OPERATING AND MAINTENANCE INSTRUCTIONS

TSU-C/D for External Melt ICE CHILLER®Thermal Storage Unit
TSC-C/D for External Melt ICE CHILLER®Thermal Storage Coil only

Baltimore Aircoil Company's ICE CHILLER® Thermal Storage Units and Thermal Storage Coils have been developed for long, trouble-free service when installed, operated and maintained properly. To ensure optimal performance and maximum equipment life for your ICE CHILLER® Thermal Storage Unit, it is important that a regular inspection/maintenance program be developed and implemented. This manual is provided as a guide to unit operation and establishing an effective maintenance program for external melt systems.

Included in the manual are start-up and shutdown procedures, maintenance procedures and a schedule of maintenance items and their recommended frequency for the ICE CHILLER® Thermal Storage Unit and its related components. An illustration of the Thermal Storage Unit, with its major components identified, is provided on page 2. All inspections, maintenance and monitoring actions should be recorded in a cooling system logbook.

As part of your maintenance record, it is advisable to have a copy of the unit's certified drawing available for reference during inspection and maintenance. If you do not have a copy of this drawing, or need further information about the unit, contact your local BAC Service provider. You can find name, e-mail and phone number on the website www.BACService.eu.

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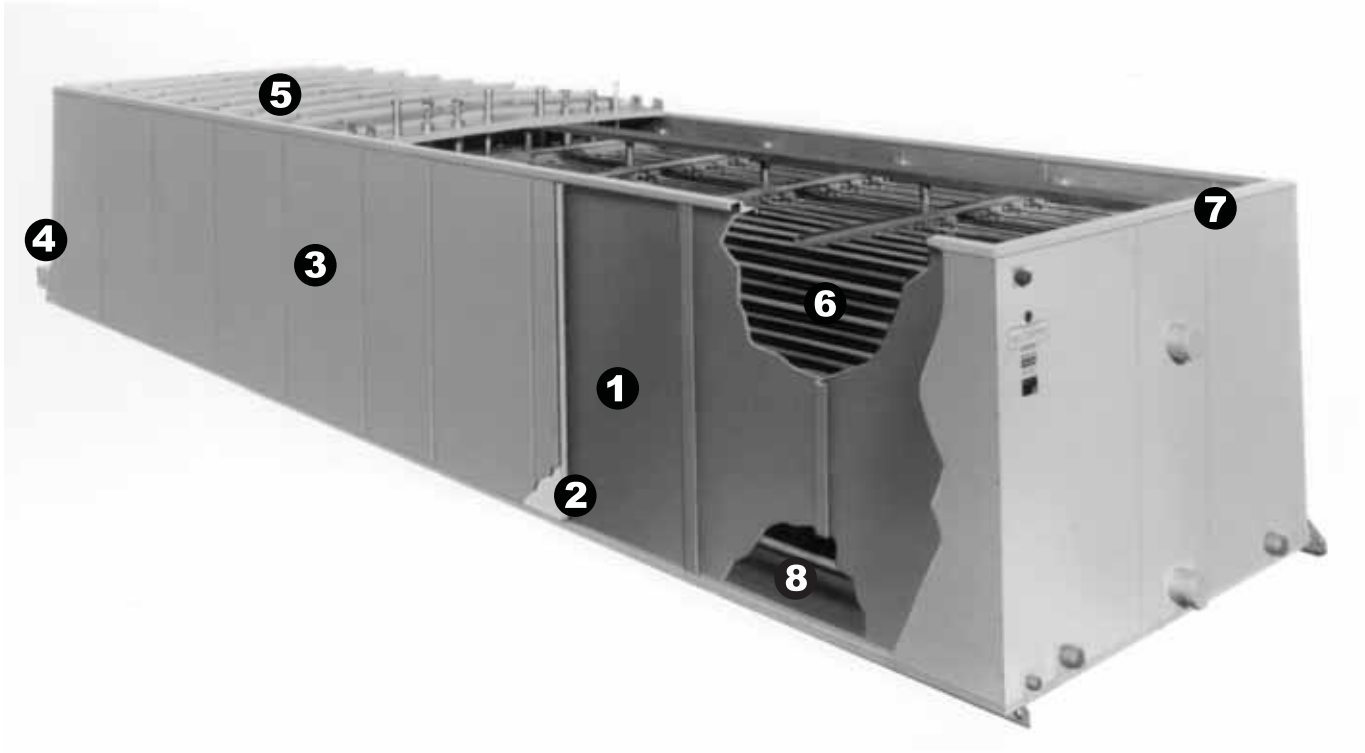
TSU-C/D ICE CHILLER®

EXTERNAL MELT APPLICATION



1. Tank
2. Insulation
3. Exterior Panels
4. Air Pump
5. Covers
6. Galvanised Steel Coil
7. ICE LOGIC™ Ice Thickness Controller (Not Shown)
8. Air Distribution

Operating Conditions

BAC cooling equipment is designed for the operating conditions specified below, which must not be exceeded during operation.
Wind Load: For safe operation of unshielded equipment exposed to wind speeds above 120 km/h installed at a height above 30 m from the ground contact your local BAC-Balticare representative.
Seismic Risk: For safe operation of equipment installed in moderate and high hazard area's contact your local BAC Balticare representative.

