maximum solution concentration inside the machine and compare it with the calculated critical value. If actual concentration is too close to the critical value, concentration control system takes the control of the machine, modulating the control valve to take the concentration level back to safe values. A decrystallisation system starts acting when crystallisation has already taken place: the Thermax concentration control instead ensure that machine will always work far away from crystallisation area.

- Thanks to this concentration control system it is possible to operate the chiller with cooling water inlet temperatures as low as 10°C.

GRAVITY FEED TRAYS

- The machines are provided with a gravity feed tray system, composed of a series of steel drilled trays for the distribution of the refrigerant and the solution over the respective tube bundles. These gravity feed trays are located just above the top of the respective tube bundle and have perforations perfectly aligned with and running along the entire length of the tube bundle. This gravity feed arrangement enhances high degree reliability in operation and longer machine life by eliminating the erosion of the spraying nozzles and the disruption of flow due to the clogging of the nozzles with impurities. Furthermore this system doesn't require a supplementary solution pump to provide extra pressure to win the pressure drop generated by the nozzles of a spray system.

CAPACITY CONTROL

- Stepless and continuous capacity control from 10% to 100%, based on the chilled water outlet temperature. The chilled water flow to the chiller is kept constant. So the cooling capacity is proportional to the temperature difference between the inlet and the outlet water temperature. Load fluctuations reflect in increasing or decreasing of the inlet chilled water temperature, and consequently of the outlet one. A sensor on the chilled water outlet senses the temperature change and gives a control signal. The signal is electrically amplified by a PLC and converted into a 4-20mA control signal by a PID algorithm, then it goes to the actuator of the control valve. As the load starts increasing, the control valve starts opening and closes as the load decreases.

CORROSION INHIBITOR

- A proper corrosion inhibitor is added to the solution to minimize the possibility of any corrosion taking place in the machine. A large number of first generation absorption machines used lithium nitrate or chromate as the corrosion inhibitor. But the nitrate desiccates at high temperatures, becomes instable and can lead to the generation of ammonia, while the chromate is toxic. These machines use the lithium molybdate as corrosion inhibitor, since it has excellent corrosion inhibitor properties, it doesn't desiccate at high temperatures and it is not toxic.

REFRIGERANT BLOWDOWN VALVE

- A refrigerant blow down valve placed between the evaporator and the absorber to allow the by pass of refrigerant from one to the other. The refrigerant vapors generated in the generator are always contaminated with small solution drops that are continuously stopped by the eliminators. In spite of them a small quantity of solution always remains with the refrigerant and goes to the condenser. As the quantity of solution in the refrigerant increases, the machine will slowly but continuously reduce its capacity. In fact during the refrigerant evaporation in the evaporator, the LiBr solution is not effective in the heat transfer process and so the capacity will be reduced. For this reason the refrigerant blowdown valve has to be operated on a periodic basis.

ABSORBER SOLENOID VALVE

- A solenoid valve is provided in absorber, connected with the refrigerant piping. When the solution level in absorber goes below a set value, the solenoid valve on refrigerant line gets open and refrigerant is directly sent to absorber, so that the solution pump can send the proper quantity of dilute solution to the generator, in order to keep under control the concentration.

REFRIGERANT AND SOLUTION LEVELS CONTROL

- All the units are provided with reliable level electrodes to control the refrigerant level in the evaporator and the solution level in absorber and high temperature generator. These electrodes ensure that the correct signal is given to the control panel to avoid the refrigerant and solution pumps entering a cavitation zone and to ensure that the correct quantity of solution is circulated inside the machine. They are more precise and reliable than the traditional floating system.

RUPTURE DISK

- All the machines are provided with a rupture disk as a standard feature. It is mounted on the shell side of the generator. When the pressure inside the generator raises above the critical value, the disk bursts open releasing the pressure inside, avoiding any major damage to the machine.

FACTORY TESTS

SOAP TEST

- Nitrogen is charged into the machine at a pressure up to 130 to 140 kPa. After charging is over, test is carried out with soap solution. A soap solution is spread evenly over the joints and on the expanded tube ends. If there is any leakage the nitrogen will try to leak from the joint, and because of the soap solution, bubbles will be formed. These leak points are marked and repaired/rewelded.

DECAY TEST

- After repairing the leaks found out during nitrogen testing, the machine is again charged with nitrogen up to 130 kPa pressure. The machine is kept at this pressure for 30 minutes. If any leakage occurs nitrogen will escape to the atmosphere and the pressure will start reducing thus showing the leakage. If a leakage is found in the decay test, the joints are thoroughly rechecked as in the previous step and they are repaired.

HELIUM SPRAY TEST

- The helium molecule is the next smallest molecule after the hydrogen molecule in the periodic table and it will leak through very minute holes. The absorption machine is fully evacuated (vacuumed). After vacuuming, the machine is connected to a special helium leak detector. The helium is spread on all the joints. As the machine is under vacuum, a leakage in the joints will result in helium entering into the machine which will be shown on the screen of the helium leak detector. If the cumulative leak rate is more than 1 x 10-7 standard cc/sec. then the joints are marked and repaired.

HELIUM SHROUD TEST

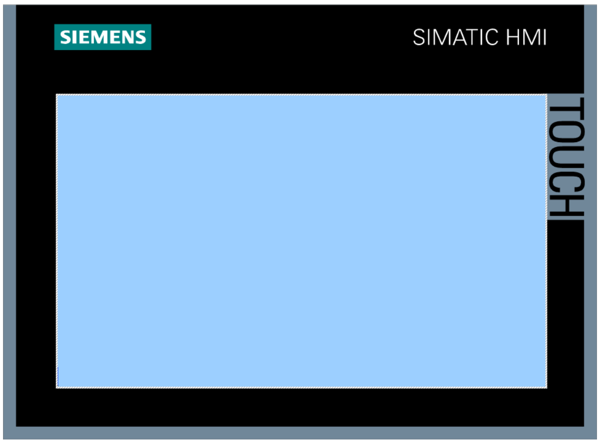
- The machine is fully covered by a polythene sheet and the helium is passed under the polythene cover. The leak rate is observed in the leak detector machine for 30 minutes. In this test, the leak rate allowable is up to 1 x 10-7 standard cc/s..

