BALTIMORE
AIRCOIL COMPANY

RCF Closed Circuit Cooling Tower
RCC Evaporative Condenser

OPERATION & MAINTENANCE MANUAL

Recommended Maintenance Service

Inspect and clean as necessary:	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect general condition of the tower[2] and check unit for unusual noise or vibration	✓	✓			
Clean and flush basin	✓	✓			✓
Inspect spray nozzles	✓	✓			✓
Clean basin strainer	✓	✓			✓
Drain basins and piping					✓
Inspect air inlet louvers	✓	✓			
Check and adjust water level in basins	✓	✓			
Check operation of make-up valve	✓	✓			
Check and adjust bleed rate	✓	✓			
Inspect heat transfer section	✓	✓			
Mechanical equipment system:	**Start-Up**	**Monthly**	**Quarterly**	**Annually**	**Shutdown**
Check belt condition	✓	✓			
Adjust belt tension[3]	✓		✓		
Lubricate fan shaft bearings	✓		✓		✓
Lubricate motor base adjusting screw	✓		✓		✓
Check drive alignment				✓	
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			✓		
Check fan for rotation without obstruction	✓		✓		

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

NOTES:

1. Recommended service intervals are for typical installations. Different environmental conditions may dictate more frequent servicing.
2. When operating in ambient temperatures below freezing, the cooling tower should be inspected more frequently.
3. Refer to "Cold Weather Operation" on Page N102 for more details.
4. Tension on new belts must be readjusted after the first 24 hours of operation and quarterly, thereafter.

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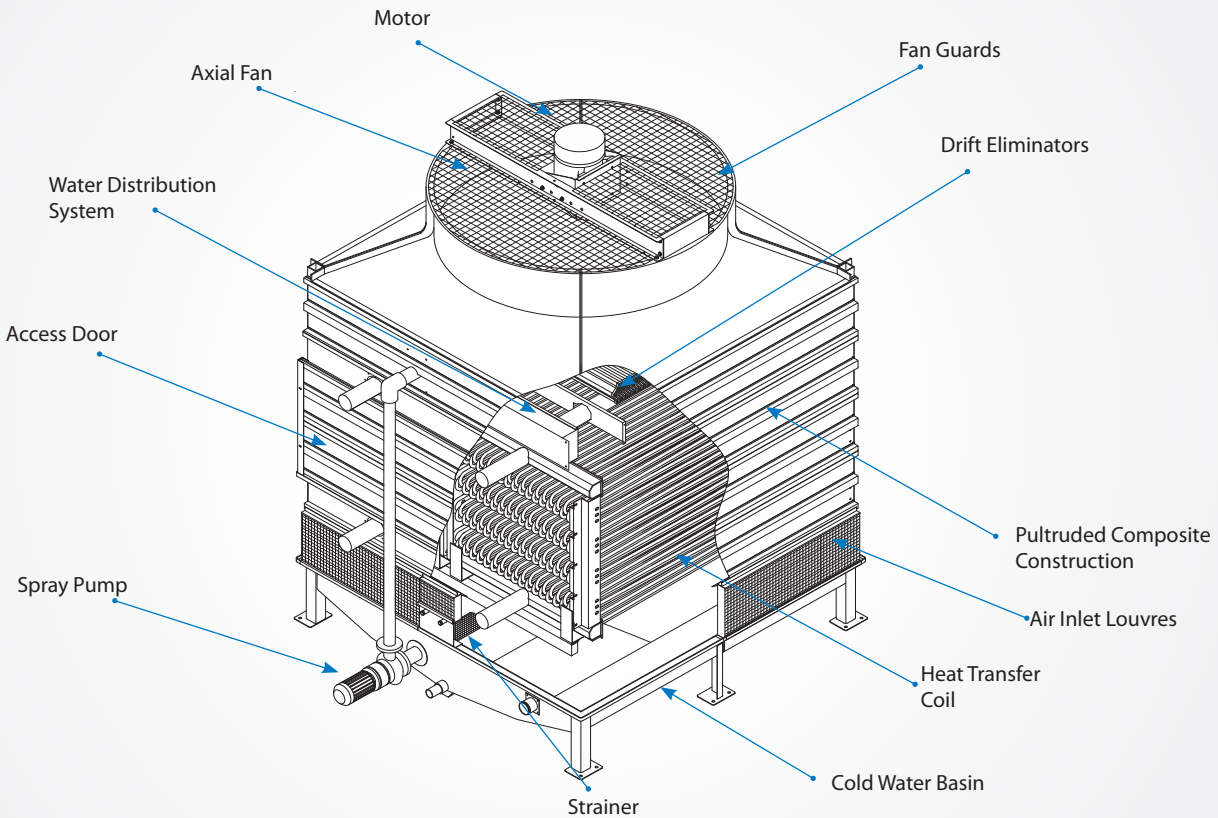

