



Vertex[®] Evaporative Condenser

OPERATION & MAINTENANCE MANUAL





Vertex® Evaporative Condenser

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1. Recommended Maintenance Intervals

Inspect and clean as necessary ^[1] :	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect general condition of the unit ^[2] and check unit for unusual noise or vibration	✓	✓			
Inspect basin	✓		✓		
Flush water distribution system/Inspect spray nozzles	✓		✓		
Clean basin strainer	✓	✓			✓
Clean water guards	✓		✓		
Drain basin and piping	✓				✓
Check and adjust water level in basin	✓	✓			
Check operation of make-up valve	✓	✓			
Inspect coil			✓		
Check and adjust bleed rate	✓	✓			
Inspect unit finish				✓	
Mechanical equipment system ^[1] :	Start-Up	Monthly	Quarterly	Annually	Shutdown
Check belt condition ^[3]	✓	✓			
Adjust belt tension ^{[3],[4]}	✓		✓		
Lubricate fan shaft bearings ^[3]	✓		✓		✓
Lubricate motor base adjusting screw ^[3]	✓		✓		✓
Check drive alignment ^[3]				✓	
Check motor voltage and current	✓		✓		
Clean fan motor exterior	✓		✓		
Check fan motor for proper rotation	✓				
Check general condition of the fan	✓		✓		
Check fan for uniform pitch ^[3]			✓		
Check fan for rotation without obstruction	✓		✓		
Check and recoat steel shafts with RUST VETO® ^[3]	✓		✓		✓
Check optional basin heater and stand alone BAC heater control panel				✓	
Test optional vibration cutout switch ^[3]	✓			✓	

¹ Recommended service intervals are the minimum for typical installations. Harsh environmental conditions may dictate more frequent servicing.

² When operating in ambient temperatures below freezing, the unit should be inspected more frequently. Refer to section 7. **Cold Weather Operation** on Page 30 for more details.

³ On units equipped with BALTDRIIVE® Power Train only.

⁴ Tension on new belts must be readjusted after the first 24 hours of operation and quarterly, thereafter.

2. Warnings and Cautions

Safety Precautions

- **⚠ DANGER**: Rotating equipment will cause severe personal injury or death to persons who come in contact. 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.
- **⚠ DANGER**: Risk of electrocution which will cause severe personal injury or death. Use appropriate lockout procedures. Do not perform any service on or near the unit without first ensuring the unit is de-energized.
- **⚠ WARNING**: The top horizontal surface of the unit is not intended to be used as a walking surface or working platform. If access to the top of the unit is desired, the purchaser/end-user is cautioned to use appropriate means complying with OSHA or other applicable safety standards of governmental authorities.
- **⚠ 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**: Before performing an adjustment or inspection of the VCOS, make certain that all power has been disconnected and locked in the off position. Moisture inside the switch can lead to switch failure. Care must be taken when replacing the cover on the vibration switch to ensure that the proper watertight seal is obtained.
- **⚠ WARNING**: When the fan speed of the unit is to be changed from the factory set speed, including changes achieved by the use of a variable fan speed device, steps must be taken to avoid operation at or near the fan's "critical speed" which could result in fan failure and possible personal injury or damage. Contact your local BAC Representative regarding any such applications.
- **⚠ WARNING**: A lockable disconnect switch should be located within sight of the unit for each fan motor associated with this equipment. Before performing any type of service or inspection, make certain that all power has been disconnected, and the switch is locked out in the "OFF" position.
- **⚠ 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**: This equipment should never be operated without all fan screens, access panels, and access doors in place.
- **⚠ CAUTION**: Water in the bottom of the basin may conceal openings and/or submerged obstructions. Use caution when walking inside this equipment.

- **⚠ CAUTION**: Do not use the plastic drift eliminators as a walking, working, or storage surface. Stepping on or placing weight on an eliminator can result in physical injury and/or equipment damage. After ensuring that the fan and pump motors are locked and tagged out, lift and remove eliminators as necessary to perform recommended maintenance and inspections. If access to the top of the coil is required, place a piece of plywood at least 1/2 inch thick on top of the coil to protect the surface while performing the recommended maintenance. When finished, carefully remove the plywood and re-install any eliminators which were removed.
- **⚠ CAUTION**: Drift eliminators can separate from the product during high winds. Fasten drift eliminators in place using the retaining system.

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 either before or after installation, certain precautions should be observed, as outlined in section **Prolonged Outdoor Storage** on **Page 17**.
- Spray system pressure greater than 10.0 psig may cause damage to the distribution system.
- Check to ensure the controls for the fan motor are set to allow a maximum of six on-off cycles per hour to prevent motor overload.
- 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 with vents should be used.
- Do not use steam or high-pressure water to clean PVC eliminators or materials other than steel.
- 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.
- Mechanical and operational methods must be employed to protect these products against damage and/or reduced effectiveness due to possible freeze-up. Please refer to BaltimoreAircoil.com or contact your local BAC Representative for recommended protection alternatives.
- The basin heater is not designed to prevent icing during unit operation.
- The stand alone BAC heater control panel temperature/low level control can only be used with the supplied combination temperature/liquid level sensor probe.
- For the stand alone BAC heater control panel, 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.
- For the stand alone BAC heater control panel, 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.
- For a unit with a VFD, with a switching frequency of 2.5 kHz, the line lead length cannot exceed 100 feet. If the switching frequency is higher than 2.5 kHz and/or the line lead length exceeds 100 feet, a dV/dT output filter is recommended to protect the motor. Since the switching frequency and maximum line length requirements vary between VFD and motor suppliers, contact your local BAC Representative to determine if a dV/dT filter is required. For fan motors controlled with VFDs, when reversing the direction of fan rotation, allow the fan to come to a complete stop before restarting the motor.
- For fan motors controlled with VFDs, when reversing the direction of fan rotation, allow the fan to come to a complete stop before restarting the motor.

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 from the make-up water are left behind. 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 governs the extent of water treatment which can vary from a simple continuous bleed and biological control to a sophisticated treatment system. Refer to section **Water Treatment** on **Page 33** and section **Biological Control** on **Page 36** for more details.

Please refer to the Limitation of Warranties in the submittal packet 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.

3. Unit Operation and Storage

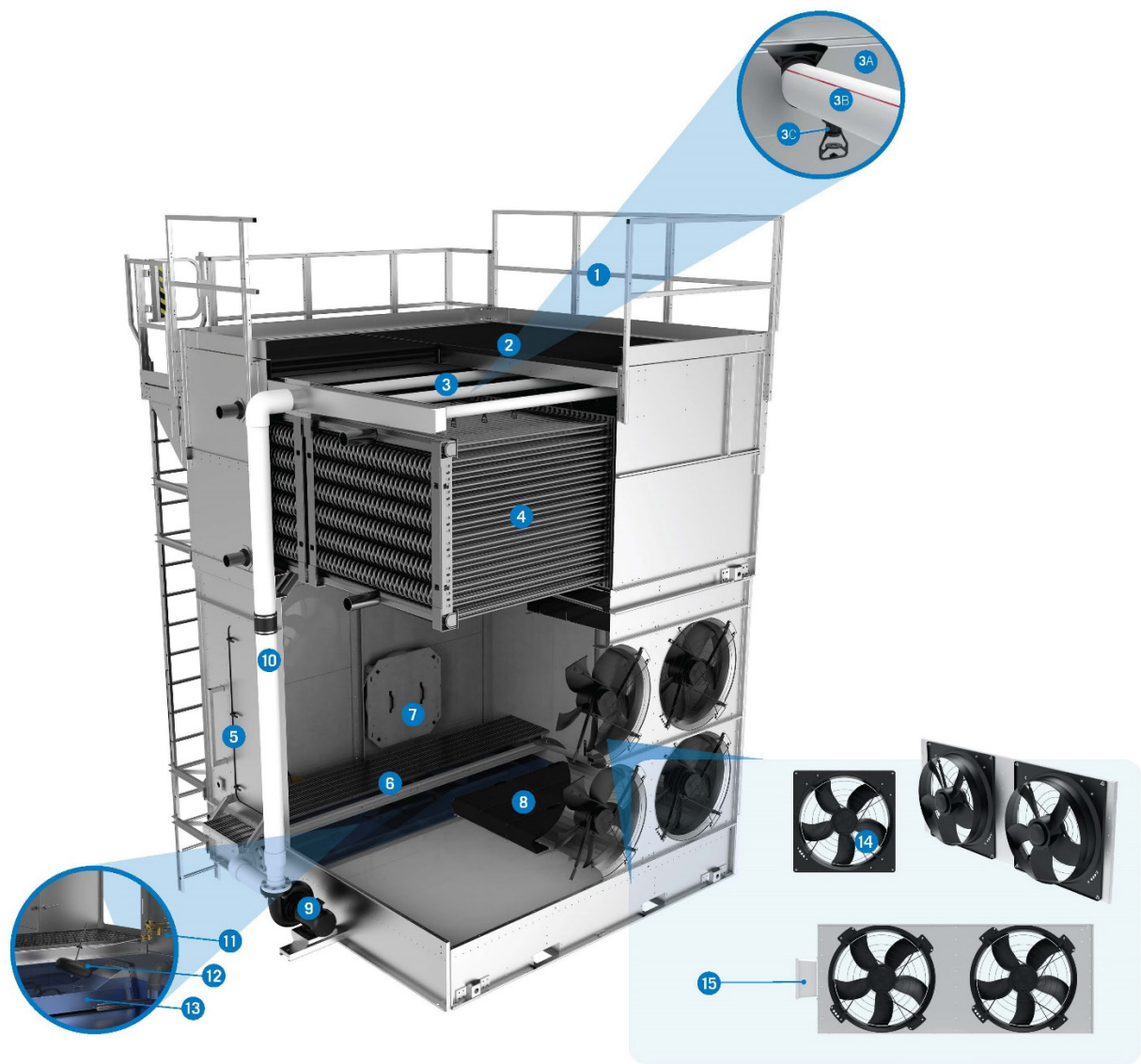


Figure 1. Vertex® Evaporative Condenser with EC Fan System

Upper Casing Section		Basin Section	
1	Factory Pre-Assembled Platforms with Perimeter Handrails	5	Access Door with Safety Handle and Step
2	Drift Eliminators	6	Internal Walkway
3	BranchLok™ Removal System	7	Fan Cover
3A	Feed Box Assembly	8	Water Guards
3B	Spray Branch	9	Pump
3C	Nozzles	10	Pump Riser Piping
4	Coil	11	Make-Up Valve Assembly
		12	Float Ball
		13	Strainer Assembly
		14	EC Direct Drive Fan System Assembly
		15	Terminal Box

Table 1. Vertex® Evaporative Condenser with EC Fan System Parts List

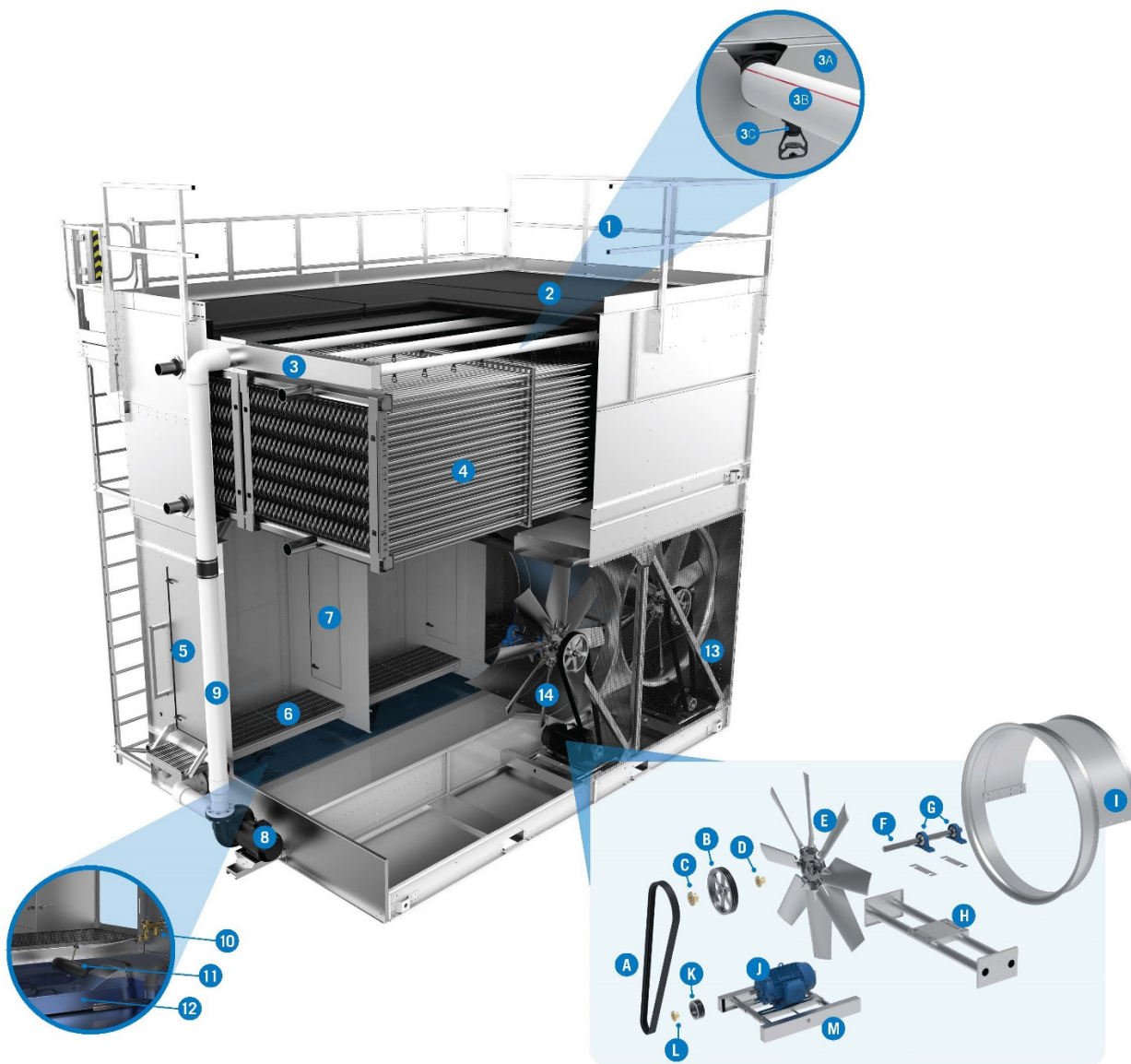


Figure 2. Vertex® Evaporative Condenser with Baltidrive® Power Train

Upper Casing Section		Basin Section		Baltidrive® Power Train	
1	Factory Pre-Assembled Platforms with Perimeter Handrails	5	Access Door with Safety Handle and Step	A	Belt Set
2	Drift Eliminators	6	Internal Walkway	B	Fan Sheave
3	BranchLok™ Removal System	7	Partition Doors	C	Fan Sheave Bushing
3A	Feed Box Assembly	8	Pump	D	Fan Bushing
3B	Spray Branch	9	Pump Riser Piping	E	Axial Fan Assembly
3C	Nozzles	10	Make-Up Valve Assembly	F	Fan Shaft
4	Coil	11	Float Ball	G	Bearing Kit
		12	Strainer Assembly	H	Mechanical Equipment Support
		13	Air Intake Screens	I	Fan Cowl Assembly
		14	Baltidrive® Power Train	J	Motor
				K	Motor Sheave
				L	Motor Sheave Bushing
				M	Motor Base and Adjustment Rod Kit Assembly

Table 2. Vertex® Evaporative Condenser with Baltidrive® Power Train Parts List

Recommended Spare Parts

BAC Factory Authorized Parts are manufactured to meet rigorous specifications and are guaranteed to fit your unit and perform as original equipment. BAC Factory Authorized Parts can be ordered through your local BAC Representative. Most BAC Representatives maintain a local inventory of commonly used parts. For a free unit inspection and a specific parts list for your serial number, contact your [local BAC Representative](#) today. Even with BAC's fast delivery capability, it is still recommended that certain essential and emergency repair part be maintained in your inventory to minimize any potential downtime.

Vertex® Evaporative Condenser with EC Fan System

Basic Recommended Spare Parts	Parts to Consider if Extended Downtime is a Concern
Basin Heater & LWCO (if equipped)	EC Direct Drive Fan System Assembly
Door Gaskets	Pump
Make-Up Valve Assembly & Float Ball	
Spray Nozzles	
Suction Strainer	
Pump Seal Kit	

Vertex® Evaporative Condenser with Baltidrive® Power Train

Basic Recommended Spare Parts	Parts to Consider if Extended Downtime is a Concern
Bearings	Fan and Fan Bushing
Bearing Greaser Refill Kit (if equipped)	Fan Shaft
Belts	Fan Motor
Basin Heater & LWCO	Pump
Door Gaskets	
Make-Up Valve Assembly & Float Ball	
Solenoid Valve (if unit equipped with EWLC)	
Spray Nozzles	
Suction Strainer	
Sheave and Bushing Sets	
Pump Seal Kit	

Start-Up Procedure

Considerations for Initial Start-Up

- For independent fan control recommendations on units with the BALTIDRIVE® Power Train, see **Page 27**.
- For units with VFDs, see **Page 27**.
- For units with vibration cutout switches, see **Page 46**.

General

- If the unit is mounted on vibration isolators or isolation rails (by others), refer to the vibration isolation manufacturer's guidelines before loading/unloading weight from the unit.
- Verify fans and the pump motor are disconnected, locked out, and tagged out.
- The unit must be level in both the length and width directions for proper operation.


Cleaning


- Drain the basin with the strainer in place.
- Remove all dirt and debris from the fan guard(s) and combined inlet shields.
- Inspect and clean all spray nozzles.
- Clean all the mechanical components, such as the fan and motor.
- Remove accumulated dirt and debris from the water guards.
- Flush the basin to remove any accumulated dirt and debris.
- Remove, clean, and replace the basin strainer.


Inspection


- Conduct external inspection of the equipment. 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 piping and connections.
- Thoroughly inspect the fans for any mechanical or physical damage.
- At seasonal start-up or after prolonged shutdown, check the motor insulation with an insulation tester prior to the motor start-up.
- Check and adjust the belt tension. Units equipped with the EC Fan System use direct drive motors and do not require belt tension.

Start-Up

 **DANGER** : Rotating equipment will cause severe personal injury or death to persons who come in contact. 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.

 **DANGER** : Risk of electrocution which will cause severe personal injury or death. Use appropriate lockout procedures. Do not perform any service on or near the unit without first ensuring the unit is de-energized.

 **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** : This equipment should never be operated without all fan screens, access panels, and access doors in place.



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 either before or after installation, certain precautions should be observed, as outlined in section **Prolonged Outdoor Storage** on **Page 17**.

- For EC Fan System units refer to section **9. EC Fan Controls (Models VRC-xxxxA-xxxxN-xB)** on **Page 52** or section **10. EC Fan & Pump Controls (Models VRC-xxxxB-xxxxN-xB)** on **Page 58**.
- For BALTIDRIVE® Power Train units only, prior to seasonal start-up, lubricate the motor base adjusting screw (see **Figure 9** on **Page 25**) and the fan shaft bearings (see **Page 26**). At initial start-up, no bearing lubrication is required since the bearings are factory lubricated prior to shipment.
- For BALTIDRIVE® Power Train units only, apply RUST VETO® to steel shafts.
- Fill the basin with fresh water to the overflow level via the make-up valve.
- Set the make-up valve float so the water shuts off at the operating level (see **Table 3** on **Page 20**).

- Execute one of the following biocide treatment programs while operating the circulating pump and prior to operating the unit fans:
 - Resume treatment with the biocide that was used prior to shut down. Operate the pump only while maintaining the maximum recommended biocide residual for a sufficient duration (residual and time will vary with the biocide) as recommended by the water treatment supplier. Start the fan only after this treatment period is completed.
 - Check the pH of the circulating water and, if necessary, adjust it to 7.0 - 7.6 pH. Then, running the pump only, treat the system with sodium hypochlorite to maintain a level of 4 to 5 mg/l (ppm) free chlorine (as Cl₂) over a six-hour period. Test kits for measuring the free residual of chlorine are commercially available. Start the fan only after this treatment period is completed.
- If the unit was supplied with redundant pump system refer to the initial startup instructions in section **Redundant Spray Water Pump System** on **Page 48**.
- Start the unit pump and check for the proper rotation indicated by the arrow on the pump cover.
- On installations where the unit pump was not furnished by BAC, a globe valve should be installed in the pump discharge line and the pump flow rate adjusted to the correct water flow and pressure (2.25 psig at spray header connection).



NOTICE: Spray system pressure greater than 10.0 psig may cause damage to the distribution system.

- Check that the float operated make-up valve is operating freely. Closely monitor the water level and adjust as necessary during the first 24 hours of operation.
- Inspect the nozzles and heat transfer section as described section **Water Distribution System and Heat Transfer Section** on **Page 30**.
- For units with the BALTIDRIVE® Power Train, verify proper fan tip clearance. See section **BALTIDRIVE® Power Train** on **Page 18**.
- Open the valve in the unit bleed line and adjust the bleed by closing or opening the valve until the desired bleed rate is reached.
- For initial start-up, briefly energize the fan motor(s) and note the direction of rotation. The fan should rotate in the direction indicated by the arrow on the fan cowl.
- Run the fan in manual mode for several minutes to check for any unusual noise or vibrations.
- For a 2-speed motor, check to ensure the starter includes a minimum 15 second time delay when switching from high speed to low speed.
- Check the operation of the optional vibration cutout switch.
- Once the unit is operating, check the current and voltage of all three phases (legs) of the fan motor with a heat load on the unit under warm ambient conditions. The current must not exceed the motor nameplate rating.