CONTROLS AND SAFETIES

GENERAL FEATURES

The units come with a Siemens S7/1200 Programmable Logic Controller (PLC), provided with the most advanced technological features to grant safe and economic operation, in order to make these products highly efficient, reliable and user friendly.
The control equipment is enclosed in a rugged dust proof sheet metal casing mounted on the chiller with IP42 protection. The control panel consists of the following:

- Main circuit breaker for safety against electrical hazards.
- MPCBs for solution pump, refrigerant pump and vacuum pump.
- Terminal blocks for control and power connections.
- Microprocessor based PLC Siemens S7/1200 for operational logic and sequence, safety and capacity control through PID algorithm. PLC uses a powerful CPU Siemens 1215C.
- 7” touchscreen display Siemens TP700.
- Modbus connectivity as a standard feature.



Touchscreen TP 700

- Ultra isolation control transformer with MCB protection for control circuit.
- Level electrodes for refrigerant level monitoring in the evaporators and solution level monitoring in absorber and high temperature generator.
- Individual contactors and thermal overcurrent relays for all pumps motors.
- A/C drive on solution pump.
- Interlocks for chilled and cooling water pumps.
- Temperature sensors and display for the following:
    - Chilled water inlet and outlet.
    - Cooling water inlet and outlet.
    - Intermediate solution at HTG outlet.
    - Concentrated solution at LTG outlet.
    - Concentrated solution sprayed in absorber.
    - Dilute solution.
    - Condensed refrigerant in “U” tube.

- Refrigerant vapours at HTG outlet.
- HTG bottom and top.

- ❖ Antifreeze protection safeties (PLC inbuilt antifreeze alarm, antifreeze thermostat, low temperature cut-out for the refrigerant pump (L-cut), flow switch and a D.P. switch for chilled water)..
- ❖ Crystallisation prevention (low and high cooling water inlet temperature cut-out, high temperature control for HTG, control valve PLC regulation based on HTG temperature, high refrigerant vapours temperature cut out, active concentration control for safe operation with low cooling water inlet temperatures, solution level control in absorber for solenoid absorber valve opening).
- ❖ Condensate removal system from high temperature generator tubes: based on the indications of some temperature sensors the machine is able to detect the presence of condensate steam accumulating inside the tubes of high temperature generator and by mean of a solenoid valve at the outlet of heat reclaimer it can facilitate the removal of the condensate from the HTG.
- ❖ Alarm state annunciation through an audio signal and appropriate messages display on the operator interface terminal.
- ❖ Last 24 hour logging facility at a sampling time of one hour intervals and last six alarms logging facility are provided for better understanding of the behavior of the unit during alarm conditions and for easy diagnosis.
- ❖ Possibility to modify data logging frequency time.
- ❖ Machine status indication on the display.

CONTROL AND SELF DIAGNOSTIC FUNCTIONS

The control panel has the following functions:

- ❖ Remote and local access for sequential operation of the chiller.
- ❖ Steam consumption control by a tight control of the chilled water outlet temperature accomplished by a microprocessor PID algorithm. This algorithm allows the machine to keep the chilled water temperature fluctuations within the set values by continuously modulating the control valve and allowing to partialize the load from 10 to 100% of the nominal value. Keypad variation of the set point is possible to get a minimum of 3,5°C outlet chilled water temperature (restrictions may apply, contact a Thermax engineer for more information).
- ❖ Status indication with audio visual alarm for malfunction.
- ❖ Thermal shock protection: in order to avoid dangerous thermal shock of the tubes material, at machine starting the PLC control system generates a 4-20 mA control signal

that gradually opens the control valve without taking care of outlet chilled water temperature. This signal starts only if the outlet chilled water temperature is more than the set point one. After 7 minutes, the control is switched over to chilled water temperature modulation automatically.

- Nuisance trip prevention anti chattering timer delays tripping of chilled water flow switch and differential pressure switch by a few seconds, in order to avoid dangerous starting and stopping of the machine due to fluctuations in the chilled water flow.

SAFETY FUNCTIONS

The safety functions protect the machine from abnormal working conditions. The different safety functions are as follows:

- Thermal shock protection.
- Antifreeze protection.
- Crystallisation protection.
- Cavitation protection of refrigerant pump.
- Cavitation protection of solution pump.
- Motors protection.

Thermal shock protection

In order to avoid dangerous thermal shock to the tube material, at machine starting the control valve is gradually and slowly opened for the first 7 minutes, when the generator temperature is very low irrespective of the outlet chilled water temperature. After 7 minutes, the control is switched over to chilled water temperature modulation automatically.

Antifreeze protection

In order to prevent the chilled water freezing in the evaporator tubes, the following functions stop the machine in abnormal conditions leading to the formation of ice:

L-cut. If the chilled water outlet temperature drops below the L-cut set point, the refrigerant pump is switched off. This prevents a further temperature drop of the chilled water below the set value.

Internal antifreeze thermostat. If the chilled water outlet temperature drops below the internal antifreeze set point, the machine trips.

Antifreeze thermostat. If the chilled water outlet temperature drops below the antifreeze thermostat set point the machine trips.

Chilled water pump interlock. The chilled water flow is essential for the machine operation. A potential free contact is to be wired from the chilled water pump motor starter or from one flow switch (in customer scope) to the machine panel to sense the chilled water pump on/off/trip status. The machine starts only if the chilled water pump is on. In case the chilled water pump trips and in order to avoid the freezing of the static chilled water in the tubes inside the machine, it is mandatory to stop the cooling water pump. For this reason it is mandatory that the PLC has control over the chilled and cooling water pumps. Four potential free contacts are provided in the panel to control the pumps switching on and off.

Chilled water differential pressure switch. If the chilled water flow drops below 50% of the rated value, machine trips.

Chilled water flow switch. If the chilled water flow drops below 50% of the rated value, machine trips.

