HXV
Closed Circuit Hybrid Cooling Towers

Product Detail

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HXV Closed Circuit Hybrid Cooling Towers

Single Cell Capacity:
160 – 305 Nominal Tons
480 – 915 GPM at 95°F/85°F/78°F

HXV Closed Circuit Hybrid Cooling Towers deliver fully rated thermal performance over a wide range of flow and temperature requirements. Distinct advantages of the HXV include plume abatement, significant water savings over traditional water-cooled equipment, and its suitability for high temperature cooling (>180°F). Standard design features satisfy today’s environmental concerns, minimize installation costs, maximize year-round operating reliability, and simplify maintenance requirements.

HXV Closed Circuit Cooling Towers

• Plume abatement
• Maximum water savings
• High temperature cooling (>180°F)
• Low energy consumption
• Low installed cost
• Easy maintenance
• Reliable year-round operation
• Long service life
• ASME B31.5 compliant prime surface coil
• Five-year warranty on mechanical equipment
Closed Circuit Cooling Towers

...because temperature matters™
Benefits

Plume Abatement
The HXV offers a combination of sensible, adiabatic, and evaporative heat transfer to significantly reduce any plume that may occur with conventional evaporative cooling equipment. During the coldest times of the year, when the potential for visible discharge is greatest, the HXV operates 100% dry, completely eliminating plume.

Maximum Water Savings
Water savings are achieved throughout the year with each of three different operating modes HXV. In some areas, the water cost savings alone can pay for the equipment in as little as two years!

  • At peak conditions in the “dry/wet” operating mode, a significant amount of heat is removed by sensible heat transfer, providing reduced water consumption versus conventional evaporative cooling
  • When the heat load and/or ambient temperatures drop, water consumption is further reduced in the “adiabatic” operating mode
  • Water consumption is totally eliminated in the “dry” operating mode

See page E75 for details on operating modes.

High Temperature Cooling
The finned dry coil tempers the incoming fluid, allowing higher inlet fluid temperatures than traditional closed circuit cooling towers.

Low Energy Consumption
The HXV provides heat rejection at the lowest possible energy input and maintenance requirements via:

  • High efficiency, low horsepower axial fans
  • Closed loop cooling, which minimizes process fouling
  • Patented combined flow technology, which reduces evaporation directly off the coil, minimizing the potential for scaling and fouling
  • Variable Frequency Drives (see page G1 for details)
  • ENERGY-MISER® Fan System available (see page E69 for details)
  • BALTIGUARD PLUS™ Fan System (see page G1 for details)
Low Installed Cost

- **Support** — All models mount directly on parallel I-beams and ship complete with motors and drives factory-installed and aligned.

- **Modular Design** — Units ship in three pieces to minimize the size and weight of the heaviest lift, allowing for the use of smaller, less costly cranes.

Easy Maintenance

- **Access** — Hinged access doors on each end wall and a standard internal walkway provide easy access to the unit interior.

- **Spacious Interior** — Provides easy access to the cold water basin, drift eliminators, fan drive system and the prime surface coil.

- **Access to Spray Distribution** — Parallel flow of air and spray water over the coil allows for inspection and access to the top of the coil during full operation.

Reliable Year-Round Operation

- **BALTIDRIVE® Power Train** — Backed by a five-year fan motor and drive warranty, the BALTIDRIVE® Power Train utilizes special corrosion-resistant materials of construction and state-of-the-art technology to ensure ease of maintenance and reliable year-round performance.

- **Separate Air Inlet Louvers** — Reduce the potential for scale build-up and damaging ice formations at the air/water interface by providing a line of sight from the outside of the unit into the fill.

Long Service Life

**Materials of Construction** — Various materials are available to meet the corrosion resistance, unit operating life, and budgetary requirements of any project (see page E67 for construction options).
Construction Details
1. Heavy-Duty Construction
   • G-235 (Z700 metric) hot-dip galvanized steel panels

2. BALTIDRIVE® Power Train (Not Shown)
   • Premium quality, solid-backed, multi-groove belt
   • Corrosion resistant cast aluminum sheaves
   • Heavy-duty bearings (280,000 hour average life)
   • Cooling tower duty fan motor
   • 5-year motor and drive warranty

3. Low HP Axial Fan(s) (Not Shown)
   • High efficiency
   • Quiet operation
   • Corrosion resistant

4. Water Distribution System
   • Overlapping spray patterns ensure proper water coverage
   • Large orifice, 360° non-clog nozzles
   • Visible & accessible during operation

5. Prime Surface Coil (Not Shown)
   • Continuous serpentine, steel tubing
   • Hot-dip galvanized after fabrication (HDGAF)
   • Pneumatically tested at 375 psig (2,585 kPa)
   • Sloped tubes for free drainage of fluid
   • ASME B31.5 compliant
   • When required, orders shipping into Canada are supplied with a CRN

6. Dry Finned Coil
   • Copper tubing with high density aluminum fins
   • Pneumatically tested at 320 psig (2,206 kPa)
   • Sloped tubes for free drainage of fluid

7. BACross® Fill with Integral Drift Eliminators (Not Shown)
   • High efficiency heat transfer surface
   • Polyvinyl chloride (PVC)
   • Impervious to rot, decay and biological attack
   • Flame spread rating of 5 per ASTM E84-77a

8. FRP Air Inlet Louvers
   • Corrosion resistant
   • UV resistant finish
   • Maintenance free

9. Cold Water Basin
   • Sloped cold water basin for easy cleaning
   • Suction strainer with anti-vortex hood
   • Adjustable water make-up assembly
   • Integral internal walkway

10. Recirculating Spray Pump (Not Shown)
    • Close coupled, bronze fitted centrifugal pump
    • Totally enclosed fan cooled (TEFC) motor
    • Bleed line with metering valve installed from pump discharge to overflow

11. Hinged Access Doors
    • Inward swinging door on each end wall

12. Optional Flow Control Package
    • Temperature sensor
    • 3-way flow control valve with actuator
    • All interconnecting piping

...because temperature matters™
Custom Features and Options

Construction Options

• **Standard Construction**—
  Steel panels and structural elements are constructed of heavy-gauge G-235 (Z700 metric) hot-dip galvanized steel. Inlet louvers are constructed of UV resistant, fiberglass reinforced polyester (FRP).

