General Information

The Trane Single-Stage Absorption Chiller is designed to operate on 12 or 14 psig steam or hot water up to 270F. The working fluids are lithium bromide, which acts as the absorbent, and water, acting as the refrigerant. Steam or hot water is used to reclaim refrigerant from the lithium bromide solution and to sustain the refrigerant cycle. Each machine has four internal sections: generator, condenser, evaporator, and absorber.

Additional components include heat exchanger, electronic microprocessor control panel, control valves, solution pump and purge assembly. Figure 1 illustrates the location of these components.

Refrigerant and Absorbent

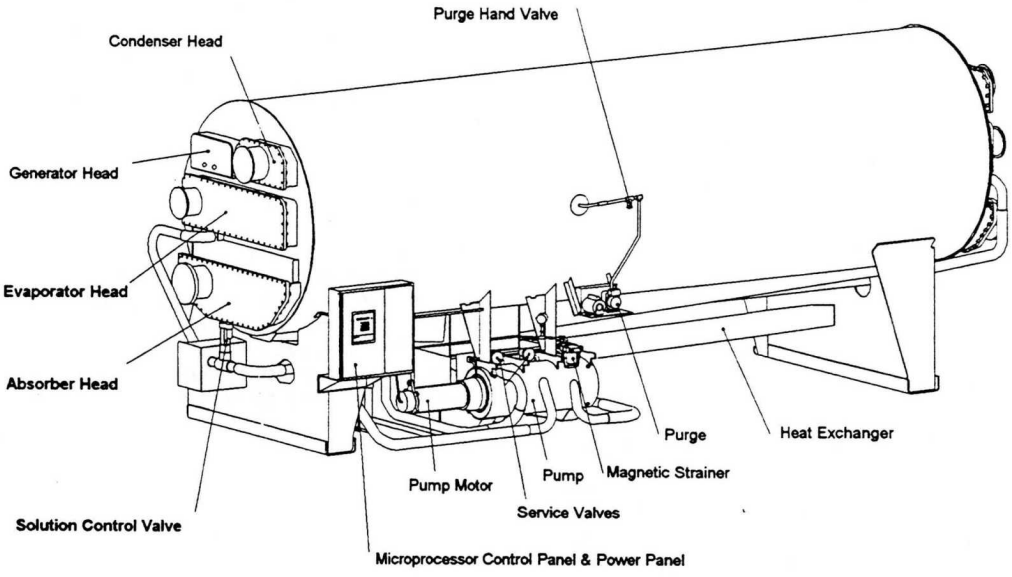
The refrigerant in the Trane absorption cycle is water. Water is an excellent refrigerant because it boils easily at a low evaporation pressure, has a relatively high refrigeration effect, and is easily separated from the lithium bromide when it is boiled.

Lithium bromide, the absorbent, is used because it has an high affinity for water vapor, releases refrigerant vapor at a relatively low temperature and has a very high boiling point.

Basic Principles of the Absorption Cycle

The four major internal sections of the machine are split into high pressure and a relatively low pressure area. The generator and condenser are the high pressure side while the evaporator and absorber are the low pressure side. Pressure in the high side is approximately ten times greater than the low side of 5 mm with the chiller operating at design conditions.

Figure 1
Typical Single-Stage Absorption Chiller



High Pressure Section Generator and Condenser

Steam or hot water moving through the generator tubes causes the lithium bromide solution to boil. The refrigerant, as water vapor, is liberated from the lithium bromide as it boils. Refrigerant vapor then passes through an eliminator section that separates the generator from the condenser. The eliminators remove droplets of lithium bromide from the vapor as it passes to the condenser. Water flowing through the condenser tubes cools the refrigerant vapor as it passes into the condenser. This causes the vapor to condense. The condensed refrigerant falls to the condenser pan and is directed into the evaporator section through several pipes which terminate at an orifice. As the condensed refrigerant passes through the orifice into the lower pressure evaporator section, a portion flashes to vapor, causing the temperature of the remaining liquid refrigerant to drop to evaporator saturation temperature.

Low Pressure Section Evaporator and Absorber

The relatively warm evaporator system water causes the refrigerant to vaporize at approximately 40F in the evaporator section. As the refrigerant changes state, heat is removed from the system water. The relatively lower pressure absorber section attracts the water vapor which is absorbed into an aqueous solution of lithium bromide.

Cooling water is circulated through the absorber tube bundle in order to remove the heat of dilution from the lithium bromide solution. The lithium bromide solution that is sprayed over the absorber tubes absorbs the refrigerant water vapor, and becomes diluted. Therefore, it is necessary to return the dilute solution to the generator to reclaim the refrigerant and to sustain the cycle.

Solution Heat Exchanger

The heat exchanger is very important to the overall efficiency of the absorption cycle.