Figure 1. RCF Closed Circuit Cooling Tower/ RCC Evaporative Condenser

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RCF CLOSED CIRCUIT COOLING TOWER
RCC EVAPORATIVE CONDENSER

Operation and Maintenance

INITIAL AND SEASONAL START-UP

EXTENDED SHUTDOWN

Initial & Seasonal Start-Up

General

- If the unit is mounted on vibration isolators or isolation rails, refer to the vibration isolation manufacturer's guidelines before loading/unloading weight from the unit.
- Verify fan and system pump motors are disconnected and locked out.
- Conduct external inspection of the equipment. Check for leaks, corrosion, and any structural damage.
- Inspect piping and connections.

Cleaning

- Drain the cold water basin with the strainer in place.
- Clean and inspect the fan deck.
- Remove all dirt and debris from the fan guard.
- Clean all mechanical components, such as the fan and motor.
- Flush the cold water basin interior to remove any accumulated dirt and debris.
- Remove, clean, and replace the strainer.

Inspection

- Thoroughly inspect the fan(s) 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.
- Prior to the seasonal start-up, check and adjust the belt tension. At the initial start-up, the belt tension may not require adjustment as the drive will be properly tensioned at the factory prior to shipment.
- Start the fan motor(s) and check for proper fan rotation. The fan should rotate in the direction of the arrow indicated on the fan cowl.
- Run the fan in manual mode for several minutes to check for any unusual noise or vibrations.
- For two speed motors check that the starter incorporates a 15 second time delay when switching from high to low speed.
- Check that the float operated make-up valve is operating freely.

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

WARNING: Check to ensure the controls for the fan motor are set to allow a maximum of 6 on-off cycles per hour.

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

Start-up

- Prior to seasonal start-up, lubricate the motor base adjusting screw (see Figure 2) and the fan shaft bearings. At initial start-up, no bearing lubrication is required since the bearings are factory lubricated prior to shipment.
- Fill the cold water basin with fresh water to the overflow level via the quick fill connection.
  - Water treatment for new installations: Initiate the biocide water treatment program at this time. Refer to "Biological Control" on Page 17 for more details.
  - Water treatment for seasonal start-up or after a shutdown period in excess of 3 days: Resume the biocide treatment program and administer a shock treatment of appropriate biocides prior to operating the fans. This will eliminate accumulated biological contaminants. Refer to "Biological Control" on Page 17 for more details.
- Set the make-up valve float so the water shuts off at the operating level statedon page 7.
- Start the system pump. See "Water Distribution System" on Page N36 for details.
- For multicell arrangements, balance flow between the cells to obtain even water distribution.
- Open the valve in the tower bleed line, and adjust the bleed by closing or opening the valve.
- Once the evaporative condenser is operating, check the current and voltage of all three phases (legs) of the fan motor with a heat load on the tower under warm ambient conditions. The current must not exceed the nameplate ratings.
- Check the operation of the vibration cutout switch (if supplied).