Crystallisation prevention

If the concentrated solution returning to the absorber from the generator is excessively cooled, it crystallises in the heat exchanger and the operation of the machine is affected. Crystallisation occurs either when the concentration of the solution (for a particular temperature) goes too high or its temperature (for a particular concentration) goes too low. The following safety functions prevent the machine from crystallising:

Control valve. When the generator temperature is more than the critical temperature set in the PLC, the control valve immediately closes. This is to avoid a further increase in concentration.

Generator high temperature safety. If the generator temperature exceeds the generator high temperature set point, the machine trips.

Refrigerant vapours high temperature safety. If the refrigerant vapours temperature exceeds the maximum allowed set point, the machine trips.

Cooling water low temperature safety. If the cooling water inlet temperature drops below the cooling water low temperature set point, the machine trips.

Cooling water high temperature safety. If the cooling water inlet temperature goes above the cooling water high temperature set point, the machine trips.

Active concentration control. By means of a series of different sensors, machine's PLC is able to calculate in every moment the maximum solution concentration inside the machine and compare it with the calculated critical value. If actual concentration is too close to the critical value, concentration control system takes the control of the machine, modulating the control valve to take the concentration level back to safe values.

Level electrodes in absorber. When the solution level in absorber goes below a set value, the solenoid valve on refrigerant line gets open and refrigerant is directly sent to absorber.

When the solution level goes below the minimum set, the control valve is closed until the level has raised to a safety level.

Cavitation protection of refrigerant pump

If the refrigerant level in the evaporator pan falls excessively, the pressure in the refrigerant pump suction drops below the saturation pressure of the refrigerant and the refrigerant pump starts to cavitate. To ensure the minimum acceptable suction pressure the level of the refrigerant is not allowed to fall below a certain level. This is done by means of three level electrodes RE1, RE2, RE3 and a level relay, 33RL.

The three electrodes are mounted in the refrigerant level box assembly on the lower shell (evaporator side). RE1 electrode is the smallest in length and RE3 is the longest. The level is maintained between RE1 and RE2. RE3 acts as a reference electrode. When the level reaches RE1, the pump starts and when goes below RE2, the pump stops and restarts only when the level reaches RE1 again. When the level goes below RE2, a delay of 10 seconds is provided before the pump is switched off.

Cavitation protection of solution pump

If the solution level in the high temperature generator rises excessively, the solution will start flowing into the condenser, contaminating the refrigerant. Furthermore a high solution level in HTG means a low level in absorber, with the risk of cavitation for the solution pump. To ensure the presence of the correct quantity of solution in HTG, the level is monitored by 4 level electrodes: GE1, GE2, GE3 and GE4, with their respective level relays. Solution pump is controlled based on the signal sent to PLC by these electrodes.

Motors protection

Solution, refrigerant and purge pump overload relay.

INFORMATION DISPLAY

Operating information is in English language with SI units. Standard information shown are:

- Chilled water inlet and outlet temperatures.
- Cooling water inlet and outlet temperatures.
- Intermediate solution temperature at HTG outlet.
- Concentrated solution temperature at LTG outlet.
- Concentrated solution temperature sprayed in absorber.
- Dilute solution temperature.
- Condensed refrigerant temperature in “U” tube.

- Refrigerant vapours temperature at HTG outlet.
- HTG bottom and top temperatures.
- Percentage opening of control valve.
- Machine operating hours.
- Purge pump operating hours.
- Date of last purge cycle.

FUNCTIONAL COMMANDS

- Chiller remote/local mode.
- Chiller start/stop in local access.
- Refrigerant pump auto/manual mode.
- Refrigerant pump start/stop in manual.
- Vacuum pump start/stop.
- Control valve auto/manual mode.
- Control valve open/close in manual.
- Alarm acknowledge.
- Alarm reset.
- Maximum opening of control valve setpoint.
- Chilled water shut off valve open/close (if present).
- Cooling water shut off valve open/close (if present).

STATUS DISPLAY

- Chiller on/off/In dilution cycle.
- Chiller local/remote mode.
- Chilled water flow switch healthy/trip.
- Chilled water differential pressure switch healthy/trip.
- Chilled water interlock healthy/trip
- Temperature sensors healthy/trip.
- Chilled water antifreeze thermostat healthy/trip.
- Cooling water pump on/off/trip.
- Cooling tower fans ON/OFF (if wired).
- Solution pump on/off/trip.
- Refrigerant pump auto/manual mode.
- Refrigerant pump on/off/trip.
- Purge pump on/off/trip.

- L-cut function healthy / trip.
- Control valve status.
- Refrigerant level indication in the evaporator.
- Solution level indication in the absorber.
- Solution level indication in the HTG.

POTENTIAL FREE CONTACTS FOR REMOTE WORKING

- Remote machine start / stop.
- Remote machine status indication (On / Off).
- Remote machine trip indication.
- Chilled water pump start / stop.
- Cooling water pump start / stop.

4-20 mA OUTPUT SIGNALS

- Steam control valve signal.
- Cooling tower control signal (if applicable).
- Control signal to AC drive of cooling water pump (if applicable).
- Control signal to mixing valve in chilled water circuit (if applicable).

4-20 mA INPUT SIGNALS

- Chilled water temperature remote setpoint.
- Maximum opening of hot water control valve remote setpoint.
- Hot water control valve feedback (if applicable).
- Cooling water control valve feedback (if applicable).

ACCESSORIES

- Special tubes material for shell and tube heat exchangers of evaporator, absorber and condenser, based on the water quality circulating in the tubes. Materials available are:
  - Cupro-Nickel
  - Stainless steel
  - Titanium
- Automatic pneumatic purge system: PLC will sense the pressure in purge tank and it will operate vacuum pump and pneumatic valves to purge the system in a fully automatic mode.

- Insulation of hot and cold surfaces directly done at factory (except hot surfaces with T > 150°C).
- TRG reading directly from control panel through analogic device rather than through free potential contact is control panel.
- Three pieces shipment (lower shell, upper shell and HTG) for convenience of shipping and rigging, especially for retrofit jobs.
- Profibus connectivity.
- Ethernet connectivity.