• **Optional BALTIBOND® Corrosion Protection System**—
The BALTIBOND® Corrosion Protection System, a hybrid polymer coating used to extend equipment life, is applied to all hot-dip galvanized steel components of the closed circuit hybrid cooling tower (excluding heat transfer coils).

• **Optional Stainless Steel Cold Water Basin**—
  A Series 300 stainless steel cold water basin is available. Seams between panels inside the cold water basin are welded. The basin is leak tested at the factory and welded seams are provided with a five year leak-proof warranty.

• **Optional Stainless Steel Construction**—
  Steel panels and structural elements are constructed of Series 300 stainless steel. Seams between panels inside the cold water basin are welded. The basin is leak tested at the factory and welded seams are provided with a five-year leak-proof warranty.

See page M26 for more details on the materials described above.

Prime Surface Coil Configurations

• **Standard Serpentine Coil**—
The standard cooling coil is constructed of continuous lengths of all prime surface steel, hot-dip galvanized (outside surface) after fabrication (HDGAF). The coil is designed for low pressure drop with sloping tubes for free drainage of fluid. Each coil is pneumatically tested at 375 psig (2,586 kPa) and is ASME B31.5 compliant.

• **Stainless Steel Coil**—
  Coils are available in Series 300 stainless steel for specialized applications. The coil is designed for low pressure drop with sloping tubes for free drainage of fluid. Each coil is pneumatically tested at 375 psig (2,586 kPa) and is ASME B31.5 compliant.
• **Optional ASME “U” Stamp Coil**—
  This coil is manufactured and tested in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, and bears the ASME “U” stamp. ASME coils are hot-dip galvanized (outside surface) after fabrication (HDGAF). The coil is designed for low pressure drop with sloping tubes for free drainage of fluid. Each coil is pneumatically tested at 375 psig (2,586 kPa).

Other coil configurations are available for specific applications. Contact your local BAC Representative for details.

**Dry Finned Coil Configurations**

The standard finned coil on the HXV unit has 6 rows and is available in 1-1/2 serpentine and triple serpentine arrangements. The serpentine arrangement indicates the way in which these rows are circuited internally, and influences the process fluid velocity and the total fluid pressure through the unit. Hence, the unit flow and pressure drop allowance must be taken into account when the finned coil serpentine is selected to obtain the most suitable HXV selection. Consult your local BAC Representative for selection assistance.

*Note:* The dry finned coil is available in alternate materials of construction to meet specific application requirements.

**Fan Drive System**

The fan drive system provides the cooling air necessary to reject unwanted heat from the system to the atmosphere. The standard fan drive system on all models is the exclusive BALTIDRIVE® Power Train. This BAC engineered drive system consists of a specially designed powerband and two cast aluminum sheaves located on minimum shaft centerline distances to maximize belt life. A cooling tower duty fan motor, custom engineered for BAC to provide maximum performance for cooling tower service, is provided and backed by BAC’s comprehensive five-year motor and fan drive warranty.
Custom Features and Options

ENERGY-MISER® Fan System
The ENERGY-MISER® Fan System consists of two standard single-speed fan motors and drive assemblies. One drive assembly is sized for full speed and load, and the other is sized for approximately 2/3 speed and consumes only 1/3 the design horsepower. This configuration allows the system to be operated like a two-speed motor, but with the reserve capacity of a standby motor in the event of failure. As a minimum, approximately 70% capacity will be available from the low horsepower motor, even on a design wet-bulb day. Controls and wiring are the same as those required for a two-speed, two-winding motor. Significant energy savings are achieved when operating at low speed during periods of reduced load and/or low wet-bulb temperatures.

BALTIGUARD PLUS™ Fan System
The BALTIGUARD PLUS™ Fan System builds on the advantages of the ENERGY-MISER® Fan System by adding a VFD to the smaller motor. Using the VFD on the smaller fan motor, as opposed to the larger motor, reduces the cost of the VFD, and wiring for the motor. For more information on the BALTIGUARD PLUS™ Fan System refer to page G1.

Independent Fan Operation
Models HXV-64X and Q64X are provided with one fan motor driving two fans as standard. Models HXV-66X and Q66X are provided with two fan motors driving three fans as standard. The independent fan option consists of one fan motor and drive assembly for each fan to allow independent operation, providing an additional step of fan cycling and capacity control.

Low Sound Operation
The low sound levels generated by HXV Closed Circuit Hybrid Cooling Towers make them suitable for installation in most environments. For extremely sound sensitive installations, factory designed, tested and rated sound attenuation is available for both the air intake and discharge.
Accessories

External Service Platforms
For external service, louver face and access door platforms can be added to the unit when purchased or as an aftermarket item. Safety cages and safety gates are also available. All components are designed to meet OSHA requirements.

Internal Ladder
For access to the motor and drive assemblies, an internal ladder is available.

Internal Service Platforms
For access to the motor and drive assemblies, an internal ladder and upper service platform with handrails is available. Safety gates are available for all handrail openings. All components are designed to meet OSHA requirements.

Vibration Cutout Switch
A factory mounted vibration cutout switch is available to effectively protect against equipment failure due to excessive vibration of the mechanical equipment system. BAC can provide either a mechanical or solid-state electronic vibration cutout switch in a NEMA 4 enclosure to ensure reliable protection. Additional contacts can be provided to activate an alarm.

Basin Heaters
Although most HXV units will operate dry in the winter, basin heaters are available for freeze protection when required. Basin heaters prevent freezing of the water in the cold water basin when the unit is idle. Factory-installed electric immersion heaters, which maintain +40°F (4.4°C) water temperature, are a simple and inexpensive way of providing such protection.

Heater Sizing Data

<table>
<thead>
<tr>
<th>Model Number</th>
<th>0°F (-17.8°C) Ambient Heaters</th>
<th>-20°F (-28.9°C) Ambient Heaters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Heaters</td>
<td>kW per Heater</td>
</tr>
<tr>
<td>HXV-64X, Q64X</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>HXV-66X, Q66X</td>
<td>1</td>
<td>16</td>
</tr>
</tbody>
</table>
## Accessories

### Electric Water Level Control Package

The electric water level control replaces the standard mechanical makeup valve when a more precise water level control is required. This package consists of a conductance-actuated level control mounted in the basin and a solenoid activated valve in the make-up water line. The valve is slow closing to minimize water hammer.