NOTICE: Check to ensure the controls for the fan motor are set to allow a maximum of six on-off cycles per hour to prevent motor overload.



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 basins.
- ✓ Adjust the make-up valve if necessary.
- ✓ Check the belt tension and readjust if necessary.
- ✓ Inspect the spray nozzles and heat transfer section.

Extended Shutdown

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

- 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, lock out, and tag out the fans, pump, and motors.
- Close the shut-off valve in the make-up water line (supplied by others) and drain the basin and all exposed water piping. Heat trace and insulate all exposed piping.
- To minimize the risk of biological contamination during shutdown, it is recommended the entire system be drained.
- Clean all debris, such as leaves and dirt, from the interior and exterior of the unit, including the combined inlet shields.
- Clean and flush the basin with the basin strainer in place.
- Leave the basin drain open so rain and melting snow will drain from the unit.
- Remove the bottom drain plug to the spray pump(s). Put the plug(s) in a marked plastic bag and attach to the spray pump(s) for future use.
- Clean the basin strainer and re-install.
- Cover the fan discharge to keep out dirt and debris.
- Lubricate the fan shaft bearings, motor base, and motor base adjusting screw (if applicable).
- Apply RUST VETO® to steel shafts (for BALTIDRIVE® Power Train units only).
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to section **5. Corrosion Protection** on **Page 33** for more details.
- Lockout the fan motor starting device in the "OFF" position to ensure personal safety in case of future inspection or service.

Prolonged Outdoor Storage

Storage Preparation



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 with vents should be used.

- Conduct the **Extended Shutdown** procedure on **Page 16** if the unit is installed.
- Ensure the basin is fully drained and the drain is open.
- For storage prior to installation, all components, and accessories, which sometimes ship inside the unit and are not a permanent fixture in the basin, should be removed and stored indoors.
- Remove the bottom drain plug to the spray pump(s). Put the plug(s) in a marked plastic bag and attach it to the spray pump(s) for future use.
- Remove and store fan belts (if supplied) at room temperature. Tag belts appropriately for future identification.
- During storage, the coils should be charged with inert gas and capped. Note that coils with steel connections are charged with 15 psig nitrogen at the factory prior to shipment.
- If the condenser is removed from the system, charge the coil with 15 psig of inert gas, and cap the connections to reduce the risk of internal corrosion.
- Apply a weather-resistant lubricant or heavy grease such as Anti-Seize (BAC Part # 160069) to all exposed threaded or flanged connections and the adjustable motor base threaded rod.
- Insert desiccant bags into the control panel (if supplied) to absorb moisture. Seal the control panel for storage.
- Spray coat electrical component housings (if supplied) with a suitable protective coating, such as Cosmoline® Weathershed, and individually cover them with plastic, taking care to leave openings for free air circulation.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to section **5. Corrosion Protection** on **Page 33** for more details.

Motor Recommendations



Figure 3. Vertex® Evaporative Condenser with BALTIDRIVE® Powertrain



Figure 4. Vertex® Evaporative Condenser with EC Fan System

Electronically Commutated (EC) Motors

Vertex® Evaporative Condenser EC motors are designed for storage at ambient temperatures of -40°F to 176°F (-40°C to 80°C). Prolonged periods of exposure above or below these specified conditions could degrade components of the motor and cause malfunction or premature failure.

- 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 damage.
- Keep stored motor(s) dry and protected from weather.
- Rotate the fan once per month.
- Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the motors. In areas where they are prevalent, precautions must also be taken to prevent insects from gaining access to the interior of the motor.

BALTIDRIVE® Power Train

BAC standard motors are designed for storage at ambient temperatures of -20°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.

- Motors should be removed and stored inside whenever possible. When indoor storage is not possible the motors must be covered with a tarpaulin. Do not use plastic or 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.

- Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the motors. In areas where they are prevalent, precautions must also be taken to prevent insects from gaining access to the interior of the motor.
- 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 the winding temperature at a minimum of 9°F (5°C) above the ambient temperature of the surrounding environment, keeping it from dropping below the dew point where condensation could form inside the motor. If space heaters are supplied, they should be energized. Request the required voltage and transformer capacity from your local BAC Representative. A third option is to use an auxiliary heat source and keep the winding warm by either convection or blowing warm air into the motor.
- Rotate the motor shaft monthly to redistribute bearing grease.

Maintenance Requirements During Storage

- Rotate all fans and motor shafts monthly by hand. Hand-turning will ensure that the shafts and bearings are free and will redistribute grease within the bearings.
- Inspect the basin monthly to ensure that the drain is open and remove any leaves or debris that may have accumulated on the water guards and in the basin.
- Inspect the axial fans annually to ensure the blades are tight and there is no obvious corrosion between the hub and the fan blade.
- Inspect the rust preventative coating on all motor external machined surfaces including shaft extensions monthly. If necessary, re-coat the surfaces with RUST VETO®.

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.

- Motors should be thoroughly inspected, cleaned, and restored to pre-storage condition.
- Inspect axial fans prior to start-up to ensure that the blades are tight and that there is no obvious corrosion between the hub and the fan blade. Do not energize the fans if there is obvious corrosion of fan components. Loose fan blades could result in fan failure and possible injury or damage.
- Reinstall all fan belts, motors, door gaskets, 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, available on www.BaltimoreAircoil.com or by contacting your local BAC Representative.
- Perform an insulation test of motor windings to ensure satisfactory insulation resistance.
- Conduct full start-up procedure as stated in the **Start-Up Procedure** on **Page 13**. Be especially thorough for cleaning and inspection prior to start-up.

4. Component Operation & Maintenance

Basin

The basin is constructed from one of the following materials and the maintenance information in this section applies to all basin materials of construction.

- Galvanized steel
- TriArmor® Corrosion Protection System
- Welded Type 304 stainless steel

Operating Water Levels in the Basin

Model Number	Operating Depth ^[5] (in)	Operating Height ^[6] (in)	Operating Volume (gal)	Overflow Volume (gal)
VRC-xxxxA-1012N-xx	9	15.43	254	479
VRC-xxxxA-1018N-xx	9	15.43	385	701
VRC-xxxxA-1024N-xx	9	15.43	508	959
VRC-xxxxA-1036N-xx	9	15.43	770	1,402
VRC-xxxxA-2012N-xx	9	15.43	508	959
VRC-xxxxA-2018N-xx	9	15.43	770	1,402
VRC-xxxxA-1212N-xx	9	15.43	254	521
VRC-xxxxA-1218N-xx	9	15.43	385	774
VRC-xxxxA-1224N-xx	9	15.43	508	1,042
VRC-xxxxA-1236N-xx	9	15.43	770	1,549
VRC-xxxxA-2412N-xx	9	15.43	508	1,042
VRC-xxxxA-2418N-xx	9	15.43	770	1,549
VRC-xxxxB-1012N-xx	10	16.43	293	480
VRC-xxxxB-1018N-xx	10	16.43	444	702
VRC-xxxxB-1024N-xx	10	16.43	585	959
VRC-xxxxB-1036N-xx	10	16.43	887	1,403
VRC-xxxxB-2012N-xx	10	16.43	585	959
VRC-xxxxB-2018N-xx	10	16.43	887	1,403
VRC-xxxxB-1212N-xx	10	16.43	294	521
VRC-xxxxB-1218N-xx	10	16.43	445	775
VRC-xxxxB-1224N-xx	10	16.43	587	1,042
VRC-xxxxB-1236N-xx	10	16.43	890	1,549
VRC-xxxxB-2412N-xx	10	16.43	587	1,042
VRC-xxxxB-2418N-xx	10	16.43	890	1,549

Table 3. Basin Water Levels

⁵ Depth is measured from the interior basin floor to water level.

⁶ Height is measured from unit's base (mounting point) to water level.

- The operating water level in the basin will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure.
- The make-up valve controls the operating water level. Operating water levels should be maintained at the levels shown in **Table 3**.
- Check the operating water level monthly and readjust the float as necessary to maintain the recommended operating level.

Inspection & Maintenance



CAUTION: Water in the bottom of the basin may conceal openings and/or submerged obstructions. Use caution when walking inside this equipment.

- Inspect the basin monthly. Remove trash or debris that may have accumulated in the basin or on the strainer.
- At least quarterly and more often, if necessary, drain, clean, and flush the entire basin with fresh water. This will remove the sediment, which can collect in the basin during operation. If not removed, sediment can become corrosive and cause deterioration of the protective finish of metallic basins.
 - When flushing the basin, leave the strainer in place to prevent the sediment from re-entering the spray pump.
 - Remove the strainer after the basin has been flushed.
 - Clean and replace the strainer before refilling the basin with fresh water.
 - Remove accumulated dirt and debris from the water guards.
- Adjust the float to maintain the design operating level. See **Table 3**.

EC Fan System

For units supplied with electronically commutated (EC) motors, very little maintenance is required. As the fans are provided with sealed bearings, lubrication is not required.

- With the fans running, check for any unusual noises or vibrations.
- Thoroughly inspect the fans for damaged or deteriorated fan blades and replace the fan system as required.

Electronically Commutated (EC) Fan Motors

An EC motor has been designed to accept an AC power supply and use onboard electronics to operate similarly to a permanent magnet brushless DC motor. All EC motors provided by BAC have an onboard speed control module, eliminating the need for VFDs. To optimize thermal efficiency, all fans will ramp up or down simultaneously.

EC Fan System Control Types

Refer to the EC fan system control information associated with the unit's model number. For Models VRC-xxxxA-xxxxN-xB refer to **Page 52** for more information. For Models VRC-xxxxB-xxxxN-xB refer to **Page 58** for more information.

EC Fan & Motor Assembly Weight

Model Number	Approximate EC Fan & Motor Assembly Weight (lbs.) ⁽⁷⁾
VRC-xxxxA-xxxxN-xB	112
VRC-xxxxB-xxxxN-xB	196

Table 4. Approximate EC Fan & Motor Assembly Weight

Emergency Fan Cover

Vertex EC units are supplied with an emergency fan cover. The emergency fan cover is intended to be used in the event of a fan/motor failure. The emergency fan cover is designed to be placed over the idle fan opening to prevent water/air from exiting the unit during normal operation. For models VRC-xxxxA-xxxxN-xB the emergency fan cover is mounted in the bottom section adjacent to the internal walkway as shown in **Figure 5**. For models VRC-xxxxB-xxxxN-xB the emergency fan cover is shown installed in **Figure 6** and ships loose with the unit.



Figure 5. Emergency Fan Cover, Models VRC-xxxxA-xxxxN-xB



Figure 6. Emergency Fan Cover, Models VRC-xxxxB-xxxxN-xB

⁷ Approximate EC fan and motor assembly weight does not include weight of fan cowls.

BALTIDRIVE® Power Train

⚠ WARNING : When the fan speed of the unit is to be changed from the factory set speed, including changes achieved by the use of a variable fan speed device, steps must be taken to avoid operation at or near the fan's "critical speed" which could result in fan failure and possible personal injury or damage. Contact your local BAC Representative regarding any such applications.

⚠ WARNING : A lockable disconnect switch should be located within sight of the unit for each fan motor associated with this equipment. Before performing any type of service or inspection, make certain that all power has been disconnected, and the switch is locked out in the "OFF" position.

- If the unit is already in operation, while the fan is running, check for any unusual noises or vibrations.
- With the fan off and the fan motor disconnected, locked out, and tagged out, check the general condition of the fan:
 - Inspect for any loose or missing bolts in the fan shaft bushing, the fan hub, and the fan shaft bearing(s).
 - Check the fan blades for looseness, first by twisting the blade by hand, and then by moving the blade tip forward and back. There should be no play or slippage.
 - Inspect each blade for excessive scale build-up that could cause vibration.
 - Check each blade for any cracks. If cracks are found, the fan motor should be locked out until the fan is replaced. Contact your local BAC Representative for assistance.
- **Tip Clearance:** Check the clearance between the tip of the blade and the fan cowl. The clearance should be between 3/16" to 1/4".
- **Blade Pitch:** Check to ensure that the blades are all at the same pitch. If uncertain, measure the pitch with an inclinometer. All blades should be within 1/2° of each other.
- **Rotation:** Turn the fan by hand to ensure that it moves freely with no rough spots, binding, or other malfunctions that could cause vibration or fan motor overload. While rotating the fan, check the blade tracking. All blades should track within a 1/2" band at any single point around the cowl.
- **Direction of Rotation:** On initial start-up, or if the fan motor has been rewired, briefly energize the fan motors and note the direction of rotation. Fans should rotate in the direction indicated by the arrow on the fan cowl.
- **Belt tension check:**



NOTE: If belts are properly tensioned, there should be no "chirp" or "squeal" when the fan motor is started.

- Place a straight edge along the belt from sheave to sheave as shown in **Figure 7** or use a tape measure as shown in **Figure 8** to measure belt deflection.

- Apply a moderate force by hand (approximately 40 lbs/275 kPa) evenly across the width of the belt in the center of the span between the sheaves.
- There is adequate belt tension if the belt deflects between 1/4" and 3/8" as shown in **Figure 7** and **Figure 8**.

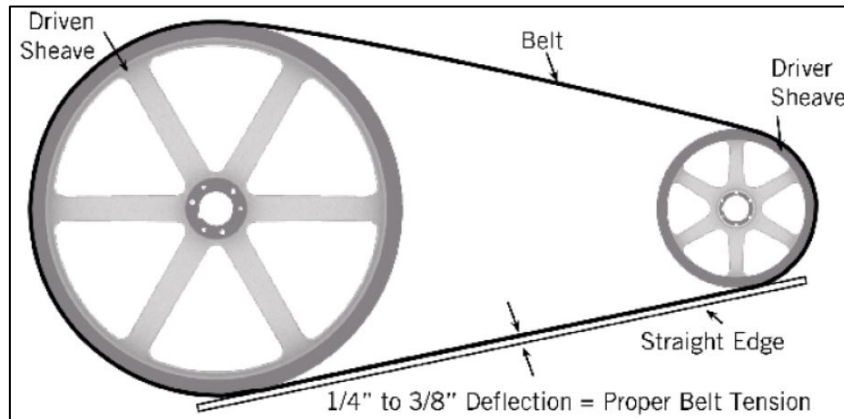


Figure 7. Belt Tension with a Straight Edge

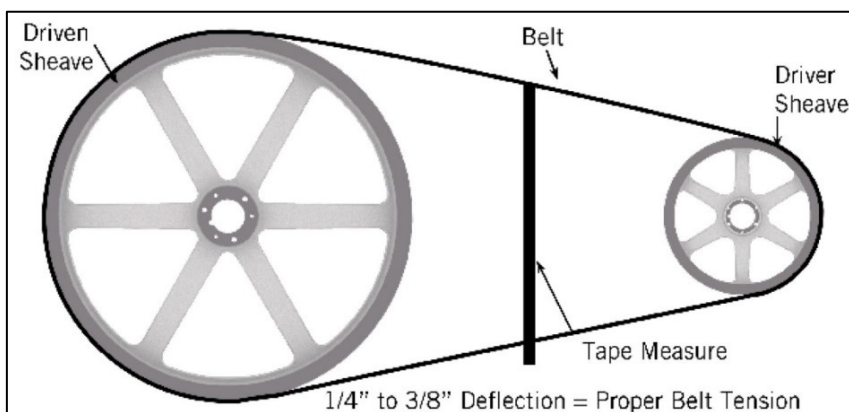


Figure 8. Belt Tension with a Tape Measure

- **Belt tension adjustment (if required):**

- Using a wrench or impact gun, turn the motor base adjusting screw (**Figure 9**) clockwise to tension the belt or counterclockwise to relieve belt tension. During adjustment of the belt tension, rotate the drives several times by hand to evenly distribute the tension throughout the belt.

Motor Adjusting Screw

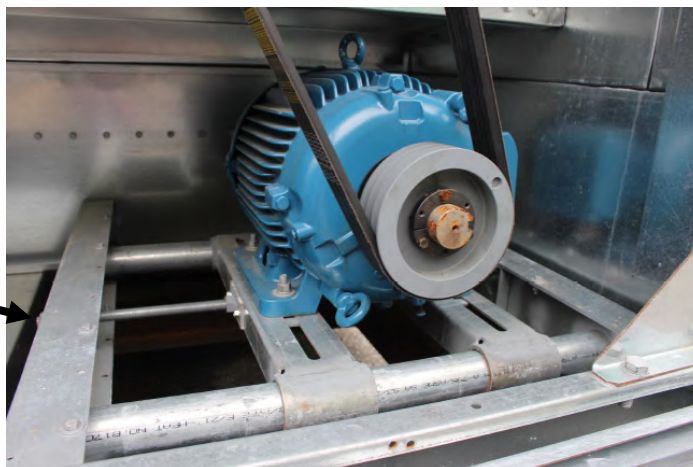


Figure 9. Motor Adjusting Screw

- **Drive alignment check and adjustment:**
 - Place a straight edge across the driver and the driven sheaves as shown in **Figure 10**.
 - The straight edge should contact all four points as shown in **Figure 10** indicating that the drives are properly aligned.
 - There should be no more than 1/16" deviation from the four points of contact.
 - In case of realignment, loosen the driver sheave, and align it with the driven sheave. Allow 1/4" for draw-up as the bushing screws are retightened.

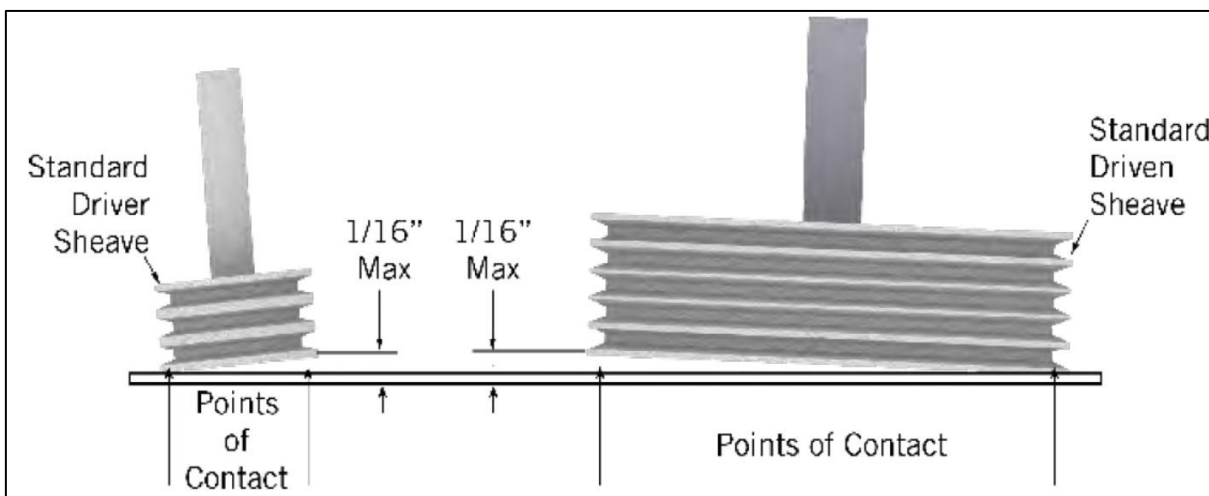


Figure 10. Drive Alignment

Adjustable Motor Base

Coat the motor base slides and adjusting screws (refer to **Figure 9**) prior to start-up, every three months while in operation, and following shutdown. Use good quality, corrosion inhibiting grease such as one of those recommended for lubricating the fan shaft bearings in **Table 5**.

Fan Motor Inspection & Maintenance

- Clean the outside of the motor at least quarterly to ensure proper motor cooling.

- After prolonged shutdowns, check the motor insulation with an insulation tester prior to restarting the motor.
- Check the motor voltage and current following start-up and every three months while in operation.

Fan Shaft Bearing Inspection & Maintenance

- For all units ordered with the BALTIDRIVE® Power Train, two pillow block ball bearings support the fan shaft and are provided with extended lube lines as standard on the Vertex® Evaporative Condenser. Each bearing is equipped with a lubrication fitting and a locking collar to keep out moisture.
- Only lubricate the bearings with a manual grease gun or BAC's optional Automatic Bearing Greaser. Do not use high-pressure grease guns since they may rupture the bearing seals or the extended lubrication lines.
- Only lubricate the bearings with one of the following compatible water-resistant greases which are suitable for ambient temperatures ranging from -65°F (-53.9°C) to +250°F (121.1°C).

Compatible Greases
Amoco - Rycon Premium #3
Chevron - SRI
Citgo - Polyurea MP2™
Conoco - Polyurea 2™
Exxon - Polyrex® EM
Exxon - Unirex N™
MobilGrease® - AW2
Shell - Gadus S2 V100 3
Shell - Gadus S3 T100 2
SKF - LGHP2™
Unocal 76 - Unilife Grease™

Table 5. Compatible Water-resistant Greases

- Lubricate the bearings as follows:
 - **Initial Start-Up:** Normally, no lubrication is required since the bearings have been lubricated at the factory prior to shipment. However, if the unit has been stored at the job site for more than three months, both bearings should be lubricated with new grease before initial operation. When lubricating, purge the old grease from the bearing by gradually adding grease until a bead of new grease appears at the seal on the underside of the bearing.
 - **Seasonal Start-Up:** Purge the bearings with new grease prior to start-up.
 - **Operation:** Purge the bearings with new grease every three months while in operation.
 - **Extended Shutdown:** Purge the bearings with new grease prior to any prolonged storage or downtime.

