evapco® for LIFE

ENGINEERED MODULAR ICE TANKS



ICE-PAK™ ICE-CHILLED-ENERGY STORAGE UNITS

DESIGNED FOR THERMAL ICE STORAGE SYSTEMS

Featuring Extra-Pak® Ice Coil Technology
Capacities to 1,000 Ton-Hours



EVAPCO World Headquarters in Taneytown, MD

EVAPCO for LIFE

EVAPCO is more than a name. We are the global innovator in heat transfer solutions for the commercial HVAC, industrial refrigeration, power, and industrial process markets. We pledge to make everyday life easier, more comfortable, more reliable, and more sustainable for people everywhere.

Our Commitment

We never stop innovating. We set out to find groundbreaking solutions that transform the way the world works for the better. It's why we have more than 500 active patents worldwide. We also guarantee performance and put every solution through rigorous research and testing to ensure maximum efficiency and reliability.

Protecting the Environment

Innovation and environmental sustainability go hand-in-hand at EVAPCO. Our industrial heat transfer equipment not only conserves natural resources and helps reduce noise pollution, but also features recycled steel content in construction. Our stainless steel units are constructed of panels that contain up to 65% recycled content and our galvanized units contain over 79%*. From sound reduction to water conservation to chemical elimination, we are developing new technologies that deliver ultimate operating advantages to our clients while protecting the planet for every generation to come.

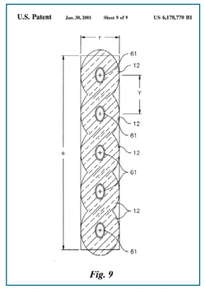
*Applicable to U.S.-manufactured products.

Technology for the Future, Available Today!

Experience, Innovation, Guaranteed Performance

EVAPCO combines engineering expertise with practical application experience to develop heat transfer solutions that meet demanding cooling requirements. For ICE-PAK™ storage units, that expertise delivers efficient ice storage in a compact footprint.

ICE-PAK™ Ice-Chilled-Energy storage units feature EVAPCO's patented Extra-Pak® ice coil technology* with elliptical tubes that increase packing efficiency compared with round-tube designs. This design maximizes the heat transfer surface within the tank, making efficient use of available space.



*US Patent No. 6,178,770 B1

For 50 years, EVAPCO has supported product development through continuous investment in research, testing, and engineering. The Wilson E. Bradley Research & Development Center in Taneytown, Maryland, brings that commitment to life. With more than 100,000 square feet of indoor and outdoor testing space, the facility supports product development, performance validation, and technology advancement across the commercial HVAC, industrial refrigeration, power generation, and industrial process markets.

The research campus features nine specialized laboratories, including six environmental test chambers, providing engineers with the ability to evaluate products under a wide range of real-world operating conditions. Advanced testing capabilities include thermal performance validation, refrigeration system development, fan performance analysis, durability testing, materials evaluation, and full-scale equipment qualification.



HIGH-DENSITY INSULATION

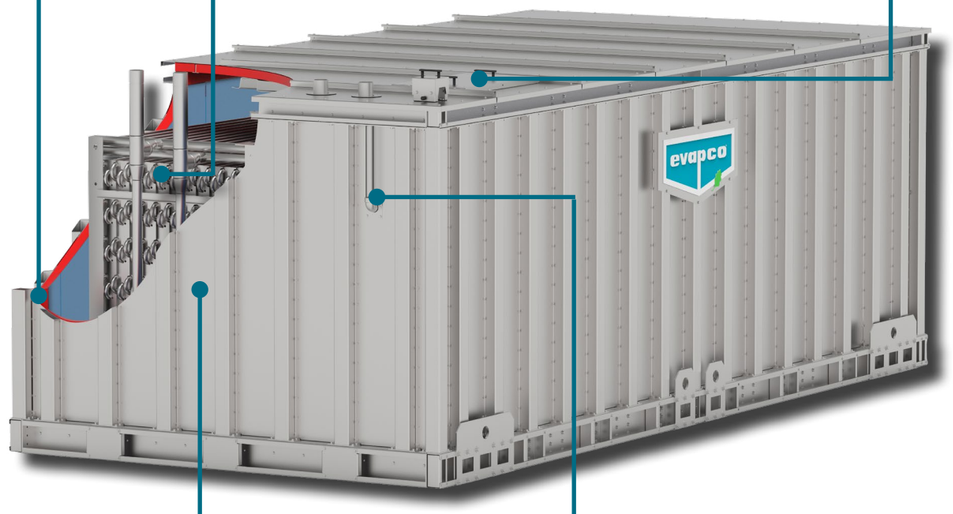
- Fully isolates tank from structure – no cold bridges
- R-19.5 sides
- R-13 bottom and top

