Steam Driven Vapour Absorption Chiller

120 TR to 2500 TR (420 kW to 8775 kW)
Vapor Absorption Technology from Thermax is at work for clients in more than 50 industries including Pharmaceuticals, Chemicals, Fertilizers, Steel, Textiles, Petrochemicals, Food & Beverages and Automobile industries as well as in Hotels, Commercial Complexes, Shopping Complexes, Office Buildings, Educational Institutes, Airports, Cinema halls and Medical Centers.

Manufacturing capabilities of Thermax's Cooling SBU are confirmed by the fact that, over the years, Thermax has installed thousands of machines in more than 70 countries including USA, Brazil, Germany, Spain, UK, Italy, UAE, Saudi Arabia, India, China, Australia, Thailand, Philippines, Malaysia, Russia and Nigeria with the products conforming to the respective country standards like ETL, CE, TUV, DNV, ASME etc. Thermax has its fully owned subsidiaries namely Thermax Inc. in USA, Thermax Europe Limited in UK and Thermax (Zhejiang) Cooling and Heating Engg. Company Limited in China.

Thermax believes in efficient and responsive services to its clients and exhibits in its way of business, by giving optimal and quality solutions and achieving customer delight. Thermax has a worldwide sales, service and distribution network to fulfill the needs of its valuable customers.

Cooling & Heating Division - Cooling SBU

The Cooling SBU of THERMAX promotes Vapor Absorption Chillers as a cost effective and environment friendly alternative to electricity driven compression chillers.

It offers expert solutions in Process Chilling & Air Conditioning for industrial as well as commercial applications. Cooling SBU's strength lies in customized solutions as per the requirements of its customers.

Unlike electrical chillers, Absorption Chillers are powered by heat. These machines can run on a variety of heat sources, e.g. steam, hot water, liquid/gaseous fuels, exhaust gases and/or a combination of above.

Thermax - Conserving Energy, Preserving the Environment

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Quality assured manufacturing to international codes

Thermax manufactures environment friendly and energy efficient vapor absorption chillers at its plants in Pune, India, and China. Its state-of-the-art manufacturing facility has been awarded with ISO 9001 and ISO 14001 certifications. Stringent quality control procedures, along with a skilled workforce, ensure that a highly reliable product leaves the factory. The equipment and manufacturing processes conform to international standards.

Thermax’s pressure part manufacturing has been approved by ASME and bears the ‘S’, ‘U’, ‘H’ and ‘R’ stamps. The vapor absorption chillers are CE certified for the European Union and ETL listed for the US and Canadian markets. They conform to the Kyoto Protocol and are in absolute tandem with the Clean Development Mechanism code (CDM).

Thermax also conforms to Environmental Management System standard 14001 and OHSAS 18001.

CNC twin spindle drilling machine with high speed and direct feed technology ensures fine tube hole finish and accuracy, which is important for leak tight expansion and effective heat transfer.

A Helium leak detection test ensures there is no leak at welding joints.

Welding robot for high precision automatic welding.

CNC gas cutting machine for plate cutting ensures precision cutting of shell plates and profile cut tube plates.

Press Brake Machine

Rolling Machine
**Advanced Series Flow Cycle**

Advanced Series Flow Cycle to avoid simultaneous occurrence of high temperature and high concentration, thereby minimizing the probability of corrosion.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parallel Flow</th>
<th>Advanced Series Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTG Temperature</td>
<td>324°F</td>
<td>310°F</td>
</tr>
<tr>
<td>LiBr Concentration</td>
<td>64 - 65%</td>
<td>60.5%</td>
</tr>
<tr>
<td>LTG Temperature</td>
<td>191°F</td>
<td>194°F</td>
</tr>
<tr>
<td>LiBr Concentration</td>
<td>62 - 64%</td>
<td>63%</td>
</tr>
</tbody>
</table>

**Unique Two Stage Evaporation Technology**

Thermax chillers are designed based on unique two stage evaporation technology. This ensures that the specific heat input is one of the lowest in the industry, resulting in higher cooling output for the same heat input. Also, larger temperature difference in chilled water to the tune of 55°F, is possible.