Locking Collars

Each eccentric locking collar should be checked quarterly to ensure that the inner bearing race is secured to the fan shaft. The locking collar can be set using the following procedure (see **Figure 11**):

- Loosen the set screw.

- Using a drift pin or center punch, tap the collar (in the hole provided) tangentially in the direction of rotation while holding the shaft.
- Retighten the set screw.

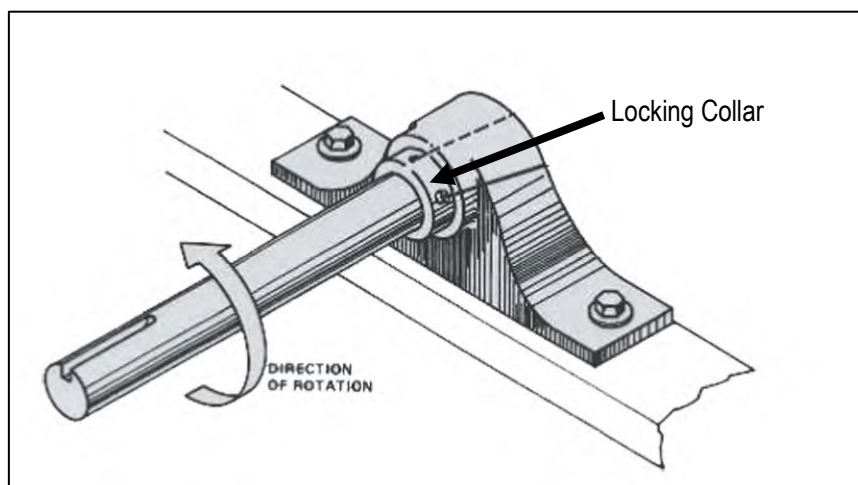


Figure 11. Locking Collar Assembly

Independent Fan Control Recommendations

To maintain high efficiency and performance of the unit, an even distribution of airflow across the coil is required. On all Vertex® Evaporative Condensers that are equipped with BALTIDRIVE® Power Train the recommended fan control option is to use a variable frequency drive to control all fan motors synchronously. VFDs regulate motor speed electronically and start motors with reduced voltage and frequency.

BALTIDRIVE® Power Train Variable Frequency Drive (VFD) Operation

- Applications utilizing variable frequency drives (VFDs) for fan motor control must use inverter duty motors built in compliance with NEMA standard MG-1, Part 31.
- Operation of the unit at a speed which resonates with components of the drive system or support structure may result in vibrations which could damage the components or structure, and/or create objectionable noise. Therefore, these resonant speed ranges should be identified at start-up and locked out to prevent operation of the motor at these resonant speeds. The **BALTIDRIVE® Power Train Resonant Speed Identification Procedure** on **Page 28** must be conducted.
- Please refer to the manufacturer's variable frequency drive recommended start-up procedure for further information or consult with your local BAC Representative for any VFD applications. For projects with BAC controls, visit www.BaltimoreAircoil.com.



NOTICE: For a unit with a VFD, with a switching frequency of 2.5 kHz, the line lead length cannot exceed 100 feet. If the switching frequency is higher than 2.5 kHz and/or the line lead length exceeds 100 feet, a dV/dT output filter is recommended to protect the motor. Since the switching frequency and maximum line length requirements vary between VFD and motor suppliers, contact your local BAC Representative to determine if a dV/dT filter is required. For fan motors controlled with VFDs, when reversing the direction of fan rotation, allow the fan to

come to a complete stop before restarting the motor.



NOTICE: For fan motors controlled with VFDs, when reversing the direction of fan rotation, allow the fan to come to a complete stop before restarting the motor.



NOTE: The minimum turndown ratio for units with a belt drive is 10:1 (or 6 hz).

BALTIDRIVE® Power Train Resonant Speed Identification Procedure



NOTE: The BALTIDRIVE® Power Train Resonant Speed Identification Procedure on Page 28 must be performed at start-up for units with VFDs.

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. If the vibration levels are excessive at these resonant speeds, they need to be locked out to prevent the VFD from operating the motor at these speeds. The following procedure describes how to identify the lockout speed ranges:

- Ensure the VFD that controls the fan motor is off, and the power to the motor circuit is locked out.
- Attach the accelerometer (provided by others) onto the box beam as shown in **Figure 12**. The accelerometer should be placed on the top of the bearing support channel, near the fan side bearing, as shown.

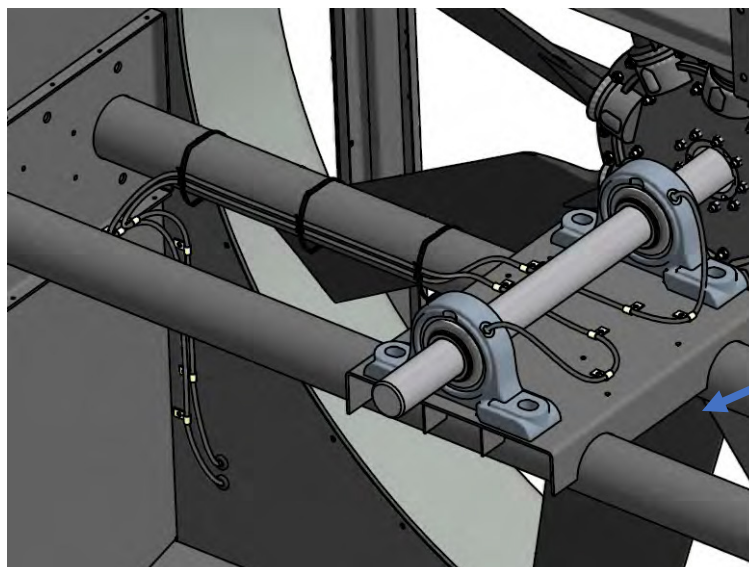


Figure 12. Accelerometer Location - Belt Drive

- Connect the signal wire from the accelerometer (provided by others) to the vibration analyzer (provided by others). Be sure to route and fasten the wire so that it will not contact any rotating parts inside the unit when the drive system is operational.
- Get out of the unit and ensure that the drive system is "all clear". Remove the lockout from the motor circuit.
- With the VFD off, record the vibration level indicated on the vibration analyzer, and confirm that it is very low (only picking up ambient vibration). Record this overall vibration level (0-peak) in inches per second (ips). If the ambient vibration level is greater than 0.35 ips, identify and correct the cause of the vibration. It could be vibration transmitted from another source, instrumentation malfunction, radio frequency interference, etc. If the cause is vibration transmitted from another source, and that source cannot be isolated or turned off for the duration of the measurements, note the source and magnitude of the vibration before continuing.
- After it is confirmed that the drive system is "all clear" and the unit access doors are closed, turn the VFD on, and verify that the fan is turning in the correct direction.
- Using the VFD, slowly (about 1 RPM increase every five to ten seconds) adjust the motor speed from the lowest limit to full speed while monitoring the vibration levels. Record the overall vibration levels at regular intervals if desired.
- As stated previously, when adjusting the VFD speed, proceed slowly while monitoring the vibration levels. If the vibration value approaches 0.35 ips (0-peak), slowly "zero in" on the speed where the value equals 0.35 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 0.35 ips as the speed is increased. After the vibration level has peaked and continues to fall, record the speed where the value equals 0.35 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, ensure the VFD that controls the fan motor is then turned off, and the power to the motor circuit is locked out.
- Enter the unit, and carefully remove the accelerometer, along with any associated wiring from the unit.
- Work with the VFD contractor to enter the lockout speed ranges, if any have been identified, into the VFD, so 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.

Water Distribution System and Heat Transfer Section

WARNING

: The top horizontal surface of the unit is not intended to be used as a walking surface or working platform. If access to the top of the unit is desired, the purchaser/end-user is cautioned to use appropriate means complying with OSHA or other applicable safety standards of governmental authorities.

CAUTION

: Do not use the plastic drift eliminators as a walking, working, or storage surface. Stepping on or placing weight on an eliminator can result in physical injury and/or equipment damage. After ensuring that the fan and pump motors are locked and tagged out, lift and remove eliminators as necessary to perform recommended maintenance and inspections. If access to the top of the coil is required, place a piece of plywood at least 1/2 inch thick on top of the coil to protect the surface while performing the recommended maintenance. When finished, carefully remove the plywood and re-install any eliminators which were removed.

CAUTION

: Drift eliminators can separate from the product during high winds. Fasten drift eliminators in place using the retaining system.

Water is distributed through a corrosion resistant polyvinyl chloride (PVC) spray distribution system. The drift eliminators are made of PVC, which requires no protection against rot, decay, rust, or biological attack.

The inspection procedure is as follows:

- Shut off the fan and lock out and tag out the fan and pump motors.
- Remove drift eliminators to allow a clear view of the spray distribution system and nozzle patterns.
- Start the recirculating pump. Make sure the fan motor is locked out and tagged out. Check to see if the nozzles are all spraying consistently and producing the spray pattern shown in **Figure 13**.
- Clean any nozzles that are clogged. If necessary, the nozzle and rubber grommet may be removed for cleaning. If additional cleaning is necessary, the branch may be removed for cleaning. With the BranchLok™ System, tools are not required to remove the branches.
- Inspect the coil surface. Any corrosion, damage, or obstructions must be corrected.
- The coil is designed for seasonal dry operation followed by seasonal wet operation, and not for frequent cycling of the spray pump. Frequent spray pump cycling may lead to excessive scale buildup.

With electrical heater tape, heat trace and insulate all exposed water piping, including pump piping below the overflow level and make-up water lines.



NOTICE: Do not use steam or high-pressure water to clean PVC eliminators, fill or materials other than steel.

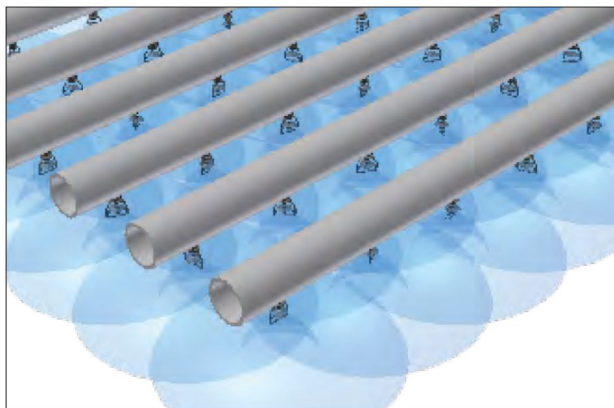


Figure 13. Nozzle Spray Pattern

Water Level Control

There are two types of water level controls used on Vertex® Evaporative Condensers:

- Mechanical make-up valve assembly
- Optional electric water level control package (EWLC)

Mechanical Make-up Valve Assembly



NOTE: If the unit has been ordered with the optional electric water level control package or is intended for remote sump application, a mechanical water make-up valve will not be provided.

A float-operated mechanical water make-up assembly is furnished as standard equipment on the unit. The standard make-up assembly consists of a corrosion resistant make-up valve connected to a float arm assembly actuated by a polystyrene-filled plastic float. The float is mounted on an all-thread rod held in place by wing nuts. The basin operating water level can be adjusted by repositioning the float and all-thread rod using the wing nuts provided.

- Inspect the make-up valve assembly monthly and adjust if necessary.
- Inspect the valve annually for leakage. Replace the valve seat if necessary.
- Maintain the make-up water supply pressure between 15 psig and 50 psig for proper operation. BAC recommends a pressure regulator valve (provided by others) for pressures over 50 psig.
- Set the initial basin water level by adjusting the wing nuts so that the make-up valve is completely closed when the water level in the basin is at the operating level as stated in **Table 3**.
- With the design thermal load and the average water pressure (15 to 50 psig) at the valve, the above setting will produce operating water levels as stated in **Table 3**.
- If the thermal load is less than the design load at the time of unit start-up, the procedure may produce operating levels greater than those shown in **Table 3**. If operating levels are higher than specified, readjust the float in order to attain the recommended operating level.
- Closely monitor the water level in the 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.

Optional Electric Water Level Control Package (EWLC)

As an option, an electric water level control package is available in lieu of the mechanical make-up assembly. The package consists of a probe-type liquid level control assembly and a slow-closing solenoid valve. Stainless steel electrodes, factory-set at predetermined lengths, extend from an electrode holder into the basin. For more information, refer to the Electric Water Level Control Operation & Maintenance Manual available at BaltimoreAircoil.com.

- Clean the stainless-steel electrodes periodically to prevent accumulations of scale, corrosion, sludge, or biological growth, which could interfere with the electrical circuit.
- The water level is maintained at the recommended operating level regardless of the system thermal load. Therefore, it is not recommended that the operating level be adjusted.
- During the start-up of units equipped with the electric water level control package, bypass the control unit in order to fill the unit to the overflow connection.

5. Corrosion Protection

BAC products are constructed of corrosion-resistant materials. Other materials listed below are used in the equipment construction:

- **Galvanized Steel Components:** Inspect the galvanized steel components for blemishes or corrosion. Wire brush and recoat the affected areas with a cold galvanizing compound such as zinc rich compound (ZRC).
- **Baltibond™ Hybrid Coating:** Galvanized steel components protected with Baltibond™ Hybrid Coating can be scratched, scraped, or blemished. To touch up these areas use a repair kit (BAC Part # 160133) available from your local BAC Representative.
- **Stainless Steel Components:** Inspect stainless steel components for signs of blemishes or corrosion. See section **Long Term Care of Stainless Steel** on **Page 36** for cleaning and care instructions.
- **TriArmor® Corrosion Protection System:** Inspect components protected with the TriArmor® Corrosion Protection System for signs of deep scratches or blemishes, especially in areas with field penetrations. Touch these up with 3M™ Windo-Weld™ Super Fast Urethane which is available through your local BAC Representative (BAC Part # RK1015).

Water Treatment

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.



NOTE: 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 qualified 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.

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 on galvanized surfaces 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 fill and severely impact thermal performance.
- **Biological Fouling** – Slime and algae formations may reduce heat transfer, promote corrosion, and harbor pathogens such as Legionella.

Corrosion and Scale Control

- To control corrosion and scale, maintain the water chemistry of the recirculating water within the parameters listed in **Table 6**. 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 6**. 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 6**.

Property of Water	Recommended Levels for Various Materials of Construction ^{[8][9]}			
	Galvanized Steel	Baltibond™ Hybrid Coating	Type 304 Stainless Steel	TriArmor® Corrosion Protection System ^[10] or Type 316 Stainless Steel
pH	6.5 to 9.0 ^[11]	6.5 to 9.2 ^[11]	6.5 to 9.2 ^[11]	6.5 to 9.5 ^[11]
Total Suspended Solids	25 ppm	25 ppm	25 ppm	25 ppm
Total Dissolved Solids (TDS) ^[12]	1,500 ppm	2,050 ppm	2,050 ppm	2,500 ppm
Conductivity ^[12]	2,400 (micromhos/cm)	3,300 (micromhos/cm)	3,300 (micromhos/cm)	4,000 (micromhos/cm)
Alkalinity as CaCO ₃	500 ppm ^[13]	600 ppm ^[13]	600 ppm ^[13]	600 ppm ^[13]
Calcium Hardness as CaCO ₃	50 to 600 ppm ^[13]	50 to 750 ppm ^[13]	50 to 750 ppm ^[13]	50 to 750 ppm ^[13]
Chlorides (CL)	250 ppm	300 ppm	300 ppm	750 ppm
Sulfates	250 ppm	350 ppm	350 ppm	750 ppm
Silica	150 ppm	150 ppm	150 ppm	150 ppm

Table 6. Quality Guidelines for treated Circulated Water

Gray Water and Reclaimed Water

The use of water reclaimed from another process as a source of makeup water for evaporative cooling equipment can be considered as long as the resultant recirculating water chemistry conforms to the parameters noted in **Table 6**. It should be noted that using water reclaimed from other processes may increase the potential of corrosion, microbiological fouling, or scale formation. Gray water or reclaimed water should be avoided unless all the associated risks are understood and documented as part of the site-specific treatment plan.

Chemical Treatment Requirements

Chemical treatment programs must meet the following requirements:

- The chemicals must be compatible with the unit materials of construction as well as other materials used in the system (pipe, heat exchanger, etc.).
- BAC discourages acid dosing as means of scale control except for open circuit cooling towers with remote sump applications or towers constructed from stainless steel. This should be done at a point in the system where total mixing and dilution occur before reaching the evaporative cooling equipment. The preferred injection point for chemical scale and corrosion inhibitors is on the discharge side of the system circulating pump(s). These chemicals should not be batch fed directly into the unit's basin or water distribution system, as this can severely damage areas directly contacted.
- When chlorine is added to the system, free residual chlorine should not exceed 1 ppm, except as noted in **Start-Up Procedure** on **Page 13** and **Extended Shutdown** on **Page 16**. Exceeding this limit may accelerate corrosion.

⁸ The guidelines in **Table 6** refer to the materials used in construction. Different combinations of materials may be used on the same unit.

⁹ Water chemistry will change with operating temperatures. The recommended guidelines listed in **Table 6** refers to water temperature at 95°F.

¹⁰ EVERTOUGH™ Construction units have a TriArmor® Corrosion Protection System basin.

¹¹ Galvanized steel units require passivation in order to prevent white rust (refer to "Passivation").

¹² The conversion factor used to determine conductivity is 0.625 (TDS = 0.625 x Conductivity).

¹³ Hardness and alkalinity limits may be exceeded under certain circumstances. Consult your water treatment specialist for recommendations.

Passivation



NOTE: Stainless steel basins and basins protected by the TriArmor® Corrosion Protection System or Baltibond™ Hybrid Coating do not require passivation. However, if the upper structure is galvanized steel, passivation is required on the galvanized area including any Hot Dip Galvanized After Fabrication (HDGAF) coil(s).

When new systems are first commissioned, special measures should be taken to ensure that galvanized steel surfaces are properly passivated to provide maximum protection from corrosion. Passivation is the formation of a protective, passive, oxide layer on galvanized steel surfaces. To ensure the galvanized steel surfaces are passivated, the pH of circulating water should be kept between 6.5 and 8.2 and calcium hardness between 50 and 600 ppm (as CaCO₃) for four to eight weeks after start-up, or until new zinc surfaces turn dull gray in color. If white deposits form on galvanized steel surfaces after the pH is returned to normal service levels, it may be necessary to repeat the passivation process. In case the pH can't be kept below 8.2, a secondary approach is to conduct a chemical passivation using inorganic phosphate or film-forming passivation agents. Consult your water treatment specialist for specific recommendations.

Biological Control



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

- The warm, oxygen and nutrient rich environment inside evaporative cooling equipment provides an ideal environment conducive to 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. Diluted liquid biocides may be added directly to the basin.

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.

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.

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.

Recommended Cleaning Procedure



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.

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 electrochemical cleaning in the field. Contact your local BAC Representative for more information.



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>.

System Cleaning

Coil Cleaning

The outside of the coil may require occasional cleaning. The chemicals used must be compatible with the materials being treated. For example, the standard coil outside is galvanized steel. The inside of the coil is black carbon steel. For specific recommendations on coil cleaning, contact a qualified consultant.

Weld Byproduct Cleaning

The installation and manufacturing processes commonly used for field assembly of steel-piped systems may leave weld byproducts inside coils and connecting piping (especially in refrigeration systems). 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.

6. 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 the safe operation and longevity of evaporative cooling equipment, as well as other system components.

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 cause scaling, corrosion, and sludge accumulations that reduce heat transfer efficiency and increase system operating costs, 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 equal 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 make-up water.

- In order to optimize heat transfer efficiency and maximize equipment life, bleed or blowdown a small amount of recirculating water from the system. This controls the cycles of concentration to maintain the quality of the recirculating water within the guidelines given in **Table 6**.
- Replenish the “bleed” water with fresh make-up water, thereby limiting the build-up of impurities.
- Bleed/blowdown:
 - To minimize water usage, accomplish the bleed automatically through a solenoid valve controlled by a conductivity meter. The set point is the water conductivity at the desired cycles of concentration and should be determined by a water treatment expert.

Bleed Line Calculations: The approximate design 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: The solenoid valve and conductivity meter must be supplied by others. Evaporation is proportional to the load and will vary seasonally. BAC recommends the use of a conductivity meter to maximize water conservation.

7. Cold Weather Operation



NOTICE: Mechanical and operational methods must be employed to protect these products against damage and/or reduced effectiveness due to possible freeze-up. Please refer to BaltimoreAircoil.com or contact your local BAC Representative for recommended protection alternatives.

Inspection & Maintenance

BAC products can be operated at subfreezing ambient temperatures provided proper operating methods are established and diligently followed.

- Carry out frequent visual inspections and routine maintenance services during operation in subfreezing weather.
- Ensure all controls for capacity and freeze protection are set properly and functioning normally.
- Prevent excessively high-water levels and possible overflow of the basin due to over pumping, clogged strainers, or make-up valve malfunction.
- Some unit icing can be expected in very cold weather. Usually this will not affect the operation of the unit. Resolve any icing conditions that may damage the unit or the supports, impair the system performance, or create a safety hazard.