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

- ✓ Check the tower for any unusual noise or vibrations.
- ✓ Check the operating water level in the cold water basin.
- ✓ Adjustthebalancingvalves if necessary.
- ✓ Adjust make-up valve if necessary.
- ✓ Checkthebelttensionand readjust if necessary.

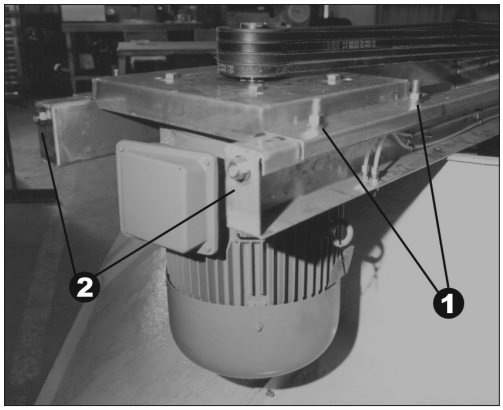

Figure 2. Adjustable Motor Base (cover removed)
RCC Models RCC0808-2-K – RCC1116-3-P and
RCF Models RCF0808-3-J - RCF1116-3-P

1. Motor base locking nuts (both sides)
2. Adjusting Screws

Extended Shutdown

Perform the following services whenever the cooling tower is shutdown un excess of 3 days:

- If the unit is mounted on vibration isolators or isolation rails, refer to the manufacturer's guidelines before loading/unloading weight from the unit.
- Drain the cold water basin and all the piping that will be exposed to freezing temperatures. Heat trace and insulate all exposed piping.
- Clean all debris, such as leaves and dirt, from the interior and exterior of the unit.
- Clean and flush the cold water basin with the basin strainer in place.
- Leave the cold water basin drain open so rain will drain from the tower.
- Clean the basin strainer and re-install.
- Cover the fan intake opening to keep out dirt and debris.
- Lubricate the fan shaft bearings, motor base, and motor base adjusting screw.
- Close the shut off valve in the make-up water line.
- Secure the fan motor starting device in the "OFF" position to ensure personal safety in case of future inspection or service.

WARNING: Do not perform any service on or near the fans, motors, drives, or inside the unit without first ensuring that the fans and the pumps are disconnected and locked out.

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RCF CLOSED CIRCUIT COOLING TOWER
RCC EVAPORATIVE CONDENSER

Detailed Component Maintenance Procedures

Cold Water Basin

As water circulating through the cooling tower is cooled, it collects in the cold water basin and passes through the suction strainer into the system. The cold water basin is constructed from Fibre Reinforced Polyester and the strainer from one of the following materials of construction and the following maintenance applies to all basin materials of construction.

- Type 304 stainless steel
- Type 316 stainless steel

Water Levels

For all RCF and RCC models the recommended operating water level is 140mm below the basin ledge on which the louvres rest.

- The make-up valve controls the operating level, which is maintained at the levels mentioned above.
- The operating water level in the cold water basin will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure.
- Check the operating water level monthly, and readjust the float when necessary to maintain the recommended operating level.

Inspection & Maintenance

- Inspect the cold water basin regularly. Remove trash or debris accumulated in the basin or on the strainer.
- Quarterly, or more often if necessary, drain, clean, and flush the entire cold water basin with fresh water.This will remove the silt and sediment, which normally collects 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 system.
- Remove the strainer after the basin has been flushed.
- Clean and replace the strainer before refilling the basin with fresh water.
- Adjust the float to maintain the design operating level.

WARNING: Openings and/ or submerged obstructions may exist in the bottom of the cold water basin. Use caution when walking inside this equipment.

Fan

The RCF Closed Circuit Cooling Tower and RCC Evaporative Condenser use an axial fan. Thoroughly inspect the fan for damaged or deteriorated fan blades and replace the fan as required.