ICE THERMAL STORAGE UNIT (TSU-C/D)

1. For units designed to work with direct refrigerants:
   - Acceptable Refrigerants: R-717 (ammonia)
   - Coil design pressure: max. 22 bar
   - Max. temperature of refrigerant in coil(s): +50°C.
   - Min. temperature of refrigerant in coil(s): -20°C.
2. For units designed to work with secondary coolants:
   - Fluid Compatibility: Fluids circulated through the coil(s) must be compatible with the coil construction material. Standard coils are constructed of black steel.
   - Coil design pressure: max. 10 bar
   - Max. temperature of fluid: +50°C
   - Min. temperature of fluid: -20°C

PURGE REQUIREMENTS

The installer of BAC equipment must ensure proper system purging of air prior to operation. Entrained air can obstruct the proper flow of glycol solution, resulting in higher operating pressures than design and reduced thermal storage capacity.

Connecting Pipework

All connections in the external pipework (installed by others) must be leak free and tested accordingly. All piping external to BAC cooling equipment must be supported separately.

Safety Precautions

All electrical, mechanical and rotating machinery constitute a potential hazard, particularly for those not familiar with its design, construction and operation. Accordingly, adequate safeguards (including use of protective enclosures where necessary) should be taken with this equipment both to safeguard the public (including minors) from injury and to prevent damage to the equipment, its associated system and the premises.
If there is doubt about safe and proper rigging, installation, operation or maintenance procedures, contact the equipment manufacturer or his representative for advise.
When working on operating equipment, be aware that some parts may have an elevated temperature. Any operations on elevated level have to be executed with extra care to prevent accidents.
Air piping between air pump and TSU/TSC can have temperatures above 40°C. Insulate the piping if necessary to prevent personal injury.

AUTHORIZED PERSONNEL

The operation, maintenance and repair of this equipment should be undertaken only by personnel authorized and qualified to do so. All such personnel should be thoroughly familiar with the equipment, the associated systems and controls and the procedures set forth in this and other relevant manuals. Proper care, procedures and tools must be used in handling, lifting, installing, operating and repairing this equipment to prevent personal injury and/or property damage.

MECHANICAL SAFETY

Mechanical safety of the equipment is in accordance with the requirements of the EU machinery directive. Depending upon site conditions it also may be necessary to install items such as screens, ladders, safety cages, stairways, access platforms, handrails and toe boards for the safety and convenience of the authorized service and maintenance personnel. At no time this equipment should be operated without all, access cover panels and access doors in place. For more information consult your local BAC Balticare representative.

ELECTRICAL SAFETY

Each motor associated with this equipment should be installed with a lockable disconnect switch located within the sight of the equipment. No service work should be performed on or near the motors or inside the equipment unless motors are electrically isolated.

LOCAL REGULATIONS

Installation and operation of cooling equipment may be subject of local regulations, such as establishment of risk analysis. Ensure regulatory requirements are consistently met.

Start-Up and Shutdown Procedures

START-UP PROCEDURE

Before initial start-up or after prolonged shutdown, the BAC ICE CHILLER® Thermal Storage Units should be thoroughly inspected and cleaned:

1. Clean all debris from the interior of the tank.
2. Flush the ICE CHILLER® tank with water, then drain to remove any accumulated dirt.
3. Visually inspect the air pump for damage.
4. Connect the motor using a thermal overload motor starter.
5. Start the air pump and check for correct rotation. Also check for any unusual noise or vibration.
6. Check the voltage and current of the air blower. The current should not exceed the nameplate rating.
7. Inspect the PVC air distribution piping for cracks or other signs of damage.
8. Check the ICE LOGIC™ ice thickness control to be sure it is securely mounted and has not been damaged. Check control wiring for proper connections.
9. Caulk around the base of the tank (caulk is provided with the unit).
10. Inspect and leak test all the components and piping of the refrigerant and/or secondary coolant system.
11. Fill the ice tank with good quality water (see section Water Care on page 8) to a height of at least 25 mm above the coil. Start the water circulation pumps and check the water level again. Add water until it is at least 25 mm above the coil, which is the appropriate level when there is no ice in the tank.

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Do not overfill!
Overflowing the tank may damage the insulation and/or cause the operating controls to malfunction.

12. If using a secondary coolant, charge the system with the proper industrial grade inhibited glycol solution (see section Protection against Coil Freezing on page 9) and ensure all air is purged from the system. Do not attempt to mix the glycol solution in the ICE CHILLER® unit coil.
13. If using refrigerant, evacuate the system and charge with the specified refrigerant.