Fan Section Icing Protection

There are three basic operational methods which can be used to provide the system's required cooling: temperature setting, fan control, and dry operation. The method of control employed on a given application depends upon the climatic extremes which are expected, the variations in heat load that will be encountered, and the compatibility of the control system with other portions of the installation.

In subfreezing ambient temperatures, effective icing control may require a combination of these three methods. Operate each unit with the highest thermal load it can handle, rather than evenly dividing the total heat load across all cells. During prolonged cold weather periods, bypass the idle units and drain the basins.

Fan Control

Reduce the unit capacity by cycling the fans, thus modulating the airflow through the unit. Rapid on-off cycles can cause induction fan motors to overheat. For induction motors, set the controls to allow a maximum of six on-off cycles per hour. EC motors will self-limit fan speed to prevent overheating. Periodically, cycle the fans off to prevent ice formation and/or to melt ice that accumulates on the equipment.

The following are fan control methods:

- **Variable Frequency Drives and EC motors:** VFDs and EC motors offer the most precise method of capacity control by modulating fan motor speed. When using them, avoid operating at or near resonant speeds. Units with VFDs require premium efficient/inverter duty motors.
- **Fan Cycling:** Cycle the fan off for five minutes every 15 to 20 minutes for each cell. If ice continues to build on the air intake, decrease the on-time. Observe the air intake of the unit at least every four to eight hours.



NOTE: Modulating the water flow rate to the unit is NOT a recommended method of controlling cooling capacity.

Dry Operation

One method to prevent icing is dry operation. Dry operation of the unit protects fans from ice formation due to mist and splash from the basin. The water in the basin must be drained in dry operation. For dry operation switch points and recommendations, contact your local BAC representative.

Basin Water and Internal Piping Freeze Protection

Basin Protection

It is important to protect the basin and internal piping. The basin water could freeze when the unit is shutdown and exposed to subfreezing ambient temperatures.

- **Remote Sump:** The ideal method of protection is a remote sump located in a heated indoor space. When the circulating pump stops, the water in the connecting piping will drain by gravity to this indoor sump.
- **Basin Heaters:** On applications without a remote sump, heat must be provided to the basin. Electrical immersion heaters can provide the required function. Contact your local BAC Representative for details.
- **Electric Water Level Control:** An electric water level control will maintain the proper water level regardless of the thermal load or variations in make-up water supply pressure. The two-position, slow closing solenoid valve provided with the BAC electric water level control package also minimizes valve freezing problems (see **Page 32**).
- **Heat Tracing:** Heat trace and insulate all exposed water piping including pump piping below the overflow level and make-up water lines with electrical heater tape.



NOTE: For remote sump applications, the water level in the basin of the equipment is a function of the design flow rate, the quantity, size and location of the remote sump connection and the pipe design between the cooling tower and the remote sump. Units installed on remote sump applications are supplied without a make-up connection.

Coil Freeze Protection

For protection against coil freeze-up, recommended solutions 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.

Coil volumes for the Vertex Evaporative Condenser using liquid cooling circuits is job specific.

Minimum Operation

When utilizing an auxiliary cooling circuit with water as the cooling media, the system must be operated to meet minimum flow and temperature requirements. Maintain a minimum heat load so that the temperature of the fluid leaving the coil is not less than 50°F (10°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. Otherwise, a glycol solution can be used as the cooling media to prevent freezing.

8. Operation & Maintenance of Optional Accessories

Basin Heater

One or more electric immersion heaters prevent the 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.

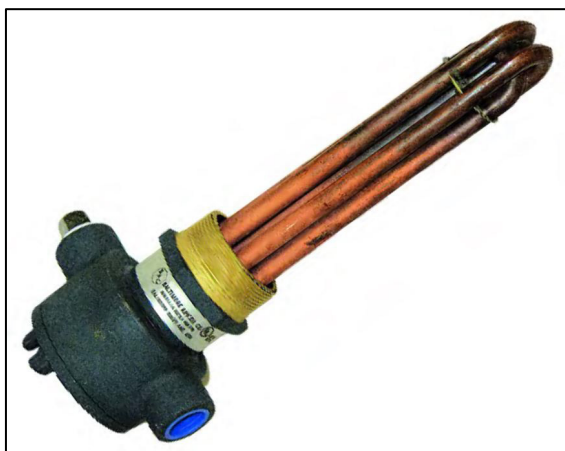


Figure 14. Basin Heater

Operation

Ensure that the heating element is completely submerged before energizing the main disconnect. For installations that have a BAC Controls Enclosure, please consult the submittal packet provided with the unit and contact your local BAC Representative for support. For installations that use a stand alone BAC heater control panel, see below.



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

Stand Alone BAC Heater Control Panel

The heater control system consists of a 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.

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.



NOTICE: The stand alone BAC 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.

Operation



NOTICE: For the stand alone BAC heater control panel, 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: For the stand alone BAC heater control panel, 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.

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 (4.5°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.

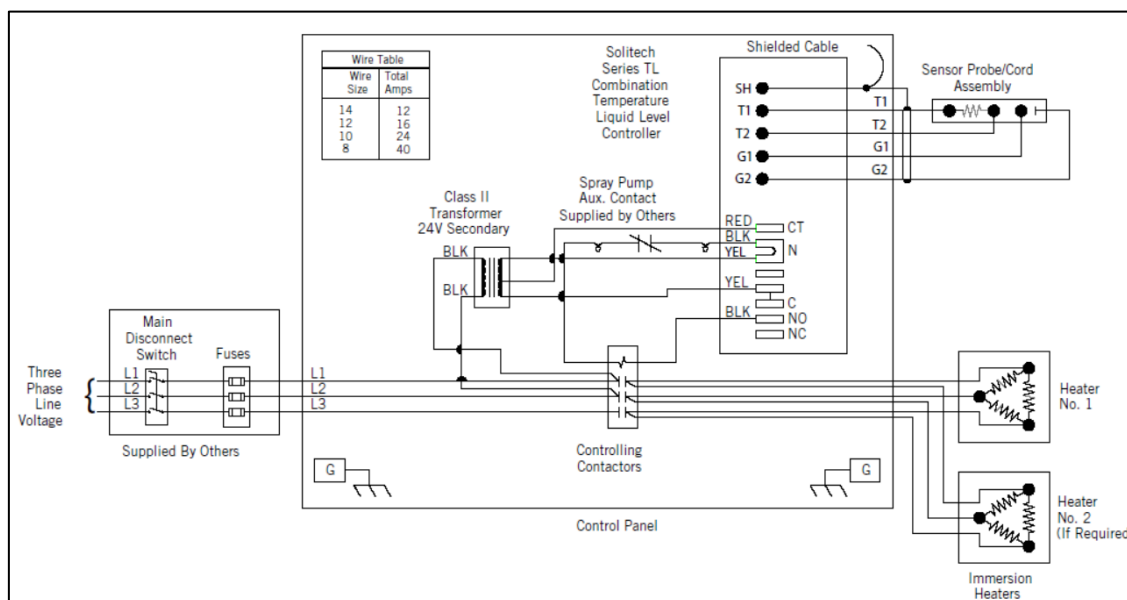


Figure 15. Example Wiring Diagram for Stand Alone BAC Heater Control Panel (Refer to Submittal Drawing for Specific Wiring Diagram)



NOTE: Figure 15 is superseded by any drawing supplied with the panel by the manufacturer.

Vibration Cutout Switch (VCOS)

The Mechanical Vibration Cutout Switch and the Optional Electronic Vibration Cutout Switch should be tested and field adjusted at start-up and yearly thereafter. Both are located on the outside of the unit, next to the access door. For units equipped with the EC fan drive system, vibrations are monitored by built-in sensors in the motors. A separate vibration cutout switch is not needed.



NOTE: If the VCOS trips, turn off, then lock and tag out the electrical supply to the fan motor(s). Adjust the set point screw an additional 1/4 turn clockwise, and push in the manual reset button. Start up the fan motor(s) to determine if the start-up will cause the VCOS to trip. Repeat this adjustment process until the VCOS no longer trips when the unit is operated. Make sure to lock out and tag out the electrical supply to the fan motor(s) before entering the unit or re-setting the switch, each time an adjustment to the VCOS is made. After the final adjustment has been made, start and stop the fan motor(s) two more times to ensure that the VCOS is properly set.

Mechanical Vibration Cutout Switch (Optional)

Set Point Adjustment When Installed:

1. For safety, turn off, then lock and tag-out the electrical supply to the fan motor(s).
2. Turn adjustment screw counterclockwise 1/8 turn at a time until you hear the control trip.
3. Once tripped, rotate adjustment screw 1/4 turn clockwise. Push in the manual reset button.
4. Start up the fans to determine if the start-up will cause the cut-out switch to trip.
5. If the VCOS does not trip, start and stop the fan two more times. If the VCOS still does not trip, then calibration is complete.
6. If the VCOS trips, follow the steps in the note to the right.

Electrical Reset and Start-up Lockout (Optional):

1. If rated voltage is continuously applied to the reset circuit at unit start-up, the reset solenoid energizes for a fixed time interval (approximately 30 sec), after which time the solenoid is automatically de-energized by the thermistor. This provides a trip lockout during machine start-up roughness.
2. The voltage must be removed from the reset circuit when the machine is stopped to allow the thermistor to cool off.
3. The switch mechanism can be reset electrically by a momentary application of the reset voltage or it can be reset manually.

Electronic Vibration Cutout Switch (Optional)

Two models of electronic vibration cutout switches are available. The single set point model contains one trip limit for shutdown. The dual set point model contains two independent trip limits; one for alarm and one for shutdown. The shutdown set-point is factory set at 0.45 in/sec. Additional details can be found in the submittal packet.

⚠ WARNING: Before performing an adjustment or inspection of the VCOS, make certain that all power has been disconnected and locked in the off position. Moisture inside the switch can lead to switch failure. Care must be taken when replacing the cover on the vibration switch to ensure that the proper watertight seal is obtained.

Testing:

- The test position sets in the minimum set point so that any vibration will cause a trip condition.
- The light will come on immediately, and the trip will occur after the duration of the time delay, proving the complete system is operational.
- If test position is maintained for less than the duration of the time delay, the trip will not occur, thus permitting the system test without shutdown.

Calibration:

- A light adjacent to the set point control comes on the instant the measured vibration level exceeds the set point.
- The unit can be periodically calibrated on line by turning the set point control down until the light comes on. This setting is then compared with the vibration measured with a portable vibration meter, thus providing a calibration check of the unit.
- If the trip setting is maintained, trip will occur after the duration of the time delay.

Remote Reset: Connection of between terminals 6 and 7 latches electromechanical relay output in alarm state after set point is exceeded. Opening the connection will reset the output to non-alarm state.

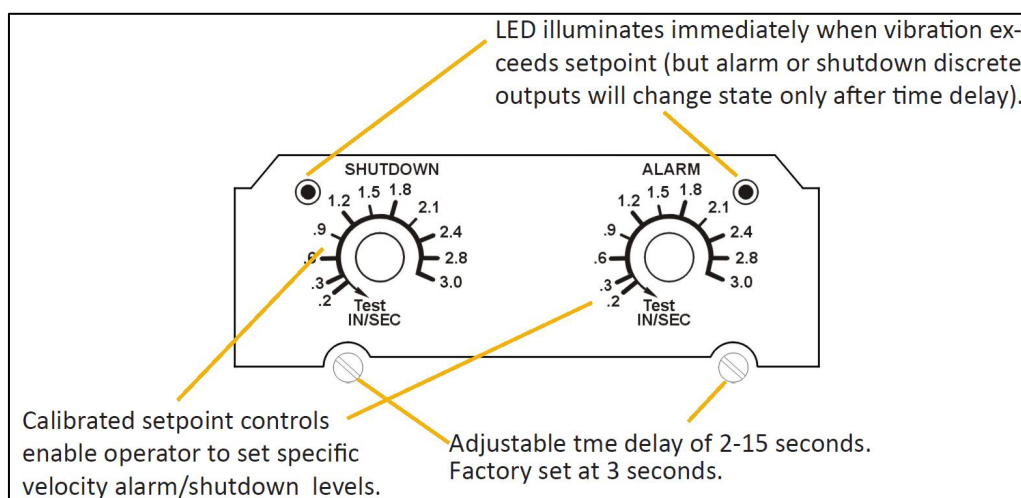


Figure 16. Electronic VCOS with Alarm Contact is Shown

Redundant Spray Water Pump System

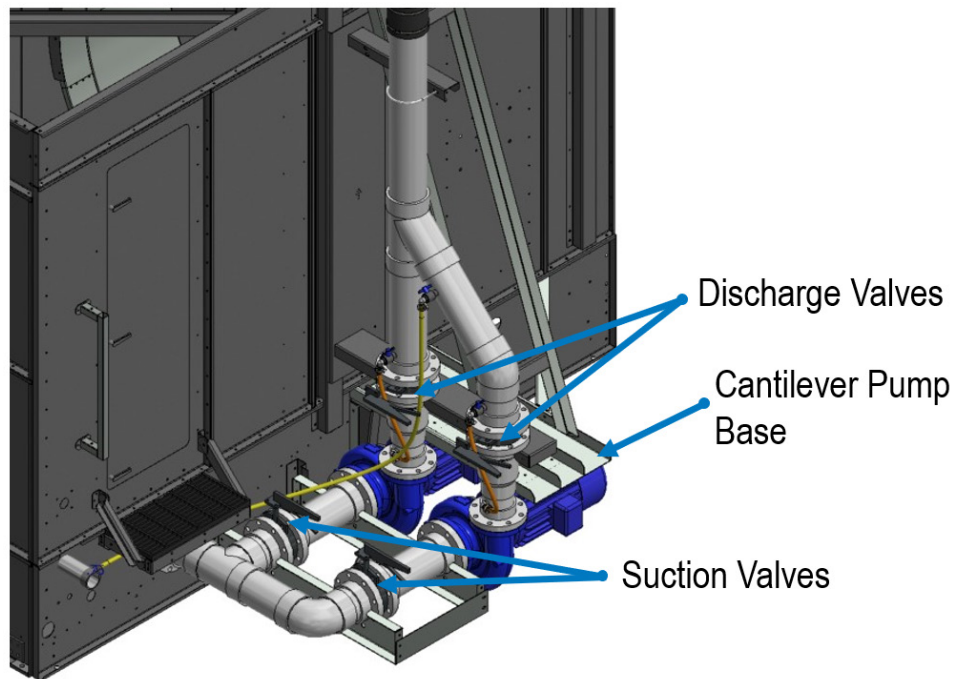


Figure 17. Discharge and Suction Valves

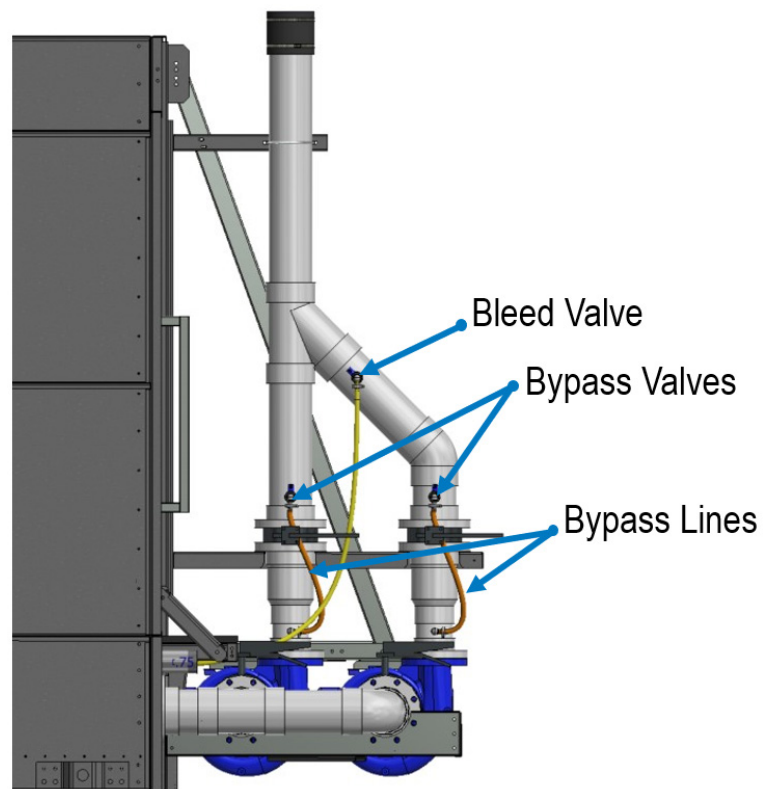


Figure 18. Bleed and Bypass Valves

An optional secondary spray pump may be provided. This pump can be switched easily and maintained while the unit remains in operation. Only one spray pump may be operated at one time. During normal operation follow the **Table 7** to prevent water stagnation.

Table 7. Valve Position for Normal Operation			
	Discharge Valve	Suction Valve	Bypass Valve
Operational Pump	OPEN	OPEN	OPEN
Non-Operational Pump	CLOSED	OPEN	OPEN

Table 7. Valve Position for Normal Operation

Initial Startup:

1. Verify that both bypass lines are open and are not obstructed or kinked. Both bypass valves are to remain open during normal operation.
2. Open both suction valves. Both suction valves are to remain open during normal operation.
3. Open the discharge valve for the pump that will be in operation
4. Close the discharge valve for the pump that will not be in operation.

Pump Switch Over:

1. Turn off the pump in operation and close the discharge valve for that pump.
2. Open the discharge valve for the pump that will be in operation. NOTE: The discharge valve for the pump in operation is the only discharge valve that should be open during normal operation.
3. Start the pump that will be in operation.

Pump Removal:

1. Shut down, lock out, and tag out power to the pump motor for the pump that will be removed.
2. Close the bypass valve for the pump that will be removed.
3. Close the suction valve and the discharge valve to isolate the pump that will be removed.
4. Loosen and remove the flange hardware and gaskets from the suction and discharge flanges of the pump volute. See **Figure 19**. Pump flange connection uses 3/4"x3-3/4" hardware. NOTE: Do not remove hardware from the discharge or suction valves.
5. Loosen and remove 3/8" hardware that fastens the pump mount to the cantilever pump base or remove the 3/8" hardware that fastens the pump feet to the pump mount. See **Figure 21**.
6. If the pump will be removed for an extended period install blind flanges with gaskets on the suction and discharge side of the removed pump. Pump flange connection uses 3/4"x3-3/4" hardware. Torque flange hardware to 40 ft-lbs. Do not overtighten. Tee the bypass line of the removed pump into the adjacent bypass line. Open the bypass valve for the removed pump. See **Figure 20**.

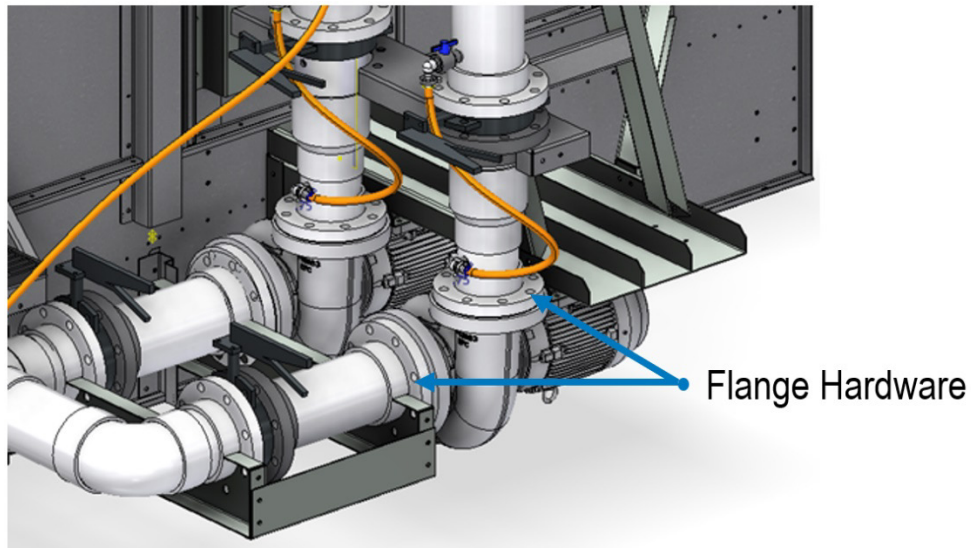


Figure 19. Pump Volute Flanges

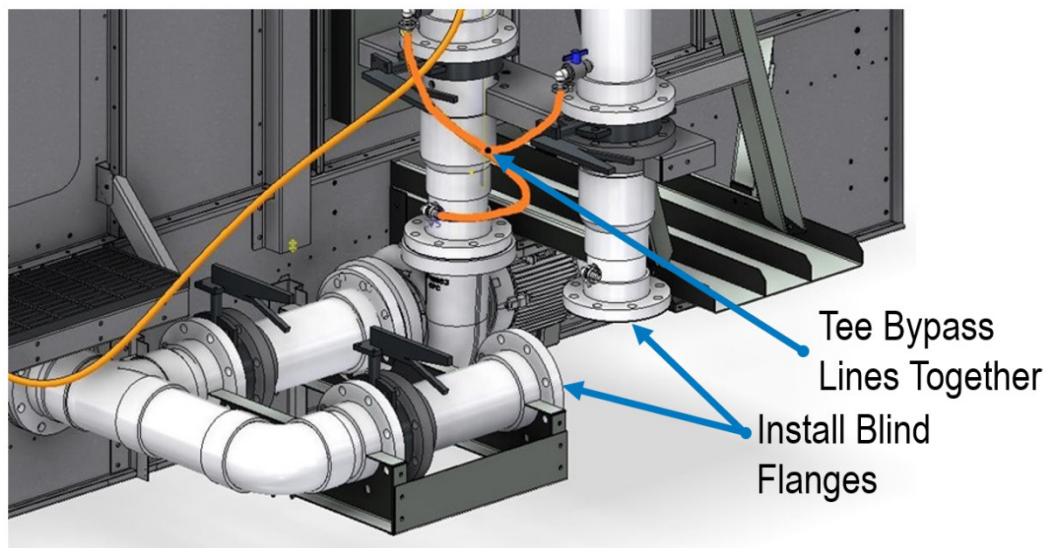


Figure 20. Long Term Pump Removal

Pump Installation:

1. Attach 3/8" hardware that fastens the pump mount to the cantilever pump base or attach the 3/8" hardware that fastens the pump feet to the pump mount. See **Figure 21**.
2. Attach the flange hardware and gaskets to the suction and discharge flanges of the pump volute. See **Figure 19**. Pump flange connection uses 3/4"x3-3/4" hardware. Torque flange hardware to 40 ft-lbs. Do not overtighten.
3. After the new pump and new gaskets are installed and all connections are properly fastened, open the bypass valve for the new pump.
4. Open the suction valve for the new pump.
5. If the newly installed pump is to be operated, refer to the instructions for pump switch over.

