BALTIMORE
AIRCOIL COMPANY

NEXUS™

MODULAR HYBRID COOLER

OPERATION & MAINTENANCE MANUAL

Recommended **Maintenance** Intervals[1]

Inspect and clean as necessary:	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect general condition of the unit and check unit for unusual noise or vibration	✓	✓			
Inspect and clean the fan guard	✓		✓		
Inspect spray water basin and clean as required	✓	✓			
Inspect and flush water distribution system as required	✓		✓		
Check operation of solenoid make-up valve, mechanical make-up valve, and drain valve	✓		✓		
Check and adjust water level in the spray water basin	✓		✓		
Check operation of pump(s)	✓		✓		
Inspect and clean conductivity sensor[2]	✓			✓	
Check basin heater and stand alone BAC heater control panel (optional)	✓			✓	
Drain spray water basin and connected piping					✓
Inspect hCore™ Heat Transfer Technology	✓		✓		
Inspect and clean strainers in piping (by others)	✓		✓		
Inspect unit finish	✓			✓	
Mechanical equipment system:	**Start-Up**	**Monthly**	**Quarterly**	**Annually**	**Shutdown**
Check motor voltage and current	✓			✓	
Check general condition of EC Fan System and clean motor exterior when required	✓			✓	
Check fan for rotation without obstruction	✓		✓		
Check fan cycling for smooth operation	✓		✓		

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service, maintenance, or inspection on or near the fan(s), motor(s), or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

NOTE:

1. Recommended service intervals are the minimum for typical installations. Different environmental conditions may dictate more frequent servicing.
2. Clean the conductivity sensor two weeks after initial start-up.

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NEXUS™ MODULAR HYBRID COOLER

Safety Precautions

DANGER

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service, maintenance, or inspection on or near the fan(s), motor(s), or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

WARNING

- **WARNING:** For basin and heater maintenance – switch off both of the control panels and lock and tag out the main disconnects.
- **WARNING:** The top horizontal surface of the unit is not intended to be used as a walking surface or working platform, and all maintenance should be done in front of the equipment. If access to the top of the unit is desired, the purchaser/end-user is cautioned to use appropriate means complying with applicable safety standards of governmental authorities.
- **WARNING:** Steps must be taken to avoid operation at or near system resonant frequency which could result in fan failure and possible personal injury or damage. Refer to "Resonant Speed Identification Procedure" on **page 40** for more details.
- **WARNING:** The recirculating water system may contain chemicals or biological contaminants, including Legionella, which could be harmful if inhaled or ingested. Personnel exposed directly to the discharge airstream and the associated drift mists, generated during operation of the water distribution system and/or fans, or mists produced by high pressure water jets or compressed air (if used to clean components of the recirculating water system), must wear respiratory protection equipment approved for such use by governmental occupational safety and health authorities.
- **WARNING:** Dangerous voltages are present in this equipment. To service the iPilot™ Control System, disconnect the main electric power supply to the control panel lock out and tag out the circuit. To service all other components on the unit, lock out and tag out the iPilot™ Control System. If ordered, the optional heater control panel should also be locked out and tagged out during service or maintenance.

CAUTION

- **CAUTION:** The operation, maintenance, and repair of this equipment shall be undertaken only by personnel authorized and qualified to do so. All such personnel shall be thoroughly familiar with the equipment, the associated system and controls, and the procedures set forth in this manual. Proper care, personal protective equipment, procedures, and tools must be used in handling, lifting, installing, operating, maintaining, and repairing this equipment to prevent personal injury and/or property damage.
- **CAUTION:** Protect and secure this equipment and its premises against access by unauthorized personnel. Personal injury to members of the public could result from interaction with the electrical and mechanical elements of this equipment.
- **CAUTION:** All electrical, mechanical, and rotating machinery are potential hazards, particularly for those not familiar with their design, construction, and operation. Accordingly, use appropriate lockout procedures. Adequate safeguards (including the use of protective enclosures where necessary) should be taken with this equipment both to safeguard the public from injury and to prevent damage to the equipment, its associated system, and the premises.
- **CAUTION:** This equipment should never be operated without all access panels in place. For the protection of authorized service and maintenance personnel, install a lockable disconnect switch located within sight of each equipment control panel.
- **CAUTION: S**teps must be taken to avoid operation at or near system resonant frequency which could result in fan failure and possible personal injury or damage.

Equipment Precautions

NOTICE

- BAC units are typically installed immediately after shipment and many operate year round. However, if the unit is to be stored for a prolonged period of time either before or after installation, certain precautions should be observed, as outlined in "Storage & extended Shutdown" on **page 17**.
- Covering the unit with a clear plastic tarpaulin during storage can trap heat inside the unit and cause damage to the PVC components. If units must be covered during storage, an opaque, reflective tarp should be used.
- Do not use steam or high pressure water to clean PVC eliminators, or materials other than steel.
- Do not use high pressure water exceeding 60 psi to clean the hCore™ Heat Transfer Technology
- Do not use sharp or pointed objects, including screwdrivers and similar, for cleaning the hCore™ Heat Transfer Technology.
- If noise or vibration persists, shut the unit down and correct the cause before continuing operation.
- Never use chloride or chlorine based solvents such as bleach or muriatic (hydrochloric) acid to clean stainless steel. It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.
- The basin heater is not designed to prevent icing during unit operation.

General Maintenance Information

The services required to maintain a piece of evaporative cooling equipment are primarily a function of the quality of the air and water in the locality of the installation:

- **AIR:** The unit should be located such that unusual quantities of industrial smoke, chemical fumes, salt, or heavy dust do not enter the equipment. Such airborne impurities entering into the equipment and absorbed by the recirculating water, which can form a corrosive solution.
- **WATER:** As water evaporates from the equipment, dissolved solids are left behind, which were originally contained in the make-up water. These dissolved solids may be either alkaline or acidic and as they are concentrated in the circulating water, they can cause scaling or accelerated corrosion.

The extent of impurities in the air and water determines the frequency of most maintenance services and also governs the extent of water treatment which can vary from a simple continuous bleed and biological control to a sophisticated treatment system. Refer to "Water Treatment" on **page 30** and "Biological Control" on **page 32** for more details.

Warranties

Please refer to the Limitation of Warranties in the submittal package applicable to and in effect at the time of the sale/purchase of these products. Described in this manual are the recommended services for start-up, operation, and shutdown, and the approximate frequency of each.

1

NEXUS™ MODULAR HYBRID COOLER

Start-Up & Operation

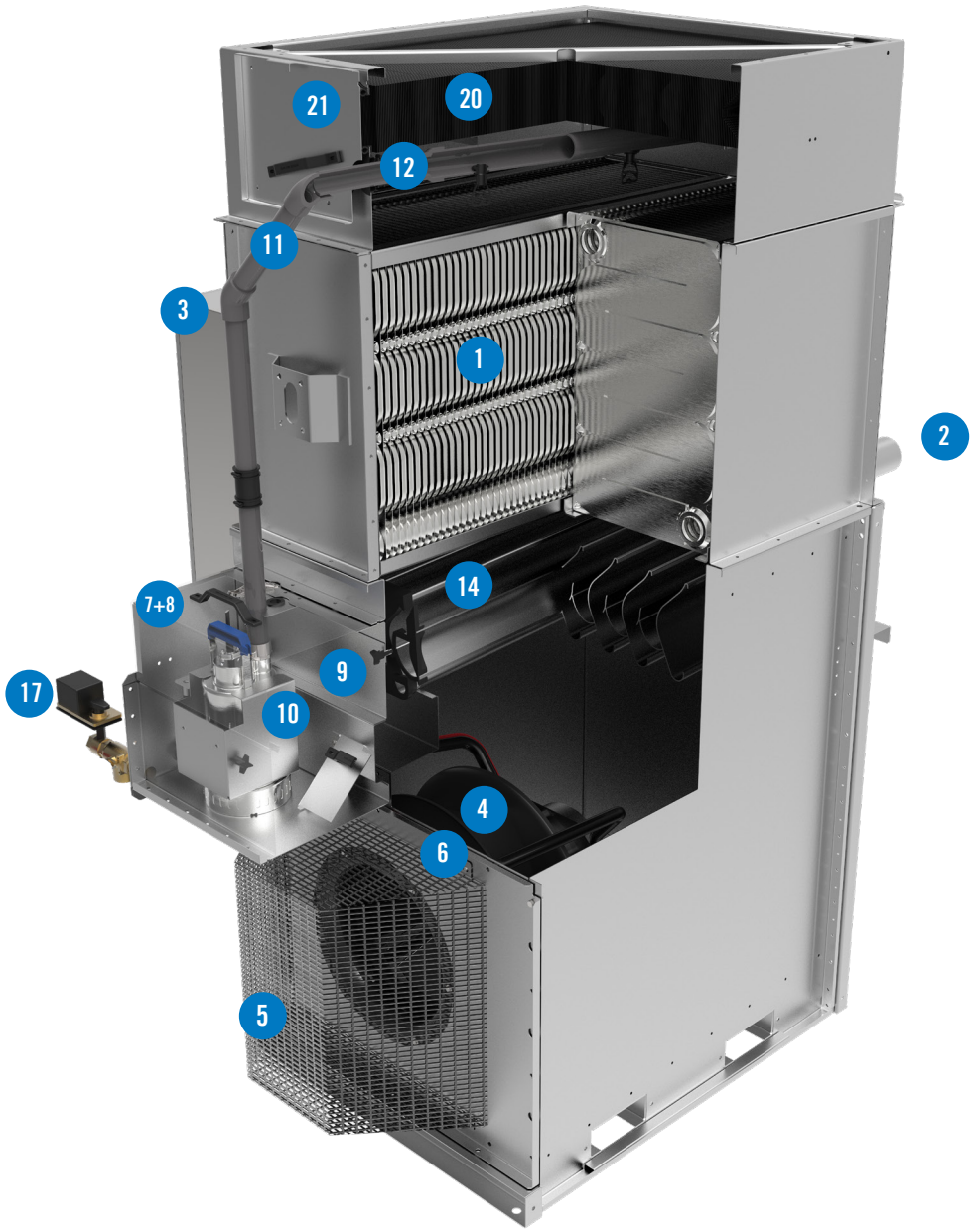

Figure 1. Nexus™ Modular Hybrid Cooler

1. **hCore™ Heat Transfer Technology:** Exclusive closed loop heat transfer section with stainless steel construction that offers high corrosion-resistance.
2. **Fluid Connections:** Fewest field piping connections due to innovative, easy-to-install manifold with grooved connections.
3. **iPilot™ Control System:** Automatically controls equipment operation according to your specific needs, including energy savings desired, water savings desired, and water management.
4. **EC Fan System:** This Electronically Commutated (EC) Fan System includes a direct-drive radial fan and a variable-speed EC motor.
5. **Fan Guard:** Protects operators and blocks large debris.
6. **Hinged EC Fan System Access Panel:** Allows for easy access to the EC Fan System.
7. **Spray Water Basin:** Small, workbench-height basin that collects recirculating spray water.
8. **Basin Access Cover:** Allows easy access inside the spray water basin for inspection and service.
9. **Basin Interior Access Panels:** Allows access to the water diverter and air baffle.
10. **Spray Pump:** Continuously circulates water through the system to meet cooling demand. There is also an integral strainer to the spray pump which prevents large debris from entering pump and spray distribution. Constructed of stainless steel for corrosion-resistance.
11. **Riser Pipe:** Directs water to the spray distribution.
12. **Water Distribution System:** Evenly wets the hCore™ Heat Transfer Technology for optimal thermal performance and reliability.
13. **Water Diverter:** Creates water turbulence in basin to minimize maintenance.
14. **High and Low Level Switches (Not Shown):** Sends water level signals for monitoring and control.
15. **Mechanical Make-up Valve (Not Shown):** Provides fresh water to the unit to replenish water that evaporates through the evaporative cooling process and is bled from the sump.
16. **Solenoid Make-up Valve (Not Shown):** Normally closed valve controls when water is sent to the basin during wet operation.
17. **Drain Valve:** This motorized valve is conductivity-controlled and is used to periodically drain water to maintain water quality. It is also used to fully drain the basin to minimize maintenance.
18. **Conductivity Sensor (Not Shown):** Sends signal that controls drain valve based on water conductivity.
19. **Outside Air Temperature Sensor (Not Shown):** Sends signal that controls fan and pump operation based on user inputs.
20. **High Efficiency Drift Eliminators:** Ensures that recirculating water remains in the unit during operation.
21. **Spray Distribution Access Panel:** Allows for access to spray branches, nozzles, and drift eliminators

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Start-Up

General

- If the unit will be in storage prior to start-up, follow the "Prolonged Outdoor Storage" instructions on **page 17**.
- It is strongly recommended to install a removable 1/16" mesh strainer upstream of the process fluid inlet to prevent large debris from entering the hCore™ Heat Transfer Technology (closed loop heat transfer section).
- If the unit is mounted on vibration isolators (by others), refer to the vibration isolation manufacturer's guidelines before loading/unloading weight from the unit.
- Before opening the iPilot™ Control System panel, follow the proper lockout / tagout procedures.
- It is recommended to install a strainer or filter in the make-up water supply line as close as possible to the solenoid valve as possible to protect the valve from debris buildup and diminished operation.
- Before starting the system the first time, flush the make-up supply water piping to the unit for at least 5 minutes to remove construction debris.
- Before starting system the first time, flush the hCore™ Heat Transfer Technology for at least 5 minutes to remove construction debris.

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Cleaning and Inspection

- Ensure that the water diverter (see **Figure 2**) is free of dirt and debris.
- Flush the spray water basin interior to remove any accumulated dirt and debris. Use a garden hose to remove any dirt and debris.

Figure 2. Water Diverter

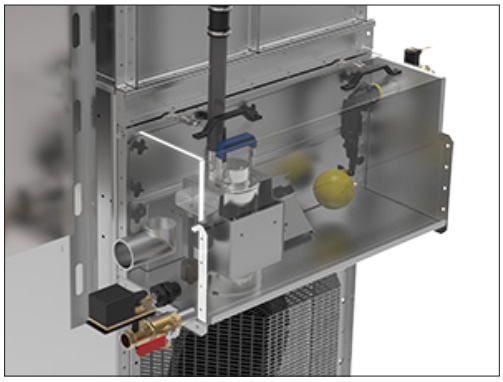

Figure 3. Spray Water Basin

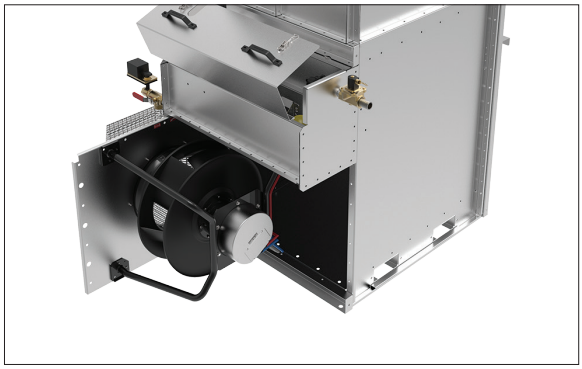

Figure 4. Hinged Access Fan Panel

- Remove spray distribution access panels, and inspect and clean the spray branch, nozzles, and drift eliminators as necessary.
- Remove all dirt and debris from the fan guard(s).
- Open hinged access fan panel (see **Figure 4**) to clean all mechanical components and to remove dirt and debris from plenum area.
- The installation and manufacturing processes used for field assembly of steel-piped systems may leave weld byproducts inside the hCore™ Heat Transfer Technology and connecting piping. It is common practice to install filters and/or strainers that remove contaminants during initial system operation. Shortly after system start-up, the filters and/or strainers should be cleaned or replaced.
- Conduct external inspection of the equipment, sensors and probes. Check for leaks, corrosion, and any structural damage.
- Conduct internal inspection of the equipment. Check for anything unusual such as structural or mechanical component damage.
- Inspect wiring and connections for all the components.
- Confirm that wiring and connections inside of the iPilot™ Control System panel are secured.
- Inspect riser pipe(s) and connections.
- Inspect process fluid manifold piping and connections.
- Thoroughly inspect the fan(s) and pump(s) for any mechanical or physical damage.
- Verify that fan(s) rotates freely.
- Inspect solenoid valves, make-up valves, drain valves, and level switches.
- Check that the mechanical make-up valve is operating freely.

