TRANE

LET'S GO BEYOND™

Ice Bank® Energy Storage

OPERATION & MAINTENANCE MANUAL

IB-SVX147C-EN
June 6, 2019

CALMAC®

Ingersoll Rand®

INTRODUCTION

For thermal energy storage to efficiently and effectively cool a building, it is important for the operators and maintenance personnel to understand the overall concept, not just the monthly routine. Therefore, we have started this manual with a brief overview of the technology and its application.

Air-conditioning can account for over 40% of average summer peak-day loads.* In the afternoon, as more air conditioning is needed to maintain comfortable temperatures, the increased demand for electricity adds to that already created by lighting, operating equipment, computers and thousands of other uses. This requires the utility to use additional, more costly generating sources to handle its increased demand. Commercial users, whose large air-conditioning loads contribute to these added generating requirements are normally assessed an additional charge based on their highest on-peak demand for electricity.

Thermal energy storage will not only significantly lower demand charges during the air-conditioning season but also can lower total energy usage as well. It uses a standard packaged chiller to produce solid ice at night during off-peak periods when the building's electrical needs are at a minimum and the utility's generating capacity is typically underutilized. The ice is built and stored in modular Ice Bank® energy storage tanks to provide cooling to help meet the building's air-conditioning load requirement the following day.

Product Description and Normal Operation

The Ice Bank tank is a modular, insulated polyethylene tank containing a spiral-wound plastic tube heat exchanger which is submerged in water. They are available in various sizes. At night, a solution typically 75% water and 25% ethylene glycol, circulates through a standard packaged air-conditioning chiller and the tubing in the tank heat exchanger, extracting heat until eventually almost all the water in the tank is frozen solid. The ice is built uniformly throughout the tank by the patented temperature-averaging effect of closely spaced counterflow heat exchanger tubes. (See Figure 1). Water does not become surrounded by ice during the freezing process and can move freely as ice forms, preventing stress or damage to the tank.

Flow diagrams for a Partial Storage system are shown in Figures 2 and 3. The temperatures shown are typical however, many other ranges are used.

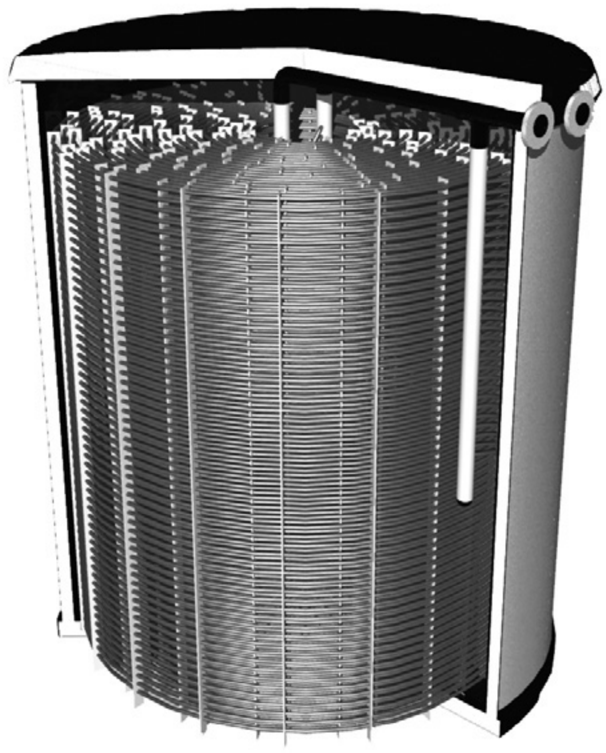

Figure 1. Counterflow heat exchanger tubes

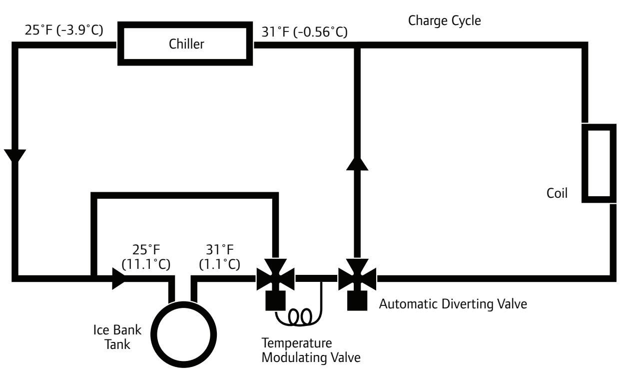

Figure 2. Charge cycle flow diagram

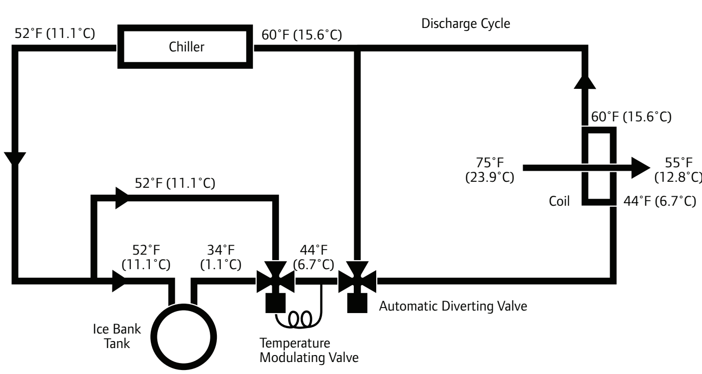

Figure 3. Discharge cycle flow diagram

* ACEEE 2008 Summer Study on Energy Efficiency in Buildings

In a standard installation, ice is made at night. The water-glycol solution circulates through the chiller and the Ice Bank® heat exchanger, bypassing the air handler coil. (See Figure 2). The fluid temperature is about 25ºF (-3.9ºC) and the water surrounding the heat exchanger freezes.