REMOVABLE ACCESS COVER

- Large size – 20" × 34"
- Easily handled – 15 lb
- Fully insulated

HEAVY-DUTY STEEL COIL

- Exclusive Extra-Pak® coil technology*
- ASME B31.5 design and construction
- 300 psig working pressure
- Hot-dip galvanized after fabrication
- Connections grooved for mechanical coupling



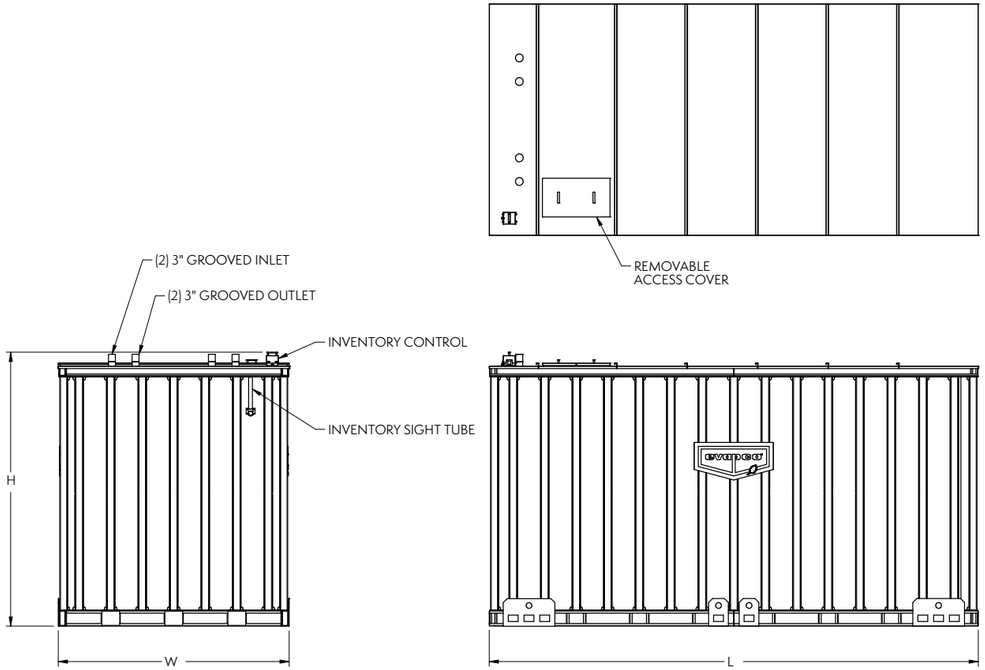
HEAVY-DUTY CONSTRUCTION

- Corrosion-resistant stainless steel tank, welded watertight
- G-235 hot-dip galvanized steel structural supports
- G-235 hot-dip galvanized steel panels protect insulation

INVENTORY MEASUREMENT AND CONTROL

- Clear sight tube for viewing water level
- Electronic controller with 4-20 mA output signal
- Mechanical relays for ice charge termination and low-level alarm