TECHNICAL DATA - 1

MODEL		2B 2K C	2B 2L C	2B 2M C	2B 2N C	2B 3K C	2B 3L C
Cooling capacity	kW	476	568	704	840	1.005	1.130
CHILLED WATER							
Inlet/outlet temperature	°C	12/7					
Flow	m	81,6	97,4	120,7	144,1	172,4	193,8
Friction loss	kPa	14,6	17,6	43,4	52	45,8	49,4
Number of passes		1+1					
Maximum working pressure	kPa	785					
Nozzle dimension	DN	125				150	
Heat exchanger hold up volume	l	180	190	230	260	340	370
COOLING WATER							
Inlet/outlet temperature	°C	29-34	29-34	29-34	29-34	29-34	29-34
Flow	m	142	170	210	252	300	335
Friction loss	kPa	31,4	33,9	42,9	49,3	75,1	75,7
Number of passes		1+1/1	1+1/1	1,1/1	1,1/1	1+1/1	1+1/1
Maximum working pressure	kPa	785					
Nozzle dimension	DN	150				200	
Heat exchanger hold up volume	l	440	470	510	560	790	840
STEAM							
Steam pressure	kPa (g)	800					
Steam consumption	kg/h	511,6	610,5	757,7	903,2	1.071,9	1.205,1
Condensate temperature	°C	80-100					
Condensate pressure	kPa (g)	98,1					
Maximum working pressure	kPa (g)	1.030					
Steam nozzle dimension	DN	65				80	
Condensate nozzle dimension	DN	40					
ELECTRICAL DATA							
Power supply		415V +/- 10%, 50 Hz +/- 3%, 3ph + N					
Solution pump	kW (A)	2,2 (6,0)				3,0 (8,0)	
Refrigerant pump	kW (A)	0,3 (1,4)					
Vacuum pump	kW (A)	0,75 (1,8)					
Total electric consumption	kVA	7,6				9,1	

Dry saturated steam
Fouling factors 0,018 m^2 K/kW in chilled water circuit, 0,044 m^2 K/kW in cooling water circuit.
For working conditions different from above, please contact authorised Thermax office to request a customised selection.

TECHNICAL DATA - 2

MODEL		2B 3M C	2B 4K C	2B 4L C	2B 4M C	2B 5K C	2B 5L C
Cooling capacity	kW	1.354	1.515	1.705	1.885	2.086	2.302
CHILLED WATER							
Inlet/outlet temperature	°C	12/7					
Flow	m	232,2	259,9	292,4	323,2	357,8	394,8
Friction loss	kPa	81,9	72,7	72,4	76,8	76,1	76,3
Number of passes		1+1					
Maximum working pressure	kPa	785					
Nozzle dimension	DN	150	200				
Heat exchanger hold up volume	l	410	540	580	610	740	800
COOLING WATER							
Inlet/outlet temperature	°C	29-34	29-34	29-34	29-34	29-34	29-34
Flow	m	404	450	500	562	622	688
Friction loss	kPa	56,1	45,3	47,2	51,7	44,7	47,2
Number of passes		1,1/1	1,1/1	1,1/1	1,1/1	1,1/1	1,1/1
Maximum working pressure	kPa	785					
Nozzle dimension	DN	200	250			300	
Heat exchanger hold up volume	l	910	1.230	1.290	1.350	1.670	1.740
STEAM							
Steam pressure	kPa (g)	800					
Steam consumption	kg/h	1.448,7	1.616,2	1.819,1	2.012,7	2.225,3	2.454,5
Condensate temperature	°C	80-100					
Condensate pressure	kPa (g)	98,1					
Maximum working pressure	kPa (g)	1.030					
Steam nozzle dimension	DN	80	100				
Condensate nozzle dimension	DN	40				50	
ELECTRICAL DATA							
Power supply		415V +/- 10%, 50 Hz +/- 3%, 3ph + N					
Solution pump	kW (A)	3,0 (8,0)	3,7 (11,0)			5,5 (14,0)	
Refrigerant pump	kW (A)	0,3 (1,4)					
Vacuum pump	kW (A)	0,75 (1,8)					
Total electric consumption	kVA	9,1	11,2			13,4	

Dry saturated steam
Fouling factors 0,018 m^2 K/kW in chilled water circuit, 0,044 m^2 K/kW in cooling water circuit.
For working conditions different from above, please contact authorised Thermax office to request a customised selection.

TECHNICAL DATA - 3

MODEL		2B 5M C	2B 5N C	2B 6K C	2B 6L C	2B 7K C	2B 7L C
Cooling capacity	kW	2.654	2.965	3.280	3.655	4.665	5.160
CHILLED WATER							
Inlet/outlet temperature	°C	12/7					
Flow	m	455,2	508,6	562,6	626,9	800,1	885
Friction loss	kPa	55,9	57,3	101,7	103,3	52,2	55,6
Number of passes		1+1					
Maximum working pressure	kPa	785					
Nozzle dimension	DN	250				350	
Heat exchanger hold up volume	l	880	950	1.070	1.160	2.030	2.130
COOLING WATER							
Inlet/outlet temperature	°C	29-34	29-34	29-34	29-34	29-34	29-34
Flow	m	792	882	970	1.094	1.380	1.530
Friction loss	kPa	59,3	61,9	82,2	86,8	83,8	92,2
Number of passes		1,1/1	1,1/1	1,1/1	1,1/1	1,1/1	1,1/1
Maximum working pressure	kPa	785					
Nozzle dimension	DN	350				400	
Heat exchanger hold up volume	l	2.050	2.160	2.560	2.700	4.040	4.200
STEAM							
Steam pressure	kPa (g)	800					
Steam consumption	kg/h	2.828,8	3.160,7	3.535,1	3.938	5.015,4	5.545,2
Condensate temperature	°C	80-100					
Condensate pressure	kPa (g)	98,1					
Maximum working pressure	kPa (g)	1.030					
Steam nozzle dimension	DN	125				150	
Condensate nozzle dimension	DN	50				65	
ELECTRICAL DATA							
Power supply		415V +/- 10%, 50 Hz +/- 3%, 3ph + N					
Solution pump	kW (A)	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)					
Total electric consumption	kVA	15,5		20,3			

Dry saturated steam
Fouling factors 0,018 m^2 K/kW in chilled water circuit, 0,044 m^2 K/kW in cooling water circuit.
For working conditions different from above, please contact authorised Thermax office to request a customised selection.