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Do not close both inlet (liquid supply) and outlet (wet return) valves on the ICE CHILLER® Coils without the use of a by-pass relief around the valves. This will prevent an excess build-up of pressure in the coils as a result of expansion of the refrigerant as the coils warm up.

14. Inspect the BALTIBOND® Corrosion Protection System finish on the unit.
15. If the unit will be subjected to subfreezing ambient conditions, heat tape the drain and drain ball valve to prevent cracking.

AFTER 24 HOURS

After 24 hours of operational load, proceed as follows:

1. Check the air pump for any unusual noise or vibration.
2. Examine ice build along the tubes for even thickness and distribution after the ice build is complete. If ice build along the coil is significantly uneven, adjust glycol or refrigerant flow through each coil.

Note: At full ice build, the ice layer on the tubes will be slightly conical, particularly for glycol feed systems.

3. Check the water level and adjust if required.

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Do not overfill!
Overflowing the tank may damage the insulation and/or cause the operating controls to malfunction.

4. Adjust water distribution using balancing valves on each water inlet connection (valves to be provided by others):
   - Start with the valves on the two outermost inlets closed so all warm water is guided through the central water inlet connection.
   - Run the unit for a few cycles of ice build/melt.
   - Determine areas of ice bridging (if any).
   - If bridging occurs in certain areas, open the appropriate valves to direct more water flow to the areas of bridging. The central inlet brings warm water to the opposite of the tank, while the outermost (smaller) inlets bring warm water to the near end of the tank.
   - Readjust the valves if necessary after a few cycles, until a quite uniform melt-out ice shape is obtained. The final position of the valves depends strongly on the water flow rate and the load profile.

(SEASONAL) SHUT-DOWN PROCEDURE

The following procedures should be performed when the ICE CHILLER® Thermal Storage Unit is to be shutdown for an extended period of time.

1. If using direct refrigerant, pump out the ICE CHILLER® Thermal Storage Coils and store the refrigerant in the high pressure receiver.
2. Allow any ice present on the tubes of the ICE CHILLER® Coils to melt. If the tank is located outdoors or in an unheated area and there is a possibility of the water in the tank freezing, drain the tank and all exposed water piping. If freezing is not a problem, the tank does not need to be drained and full melt out is not necessary.
3. If the tank is drained, leave the drain connection open to allow any water that might enter the tank to drain out.
4. Properly position the insulated tank covers to minimize dirt and debris accumulation within the tank.

Daily Operating Guidelines

The ICE CHILLER® Thermal Storage Coils typically run in either an Ice Build or Ice Melt mode of operation. On external melt applications, the BAC ICE LOGIC™ ice thickness controller is provided to control compressor/glycol chiller operation as a function of ice thickness. The basic sequence of operation and control points for each of these modes is described below. Each system design is unique and variations in the operating modes may occur. If you have any questions about application of the operating sequences listed below, please contact your BAC Balticare representative to review your specific application.

Since the ICE LOGIC™ ice quantity controller can only measure the ice thickness at the point where the sensors are installed, it is necessary to regularly inspect if the ice is built evenly on all the ice coils. During ice melt-out, it is typical to see some non-uniformity of the ice pattern. The ice pattern can be considered normal when no significant horizontal bridging (blockage) is apparent in the unit at the end of the ice build cycle and when low leaving temperatures are obtained.

ICE BUILD - DIRECT REFRIGERANT FEED

1. Begin the ice build cycle upon receiving a signal from the plant control system. Usually, this signal is triggered by a time clock indicating the start of the available ice build time.
2. Turn on the air agitation blower(s) feeding the ice storage tank.

3. On coils fed by pump recirculation, open the wet suction return valves, then any liquid feed valves installed at the ICE CHILLER® Coils.
4. Turn on the compressors and refrigerant feed system.
5. After the first three hours of ice build, it is suitable to turn off the air agitation blower(s).
6. In response to a signal from the plant control system, stop the ice build cycle. The signal to end the ice build cycle can come from a number of sources. Typical examples follow:
   - The ice thickness control

Note: The ice thickness control is a safety control and must override all other controls to prevent damage to the coils.

   - A control system time clock.
7. Close the refrigerant feed valves, then close the refrigerant suction or wet return valves.
8. Turn off the refrigeration system.
9. The ICE CHILLER® Coils are now charged and available to provide cooling.

ICE BUILD - SECONDARY COOLANTS

1. Begin the ice build cycle upon receiving a signal from the plant control system. Usually, this signal is triggered by a time clock indicating the start of the available ice build time.
2. Open any glycol inlet and outlet valves installed at the ICE CHILLER® Unit Coils.

Note: If both inlet and outlet glycol valves are used on the ICE CHILLER® Coils, the design must allow for a bypass relief around the valves. This will prevent an excess build-up of pressure in the coils as a result of the expansion as glycol in the coils warms up.