Inspection & Maintenance

Figure 3. Fan Belt Adjustment

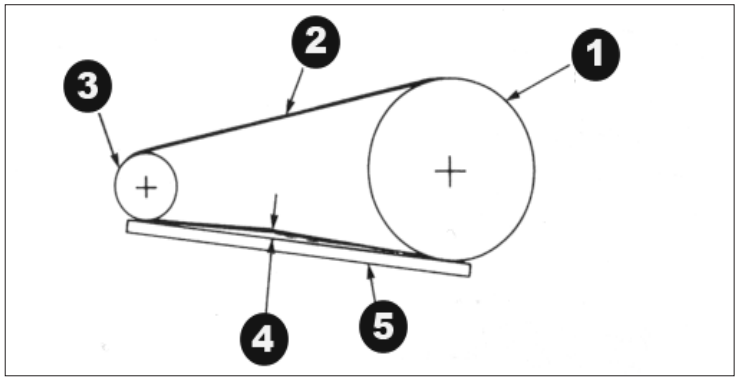
- If the unit is already in operation, while the fan is running, check for any unusual noise or vibration.
- With the fan off and the motor locked out and tagged, check the general condition of the fan:
  - Inspect for any loose or missing bolts in the fan shaft bushing, the fan hub, and the fan shaftbearing(s).
  - Check the fan blades for looseness, first by twisting the blade by hand; and then, by moving the blade tip up and down. There should be no play or slippage.
  - Inspect each blade for excessive scale build-up that could cause vibration.
  - Check each blade, in the area of the shank, for any signs of cracking. If cracking is found, the fan motor should be locked out immediately. 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 within 5/16" to 1/2".
- Blade Pitch: Check to ensure that the blades are all at the same pitch. If uncertain, measure the pitch with an inclinometer.
- 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 3/4" to 1" band at any single point around the cowl.
- Direction of Rotation: On initial start-up, or if the fan motor has been rewired, bump the fan motor and note the direction of rotation. It should rotate in the direction indicated by the arrow on the fan cowl.
- Operation: On initial start-up, run the fan in the manual position for several minutes and check for any unusual noises or vibration.

Fan Drive System

RCF Closed Circuit Cooling Towers and RCC Evaporative Condensers use V-belts on selected models. Belt tension should be checked and adjusted at least quarterly, or as needed.

Inspection & Maintenance

- These drives require a periodic check of the belt condition and, when necessary, tension adjustment. The recommended service intervals are as follows:
  - Initial Start-up: Servicing is not required prior to initial tower start-up. The drive has been tensioned and aligned at the factory.
  - Seasonal Start-up: Readjust the belt tension.
  - Operation: After the first 24 hours of operation, readjust the belt tension on a new unit start-up or installation of a new belt. Thereafter, check the belt condition monthly, and adjust tension as necessary. Readjust tension at least once every 3 months.
- Belt tension check:
  - Place a straight edge along the belt from sheave to sheave as shown in Figure 4a, or use a tapemeasure as shown in Figure 4b, to measure belt deflection.
  - Apply a moderate force by hand (approximately 6.8 kg) evenly across the width of the belt in thecenter of the span between the sheaves.
  - There is adequate belt tension if the belt deflects between 6mm and 10mm/ m free belt length as shown in Figure 4.



1. Fan Pulley
2. Belt
3. Motor Pulley
4. 10mm/m Deflection
5. Straight Edge

Figure 4: Fan Belt Check and Adjustment

NOTE: Direct drive units (RCF and RCC units with nominal box sizes 5'X5' to 7'X7') do not employ fan shaft bearings, adjustable motor bases, fan drives or belts. The fans are driven directly by the motor and there is never a need for any adjustment.

NOTE: There should be no "chirp" or "squeal" when the fan motor is started.