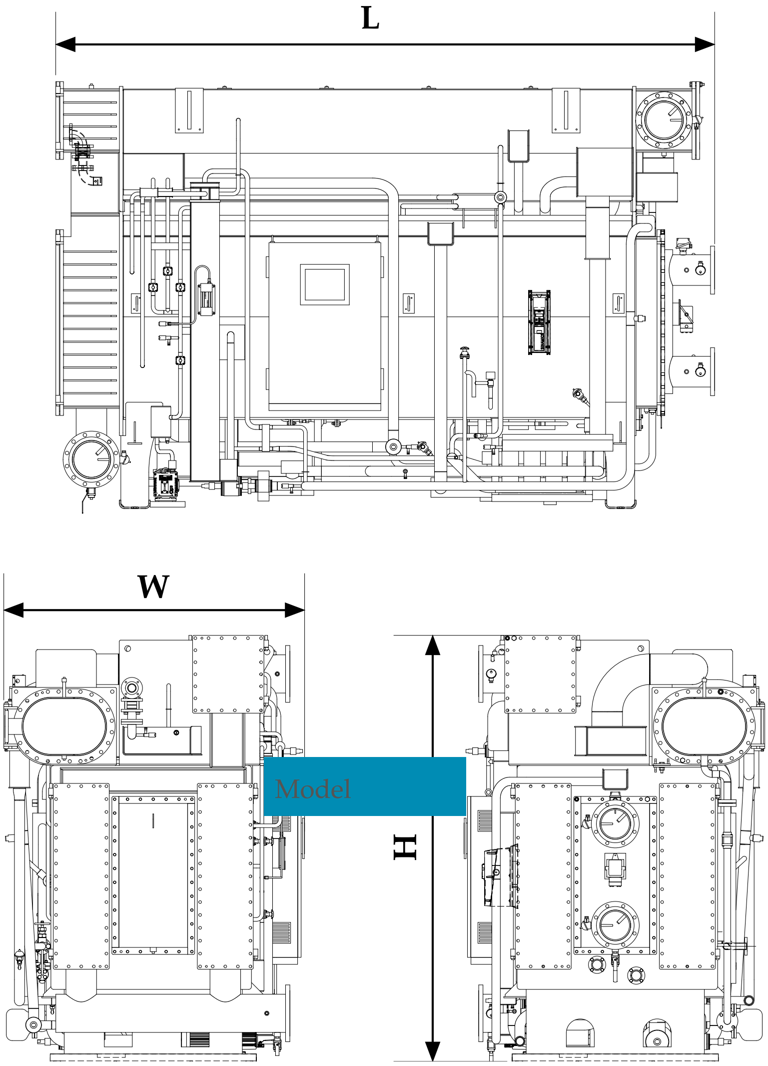
TECHNICAL DATA - 4

MODEL		2B 7M C	2B 8K C	2B 8L C	2B 8M C	2B 8N C
Cooling capacity	kW	5.680	6.580	7.110	7.940	8.490
CHILLED WATER						
Temperatura ingresso/uscita	°C	12/7				
Inlet/outlet temperature	m	974,2	1.128,6	1.219,5	1.361,9	1.456,2
Flow	kPa	59,4	58	60,4	94,1	96,1
Friction loss		1+1				
Number of passes	kPa	785				
Maximum working pressure	DN	350	400			
Nozzle dimension	l	2.230	2.700	2.810	3.060	3.200
COOLING WATER						
Inlet/outlet temperature	°C	29-34,1	29-34	29-34	29-34	29-34,4
Flow	m	1.641	1.960	2.100	2.337	2.337
Friction loss	kPa	97,3	86,7	92,5	117,5	115
Number of passes		1,1/1	1,1/1	1,1/1	1,1/1	1,1/1
Maximum working pressure	kPa	785				
Nozzle dimension	DN	400	450			
Heat exchanger hold up volume	l	4.500	5.360	5.530	5.940	6.140
STEAM						
Steam pressure	kPa (g)	800				
Steam consumption	kg/h	6.108,6	7.071,1	7.640,5	8.533,8	9.128,9
Condensate temperature	°C	80-100				
Condensate pressure	kPa (g)	98,1				
Maximum working pressure	kPa (g)	1.030				
Steam nozzle dimension	DN	150	200			
Condensate nozzle dimension	DN	65				
ELECTRICAL DATA						
Power supply		415V +/- 10%, 50 Hz +/- 3%, 3ph + N				
Solution pump	kW (A)	9,0 (27,0)			11,0 (28,0)	
Refrigerant pump	kW (A)	1,5 (5,0)				
Vacuum pump	kW (A)	0,75 (1,8)				
Total electric consumption	kVA	25,3			26,0	

Dry saturated steam
Fouling factors 0,018 m^2 K/kW in chilled water circuit, 0,044 m^2 K/kW in cooling water circuit.
For working conditions different from above, please contact authorised Thermax office to request a customised selection.