3. Turn on the glycol circulating pump(s) to establish flow between the glycol chiller(s) and the ICE CHILLER® Unit.
4. Turn on the air agitation blower(s) feeding the ice storage tank.
5. Once glycol flow has been established, turn on the glycol chiller(s). Follow the chiller manufacturer's start-up procedures and safeties.
6. After the first three hours of ice build, it is suitable to turn off the air agitation blower(s).
7. In response to a signal from the plant control system, stop the ice build cycle. The signal to end the ice build cycle can come from a number of sources. Typical examples follow:
   - The ice thickness control

Note: The ice thickness control is a safety control and must override all other controls to prevent damage to the coils.

   - A control system time clock.
   - A kW counter that indicates a stored input equal to the preceding day's melted output.
8. Turn off the glycol chiller(s) and glycol pump(s) and close the inlet valves to the ICE CHILLER® Coils.

Note: If both inlet and outlet glycol valves are used on the ICE CHILLER® Coils, the design must allow for a bypass relief around the valves. This will prevent an excess build-up of pressure in the coils as a result of the expansion as glycol in the coils warms up.

9. The ICE CHILLER® Coils are now charged and available to provide cooling.

ICE MELT

1. Begin the ice melt cycle upon receiving a signal from the plant control system. Usually, this signal is triggered by a cooling load to be handled by the stored ice.
2. Open any chilled water inlet and outlet valves installed at the ice storage tank.
3. Turn on the air agitation blower(s) feeding the ice storage tank.
4. Turn on the circulating chilled water pump(s) to establish flow between the ice storage tank and the cooling load.
5. Upon receiving a signal from the plant control system to stop the ice melt cycle, turn off the chilled water pump(s) and the air agitation blower(s), and close the chilled water inlet and outlet valves to ice storage tank.
6. The signal to end the melt cycle can come from a number of sources. Typical examples follow:
   - A time clock.
   - A signal that the cooling load has been satisfied.
   - A kW counter that indicates the maximum cooling for the day has been drawn from the storage tank.
7. The ICE CHILLER® Coils are now ready to be recharged following the Ice Build procedures above.

Note: Full melt-out after every cycle results in minimum energy consumption.

When the required melt performance cannot be obtained due to significant horizontal ice bridging, melt the ice completely during the next cycle. Full melt-out can be detected by 0% ice display on the ICE LOGIC™ Ice Thickness Controller combined with a rapidly increasing water leaving temperature.

To minimize the possibility for ice bridging, operating according to the following guidelines:

- Limit the cooling load through the TSU-C/D during ice build to less than 15% of the installed compressor capacity.
- Maintain a constant high water flow on the TSU-C/D during melt-out. The corresponding temperature difference between entering and leaving water should be kept as low as possible to minimize conical melt-out pattern (10°C maximum).
- Try to melt out the TSU-C/D completely at the end of each cooling cycle by limiting the amount of ice build to the expected cooling load. For multiple TSU-C/D installations, a melt-out in sequence assures at least one full melt-out at regular intervals. Full melt can be detected by 0% ice display on the ICE LOGIC™ Ice Thickness Controller combined with a rapidly increasing leaving water temperature.
- To increase control flexibility, use 1 additional ICE LOGIC™ Ice Quantity Controller on a 4 coil unit (available as an option).

ICE LOGIC® Ice Quantity Controller

The ice quantity in the ICE CHILLER® Unit will be measured by means of a sensor measuring the ice thickness. The measurement is done in steps of 20%: 0, 20, 40, 60, 80 and 100% of the **nominal ice storage capacity** of the ICE CHILLER® unit.

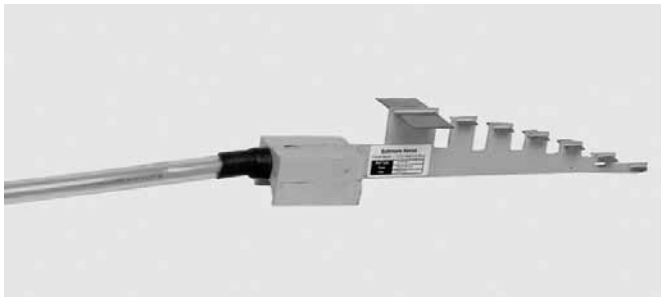
Figure 1: ICE LOGIC TM

The control panel at the connection end of the unit has following features:

- A maximum ice quantity setting knob to select the maximum required ice quantity.
- A minimum ice quantity setting knob to select the minimum ice quantity before the chiller should start again.
- An override switch to start/stop cooling machine.
- Ice quantity indication LED's to show ice quantity available.

Other control devices such as time clocks and water temperature sensors must be provided by others.

ICE LOGIC TM SENSOR

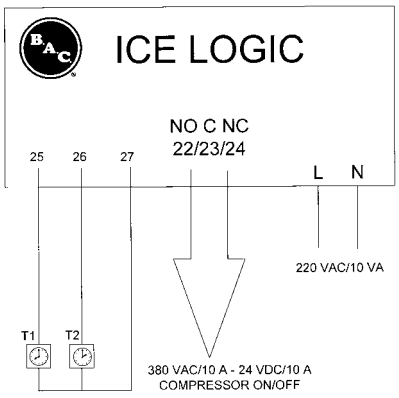


A series of accurately positioned electrodes detect the ice thickness on the coil tube. The measurement is based on the difference in electrical conductivity between ice and water. The ICE LOGIC^{TM} ice quantity controller combined with this sensor permits to limit the maximum ice thickness to typically 35 mm.