### Flow Control Package

A flow control package is available to provide maximum plume control and water savings. This package consists of a temperature sensor, a 3-way flow control valve arrangement with actuator, and all connecting piping. 3-way flow control valve arrangement shown below for single prime surface and double prime surface coil connections.
Extended Lubrication Lines
Extended lubrication lines are available for lubrication of the fan shaft bearings. Grease fittings are located inside the plenum area next to the access door.

High Temperature Fill
Optional high temperature fill material is available for high entering fluid temperatures.

Air Inlet Screens
Mesh screens can be factory-installed over the inlet louvers to prevent debris from entering the unit.

Basin Sweeper Piping
Basin sweeper piping provides an effective method of preventing debris from collecting in the cold water basin of the tower. A complete piping system, including nozzles, is provided in the tower basin for connection to side stream filtration equipment (by others).

Equipment Controls
BAC control panels are specifically designed to work seamlessly with all BAC units and engineered to meet you particular application. For more on BAC Equipment Controls, see pages G1-G13.
Engineering Data

Do not use for construction. Refer to factory certified dimensions. This handbook includes data current at the time of publication, which should be reconfirmed at the time of purchase. Up-to-date engineering data, and more can be found at www.BaltimoreAircoil.com.

**HXV-64X/Q64X**

**HXV-66X/Q66X**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Nominal Tons</th>
<th>Motor Hp</th>
<th>Weights (lbs)</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td></td>
<td>Operating</td>
<td>15</td>
</tr>
<tr>
<td>HXV-641-OM</td>
<td>160</td>
<td>30</td>
<td>24,800</td>
<td>16,800</td>
</tr>
<tr>
<td>HXV-642-OM</td>
<td>180</td>
<td>30</td>
<td>26,300</td>
<td>16,900</td>
</tr>
<tr>
<td>HXV-646-OM</td>
<td>191</td>
<td>30</td>
<td>29,300</td>
<td>16,900</td>
</tr>
<tr>
<td>HXV-645-OM</td>
<td>252</td>
<td>30 &amp; 15</td>
<td>35,700</td>
<td>22,400</td>
</tr>
<tr>
<td>HXV-662-OM</td>
<td>283</td>
<td>30 &amp; 15</td>
<td>38,000</td>
<td>23,900</td>
</tr>
<tr>
<td>HXV-666-OM</td>
<td>305</td>
<td>30 &amp; 15</td>
<td>38,000</td>
<td>23,900</td>
</tr>
<tr>
<td>HXV-661</td>
<td>305</td>
<td>30 &amp; 15</td>
<td>42,400</td>
<td>27,100</td>
</tr>
</tbody>
</table>

**Notes:**

1. Operating weight is for the tower with the water level in the cold water basin at the overflow.
2. The actual size of the inlet and outlet connection may vary with the design flow rate. Consult the unit print for dimensions.
3. Pipe sizes are nominal diameters. Standard connections are beveled-for-welding (BFW).
4. Dimensional drawings show standard (right hand) arrangements with the standard finned coil arrangement.
5. Nominal tons of cooling represents 3 GPM of water from 95°F to 85°F at a 78°F entering wet-bulb temperature.
Engineering Data

Winter Operation

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Heat Loss Data (BTU/HR, Standard Unit)</th>
<th>Internal Coil Volumes</th>
<th>Cold Water Basin Volume at Operating Level (Gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HXV-641-OM</td>
<td>904,180</td>
<td>163</td>
<td>119 207</td>
</tr>
<tr>
<td>HXV-642-OM</td>
<td>962,184</td>
<td>218</td>
<td>119 207</td>
</tr>
<tr>
<td>HXV-644-OM</td>
<td>962,184</td>
<td>218</td>
<td>119 207</td>
</tr>
<tr>
<td>HXV-661-OM</td>
<td>1,074,780</td>
<td>326</td>
<td>119 207</td>
</tr>
<tr>
<td>HXV-662-OM</td>
<td>1,354,564</td>
<td>255</td>
<td>170 314</td>
</tr>
<tr>
<td>HXV-666-OM</td>
<td>1,436,452</td>
<td>340</td>
<td>170 314</td>
</tr>
<tr>
<td>HXV-6661</td>
<td>1,598,816</td>
<td>510</td>
<td>170 314</td>
</tr>
</tbody>
</table>

Notes:
1. Heat loss data based on 50°F (-10.0°C) coil water and –10°F (-23.3°C) with a 45 mph (72.4 Km/hr) wind velocity (fans and pump are off).
2. Electric immersion heaters with thermostat and low level cutout. All components are factory installed in the unit basin. Heaters are selected to maintain 40°F (4.4°C) basin water at 0°F (-17.8°C) ambient temperature. In outdoor locations, trace heating and insulation of spray pump(s) (by others) may be required for freeze protection. See page E84-E85 for more information on winter operation.

Structural Support

The recommended support arrangement for HXV Closed Circuit Hybrid Cooling Towers consists of parallel I-beams positioned as shown in the drawings. Besides providing adequate support, the steel also serves to raise the unit above any solid foundation to assure access to the bottom of the tower. To support an HXV on columns or in an alternate arrangement not shown here, consult your local BAC Representative.