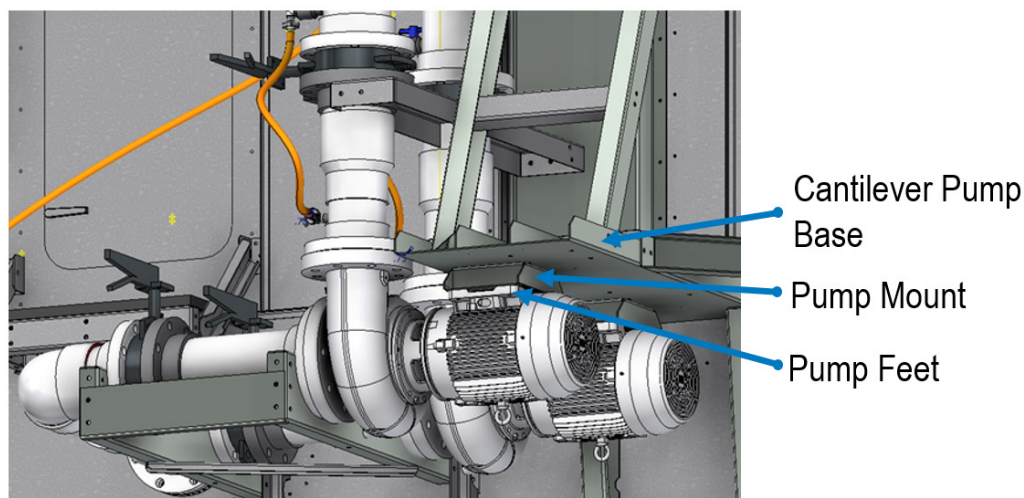


Figure 21. Pump Mounting

Basin Sump Sweeper Piping

Regular maintenance of the basin in evaporative cooling equipment is vital to keeping a cooling system clean and efficient. Sweeper piping is a simple solution that complements the filtration system by automating the cleaning of the basin. Often installed in conjunction with a side stream filtration system, sweeper piping uses pressurized streams of water to reduce the buildup of sediment. Spray water directed towards the sweeper drain connection flushes solid debris to the filtration system, while the added turbulence in the basin inhibits biological growth. **Table 8** lists typical basin sump sweeper piping information. Please consult the submittal packet provided with the unit for specific information.

Box Footprint	Design Flow Rate (GPM)	Design Pressure (psi) ¹⁴	Inlet Connection Size	Outlet Connection Size ¹⁵
10'x12'	64	20	2"	3"
10'x18'	96	20	2"	3"
12'x12'	64	20	2"	3"
12'x18'	96	20	2"	3"
10'x24'	128	20	(2) 2"	(2) 3"
10'x36'	192	20	(2) 2"	(2) 3"
12'x24'	128	20	(2) 2"	(2) 3"
12'x36'	192	20	(2) 2"	(2) 3"

Table 8. Basin Sump Sweeper Piping Information

¹⁴ Design pressure is required at the basin sump sweeper piping water inlet connection.

¹⁵ Basin sump sweeper piping outlet connection and drain share a common connection. Unit drain must be piped off from basin sump sweeper piping outlet.

9. EC Fan Controls (Models VRC-xxxxA-xxxxN-xB)

General

The information in this section is applicable to Vertex™ Evaporative Condenser models VRC-xxxxA-xxxxN-xB that utilize the unit mounted electrical panel shown in **Figure 22**.



Figure 22. EC Fan Control Enclosure for Models VRC-xxxxA-xxxxN-xB

Unit Mounted Electrical Panel

EC motors are factory-wired to the unit-mounted electrical control panel shown in **Figure 22**. This panel provides a single location for a 3-phase power connection, a 4-20 mA motor control signal, and an alarm feedback signal. Two LED lights, one for the ALARM (red) and one for the OVERRIDE (yellow), are provided on the outside of the control panel. An override switch (ON/OFF) is provided on the enclosure, allowing the operator to override an alarm condition and continue equipment operation.

Alarm Signal

The alarm light indicator (red) on the control panel indicates that one or more fans have had an event that is preventing them from operating correctly. When the indicator illuminates, all fans will operate at a factory pre-set emergency speed, which is around 40% full speed.

Override Switch

The override switch bypasses the alarm signal coming from one or more fans and allows the user to regain control of the fans using the 4-20mA speed signal. This switch should be used when waiting for a fan replacement or if one or more fans are de-energized for any reason. If the unit must operate at higher speeds than the emergency speed, install the included fan cover over the inoperable fan to prevent water from leaving the fan housing.

EC Fan System Fan Control (Models VRC-xxxxA-xxxxN-xB)

EC fan motors are controlled simultaneously by a single 4-20mA analog signal where 4mA is 0% speed and 20mA is 100% speed. Control signals outside of this range will cause the unit to operate in emergency mode (approx. 40% fan speed).

Sequence of Operation

Fan Ramp Sequence

Before start-up, ensure that the unit is energized and a control signal between 4 and 20mA is provided to terminals AIN and AGND. The fans will respond to an increasing speed signal, per **Figure 23**:

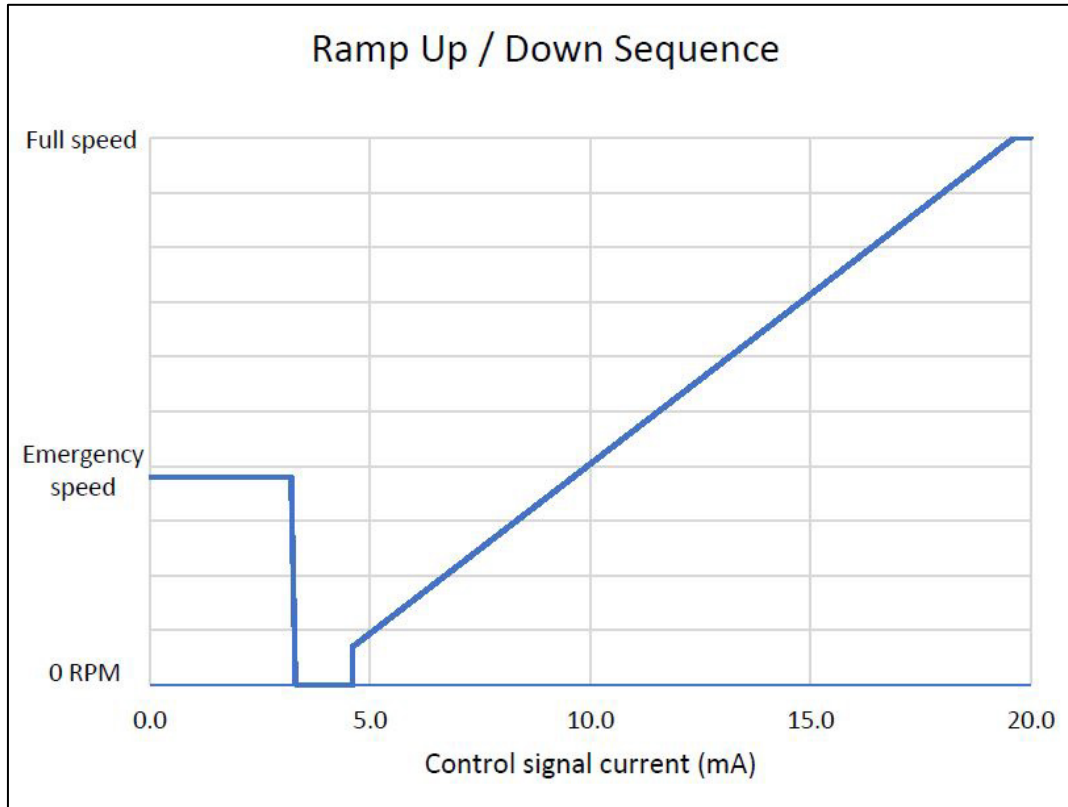


Figure 23. Ramp-up Sequence

1. If the control signal is less than or equal to 3.2mA for more than 60 seconds:
 - a. The alarm light on the control panel will turn ON and an alarm signal will be enabled.
 - b. All fans will rotate at the emergency speed.
2. When the control signal reaches 4.6mA, the fans will initiate rotation.
3. Between 4.6mA and 20mA, the fans ramp up linearly and proportionally to the input speed signal.

VERTEX® Fan Ramp-down

The fans will respond to decreasing speed signal, per **Figure 23**:

1. Between 20mA and 4.4mA the fans ramp down linearly and proportionally to the input speed signal.
2. For control signals between 4.4 and 1.9mA, the fans will stop.
3. If the fan signal is less than 1.8mA for more than 60 seconds:
 - a. The alarm light on the control panel will turn ON and an alarm signal will be enabled.
 - b. All fans will rotate at the emergency speed.

EC Fan System Troubleshooting (Models VRC-xxxxA-xxxxN-xB)

Loss of Control Signal

Refrigeration System Controller Power Outages

1. When a power outage lasts for less than 60 seconds:
 - a. The fans will remain on at the last known speed.
 - b. After power restoration, the fans will resume operation according to the control signal. No alarm signal will be sent to the control system.
2. When a power outage lasts for more than 60 seconds:
 - a. The fans will rotate at the emergency speed.
 - b. An alarm light on the control panel will turn on, and an alarm signal will be enabled.

Single Fan Communication Loss

1. If the signal is restored within 60 seconds:
 - a. The affected fan will run at the last known control signal as long as the signal returns in less than 60 seconds.
 - b. The remaining fans will run according to the control signal.
2. If the signal is not restored within 60 seconds:
 - a. All fans will run at the emergency speed.
 - b. The alarm light on the control panel will turn on and an alarm signal will be enabled.
3. To troubleshoot:
 - a. Confirm that all fans are powered.
 - b. Turn the override switch on the control panel to the ON position and amber light will turn ON.
 - c. All the remaining fans that are not in an alarm state will start to rotate based on the fans speed signal.
 - d. If there is a problem with any individual fan that either does not rotate or rotates backwards, visually observe the fans to identify the affected fan.
 - e. Shut down the unit completely, including the spray pump and breaker for the affected fan.

- f. Follow all applicable safety procedures and lockout/tagout procedures before entering the unit.
- g. Cover the affected fan with the fan cover that is included with the unit inside the lower section.
- h. Turn the unit ON by following the start-up procedure:
 - i. The unit will go into emergency mode. An alarm light on the control panel will turn ON and an alarm signal will be enabled.
 - ii. Turn the override switch on the control panel ON, and an amber light on the control panel will also turn ON.
 - iii. All fans except the affected fan will start to rotate based on the control signal.

All Fan Communication Loss

1. If the signal is restored within 60 seconds:
 - a. The unit will operate as normal, and no alarm signal will be enabled.
2. If the signal is not restored within 60 seconds:
 - a. All fans will rotate at the emergency speed.
 - b. An alarm light on the control panel will turn on and an alarm signal will be enabled.
3. To troubleshoot:
 - a. Ensure that all fans have power and that the communication signal is restored.
 - b. Turn on the override switch on the control panel, and an amber light will turn on.
 - c. All fans will start to operate based on the control signal.
4. To turn off the override light, the unit must be restarted with a valid control signal present.

Power Outage

Single Fan Power Outage

1. If power is restored within 60 seconds and an uninterrupted control signal is maintained to all fans:
 - a. The remaining fans will rotate based on the control signal except the affected fan.
 - b. After power is restored, the affected fan will resume operation based on the control signal.
 - c. No alarm signal will be enabled.
2. If power is out for more than 60 seconds:
 - a. An alarm light on the control panel will turn ON and an alarm signal will be enabled.
 - b. The remaining fans will rotate at emergency speed.
3. Troubleshooting the Issue:
 - a. Shut down the unit completely, including the spray pump and fans.
 - b. Follow all safety procedures before entering the equipment.
 - c. Cover the affected fan that is not operating with the fan cover, provided by BAC.

- d. Turn on the unit by following the start-up procedure:
 - i. The unit will go into an emergency mode. An alarm light on the control panel will turn ON and an alarm signal will be enabled.
 - ii. Turn the override switch on the control panel ON, and an amber light on the control panel will also turn ON.
 - iii. All fans except the affected fan will start to rotate based on the control signal.

Unit Power Outage

1. If power to the entire unit goes out, then once power is restored:
 - a. If the control signal is restored within 60 seconds of power restoration:
 - i. The unit will operate based on the control signal.
 - b. If the control signal is not restored within 60 seconds of power restoration:
 - i. The alarm light on the control panel will turn ON and an alarm signal will be enabled.
 - ii. After power is restored, all fans will rotate at the emergency speed.
2. Troubleshooting the Issue:
 - a. Make sure that a valid control signal and power are restored to the unit.
 - b. Turn the override switch on the control panel ON, and an amber light will also turn ON.
 - c. All fans will start to operate based on the control signal.
 - d. To turn off the override light, send a valid 4-20mA control signal and restart the

Fan Alarm Codes

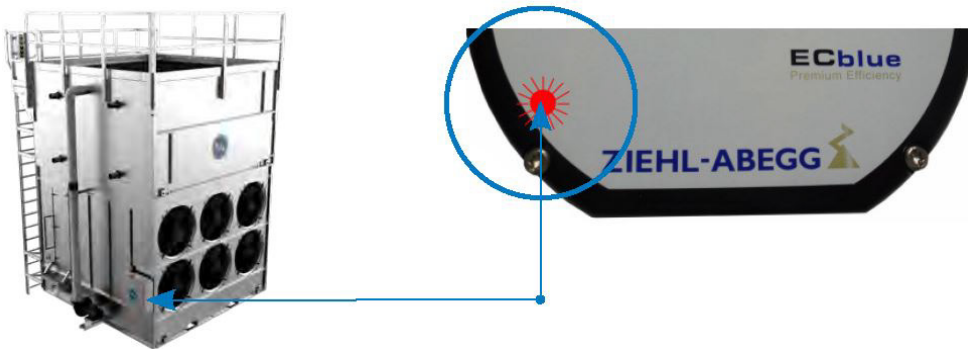


Figure 24. Flashing Light indicates Error Code

10. EC Fan & Pump Controls (Models VRC-xxxxB-xxxxN-xB)

General

The information in this section is applicable to Vertex™ Evaporative Condenser models VRC-xxxxB-xxxxN-xB that utilize the factory supplied control enclosure shown in **Figure 26**.



Figure 26. EC Fan & Pump Control Enclosure for Models VRC-xxxxB-xxxxN-xB

Sequence of Operation

The sequence of operation is described via categories listed in **Table 10**.

Category	Reference
System Operation	Page 58
Fan Operation	Page 60
Spray Water Pump Operation	Page 62

Table 10. Sequence of Operation References

System Operation

Remote Enable/Disable: Remote Enable provides system level On/Off control common in large equipment. It can be disabled if the end user does not want to make use of the feature. The Remote Enable feature allows the system to be enabled by a customer provided discrete signal. When the Remote Enable feature is activated, the system pump and fan will respond to customer run signals (and will not if the feature is disabled). Remote enable digital contact state may be changed from Normal to Reverse, refer to **Figure 41**.

General Alarm: General alarm status will be indicated by a normally open dry contact. The alarm output will be initiated as indicated below. Alarm output digital contact state may be changed from Normal to Reverse, refer to **Figure 40**.

Fan: The general alarm output will be initiated in the event of a mismatch between start/stop command and fan run status or loss of signal from one or more fans.

Spray Water Pump: The general alarm output will be initiated in the event of a mismatch between the start/stop command and pump run status.

Emergency Override Switch: The emergency override switch is a switch on the enclosure shown in **Figure 26**. The emergency override switch is shown in **Figure 27**. The emergency override switch is used to bypass the emergency fan speed function. Any alarm(s) that cause(s) one or more fans to stop when commanded to run will result in all fans entering emergency fan speed. Recommended emergency fan speed is 40% maximum speed and is intended to mitigate drift discharge from idle fan(s).

When turned on, the emergency override switch will override the emergency fan speed limit imposed by a fan failure. When the emergency override switch is on, a fan failure will not result in emergency fan speed. The Fan Bypass menu shown in **Figure 42** on **Page 68** can be used to override a single fan and maintain safety of the system.

Emergency override switch positions are as follows:

OFF – Any alarm(s) that cause(s) one or more fans to stop when being commanded to run will result in all fans entering emergency fan speed. All fans will continue in emergency speed until at least one of the following conditions are met:

- a) Emergency override switch is turned to ON.
- b) Fan alarms are released.
- c) Fan(s) in alarm state are bypassed in the Fan Bypass menu shown in **Figure 42** on **Page 68**.

ON – All fans without an alarm will immediately exit from emergency speed and return to commanded speed. Fans will not enter emergency fan speed regardless of fan alarm status.



Figure 27. Emergency Override Switch

Controller Switch (Local Enable): The controller switch (local enable) is a switch on the enclosure shown in **Figure 26**. The controller switch (local enable) is shown in **Figure 28**. The controller switch (local enable) can stop the unit while leaving it powered so that status can be checked through the HMI menu. Figure 28The controller switch is a local switch input used to turn the system off regardless of Remote Enable and speed commands.

⚠ WARNING: On Vertex™ Evaporative Condenser EC Fan System models, do not use the controller switch (local enable) as a substitute for de-energizing the equipment. The controller switch (local enable) is not a disconnect and does not remove power from components. Risk of electrocution which will cause severe personal injury or death. Use appropriate lockout procedures. Do not perform any service on or near the unit without first ensuring the unit is de-energized.

Controller (local enable) switch positions are as follows:

OFF – The system will not respond to customer commands.

AUTO – The system will respond to customer commands.



Figure 28. Controller Switch (Local Enable)

Fan Operation

Fan Start/Stop: Fan start/stop is a customer provided digital input. Upon receiving the fan start signal, the fans shall start and run according to the customer provided analog speed signal. Fan run digital contact state may be changed from Normal to Reverse, refer to **Figure 41**. **Table 11** lists all possible command scenarios for fan run command.

Local Enable	Remote Enable	Fan Run Input	Fan Run Command
Off	Off	Off	Off
On	Off	Off	Off
Off	On	Off	Off
On	On	Off	Off
Off	Off	On	Off
On	Off	On	Off
Off	On	On	Off
On	On	On	On

Table 11. Fan Start/Stop Command Conditions

Fan Run Status: The system shall provide a normally open digital contact to indicate fan run status. The run status contact will close when the user selected number of fans are running.

Fan Speed Control: The fan speed is controlled by a customer provided analog signal. The fan speed shall have a proportional response as shown in **Figure 29** and **Figure 30**. The signal can be either 4-20mA, 0-10V, 10-0V or BMS. In the event of a failure of one or more fans, the emergency fan speed will take effect and is limited to a maximum of 40% maximum fan speed. Refer to **Emergency Override Switch** on **Page 58** for more information.