ICE LOGIC TM CONTROL PANEL

The ICE LOGIC^{TM} ice quantity controller can be operated either manually, by remote control using the 6 NO contacts, or by using an analog output signal of 4-20 mA (available as an option).

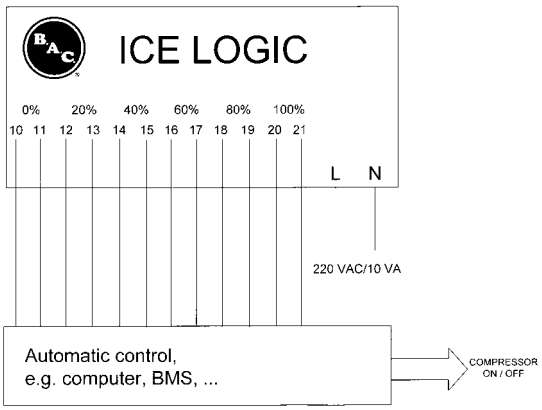
Manual Control



The required ice quantity for the next cooling cycle can easily be set from the control panel in steps of 20%. In addition, the minimum ice quantity, before the cooling equipment should start again, can be set from the minimum % ice knob. If a minimum of 0% is selected, the compressor will not be allowed to start before all ice is melted. Use contact 22/23 NO or 23/24 NC to start or stop the compressor as a function of predetermined minimum and maximum ice quantity.

An additional switch on the control panel allows to force a compressor start or stop, when actual ice quantity is between preset minimum and maximum level. Instead of using the switch, the contacts 25/26/27 can be used. A short circuit of 1 sec. between 25/27 makes the compressor start, a short circuit between 26/27 makes the compressor stop.

Remote Control via PLC or Computer

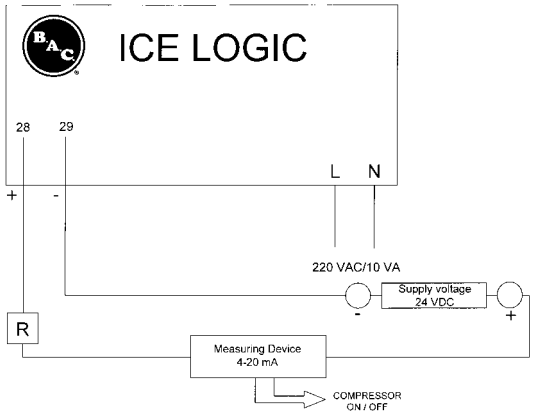


The ICE LOGIC^{TM} ice quantity controller has six output contacts (NO) which can be used to control the cooling equipment. These contacts are normally open and will close when the desired ice quantity is reached.

- contact 10-11 closes at 0% ice and more
- contact 12-13 closes at 20% ice and more
- contact 14-15 closes at 40% ice and more
- contact 16-17 closes at 60% ice and more
- contact 18-19 closes at 80% ice and more
- contact 20-21 closes at 100% ice

Contacts open again when the % ice is below the corresponding level.

Remote Control with 4-20 mA Output Signal (Option)



Instead of 6 output signals for remote control, an analog output signal of 4-20 mA can be generated using contacts 28/29. The customer must provide a 24 VDC supply voltage with a loop resistance of max. 600 Ohms (see R). In that case contacts 10 to 21 are no longer available. Contact 28 should be connected to the positive, 29 to the negative signal of the supply voltage.

The analog signal can have only 7 different values:

4 mA	no ice
4.5 mA	0-20 % ice
7.2 mA	20-40 % ice
10.4 mA	40-60 % ice
13.6 mA	60-80 % ice
16.8 mA	80-100 % ice
20 mA	100 % ice

There will be no intermediate mA output as measurement is based on a 6 step measurement only.

ELECTRICAL SPECIFICATION

Control panel: IP55 execution

Supply voltage: 230 VAC (220/240 VAC)/10 VA, max. cable section 2.5 mm2.

Output contacts:

1. to automatic control system:
   - 6 NO contacts close if corresponding ice quantity is reached (0, 20, 40, 60, 80, 100%)
   - 110 VAC/0.5 A or 24 VDC/1 A, max. cable section 1.5 mm².
2. for manual compressor/chiller control:
   - NO/NC contact closes/opens if compressor or chiller operation is required.
   - 380 VAC/10 A or 24 VDC/10 A, max. cable section 2.5 mm².

About Water Care

In the near freezing temperatures of the ICE CHILLER® Thermal Storage Unit, scale and corrosion are naturally minimized. Therefore, for the tank water side of the units, a water treatment program to prevent scale or corrosion is not normally needed, unless the water is corrosive in nature. To control biological growth, a biocide may be needed on a periodic basis to prevent the growth of corrosive bacteria. In general, BAC recommends the following guidelines. (See Table below).