*US Patent No. 6,178,770 B1



Model No.	Latent Capacity (Ton-Hours)	Weights (lb)		Volumes (gal)		Dimensions		
		Shipping	Operating	Tank Water	Coil Glycol	W	L	H
ICE-370TD	370	20,550	57,570	4,115	355	7′-9 11/16″	20′-8 5/16″	7′-9 3/4″
ICE-480TD	480	24,580	72,760	5,345	460	9′-9 5/16″	20′-8 5/16″	7′-9 3/4″
ICE-590TD	590	28,320	87,970	6,610	565	11′-8 15/16″	20′-8 5/16″	7′-9 3/4″
ICE-476TE	476	23,650	75,380	5,775	455	7′-9 11/16″	20′-8 5/16″	9′-3 1/4″
ICE-620TE	620	28,160	95,420	7,495	590	9′-9 5/16″	20′-8 5/16″	9′-3 1/4″
ICE-760TE	760	32,730	115,740	9,245	725	11′-8 15/16″	20′-8 5/16″	9′-3 1/4″
ICE-625TH	625	29,530	89,460	6,600	600	7′-9 11/16″	20′-8 5/16″	11′-7 1/8″
ICE-815TH	815	34,790	113,230	8,670	750	9′-9 5/16″	20′-8 5/16″	11′-7 1/8″
ICE-1000TH	1,000	40,890	137,160	10,590	955	11′-8 15/16″	20′-8 5/16″	11′-7 1/8″

Whether the application is air conditioning or process cooling, an accurate design-day cooling load profile is recommended for sizing ICE-PAK™ Ice-Chilled-Energy storage units and other system components. Before selecting the system components, it is necessary to make decisions regarding the overall system operation. Consider the following:

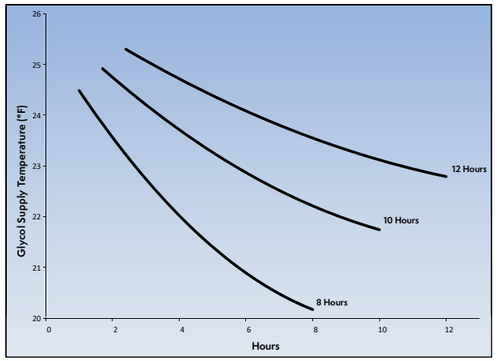
1. Review the electric utility company's applicable schedules or tariffs to understand peak demand and hourly energy costs.
2. Review the design-day hourly cooling load profile and determine if full storage or partial storage system design is preferred. Note that full storage system design should generally be considered only where peak electrical supplies are limited and/or energy costs are very high.
3. Review the design-day hourly cooling load profile and determine if base load or conventional water chillers will be necessary for cooling during on-peak and off-peak hours.
4. Determine the chilled water system design flow and delta-T.
5. Determine low-temperature supply capability of available or desired glycol chillers.

In summary, the selection process requires defining the 24-hour design-day loads and operating strategy for chillers and ice (see page 6 for system operating modes), flows and temperatures, chiller size and temperature limitations. Based on this information, EVAPCO can provide a custom solution using its evapSelect® computer selection software.

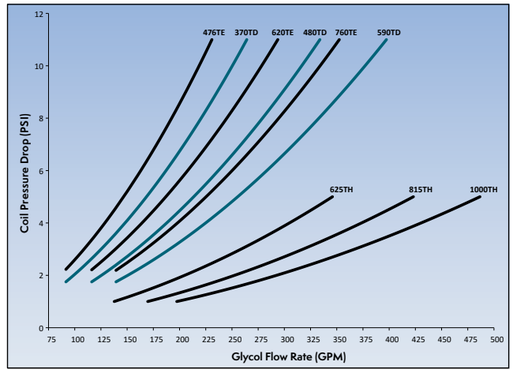
The system design solution is reported in a format as recommended by AHRI Guideline T. Data includes quantity and size of ICE storage units, minimum required chiller size, hourly glycol and base water chiller capacities, net ice in storage, and primary/secondary loop flows and temperatures. A chart that graphically represents system operation is also included. An example of the report is shown below.



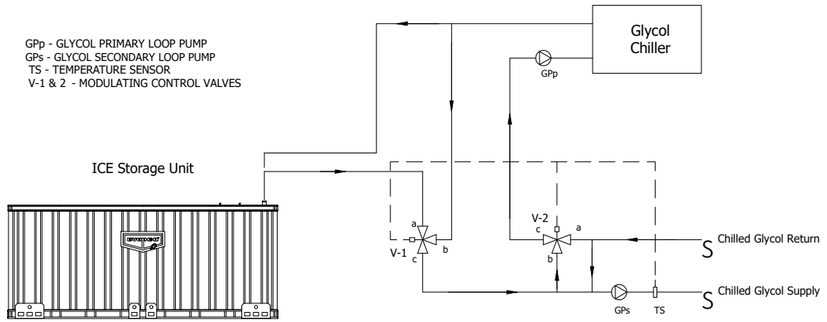
Size of the glycol chiller is largely determined by the time available to build ice. Larger chillers are required to build ice in shorter periods of time. At the start of the ice build mode, the chiller capacity and glycol supply temperature will be high. As the ice build process continues, the ice will become thicker, requiring a lower glycol temperature resulting in reduced chiller capacity. Chillers sized to build ice in shorter periods of time must also have a lower temperature supply capability (see chart below).