**Split Absorber Design**

Split absorber design helps to improve absorption rate of LiBr, thereby improving efficiency. This also reduces surface area under cold insulation.

**Gravity Feed LiBr and Refrigerant Distribution Mechanism**

Nozzle-less, non-clogging gravity feed distribution mechanism for stable and reliable operation throughout the life of the machine. Drop in performance due to nozzle wear, clogging eliminated. Need for separate pump for spray eliminated, resulting in lower power consumption.

**Zero Crystallization**

Unique State-of-the-Art concentration monitoring and control that virtually eliminates crystallization and is distinctly different from the conventional auto de-crystallization. This helps the chiller to operate even at low cooling water inlet temperature without crystallisation.

**Lowest Chilled Water/ Brine Outlet Temperature**

Thermax innovative absorption chillers can deliver leaving chilled water temperatures down to 38.5°F and leaving chilled brine solution up to 32°F, enabling absorption chillers to be used for applications involving low chilled water / brine temperature.

**Best-in-class Coefficient of Performance**

Process design to ensure maximum internal Heat recovery to give the lowest specific steam consumption benefit to the customer.

**Avenues for COP improvement**

<table>
<thead>
<tr>
<th>Avenues for COP improvement</th>
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</thead>
<tbody>
<tr>
<td>Enhancement of heat transfer area</td>
<td>Done by all manufacturers</td>
</tr>
<tr>
<td>Two stage evaporation</td>
<td>Unique feature of Thermax chillers</td>
</tr>
<tr>
<td>Advanced series flow</td>
<td>Design unique to Thermax chillers</td>
</tr>
<tr>
<td>Refrigerant heat exchanger</td>
<td>Unique feature of Thermax chillers</td>
</tr>
</tbody>
</table>

**Highly Efficient and Reliable Solution Heat Exchangers for Maximum Internal Heat Recovery**

All regenerative heat exchangers are high efficiency plate type heat exchangers with SS316 plates, for improved reliability.

**Welded Plate Heat Exchanger for Condensate Heat Recovery**

Specially designed welded type plate heat exchanger with SS316 plate used as heat reclaimer for condensate heat recovery. These are best suited for two phase flow and are highly reliable compared to conventional brazed heat exchangers.

**Isolation Valves for Canned Motor Pumps**

Double seal isolation valves and bolted pumps facilitate easy maintenance of the machine mounted canned motor pumps without any loss of vacuum in the system. This significantly reduces the down time of the chiller.

**Ferritic Stainless Steel Tubes in Generators**

Titanium stabilized ferritic stainless steel tubes (SS430 Ti) used in both high temperature and low temperature generator for lowest differential thermal expansion, thereby protecting the tubes from stress corrosion cracking. Suitable for steam with dissolved ammonia compounds, where copper alloys are not recommended.

**De-oxidised Low Phosphorus Copper Tubes**

Copper tubes conforming to ASTM/JIS standards, with phosphorus content maintained below 0.005 ppm, used in chilled water and cooling water circuits. This protects the tubes from hydrogen embrittlement in LiBr environment.
**Improved Online Purge System**

Factory fitted high efficiency purge system with purge cooler, continuously removes non-condensable gases from the chiller into the storage tank while in operation.

**PLC Based Control Panel**

Thermax chillers are provided with State-of-the-Art PLC based control panel, user friendly 7 inch touch screen operator interface and data logging system.

**Non-clogging Filters to protect Solution Heat Exchangers**

Stainless steel filters provided on both high temperature and low temperature generator outlet to safe guard the solution heat exchangers. Non-clogging design ensures uninterrupted circulation of lithium bromide, resulting in smooth operation.