DIMENSIONS AND WEIGHTS

DIMENSIONS (in mm)

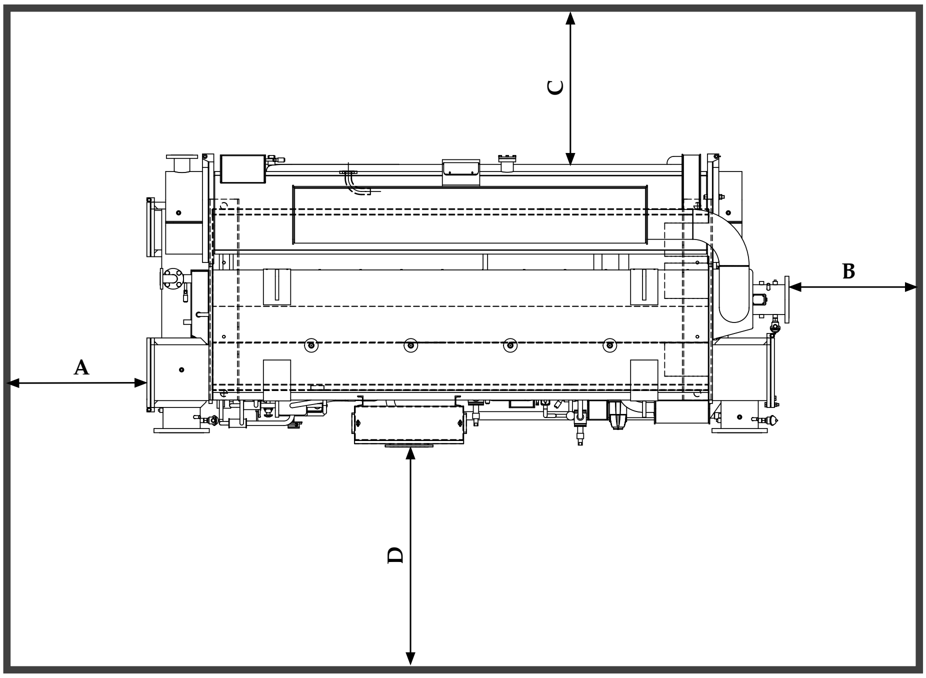


Model	2B 2K C	2B 2L C	2B 2M C	2B 2N C	2B 3K C	2B 3L C	2B 3M C	2B 4K C	2B 4L C
Length (L)	2.850	2.850	3.870	3.870	3.990	3.990	4.590	4.720	4.720
Width (W)	2.050	2.050	1.890	1.890	1.960	1.960	2.010	2.150	2.150
Height (H)	2.680	2.680	2.680	2.680	2.790	2.790	2.790	3.060	3.060

Model	2B 4M C	2B 5K C	2B 5L C	2B 5M C	2B 5N C	2B 6K C	2B 6L C	2B 7K C	2B 7L C
Length (L)	4.720	4.810	4.810	5.870	5.870	7.340	7.340	7.480	7.480
Width (W)	2.150	2.375	2.375	2.470	2.470	2.450	2.450	2.940	2.940
Height (H)	3.060	3.250	3.250	3.350	3.350	3.430	3.430	3.800	3.800

Model	2B 7M C	2B 8K C	2B 8L C	2B 8M C	2B 8N C
Length (L)	7.480	7.580	7.580	8.830	8.830
Width (W)	2.940	3.180	3.180	3.310	3.310
Height (H)	3.800	4.200	4.200	4.230	4.230

SERVICE CLEARANCE (in mm)



Model	2B 2K C	2B 2L C	2B 2M C	2B 2N C	2B 3K C	2B 3L C	2B 3M C	2B 4K C	2B 4L C
A (**)	2.500	2.500	3.500	3.500	3.600	3.600	4.200	4.250	4.250
B	500	500	500	500	500	500	500	500	500
C	500	500	500	500	500	500	500	500	500
D	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200
TOP	200	200	200	200	200	200	200	200	200

Model	2B 4M C	2B 5K C	2B 5L C	2B 5M C	2B 5N C	2B 6K C	2B 6L C	2B 7K C	2B 7L C
A (**)	4.250	4.350	4.350	5.400	5.400	6.860	6.860	6.910	6.910
B	500	500	500	500	500	500	500	500	500
C	500	500	500	500	500	500	500	500	500
D	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200
TOP	200	200	200	200	200	200	200	200	200

Model	2B 7M C	2B 8K C	2B 8L C	2B 8M C	2B 8N C
A (**)	6.910	6.910	6.910	8.220	8.220
B	500	500	500	500	500
C	500	500	500	500	500
D	1.200	1.200	1.200	1.200	1.200
TOP	200	200	200	200	200

(**): "A" is the clearance space for tubes maintenance and removal. It can be left on either side of the chiller, depending on the convenience of site.

WEIGHTS (in kg)

Model	2B 2K C	2B 2L C	2B 2M C	2B 2N C	2B 3K C	2B 3L C	2B 3M C	2B 4K C	2B 4L C
Dry weight	5.500	5.600	6.600	6.800	7.700	7.800	8.700	10.400	10.700
Shipping weight	6.200	6.300	7.600	7.800	8.900	9.100	10.200	12.200	12.700
Operating weight	6.800	7.000	8.300	8.600	10.000	10.300	11.500	14.000	14.500
Flooded weight	9.300	9.300	12.000	12.100	14.400	14.600	16.600	21.000	21.400

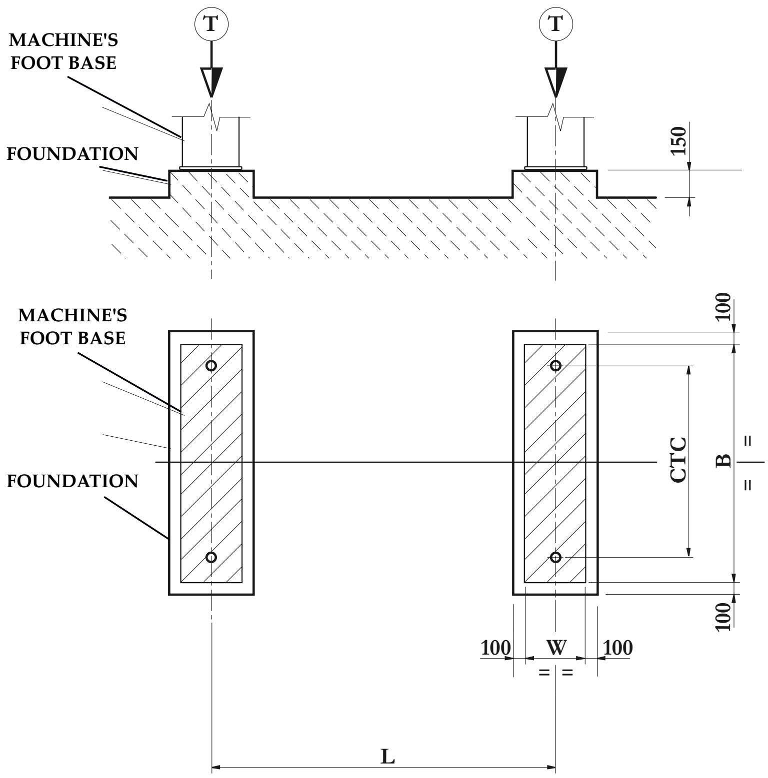
Model	2B 4M C	2B 5K C	2B 5L C	2B 5M C	2B 5N C	2B 6K C	2B 6L C	2B 7K C	2B 7L C
Dry weight	10.900	12.700	13.000	15.700	16.000	19.800	20.300	28.200	28.800
Shipping weight	12.900	15.100	15.400	18.800	19.300	24.100	24.800	34.600	35.400
Operating weight	14.900	17.500	18.000	21.700	22.400	27.800	28.700	40.600	41.700
Flooded weight	21.500	25.600	25.800	32.200	32.500	42.300	42.800	62.400	63.000