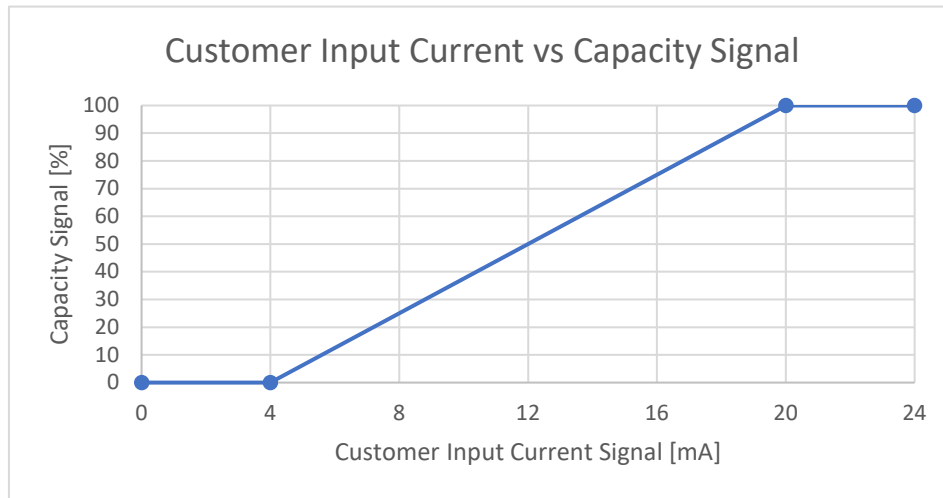


Figure 29. Fan Speed with Current signal

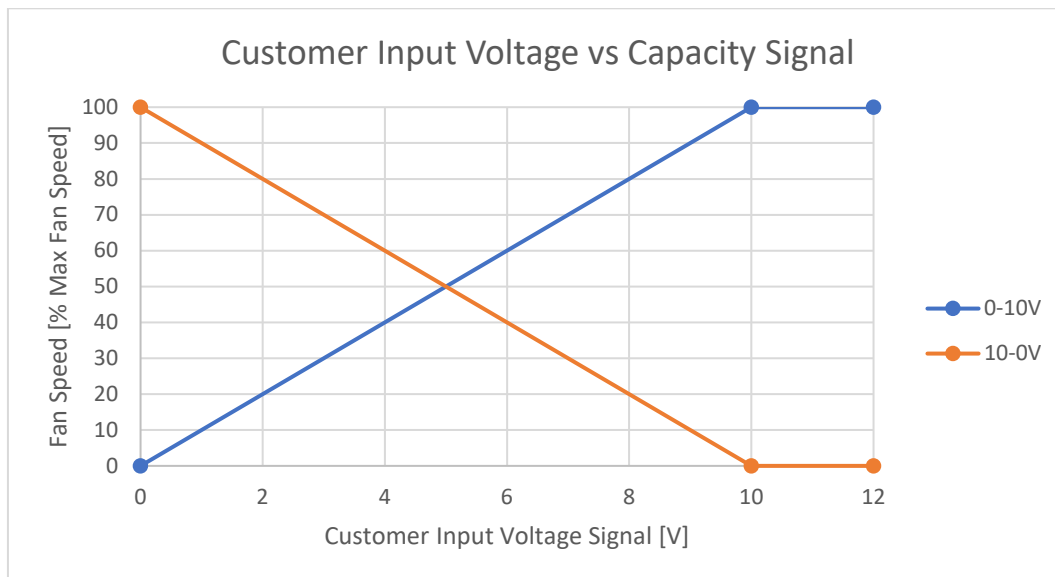


Figure 30. Fan Speed with Voltage signals

Spray Water Pump Operation

Pump Start/Stop: Pump start/stop is a customer provided digital input. Upon receiving the pump start signal, the pump will start and run at its fixed speed. Pump run digital contact state may be changed from Normal to Reverse, refer to **Figure 41**.

Table 12 lists all possible command scenarios for pump run command.

Local Enable	Remote Enable	Pump Run Input	Pump Run Command
Off	Off	Off	Off
On	Off	Off	Off
Off	On	Off	Off
On	On	Off	Off
Off	Off	On	Off
On	Off	On	Off
Off	On	On	Off
On	On	On	On

Table 12. Pump Start/Stop Command Conditions

Pump Run Status: The system shall provide a normally open digital contact to indicate pump run status. The pump run status contact shall close any time the pump is running. **Table 13** lists all possible command scenarios for pump status output.

Local Enable	Remote Enable	Pump Status Input	Pump Status Output
Off	Off	Off	Off
On	Off	Off	Off
Off	On	Off	Off
On	On	Off	Off
Off	Off	On	On
On	Off	On	On
Off	On	On	On
On	On	On	On

Table 13. Pump Status Command Conditions

User Interface

Human Machine Interface (HMI)



Figure 31. HMI Layout


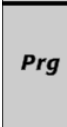
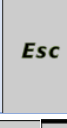


Button	Name	Description
	Alarm	Illuminates red when an alarm is present. Pressing the button will display the alarm description.
	Program	Displays all the main submenus.
	Esc	Brings the menu back to the previous screen.
	Up and Down	Scrolls through options.
	Enter	Accepts changes.

Table 14. HMI Button Descriptions

Access Levels

Multiple access levels are present within the software. Access level specific passwords are listed in **Table 15**. The minimum access level does not require a password and provides read only access to the home screens shown in **Figure 32** through **Figure 35**. To log into an access level, press the Program button, use the Up and Down arrows to enter the access level specific password, and press the Enter button.

Login Description	Password
Customer	2995
Service	8253

Table 15. Access Level Passwords

Home Screen

The Home Screens shown in **Figure 32** through **Figure 35** display the status of the parameters listed in **Table 16**. Any user will have access to the Home Screens; an access level password is not required. The parameters listed on the Home Screens are read only.

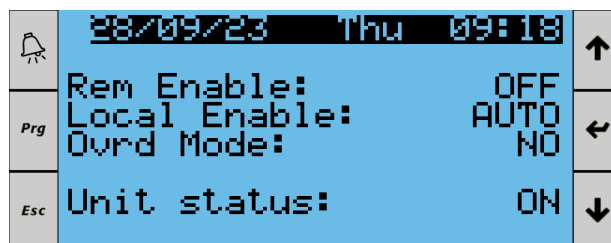


Figure 32. Home Screen, Page 1

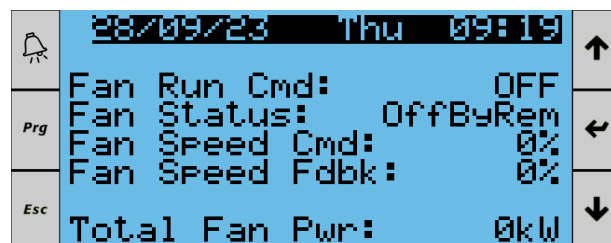


Figure 33. Home Screen, Page 2

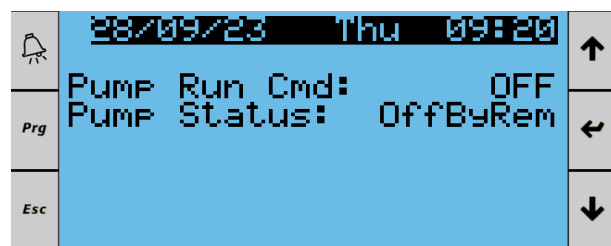


Figure 34. Home Screen, Page 3

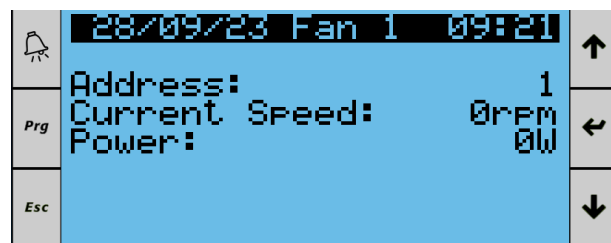


Figure 35. Home Screen, Fan X

Parameter	Description
Rem Enable	Remote enable/disable status. Refer to System Operation on Page 58 for more information.
Local Enable	Controller switch (local enable) status. Refer to System Operation on Page 58 for more information.
Ovrd Mode	Emergency override switch status. Refer to System Operation on Page 58 for more information.
Unit status	Unit status is used to indicate whether the unit is operating or not.
Fan Run Cmd	Fan run command status is the fan start/stop signal currently being supplied to the unit. Refer to Fan Operation on Page 60 for more information.
Fan Status	Fan status is used to indicate fan run status. Refer to Fan Operation on Page 60 for more information.
Fan Speed Cmd	Fan speed command is the fan speed input currently being supplied to the unit. Refer to Fan Operation on Page 60 for more information.
Fan Speed Fdbk	Fan speed feedback
Total Fan Pwr	Total fan power is the summation of all fan power
Pump Run Cmd	Pump run command status is the pump start/stop signal currently being supplied to the unit. Refer to Spray Water Pump Operation on Page 62 for more information.
Pump Status	Pump status is used to indicate pump run status. Refer to Spray Water Pump Operation on Page 62 for more information.
Address	Fan specific unique address
Current Speed	Fan specific current speed
Power	Fan specific current power

Table 16. Home Screen Parameters

Main Menu

From the Home Screens (shown in **Figure 32** through **Figure 35**), press the Program button and enter an access level password. Refer to Access Levels on **Page 64** for more information. Once an access level password is entered, the Main Menu shown in **Figure 36** and **Figure 37** will appear. Access to the Main Menu submenus may be restricted due to access level. Refer to **Table 17** for minimum access level requirements and where to look for more information about a submenu.



Figure 36. Main Menu, Page 1

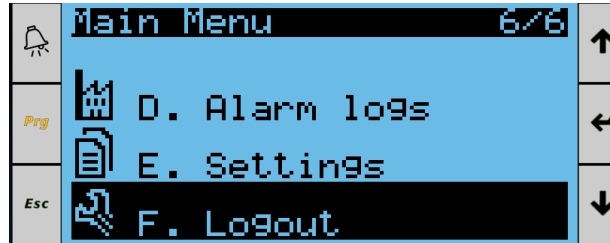


Figure 37. Main Menu, Page 2

Submenu	Minimum Access Level Required	Reference
Customer	Customer	Page 66
Service	Service	Page 68
Manufacture	Manufacture	n/a
Alarm logs	Customer	Page 70
Settings	Customer	Page 71
Logout	Customer	n/a

Table 17. Main Menu Directory

Customer Menu

Customer Menus are shown in **Figure 38** and **Figure 39**. The parameters listed in these menus are listed in **Table 18**. The Customer Menu can only be accessed with customer access level or higher. Refer to Access Levels on **Page 64** for more information.

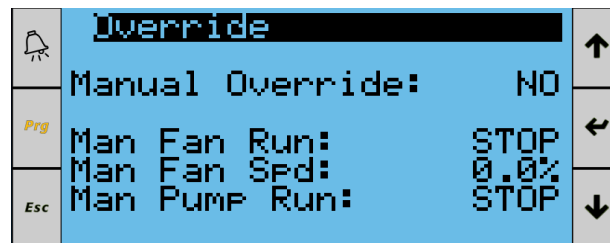


Figure 38. Customer Menu, Page 1

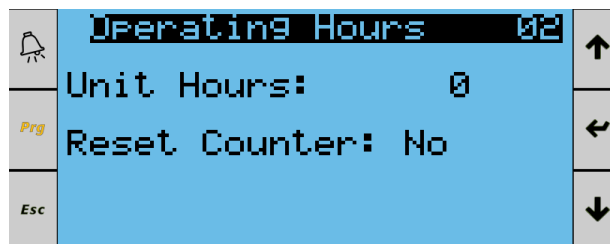


Figure 39. Customer Menu, Page 2

Parameter	Description
Manual Override	Setting manual override to YES will allow user to manually initiate commands.
Man Fan Run	Manual fan run can manually initiate all fans to RUN/STOP.
Man Fan Spd	Manual fan speed can manually command speed for all fans. Press enter to initiate speed command.
Man Pump Run	Manual pump run can manually initiate pump to RUN/STOP.
Unit Hours	Unit operating hour counter
Reset Counter	Reset unit operating hour counter

Table 18. Customer Menu Parameters

Service Menu

Service Menus are shown in **Figure 40** through **Figure 44**. The parameters listed in these menus are listed in **Table 19**. The Service Menu can only be accessed with service access level or higher. Refer to **Access Levels** on **Page 64** for more information.

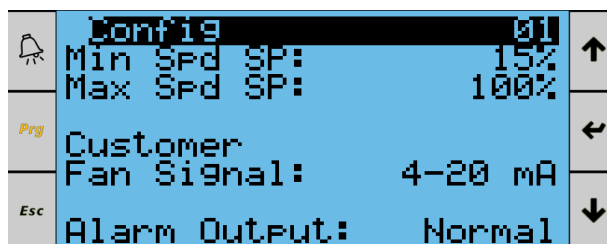


Figure 40. Service Menu, Page 1

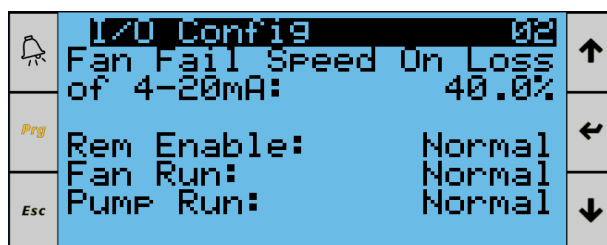


Figure 41. Service Menu, Page 2

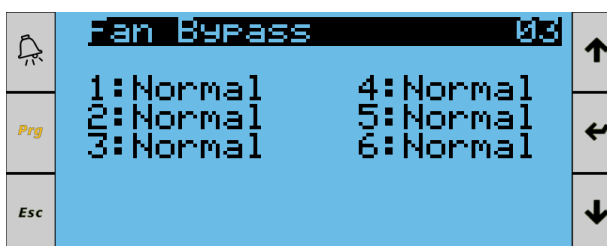


Figure 42. Service Menu, Page 3

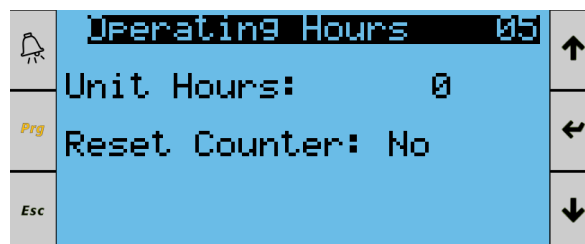


Figure 43. Service Menu, Page 4

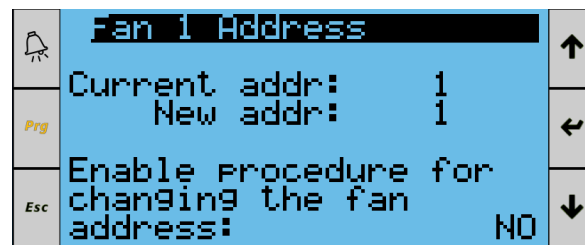


Figure 44. Service Menu, Page 5

Table 19. Service Menu Parameters	
Parameter	Description
Min Spd SP	Minimum fan speed for all fans. Recommended value is 15%
Max Spd SP	Maximum fan speed for all fans. Recommended values is 100%
Customer Fan Signal	Customer supplied fan speed signal. Options are 4-20mA, 0-10V, 10-0V, BMS
Alarm Output	Alarm output digital contact state. Normal: Normally closed Reverse: Normally open
Fan Fail Speed on Loss of 4-20mA	Fan fail speed on loss of 4-20mA fan speed signal
Rem Enable	Remote enable digital contact state. Normal: Normally closed Reverse: Normally open
Fan Run	Fan run digital contact state. Normal: Normally closed Reverse: Normally open
Pump Run	Pump run digital contact state. Normal: Normally closed Reverse: Normally open
Fan Bypass	Fan bypass status for each fan. Changing fan bypass status from Normal to Bypass will override alarms for the selected fan. Refer to System Operation on Page 58 for more information.
Unit Hours	Unit operating hour counter
Reset Counter	Reset unit operating hour counter
Current addr	Fan specific unique address
New addr	Fan specific unique address to be changed to
Enable procedure for changing the fan address	Changing status from NO to YES starts the fan address procedure. Refer to Fan Addressing Procedure on Page 92.

Table 19. Service Menu Parameters

Alarm Logs Menu

The alarm log menu is shown in **Figure 45**. This is a list of all previously occurring alarms. The alarm log menu does not show active alarms. To view an active alarm, press the alarm button. Refer to **Alarms & Troubleshooting** on **Page 82** for more information on alarms.

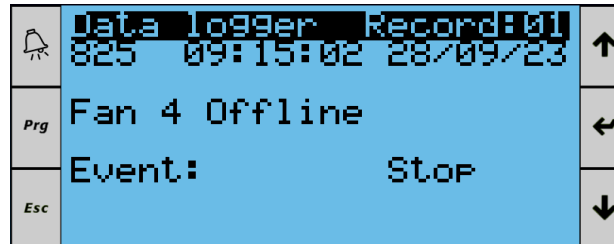


Figure 45. Alarm logs Menu

Parameter	Description
Line 1	Alarm code & time stamp associated with alarm
Line 2	Alarm description
Line 3	Alarm effect

Table 20. Alarm Logs Menu Parameters

Settings Menu

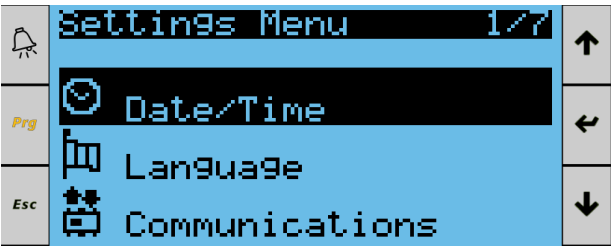


Figure 46. Settings Menu, Page 1

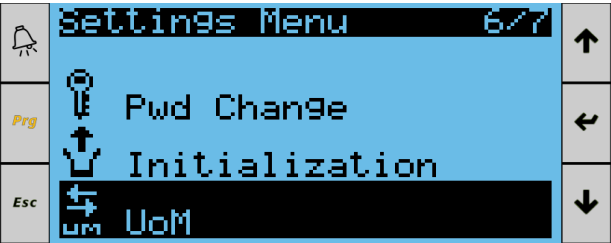


Figure 47. Settings Menu, Page 2



Figure 48. Settings Menu, Page 3

Sub Menu	Reference
Date/Time	Page 71
Language	Page 72
Communications	Page 73
Pwd Change	Page 75
Initialization	Page 76
UoM	Page 76
Import/Export	Page 77

Table 21. Settings Menu Directory

Settings Menu, Date/Time

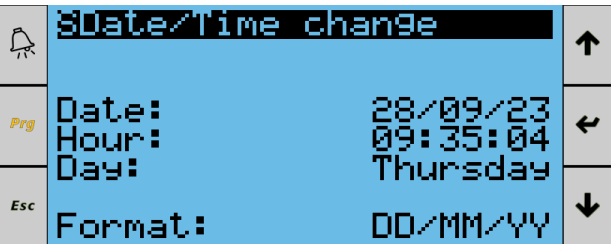


Figure 49. Settings Menu, Date/Time, Page 1

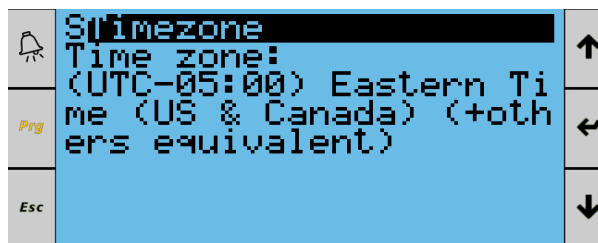


Figure 50. Settings Menu, Date/Time, Page 2

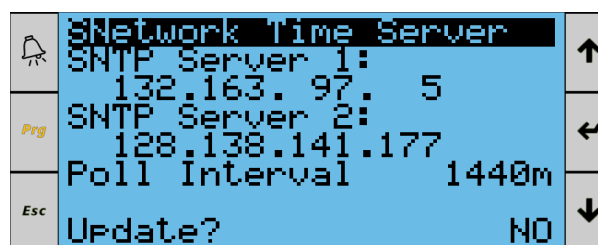


Figure 51. Settings Menu, Date/Time, Page 3

Parameter	Description
Format	Determines whether the date is displayed in DD/MM/YY or MM/DD/YY
Time Zone	Use this to appropriately select your time zone
SNTP Server 1	TCP/IP Address of SNTP server for clock and calendar information
SNTP Server 2	Secondary TCP/IP Address of SNTP server for clock and calendar information.
Poll Interval	Specifies how often the switch polls the server for a time update. Recommended default is 1440m.
Update	Use this to confirm and save the previous settings

Table 22. Settings Menu, Date/Time Parameters

Settings Menu, Language

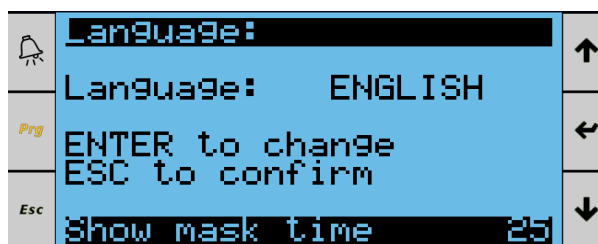


Figure 52. Settings Menu, Language

Parameter	Description
Language	Changing the selected language will translate the HMI text

Table 23. Settings Menu, Language Parameters

Settings Menu, Communications

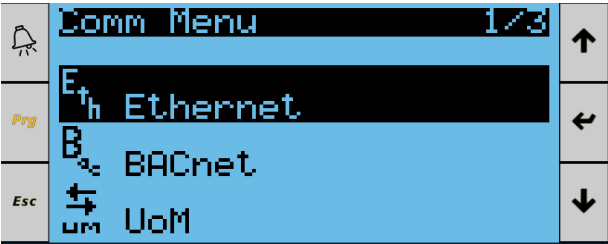


Figure 53. Settings Menu, Communications Sub-Menu

Sub Menu	Reference
Ethernet	Page 73
BACnet	Page 74
UoM	Page 75

Table 24. Settings Menu, Communications Sub-Menu Directory

Note: Only BACnet IP and Modbus TCP protocols are supported by the PLC.