**Non-toxic Corrosion Inhibitor**

New generation non-precipitating, non-toxic molybdenum based corrosion inhibitor which is more effective than conventional inhibitors based on Chromate (Cancer causing, prohibited in several countries) and Nitrate.

**Variable Frequency Drive on Absorbent Pump**

Variable Frequency Drive on absorbent pump for higher reliability, savings in steam & savings in power, during part load operation.

**10-100% Stepless Modulation**

For cooling loads ranging from 10% to 100% of the designed capacity, the steam control valve automatically varies steam flow in order to maintain the temperature of chilled water leaving the chiller.

**Multi-stage Level Control**

Multiple stage level control in three locations enables effective operation during part load and prevents cavitation of refrigerant and absorbent pumps.

**BAS/DCS Connectivity**

Direct connectivity of machine PLC panel with Third party monitoring systems like BAS (Building Automation System), DCS (Distributed Control System) or PLC (Programmable Logic Controller) can be provided via Modbus RTU protocol on RS485 network.
Tailor Made, High Efficiency Solutions for Low Steam Pressure

Double effect lithium bromide absorption chillers can be offered for steam pressures as low as 45 Psig, where conventionally single effect chillers are used.

LiBr Absorption Chillers for Sub-Zero Cooling Applications

Double effect Lithium bromide absorption chillers can be offered for leaving brine temperatures as low as 23°F, offering great savings in operating costs.

Stand-by Pumps

For critical applications where scheduled maintenance of pumps cannot be carried out, stand-by absorbent, refrigerant and/or vacuum pump can be provided.

Fully Automatic Purging

The automatic purging system eliminates the need for periodic monitoring of purge tank pressure and operation of purge system.

Special Tube Metallurgy

Special tube materials like Cupro-Nickel, Stainless Steel or Titanium depending on water quality on site. This not only improves the reliability & efficiency but also makes the chiller suitable for special applications involving sea water and brackish water.

Instrumentation and Safety Features

- Pumps
- Controls
- Instruments
- PLC
- HMI

CRYSSTALISATION PREVENTION
- Concentration Measurement
- Cooling water low temperature
- Generator high temperature

CAVITATION PROTECTION
- Absorber level measurement
- Evaporator level measurement
- HTG Level measurement

SAFETIES
- MOTOR PROTECTION
  - Absorbent pump overload relay
  - Refrigerant pump overload relay
  - Vacuum pump overload relay

- ANT FREEZE PROTECTION
  - Chilled water flow switch
  - Chilled water DP switch
  - Chilled water pump interlock

THERMMONITOR - Remote Performance Monitoring System (RPMS)

Advanced feature that monitors the chiller performance & provides data via internet. This feature enables the facility manager or Thermax engineer to monitor the performance remotely. It offers features like e-log book, status, trends, abnormal maintenance schedules, alerts etc.

Multi Sectional Shipment Arrangement

For convenience of shipping, the absorption chillers can be shipped in two or more sections depending upon the site requirement. This is particularly convenient arrangement for retrofit / replacement jobs.
Helium Spray Test

Helium, the next smallest molecule after Hydrogen, can leak through very minute holes. In this test helium is sprayed on all the joints of the chiller. As the chiller is under vacuum conditions, leakages, if any, will result in helium entering into the chiller and thus will be displayed on the screen of helium leak detector. Every machine has to clear this test before it is shipped to the customer.

Testing Procedure

As the Vapor absorption chillers work under vacuum conditions, the manufacturing of these chillers is very critical with respect to leak tightness. Hence it is necessary to follow stringent quality control procedures and also perform leak detection test. Understanding the importance, Thermax carries out the leak detection test in the following sequence:

- Helium Shroud Test
  In this test, the chiller is fully covered by a polythene sheet and helium is passed from below, to observe the cumulative leak rate of the entire chiller. It can detect leakage to the tune of $5.0 \times 10^{-7}$ std cc/sec.