Notes:
1. Supporting steelwork and anchor bolts are to be designed and furnished by others.
2. All support steel must be level at the top.
3. Each beam should be designed, as a minimum, for 65% of the total unit operating weight applied as a uniformly distributed load.
4. Beams must be selected in accordance with accepted structural practice. Maximum deflection of the beam under the unit to be 1/360 of span, not to exceed 1/2 inch.
5. If vibration isolation rails are to be used between the unit and the supporting steel, be certain to allow for the length of the vibration rails when determining the length of the supporting steel, as vibration rail length and mounting hole locations may differ from those of the unit.
6. If point vibration isolation is used with multi-cell units, the isolators must be located under the support steel, not between the support steel and the towers.
Modes of Operation

<table>
<thead>
<tr>
<th>Operation Mode</th>
<th>Dry Finned Coil Fluid Flow</th>
<th>Wet Primed Surface Coil Fluid Flow</th>
<th>Spray Pump</th>
<th>Fan(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Dry/Wet</td>
<td>100%</td>
<td>Modulating</td>
<td>0 on</td>
<td>0 on</td>
</tr>
<tr>
<td>Adiabatic</td>
<td>100%</td>
<td>0%</td>
<td>0 on</td>
<td>0 on</td>
</tr>
<tr>
<td>Dry</td>
<td>100%</td>
<td>100%</td>
<td>0 off</td>
<td>0 on</td>
</tr>
</tbody>
</table>

Notes:
1. During dry mode, two-speed, variable frequency drive (VFD), or ENERGY-MISER® Fan System operation is also possible.
2. For both dry/wet and adiabatic operation modes, the use of an automatic blowdown system is recommended to minimize water consumption.

Combined Dry/Wet Operation Mode

In this mode, the fluid to be cooled flows first to the dry finned coil and then to the prime surface evaporative coil, where the cooled fluid exits the unit. Spray water is drawn from the cold water basin and pumped to the water distribution system above the prime surface coil. Wetting the prime surface coil allows evaporative cooling to occur. The spray water falls from the prime surface coil over the fill surface, enhancing the evaporative heat transfer by sub-cooling the spray water. Air is drawn through both the prime surface coil and through the fill where it is saturated and picks up heat. The air, however, still cold enough to achieve significant cooling within the finned coil, which is installed at the discharge above the fan(s).

In the dry/wet mode, both sensible and evaporative heat transfer are used. Compared to a conventional evaporative unit, the potential for plume is substantially reduced and significant water savings can be obtained, even at peak design conditions. At reduced heat load and/or ambient temperatures, the evaporative cooling portion, and hence water usage, is further reduced as the flow through the evaporative coil is gradually decreased. This is accomplished by a modulating flow control valve arrangement, which controls the outlet fluid temperature. This control arrangement automatically assures maximum use of sensible cooling in the finned coil and minimum use of evaporative cooling in the prime surface coil. The heat transfer method and flow control are arranged to achieve maximum water savings in the dry/wet mode. Plume is minimized by reducing the amount of evaporated water and the heating of the entire discharge air with the dry finned coil.

Water consumption
Adiabatic Mode

The adiabatic mode occurs when the fluid to be cooled completely bypasses the evaporative prime surface coil. No heat is rejected from this coil and the recirculating spray water merely serves to saturate and adiabatically pre-cool the incoming outside air. In most climates, the ambient air still has considerable potential for absorbing moisture.

Thus adiabatic cooling of the incoming air results in significantly lower air temperatures, which greatly increases the rate of sensible heat transfer. Compared to conventional evaporative cooling equipment, visible plume and water consumption are greatly reduced while maintaining the low fluid design temperatures required to maximize system efficiency.

Dry Mode

During the dry operation mode the spray water system is turned off, saving on pump energy. The fluid to be cooled is fed from the finned coil to the prime surface coil. The modulating flow control valve remains fully open to ensure both coils receive the full fluid flow in series; hence the maximum heat transfer surface is available. In this mode no water consumption occurs, and plume is completely eliminated. HXV units can be economically selected for dry bulb switchover points of 50°F (10°C) to 60°F (15°C) or higher, depending on the specific needs of the project.

When the equipment operates in the dry mode for prolonged periods, draining the cold water basin is recommended, eliminating the need for freeze protection and water treatment.
Engineering Specifications

1.0 Closed Circuit Hybrid Cooling Tower

1.1 General: Furnish and install, as shown on the plans, ___ factory-assembled closed circuit hybrid cooling tower(s) of induced draft design with vertical air discharge. The unit shall be able to operate in combined dry/wet, adiabatic and dry modes for plume abatement and minimum water consumption. Overall dimensions shall not exceed approximately ___ ft (m) x ___ ft (m), with an overall height not exceeding approximately ___ ft (m). Operating weight shall not exceed ______ lbs (kg). The closed circuit hybrid cooling tower shall be Baltimore Aircoil Company Model HXV-___.

1.2 Thermal Capacity (water as heat transfer fluid): The closed circuit cooling tower shall be warranted by the manufacturer to have capacity to cool ______ USGPM (l/s) of water from ______°F (°C) to ______°F (°C) at ______°F (°C) entering wet-bulb temperature. Coil pressure drop shall not exceed ______ psi (kPa).

1.3 Quality Assurance: The tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO-9001 to ensure consistent quality of products and services.

2.0 Construction Details

2.1 G-235 (Z700 metric) Hot-Dip Galvanized Steel Structure: All steel panels and structural elements shall be constructed from heavy-gauge, G-235 (Z700 metric) hot-dip galvanized steel, with cut edges given a protective coat of zinc-rich compound.

(Alternate) 2.1 Corrosion Resistant Construction: Unless otherwise noted in this specification, all steel panels and structural members shall be protected with the BALTBOND® Corrosion Protection System. The system shall consist of G-235 (Z700 metric) hot-dip galvanized steel prepared in a four-step (clean, pre-treat, rinse, dry) process with an electrostatically sprayed, thermosetting, hybrid polymer fuse-bonded to the substrate during a thermally activated curing stage and monitored by a 23-step cure cooling tower shall be warranted by the manufacturer to have capacity to cool ______ USGPM (l/s) of water from ______°F (°C) to ______°F (°C) at ______°F (°C) entering wet-bulb temperature. Coil pressure drop shall not exceed ______ psi (kPa).

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1.3 Quality Assurance: The tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO-9001 to ensure consistent quality of products and services.

2.0 Construction Details

2.1 G-235 (Z700 metric) Hot-Dip Galvanized Steel Structure: All steel panels and structural elements shall be constructed from heavy-gauge, G-235 (Z700 metric) hot-dip galvanized steel, with cut edges given a protective coat of zinc-rich compound.