Pre Start-up Checks

- Verify that the following items are turned off and the unit is locked out/tagged out:
  - Supply power disconnect
  - Fan motor(s)
  - Pump motors
  - iPilot™ Control System (control panel)
  - Basin heater control panel (optional)
  - Basin heaters (optional)
  - Positive closure dampers
- Verify that all panels are closed and secure, including the following:
  - Fan access panel
  - Spray distribution access panel
  - Basin access cover
  - iPilot™ Control System panel door
  - Heater control panel door (if ordered)
- Verify the following water connections:
  - Solenoid make-up valve – Incoming water pressure must be between 20 and 75 psig

Figure 5. Panels to Secure

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DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service, maintenance, or inspection on or near the fans, motors, or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

WARNING: Dangerous voltages are present in this equipment. Disconnect the electrical service of the source and tag the circuit out before servicing or replacing components.

  - Drain valve
  - Overflow
- Turn the water supply on.
- Set the make-up float valve so the water shuts off at the operating level, see **Table 2** on **page 22** and **Figure 17** on **page 23**.
- Ensure proper water treatment. Refer to **page 30** for details.
- Verify the voltage stated in the submittal package matches the incoming power at the job site.
- Verify that the supply power is connected to the iPilot™ Control System.
- Verify that Building Management System (BMS) interface is correctly wired to the iPilot™ Control System.
- Turn on all breakers inside the iPilot™ Control System.
- Close the iPilot™ Control System panel and ensure that all the locks have been fully engaged and secured by rotating them 90° with a flathead screwdriver or coin.
- Turn on the main power supply to the unit.
- Verify wiring from each component to the iPilot™ Control System.
- Verify component operation by entering the Main Menu of the user interface, select Point Overview, and change Manual Mode to On. Refer to the "iPilot™ Control System Appendix" on **page 45**.
- On units that are powered with 230/460V three phase, the power must be connected properly to ensure that the pumps rotate clockwise. The wiring should be installed to have incoming power U phase connected to panel L1, V phase to L2, W phase to L2, and E phase to ground. It is recommended that a rotation meter be used to confirm the power is connected to allow clockwise operation.
- Verify that fan(s) are rotating in the correct direction (clockwise when looking into the unit from the outside) by operating each component in "Manual mode".
- Check for unusual noise or vibration.
- After verifying component operation, re-enter the Main Menu and change Manual Mode to Off and ensure that overational system value (OSV) is Off.

Start-Up

- For initial start-up, clean the conductivity sensor after two weeks of service.
- Ensure that main disconnect switch on the iPilot™ Control System is turned On.

The iPilot™ Control System will arrive onsite preconfigured with factory default values and requires field setup. There are three methods of equipment control:

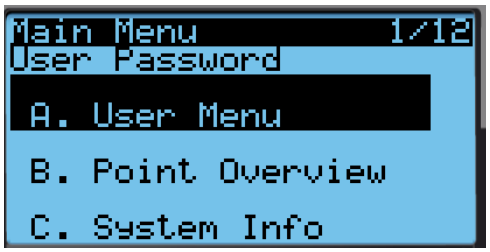
1. Local control without a Building Management System (BMS) interface
2. Local control with a BMS interface (See **Table 15** on **page 57** for the BMS data points).
3. Customer Input: Control using analog input (0-10 VDC, 10-0 VDC, or 4-20 mA) by others.

- Refer to "iPilot™ Control System Appendix" on **page 45** for more information including for controls connections.
- Anytime equipment operation is required, Run Enable must be turned On either locally through the iPilot™ Control System interface or remotely with a signal by others.

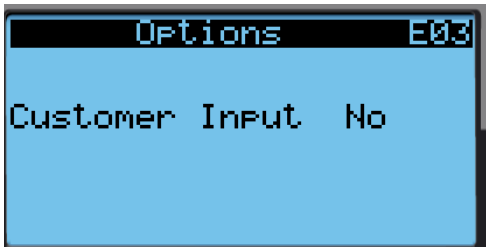
For Local Control without a Building Management System (BMS) Interface

- Enter password “0000” to access user menus. We recommend creating a unique password at start-up.

- Navigate to User Menu and press enter.

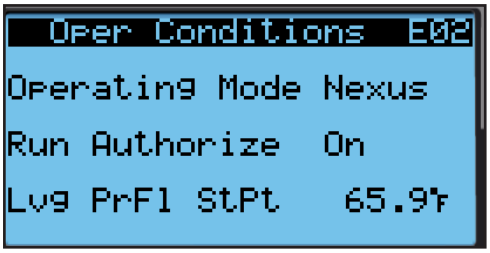


- Ensure that Customer Input is set to “No”.



- Ensure that BMS On/Off Control is set to “No”.

- Select desired “Operating Mode” (see Selecting Your Operating Mode on **page 50** for details about which mode to select), set Run Authorize to On, and adjust setpoint to desired leaving fluid temperature. Run Authorize may also be toggled by remote contacts by others; see wiring diagram for details.

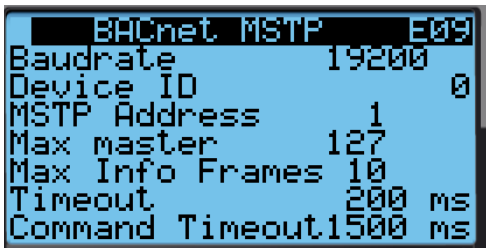


For Local Control with a BMS Interface

Unit Run Authorization Disabled

- Ensure that the BMS is wired properly per wiring diagram located in the iPilot™ Control System.
- Navigate to BMS Communication screen and select your communication type (Modbus or BACnet).

- On the following screen, adjust your BMS configuration as required.

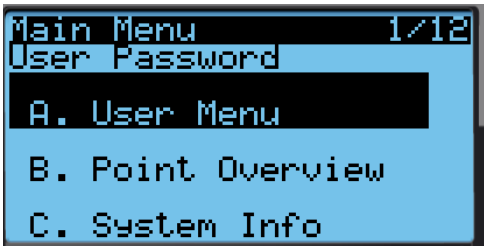


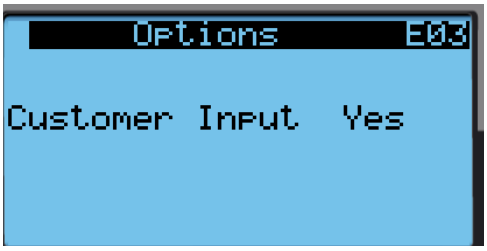
Unit Run Authorization Enabled

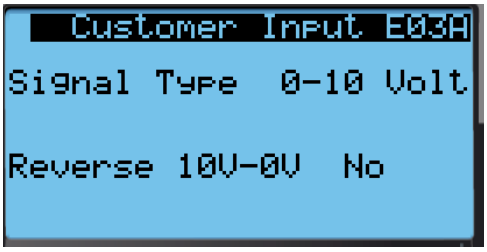
- To enable unit access via BMS, change "Enable Unit Run Access via BMS" to "Yes".
- Do Not enable "Yes" unless unit run authorization access via BMS is required.

For Control Using Customer Input

- Ensure that analog input is wired properly per the wiring diagram located in the iPilot™ Control System.
- Navigate to User Menu.
- Change Customer Input to Yes, then select signal type.







After 24 hours of operation under thermal load, perform the following services:

- ✓ Check the unit for any unusual noises or vibrations.
- ✓ Check the operating water level in the cold water basins.
- ✓ Adjust the mechanical make-up valve if necessary.
- ✓ Inspect the spray nozzles and the hCore™ Heat Transfer Technology.

Optional Controls Settings

For optimal control setup based on your system needs, you may select the following optional controls settings (refer to the "iPilot™ Control System Appendix" on **page 45** for more details):

- **Water Management**
  - **Time-based Bleed:** Frequency and duration of bleed

- **Conductivity-based Bleed**: Conductivity threshold value for bleed (recommended)
- **Time-based Drain**: Time and frequency of complete basin drain (optional)

- **PI-Parameters**
  - **Prop. Band** – Proportional band of PI controller
  - **Integr. Time** – Integration time of PI controller
  - For addition parameters, see the "iPilot™ Control System Appendix" on **page 45**.

Operation

The Nexus™ Modular Hybrid Cooler balances energy and water savings by operating each module wet or dry. One of the following operating modes can be selected (see **page 40)** to best fit your system needs:

Energy Saver Mode

Maximum Energy Savings

In Energy Saver Mode, energy savings are maximized by leveraging the full power of evaporative cooling. During periods when ambient temperatures or loads from the building or process are relatively high, the Nexus™ Modular Hybrid Cooler operates with all spray systems active across all modules. During off-design conditions, the EC Fan System will automatically and intelligently reduce speed whenever possible. As the load is satisfied, the fans and spray pumps will cycle off.

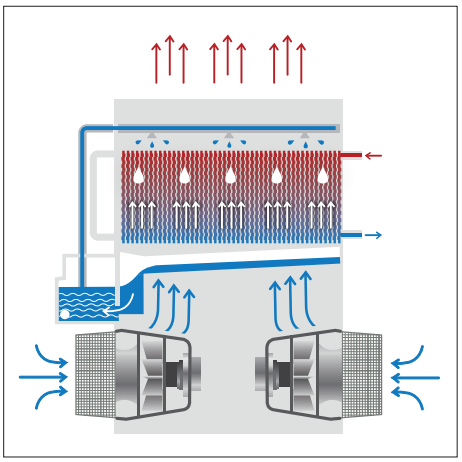


Figure 6. Energy Saver Mode

When demand increases and calls for heat rejection, each module turns on in sequence. Once all modules are turned on, all fans operate at a synchronized speed.

Nexus Mode

Balanced Energy and Water Savings

In the revolutionary Nexus Mode, you can prioritize water and energy savings to achieve the right balance of both. Your climate, cooling load profile and the rates you pay for water and energy will determine your specific settings, which can easily be re-adjusted as needed. You can specify the importance of water versus energy savings to automatically achieve the right balance for your specific situation.

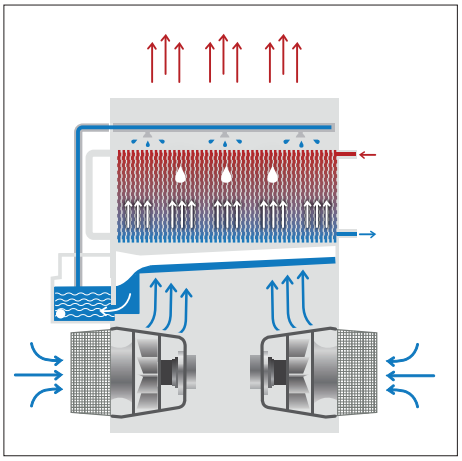


Figure 7. Nexus Mode

When demand increases and calls for heat rejection, all fans ramp up simultaneously. Once all fans reach 100% fan speed, each pump turns on one module at a time to meet building demand. In Nexus mode, the user can choose how to balance energy savings and water savings by adjusting the iPilot™ Control System by selecting a program setting from 1-7 with 1 being maximum energy savings while dry and 7 being maximum water saving.

Water Saver Mode

Maximum Water Savings

In Water Saver Mode, water savings are maximized by leveraging the dry efficiency of the hCore™ Heat Transfer Technology and operating without spray water. To meet increasing loads, the EC Fan System will automatically and intelligently increase speed and the spray pumps will activate only when necessary (Winter Guard Disabled).

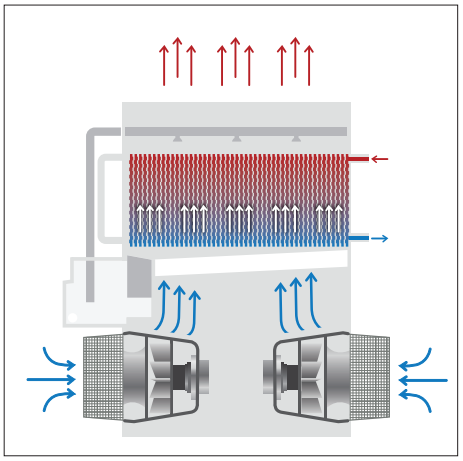


Figure 8. Water Saver Mode

Within Water Saver Mode, there are two options:

1. **Winter Guard Disabled (Recommended)**: When demand increases and calls for heat rejection, each pump will turn on when demand exceeds the capacity of the unit while running dry. This mode is recommended to ensure that heat load can be rejected by evaporative cooling when required.
2. **Winter Guard Enabled:** When demand increases and calls for heat rejection, all fans ramp up simultaneously, and all modules will only run dry. This mode is typically utilized when the make-up water line has been winterized / shutoff to the unit during cold weather and / or the load is greatly reduced during winter months.

NOTE: Be sure to open make-up supply line before Winter Guard is disabled and confirm that the spray water basin is filled. .

Spray Water Basin and Pump Water Control

- Verify that incoming water pressure is between 20 and 75 psig.
- When the iPilot™ Control System calls for evaporative cooling, the solenoid make-up valve will open, the mechanical make-up valve will open, the drain valve will close, and water will fill the basin.
- Once the water reaches operating level, the mechanical make-up valve will close, there will be a brief delay, and the pump(s) will cycle on in a staged operation to recirculate water.
- As water evaporates, the mechanical make-up valve will open to ensure that the water level is maintained.
- If the pump receives a signal to operate and the water level is too low, the iPilot™ Control System will indicate a corresponding fault and the system will switch to Water Saver Mode with Winter Guard enabled. To re-enable evaporative cooling, correct the issue and reset the alarm on the user interface.

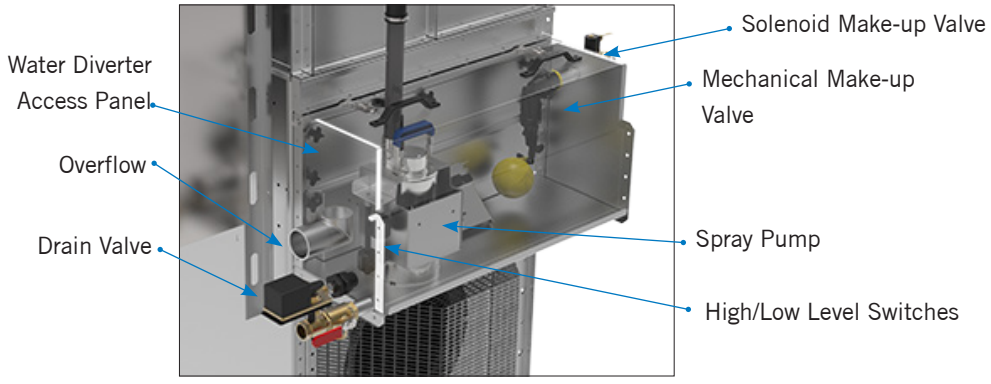


Figure 9. Spray Water Basin

Maintaining Water Quality

The iPilot™ Control System is preset at the factory in accordance with BAC's Water Quality Guidelines. Water quality can be controlled as follows:

- A conductivity sensor is included to constantly measure water conductivity. During operation, the drain valve will slowly open to control conductivity by draining water from the spray water basin to meet the setpoint (the default setpoint is set at 3300 micro ohms/cm).
- BAC recommends adjusting the conductivity setpoint in the iPilot™ Control System to to best minimize water consumption and keep heat transfer surfaces scale-free. . Refer to "Corrosion Protection" on **page 30** for more details.
- A time-based bleed can be enabled by entering frequency and duration.
- An optional time-based drain can be enabled during periods of inactivity, and the basin will not refill until building demand requires evaporative cooling. Refer to the "iPilot™ Control System Appendix" on **page 45**.