ICE-PAK™ Ice-Chilled-Energy storage units are designed to minimize operating costs, including pumping energy. Pressure drop through the ICE storage coils is low and comparable to other heat exchangers that may be used in the system. Below is a chart showing coil pressure drop for a range of unit flow rates using 25% ethylene glycol heat-transfer solution.



SYSTEM OPERATING MODES



The cooling system controls or building automation system must vary the modes of operation based on time of day, predicted cooling profile, or season of the year. Any or all of the operating modes described below may be used daily.

Ice Build

Low-temperature glycol is circulated through the ICE storage coils to build ice. Ice build will begin when the bulk tank water temperature is below freezing and continue until a full build is reached. The leaving glycol temperature required from the chiller will decrease throughout the build cycle. The chiller must be selected to supply the lowest temperature required based on the Summary Selection sheet. This may be 22°F or lower at the end of the build cycle. The chiller should operate at full load (100% capacity) during the ice build period. To keep the chiller from unloading, it is a common practice to set the leaving temperature of the chiller at 2°F below the final build temperature (in this case 20°F). This will assure that the chiller remains fully loaded. Ice build continues until terminated by the ice inventory control or operating mode is changed.

Component Settings: Chiller set to supply 20°F glycol. Glycol Pump GPp is on and Glycol Pump GPs is off. Valve V-1 ports a > c, Valve V-2 ports b > c.

Chiller Only Direct Cooling

The direct cooling mode is intended to provide cooling directly from the chiller to the cooling loop. Often this mode is used after ice build is completed and prior to the on-peak period while energy prices are still low. All cooling is satisfied by the chiller, thus saving the ice inventory for use during the high-cost on-peak period. If the cooling load is greater than expected, a small amount of ice storage may be needed to reduce glycol supply temperature during this period. Ideally, this mode should maximize chiller use and minimize ice storage use.

Component Settings: Chiller is reset to supply the desired system cooling loop temperature, 42°F for example. Glycol Pumps GPp and GPs are on. Valve V-1 ports b > c, Valve V-2 ports a > c. If the chiller is unable to handle the cooling load and the supply temperature to the cooling loop is higher than desired, temperature sensor TS can modulate Valve V-1 to provide supplemental cooling from storage.

Chiller and Ice Melt

The chiller operates in combination with the ice storage to meet the cooling needs. The ideal arrangement is to have the chiller and ice storage piped in series with the ice storage located downstream, as shown in the schematic above. The glycol chiller's supply temperature set point can be reset to a temperature of, for example, 45°F. For a system designed for an 18°F delta-T, the chiller would provide the cooling from 56°F to 45°F and the ice storage would provide the final cooling to 38°F. Locating the chiller upstream of the ice storage allows for a higher chiller leaving set point of 45°F and better chiller efficiency. The chiller may cycle off automatically when the return temperature approaches the 45°F set point. When this occurs, the partial storage system becomes a full storage system.

Component Settings: Chiller is reset to provide 45°F. Glycol Pumps GPp and GPs are on. Valve V-1 modulates flow in response to TS to provide 38°F, Valve V-2 ports a > c.

Ice Melt Only

As the name implies, all cooling is provided by the ICE storage system. Chiller and condenser heat rejection components are turned off. Only the glycol primary and secondary loop pumps will operate.

Component Settings: Chiller is off. Glycol Pumps GPp and GPs are on. Valve V-1 modulates flow in response to TS to provide 38°F, Valve V-2 ports a > c.

Ice Build with Cooling

Small, nighttime loads (no greater than 10% of design) may be cooled by the system during the ice build process by modulating control Valve V-2 to blend some of the glycol returning from the ICE storage coils into the secondary loop. The secondary loop return fluid is mixed with the remainder of the glycol build fluid and returned to the chiller.