	Recommended Tank Water Quality
pH	7.0 to 9.0 *
Hardness (as $CaCO_3$)	90 to 500 mg/l
Alkalinity (as $CaCO_3$)	500 mg/l max.
Total Dissolved Solids	1000 mg/l max.
Chlorides	125 mg/l max.
Sulfates	125 mg/l max.
Conductivity	100-700 µS/cm

Table 1: Water Quality Guidelines

* Tank water pH of 8.2 or higher will require periodic passivation of the galvanized steel coils to prevent "white rust", the accumulation of white, waxy, non-protective zinc corrosion products on galvanized steel surfaces.

Note: Minimum conductivity of 100 µS/cm and minimum of 700 µS/cm (at 0°C) is important for proper operation of the ICE LOGIC™ ice quantity controller.

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DO NOT TREAT THE TANK WATER WITH CHEMICALS THAT ALTER THE FREEZE POINT OF WATER

Passivation

When new systems are first commissioned, special measures should be taken to ensure that galvanized steel surfaces are properly passivated to provide maximum protection from corrosion. PASSIVATION is the formation of a protective, passive, oxide layer on galvanized steel surfaces. To ensure that galvanized steel surfaces are passivated, for the first 6-8 weeks of operation, the pH of the tank water should be maintained between 7.0 and 8.2 and calcium hardness maintained between 100 and 300 mg/l (as $CaCO_3$). The passivation is complete and effective when the new zinc surfaces turn dull grey in colour. If white deposits form on galvanized steel surfaces after the pH is returned to normal, this is a sign of white rust, and therefore, the passivation process should be repeated to insure proper passivation and maximum corrosion resistance.
In case that your water quality does not allow the pH to remain below 8.2, then you should consult a water treatment specialist for advice on pH reduction or special passivation agents to promote proper passivation.

Special Water Treatment Considerations

ICE TANK WATER

- Since ice tanks can be on and off during the course of the year, it is possible for microbiological growth to develop. Therefore, the best practice hygiene recommendation is for a dosage of non-oxidizing biocide once/year. If the unit is an external melt, the biocide should be added after the unit is brought down for cleaning and during the refill process, to insure proper mixing
- Following passivation, if the tank water is corrosive in nature (low hardness, low pH or alkalinity), the addition of a corrosion 'non-precipitating' corrosion inhibitor is recommended. Examples of 'non-precipitating' corrosion inhibitors are nitrites, molybdates and silicate based blends. Care must be taken not to use corrosion inhibitors that raise the conductivity > 700 us/cm, or alter the freezing point of the water. Therefore, such decisions need to be taken with the advice of a water treatment specialist. For example, if the ice water needs food grade approval because it could contaminant food products, then the silica based treatment programme is normally used, if it meets food grade regulations.

GLYCOL SIDE OF THE ICE COIL

- Only use "inhibited" glycol that contains pH buffers. Never use industrial grade ethylene glycol. The reason for this recommendation is that over time, glycol degrades and produces "glycolic acid" as a result. These acids reduce the pH of the circulating water, and this will cause corrosion of steel materials of construction.
- As an added protection, the glycol loop should be treated with a nitrite, molybdate or silicate-based corrosion inhibitor to promote metal passivation, and provide additional alkalinity to raise the pH above 9.0. Always consult a water treatment specialist for recommendations on which corrosion inhibitor is most effective for your specific water quality

About Cold Weather Operation

BAC equipment can be operated in subfreezing ambient conditions provided the proper measures are taken :

1. Insulation of piping.
2. Protection against coil freezing.
3. Elimination of ice due to sub-freezing ambient.

Listed below are general guidelines which should be followed to minimize the possibility of freeze-up. As these guidelines may not include all aspects of the anticipated operation scheme, system designer and operator must thoroughly review the system, location of the equipment, controls and accessories to ensure reliable operation at all times.

Insulation of Piping

Precautions must be taken to protect the associated piping from freezing conditions. Heat tracing and insulation should be installed on all piping connected to the unit to prevent cracking.

Protection Against Coil Freezing

TSU Ice Thermal Storage coil(s) must be protected from damage by freezing of the fluid inside the coil(s) when in operation. Freeze protection must be obtained by the use of ethylene or propylene glycol or other anti-freeze solutions in appropriate concentrations.
TSU Ice Thermal Storage units typically use a 30% (by weight) solution of industrially inhibited ethylene glycol for both corrosion and freeze protection. The systems lowest operating temperature should be at least 3°C to 4°C above the anti-freeze solution freeze point. Uninhibited ethylene glycol and automotive antifreeze solutions are NOT to be used in TSU Ice Thermal Storage coil(s).