Model	2B 7M C	2B 8K C	2B 8L C	2B 8M C	2B 8N C
Dry weight	29.500	33.800	34.400	38.700	39.500
Shipping weight	36.400	42.300	43.200	49.500	50.700
Operating weight	43.100	50.300	51.600	58.500	60.000
Flooded weight	63.800	76.100	76.800	90.100	91.000

Dry weight: weight of the machine without any liquid inside.

Shipping weight:	weight of the machine + weight of the working liquids (LiBr solution and refrigerant)
Operating weight:	weight of the machine + weight of the working liquids + weight of the water inside the heat exchangers
Flooded weight:	maximum weight the machine can reach when all internal volume is filled with water.

FOUNDATIONS



Model	2B 2K C	2B 2L C	2B 2M C	2B 2N C	2B 3K C	2B 3L C	2B 3M C	2B 4K C	2B 4L C
L (mm)	1.846	1.846	2.866	2.866	2.866	2.866	3.474	3.474	3.474
W (mm)	220	220	220	220	220	220	220	220	220
B (mm)	1.150	1.150	1.150	1.150	1.315	1.315	1.315	1.475	1.475
CTC (mm)	1.054	1.054	1.054	1.054	1.214	1.214	1.214	1.374	1.374
T (kg)	3.400	3.500	4.200	4.300	5.000	5.200	5.800	7.000	7.200
T_{max}	4.650	4.650	6.000	6.050	7.200	7.300	8.300	10.500	10.700

Model	2B 4M C	2B 5K C	2B 5L C	2B 5M C	2B 5N C	2B 6K C	2B 6L C	2B 7K C	2B 7L C
L (mm)	3.474	3.424	3.424	4.374	4.374	5.826	5.826	5.724	5.724
W (mm)	220	270	270	320	320	320	320	425	425
B (mm)	1.475	1.635	1.635	1.635	1.635	1.780	1.780	2.355	2.355
CTC (mm)	1.374	1.534	1.534	1.534	1.534	1.610	1.610	2.184	2.184
T (kg)	7.400	8.700	9.000	10.900	11.200	13.900	14.400	20.300	20.900
T_{max}	10.750	12.800	12.900	16.100	16.250	21.150	21.400	31.200	31.500

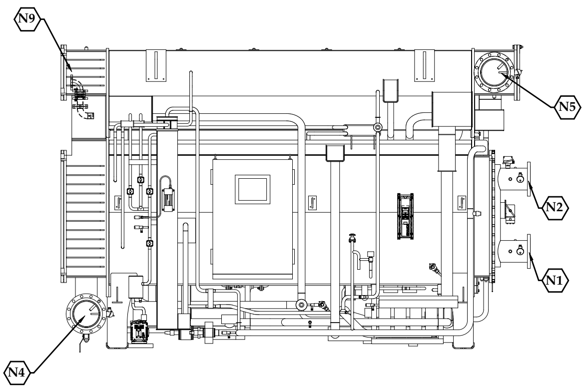
Model	2B 7M C	2B 8K C	2B 8L C	2B 8M C	2B 8N C
L (mm)	5.724	5.724	5.724	6.974	6.974
W (mm)	425	425	425	425	425
B (mm)	2.355	2.545	2.545	2.545	2.545
CTC (mm)	2.184	2.374	2.374	2.374	2.374
T (kg)	21.500	25.200	25.800	29.300	30.000
T_{max}	31.900	38.050	38.400	45.050	45.500

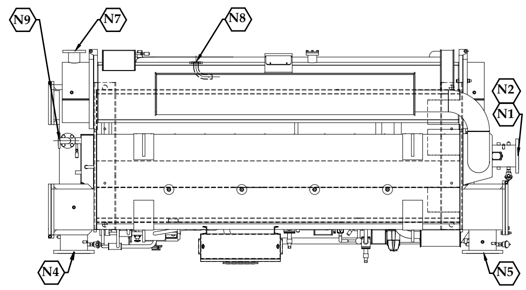
T: machine’s operating weight on each foundation
Tmax: maximum machine’s flooded weight on each foundation
NOTE: in case of PED approval or non standard pressures in water circuits, weights may change.

WATER NOZZLES DISPOSITION

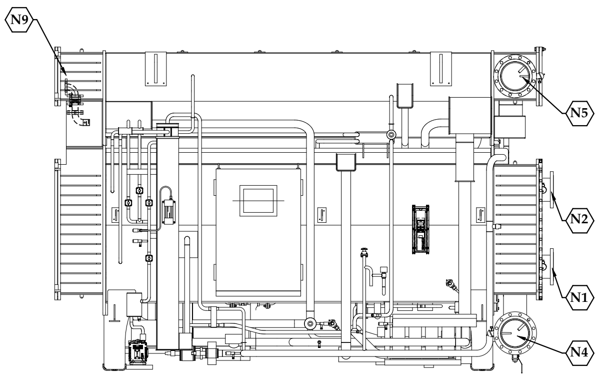
For standard machines there are two possible water nozzles dispositions, depending on number of passes of water circuits. “E” means an even number of passes, “O” an odd number of passes. “+” symbol means a configuration with heat exchangers in series, “,” symbol means a configuration with heat exchangers in parallel.

