BALTIMORE
AIRCOIL AUSTRALIA

PCT Cooling Towers

OPERATION & MAINTENANCE MANUAL

Construction Details

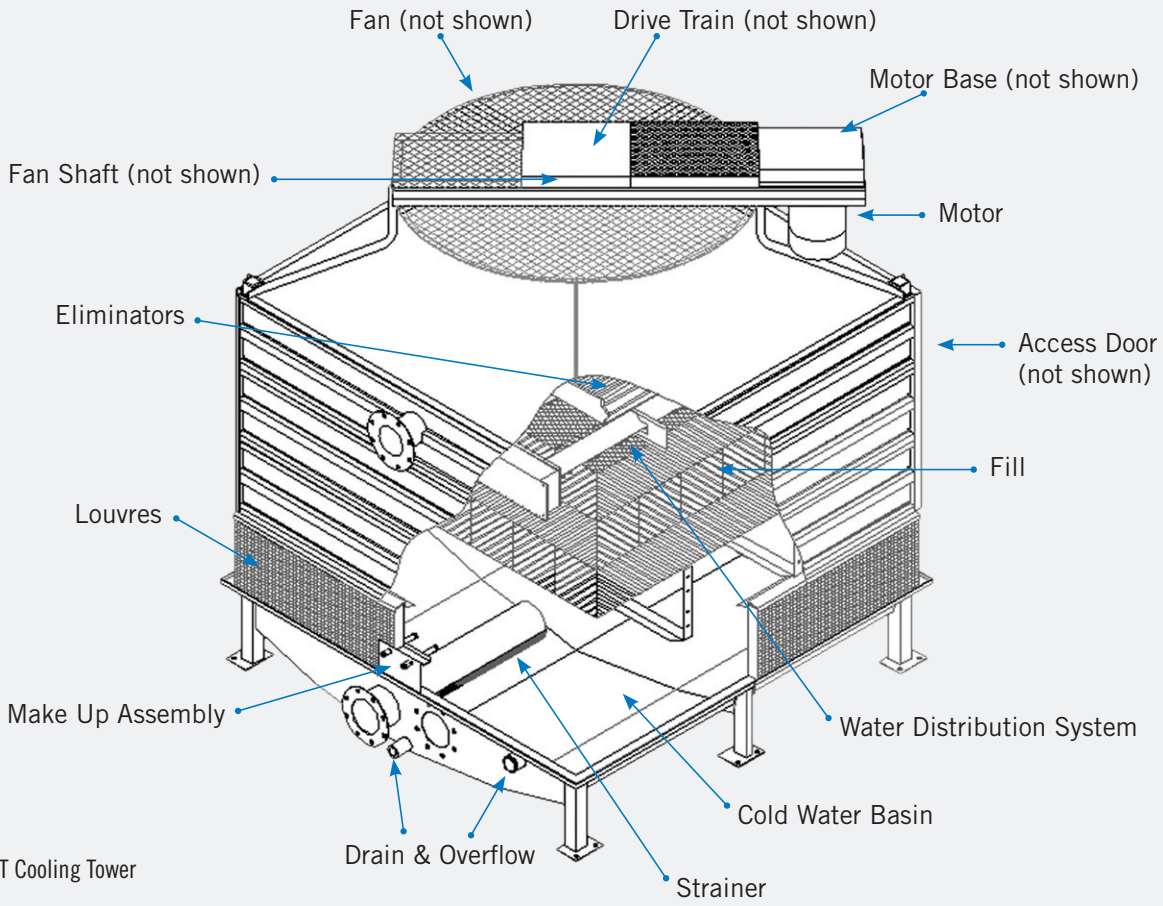

Figure 1. PCT Cooling Tower

Warnings

- **WARNING:** 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.
- **WARNING:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.
- **WARNING:** 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.
- **WARNING:** Openings and/or submerged obstructions may exist in the bottom of the cold water basin. Use caution when walking inside this equipment.
- **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 applicable safety standards of governmental authorities.
- **WARNING:** Drift eliminators on PCT units are not designed to support the weight of a person or to be used as a storage or work surface for any equipment or tools.
- **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. Additionally, inverter duty motors are required on installations that are to be controlled by VFDs.
- **WARNING:** The re-circulating 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 re-circulating water system), must wear respiratory protection equipment approved for such use by governmental occupational safety and health authorities.
- **WARNING:** The basin heater is not designed to prevent icing during unit operation.

Warranties

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.

Cautions

- **CAUTION:** BAC units are typically installed immediately after shipment and many operate year round. However, if the unit is to be stored for a prolonged period of time either before or after installation, certain precautions should be observed. For instance, covering the unit with a clear plastic tarpaulin during storage can trap heat inside the unit, potentially causing damage to the fill and other components. If units must be covered during storage, an opaque, reflective tarp should be used. For normal seasonal shutdowns, refer to the applicable section in this manual.
- **CAUTION:** All electrical, mechanical, and rotating machinery are potential hazards, particularly for those not familiar with their design, construction, and operation. Accordingly, use appropriate lockout procedures. Adequate safeguards (including the use of protective enclosures where necessary) should be taken with this equipment both to safeguard the public from injury and to prevent damage to the equipment, its associated system, and the premises.
- **CAUTION:** When reversing the direction of fan rotation, allow the fan to come to a complete stop before restarting the motor.
- **CAUTION:** Do not use oils containing detergents for bearing lubrication. Detergent oils will remove the graphite in the bearing sleeve and cause bearing failure. Also, do not disturb bearing alignment by tightening the bearing cap adjustment on a new unit, as it is torque adjusted at the factory.
- **CAUTION:** Do not use steam or high pressure water to clean PVC eliminators or materials other than steel.
- **CAUTION:** This equipment should never be operated without all fan screens, access panels, and access doors in place. For the protection of authorised service and maintenance personnel, install a lockable disconnect switch located within sight of the unit on each fan motor associated with the equipment.
- **CAUTION:** Mechanical and operational methods must be employed to protect these products against damage and/or reduced effectiveness due to possible freeze-up. Contact your local BAC Representative for recommended protection alternatives.
- **CAUTION:** Pressure greater than 69 kPa may cause damage to the distribution system.
- **CAUTION:** 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.