Alignment

- Check the drive alignment annually to ensure maximum belt life.
- Drive alignment check and adjustment:
  - Place a straight edge across the driver and the driven sheaves as shown in Figure 5.
  - The straight edge should contact all four points as shown in Figure 5 indicating proper drive alignment.
  - There should be no more than 0.5mm per 100mm of fan pulley diameter deviation from four points of contact.
  - In case of realignment, loosen the motor sheave and align it with the fan sheave.

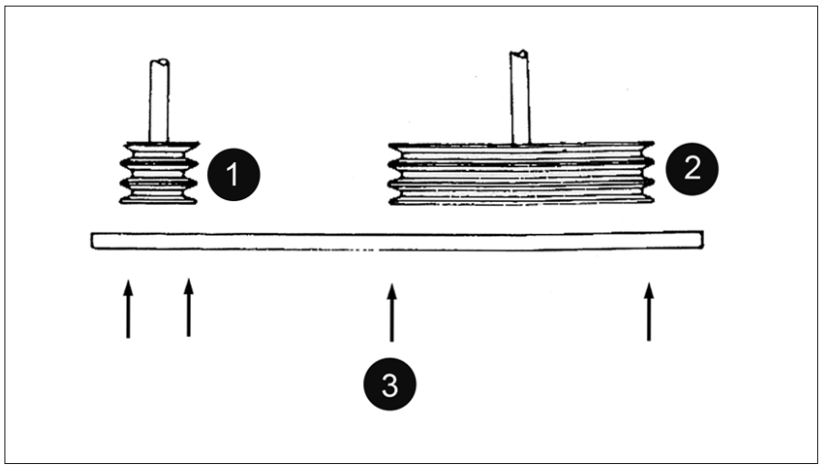


Figure 5. Drive Alignment

1. Motor Pulley
2. Fan Pulley
3. Points of Contact

Fan Motors

RCF Closed Circuit Cooling Towers and RCC Evaporative Condenders use cooling tower duty, premium efficient, totally enclosed, single-speed, single-winding, reversible ball bearing type motor(s).

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.

Adjustable motor base

Coat the motor base slides and adjusting screws (refer to Figure 2 on Page 4) every 3 months using good quality corrosion inhibiting grease such as one of those recommended for lubricating the fan shaft bearings below.

WARNING: Check to ensure the controls for the fan motor are set to allow a maximum of 6 on-off cycles per hour.

Fan Shaft Bearings

Two pillow block ball bearings support the fan shaft.
Each bearing is equipped with a lubrication fitting.

Inspection & Maintenance

- Lubricate the bearings with only a manual grease gun. Do not use high-pressure grease guns since theymay rupture the bearing seals.
- Lubricate the bearings with only one of the following compatible water resistant greases* which are suitable for ambient temperatures ranging from --55ºC to 120ºC.
  - Amoco - Rycon Premium #3
  - Chevron - SRI
  - Citgo - Polyurea MP2™
  - Conoco - Polyurea 2™
  - Exxon - Polyrex® EM
  - Exxon - Unirex N™
  - MobilGrease® - AW2
  - Shell - Alvania RL3™
  - Shell - Alvania #3
  - Shell - Dolium "R"
  - SKF - LGHP2™
  - Unocal 76 - Unilife Grease™
- 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 cooling tower has been stored at the job site for more than 1 year, 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 both bearings with new grease prior to start-up.
  - Operation: Purge bearings every 2,000 hours of operation or once every 3 months, whichever occurs first.
  - Extended Shutdown: Purge bearings with new grease prior to any prolonged storage or downtime.

NOTE: List of brand names is for identification only and are not exclusive recommendations.

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 Figures 8a & 8b).

Inspection & Maintenance

- 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.