(Alternate) 2.1 Corrosion Resistant Construction: Unless otherwise noted in this specification, all steel panels and structural members shall be protected with the BALTBOND® Corrosion Protection System. The system shall consist of G-235 (Z700 metric) hot-dip galvanized steel prepared in a four-step (clean, pre-treat, rinse, dry) process with an electrostatically sprayed, thermosetting, hybrid polymer fuse-bonded to the substrate during a thermally activated curing stage and monitored by a 23-step cure cooling tower shall be warranted by the manufacturer to have capacity to cool ______ USGPM (l/s) of water from ______°F (°C) to ______°F (°C) at ______°F (°C) entering wet-bulb temperature. Coil pressure drop shall not exceed ______ psi (kPa).

1.3 Quality Assurance: The tower manufacturer shall have a Management System certified by an accredited registrar as complying with the requirements of ISO-9001 to ensure consistent quality of products and services.
5.0 Air Inlet Louvers

5.1 Air Inlet Louvers: Air inlet louvers shall be wave-formed, fiberglass-reinforced polyester (FRP), spaced to minimize air resistance and prevent water splash-out.

6.0 Mechanical Equipment

6.1 Fan(s): Fan(s) shall be heavy-duty, axial flow, with aluminum alloy blades. Air shall discharge through a fan cylinder designed for streamlined air entry and minimum fan blade tip clearance for maximum fan efficiency. Fan(s) and shaft(s) shall be supported by heavy duty, self-aligning, grease-packed ball bearings with moisture-proof seals and integral slinger rings, designed for minimum L10 life of 40,000 hours. Fan(s) shall be driven by a one-piece, multi-groove neoprene/polyester belt designed specifically for evaporative cooling service. Fan and motor sheave(s) shall be fabricated from cast aluminum.

6.2 Fan Motor: Fan motor(s) shall be totally enclosed air over (TEAO), reversible, squirrel cage, ball bearing type with 1.15 service factor, designed specifically for evaporative cooling duty on ____ volt/ ____ hertz/ ____ phase electrical service. The motor shall be furnished with special moisture protection on windings, shafts, and bearings. Each motor shall be mounted on an easily adjusted, heavy-duty motor base.

6.3 Mechanical Equipment Warranty: The fan(s), fan shaft(s), sheaves, bearings, mechanical equipment support and fan motor shall be warranted against defects in materials and workmanship for a period of five (5) years from date of shipment.

6.4 ENERGY-MISER® Fan System (optional): Two single-speed fan motors, one sized for full speed and load, the other sized for 2/3 speed and approximately 1/3 the full load horsepower, shall be provided for capacity control and stand-by protection from drive or motor failure. Two-speed motor(s) are not an acceptable alternative.

(Alternate) 6.5 BALTIGUARD PLUS™ Fan System: Two single speed fan motors, one sized for full load, the other sized for 1/3 of the full load horsepower shall be provided in each cell for capacity control and standby protection from drive or motor failure. The manufacturer of the equipment shall supply controls for the larger motor, a VFD for the smaller motor and factory programmed logic controller to maximize energy saving for off peak load and wet-bulb conditions.

7.0 Access

7.1 Plenum Access: A large, hinged access door shall be provided on each end wall for access to the prime surface coil, drift eliminators, and fan plenum section. The water make-up valve, float ball, and suction strainer shall be easily accessible.

8.0 Sound

8.1 Sound Level: To maintain the quality of the local environment, the maximum sound pressure levels (dB) measured 50 ft from the tower operating at full fan speed shall not exceed the sound levels detailed below.

<table>
<thead>
<tr>
<th>Location</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
<th>8000</th>
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</thead>
<tbody>
<tr>
<td>Discharge</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Air Inlet</td>
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<td></td>
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<tr>
<td>Cased Face</td>
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<td></td>
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</tr>
</tbody>
</table>

Accessories

9.1 Basin Heater(s): The cooling tower cold water basin shall be provided with electric heater(s) to prevent freezing in low ambient conditions. The heater(s) shall be selected to maintain 40°F (4.4°C) basin water temperatures at ____°F ambient. The heater(s) shall be ____ volt/ ____ phase/ ____ Hz electric and shall be provided with low water cutout and thermostat.

(Alternate) 9.1 Basin Heaters: A steam coil shall be factory installed in the cooling tower depressed sump of the cold water basin to prevent freezing during cold weather shutdown. The steam coil shall be capable of maintaining 40°F (4.4°C) basin water temperature at a –20°F (-28.9°C) ambient temperature given 5 psig at the coil inlet connection.

(Alternate) 9.1 Basin Heaters: A hot water coil shall be factory installed in the cooling tower depressed sump of the cold water basin to prevent freezing during cold weather shutdown. The hot water coil shall be capable of maintaining 40°F (4.4°C) basin water temperature at a –20°F (-28.9°C) ambient using 180°F (82.2°C) entering water temperature and 170°F (76.7°C) leaving water temperature.

9.2 Basin Water Level Control: The cooling tower manufacturer shall provide an electric water level control (EWLC) system. The system shall consist of water level sensing and control units in quantities and locations as indicated on the drawings. Each water level sensing and control unit shall consist of the following: NEMA 4 enclosure with gasketed access cover; solid state controls including all necessary relays and contacts to achieve the specified sequence of operation; stainless steel water level sensing electrodes with brass holder; Schedule 40 PVC standpipe assembly with vent holes, and all necessary stainless steel mounting hardware. Provide PVC union directly below the control enclosure to facilitate the removal and access of electrodes and control enclosure.

The number and position of water level sensing electrodes shall be provided to sense the following: high water level, low water level, high water alarm level, low water alarm, and heater safety cutout.

9.3 Vibration Cutout Switch: Provide mechanical local reset vibration switch. The mechanical vibration cut out switch will be guaranteed to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be a frequency range of 0 to 3,600 RPM and a trip point of 0.2 to 2.0 g’s.

(Alternate) 9.3 Vibration Cutout Switch: Provide electronic remote reset vibration switch with contact for BAS monitoring. Wiring shall be provided by the installing contractor. The electronic vibration cut out switch shall be set to trip at a point so as not to cause damage to the cooling tower. The trip point will be 0.45 in/sec.

9.4 Basin Sweeper Piping: The cold water basin of the cooling tower shall be equipped with PVC sump sweeper piping with plastic educator nozzles. The piping should create a grid under the fill section and force all dirt and debris to the center depressed section of the cold water basin.