% Ethylene	Freeze Protection
20%	-10°C
30%	-16°C
40%	-25°C
50%	-39°C

Table 2: Freeze Protection of Ethylene Glycol Solutions

Ice due to Sub-Freezing Ambients

ICE CHILLER® tanks that have been exposed to severe or sustained subfreezing ambient temperatures, should be checked before initiating an ice build cycle. Ice created by subfreezing ambient temperatures which accumulates at the top of the tank and around the walls must be melted out before initiating a build cycle. This ice can prevent normal water displacement during the build cycle, possibly leading to physical damage to the coil and tank walls.

Inspections and Corrective Actions

GENERAL CONDITION OF THE EQUIPMENT

The inspection should focus on following areas:

- damage of corrosion protection
- signs of scale formation or corrosion
- accumulation of dirt and debris
- presence of biofilms

Smaller damages of the corrosion protection can be repaired. For BALTIBOND® protection use kit (part number RK1057). Larger damages should be reported to the local BAC Balticare representative.

If there is evidence of scale formation or corrosion, the water quality must be checked and adjusted.

Any dirt and debris need be removed following the_CLEANING PROCEDURES described in this manual (See page 11).

If there is evidence of biofilms, the system, including piping, should be drained, flushed and cleaned of slimes and other organic contamination. Refill system with water and apply biocide shock treatment. Check pH value and functionality of ongoing biocide treatment.

ICE CHILLER® TANK

All ICE CHILLER® Thermal Storage Units are provided with sectional insulated tank covers, which, when kept in place, will minimize the accumulation of trash or debris in the tank. However, an ICE CHILLER® unit installed outdoors may be susceptible to dust infiltration. Therefore, it is necessary to inspect the tank regularly to determine whether or not it needs to be cleaned. To clean the tank, drain it and flush with fresh water.

ICE CHILLER® WATER LEVEL

On a monthly basis and at seasonal start-up, inspect the water level in the ICE CHILLER® tank. To properly check the water level in the tank, the **ice must be completely melted.**

The water level in the ICE CHILLER® tank should be maintained 25 mm above the height of the coil (no ice on coil). As ice is built on the ICE CHILLER® coil, the level of the water in the tank will rise slightly. Therefore, the level of water should be observed at its lowest point, **when there is no ice on the coil**. If the tank level drops to less than 25 mm above the height of the coil, use the make-up connection provided (see certified print) to bring the water level in the tank up to the recommended operating level.

COIL

The coil should be observed when there is no ice on the coil.

1. Inspect the coil for
   - obstructions
   - damages
   - corrosion
   - fouling
2. Remove any obstructions from the coil

Any damages or corroded areas need to be repaired. Call your local BAC representative for assistance.

Minor fouling can usually be removed chemically or by temporary changes to the water treatment programme. Contact your water treatment supplier for advice. Major fouling requires cleaning and flushing according to the CLEANING PROCEDURES (See page 11).

Regular checking of the total aerobic bacteria count (TAB) and maintaining it within acceptable levels are the key to prevent fouling.

ICE LOGIC TM ICE QUANTITY CONTROLLER

1. Check monthly the control sensors for any visual signs of damage.
2. Check annually the conductivity of the tank water. A conductivity of less than 700 µS/cm must be maintained to assure proper operation of the BAC ICE LOGIC™ ice quantity controller.

Note: Steps should be taken to prevent the tank water from contamination by greasy substances which could lead to malfunctioning of the ICE LOGIC™ ice quantity controller. If this contamination occurs, tank and sensors must be cleaned after full drainage.

AIR PUMP

The air pump assembly is designed to provide air to the ICE CHILLER® Thermal Storage Unit for tank water agitation. The air pump should run as a minimum during the first 3 hours of ice build to ensure a homogenous water temperature in the tank. For applications with limited cooling requirements during the ice build (< 15% of installed compressor capacity), the air pump must run continuously during the ice build. To ensure high melt out rates, continuous air pump operation during melt off is required.

The air blown in the ICE CHILLER® Unit will entrain in the water piping and can accumulate in the upper part if the outlet piping is located above the operating water level. In these installations an air vent must be provided at the highest point of the piping.

The air pump is designed to require little maintenance, but some guidelines should be followed to assure trouble-free operation.

1. Do not run the blower with air supply line closed or low flow condition. This will cause a temperature rise in the blower casing. Allow adequate space around the air pump for unobstructed flow of air.
2. Check and clean the air filter once a month and change the filter every 3000 operating hours or at least every year.
3. The air pump bearings are permanently greased and sealed and require no maintenance.

GLYCOL

Every six months, or at the seasonal start-up, draw a sample of the glycol solution from the system and check the concentration using a refractometer. If necessary, adjust the concentration using the proper type of industrially inhibited glycol.

REFRIGERANT

Every 6 months, or as necessary, purge refrigerant oil from the coil, using the purge connections provided (see certified print).

AIR DISTRIBUTION PIPING

Inspect the PVC air distribution piping for cracks or other signs of damage at initial and seasonal start-up.