Settings Menu, Communications, Ethernet Port Configuration

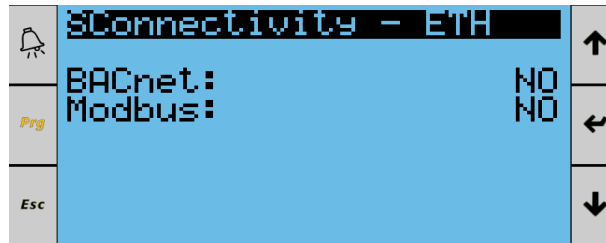


Figure 54. Settings Menu, Communications, Ethernet, Page 1



Figure 55. Settings Menu, Communications, Ethernet, Page 2

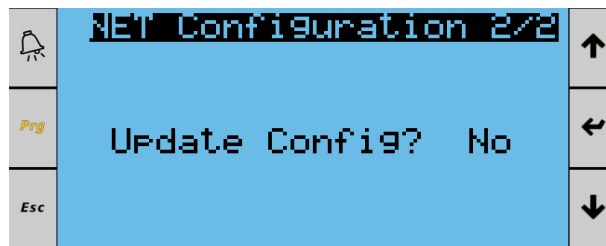


Figure 56. Settings Menu, Communications, Ethernet, Page 3

Parameter	Description
BACnet: / Modbus:	Enable BMS for BACnet or Modbus. Only enable one at a time.
DHCP/AutoIP	Static/dynamic address
IP	IP address (In IPv4 format)
Mask	Net mask (In IPv4 format)
GW	Gateway (In IPv4 format)
DNS	DNS (In IPv4 format)
Update Config	Update settings

Table 25. Ethernet Menu Parameters

Settings Menu, Communications, BACnet

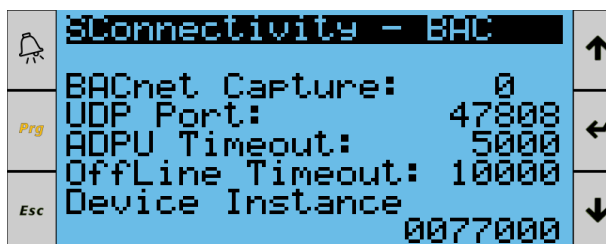


Figure 57. Settings Menu, Communications, BACnet, Page 1

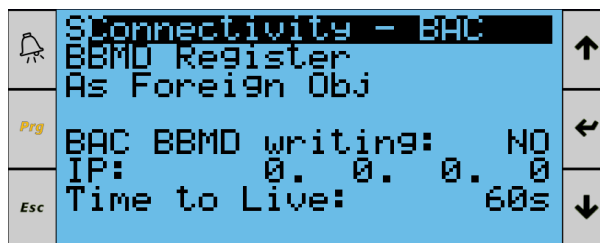


Figure 58. Settings Menu, Communications, BACnet, Page 2

Parameter	Description
UDP Port	BACnet port number.
ADPU Timeout	Time between ADPU retransmissions.
Device Instance	Sets the correct value.
BAC BBMD Writing	Broadcast Management Device Enable
IP	BBMD IP Address (In IPv4 format)
Time to Live	Time in which the device must re-register to the BBMD

Table 26. BACnet Menu Parameters

Settings Menu, Communications, UoM

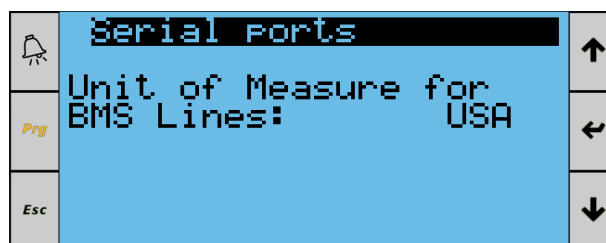


Figure 59. Settings Menu, Communications, UoM

Parameter	Description
Unit of Measure for BMS Lines	Sets the unit of measure. Options are USA, SI, N/A, SI(bar), LON, CAN, UK.

Table 27. UoM Menu Parameters

Settings Menu, Pwd Change

Figure 60 is used to change a default access level password. Refer to Access Levels on **Page 64** for more information.



Figure 60. Settings Menu, Pwd Change

Settings Menu, Initialization

The Initialization Menu is shown on **Figure 61** and **Figure 62**. Parameters in the initialization menu are read only and restricted to customer and service access levels.

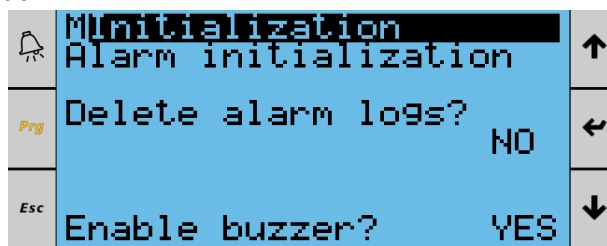


Figure 61. Settings Menu, Initialization, Page 1



Figure 62. Settings Menu, Initialization, Page 2

Parameter	Description
Delete alarm logs?	Delete all alarm logs
Enable buzzer?	Enable or disable alarm buzzer
Wipe retain mem.	The “Retain” variables return to the default values
Wipe NVRAM mem.	Clear clock or RAM buffer memory. This stores the values of parameters that change often, such as counters (if parameterized in the application).
Wipe both mem.	Wipe both retain and NVRAM memory.

Table 28. Initialization Menu Parameters

Settings Menu, UoM

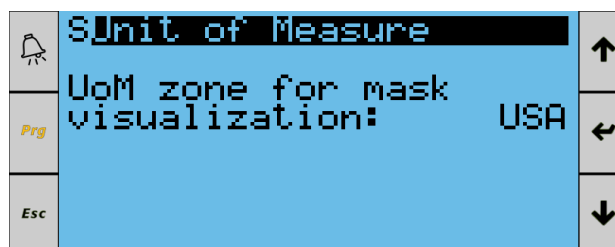


Figure 63. Settings Menu, UoM

Parameter	Description
UoM Mask	Determines the metric units that are displayed on the HMI

Table 29. UoM Menu Parameters

Settings Menu, Import/Export

Settings Menu, Import/Export is shown in **Figure 64** through **Figure 67**. From these menus, parameter files, alarms, and logs can be exported, and parameter files can be imported. Refer to **Programmable Logic Controller (PLC) Backup and Restore** on **Page 91** for more information.



Figure 64. Settings Menu, Import/Export, Page 1

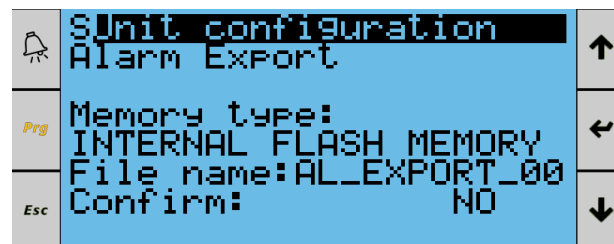


Figure 65. Settings Menu, Import/Export, Page 2



Figure 66. Settings Menu, Import/Export, Page 3

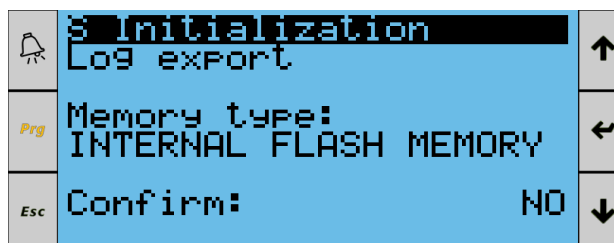


Figure 67. Settings Menu, Import/Export, Page 4

Parameter	Description
Import/Export	Set the correct value.
Memory Type	Choose whether import/export to a USB or internal flash memory.
File Name	Set the correct import/export file name.
Log Name	Set the correct value.
Period	Set the time interval for alarm log export

Table 30. Import/Export Menu Parameters

Building Management System (BMS) Connectivity

All values are scaled 1-1 unless noted otherwise. All the addresses below correspond to holding registers. Note that only IP based protocols are supported.

BACnet Points List

Table 31. BACnet Points List					
Variable	Description	Default	Data Type	BACnet Registers	R/W
Unit Status	1 = Running 2 = Off by Alarm 3 = Off by BMS 4 = Reserved 5 = Off by DI 6 = Off by Local Enable	-	Multistate Value (MV)	1	Read only
Unit Alarm	0 = Inactive 1 = Active	-	Binary Value (BV)	1	Read only
BMS Enable	0 = Disabled 1 = Enabled	0	Binary Value (BV)	2	Read/Write
BMS Fan Run Cmd	0 = Disabled 1 = Enabled	0	Binary Value (BV)	3	Read/Write
BMS Pump Run Cmd	0 = Disabled 1 = Enabled	0	Binary Value (BV)	4	Read/Write
Fan Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	5	Read only
Pump Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	6	Read only
BMS Fan Speed Cmd	Fan Speed Customer Setpoint in %	0	Analog Value (AV)	1	Read/Write
Fan Speed to Fans	Fan Speed Command to the Fans	-	Analog Value (AV)	2	Read only
Fan 1 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	10	Read only
Fan 1 Speed	Fan 1 Speed Feedback	-	Analog Value (AV)	10	Read only
Fan 1 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	11	Read only
Fan 1 Override	0 = Override 1 = Normal	1	Binary Value (BV)	12	Read/Write
Fan 2 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	20	Read only
Fan 2 Speed	Fan 2 Speed Feedback	-	Analog Value (AV)	20	Read only
Fan 2 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	21	Read only
Fan 2 Override	0 = Override 1 = Normal	1	Binary Value (BV)	22	Read/Write
Fan 3 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	30	Read only
Fan 3 Speed	Fan 3 Speed Feedback	-	Analog Value (AV)	30	Read only
Fan 3 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	31	Read only

Table 31. BACnet Points List					
Variable	Description	Default	Data Type	BACnet Registers	R/W
Fan 3 Override	0 = Override 1 = Normal	1	Binary Value (BV)	32	Read/Write
Fan 4 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	40	Read only
Fan 4 Speed	Fan 4 Speed Feedback	-	Analog Value (AV)	40	Read only
Fan 4 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	41	Read only
Fan 4 Override	0 = Override 1 = Normal	1	Binary Value (BV)	42	Read/Write
Fan 5 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	50	Read only
Fan 5 Speed	Fan 5 Speed Feedback	-	Analog Value (AV)	50	Read only
Fan 5 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	51	Read only
Fan 5 Override	0 = Override 1 = Normal	1	Binary Value (BV)	52	Read/Write
Fan 6 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	60	Read only
Fan 6 Speed	Fan 6 Speed Feedback	-	Analog Value (AV)	60	Read only
Fan 6 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	61	Read only
Fan 6 Override	0 = Override 1 = Normal	1	Binary Value (BV)	62	Read/Write
Fan 7 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	70	Read only
Fan 7 Speed	Fan 7 Speed Feedback	-	Analog Value (AV)	70	Read only
Fan 7 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	71	Read only
Fan 7 Override	0 = Override 1 = Normal	1	Binary Value (BV)	72	Read/Write
Fan 8 Run Status	0 = Not Running 1 = Running	-	Binary Value (BV)	80	Read only
Fan 8 Speed	Fan 8 Speed Feedback	-	Analog Value (AV)	80	Read only
Fan 8 Alarm	0 = No Alarm 1 = Alarm Active	-	Binary Value (BV)	81	Read only
Fan 8 Override	0 = Override 1 = Normal	1	Binary Value (BV)	82	Read/Write

Table 31. BACnet Points List

Modbus Points List

Table 32. Modbus Points List					
Object Name	Description	Default	Data Type	Modbus Registers	R/W
Unit Status	1 = Running 2 = Off by Alarm 3 = Off by BMS 4 = Reserved 5 = Off by DI 6 = Off by Local Enable	-	BOOL	30001	Read only

Table 32. Modbus Points List					
Object Name	Description	Default	Data Type	Modbus Registers	R/W
Unit Alarm	0 = Inactive 1 = Active	-	BOOL	10001	Read only
BMS Enable	0 = Disabled 1 = Enabled	0	BOOL	1	Read/Write
BMS Fan Run Cmd	0 = Disabled 1 = Enabled	0	BOOL	2	Read/Write
BMS Pump Run Cmd	0 = Disabled 1 = Enabled	0	BOOL	3	Read/Write
Fan Run Status	0 = Not Running 1 = Running	-	BOOL	10002	Read only
Pump Run Status	0 = Not Running 1 = Running	-	BOOL	10003	Read only
BMS Fan Speed Cmd	Fan Speed Customer Setpoint in %	-	REAL	40001	Read/Write
Fan Speed to Fans	Fan Speed Command to the Fans	-	REAL	30002	Read only
Fan 1 Run Status	0 = Not Running 1 = Running	-	BOOL	10010	Read only
Fan 1 Speed (RPM)	Fan 1 Speed Feedback	-	REAL	30010	Read only
Fan 1 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10011	Read only
Fan 1 Override	0 = Override 1 = Normal	1	BOOL	10	Read/Write
Fan 2 Run Status	0 = Not Running 1 = Running	-	BOOL	10020	Read only
Fan 2 Speed (RPM)	Fan 2 Speed Feedback	-	REAL	30020	Read only
Fan 2 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10021	Read only
Fan 2 Override	0 = Override 1 = Normal	1	BOOL	20	Read/Write
Fan 3 Run Status	0 = Not Running 1 = Running	-	BOOL	10030	Read only
Fan 3 Speed (RPM)	Fan 3 Speed Feedback	-	REAL	30030	Read only
Fan 3 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10031	Read only

Table 32. Modbus Points List					
Object Name	Description	Default	Data Type	Modbus Registers	R/W
Fan 3 Override	0 = Override 1 = Normal	1	BOOL	30	Read/Write
Fan 4 Run Status	0 = Not Running 1 = Running	-	BOOL	10040	Read only
Fan 4 Speed (RPM)	Fan 4 Speed Feedback	-	REAL	30040	Read only
Fan 4 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10041	Read only
Fan 4 Override	0 = Override 1 = Normal	1	BOOL	40	Read/Write
Fan 5 Run Status	0 = Not Running 1 = Running	-	BOOL	10050	Read only
Fan 5 Speed (RPM)	Fan 5 Speed Feedback	-	REAL	30050	Read only
Fan 5 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10051	Read only
Fan 5 Override	0 = Override 1 = Normal	1	BOOL	50	Read/Write
Fan 6 Run Status	0 = Not Running 1 = Running	-	BOOL	10060	Read only
Fan 6 Speed (RPM)	Fan 6 Speed Feedback	-	REAL	30060	Read only
Fan 6 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10061	Read only
Fan 6 Override	0 = Override 1 = Normal	1	BOOL	60	Read/Write
Fan 7 Run Status	0 = Not Running 1 = Running	-	BOOL	10070	Read only
Fan 7 Speed (RPM)	Fan 7 Speed Feedback	-	REAL	30070	Read only
Fan 7 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10071	Read only
Fan 7 Override	0 = Override 1 = Normal	1	BOOL	70	Read/Write
Fan 8 Run Status	0 = Not Running 1 = Running	-	BOOL	10080	Read only
Fan 8 Speed (RPM)	Fan 8 Speed Feedback	-	REAL	30080	Read only
Fan 8 Alarm	0 = No Alarm 1 = Alarm Active	-	BOOL	10081	Read only
Fan 8 Override	0 = Override 1 = Normal	1	BOOL	80	Read/Write

Table 32. Modbus Points List

Alarms & Troubleshooting

Potential unit alarms and troubleshooting recommendations are listed in **Table 33**. The unit alarm codes are listed in **Table 34**. Unit alarm codes are enumerations porting a number code to a specific alarm. These codes are used in the HMI, BMS and Data logs to effectively communicate alarms.

Table 33. Unit Alarms		
Name	Description	Troubleshooting
Al_retain	Alarm-Too Many Retain writings	Stop operating the controller or power off for 3 minutes
Al_Err_retain_write	Alarm- Retain write error	Stop operating the controller or power off for 3 minutes
Al_Pump_Run_Failed	Pump run failed alarm	Check pump, current switch, and wiring
Al_RunSta_Failed_Fan_X	Fan X Not Running	Check fan X communication wiring or communication shielding
Al_Fan_Hand	Fan state is on when command is off	Check fan X communication wiring or communication shielding
Al_Pump_Hand	Pump state is on when command is off	Check pump, current switch, and wiring
Al_Offline_Fan_X	Fan X Offline	Verify Fan X's circuit breaker in the control panel
Al_OverCurrent_Fan_X	Fan X Overcurrent	Verify fan can rotate freely
Al_DC_Overcurrent_Fan_X	Fan X DC Overcurrent	Verify wiring to motor
Al_Unervoltage_Fan_X	Fan X Undervoltage	Verify incoming power
Al_Overheat_Fan_X	Fan X Overheat	Contact your BAC representative for support
Al_MotorOvrld_Fan_X	Fan X Motor Overload	Inspect Fan X and ensure there are no obstructions
Al_Ext_Malf_Fan_X	Fan X External Malfuction	Contact your BAC representative for support

Table 33. Unit Alarms

Alarm Description	Fan Number							
	1	2	3	4	5	6	7	8
	Alarm Code							
No Fan Alarm	0	0	0	0	0	0	0	0
Too many Retain writings	1	1	1	1	1	1	1	1
Retain Write Error	2	2	2	2	2	2	2	2
Fan Status Mismatch	820	820	820	820	820	820	820	820
Pump Status Mismatch	821	821	821	821	821	821	821	821
Pump Run Failed Alarm	787	787	787	787	787	787	787	787
Run Status Failed	804	805	806	807	808	809	810	811
Fan Offline	822	823	824	825	826	827	828	829
Fan Overcurrent	830	836	842	848	854	860	866	872
Fan DC Overcurrent	831	837	843	849	855	861	867	873
Fan Undervoltage	832	838	844	850	856	862	868	874
Fan Overheat	833	839	845	851	857	863	869	875
Fan Motor Overload	834	840	846	852	858	864	870	876
Fan External Malfunction	835	841	847	853	859	865	871	877

Table 34. Unit Alarm Codes

Startup & Operation Procedures

Startup Procedure

1. Ensure all Danger, Warning, and Caution statements listed in the Product Operation and Maintenance manual have been reviewed and understood by those performing startup activities.
2. Verify the equipment voltage noted on the equipment nameplate is equivalent to the site voltage.
3. Verify all wiring and incoming power is correct per the submittal drawing package. Verify all wiring and incoming power conforms to NEC and local code.
4. Before power has been provided to the unit, turn all breakers to the On position inside the control panel.
5. Close the control panel and ensure locks have been fully engaged by rotating 90 degrees on each bolt.
6. Ensure the emergency override switch shown in **Figure 68** below is set to OFF.



Figure 68. Emergency Override Switch

7. Ensure the controller switch (local enable) shown in **Figure 69** below is set to OFF.



Figure 69. Controller Switch (Local Enable)

8. Remove any materials from the unit basin and ensure the unit access doors are closed and secured.
9. Turn on breaker or other power supply that supplies power to the unit.
10. Turn the control panel main disconnect switch to the On position.
11. Wait for the HMI to load the home screen shown in **Figure 70** below.

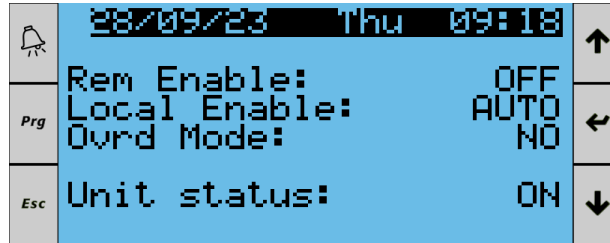


Figure 70. Home Screen, Page 1

12. Press the program button as shown in **Figure 71** below.

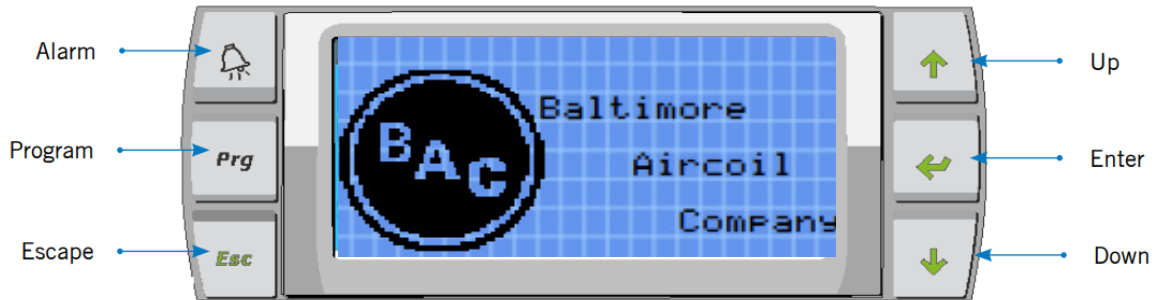


Figure 71. HMI Layout

13. Log in with **Service** access level, refer to Access Levels below. Note that when switching between access levels you may need to logout on the home screen. Hit the “Enter” button after inputting the password.