...because temperature matters™
9.5 Air intake Option: Provide removable hot dip galvanized steel 1"x1" mesh air intake screens.
(Alternate) 9.5 Air intake Option: Provide removable hot dip galvanized steel 1"x1" mesh air intake screens protected with the BALTIBOND® Corrosion Protection system or Series 300 stainless steel.
(Alternate) 9.5 Air Intake Option: The unit shall be equipped with intake sound attenuators consisting of fiberglass acoustical baffles encased in steel to further reduce sound levels.

9.6 Discharge Option: The discharge plenum shall be equipped with sound absorbing material.

9.7 Access Door Platform: A galvanized steel platform and aluminum ladder to grade shall be provided at all access doors to access the plenum section of the cooling tower. All working surfaces shall be able to withstand 50 psf live load or 200 pound concentrated load.

9.8 Internal Platform: An internal platform shall be provided in the plenum section to provide for inspection and maintenance. All working surfaces shall be able to withstand 50 psf live load or 200 pound concentrated load. Other components of the cooling tower, i.e. basin floor and fill/drift eliminators, shall not be considered an internal working surface. Cooling tower manufacturers that require that these surfaces be used as a working platform shall provide a two-year extended warranty to the Owner to repair any damage to these surfaces caused by routine maintenance.

9.9 Heat Loss: The heat loss shall be no greater than __________. If the heat loss is greater than the specified limit, positive closure dampers or insulation on the hood/casin provided.

10.0 Equipment Controls (Optional)

10.1 Variable Frequency Drive(s): A variable frequency drive (VFD) shall be provided for each fan motor. The supplier of the VFD shall be the manufacturer of the evaporative cooling equipment. The VFD shall have a 3-contactor bypass, 3% input line reactor, a removable keypad, an RS232 terminal for PC connection, and a circuit breaker disconnect. Fuse protection will not be accepted. Control voltage shall be 24V to minimize the size of the enclosure which should not exceed _____ ft x _____ ft x _____ ft and the weight should not exceed _____ lbs. VFD shall be provided in a NEMA (1)(3R)(12) enclosure. The VFD shall be compatible with a (ModBus) (LonWorks) (Johnson N2) Building Automation System.

OR

10.2 Enclosed Controls: An enclosed control panel shall be provided for each cell of the evaporative cooling equipment. The panel shall include full voltage, non-reversing (FVNR) fan motor and pump motor (if applicable) starters in a common enclosure. The panel shall be provided with a main a circuit breaker disconnect and a separate circuit breaker for each motor or speed. Fuse protection will not be accepted. Panels containing basin heaters shall have an Earth Leakage Breaker containing ground fault protection. Starters above 25 A shall be NEMA rated. IEC starters will be accepted for motors below 25 A. Panel shall include a 120V/60Hz control power transformer, Hand-Off-Auto switches for each starter or contactor, and pilot lights for each component. Enclosed controls shall be provided in a NEMA (1)(3R)(4)(4X)(12) enclosure.

Optional enclosed control features: (A temperature sensor shall be provided with the enclosed controls.) (A temperature controller shall be provided with the enclosed controls.) (A basin heater contactor with circuit breaker shall be provided.) (A vibration cutout switch input shall be provided.)

10.3 Safety Switch(es): A heavy-duty, non-fusible safety disconnect switch shall be provided by the manufacturer of the evaporative cooling equipment. Switch shall be single-throw, 3-pole design, rated up to 600 VAC. Switch shall have triple padlocking capability, a visible double break rotary blade mechanism, a clearly visible On/Off handle, an interlocking mechanism to prevent door opening with handle in On position, and a clear line shield. Safety switch shall be provided in a NEMA (1)(3R)(12) enclosure.

10.4 Flow Control Package: The manufacturer shall provide a flow control package consisting of a 3-way flow control valve arrangement with actuator, and all interconnecting piping between the finned coil and the prime surface coil. The package will be designed to maximize plume control and water savings.
HXV Offers Economic Advantages

HXV First Cost Benefits

Heat rejection equipment must be selected for the maximum heat load at summer peak air temperatures. In most climates peak wet-bulb temperatures are significantly lower than peak dry-bulb temperatures. Evaporative cooling equipment based on the ambient air wet-bulb therefore has a greater temperature driving force, thus allowing the use of lower system temperatures. This greater driving force also allows the use of less and thus more cost-effective heat transfer surface area. Since the HXV utilizes evaporative cooling during peak load operation it inherently benefits from this advantage. Evaporatively cooled units such as the HXV have a plan area and fan horsepower advantage over the typical air-cooled arrangement, saving on support structures and electrical hook-ups. The HXV design also avoids the corrosion and scaling that can be associated with spraying of standard air-cooled equipment on design days for additional capacity. The lower process fluid temperatures that can be achieved compared to air-cooled systems and the greatly reduced fouling factors of closed loop cooling result in lower first cost of process equipment such as chillers or refrigeration compressors. Lastly, the costs associated with plume abatement are eliminated, as the design is inherently plume-free.

HXV Operating Cost Benefits

Due to its water saving concept and combined flow design, the HXV offers significant operating cost benefits. Water consumption is minimized throughout the year. During peak summer operation a large amount of heat load is already transferred by the finned coil. As the ambient temperature and/or heat load drops, the amount of evaporative heat transfer is further reduced by controlling the flow through the wet coil. This reduces the evaporation loss and blow-down as well as water treatment requirements compared to conventional evaporative cooling equipment. In the “adiabatic” mode only a small amount of water is needed to saturate the air and the amount of blow-down is reduced even further. Finally in the ‘dry’ mode no water is used at all (while saving the energy associated with running the spray pump). With HXV hybrid units water savings up to 70% or more are possible. Depending on local water costs and availability, this advantage alone can pay for the equipment in as little as two years through cost savings in water use, water treatment chemicals, and higher system efficiencies. In addition, fouling potential associated with open circuit cooling towers is eliminated through both the closed loop cooling system and the Combined Flow Technology™ design of the HXV, assuring peak efficiency and energy savings over time. Finally, the induced draft propeller fan design results in low fan energy requirements compared to centrifugal fan units.