Fan Control

The fans are controlled by the iPilot™ Control System by each of the following methods:

- The included temperature sensor at the outlet of the hCore™ Heat Transfer Technology is a negative temperature coefficient (NTC) sensor and sends a signal to the controller in the iPilot™ Control System, which modulates the fan speed accordingly.
- If the temperature signal is lost, an alarm will occur and the fans will continue to operate at the most recent fan speed prior to loss of signal.
- If required, an analog signal (0-10V, 10-0V and 4-20mA) can be provided by the user to control the fan. It is recommended to have the iPilot™ Control System automatically modulate the fan speed for optimal energy and water savings. This method of fan control is only available in Energy Saver Mode, and Water Saver Mode with Winter Guard enabled.
- For 2-fan modules (NXF-0603), ensure that both fans are operating simultaneously for proper air and water management.

Cold Weather Operation

The iPilot™ Control System has been designed to protect the equipment during freezing conditions.

- All spray pumps will turn off below 35°F (1.7°C) ambient temperature, and the equipment will automatically operate in Water Saver Mode with (Winter Guard enabled).

NOTE: For the units with the heater option installed, units are shipped with two separate control panels – one iPilot™ Control System and one heater control panel (which must be interconnected).

WARNING: For basin and heater maintenance – switch off both of the control panels and lock and tag out the main disconnects.

- When the optional basin heaters are not included:
  - Once ambient temperature drops below 35°F (1.7°C), water will remain in the basin for 1 hour and then the water will be drained.
  - The solenoid make-up valve will remain closed until the ambient temperature is above 35°F (1.7°C) and when evaporative cooling is required.
- When optional basin heater(s) are included, the basin heater(s) turn on when the

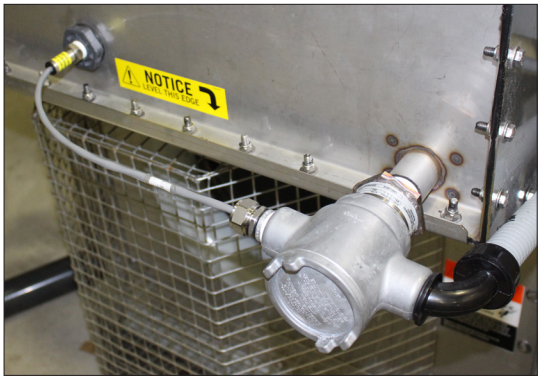


Figure 10. Optional Basin Heater(s)

following conditions are met:
  - Spray water basin temperature drops below 40°F (4.4°C).
  - Spray pumps are off.
  - Sufficient water level in the basin.
- When the ambient temperature remains below 40°F (4.4°C), water will remain in the basin for the duration of the user-defined time-based drain.

hCore™ Heat Transfer Technology Freeze Protection

For protection against freezing of the hCore™ Heat Transfer Technology (closed loop heat transfer section), recommended methods are an industrial grade inhibited ethylene glycol or propylene glycol solution. When the use of glycol is not practical, the system must be designed to meet both minimum flow and minimum temperature requirements.

- See **Table 1**, for hCore™ Heat Transfer Technology volumes for Nexus™ Modular Hybrid Cooler models.
- When a glycol solution is not utilized, operate the system to meet the following conditions.
  - Maintain the minimum recommended flow through the hCore™ Heat Transfer Technology at all times (see **Table 1**).
- Maintain a minimum heat load on the circulating fluid so that the temperature of the fluid leaving the coil is not less than 45°F (7.2°C).
- To maintain the leaving fluid temperature at 50°F (10°C) when the process load is extremely light or shut off, apply an auxiliary heat load to the circulating fluid and adjust the flow to ensure that fluid leaving the coil maintains the minimum required temperature.

Positive Closure Dampers (PCDs) (Optional)

The amount of auxiliary heat required can be substantially reduced by the use of positive closure dampers at the unit air discharge (see **Figure 11**). The dampers remain open during operation of each module, and the dampers close when the fans are turned off or when the unit is powered off. The heat loss data can be found in **Table 1.**

Model	Total Internal hCore™ Heat Transfer Technology Volume (gal)	Minimum Flow (GPM)	Equipment Heat Loss (BTU/hour)	Equipment Heat Loss with Optional PCDs (BTU/hour)
NXF-0403N-CS2TS-H1	27	24	52,706	24,402
NXF-0403N-CS2TS-H2	53	48	104,413	47,961
NXF-0403N-CS2TS-H3	79	72	155,120	70,693
NXF-0403N-CS2TS-H4	105	96	204,828	92,614
NXF-0403N-CS2TS-H5	131	120	253,537	113,741
NXF-0403N-CS2TS-H6	157	144	301,249	134,090
NXF-0403N-CS2TT-H1	27	12	52,706	24,402
NXF-0403N-CS2TT-H2	53	24	104,413	47,961
NXF-0403N-CS2TT-H3	79	36	155,120	70,693
NXF-0403N-CS2TT-H4	105	48	204,828	92,614
NXF-0403N-CS2TT-H5	131	60	253,537	113,741
NXF-0403N-CS2TT-H6	157	72	301,249	134,090
NXF-0603N-CS2TS-J1	39	36	86,654	31,244
NXF-0603N-CS2TS-J2	78	72	170,307	60,537
NXF-0603N-CS2TS-J3	117	108	250,992	87,955
NXF-0603N-CS2TS-J4	156	144	328,749	113,578
NXF-0603N-CS2TS-J5	165	180	403,623	137,484
NXF-0603N-CS2TS-J6	234	216	475,666	159,753
NXF-0603N-CS2TT-J1	39	18	86,654	31,244
NXF-0603N-CS2TT-J2	78	36	170,307	60,537
NXF-0603N-CS2TT-J3	117	54	250,992	87,955
NXF-0603N-CS2TT-J4	156	72	328,749	113,578
NXF-0603N-CS2TT-J5	165	90	403,623	137,484
NXF-0603N-CS2TT-J6	234	108	475,666	159,753

Table 1. Internal Volume and Minimum Recommended Flow and Heat Loss

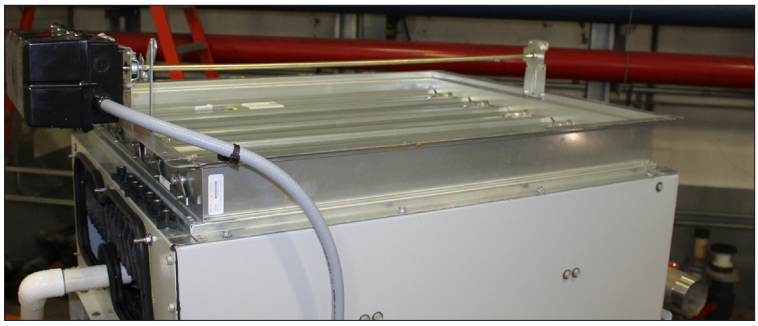


Figure 11. Optional Positive Closure Dampers (PCDs)

Emergency hCore™ Heat Transfer Technology Drain

The hCore™ Heat Transfer Technology (closed loop heat transfer section) is constructed of corrosion-resistant stainless steel, so it may be drained frequently. However, frequent draining of any piping constructed of carbon steel, including the header piping, promotes corrosion inside the pipes. Therefore, if frequent draining is required, ensure that the header and system piping are constructed of corrosion-resistant materials before draining regularly.

Draining is acceptable as an emergency method of freeze protection if the hCore™ Heat Transfer Technology is not protected by a glycol solution. If frequent draining is required for freeze protection, an automatic drain valve and vacuum breaker are recommended to drain the hCore™ Heat Transfer Technology if flow stops or the fluid temperature drops below 45°F (7.2°C) when the ambient temperature is below freezing. Further protection against hCore™ Heat Transfer Technology freeze-up is possible with the installation of an alarm to alert personnel when the temperature of the fluid leaving the section falls below 45°F (7.2°C). For more information, see "Detailed Component Maintenance Procedures" on **page 20**.

Contact your local BAC Representative for guidelines on the installation of an emergency hCore™ Heat Transfer Technology drain system.

Spray Water Basin Protection

It is important to protect the basin and internal piping. The spray water basin could freeze when the unit is shutdown and be exposed to subfreezing ambient temperatures. When optional basin heaters are not included, the spray water basin will drain one hour after the temperature remains below 35°F (1.7°C).

- **Heat Tracing:** Heat trace the make-up water lines and the drains with electrical heater tape.
- **Basin Heaters (Optional):** For buildings that benefit from keeping water in the spray water basin, basin heaters can be inclued in the spray water basin for freeze protection duing subfrezing ambient temperature.

Contact your local BAC Representative for more details.

Storage & Extended Shutdown

Prolonged Outdoor Storage

- Conduct the "Extended Shutdown" procedure on **page 19** if the unit is installed.
- For storage prior to installation, all components and accessories that ship loose should be removed and stored indoors.
- Ensure the spray water basin is fully drained and the drain is open.
- If the manifold is constructed of carbon steel, then the hCore™ Heat Transfer Technology should be capped and charged with nitrogen at 15 psig in the field and capped.
- Insert desiccant bags into the control panel(s) to absorb moisture. Seal the control panel for storage.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to "Corrosion Protection" on **page 30** for more details.

NOTICE: Covering the unit with a clear plastic tarpaulin during storage can trap heat inside the unit and cause damage to the PVC components. If units must be covered during storage, an opaque, reflective tarp should be used.

Motor Recommendation

BAC standard motors are designed for storage at ambient temperatures of -13°F to 104°F (-28.9°C to 40°C). Prolonged periods of exposure above or below these specified conditions could degrade components of the motor and cause malfunction or premature failure.

- EC Fan System should be removed and stored inside whenever possible. When indoor storage is not possible the motor must be covered with a loose fitting tarpaulin. Do not use plastic/plastic film. This cover should extend below the motor and be secured; however, it should not tightly wrap the motor. This will allow the captive air space to breathe, minimizing formation of condensation.
- Care must also be taken to protect the motor from flooding or from harmful chemical vapors.
- The storage area should be free from ambient vibration. Excessive vibration can cause bearing damage. Motors that must be stored in areas with high ambient vibration, such as from heavy construction equipment or other sources, must have the fan secured to prevent any movement.
- Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the unit. In areas where they are prevalent, precautions must also be taken to prevent insects from gaining access to the interior of the unit.

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service on or near the fans or motors or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

- If not stored indoors in a controlled environment, some form of heating must be utilized to prevent condensation from accumulating in the motor. This heating should maintain temperature at a minimum of 9°F (5°C) above the ambient temperature of the room, keeping it from dropping below the dew point where condensation could form inside the motor.
- Rotate the motor shaft monthly to redistribute bearing grease.

Start-Up Preparation After Prolonged Storage

Keep in mind that start-up procedures after long periods of storage are just as important as pre-shutdown procedures.

- Fans and motors should be thoroughly inspected and cleaned to restore them to pre-storage condition.
- Reinstall all components, panels, and drain plugs (as applicable), and remove all protective coverings.
- For units stored prior to installation, conduct rigging procedures as directed in the unit's *Rigging and Assembly Instructions*, by contacting your local BAC Representative.
- Perform an insulation test to ensure satisfactory insulation resistance.
- Conduct full start-up procedure as stated in "Start-Up" on **page 8**. Be especially thorough for cleaning and inspection prior to start-up.

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service, maintenance, or inspection on or near the fan(s), motor(s), or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

Extended Shutdown

Perform the following services whenever the unit is shutdown in excess of three days:

- Units that have been installed and operated should remain filled. If the unit is stored in a freezing climate, the hCore™ Heat Transfer Technology must be protected from freezing. For protection against hCore™ Heat Transfer Technology freeze-up, BAC recommends the use of an inhibited glycol solution. If protecting the hCore™ Heat Transfer Technology with glycol is not possible, then it should be drained completely and capped once as much water and moisture is removed as possible.
- If the unit is mounted on vibration isolators or isolation rails (by others), refer to the manufacturer's guidelines before loading/unloading weight from the unit.
- Disconnect, lockout, and tagout all fans and pumps.
- Close the shut-off valve in the make-up water line (supplied by others) and drain all exposed make-up water piping.
- Heat trace and insulate all exposed piping.
- To protect from freezing and to minimize the risk of biological contamination during shutdown, drain the spray water basin.
- Clean all debris, such as leaves and dirt, from the interior and exterior of the unit.
- Clean and flush the water distribution system and spray water basin.
- Leave the spray water basin drain open so rain and melting snow will drain from the unit.
- Cover the unit discharge to keep out dirt and debris.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to "Corrosion Protection" on **page 30** for more details.
- Lockout the fan motor starting device in the "OFF" position to ensure personal safety in case of future inspection or service.

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

3 Detailed Component Maintenance Procedures

hCore™ Heat Transfer Technology

The hCore™ Heat Transfer Technology is an exclusive closed loop heat transfer section with stainless steel construction that offers high corrosion-resistance.

Figure 12. Cutaway View of hCore™ Heat Transfer Technology

NOTE: This is a cutaway view of the hCore™ Heat Transfer Technology. The only access will be from the top.

NOTICE: Do not use sharp or pointed objects, including screwdrivers and similar, for cleaning.

- Quarterly, inspect the surface, and use garden hose to spray water from the top to clear any obstructions.
- For instructions and cautions regarding draining the hCore™ Heat Transfer Technology frequently, refer to "Emergency hCore™ Heat Transfer Technology Drain" on **page 16**.
- To drain the heat exchanger on models with a crossover pipe, open the vent at the top of each crossover pipe, and open the drain at the bottom to drain the fluid.

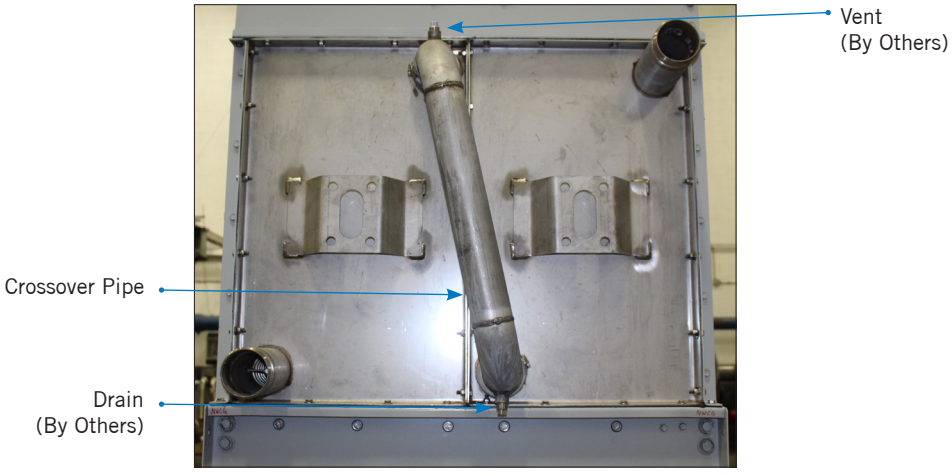


Figure 13. hCore™ Heat Transfer Technology Draining

- To drain the hCore™ Heat Transfer Technology on models without a crossover pipe, drain the system piping as necessary to remove fluid from the hCore™ Heat Transfer Technology using a centrally located drain valve.

EC Fan System

The Electronically Commutated (EC) Fan System includes a direct-drive radial fan and a variable-speed EC motor.

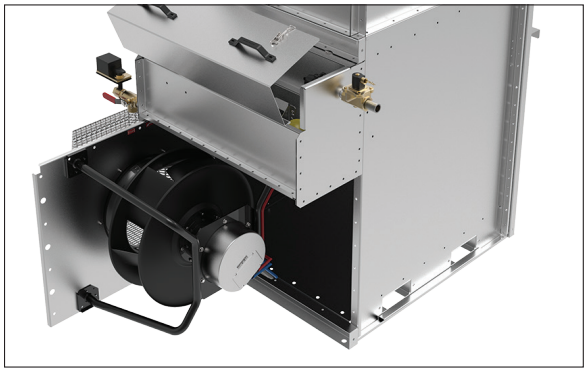


Figure 14. Swing-Out EC Fan System

- Quarterly, check for vibration and tighten external fasteners as necessary.
- For internal access to the EC Fan System, remove bolts as shown highlighted below.