The heat exchanger's function is to conserve heat within the absorption cycle. Dilute solution is pumped to the generator after passing through a heat exchanger. During operation, the heat exchanger transfers heat between the cool dilute lithium bromide solution from the absorber and the hot concentrated solution leaving the generator. Dilute solution passes through the tubes of the heat exchanger and the strong solution through the shell side around the tubes.

Heat Exchanger Bypass

A heat exchanger bypass tube connects the generator outlet directly to the absorber and serves to limit the solution level in the generator. This is done by bypassing solution directly back to the absorber if the normal return is restricted.

At start-up, the lithium bromide solution may be very dilute. Since the working pressure in the generator at this time is also low, the generator solution level may temporarily increase. Solution may then return through the bypass until the generator vapor pressure increase to stabilize solution flow.

In addition, should the lithium bromide crystallize in the return passages of the heat exchanger, the solution will return to the absorber through the bypass until the heat exchanger blockage is corrected.

During normal operation the bypass tube is sealed with lithium bromide to separate the generator section from the absorber.

Absorption Cycle

Figure 2 illustrates a full load absorption cycle. The temperatures and solution concentrations indicated are typical of a machine operating at 12 psig steam with 85F entering tower water and 44F leaving chilled water. This machine is designed to operate with entering absorber water temperature between 55F (part-load) and 85F. Figure 3 is the absorption cycle in Celsius.

Design evaporator load can be achieved down to 75F entering tower water. Below 75F, evaporator load is limited by the controls. The floating condenser water temperature makes it imperative that all controls are calibrated and synchronized to function with floating tower water temperature. The controls should be checked periodically by an authorized Trane service engineer to insure reliable machine operation. Normally, checking calibration twice a year is adequate.

Figure 2
Fluid Cycle Degrees F

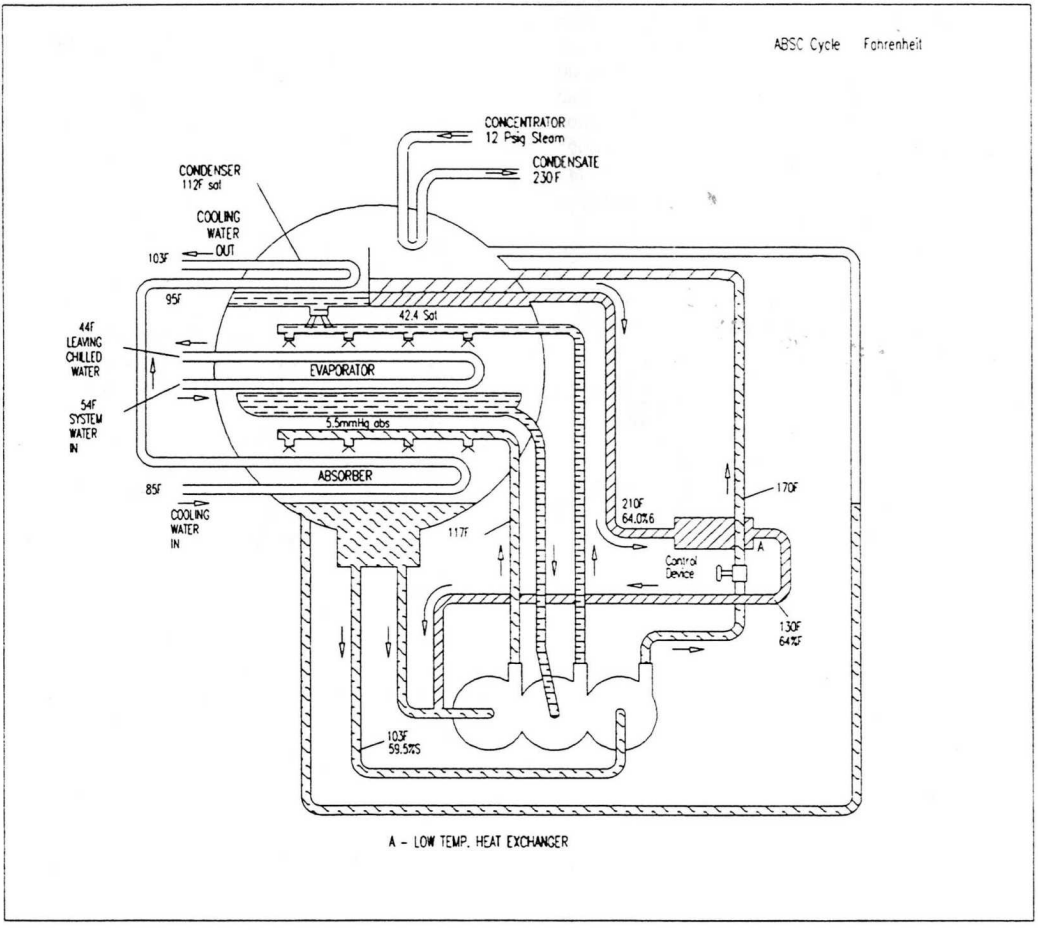


Figure 3
Fluid Cycle Degrees C