During the day, the glycol solution is cooled by the IceBank® tank from approximately 52ºF to 34ºF (11ºC to 1ºC). (See Figure 3). A temperature modulating valve is used to maintain a blended supply temperature typically 44ºF (6.7ºC) , by permitting sufficient 52ºF (11.1ºC) fluid to bypass the Ice Bank® tank and mix with the 34ºF (1.1ºC) fluid, to achieve the desired 44ºF (6.7ºC) temperature. The 44ºF (6.7ºC) fluid enters the coil, where it cools air ordinarily from 75ºF to 55ºF (24ºC to 13ºC). The fluid leaves the coil at 60ºF (15.6ºC), enters the chiller and is cooled to 52ºF (11.1ºC). In some systems, the ice will handle the entire day time load (Full Storage) and in others, the ice will help a smaller than full size chiller meet the load (Partial Storage).

MAINTENANCE

Since there are no moving parts in our standard thermal storage tanks, the list of maintenance items is short. The items we do list are important and should be done at regular intervals as indicated. The inspection port cover must always be replaced.

Water Level

The water level in the tank will rise and fall 2.5 to 7.8 inches (63 to 195mm) (depending on Model No. of tank) during the charge and discharge cycle. This change is due to the difference in the density of water and ice. Water expands approximately 9% when changing to ice at 32ºF (0ºC); therefore, during the freezing process, the level will rise. (More about this in later sections). The water stays in the tank (it is NOT pumped through the system) and the amount of water/ice in the tank remains constant except for possibly a slight amount of evaporation, which normally occurs in outdoor, very hot, dry climates.

The water level should be just covering the top heat exchanger tube, (which is 5/8" (16mm) diameter and translucent) except for Model 1220, which is filled to the bottom of the top HX tube. This measurement must be done with no ice in the tank. The water level should be checked every year except in hot, dry climates when every three months is recommended.

Inventory Meter Calibration

During operation the only time to accurately check that the the inventory meter probe level is correct is when the tank is 100% charged. (See Ice Inventory Meter Manual IB-153 for more information.)

Coolant Concentration

The coolant should be checked regularly in accordance with the manufacturer's recommendations. For ethylene glycol mixtures, after the initial start up periods, a sample should be sent once a year to the manufacturer for analysis. Checking the coolant's freeze point is recommended twice a year using a refractometer or hydrometer, and not an automotive float-type device. The maximum freezing point for our system is normally 12ºF (-11.1ºC) (25%EG/H2O); however, some jobs require lower freeze points because of particular operating conditions.

Storage Tank Water Treatment

Pour in the initial treatment of biocide into the tank water upon filling. Generally, if tanks are kept at least partially frozen year round, provide retreatment with biocide as needed. However, if tanks are not kept frozen year round, retreatment may be required more often and the tanks should be checked for slime or odor seasonally. At the end of the cooling season, you should fully charge the tanks and leave them frozen until the start of your next air-conditioning season. This will help to control biological growth. CALMAC® recommends a 20% Tetrakis hydroxymethyl phosphonium sulfate solution such as Aquacar PS20. All tank models require 16 oz. of biocide solution per tank.

The CAS number is 555-66-30-8

Minimum Shut Off Temperature

In most systems, the termination of the charge cycle is determined by the temperature of the coolant leaving the storage tanks. Typically this temperature is in the range of 27-28ºF (-2.7 to -2.2ºC). However, it is imperative that the actual temperature be calculated for each system using CALMAC Performance Data (IB-102).

This temperature is calculated by adding Coolant Temperature Rise to the minimum Charging Coolant Temperature. This temperature should be entered in the first line of the maintenance record, (see back page), and checked once every six months.

Ice Caps

The shut-off temperature, previously discussed, is very important. Setting the temperature lower than what is stated in the Performance Data can cause the water in the expansion area above the heat exchanger to freeze. It is important that this water does not freeze so that it is available to fill the voids created by the melting ice during discharge. Therefore, twice a year the tank should be checked for excessive ice-build-up above the top heat exchanger tube. Ice thicker than 1" is an early indication that the shut-off temperature is set too low.

Tanks include a patented design which incorporates a layer of insulation located just above the heat exchanger to reduce the likelihood of Ice Caps. Inspection should still be done twice a year and no ice should be seen above the insulation layer.

Warranty Repairs

Authorization for in-warranty field repair or replacement parts must be obtained in writing before any repairs are attempted.

A purchase order must be entered through the local CALMAC® representative for any possible warranty work or replacement parts.

After CALMAC inspection of the returned part, and if it is determined that the failure is due to our workmanship or material defect, a credit will be issued against the customer's purchase order.

MAINTENANCE RECORD

Date	Water Level Above top of tube w/no ice	Coolant Freeze Temp.	Coolant Analysis by Mfr.	Water Treatment (Biocide)	Shut-Off Temperature	Ice Cap Present
For example	1/4" (6mm)	12ºF (-11.1ºC)	Yes	Yes	28ºF (-2.2ºC)	No

To find out more about Ice Bank® energy storage visit calmac.com or trane.com/energystorage

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