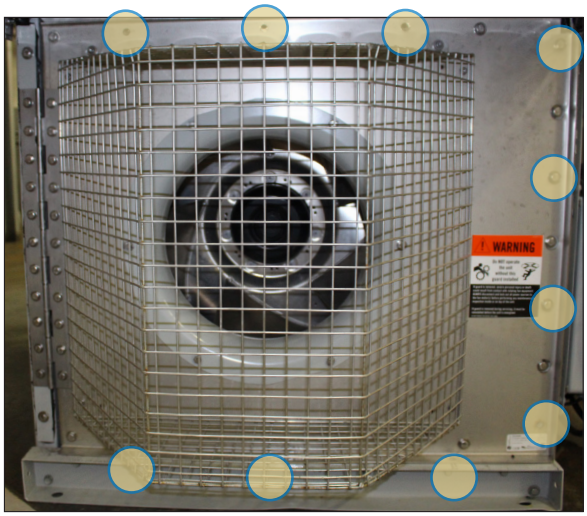


Figure 15. Swing-Out EC Fan System

- Correct any excessive noise or vibration, which is an indication of one or more of the following:
  - Misalignment
  - Imbalance of the fan
  - Operation at resonant frequency

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service, maintenance, or inspection on or near the fan(s), motor(s), or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

NOTICE: If noise or vibration persists, shut the unit down and correct the cause before continuing operation.

WARNING: If the fan guard is removed during servicing, it must be reinstalled before the unit is energized.

DiamondClear™ Design

The DiamondClear™ Design is a water-management system which provides continuous self-cleaning, significantly cutting water basin maintenance costs by reducing scale build-up and biological growth. It can also help eliminate the need for traditional water treatment. The DiamondClear™ Design includes the following components:

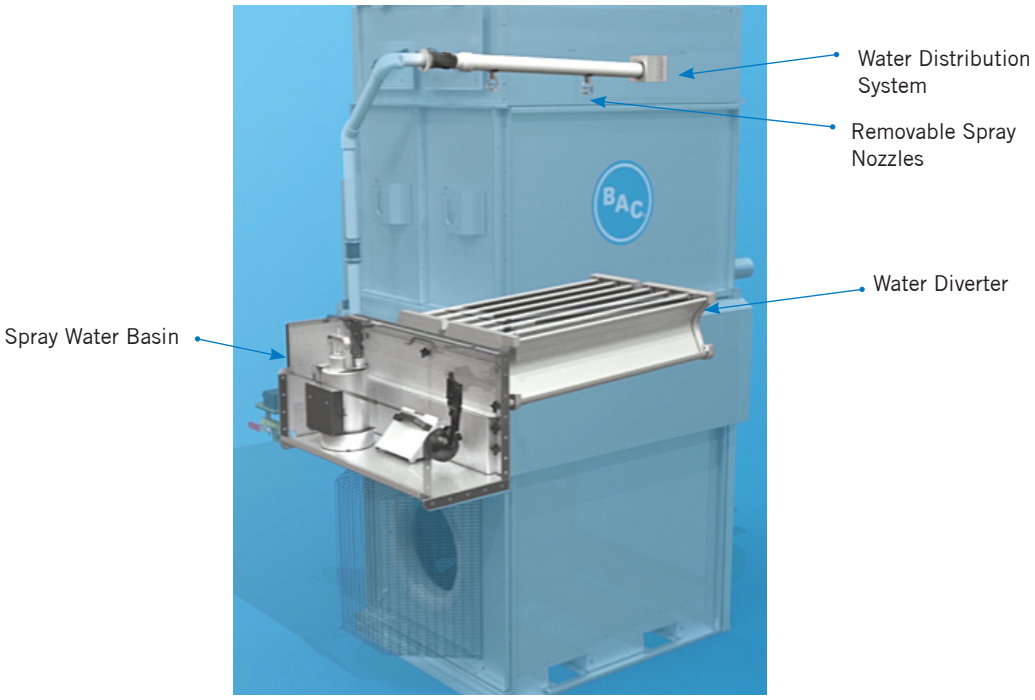


Figure 16. DiamondClear™ Design

Spray Water Basin

At least quarterly, remove trash or debris that may have accumulated in the basin or on the pump strainer and flush the basin with fresh water using a standard garden hose. This will remove any sediment, which may collect during operation.

Model Number	At Overflow Level (in.)	At Operating Level (in.)
NXF-0403-x	7 1/2”	3 5/8”
NXF-0603-x	8 1/2”	4 1/8”

Table 2. Cold Water Basin Water Levels (Measured from Inside the Cold Water Basin)

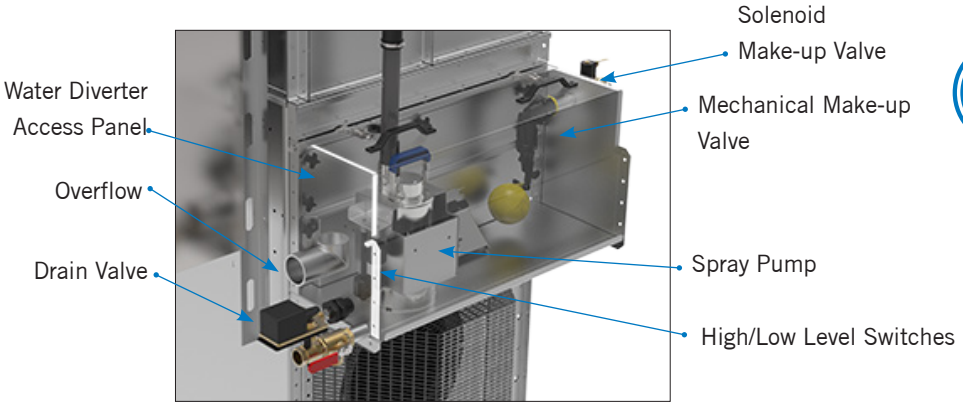


Figure 17. Spray Water Basin

Mechanical Make-up Valve

A float-operated mechanical make-up valve assembly is furnished on the unit. It consists of a corrosion resistant make-up valve connected to a float arm assembly that is actuated by a plastic float. The float consists of a primary pilot actuator that actuates the main diaphragm to open the float valve. The float that controls the spray water basin operating water level can be adjusted by loosening the thumbscrew and extending or shortening the float arm.

NOTE: Refer to the "iPilot™ Control System Appendix" on **page 45** for more information on sensors and valves.

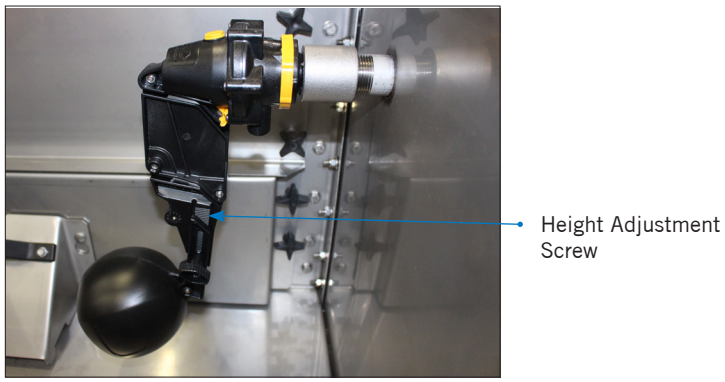


Figure 18. Mechanical Make-up Valve Assembly

- Quarterly, inspect the make-up valve assembly as well as the intake filter, and adjust and clean as necessary.

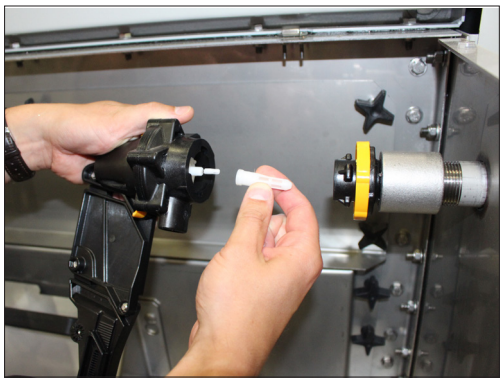


Figure 19. Mechanical Make-up Valve Assembly Filter Cleaning

- Maintain the make-up water supply pressure between 20 and 75 psig for proper operation. BAC recommends a surge protector (provided by others) for pressures over 60 psig.
- The basin water level will be factory-set. However, if additional adjustments are required, set the basin water level by adjusting the float ball so that the valve is completely closed at the operating level shown in **Table 2** on **page 22**.
- Closely monitor the water level in the spray water basin and adjust the level if necessary during the first 24 hours of operation.
- Operating at the recommended water level will ensure that the unit basin contains sufficient water volume to prevent air entrainment in the circulating pump during system start-up and provides sufficient excess basin capacity to accept the total system pull-down volume upon shutdown.

Spray Pump

Quarterly, ensure that spray pump remains clean and free of dirt or debris buildup on the inlet strainer.

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service, maintenance, or inspection on or near the fans, motors, or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

Figure 20. Spray Pump

Basin Heaters (Optional)

Annually, ensure that basin heater(s) remain clean, and remove debris buildup around the heater elements (see **Figure 10** on **page 14**).

Drain Valve

Check the nameplate for pressure, voltage, frequency, and service. Motorized valves should be inspected at start-up and shutdown. However, the interval between cleanings will vary depending on water quality and service conditions. If the voltage is correct, then sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. The valve is normally open, but faulty valve operation may cause it to fail either open or closed. See **Figure 21** for the location of the valve.

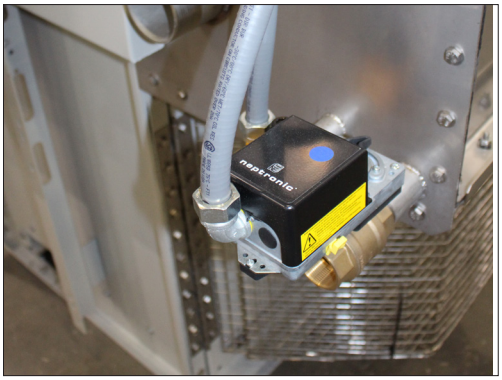


Figure 21. Drain Valve

Water Diverter

The water diverter can be accessed by opening the panel located behind the spray water basin. Quarterly, inspect and remove any trash or debris that may have accumulated from the water diverter and flush with fresh water using a standard garden hose. This will remove the sediment, which can collect during operation.

Figure 22. Water Diverter Inspection Panel

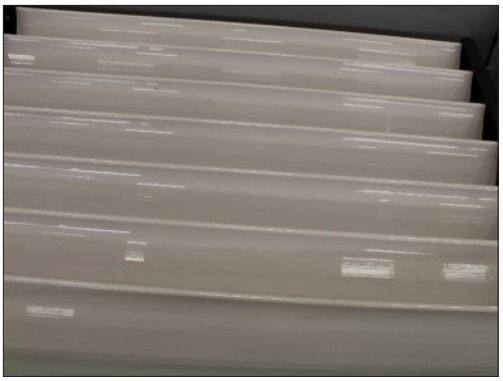


Figure 23. Water Diverter

Water Distribution System

Spray Branches and Nozzles

Water is distributed through a corrosion resistant polyvinyl chloride (PVC) water distribution system. Inspect the spray branches and nozzles quarterly. To inspect the water distribution system:

- Operate the equipment in Manual Mode, and turn the spray pump On, fan(s) Off.
- Remove the spray access panel.
- Check to see that the spray is uniform. Clean any clogged nozzles, and if additional cleaning is necessary. The distribution header can be removed for cleaning by loosening the rubber sleeve on the spray branch.
- Verify that there are no leaks in the water distribution system.

Figure 24. Spray Branch Removal

Drift Eliminators

The drift eliminators are made of PVC, which is impervious to rot, decay, rust, or biological attack. Quarterly, inspect drift eliminators and remove dirt and debris.

WARNING: The top horizontal surface of the unit is not intended to be used as a walking surface or working platform, and all maintenance should be done from in front of the equipment. If access to the top of the unit is desired, the purchaser/end-user is cautioned to use appropriate means complying with applicable safety standards of governmental authorities.

Figure 25. Drift Eliminator Removal

Positive Closure Dampers (PCDs) (Optional)

Ensure that the dampers remain open while the fan(s) are turned On and that they remain closed when the fan(s) are tuned Off (see **Figure 11** on **page 15**). Inspect for corrosion, and check for free movement of the damper blades.

iPilot™ Control System

The iPilot™ Control System automatically controls equipment operation according to your specific needs, including energy savings desired, water savings desired, and water management.

NOTE: The ambient temperature sensor is located at the bottom of the iPilot™ Control System Panel.

DANGER: Rotating equipment will cause severe personal injury or death to persons who come in contact. Do not perform any service, maintenance, or inspection on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pump motors are disconnected, locked out, and tagged out.

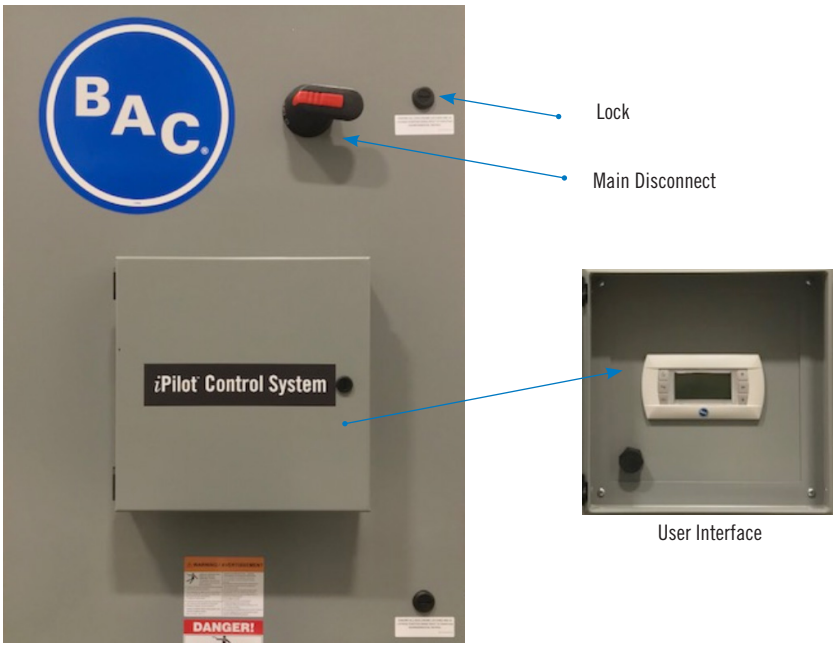


Figure 26. iPilot™ Control System

Components

The iPilot™ Control System contains the following components:

Solenoid Make-up Valve

Check the nameplate for correct catalog number, pressure, voltage, frequency, and service. Ensure that the incoming water pressure does not exceed the valve rating. Solenoid make-up valve should be inspected every six months. However, the interval between cleanings will vary depending on water quality and service conditions. If the voltage to the solenoid is correct, then sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. The valve is normally closed, but faulty valve operation may cause it to fail either open or closed. Clean strainer at supply (by others) when inspecting the valve.