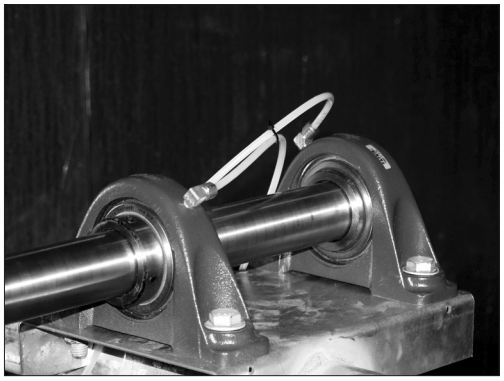


Figure 8a. Bearing With Locking Collar

Figure 8b. Bearing With Locking Collar

Water Distribution System

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

Inspection & Maintenance

The spray nozzles and heat transfer section should be inspected and cleaned each month. The inspection procedure is as follows:

- Shut off the fan, lock out and tag out the fan motor, but leave the system pump running.
- Remove the drift eliminators to allow a clear view of the spray distribution system and nozzle patterns.
- Check to see if the nozzles are all spraying consistently and producing the spray pattern in Figure 9.
- Clean any nozzles which 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. Tools are not required to remove 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.

Caution: Don't use steam or high pressure water to clean PVC eliminators or materials other than steel.

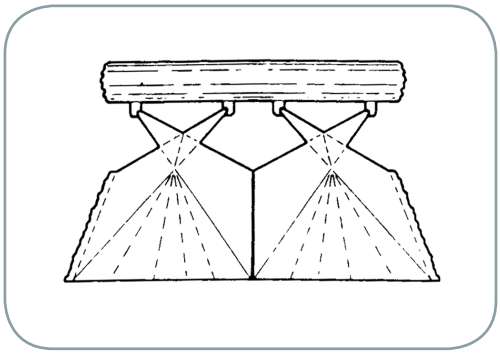


Figure 9: Nozzle Spray Pattern

Water Level Control

There are two types of water level controls used on BAC cooling towers:

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

The RCF and RCC water make-up valve assembly is located inside the unit within easy reach from the access door.

Mechanical make-up valve assembly

A float-operated mechanical water make-up assembly is furnished as standard equipment on the cooling tower. The standard make-up assembly consists of a corrosion resistant make-up valve connected to a float arm assembly actuated by a large diameter plastic float ball. The float is mounted on an all-thread rod held in place by wing nuts. The cold water 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.
- 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 cold water basin is at the overflow level.
- With the design thermal load and the average water pressure at the valve, the above setting will produce operating water levels as stated previously on page 7.
- 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 on page 7. 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 cold water basin and adjust the level if necessary during the first 24 hours of operation.
- Operating at the recommended water level will ensure that the unit basin contains sufficient water volume to prevent air entrainment in the circulating pump during system start-up and provides sufficient excess basin capacity to accept the total system pull-down volume.

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.

Optional Electric Water Level Control Package

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 cold water basin.

- 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 inorder to fill the unit to the overflow connection.

Water Care

About Water Care

In all cooling equipment, operating in evaporative mode, the cooling is accomplished by evaporating a small portion of the re-circulating water as it flows through the equipment. When this water evaporates, the impurities originally present in the water remain. Unless a small amount of water is drained from the system, known as blow down, the concentration of dissolved solids will increase rapidly and lead to scale formation or corrosion or both. Also, since water is being lost from the system through evaporation and blow down, this water needs to be replenished.

The total amount of replenishment, known as make-up, is defined as:

Make-up = evaporation loss + blow down

In addition to the impurities present in the make-up water, any airborne impurities or biological matter are carried into the equipment and drawn into the re-circulating water. Over and above the necessity to blow down a small quantity of water, a water treatment programme specifically designed to address scale, corrosion and biological control should be initiated when the system is first installed and maintained on a continuous base thereafter. Moreover there must be an ongoing programme of monitoring in place to ensure the water treatment system is maintaining the water quality within the control guidelines.

Check and adjustments of blow down depends on the blow down device actual in use.