Performance Testing Facility

Thermax has a state-of-the-art test bay capable of testing various types of vapour absorption chillers - steam driven, hot water driven, fuel fired, exhaust driven and a combination of these up to a capacity of 3500 TR (12300 kW). The entire testing facility is centrally operated by sophisticated Distributed Control Systems (ABB make) and can be operated by the touch of a button.

- Steam : 50 - 3500 TR (175 kW to 12300 kW)
- Exhaust : 50 - 3500 TR (175 kW to 12300 kW)
- Hot Water : 10 - 1730 TR (35 kW to 6080 kW)
- Fuel Fired : 50 - 3000 TR (175 kW to 10540 kW)

This is one of the largest testing facility for absorption chillers available in the world.
### Operating Principle

1. **Water circulating heat exchanger** - Tubular chilled water circuit
2. **Chilled water circuit** - Tubular chilled water circuit
3. **Cooling water circuit** - Tubular chilled water circuit
4. **Steam circuit** - Tubular chilled water circuit

#### Notes:
1. Model Nos.: 2B XX C Steam Fired Double Effect Vapour Absorption Chillers
2. Chilled water inlet / outlet temperature = 54 / 44 °F
3. As Lithium Bromide becomes dilute it loses its capacity to absorb water vapor. It thus needs to be reconcentrated using a heat source.
4. When maintained at high vacuum, water will boil and flash cool itself.
5. Chilled water inlet / outlet temperature = 85 / 94.4 °F

#### Cycle Diagram

- **Evaporator**
- **Generator**
- **Refrigerant Vapor**
- **Absorption pump**
- **Absorber**
- **Chilled water**
- **Water**
- **Refrigerant**
- **Concentrated LiBr solution**
- **Diluted solution**
- **Driving heat source**
- **Vaporized refrigerant water**
- **Cooling water**
- **Vacuum pump**
- **Refrigerant pump**
- **Absorbed pump**

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### Technical Specifications

- **Model Numbers:**
  - 2B 2K C
  - 2B 2L C
  - 2B 3K C
  - 2B 3L C
  - 2B 4K C
  - 2B 4L 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
  - 2B 7M C
  - 2B 8K C
  - 2B 8L C
  - 2B 8M C
  - 2B 8N C

- **Cooling Capacity**

<table>
<thead>
<tr>
<th>Flow rate (gpm)</th>
<th>303.5</th>
<th>363.3</th>
<th>408.9</th>
<th>547.3</th>
<th>645.3</th>
<th>724.1</th>
<th>855.6</th>
<th>1088.2</th>
<th>1190.2</th>
<th>1319.2</th>
<th>1454.5</th>
<th>1701.6</th>
<th>1922.4</th>
<th>2146.1</th>
<th>2397.1</th>
<th>3039.9</th>
<th>3328.7</th>
<th>3673.3</th>
<th>4252.0</th>
<th>4565.8</th>
<th>5131.1</th>
<th>5598.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure loss (LC)</td>
<td>3.5</td>
<td>4.2</td>
<td>10.8</td>
<td>13.0</td>
<td>11.1</td>
<td>11.9</td>
<td>19.2</td>
<td>17.1</td>
<td>17.1</td>
<td>18.0</td>
<td>17.9</td>
<td>13.9</td>
<td>14.3</td>
<td>26.3</td>
<td>26.9</td>
<td>13.1</td>
<td>14.0</td>
<td>15.0</td>
<td>14.7</td>
<td>15.3</td>
<td>23.8</td>
<td>24.5</td>
</tr>
</tbody>
</table>

- **Cooling Water Circuit**
- **Steam Circuit**
- **Overall Dimensions**
- **Weight**
- **Clearance**
- **Electric Supply**
- **Pressure Loss ft LC**
- **Flow Rate gpm**
- **Connection Diameter (Steam)**
- **Connection Diameter (Drain)**
- **Max. Shipping Length inches**
- **Max. Shipping Width inches**
- **Max. Shipping Height inches**
- **Max. Shipping Weight x 1000 lb**
- **Operating Weight x 1000 lb**
- **Power Supply**
- **Electrical Requirement**