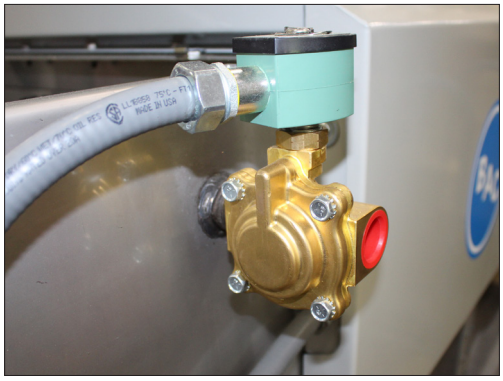


Figure 27. Solenoid Make-up Valve

Leaving Process Fluid and Ambient Temperature Sensors

Temperature sensors are constructed of stainless steel and are well-suited for corrosive environments. For accuracy of measurement, the sensors should be inspected every six months and deposit buildup should be removed.

Figure 28. Leaving Process Fluid Temperature Sensor

Figure 29. Ambient Temperature Sensor

Conductivity Sensor

NOTE: BAC recommends adjusting the conductivity setpoint in the iPilot™ Control System to best minimize water consumption and keep heat transfer surfaces scale-free.

- The conductivity sensor should be cleaned periodically. The frequency of cleaning will vary by installation.
- To determine how often the probe must be cleaned, follow the procedure below:
  - Read and record the conductivity.
  - Remove, clean and replace the conductivity probe.
  - Read conductivity and compare with the initial reading.
  - If the variance in readings is greater than 5%, increase the frequency of probe cleaning. If there is less than a 1% change in the reading, the probe can be cleaned less often.
  - An accumulation of scale, dirt, or debris on the sensor can impact the accuracy of the sensor. Thus the probe must be cleaned periodically. This can be accomplished by scrubbing with a toothbrush or other stiff brush. Depending on the impurity, various cleaners can be used to help. Detergent or isopropyl alcohol cleaner may help remove oils. A mild acid, such as white vinegar, will help to remove calcium scale. A fine grit abrasive cloth can also be used to remove scale, though harsh abrasives should be avoided. Rinse the sensor thoroughly before returning to service.
  - The conductivity controlled bleed system of the Nexus™ Modular Hybrid Cooler will automatically maintain the desired cycles of concentration in the recirculating water system. Refer to Bleed Rate on **page 36** for more details.

Figure 30. Conductivity Sensor

High Level and Low Level Switches

Water level switches are constructed of stainless steel, which is well-suited for corrosive environments. Perform routine maintenance every six months (at start-up and shutdown) to avoid any scale build up on the stem. Ensure the floats can travel freely along the stems.

Figure 31. High and Low Level Switches

Setting Date and Time

The date and time are preset from the factory and don't need modification during the initial start-up and operation of the unit. However, if the unit is in storage for an extended period of time the date and time may need to be reset. To update these parameters, follow these steps from the control panel screen (refer to the "iPilot™ Control System Appendix" on **page 45**).

- Press Prg. Use the password "0000" when prompted (it is recommended you modify the password cat start-up for security).
- Scroll up/down and select "Clock Menu", then press enter.
- While in the Clock menu press enter to begin making changes, use the up/down arrow to set the correct time and date, then press enter to accept the changes.

Software Verification for a pCO Controller

If a BAC Factory Technician is troubleshooting the controller over the phone, they may ask for the software version. To provide them with the information, follow these steps from the control panel screen (refer to the "iPilot™ Control System Appendix" on **page 45**).

- Press Prg.
- Scroll up/down and select "System Info", then press enter.
- The Version of the software will be displayed along with other information.

Retrieval of Logged Data

System core operating information can be downloaded to a USB flash drive or through a USB cable as follows:

- If using USB to download the data, turn off the main disconnect and open the main control panel door.
- Insert the USB in to the controller and close the door.
- Lock the door and turn on the main disconnect.
- In the user interface, navigate to "Point Overview", then press enter.

- Scroll down to "Data Log Export" and select File Destination as USB.
- Specify File Reference number and Confirm to download the .csv file.

For additional details, refer to "iPilot™ Control System Appendix" on **page 45.**

NEXUS™ MODULAR HYBRID COOLER

Corrosion Protection

The Nexus™ Modular Hybrid Cooler can be constructed of a variety of highly corrosion-resistant materials ranging from Thermosetting Hybrid Polymer Components to all stainless steel.

- **Thermosetting Hybrid Polymer Components:** Inspect the components protected with the thermosetting hybrid polymer for scratches, scrapes, or blemishes. To cosmetically touch up these areas with color matched polymer, use BAC Part #160133 available from your local BAC Representative.
- **Stainless Steel Components**: Inspect stainless steel components for signs of blemishes or corrosion. See "Long Term Care of Stainless Steel" **page 33** for cleaning and care instructions.

Other materials are used in the unit, including coated aluminum fan assemblies, plastic make-up valves, and EPDM grommets, all of which have been selected for corrosion resistance and long life. Periodically inspect these components for deterioration and repair or replace as necessary.

Water Treatment

A proper water treatment program, administered under the supervision of a competent water treatment specialist, is an essential part of routine maintenance to ensure the safe operation and longevity of evaporative cooling equipment, as well as other system components. In evaporative cooling products, cooling is accomplished by evaporating a small portion of the recirculating water as it flows through the unit. As the water evaporates, the dissolved solids originally present in the water remain behind and if not controlled, the concentration of dissolved solids will increase rapidly. This can lead to corrosion, scale or biological fouling which may negatively affect heat transfer as well as the longevity of system components.

- **Corrosion** – Red rust on steel components and white rust may affect the longevity of system components.
- **Scale Formation** – Scale, typically a calcium or magnesium based build-up, not only reduces heat transfer and system efficiency, but also may lead to under deposit corrosion. If scale is not controlled, it may continue building on critical components such as the heat transfer surfaces and severely impact thermal performance.
- **Biological Fouling** – Slime and algae formations may reduce heat transfer, promote corrosion, and harbor pathogens such as *Legionella.*

NOTES:

1. Since the quality of the ambient air and make-up water varies significantly from job site to job site, BAC strongly recommends obtaining the services of a water treatment specialist prior to the initial start-up of the evaporative cooling equipment. Additionally, to protect against the risk of Legionella contamination, never operate the cooling equipment without adequate biological control.
2. BAC recommends adjusting the conductivity setpoint in the iPilot™ Control System to best minimize water consumption and keep heat transfer surfaces scale-free.

The design of the Nexus™ Modular Hybrid Cooler helps to facilitate proper water treatment thanks to the DiamondClear™ Design which is a water management system that offers a self-cleaning design, very low spray water volume, and no sunlight exposure on wetted surfaces.

Water treatment guidance for the closed loop inside the hCore™ Heat Transfer Technology can be found in "Closed Loop System Cleaning" on **page 34**.

Corrosion and Scale Control

- To control corrosion and scale, maintain the water chemistry of the recirculating water within the parameters listed in **Table 3**. The specific measures required vary from system to system and are dependent on the chemistry of the make-up water, the metallurgy of the piping and heat transfer devices exposed to the recirculating water, and the temperatures at which the system will be operating.
- Bleed/blowdown, the continuous flow of a small portion of the recirculating water to a drain, is used to control the concentration of dissolved solids. On rare occasions, this may be adequate to control scale and corrosion. More often, chemical scale and corrosion inhibitors are necessary, which raise the allowable level of dissolved solids without the risk of scale and corrosion.
- Keep the chemically treated water within the guidelines given in **Table 3**. In cases where bleed/blowdown alone is being employed for corrosion and scale control without chemical treatment your water treatment specialist may recommend more conservative limits than those shown in **Table 3.**

Property of Water	Recommended Levels for Various Materials of Construction		
	Thermosetting Hybrid Polymer	Type 304 Stainless Steel	hCore™ Heat Transfer Technology Stainless Alloy
pH	6.5 to 9.2[1]	6.5 to 9.2 [1]	6.5 to 9.5[1]
Total Suspended Solids	25 ppm	25 ppm	25 ppm
Total Dissolved Solids (TDS)	2,050 ppm	2,050 ppm	2,500 ppm
Conductivity	3,300 (micromhos/cm)	3,300 (micromhos/cm)	4,000 (micromhos/cm)
Alkalinity as $CaCO_3$	600 ppm[2]	600 ppm[2]	600 ppm[2]
Calcium Hardness as $CaCO_3$	50 to 750 ppm[2]	50 to 750 ppm[2]	750 ppm[2]
Chlorides (CL)	300 ppm	300 ppm	750 ppm
Sulfates	350 ppm	350 ppm	750 ppm
Silica	150 ppm	150 ppm	150 ppm

Table 3. Quality Guidelines for Circulating Water

NOTES:

1. Hardness and alkalinity limits may be exceeded under certain circumstances. Consult your water treatment specialist for recommendations.
2. The conversion factor used to determine conductivity is 0.625 (TDS = 0.625 x Conductivity).
3. These guidelines refer to the materials used in construction. Different combinations of materials may be used on the same unit.
4. Water chemistry will change with operating temperatures. The recommended guidelines listed in **Table 3** refers to water temperature at 95˚F.

Chemical Treatment Requirements

Chemical treatment programs must meet the following requirements:

- The chemicals must be compatible with the specific unit materials of construction.
- BAC generally discourages acid dosing as means of scale control. Should acid dosing be utilized, the acid should be injected at a point in the system where total mixing and dilution occur.
- The preferred injection point for chemical scale and corrosion inhibitors is in the basin. Contact BAC for more details.
- When chlorine is added to the system, free residual chlorine should not exceed 1 ppm, except as noted in start-up section (**page 6**) and the shutdown section (**page 19**). Exceeding this limit may accelerate corrosion.

No Passivation Required

Passivation is the formation of a protective, passive, oxide layer on galvanized steel surfaces. However, since the Nexus™ Modular Hybrid Cooler is only available with components protected by either Thermosetting Polymer and / or stainless steel, there are no exposed galvanized surfaces, so passivation is not required.

Biological Control

- The warm, oxygen and nutrient rich environment inside evaporative cooling equipment provides an ideal environment for the growth of algae, slime, and other micro-organisms. Uncontrolled, this can reduce heat transfer, promote corrosion, and promote the growth of potentially harmful organisms such as *Legionella*.
- **To avoid biological contamination and minimize the risk of** ***Legionella,*** **initiate the biocide treatment program at start-up and continue on a regular basis thereafter in accordance with the treatment supplier's instructions.**
- Bleed/blowdown or chemical treatment used for corrosion and scale control alone is not adequate for control of biological contamination.
- Introduce solid or granular biocides through a chemical "pot" feeder installed in parallel with the system circulating pump(s) using a separate chemical feed pump. Diluted liquid biocides may be added directly to the cold water basin on the end of the unit where the make-up is located.

NOTE: ASHRAE Guideline 12: Minimizing the Risk of Legionellosis Associated with Building Water Systems is available for free from www.BaltimoreAircoil.com.

Alternative Water Sources

While make-up water is typically sourced from the potable water system, alternative sources of water can be considered for use in the Nexus™ Modular Hybrid Cooler, such as reclaimed water or air conditioning condensate. Often these sources are blended with potable water before introducing the water to the unit. The highly corrosion resistant construction options of the Nexus unit are ideal when using these alternative water sources due to their tolerance to withstand upset conditions which can occur more frequently with such sources. Any of the water sources can be utilized as long as the recirculating water chemistry stays within the limits established in **Table 3**. The risks of using such alternative water sources, especially regarding biological contamination, need to be recognized and understood as water quality upsets are often more frequent and the water quality not as high as potable water only sources. Thus the services of a competent water treatment professional familiar with treatment programs for such water sources should be engaged.

Long Term Care of Stainless Steel

When the percentage of chromium in steel exceeds 10.5%, it is called stainless steel. The chromium in the steel reacts with the oxygen in the air to form a chromium-oxide surface layer, also called the passivation layer that provides the corrosion resistance in stainless steel.

NOTE: This passivation process is not the same as that for galvanized steel.

BAC's Manufacturing Process

BAC takes precautions to prevent cross-contamination, processing galvanized and stainless steel parts separately. Also, stainless steel brushes are used to clean welds on stainless parts and care is taken to avoid scratching parts during processing. Organic cleaners are used to clean the finished product prior to shipping.

NOTICE: Never use chloride or chlorine based solvents such as bleach or muriatic (hydrochloric) acid to clean stainless steel. It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.

Jobsite Considerations

While stainless steel itself does not rust so long as the chromium-oxide surface layer is intact, it is not immune to contamination from its surroundings. Some common sources of surface contamination are:

- Dirt and soil
- Shop oil or grease that may carry other contaminants such as metal chips
- Machining or welding galvanized steel at the jobsite may cause debris to impinge itself into the stainless steel

These contaminants can deposit on the surface and scratch the passivation layer or prevent it from re-forming. They can also get trapped underneath the passivation layer and reduce corrosion resistance. Appropriate care in the layout and installation of the Nexus™ Modular Hybrid Cooler should be taken to avoid these potential issues.

NOTE: Long term care of stainless steel information reprinted with permission from "The Care and Cleaning of Stainless Steel"; Specialty Steel Industry of North America; http://www.ssina.com.

Recommended Cleaning Procedure

Stainless steel needs to be cleaned regularly to maintain the corrosion resistance as well as to maintain the overall aesthetics of the stainless steel.

It is fairly simple to clean most contaminants off the surface of stainless steel. Most dirt and soil can be cleaned with a clean cloth, warm water, and mild detergent. For persistent dirt, a little vinegar can be added in the cleaning water. It is important to always rinse the surface with warm water and wipe with a dry cloth after any cleaning, whether mild or aggressive.

- Fingerprints, mild stains or grease spots can be cleaned using organic solvents such as acetone, methyl or ethyl alcohol, or mineral spirits. Stainless steel wipes or glass cleaners commonly available in stores may also be used.
- Occasionally the surface of stainless steel can get iron chips or shavings embedded in it from having galvanized steel machined or welded in the vicinity. The iron chips can start to rust, reducing the corrosion resistance of the stainless steel, and stain the surface giving the impression that the stainless steel is rusting. These types of contaminants require more aggressive cleaning. Mild abrasives such as Scotch-Brite™ products may be used where aesthetic considerations are not important followed by solvent cleaning with organic solvents as described above. It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.
- If the iron chips are not removed with the Scotch-Brite™ Products, electro-chemical cleaning may be required. BAC uses commercially available equipment for electro-chemical cleaning in the field. Contact your local BAC Representative for more information.

System Cleaning

Closed Loop System Cleaning

With proper precautions, prior to start-up circulate an alkaline solution which can be used to clean condenser water systems through the Nexus™ Modular Hybrid Cooler. The necessary precautions include:

- Be sure a strainer is in place ahead of the hCore™ Heat Transfer Technology to avoid clogging of the passageways in this section with weld slag, debris, etc. Note that after start-up, a smaller mesh strainer can be substituted for the start-up strainer.
- Limit the duration of the cleaning to one day or at the most two days with a maximum opening of 1/16".
- The temperature of the solution should never exceed 100ºF (37.8°C).
- The maximum concentration of chemicals in the circulation solution should not exceed any of the following:
  - 5% Sodium Hydroxide
  - 5% Sodium Metasilicate
  - 2% Sodium Carbonate
  - 2% Tetra Sodium Pyrophosphate
  - 0.5% Trisodium Phosphate
  - 0.5% Sodium Nitrate
  - 5-10% Butyl Cellosolve

hCore™ Heat Transfer Technology Cleaning

The outside of the hCore™ Heat Transfer Technology (closed loop heat transfer section) may require occasional cleaning. The chemicals used must be compatible with all of the materials that will be contacted. If a cleaning solution is recirculated over the hCore™ Heat Transfer Technology as part of this process, the fan(s) should be locked out and the swing out fan access door(s) should be opened such that the fan assembly(ies) is / are not exposed to any cleaning solution mist that may penetrate through the water diverter system. Do not operate the unit fan(s) while the hCore™ Heat Transfer Technology is being cleaned. Before closing and resealing the fan access doors, be sure to clean and flush any cleaning solution that may have inadvertently penetrated through the water diverter assembly into the fan plenum(s). A tarp can be placed in the fan plenum to protect surfaces if desired. Be sure to remove tarp before resealing the fan access door(s). For specific recommendations on cleaning, contact a qualified consultant.

