Operation and Maintenance Manual

Ice Bank® Energy Storage

⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

August 2020 **IB-SVX147D-EN**

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.

NOTICE Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

⚠WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labeling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

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Trademarks

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Revision History

Updated for Trane Technologies.

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.[1] 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 significantly lower demand charges during the air-conditioning season but also can lower total energy usage as well. It uses a standard package 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.

Figure 1. Counterflow heat exchanger tubes

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, pre- venting stress or damage to the tank.

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

Figure 2. Charge cycle flow diagram

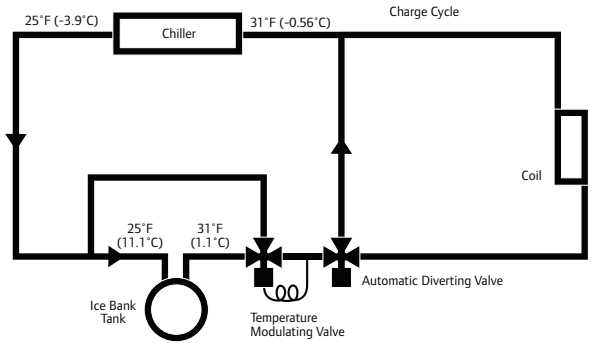
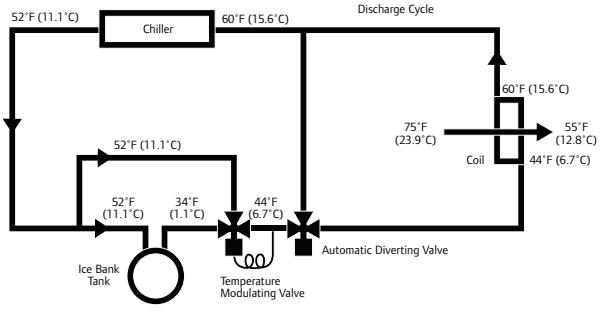


Figure 3. Discharge cycle flow diagram



[1] 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 25°F (-3.9°C) and the water surrounding the heat exchanger freezes.

During the day, the glycol solution is cooled by the Ice Bank® tank from approximately 52°F to 34°F (11°C to 1°C). (See Figure 3). A temperature modulating valve is used to maintain a blended supply temperature typically 44°F (6.7°C), by permitting sufficient 52°F (11.1°C) fluid to bypass the Ice bank® tank and mix with the 34°F (1.1°C) fluid, to achieve the desired 44°F (6.7°C) temperature. The 44°F (6.7°C) fluid enters the coil, where it cools air ordinarily from 75°F to 55°F (24°C to 13°C). The fluid leaves the coil at 60°F (15.6°C), enters the chiller and is cooled to 52°F (11.1°C). 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 difference in the density of water and ice. Water expands approximately 9% when changing to ice at 32°F (0°C); 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 inch (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 12°F (-11.1°C) (25%EG/H_2O); 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 27-28°F (-2.7 to -2.2°C). 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 Table 1), 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 inch 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.

Table 1. 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 inch (6mm)	12°F (-11.1°C)	Yes	Yes	28°F (-2.2 °C)	No

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

Trane - by Trane Technologies (NYSE: TT), a global climate innovator - creates comfortable, energy efficient indoor environments for commercial and residential applications. For more information, please visit trane.com or tranetechnologies.com.

IB-SVX147D-EN 07 Aug 2020
Supersedes IB-SVX147C-EN (Jun 2019)