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**Power Supply**
- 460 V (±10%), 60 Hz (±5%), 3 Phase+N

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**Technical Specifications**
- Maximum allowable pressure in chilled / cooling water system = 115 psi(g)
- Maximum allowable pressure in steam system = 150 psi(g)
- Control panel electric input = 1 kVA
- All water nozzle connections to suit ASME B16.5 Class 150
- Technical specification is based on ARI 560:2000
- Please contact Thermax representative / office for customized specifications
Notes:
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.

**Typical Machine Illustration**

<table>
<thead>
<tr>
<th>NOZZLE SCHEDULE</th>
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<tbody>
<tr>
<td>NOZZLE</td>
</tr>
<tr>
<td>N1</td>
</tr>
<tr>
<td>N2</td>
</tr>
<tr>
<td>N3</td>
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<tr>
<td>N4</td>
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<td>N5</td>
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<td>N6</td>
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<tr>
<td>N7</td>
</tr>
<tr>
<td>N8</td>
</tr>
<tr>
<td>N9</td>
</tr>
</tbody>
</table>

**NOTES:**

1. *Indicates the position of anchor bolts.
2. Indicates the position of the power supply connection on control panel.
3. Minimum installation clearance: control panel size: 1250 mm (50°) Top: 200 mm (8°) Others: 500 mm (20°)
4. Rupture disk outlet to be piped out according to local rules and regulations. Maximum piping elevation not to exceed the height of the machine.
Notes:

1. Pressure reducing station and a safety valve to be provided on steam inlet line, if the design/operating pressure is more than 150 Psig.
2. De-superheating to be installed on steam inlet line if the degree of superheat of steam exceeds 25°F.
3. The back pressure in the condensate drain line should not be more than 390 inch H₂O.
4. Automatic arrangements should be provided to stop cooling water flow through the machine, if the chilled water/brine flow stops.
5. Maximum working pressure in water headers is 115 Psig. This should be noted for design of chilled brine and cooling water system.
6. Clean & dry compressed air supply to the instruments to be 70 Psig.
7. Necessary arrangements to be made to maintain constant cooling water inlet temperature to chiller. Minimum allowable cooling water inlet temperature is 50°F.
8. Install automatic shut off valve on the cooling water inlet line, if cooling water pumps are not dedicated to the machine.
9. If cooling water pumps are dedicated to the machine and chilled water/brine temperature is < 40°F install cooling water automatic shut off valve only on the bypass line between cooling water inlet and outlet.
References

**Refinery & Petrochemical**
- Exxon Mobil, Saudi Arabia
- Reliance Industries, India
- Sipchem, Saudi Arabia
- IOCL, India

**Metals**
- Tata Steel, India
- Bhilai Steel Plant, India
- Concord Steel, Brazil
- Maklada Prestressed Steel, Tunisia

**Pharmaceuticals**
- AstraZeneca, UK
- Pfizer, India
- Johnson & Johnson, USA
- Glaxo SmithKline, India

**Food & Beverage**
- Nestle, Philippines
- Cadbury, Nigeria
- Ferrero, Italy
- Coca Cola, India

**Textile**
- Envoy Textiles, Bangladesh
- Indorama, Thailand
- Raymonds, India
- Garden Silks, India

**Chemical**
- SFCCL, Saudi Arabia
- Aditya Birla Chemicals, India
- Eka Chemicals, China
- Tata Chemicals, India

**Paper & Packaging**
- Phoenix Pulp And Paper, Thailand
- BILT, India
- Double A Paper, Thailand
- TNPL, India

**Commercial Centers**
- BBC Studio, UK
- Revel Casino, USA
- Henry Ford Museum, USA
- Lotus TESCO, Thailand

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