NOTICE: Do not use high pressure water exceeding 60 psi to clean the hCore™ Heat Transfer Technology.

5 Bleed Rate

NOTE: A proper water treatment program, administered under the supervision of a competent water treatment specialist, is an essential part of routine maintenance to ensure optimum thermal performance, water conservation, safe operation, and the longevity of evaporative cooling equipment, as well as other system components. The Nexus™ Modular Hybrid Cooler offers features that facilitate the time and effort required to implement and operate a successful water treatment program, including a conductivity controlled blowdown, low spray water basin volume, and a high percentage of dry operation.

NOTE: Although evaporation is proportional to the load and will vary seasonally, water can be conserved by ensuring an optimal bleed rate that protects the equipment from excessive corrosion and biological growth.

In evaporative cooling, evaporation of a small portion of the recirculating spray water as it flows through the equipment causes the cooling effect. As this water evaporates, the impurities originally present remain in the recirculating water. The concentration of the dissolved solids increases over time and can reach unacceptable levels. In addition, airborne impurities are often introduced into the recirculating water. If these impurities and contaminants are not effectively controlled, they can result in scaling, corrosion, and sludge accumulations that reduce heat transfer efficiency and increase system operating costs, while potentially shortening the useful life of the equipment. The degree to which dissolved solids and other impurities build up in the recirculating water may be defined as the cycles of concentration. Specifically, cycles of concentration equals the ratio of the concentration of dissolved solids (for example - chlorides, sulfates, etc.) in the recirculating water to the concentration of the same material in the incoming make-up water.

- In order to optimize heat transfer efficiency and maximize equipment life, a small amount of recirculating water must be bled from the system. This controls the cycles of concentration to maintain the quality of the recirculating water within the guidelines given in **Table 3**, on **page 31**.
- The included conductivity controlled blowdown system consists of a conductivity sensor and a drain valve. Refer to **page 28** for conductivity sensor cleaning instructions. The iPilot™ Control System will open the motorized drain valve whenever the conductivity meter reading exceeds the conductivity setting. This value has been factory set for the specific materials of construction of the unit, but can be adjusted under the direction of a competent water treatment specialist based on specific site conditions and make-up water quality to help minimize water usage.
- The Nexus Cooler will automatically replenish the bleed water with fresh make-up water, thereby limiting the build-up of impurities.

The following example provides more details about the bleed rate.

Example to Estimate Bleed Rate

Bleed Line Calculations: Bleed rate is determined by the following formula:

$$B = \frac{E}{(n-1)}$$

Where: B = Bleed Rate (USGPM)

E = Evaporation Rate (USGPM) = Q (USGPM) x R (°F) x 0.001

Q = Process Fluid Flow Rate (USGPM)

R = Range

n = Number of Cycles of Concentration = CR/CM

CR = Concentration in Recirculating Water

CM = Concentration in Make-up Water

Given:

- Nexus™ Modular Hybrid Cooler
- Process Fluid Flow Rate = 300 USGPM
- Maximum Allowable Chloride Concentration = 250 ppm
- Concentration of Chlorides in Make-up Water = 45 ppm
- Range = 10°F

Find: Bleed Rate

Solution: So in this case,

$$E = Q * R * 0.001 = 300 * 10 * 0.001 = 3 \text{ USGPM}$$

$$n = \frac{CR}{CM} = \frac{250 \text{ ppm}}{45 \text{ ppm}} = 5.55$$

$$B = \frac{E}{(n-1)} = \frac{3 \text{ USGPM}}{(5.55-1)} = 0/66 \text{ USGPM}$$

Therefore, in this case we must bleed approximately 0.66 USGPM to limit the concentration of impurities.

This example focuses on a single parameter (chloride concentration) of water only. The bleed rate required for a system (when evaluating more than one parameter) is the highest bleed rate required to keep all parameters within recommended limits.

NOTE: The evaporation rate (E) can be determined by any one of the following methods:

- The evaporation rate is approximately 2 USGPM per 1 million BTUH of heat rejection.
- The evaporation rate is approximately 3 USGPM per 100 tons of refrigeration.
- Evaporation Rate = Q (USGPM) * R * 0.001.

NOTE: Evaporation is proportional to the load and will vary seasonally. BAC includes a conductivity sensor to maximize water conservation.

6 Operation Considerations for Accessories

Basin Heater and Stand Alone BAC Heater Control Panel (Optional)

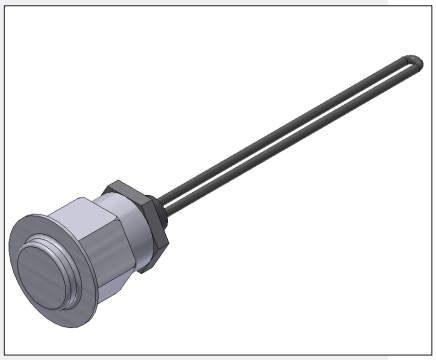


Figure 32. Basin Heater

NOTICE: The basin heater is not designed to prevent icing during unit operation.

One or more stainless steel electric immersion heaters prevent the cold water basin from completely freezing over and damaging the unit during shutdown or standby. The heaters are sized for the specific unit. The heating element has an enclosure that is suitable for outdoor use. Annually, inspect the basin heater prior to the risk of reaching freezing operating conditions.

Operation

Ensure that the heating element is completely submerged before energizing the main disconnect. The basin heater option includes a stand alone BAC heater control panel and a combination temperature/water level sensor. The stainless steel sensor probe with 1/2" NPT mounting fitting has an on/off relay output that de-energizes the heaters whenever the basin water temperature is above 45°F (7.2°C), or whenever the sensor probe is not fully submersed. The control panel enclosure is suitable for outdoor use.

NOTICE: The heater control panel temperature/low level control can only be used with the supplied combination temperature/water level sensor probe. Please contact your local BAC Representative for replacement parts.

The control system utilizes a combination temperature/low water level control sensor, which is powered by a transformer in the control panel. When the sensor provides a signal to the control panel, the panel sends a control voltage to the magnetic contactors. When energized, the magnetic contactors supply line voltage to the heaters. Annually inspect the heater control system prior to the risk of reaching freezing operating conditions.

Operation

Refer to the wiring diagram provided in the submittal package, also located on the inside of the heater control panel door. Ensure that the element is completely submerged before energizing the main disconnect. The combination temperature/low level control is preset to energize the heater at 40°F (4.4°C), but will not energize if the water level is too low or if the water temperature is above 45°F (7.2°C).

Testing the heater when water temperatures are above 45°F (7.2°C):

- Disconnect the heater control panel and tag out the circuit.
- Remove the heater control panel cover.
- Remove the sensor wires connected to terminals T1 and T2 on the combination temperature/low level control and isolate them.
- Install the 1.5K ohm test resistor supplied with the heater control panel (in bag on outside of cover) across terminals T1 and T2.
- Install the heater control panel cover.
- Energize the system and listen for the contactor closing.
- After operation, de-energize the circuit, disconnect the heater control panel, and tag out the circuit.
- Remove the resistor and place it back in the storage bag. Check all connections, reconnect sensor wires per the wiring diagram to terminals T1 and T2, replace the cover, and place the system back in service.

Operation when the sensor probe is encased in ice:

- Disconnect the heater control panel and tag out the circuit.
- Remove the heater control panel cover.
- Install a jumper wire across terminals G1 and G2 on the combination temperature/low level control circuit board.
- Install the heater control panel cover.
- Energize the system and listen for the contactor closing.
- Operate the system until the ice is melted around the probe.
- After operation, de-energize the circuit, disconnect the heater control panel, and tag out the circuit.
- Remove the jumper, check all connections, replace the cover, and place the system back in service.

Operation Considerations for Accessories

Basin Heater and Stand Alone BAC Heater Control Panel (Optional)

WARNING: Dangerous voltages are present in this equipment. Disconnect the electrical service of the source and tag the circuit out before servicing or replacing components.

NOTICE: Do not operate the system unattended or for extended periods of time during test mode (resistor across terminals T1 and T2). Operation in water temperatures above 45°F (7.2°C) could damage the unit.

NOTICE: Do not operate the system unattended or for extended periods of time with terminals G1-G2 jumpered. A low liquid level condition could occur, and the system will not shut off which could result in damage to the heater and unit.

Resonant Speed Identification Procedure

There are several characteristic frequencies at which vibration levels may resonate with unit structural components. These include fan speed, motor speed, bearing frequency, and blade pass frequency. Within the overall operating speed range of a unit, it is not unusual for one or more of these characteristic frequencies to excite the structural components over relatively small speed ranges and create an increase in vibration levels.

NOTE: The resonant speed identification procedure must be performed at start-up.

If the vibration levels are excessive at these resonant speeds, they need to be locked out to prevent the fan motors from operating at these speeds. The Nexus™ Modular Hybrid Cooler has been designed such that there are no internal resonant frequencies. However, resonant frequencies may result from external excitation, such as vibration from adjacent equipment.

If excessive vibration due to resonance is detected on a specific installation, the following procedure describes how to identify the lockout speed ranges:

CAUTION: Steps must be taken to avoid operation at or near system resonant frequency which could result in fan failure and possible personal injury or damage.

- Ensure the fan motor controls are off, and the power to the motor circuit is locked out.
- Attach the accelerometer (provided by others) onto the motor base.
- Close motor access panel, install all required hardware, and ensure that the panel is secure.
- Turn on power from equipment control panel, and in user interface, change Manual Mode to Yes.
- Adjust the fan speed for each fan motor independently and monitor the vibration levels. If the vibration value approaches 0.2 ips (0-peak), slowly “zero in” on the speed where the value equals 0.2 ips, and record the speed at which this occurs as the lower end of the lockout range. Also record the vibration level at this speed.
- Adjust the fan speed for fan motors simultaneously and monitor the vibration levels. If the vibration value approaches 0.2 ips (0-peak), slowly “zero in” on the speed where the value equals 0.2 ips, and record the speed at which this occurs as the lower end of the lockout range. Also record the vibration level at this speed.
- Continue to slowly increase the speed while monitoring the vibration level. If this is a resonance, then the value should peak and eventually decrease to a level that is below 0.2 ips as the speed is increased. After the vibration level has peaked and continues to fall, record the speed where the value equals 0.2 ips as the upper end of the lockout range.
- Using this data, a baseline for vibration history can be developed. The vibration levels can be monitored yearly and the trend used to indicate potential wear or the need to replace components in the drive system.
- After the entire speed range has been checked and any resonances identified, turn off the control panel and ensure lockout / tagout.
- Enter the unit, and carefully remove the accelerometer, along with any associated wiring from the unit.
- Contact BAC to enter the lockout speed ranges, if any have been identified, so that the unit will not operate at a resonant speed.
- Once it has been verified that the drive system is all clear, return the unit to its normal operating condition.
- Keep a record of any lockout speed ranges for future reference.

Positive Closure Dampers (PCDs) (Optional)

The dampers remain open during operation of each module, and the dampers close when the fans are turned off or when the unit is powered off.

Ensure that the actuator linkages are tight and the dampers are opening and closing. Refer to "Positive Closure Dampers (PCDs)" on **page 14** for more details. Ensure the dampers are functioning properly:

- When all fans are turned on dampers are open
- When all fans are turned off, the dampers are closed

7 Troubleshooting Guide

Problem	Possible Cause	Solution
Fan Does Not Run	No Power to the Fans	Cycle power on/off the unit.
		Confirm that power is applied to the unit at the main disconnect.
		Confirm that power is applied to each fan by checking terminals
		Check all terminals for tightness.
		Check power wires at fan housing.
		Check all terminals at Modbus module for tightness.
	Fan Internal Fault	Check for the fan alarm on the controls user interface for Fan internal fault
	Control Signal Issue	Check with a meter the control voltage at terminals -V, 10V or mA depending on control signal.
		Ensure a fan speed control signal is being sent to the unit.
Fan Spins Backwards	Fan is Off/Faulty	Turn the unit off. Allow all fans to stop completely. Check all breakers and power connections. Restart the unit and ensure all fans are operational and make sure the fan spins in right direction, and if it does not contact your local BAC representative.
Fan Does Not Respond to the Control Signal	Communications Fault	Ensure the communications cable is connected to the controller on port J26.
		Ensure the communications cable is not cut or damaged.
		Ensure the communications cable is properly connected at the fan motor..
No Spray Water or Pump Does Not Run	Incorrect Set Point	Check the leaving the process fluid temperature set point on the controller and the operating mode. The spray pump will only run when the ambient temperature is above 35°F (1.67°C). For additional details, see “Cold Weather Operation” on **page 13**.
	No Water Supply	Ensure water is being supplied to the solenoid make-up valve
		Inspect solenoid make-up valves, and clean as required.
		Check mechanical makeup valve and float assembly by manually raising and lowering the float.
	Pump Fault	Check pump voltage, and confirm that pump operates correctly in Manual Mode.
	Pump Strainer Fault	Clean the pump strainer quarterly.
	Water Distribution System Clogged	Clean the spray branches and the nozzles. See **page 25** for more details.

Table 4. Troubleshooting Guide

Problem	Possible Causes	Checks/Solutions
Low Performance	Not Performing Maintenance Intervals	Inspect the water distribution system, EC Fan System, and process fluid flow.
	Equipment is Not Operating	Ensure that leaving fluid temperature setpoint is at the desired value. Ensure that the system is not in manual mode and OSV (out of status value) status for all the components is “NO”. Refer to the “iPilot™ Control System Appendix” on **page 45** for more details.
Scale Formation on hCore™ Heat Transfer Technology	Hard Water	Ensure that conductivity setpoint is at the desired value. Ensure that the system is not in manual mode and OSV (out of status value) status for all the components is “NO”. Refer to the “iPilot™ Control System Appendix” on **page 45** for more details.
		Increase the frequency or duration of bleed by adjusting it in either time-based bleed or conductivity-based bleed mode.
	Faulty Drain Valve	Ensure the drain valve opens and closes 100% in response to the iPilot™ Control System.
Unit does not run in any operating mode OR system doesn’t go live	BMS communication	Ensure the BMS wiring and configuration.
	Manual Mode is enabled. Components OSV status is “Yes”	Turn Off the manual mode Ensure OSV status for all the components is “NO”

Table 4. Troubleshooting Guide (Continued)

Replacement Parts

To order replacement parts, contact your local BAC Representative.

iPilot™ Control System Alarm Descriptions

The iPilot™ Control System has been designed with alarms and notifications to provide operating status and ensure that the equipment is operating properly. **Table 5** shows all the alarms and warnings on Nexus™ Modular Hybrid Cooler.