Typical annual distribution of ambient temperature with the three operating modes

Dry-bulb/wet-bulb difference versus climate zone

Closed circuit cooling systems offer the lowest fluid temperatures
Engineering Considerations - Closed Circuit Cooling Towers

Location

Units must have an adequate supply of fresh air to the air inlet(s). When units are located adjacent to building walls or in enclosures, care must be taken to ensure that the warm, saturated discharge air is not deflected off surrounding walls or enclosures and drawn back to the air inlet(s).

CAUTION:

Each unit should be located and positioned to prevent the introduction of the warm discharge air and the associated drift, which may contain chemical or biological contaminants including Legionella, into the ventilation systems of the building on which the unit is located or those of adjacent buildings.

For detailed recommendations on layout, refer to our web site, www.BaltimoreAircoil.com, or consult your local BAC Representative.

For Series V products, bottom screens or solid bottom panels may be desirable or necessary for safety, depending on the location and conditions at the installation site.

Piping and Valves

Piping must be sized and installed in accordance with good piping practice. All piping should be supported by pipe hangers or other supports, not by the unit.

Some installations may require flow balancing valves (supplied by others) at the coil inlets to balance the flow to individual coils and cells. External shutoff valves on the closed circuit loop (supplied by others) may also be required if the system design necessitates the isolation of individual cells.

Although equalizing lines can be used to balance water levels between multi-cell closed circuit cooling towers, the spray water for each cell must be treated separately, and a separate make-up must be provided for each cell. Note that a common remote sump for multi-cell installations can simplify make-up and water treatment – see page M167 for details. See page E83 or the appropriate Operating and Maintenance Manual for more information on water treatment.
Capacity Control

Variable Frequency Drives (VFD)

Installations which are to be controlled by Variable Frequency Drives (VFD) require the use of an inverter duty motor as designed per NEMA Standard MG.1, Section IV, Part 31, which recognizes the increased stresses placed on motors by these drive systems. Inverter duty motors must be furnished on VFD applications in order to maintain the motor warranty.

WARNING:

When the fan speed is to be changed from the factory-set speed, including through the use of a variable speed control device, steps must be taken to avoid operating at or near fan speeds that cause a resonance with the unit or its supporting structure. At start-up, the variable frequency drive should be cycled slowly between zero and full speed and any speeds that cause a noticeable resonance in the unit should be “locked out” by the variable speed drive.

Fan Cycling

Fan cycling is the simplest method of capacity control. The number of steps of capacity control can be increased using the ENERGY-MISER® Fan System, BALTIGUARD PLUS™ Fan System, the independent motor option, or two-speed fan motors in conjunction with fan cycling (see “Custom Features & Options” section of the appropriate product line to determine whether the ENERGY-MISER® Fan System, BALTIGUARD PLUS™ Fan System, or the independent fan motor option are available for the particular product line; two-speed motors are available for all product lines with either belt or gear fan drive systems. All of these options provide substantial energy savings when compared to simple fan cycling, especially the BALTIGUARD PLUS™ Fan System, which provides energy savings and redundancy at a low cost.

WARNING:

Rapid on-off cycling can cause the fan motor to overheat. It is recommended that controls be set to allow a maximum of 6 on-off cycles per hour.

Note: Spray water pump cycling should not be used for capacity control. This method of control often results in short cycling of the pump motor as capacity changes substantially with pump cycling. In addition, alternate wetting and drying of the coil promotes scaling of the heat exchanger coil surface.

Capacity Control Dampers (Series V Models Only)

On Series V models, modulating capacity control dampers are available to provide better leaving water temperature control than can be obtained from fan cycling alone. See page E46 or contact your local BAC Representative for more details.

Vibration Cutout Switches

Vibration cutout switches are recommended on all installations. Vibration cutout switches are designed to interrupt power to the fan motor and/or provide an alarm to the operator in the event of excessive vibration. BAC offers both electronic and mechanical vibration cutout switches on all closed circuit cooling tower models.
**Water Treatment**

As water evaporates in an evaporative cooling unit, the dissolved solids originally present in the water remain in the system. The concentration of these dissolved solids increases rapidly and can cause scale and corrosion. In addition, airborne impurities and biological contaminants, including Legionella, may be introduced into the circulating water. To control all potential contaminants, a water treatment program must be employed. In many cases, a simple bleed-off may be adequate for control of scale and corrosion. Note: Bleed lines are to be provided and installed by others. However, biological contamination, including Legionella, can be controlled only through the use of biocides. Such treatment should be initiated at system startup, after periods of equipment shutdown, and continued regularly thereafter. Accordingly, it is strongly recommended a biocide treatment be initiated when the unit is first filled with water and continued regularly thereafter. For more information, consult the appropriate Operating and Maintenance Manual.

When a water treatment program is employed, it must be compatible with construction materials. The pH of the circulating water must be maintained between 6.5 and 9.0. Units having galvanized steel construction and a circulating water pH of 8.3 or higher will require periodic passivation of the galvanized steel to prevent the accumulation of white, waxy, nonprotective zinc corrosion called white rust. Batch feeding of chemicals into the unit is not recommended. If units are constructed with optional corrosion resistant materials, acid treatment may be considered; however, the water quality must be maintained within the guidelines set forth in the Operating and Maintenance Manual.

**Note:** Unless a common remote sump is utilized, each cell of a multi-cell installation must be treated as a separate entity, even if the cold water basins are flumed together or equalized.

For complete Water Quality Guidelines, see the appropriate Operating and Maintenance Manual, available at www.baltimoreaircoil.com

For specific recommendations on water treatment, contact a competent water treatment supplier.

**Fill Compatibility (FXV Models Only)**

The standard fill in FXV Closed Circuit Cooling Towers is constructed of polyvinyl chloride (PVC) and has a flame spread rating of 5 per ASTM Standard E84. This PVC fill is compatible with the water found in most evaporative cooling applications. For applications where the entering fluid temperature exceeds 140°F, contact your local BAC Representative to confirm that the standard PVC fill is acceptable.