Login Description	Password
Customer	2995
Service	8253

Table 15. Access Level Passwords

14. From the Main Menu select **Service** as shown in **Figure 72** below.



Figure 72. Main Menu, Page 1

15. Within the Service Menu shown on **Figure 73** and **Figure 74** below, set or validate the parameters below.

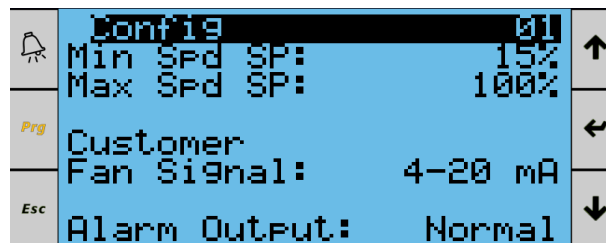


Figure 73. Service Menu, Page 1

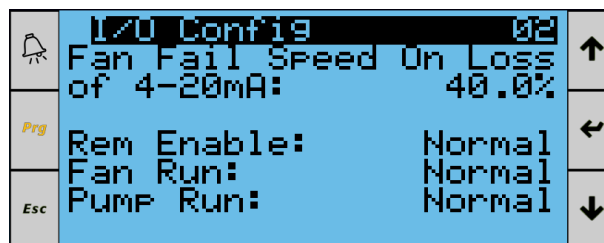


Figure 74. Service Menu, Page 2

- Min Spd SP: Set the minimum fan speed setpoint. Recommend value is 15%.
- Max Spd SP: Set the maximum fan speed setpoint. Recommend value is 100%.
- Customer Fan Signal: Set the correct customer fan speed signal type. Options are 4-20mA, 0-10V, 10-0V & BMS.
- Set appropriate contactor state for Alarm Output.
- If customer fan signal is 4-20mA set fan fail speed on loss of 4-20mA. Recommended value is 40%.
- Set appropriate contactor state for Rem Enable, Fan Run and Pump Run. If unit was not provided with spray pump from BAC, the Pump Run option may not be shown.

16. Return to the Main Menu using the “Esc” button and select **Settings** shown in **Figure 75** below.

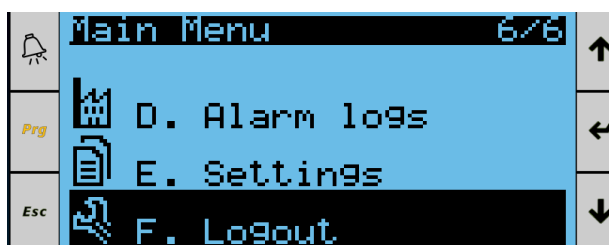


Figure 75. Main Menu, Page 2

17. Within the Settings Menu, navigate to Date/Time shown in **Figure 76** below.

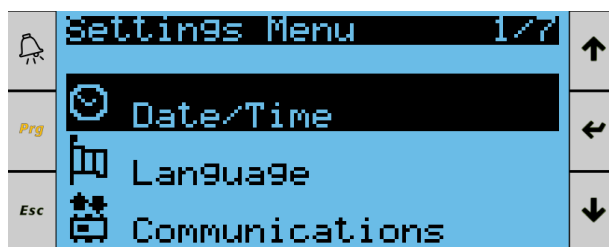


Figure 76. Settings Menu, Page 1

18. Set/validate date and time information shown in **Figure 77** through **Figure 79** below.

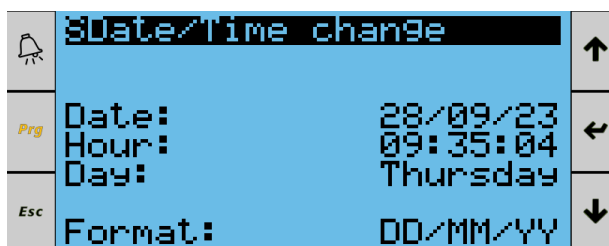


Figure 77. Settings Menu, Date/Time, Page 1

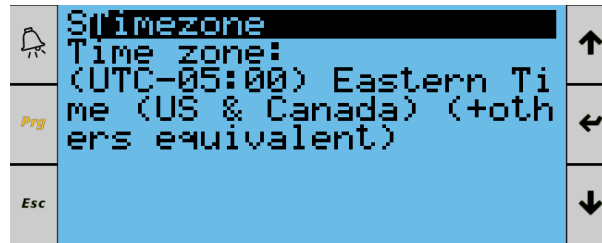


Figure 78. Settings Menu, Date/Time, Page 2

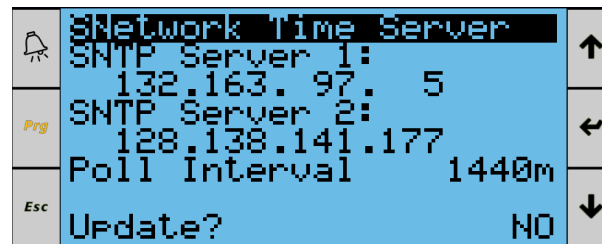


Figure 79. Settings Menu, Date/Time, Page 3

19. If BMS connectivity is not required, skip to **Step 28** on **Page 89**.
20. Return to the Settings Menu and navigate to Communications shown in **Figure 80** below.

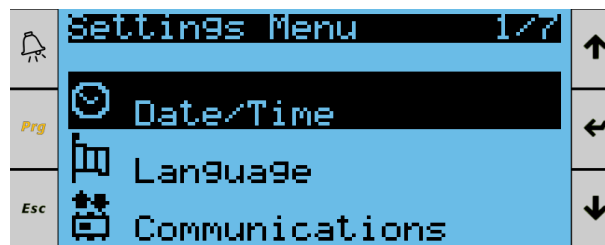


Figure 80. Settings Menu, Page 1

21. Within the Communications Menu shown in **Figure 81** below, select Ethernet.

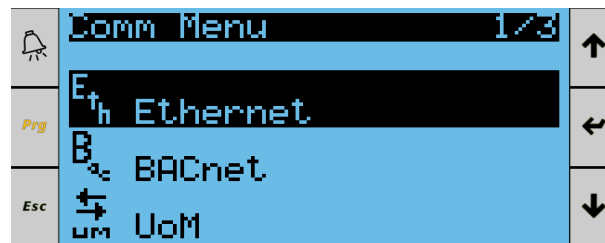


Figure 81. Settings Menu, Communications Sub-Menu

22. Set BACnet or Modbus to YES as shown in **Figure 82** below. Note that only Modbus TCP and BACnet IP protocols are supported.

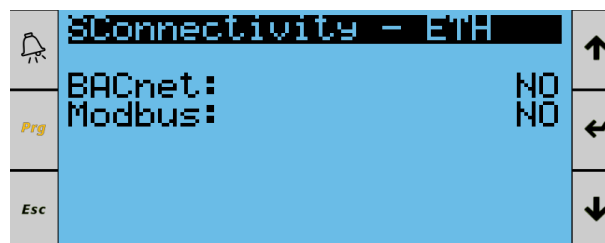


Figure 82. Settings Menu, Communications, Ethernet, Page 1

23. Set appropriate parameters for BMS connectivity as shown in **Figure 83** below.

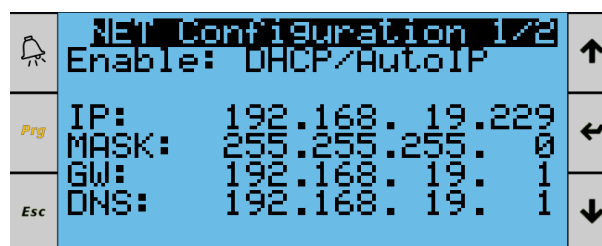


Figure 83. Settings Menu, Communications, Ethernet, Page 2

24. Set Update Config? To YES as shown in **Figure 84** below.

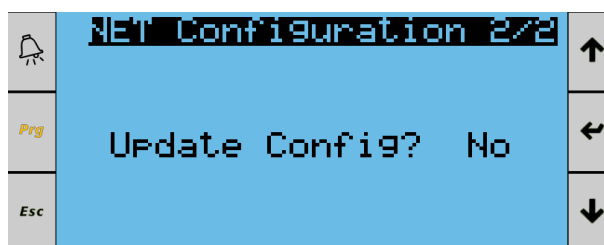


Figure 84. Settings Menu, Communications, Ethernet, Page 3

25. If BACnet BMS connectivity is used, return to the Communications Menu shown in **Figure 85** below and select BACnet.

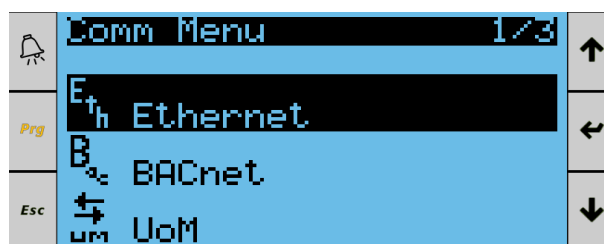


Figure 85. Settings Menu, Communications Sub-Menu

- Set appropriate parameters for BACnet BMS connectivity as shown in **Figure 86** and **Figure 87** below.

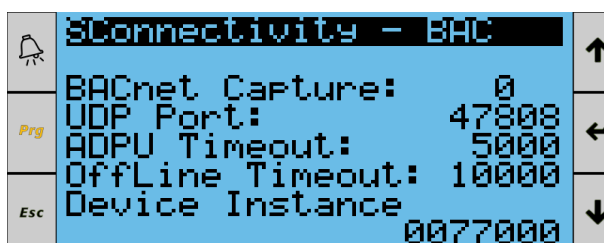


Figure 86. Settings Menu, Communications, BACnet, Page 1

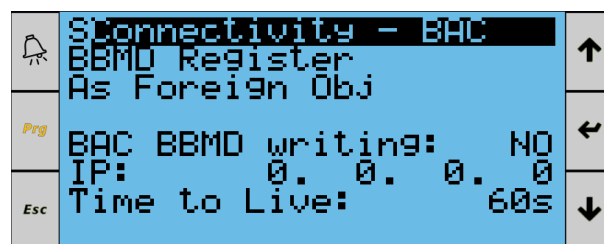


Figure 87. Settings Menu, Communications, BACnet, Page 2

26. Return to the Communications Menu shown in **Figure 88** below and select UoM.

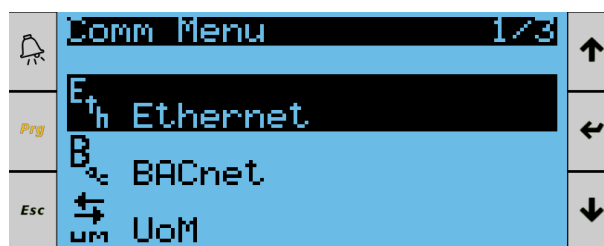


Figure 88. Settings Menu, Communications Sub-Menu

- Set appropriate unit of measure for BMS lines as shown in **Figure 89** below.

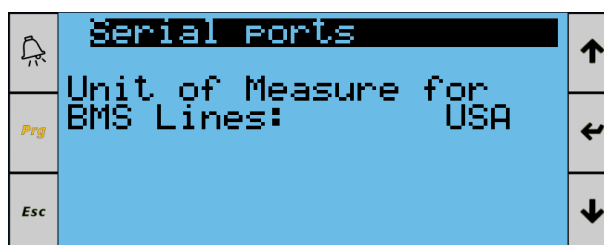


Figure 89. Settings Menu, Communications, UoM

27. Return to the Main Menu using the “Esc” button and select Customer as shown in **Figure 90** below.



Figure 90. Main Menu, Page 1

28. Ensure the fans and spray water pump (if applicable) are safe to operate by validating the following.

- Fan and drive system areas are all clear of personnel and loose objects.
- All loose items and foreign objects have been removed from inside the unit.
- The unit access doors are closed and secured.

29. Fill the basin with water to the overflow level. Set the makeup valve float so the makeup valve closes when the basin water level reaches overflow level. Note that units provided for use with a remote sump tank will not be provided with makeup valve, overflow connection, and spray pump.

30. Within the Customer Menu shown in **Figure 91** below, set Manual Override to YES.

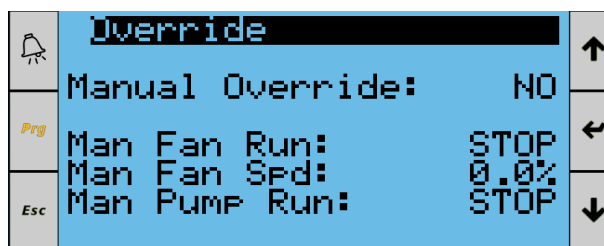


Figure 91. Customer Menu, Page 1

- Set Man Fan Run to RUN and incrementally increase Man Fan Spd from 0% to 100%. Press enter for the Man Fan Spd to initiate. Validate all fans operate synchronously.
- Validate the basin is filled with water to the overflow level and set Man Pump Run to RUN, if spray pump was provided by BAC.
- If applicable, validate the spray water pump is operating in the proper direction of rotation.
- Set Man Pump Run to STOP.
- Set Man Fan Run to STOP.
- Return Man Fan Spd to 0.0%.
- Set Manual Override to NO.

31. Return to the Main Menu using the “Esc” button and select Logout shown in **Figure 92** below.

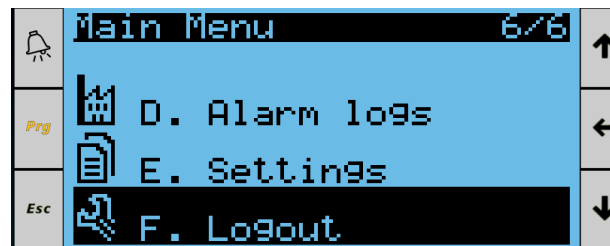


Figure 92. Main Menu, Page 2

32. Ensure the controller switch (local enable) shown in **Figure 69** on **Page 84** is set to AUTO if you are ready for the unit to respond to external inputs. You have now completed the unit startup.

Programmable Logic Controller (PLC) Backup and Restore



NOTE: An operating parameter file is stored in the PLC internal memory. A backup file should be created on an external memory device and stored for future use.

1. The PLC has a host USB port that can be connected to a USB mass storage device (typically a USB flash drive or portable hard drive), from which an application program can be loaded onto the PLC.
 - Only use flash drives with FAT file system.
 - Do not use both USB ports on the PLC at the same time.
 - Do not use mass storage peripherals that have a current draw more than 500 mA.
 - Import/Export parameters is not allowed with the unit on.
2. Ensure unit is locked out and tagged out. Open the control panel enclosure door and insert a USB mass storage device into the PLC as shown in **Figure 93**.

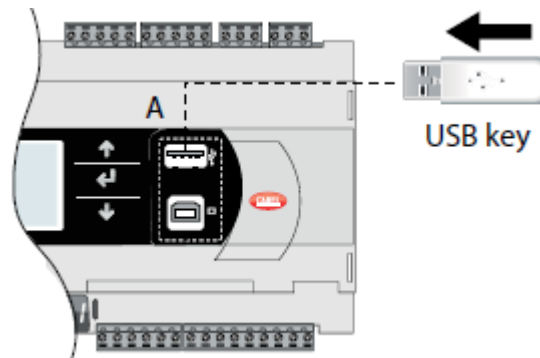


Figure 93. PLC Backup and Restore via USB

3. Energize the control panel and using the HMI log in with Service access level, refer to Access Levels on **Page 64**.
4. From the Main Menu navigate to Settings. From the Settings Menu navigate to Import/Export as shown in **Figure 64**.
5. Set Import/Export to Import or Export.
6. Set Memory type to USB.
7. Set correct File name.
8. Change Confirm to YES.

Fan Addressing Procedure

1. Log in with Service access level, refer to Access Levels on **Page 64**.
2. From the Main Menu shown in **Figure 36** select Service.
3. From the Service Menu use the down buttons to navigate to the fan address menu corresponding with the fan number being addressed. Fan 1 Address Menu is shown in **Figure 44**.
 - Refer to **Figure 94** through **Figure 97** to determine fan address number assignment.
4. Change value Current addr to 247 and change value New addr to the appropriate fan address number assignment shown in **Figure 94** through **Figure 97**.
5. Change “Enable procedure for changing the fan address” value to YES.
6. Wait for the value Current addr to update.
7. Change “Enable procedure for changing the fan address” value to NO.
8. Verify updated fan address by following the procedure on **Page 93**.

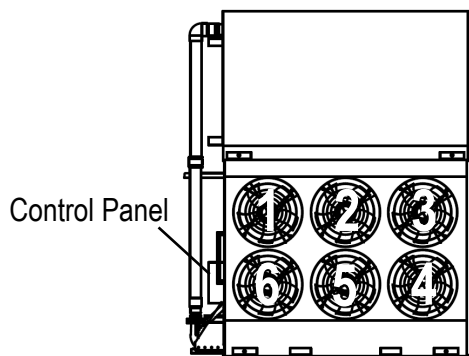


Figure 94. Right Hand 12' Long Unit Fan Addresses

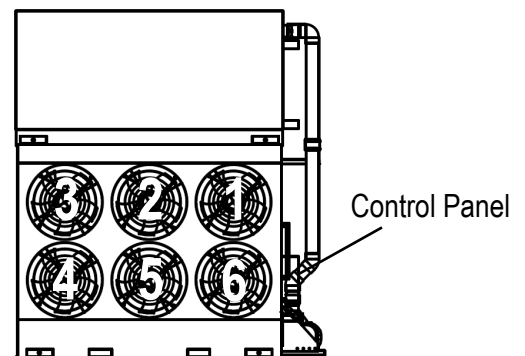


Figure 95. Left Hand 12' Long Unit Fan Addresses

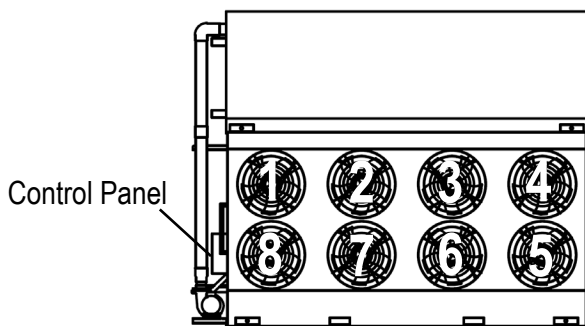


Figure 96. Right Hand 18' Long Unit Fan Addresses

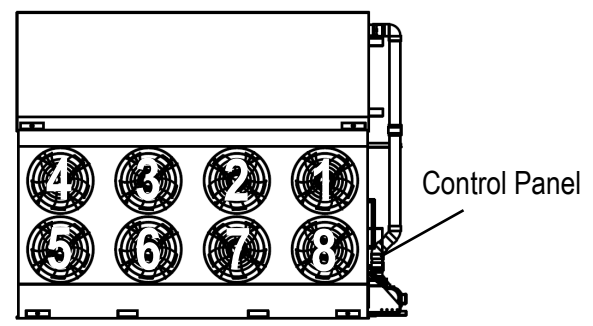


Figure 97. Left Hand 18' Long Unit Fan Addresses

Fan Address Identification Procedure

1. Turn the control panel main disconnect switch to the Off position.
2. Turn off breaker or other power supply that supplies power to the unit and follow lock out tag out procedures.
3. Open the control panel and turn off all the breakers except for the fan that's address is going to be verified. Refer to **Figure 68** through **Figure 71** to determine fan address assignment.
 - Close the control panel and ensure locks have been fully engaged by rotating 90 degrees on each bolt.
4. Turn on breaker or other power supply that supplies power to the unit and follow lock out tag out procedures.
5. Turn the control panel main disconnect switch to the On position.
6. Wait for the HMI to power on and log in with Customer access level, refer to Access Levels on **Page 64**.
7. Select submenu Customer as shown in **Figure 36**.
8. From the Override menu shown in **Figure 38**.
 - Set Manual Override to YES
 - Set Man Fan Run to RUN
 - Set Man Fan Spd to 10.0%
9. Visually verify Fan X is running at 10% speed.
10. Press the Esc button on the HMI until the home screen shown in **Figure 32** is shown.
11. Using the down arrow, navigate to the fan information screen corresponding to Fan X. Fan 1 information screen is shown in **Figure 35**.
12. Verify on the HMI Fan X Current Speed is 10% (about 128 rpm).
13. Navigate to submenu Customer as shown in **Figure 36**.
14. From the Override menu shown in **Figure 38**.
 - Set Manual Override to NO
 - Set Man Fan Run to STOP
 - Set Man Fan Spd to 0.0%
15. Turn the control panel main disconnect switch to the Off position

11. Installation Instructions for Field Connections

The following are installation instructions for adding new field connections (Equalizer/Bypass/Outlet) on a basin with the TriArmor® Corrosion Protection System.

Supplies Provided by BAC	Recommended Supplies Provided by Others
Template for the connection with bolt holes	Stainless steel threaded shoulder bolts
Type 304 stainless steel backing ring with gasket	150 lb flange, weld any piping to the flange prior to installation
Vulkem® Caulk	Gasket for the outside of the basin

Table 35. Supplies for Installing Field Connections



NOTE: BAC recommends adding a flange connection for field installed equalizers, bypass, and outlet connections. Please order the recommended supplies listed in **Table 35** prior to unit shutdown.

1. Use the BAC template provided with the accessory to layout and mark the hole pattern on the exterior of the basin.
2. Drill a pilot hole from the outside of the basin to the inside of the basin.
3. On the inside of the basin:
 - a. For connections 3" or less, score the TriArmor® Corrosion Protection System with a hole saw as shown in **Figure 98**.
 - b. For connections 3" or greater, proceed to step 4.



Figure 98. Scored TriArmor® Corrosion Protection System

4. Cut the hole from the outside of the basin.
 - a. Use a hole saw or a step drill bit for smaller connections 3" or less as shown in **Figure 99**.
 - b. Use a reciprocating saw or a Sawzall® for larger connections 3" or greater



Figure 99. Removal Material

5. Position the BAC supplied stainless steel backing ring gasket to the inside of the basin.
6. Position the flange to the outside of the basin.
7. Bolt the flange and the stainless steel backing plate together using stainless steel bolts.
8. Seal any exposed galvanized steel of the connection inside the basin with Vulkem® Caulk as shown in **Figure 100**.



Figure 100. Caulk Exposed Galvanized Steel

Vertex® Evaporative Condenser

OPERATION & MAINTENANCE MANUAL



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