Alarm/Warning	Type	Edge	Description	Comments
AI_retain	User reset	Positive	Error in the number of retain memory writings	Alarm
AI_Err_retain_write	User reset	Positive	Error in retain memory writings	Alarm
AI_Offline_EBM_n	Auto reset	Positive	Offline EBM n	Alarm
AI_PhaseFault_EBM_n	User reset	Positive	Phase Failure EBM n	Alarm
AI_MotBlocked_EBM_n	User reset	Positive	Motor blocked EBM n	Alarm
AI_MotSuperHeating_EBM_n	User reset	Positive	Motor superheat. EBM n	Alarm
AI_IntCircSuperHeat_EBM_n	User reset	Positive	Intern.circ.superheat. EBM n	Alarm
AI_CommunicationErr_EBM_n	User reset	Positive	Communic. error EBM n	Alarm
AI_CableBreak_EBM_n	Auto reset	Positive	Cable break EBM n	Alarm
AI_IceProtection_EBM_n	Auto reset	Positive	Ice protection EBM n	Alarm
AI_HeatMotStopped_EBM_n	Auto reset	Positive	Heating: motor stop EBM n	Alarm
AI_EnergySavingMode	Auto reset	Positive	Cannot maintain Temp in ES Mode	Notification
AI_DryWetModeDryAlm	Auto reset	Positive	Cannot maintain Temp in DW Dry mode	Notification
AI_DryWetModeWetAlm	Auto reset	Positive	Cannot maintain Temp in DW wet mode	Notification
AI_DryMode	Auto reset	Positive	Cannot maintain Temp in Dry Mode	Notification
AI_WaterHighLvl	Auto reset	Positive	Water High level	Notification
AI_WaterLowLvl	Auto reset	Positive	Water Low Level	Alarm
AI_AmbientTempLow	Auto reset	Positive	Ambient Temp Low	Notification
AI_ColdWeatherActive	Auto reset	Positive	Cold Weather program Activated	Notification
AI_LvgWaterTempHigh	Auto reset	Positive	Temp High limit	Notification
AI_LvgWaterTempLow	Auto reset	Positive	Leaving Water Temp Low Limit	Notification
AI_BasinWaterTempHigh	Auto reset	Positive	Basin Water Temp High Limit	Notification
AI_BasinWaterTempLow	Auto reset	Positive	Basin Water Temp Low Limit	Notification
AI_WtrCondSensorHigh	Auto reset	Positive	Water Conductivity Sensor High Limit	Notification
AI_LWT_ProbeErr	Auto reset	Positive	LWT Probe Error	Alarm
AI_OAT_ProbeErr	Auto reset	Positive	Outside Air Temp Probe Error	Alarm
AI_CustomerInputErr	Auto reset	Positive	Customer Input Error	Alarm
AI_FlowSwitch	Auto reset	Positive	Flow Switch Alarm	Alarm
AI_PumpmFault	User reset	Positive	Pump m Fault	Alarm
AL_FanCritical	User reset	Positive	Single Cell Critical Alarm - Check cell	Alarm

Table 5. Alarm Descriptions

Appendix: iPilot™ Control System

Menus

The following information describes how to adjust settings within the user interface.

Main Menu Screen

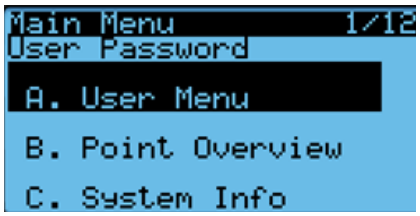
Figure 34. Main Menu

User Interface Keys and Functions

Button	Name	Description
	Alarm	This button illuminates red when an alarm is present; and pressing the button will display the alarm description.
	Prg	Displays all the main submenus.
	Esc	Brings the menu back to the previous screen.
	Up and Down	Scrolls through options.
	Enter	Accepts changes.

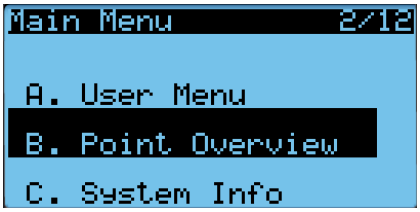
User Menu

Key system parameters can be defined in this menu, including leaving process fluid set point, language, unit and BMS configuration. See additional information in "Software Menus" on **page 48**.



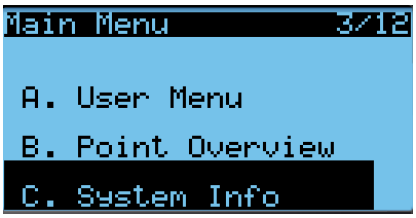
Point Overview

Components and subcomponents can be tested in manual mode during start-up and troubleshooting. See additional information in "Software Menus" on **page 48**.



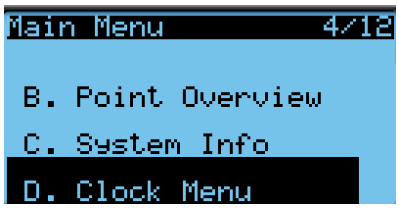
System Information

Software information and OS version can be retrieved.



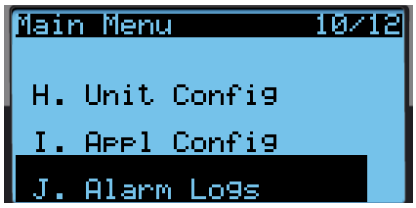
Clock Menu

This is to setup system time, date and time zone for different regions.



Alarm Logs

System alarm and warning information can be retrieved.



Software Menus

Menu Overview

Menu	Screen Ref.	Function
Main loop	P	Readout: • Unit status (ON/OFF) • Fluid outlet and ambient temperature • Fan speed – Energy saver mode • Fan speed – Water saver mode • Fan status
User Menu	E	Set: • Local ON/OFF • Language, Unit system • Operating Mode • Leaving water temperature setpoint • PI parameters • Time delay on alarm messages • BMS communication settings • Conductivity based bleed • Time based bleed and drain The standard password for the Owner menu is “0000”.
Point Overview	V	Troubleshoot wiring and components in Manual Mode: • Pump(s) • Fan(s) • High/low level switch status • Drain/make-up electronic valve • Alarm export • Data log export • Fan select • Analog and digital I/O’s
System Info.	S	Readout the software and bios version.
Clock Menu	C	Set the system time and date.
Alarm Logs	Record	Alarm and warning history from the user interface.
Manufacturer	Various	**These menus are password protected and are accessible by authorized personnel only.**
Maintenance	Various	**These menus are password protected and are accessible by authorized personnel only.**

Table 7. Menu Overview

Main Loop

The screens in the main loop are read only and are non-editable.

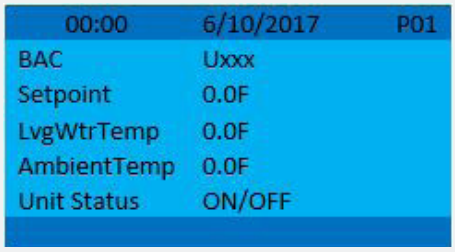
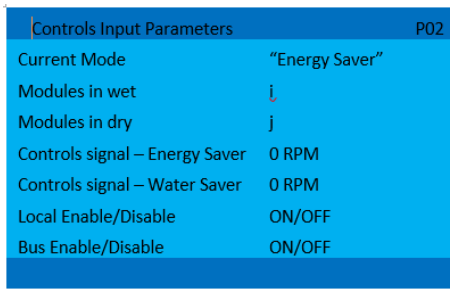
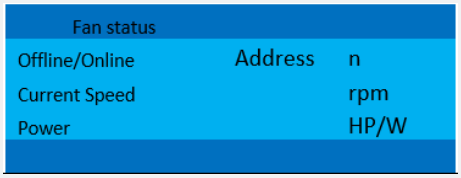
Screen Ref.	Screen	Description
P01		Main screen with general information: • Date and Time • Unit serial number (read only) • **"Setpoint":** Active setpoint for the fluid outlet temperature. • **"Tout":** Measured fluid outlet temperature. • **"Tamb":** Measured ambient temperature. • The unit status: "ON" or "OFF".
P02		Overview of all inputs: • **"Current Mode"**: Shows current operating mode, example: "Energy Saver", "Water Saver", "Nexus" • **"Modules in wet mode":** Number of Modules operating wet. • **"Modules in dry mode":** Number of Modules operating dry. • **"Controls signal – Energy Saver":** Fan Speed – Energy Saver mode • **"Controls signal – Water Saver"**: Fan Speed – Water Saver Mode • **"Local Enable /Disable":** Status of the remote start/stop (dry contact between terminals 21A and 23). • **"BUS En/Dis":** Status of the BMS controlled variable ("Run authorization" in screen E02).
P03 – P14		EC Fan System information screens: • **Fan status:** "Online" or "Offline" and fan address: "Addr: 01 and soon". • **"Fan speed"**: Actual fan operating speed. • **"Power":** Average power per fan.

Table 8. Main Loop

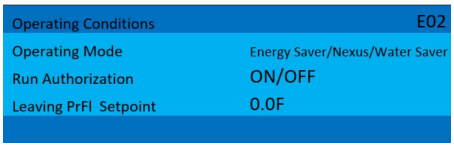
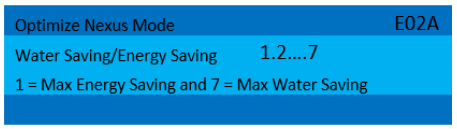
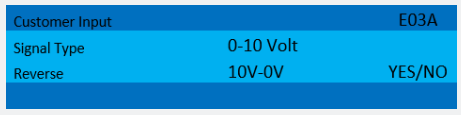
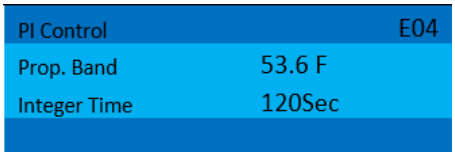
NOTE: When unit status is ON, the equipment is enabled to respond to any heat rejection requirement.

NOTES:

1. P03 – P14, for maximum 12 fans on NXF-0603-x.
2. In case an EC Fan System shows the status "Offline", check the power supply and the Modbus communication wiring to the fan. Also, make sure the Fan(s) are addressed correctly.

User Menu (E)

The screens in the User menu are editable. The default password is "0000".

Screen Ref.	Screen	Description
E01		• "**Language":** Sets the language to English, Italian, French, Dutch, Spanish or German. • **"Unit System":** Sets the unit of measure of controls to US, UK, CANADA, LONDON, SI • **"Site":** BAC job number (starts with "U...") for the job site reference.
E02		• **"Operating Mode":** Select the operating mode from: Energy Saver, Nexus, Water Saver • **"Run authorization":** activate or deactivate the unit. This variable can either be set directly in this screen or via a BMS variable Refer to "Controls Connections" on **page 56**. • **"Leaving PrFl Setpoint":** Set the required leaving process fluid temperature setpoint
		For Nexus mode selection on E02, water and energy savings can be optimized from Dry to Wet with "1" corresponding to maximum energy savings and "7" corresponding to maximum water savings
		Water Saver Mode is further divided in to two categories: • **Winter Guard Disabled (default)**: Modules are allowed to switch to wet operation as needed • **Winter Guard Enabled:** Modules always operate dry
E03		Options Enable/Disable: • **"Customer Input":** Analog input to control Fan/Fans speed
		Once the customer input signal is enabled, type of signal can be defined as 0-10V or 4-20mA. Reverse Signal - Yes/No
E04		PI-parameters: Determine the reaction speed to changes in fluid outlet temperature. • "Prop. Band": Sets value for the proportional band of the PI controller. • "Integr. Time": Sets value for the integration time of the PI controller.

NOTE: Make the unit react faster (slower) to changes in fluid outlet temperature by decreasing (increasing) the proportional band and integration time.

Table 9. User Menu (E)

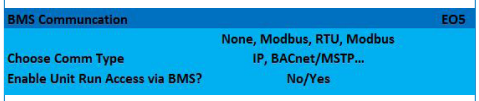
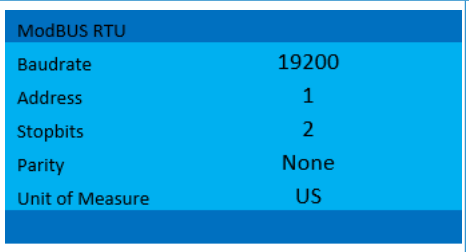
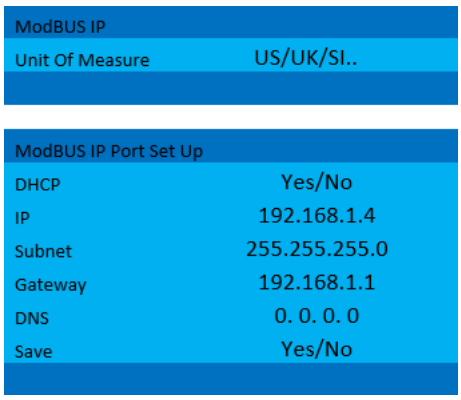
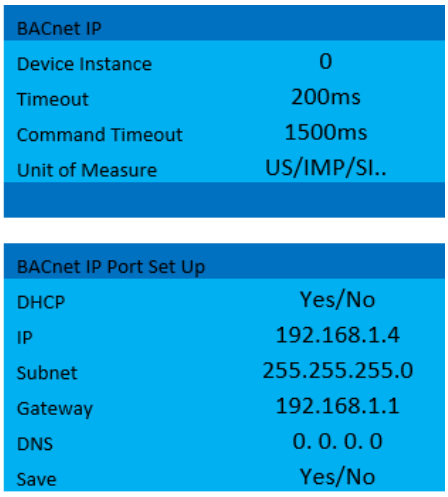
Screen Ref.	Screen	Description
E05		BMS Communication: Enable/disable and define communication type • **"Choose Comm Type"**: None, Modbus RTU, Modbus IP, BACnet/MSTP, BACnet/IP • "BMS On/Off Control": No/Yes
		Configure options for ModBUS RTU
		Configure options for BACnet MSTP
		Configure options for BACnet IP

Table 9. User Menu (E) (Continued)

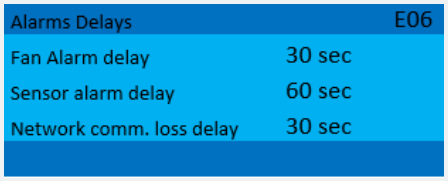
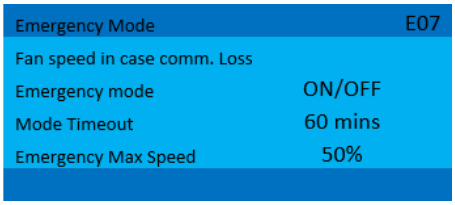
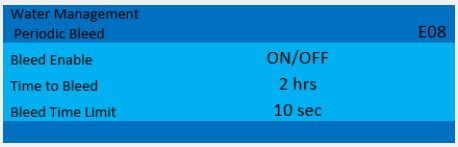
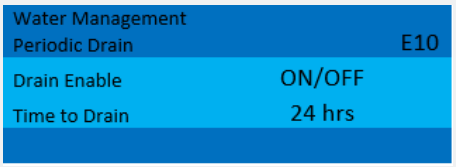
Screen Ref.	Screen	Description
E06		Alarm detection delays: • **"Alarm delay"**: Time delay for EC fan alarms and warnings. • **"Sensor alarm delay":** Time delay for alarms from the fluid outlet temperature and ambient temperature sensor. • **"Network comm. Loss delay":** Time delay for the loss of communication between units (only available for BMS and Customer Input Modes).
E07		EC fan emergency mode management: Enable the EC fan emergency mode to select a fixed fan speed when the Modbus communication between the PLC and the EC fans is lost. In case the EC fan emergency mode is disabled, the fan(s) will continue to operate at the last known fan speed. • "**Emergen. mode":** "ON" or "OFF": Enable or disable the EC fan mode. • "**Mode Timeout":** time delay before the EC fan emergency mode activates. • **"Emergency Max speed":** 50% of max allowable speed (adjustable).
E08		• Water Management – Periodic Bleed: • **"Bleed Enable":** ON/OFF • "**Bleed Cycle":** Frequency of bleed • "**Bleed Time Limit":** Duration of bleed
E09		Water Management – Conductivity Based Bleed: • "**Cond Bleed Enbl":** ON/OFF • "**Wtr Cond StPt**": Threshold value at which bleed starts • "**WtrCondPtDiff":** Differential value at which bleed stops (Setpoint – Differential)
E10		Water Management – Periodic Bleed: • **"Drain Enable":** ON/OFF • **"Drain Cycle":** Time to Drain
E11		Set and change the user password.

Table 9. User Menu (E) (Continued)

Point Overview Menu (V)

The screens in Point Overview are developed to troubleshoot and test different components in Manual Mode.