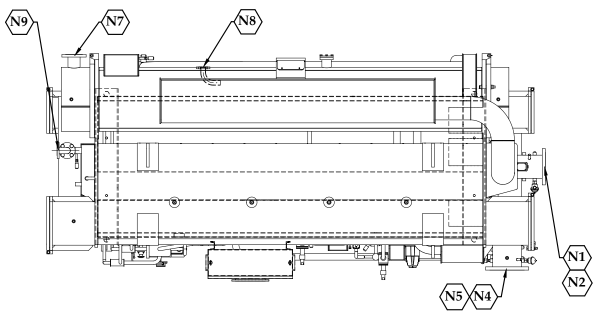
Number of passes		
Evaporator	Absorber	Condenser
E	E	1





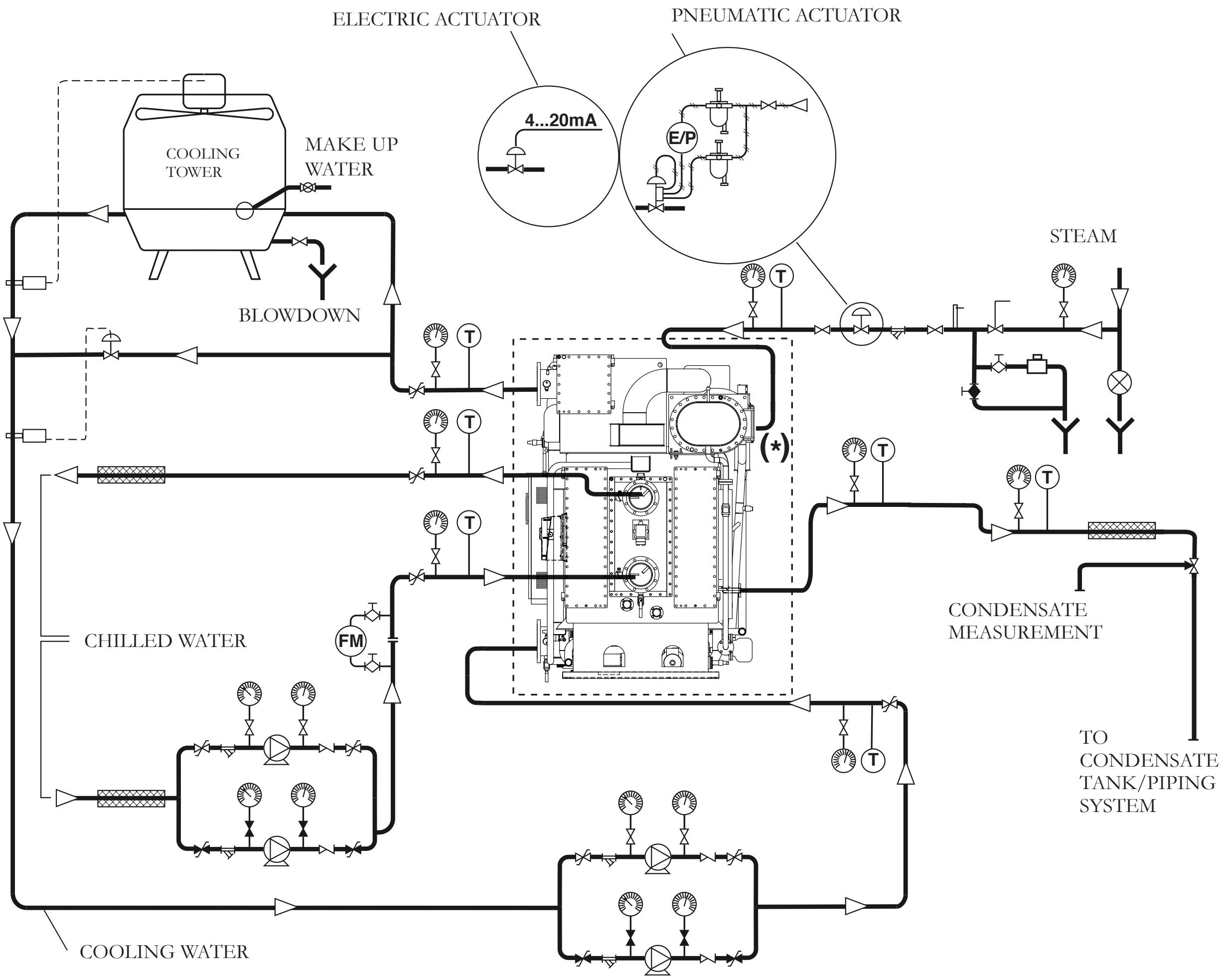
Number of passes		
Evaporator	Absorber	Condenser
E	O	1





NOZZLE	DESCRIPTION
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

TYPICAL P&I DIAGRAM



	Gate closed		Water pump		Safety valve
	Gate open		Thermostat		Steam trap
	Butterfly valve	T	Termometer		Insulation
	Globe valve	FM	Flow meter		3 way ball valve
	Non return valve		Control valve	4...20mA	Drive signal
	"Y" strainer		Steam trap		Pneumatic line
	Cock		Provision for measurement of dryness fraction		Air filter regulator
	Manometer			E/P	E/P convertor

(**): cooling water by-pass valve is required only in case of low cooling water temperatures. Refer to installation manual for more details.

NOTES

THERMAX
www.thermax-europe.com

THERMAX EUROPE LIMITED, 2 STUDIO COURT, QUEENSWAY, BLETCHLEY
MILTON KEYNES MK2 2DG, UNITED KINGDOM
Telephone: +44 1908 378914 Fax: +44 1908 379487
e-mail: info@thermax-europe.com

TECH-2B.ENG.REV1-2015