**Sound Levels**

Sound rating data is available for all BAC Closed Circuit Cooling Towers. When calculating the sound levels generated by a unit, the designer must take into account the effects of the geometry of the tower as well as the distance and direction from the unit to noise-sensitive areas. Low sound fans and intake and discharge sound attenuation can be supplied on certain models to provide reduced sound characteristics (see the “Custom Features and Options” section of the appropriate product line for details). The ENERGY-MISER® Fan System, two-speed motors, or variable frequency drives can also be used to reduce sound during periods of non-peak thermal loads. For more information on sound and how it relates to evaporative cooling equipment, see page M124. For detailed low sound selections, please consult your local BAC Representative.
Protection Against Basin Water Freezing

When a unit is shut down in freezing weather, the basin water must be protected by draining to an indoor auxiliary remote sump tank (see page H5 for remote sump engineering data; page M32 for sizing guidelines) or by providing supplementary heat to the cold water basin. Supplementary heat can be provided by electric immersion heaters or in some cases, hot water or steam coils, or steam injectors. All exposed water piping, make-up lines, and spray pumps (if applicable) that do not drain at shutdown should be traced with electric heater tape and insulated.

When dry operation is planned for low ambient conditions, centrifugal fan units should be supplied with oversized fan motors to prevent motor overload when the spray water is not operating. Dry operation with standard fan motors is acceptable for axial fan units. For remote sump applications, the spray water pump must be selected for the required flow at a total head which includes the vertical lift, pipe friction (in supply and suction lines) plus the required pressure at the inlet header of the water distribution system (2.0 psi for FXV models; 1.0 psi for Series V models). A valve should always be installed in the discharge line from the pump to permit adjusting flow to the unit requirement. Inlet water pressure should be measured by a pressure gauge installed in the water supply riser at the spray water inlet, and adjusted to the specified inlet pressure. See page M32 for more information.

Indoor Installations (Applicable to Series V Models Only)

Many indoor installations require the use of inlet and/or discharge ductwork. **Units installed with inlet ductwork must be ordered with solid-bottom panels.** Generally, intake ducts are used only on smaller units while the equipment room is used as a plenum for larger units. Discharge ductwork will normally be required to carry the saturated discharge air from the building.

Both intake and discharge ductwork must have access doors to allow servicing of the fan assembly, drift eliminators, and water distribution system. All ductwork should be symmetrical and designed to provide even air distribution across the face of air intakes and discharge openings.

**WARNING:**

The discharge opening must be positioned to prevent the introduction of discharge air into the fresh air intakes serving the unit or the ventilation systems of adjacent buildings.

**Note:** Axial fan units are not suitable for indoor installations.

Safety

Adequate precautions, appropriate for the installation and location of these products, should be taken to safeguard the public from possible injury and the equipment and the premises from damage. Operation, maintenance and repair of this equipment should be undertaken only by personnel qualified to do so. Proper care, procedures and tools must be used in handling, lifting, installing, operating, maintaining, and repairing this equipment to prevent personal injury and/or property damage.
**Fluid Compatibility**

The fluid to be cooled must be compatible with the coil material (standard serpentine and cleanable header coils are carbon steel, hot-dip galvanized on the outside only). **Fluids not compatible with coil materials can lead to corrosion and tube failure.** Certain fluids may require occasional pressure cleaning or mechanical cleaning of the inside of coil tubes. In such cases the coil must be designed to provide this capability (Optional Coil Configurations: for FXV see page E19, for Series V see page E41, and for HXV see page E67).

**Open/Closed System**

The standard galvanized steel serpentine and cleanable header serpentine coils are carbon steel, hot-dip galvanized on the outside only, and are intended for application on closed, pressurized systems which are not open to the atmosphere. Stainless steel coils or cleanable coil units (with tubes hot-dip galvanized inside and out) are available to cool corrosive fluids or water and ethylene/propylene glycol solutions in systems open to the atmosphere (Optional Coil Configurations: for FXV see page E19, for Series V see page E41, and for HXV see page E67).

**Protection Against Coil Freezing**

At below freezing ambient conditions, the closed circuit cooling tower can experience heat loss even without the recirculating spray water pump and fans in operation. Without a heat load on the circulating fluid, coil freezing can occur even at full flow. Protective means are readily available to avoid potential freeze problems. Where the system will permit, the best protection against coil freeze-up is the use of an industrially inhibited anti-freeze solution. When this is not possible, the system must be designed to meet both of the following conditions:

1. Maintain minimum recommended flow through the coil at all times, as per the table below:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>MINIMUM FLOW (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FXV-42X, 43X, 44X</td>
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<tr>
<td>FXV-Q44X</td>
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<tr>
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<tr>
<td>VFL-072 thru 096</td>
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<tr>
<td>VF1-009 thru 036</td>
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<td>VF1-072</td>
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<td>VF1-096 thru 144N</td>
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<td>VF1-192 thru 288N</td>
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<td>VF1-144 thru 216</td>
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<tr>
<td>VF1-288 thru 432</td>
<td>400</td>
</tr>
</tbody>
</table>

See product sections for applicable heat loss data:

- FXV - page E29
- Series V - page E54
- HXV - page E74
2. Maintain a heat load on the circulating fluid so that the temperature of the fluid leaving the coil will not be below 45°F (7.2°C).

If the process load is extremely light, or if the process is periodically shut off entirely, then an auxiliary heat load must be applied to the circulating fluid when below freezing ambient temperatures exist to prevent damage to the coil. Refer to the Heat Loss Data table (for FXV see page E29, for Series V see page E54, and for HXV see page E74) for the auxiliary heat load requirement. The amount of auxiliary heat necessary to prevent coil freezing can be further reduced by the use of a positive closure damper hood and insulation. Draining the coil is not recommended as a normal method of freeze protection. However, draining is acceptable as an emergency method of freeze protection. Frequent draining can promote corrosion inside the coil tubes. If the coil is not protected by an industrially inhibited anti-freeze solution, an automatic drain valve and air vent is recommended to drain the coil if flow stops or fluid temperature drops below 45°F (7.2°C) when the ambient temperature is below freezing. Note that cold water basin heaters will not provide freeze protection for the coil.

**Code Requirement**

Standard coils are ASME B31.5 compliant and are provided with a Canadian Registration Number (CRN) when required. State or local codes, or certain applications may require the use of pressure vessels designed, fabricated, tested and “U” stamped in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division I. In such cases, the optional ASME “U” Stamp coil must be provided.

**Warranties**

Please refer to the Limitation of Warranties applicable to and in effect at the time of the sale/purchase of these products.