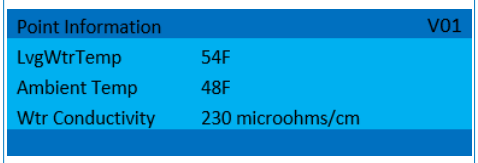
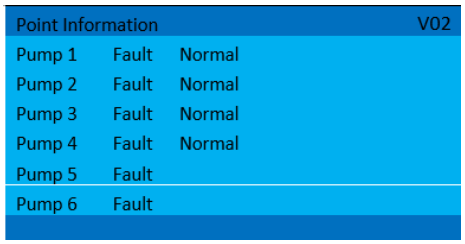
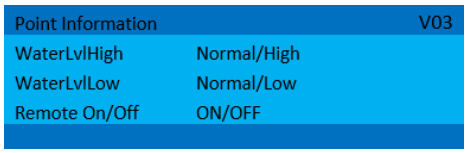
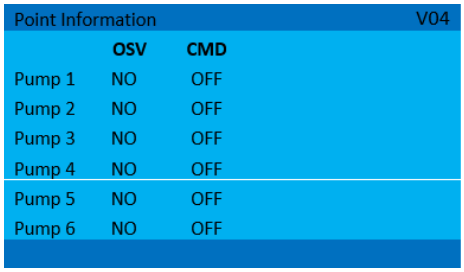
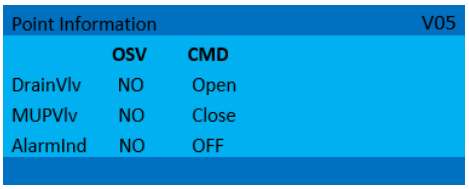
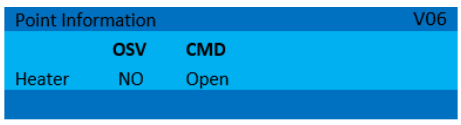
Screen Ref.	Screen	Description
V01		Shows operating values (read only) • Leaving Process Fluid Temp • Ambient Temperature • Water Conductivity
V02		Screen shows Pump status based on unit configuration • **Example** – Unit configured for 4 modules and all pumps are normal
V03		Screen shows the basin water level switch status and remote dry contact status (read only) • **"WaterLvlHigh":** High Level Switch • **"WaterLvlLow":** Low Level Switch • "**Remote 0v/Off":** Remote dry contact
V04		Pump status and testing in manual mode (Read/Write) • **OSV:** Out of status value (manual mode), for testing pump and pump wiring turn ON the OSV status on the Pump. • **CMD:** Command, when the system is live (not in manual mode) this should show "ON"
V05		Drain and make-up testing in manual mode (Read/Write) • **OSV - Out of status value (manual mode):** To test heater and corresponding wiring, turn ON the OSV status on the Heater. Ensure that heater control panel is turned ON. • **CMD - Command, when the system is live (not in manual mode)**: This will show the current state of the component
V06		Heater and heater wiring testing in Manual Mode (Read/Write). The screen will be only available if the Heater option is purchased on the product • **OSV:** Out of status value (manual mode), for testing Heater and corresponding wiring turn ON the OSV status on the Heater. Also make sure the Heater control panel is turned ON as well • **CMD:** Command, when the system is live (not in manual mode) this should show the current state of the component.

Table 11. Point Overview Menu (V)

NOTE: For V04 - V06, to run system in live mode, ensure that all pump OSV statuses are "NO".

NOTE FOR V07 AND V08: For exporting the file to USB, switch off the main disconnect on the control panel and the main door, and insert the USB into the controller. Close and lock the panel main door, turn ON the main disconnect and export the file. Follow same procedure to remove the USB from the controller.

NOTE (for V09 and V10): To operate system in live mode, ensure that all manual operation is disabled and OSV status on all the components on all other screens is "NO".

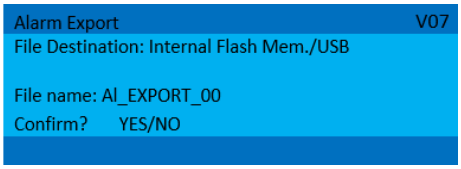
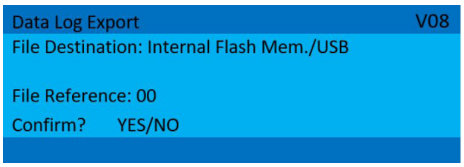
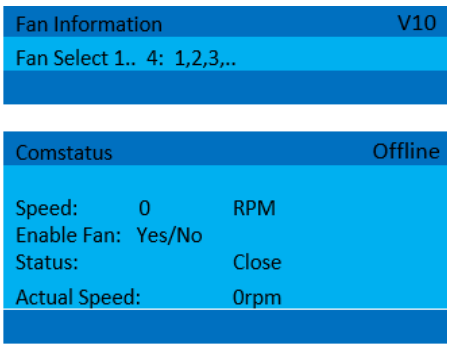
Screen Ref.	Screen	Description
V07		Exporting system Alarm/Warning • File Destination: Specify destination • File name: AI_EXPORT_00 • Confirm: YES/NO
V08		Exporting system Data Log history • **File Destination:** Specify destination • **File Reference**: 00 • **Confirm:** YES/NO
V09		The entire system can be taken offline by enabling manual mode from this screen. In live or Manual Mode, follow system/ component(s) safety protocols..
V10		To test fan(s) in Manual Mode: • Switch system to Manual Mode from screen V09 • Select Fan • On the next screen specify fan operating speed • Click Esc to come out of the screen • Once the testing is done switch of the Fan by entering "0" speed In live or Manual Mode, follow system/ component(s) safety protocols..
V11		This screen is set in the factory and locked.
V12		This screen is set in the factory and locked.
V13		This screen is set in the factory and locked.

Table 11. Point Overview Menu (V) (Continued)

System Information (S)

The screens in the System Information are read only and cannot be edited.

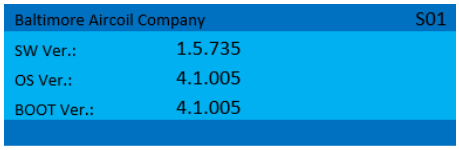
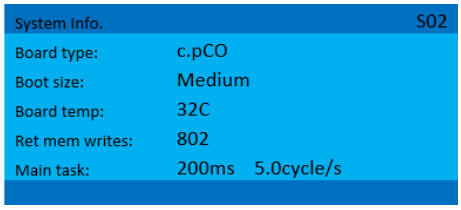
Screen Ref.	Screen	Description
S01		• **"SW Ver.":** Current Software Version installed • **"OS Ver.":** Operating System Version • **"BOOT Ver.":** Current Boot Version
S02		• **"Board type":** Controller type • "Board Size": Controller size • **"Board temp":** 32C • **"Ret mem writes":** Number of memory writes • **"Main task":** 200ms 5.0cps

Table 12. System Information (S)

Clock Menu (C)

The screens in the Clock Menu are editable.

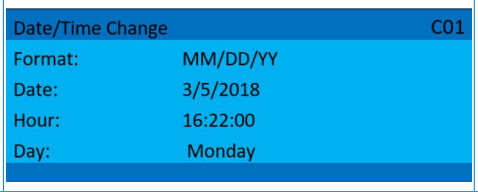
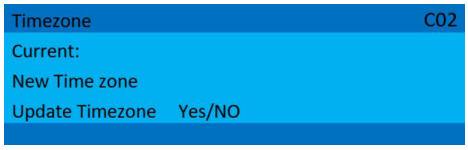
Screen Ref.	Screen	Description
C01		• **"Format":** Change the Date format • **"Date":** 00:00:00 • **"Hour":** 00:00:00 • **"Day":** Day
C02		• **"Current":** Current Time Zone • **"New Time Zone":** 00:00:00 • **"Update Time Zone":** Yes/No

Table 13. Clock Menu (C)

Alarm Logs (Record)

The screens in the Clock Menu are editable.

Screen Ref.	Screen	Description
Record: 01		• **"Alarm Number":** Alarm number • **"Time":** Time of alarm • **"Date":** Date of alarm • **"Alarm Type":** Alarm description • **"Event":** Start/Operation

Table 14. Alarm Logs (Record)

Controls Connections

The controls wiring should be provided in a separate conduit from any power wiring. It is also recommended to use of shielded wire to avoid interference.

BAC offers the following options to control the iPilot™ Control System on the Nexus™ Modular Hybrid Cooler. Check the submittal package to determine how the unit was setup and shipped:

Leaving Process Fluid Temperature Sensor (Standard)

- A leaving process fluid temperature sensor sends a signal to modulate fan(s) speed.
- The sensor should be installed on the common discharge from all modules.

Control Signal for Customer Input Control Method (Optional)

- The optional control signal should be wired to terminals per your submittal, using one of the following signal types:
  - The 0-10VDC signal commands the fans off at 0V and full speed at 10V.
  - The 10-0VDC signal commands the fans off at 10V and full speed at 0V.
  - The 4-20mA signal commands the fans off at 4mA and full speed at 20mA

BMS Communication (Optional)

- Communication through Modbus over RS485 or TCP/IP. For RS485 connection, BAC recommends the use of twisted shielded paired wire with a ground.
- Communication through BACnet over MS/TP or IP.
- For additional details, see wiring in your submittal.
- BMS data points are listed in **Table 15** on **page 57**.

Point Description	Variable	ModBUS Address	BACnet ID	Datatype	Read / Write	Comment
No of Cells	No_Cells	30901	1401	INT	Read	1..6
No of pumps Running	No_PumpsRnng	30906	1406	INT	Read	1..6
Fluid Temp	LWtrTemp.PVal	30121	1501	REAL	Read	°F/°C
Outside temp	OutTemp.PVal	30123	1502	REAL	Read	°F/°C
Conductivity Sensor	WtrCondSensor.PVal	30125	1503	REAL	Read	µΩ/cm
Average Fan Speed (dry)	ActIFanSpeed	30201	1504	REAL	Read	rpm (Nexus Mode, Water Saver Mode)
Average Fan Speed (wet)	ActIFanSpeedWet	30205	1506	REAL	Read	rpm (Nexus Mode, Energy Saver Mode, Water Saver Mode)
Average Fan Power (dry)	FanCurrPwrDry	30203	1505	REAL	Read	Watts/hp (Nexus Mode, Water Saver Mode)
Average Fan Power (wet)	FanCurrPwrWet	30207	1519	REAL	Read	Watts/hp (Nexus Mode, Energy Saver Mode, Water Saver Mode)
Fan Speed 1..12	ActIFanSpeedInfo[1..12]	30911..30934	1507..1518	REAL	Read	rpm (2 Registers each)
Fan Power 1..12	EBMpapstFan_x_Mng. BMSCurrentPower	30951..30974	1521..1532	REAL	Read	Watts/hp (2 Registers Each)
Fan Status 1..12	EbmpabstFan_x_Mng. Online_EBM_1	10201..10212	1201..1212	BOOL	Read	Online / Offline
Common Alarm Fan 1..12	AI_CommonAlm_Fanx. Active	10301..10312	1221..1232	BOOL	Read	Normal / Fault
Remote Input	Remote.PV	10221	1213	BOOL	Read	On / Off
Modules Operating (wet)	UnitLogic.No_EvapCell	30903	1403	UINT	Read	Number of modules operating wet
Modules Operating (dry)	UnitLogic.No_DryCell	30904	1404	UINT	Read	Number of modules operating dry
Operation Mode	BMSModeSw	40906	1701	UINT	Read / Write	Nexus Mode /Energy Saver Mode / Water Saver Mode
Conductivity Setpoint	UnitLogic.BMSWtrCond-StPt	40907	1602	REAL	Read / Write	µΩ/cm (default per BAC water quality guidelines)

Table 15. BMS Points Table

Point Description	Variable	ModBUS Address	BACnet ID	Datatype	Read / Write	Comment
Conductivity Differential Setpoint	UnitLogic.BMSWtrCond-DiffStPt	40909	1603	REAL	Read / Write	µΩ/cm, Increase (decrease) value to decrease (increase) frequency of bleed
Conductivity Enable	BMS_WMCondEnble	902	1302	BOOL	Read / Write	Enable / disable conductivi-ty-based bleed
Fluid Temp Setpoint	BMSLWTStPt	40911	1601	REAL	Read / Write	Leaving process fluid setpoint
Unit Status	UnitStatus	30907	1402	DINT	Read	On / Off
BAC Unit Number	BACUnitNo	30905	1405	UDINT	Read	Uxxx
Water management Time Bleed Enable	BMS_WMTmBleedEnble	903	1303	BOOL	Read / Write	Enable / disable time-based bleed
Water management Time Drain Enable	BMS_WMDrainEnble	904	1304	BOOL	Read / Write	Enable / disable time-based drain
Water Management Time Bleed	BMS_WMTimeBleed	40913	1702	UINT	Read / Write	Hrs, Frequency of time-based bleed
Water Management Time Bleed Limit	BMS_WMTimeBleedLmt	40914	1703	UINT	Read / Write	Min, Duration of time-based bleed
Water management Time Drain	BMS_WMTimeDrain	40915	1704	UINT	Read / Write	Hrs, Frequency of time-based drain
BMS Unit Command	OnOffUnitMng.BMSOnOff	901	1301	BOOL	Read / Write	Enables BMS communica-tion
Customer Input Enable	BMS_CustomerEnable	905	1305	BOOL	Read / Write	Enables equipment opera-tion via BMS communication
Customer Input Type	Inputs.BMS_Cust_Typ	906	1306	BOOL	Read / Write	0..10V or 4..20mA
Customer Input Reverse	Inputs.BMS_Cust_Typ_ Rev	907	1307	BOOL	Read / Write	10V..0V
PCD Alarm	AI_PCDHoodAlm	10353	1253	BOOL	Read	Alarm for PCD fault
Nexus Max speed limitation	BMSNexusLmt	40916	1705	UINT	Read / Write	Maximum allowable speed for modules operating dry; decrease (increase) for energy (water) savings
Water Saver Winter Guard Enable	BMSWinterGuard	911	1311	BOOL	Read / Write	Enable (disable) to allow (disallow) wet operation to meet demand
PumpStatus 1..6	PumpX.PVal	10801..10806	1801..1806	BOOL	Read	On / Off
Pump Fault 1..6	AI_PumpXFault.Active	10807..10812	1807..1812	BOOL	Read	Alarm for pump fault

Table 15. BMS Points Table (Continued)

Point Description	Variable	ModBUS Address	BACnet ID	Datatype	Read / Write	Comment
Unit of Measure BMS	BMS_UnitofMeasure	40922	1710	USINT	Read / Write	Unit of measure
Alarm Reset	AlarmMng.AlrmResBy-Bms	912	1312	BOOL	Read / Write	Manual reset of alarms
Energy Saver Mode Message	AI_EnergySavingMode. Active	10341	1241	BOOL	Read	Heat load cannot be met
Nexus Mode Dry Message	AI_DryWetModeDryAlm. Active	10342	1242	BOOL	Read	Heat load cannot be met when all modules operate dry
Nexus Mode Wet Message	AI_DryWetModeWetAlm. Active	10343	1243	BOOL	Read	Heat load cannot be met when all modules operate wet
Water saver Mode Message	AI_DryMode.Active	10344	1244	BOOL	Read	Heat load cannot be met when all modules operate wet
Water High level Message	AI_WaterHighLvl.Active	10345	1245	BOOL	Read	Water level is too high
Water Low Level Alarm	AI_WaterLowLvl.Active	10346	1246	BOOL	Read	Water level is too low
Cold Weather Active Alarm	AI_ColdWeatherActive. Active	10348	1248	BOOL	Read	Equipment has switched to dry mode (below 35°F/1.7°C, when operating wet
Leaving Water Temp High Message	AI_LvgWaterTempHigh. Active	10349	1249	BOOL	Read	Leaving water temperature is above 120°F (48.9°C)
Leaving Water Temp Low Alarm	AI_LvgWaterTempLow. Active	10350	1250	BOOL	Read	Leaving water temperature is below 32°F (0°C)
Single cell Critical Message	AL_FanCritical.Active	10352	1252	BOOL	Read	One module is operating to maintain required heat rejection

Table 15. BMS Points Table (Continued)

COOLING TOWERS

CLOSED CIRCUIT COOLING TOWERS

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