To prevent excessive build-up of impurities in the circulating water, a small amount of water must be « bled » from the system at a rate to be determined by the water treatment regime. The amount of blow down is determined by the design cycles of concentration for the system. These cycles of concentration depend on the quality of the make-up water and the design guidelines for the quality of the recirculating water given below. Make-up water to the evaporative unit should have minimum 30 ppm hardness as $CaCO_3$.
Where use of a softener is necessary to achieve this, the supply to the evaporative unit should not be totally softened, but blended with the incoming unsoftened water to achieve the minimum hardness between 30 and 70 ppm as Ca CO_3.
Maintaining a minimum hardness in the make-up water offsets the corrosive properties of totally softened water and reduces the reliance on corrosion inhibitors to protect the system.
Cycles of concentration are the ratio of the dissolved solids concentration in the circulating water compared to the dissolved solids concentration in the make-up water. The blow down rate can be calculated as follows :

Blow down = Evaporation loss / Cycles of concentration - 1

The evaporation loss is not only function of the heat load but also depends on climatic conditions, the type of equipment used and the method of capacity control, which is applied. The evaporation loss at summer conditions is approximately 0.431 l/ 1000 kJ heat rejection. This number should be used for blow down valve sizing only and not for the calculation of annual water consumption.

Biological Control

The growth of algae, slimes and other micro-organisms, if uncontrolled, will reduce system efficiency and may contribute to the growth of potentially harmful micro-organisms, such as Legionella, in the recirculating water system. Accordingly a treatment programme specifically designed to address biological control should be initiated when the system is first filled with water and administered on a regular base thereafter in accordance with any regulations that may exist or in accordance with accepted codes of good practice.
It is strongly recommended to monitor the bacteriological contamination of the recirculating water on a regular basis.
If a chemical water treatment is used, it must meet the following requirements.

Chemical Treatment

It is strongly recommended to check the key parameters of the circulating water quality on a monthly base. See Table: Circulated Water Quality Guidelines. All test results need be recorded.

pH	6.5 to 9.0
Hardness as (CaCO3)	30 to 500 mg/l
Alkaline as (CaCO3)	500 mg/l max
Total Dissolved Solids	1500 mg/l max
Chlorides	250 mg/l max
Sulphates	250 mg/l max
Conductivity	1800 µS/cm
Chlorination (as free chlorine): continuous	2 mg/l max
Chlorination (as free chlorine): batch dosing for cleansing and disinfection	5 - 15 mg/l max for 6 hours max

Table 1: Circulated Water Quality Guidelines for Pultruded Composite

NOTE: Chemicals must be compatible with the materials used in the cooling system.

Chemicals should be fed into the re-circulated water to avoid localised high concentrations, which may cause corrosion. Chemicals are normally fed into the pump discharge line. Batch feeding of chemicals does not afford adequate control of water quality and is not recommended.

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FACTORY AUTHORIZED PARTS

RecommendedSpareParts

BAC parts are the "Perfect Fit" for your cooling tower. These parts are specifically designed, engineered and manufactured to work in a cooling tower environment. They are the right parts, at competitive pricing levels, and BAC offers the best deliveries in the industry.

BAC stocks most common repair and retrofit parts in our Cape Town Factory and will ship parts to their required location In addition, most BAC Representatives maintain a local inventory of commonly used parts.

Even with this fast delivery capability, it is still recommended that certain essential, emergency repair parts be maintained in your local inventory, to minimise any potential downtime.

Basic recommended spare parts

- Bearing set
- Float valve or repair kit
- Float ball
- Solenoid valve (if unit is equipped with electric water level control)
- Set of belts
- Spray nozzle kit with grommets
- Basin heater and low water cut out
- Door gasket
- Strainer (inlet and suction)
- Fan and pulley bushings
- Pump seal and gasket kit for coil products

Parts to Consider if Extended Downtime is a Concern

- Spray pump for coil products
- Fan or fan wheel
- Fan shaft
- Pulley set
- Fan motor

COOLING TOWERS

CLOSED CIRCUIT COOLING TOWERS

ICE THERMAL STORAGE

EVAPORATIVE CONDENSERS

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PARTS & SERVICES

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