Component Settings: Chiller set to supply 20°F glycol. Glycol Pumps GPp and GPs are on. Valve V-1 ports a > c, Valve V-2 modulates flow in response to TS to meet nighttime secondary loop supply set point temperature, 42°F for example.

MECHANICAL SPECIFICATIONS

Furnish and install internal melt, hot-dip galvanized ice coils with a factory-assembled, insulated steel tank. System design and performance are based on EVAPCO model _____ modular ice tank with a net latent storage capacity of _____ ton-hours.

Coil Construction

Coils shall be designed and manufactured to meet the requirements of ASME Code B31.5 and rated for 300 psig working pressure.

Coils shall be configured to provide countercurrent glycol flow in adjacent circuits. Coil circuits shall be constructed of continuous 1.05" O.D. all prime surface high-frequency induction-welded ASTM A-1008 Carbon Steel Type B tubing.The steel tubing shall be nominal 16 gauge thickness, formed into an ellipse, and eddy current tested for continuous in-process testing. Full-length circuits with no intermediate butt welds shall be formed into serpentines and individually leak tested with air under water prior to being welded into Schedule 40 ASTM SA-53 Carbon Steel Type E, Grade B pipe headers. Headers and connecting piping shall be sized for maximum fluid velocity of 10 ft/sec.

Coil circuits, intermediate tube sheets, headers and connecting piping shall be assembled into a heavy-duty steel frame. The completed coil assembly shall be leak tested with 400 psig air pressure under water for a minimum of fifteen (15) minutes. The coils shall then be hot-dip galvanized in a zinc bath deep enough for full, uniform coverage per ASTM A123/A123M with minimum Coating Grade 45. After galvanizing, the coil assembly shall again be leak tested with 400 psig air pressure under water for fifteen (15) minutes. Coils shall then be mounted on hot-dip galvanized structural supports. Finished coil connections shall be grooved for mechanical coupling.

Tank Construction and Insulation

Tank shall be constructed of heavy-gauge (minimum 12 gauge) stainless steels (Types 304 and 439) with all seams welded watertight. All floor, wall and cover support structural members shall be constructed of G-235 hot-dip galvanized steel and thermally isolated from the tank to avoid condensation on exterior surfaces. Tank walls shall be covered with 3" of high density polyisocyanurate insulation, having a net thermal resistance (R-value) of 19.5 hr-ft²-°F/BTU. Tank floor and top covers shall be insulated with 2" of high density polyisocyanurate, having a net thermal resistance (R-value) of 13 hr-ft²-°F/BTU.

Tank walls and insulation shall be protected by hot-dip galvanized panels. Top of tank shall be covered with hot-dip galvanized panels, supported by structural members designed to handle external loads of 300 lbs/ft², and sealed to be rain-tight. A large (4 sq. ft. minimum), removable, insulated access cover shall be provided for visual inspection of the ice coil.

A clear PVC sight tube shall be provided for visual indication of water level and ice inventory. A removable cover shall be provided to avoid shipping damage and prevent algae growth due to direct sunlight.

Ice Inventory Control

The ice tank shall be provided with an electronic ice inventory controller that measures tank water level changes in direct proportion to change in ice volume on the coil. Outputs shall include a 4-20 mA analog signal and mechanical relays for low-level alarm and high-level ice charge termination.

Heat Transfer Fluid Quality

Coils shall be filled with an industrial-grade ethylene or propylene glycol, premixed with distilled or deionized water and corrosion inhibitors suitable for all materials found in the ice storage system (copper, brass and steel). Dow Chemical Company products DOWTHERM SR-1 (ethylene glycol) and DOWFROST HD (propylene glycol) shall be the minimum acceptable level of quality.

Tank Water Quality

The ice tank shall be filled with clean, fresh water meeting the following quality guidelines.

pH	7.0 to 8.2
Hardness as $CaCO_3$	50 to 500 ppm
Sulfates	250 ppm maximum
Alkalinity as $CaCO_3$	75 to 400 ppm
Chlorides as Cl	125 ppm maximum
Total Dissolved Solids	1,000 ppm maximum

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