Cleaning Procedures

MECHANICAL CLEANING

Keeping your thermal storage equipment clean will maintain its efficiency and help to prevent uncontrolled bacteriological growth. The recommended annually cleaning procedures are described below :

1. Remove the insulated tank covers.
2. Drain the tank.
3. Clean any debris from tank.
4. Flush the tank with clean water and drain to remove accumulated dirt.
5. Close drain. (For seasonal shut-down leave the drain connection open to allow any water that might enter the tank to drain out.)
6. Fill the tank with clean water (see operating instructions)
7. Properly position the insulated tank covers to minimize dirt and debris accumulation within the tank.

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Clean the air filter once a month.

DISINFECTION

Disinfection of your cooling system may be needed in case of high concentration of aerobic bacteria and/or Legionella. Disinfection is also recommended for evaporative cooling systems with known or suspected high bacteriological levels, prior to a cleaning procedure.
Some local or national guidance also recommends disinfection prior to initial start up, after a prolonged shut down, after routine cleaning operations or when significant alterations have been made to the cooling system.
Disinfection must be carried out in accordance with a proper procedure and take into account the safety of the cleaning and disinfection staff.
Typically disinfection is achieved using a sodium hyperchloride solution to maintain a residual value of 5 - 15 mg/l of free chlorine and circulate this around the system for up to 6 hours. Higher chlorine levels for a shorter period are possible, but require a higher level of corrosion protection than galvanized steel only. Consult your BAC Balticare representative for further information.
Excessive levels of chlorine must be avoided as this quickly can lead to corrosion and damage to your system.
Chlorinated water should be de-chlorinated before draining and after disinfection the system must be thoroughly flushed through with clean water.

Note: A proper regularly monitored biocide programme reduces the need for cleaning and disinfection actions significantly.

About Comprehensive Maintenance

In order to ensure maximum efficiency and minimum downtime of your ice storage equipment, it is recommended to establish and execute a programme of preventive maintenance. Your local BAC Balticare representative will assist you in establishing and implementing such programme. The preventive maintenance programme must not only avoid that excessive downtime occurs under unforeseen and unwanted conditions, but also ensures that factory authorized replacement parts are used, which are designed to fit and for their purpose carry the full factory warranty.
To order factory authorized parts, contact your local BAC Balticare representative. Be sure you include the unit serial number when ordering any parts.

Prolonged Outdoor Stay

Should the unit(s) be stored outside prior to installation and/or start-up for approximately one month or longer, or stored in severe climates, it is imperative that certain actions be performed by the installing contractor in order to maintain the unit in “as shipped” condition.

- Check tank. Ice created by subfreezing ambient temperatures, which accumulates at the top of the tank and around the walls must be melted out before initiating a build cycle. This ice can prevent normal water displacement during the build cycle, possibly leading to physical damage to the coil and tank walls. The water temperature in the tank should be raised to 5°C to ensure that all ice is melted.
- Hot dipped galvanised ammonia coil products for Ice Chillers are filled with a low pressure inert gas at the factory before shipping to ensure an optimal internal corrosion protection during transport or prolonged storage. It is recommended to check the overpressure every six months (connect a manometer to the valve).

For complete instructions, please contact your local BAC-Balticare Representative

Balticare

BAC has established a specialized independent total care company called Balticare . The BAC Balticare offering involves all elements required to ensure a safe and efficient operation of your evaporative cooling products. From a full range of risk assessment to selective water treatment, training, testing, record keeping and annual system overview. For more details, contact BAC Balticare at www.balticare.com or you can also contact your local BAC representative for further information and specific assistance at www.BaltimoreAircoil.eu.

More Information

INTERESTING WEB SITES

www.BaltimoreAircoil.eu;
www.Balticare.com;
www.eurovent-certification.com;
www.ewgli.org;
www.ashrae.org;
www.uniclima.org;
www.aicvf.org;
www.hse.gov.uk

NOTES

Schedule

Type of Action	Action	Start-Up	Monthly	Every Six Months	Annually	Shutdown
Inspections and Monitoring	General condition	X	X			
	ICE CHILLER® Tank	X			X	
	ICE CHILLER® Water (1) - Quality - Level	 X X		 X X		
	Ice Thickness	X	X			
	Coil	X				
	ICE LOGIC ™ Ice Quantity controller : - condition of sensor - conductivity of tank water	 X X	X			
	Air Pump - Air Filter Replacement	X	X		X	
	Refrigerant: - Glycol quality - NH_3 purge oil			X X		
	Air Distribution Piping	X				
Cleaning procedures	Mechanical cleaning - Air filter	X	 X		X	X
	Disinfection	X			X	X

Table 3: Recommended Maintenance & Monitoring Schedule

Notes:

1. Water Treatment and auxiliary equipment integrated in the cooling system may require additions to the table above. Contact suppliers for recommended actions and their required frequency.
2. Recommended service intervals are for typical installations. Different environmental conditions may dictate more frequent servicing.
3. When operating in ambient temperatures below freezing, the unit should be inspected more frequently.