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 most harmful atmospheric conditions are those with unusual quantities of industrial smoke, chemical fumes, salt, or heavy dust. Such airborne impurities are carried into the equipment and absorbed by the re-circulating water to form a corrosive solution.
- **WATER:** The most harmful conditions develop as water evaporates from the equipment, leaving behind the dissolved solids originally contained in the make-up water. These dissolved solids may be either alkaline or acidic and, as they are concentrated in the circulating water, can produce scaling or accelerated corrosion.

The extent of impurities in the air and water determines the frequency of most maintenance services and also governs the extent of water treatment which can vary from a simple continuous bleed and biological control to a sophisticated treatment system.

Recommended **Maintenance** Service

Inspect and clean as necessary:	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect general condition of the unit[2] and check unit for unusual noise or vibration	✓	✓			
Inspect cold water basin	✓		✓		
Flush water distribution system/Inspect spray nozzles	✓		✓		
Drain basin and piping	✓				✓
Inspect combined inlet shields	✓	✓			
Check and adjust water level in basin(s)	✓	✓			
Check operation of make-up valve	✓	✓			
Check and adjust bleed rate	✓	✓			
Inspect tower finish				✓	
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 and unplug fan drain holes (hollow blade fans)			✓		
Check fan for uniform pitch			✓		
Check fan for rotation without obstruction	✓		✓		
Check and recoat steel shafts with RUST VETO®	✓		✓		✓

Table 1. Recommended Maintenance Services for PCT Units.

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

NOTES:

1. **Recommended service intervals are the minimum for typical installations. Different environmental conditions may dictate more frequent servicing.**
2. **When operating in ambient temperatures below freezing, the unit should be inspected more frequently.**
3. **Tension on new belts must be readjusted after the first 24 hours of operation and quarterly, thereafter.**

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1

PCT COOLING TOWER

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 (by others), refer to the vibration isolation manufacturer's guidelines before loading/unloading weight from the unit.
- Verify fan and unit pump motors are disconnected, locked out, and tagged out.

Cleaning

- Drain the cold water basin with the strainer in place.
- Remove all dirt and debris from the fan guard(s).
- Flush the water distribution system. Inspect and clean all spray nozzles.
- Clean all of the mechanical components, such as the fan and motor.
- Flush the cold water 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 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.
- For PCT belt driven units, prior to 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.

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

WARNING: 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.

Start-up

- Prior to seasonal start-up, lubricate the motor base adjusting screw(s) and fan shaft bearings. At initial start-up, no bearing lubrication is required since the bearings are factory lubricated prior to the shipment.
- Apply RUST VETO® to steel shafts.
- Fill the cold water basin with fresh water up to the overflow level via the make-up valve.
  - **Water Treatment for New Installations:** Initiate the biocide water treatment program at this time.
  - **Water Treatment for Seasonal Start-up or after a Shutdown period in excess of three days:** Resume the biocide treatment program or administer a shock treatment of appropriate biocides prior to operating the cooling tower fans. This will eliminate accumulated biological contaminants.
- Set the make-up valve float so the water shuts off at the overflow level.
- Start the system pump.
- Adjust the system flow rate to the design rate. Open the supply valve slowly until the design flow is reached, based on the pressure in the distribution system.

CAUTION: Pressure greater than 69 kPa may cause damage to the distribution system.

- Check that the float operated make-up valve is operating freely. Closely monitor water level and adjust as necessary during the first 24 hours of operation.
- For multicell arrangements, balance flow between the cells to obtain even water distribution.
- Check the nozzle spray pattern as described in "Water Distribution System and Heat Transfer System" on **Page 18**.
- Open the valve in the tower bleed line, and adjust the bleed by closing or opening the valve.
- Verify fan tip clearance is between 3mm and 13mm.
- For initial start-up, bump the fan motor and note the direction of rotation. Start the fan motor(s) and verify proper fan rotation without obstruction. The fan(s) 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 15 second time delay when switching from high speed to low speed.
- Check the operation of the optional vibration cutout switch.
- Once the cooling tower is operating, check the current and the 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.

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

- ✓ Check the unit for any unusual noise or vibrations.
- ✓ Check the operating water level in the cold water basin.
- ✓ Adjust 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 all fans and pumps.
- Close the shut-off valve in the make-up water line (supplied by others) and drain all exposed make-up water piping. Heat trace and insulate all exposed piping.
- 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 the debris, such as leaves and dirt, from the interior and exterior of the unit.
- Leave the cold water basin drain open so rain and melting snow will drain from the tower.
- Clean the basin strainer and re-install.
- Cover the fan discharge to keep out dirt and debris.
- For PCT belt driven units, lubricate the fan shaft bearings, motor base, and motor base adjusting screw.
- Apply RUST VETO® to steel shafts.
- Inspect the protective finish on the unit. Clean and refinish as required.
- Maintain the fan motor starting device in the "OFF" position to ensure personal safety in the case of future inspection or service.

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

2

PCT COOLING TOWER

Detailed Component Maintenance Procedures

COLD WATER BASIN

FAN

FAN DRIVE SYSTEM (BELT DRIVE UNITS)

FAN DRIVE SYSTEM (DIRECT DRIVE UNITS)

FAN MOTORS

FAN SHAFT BEARINGS

LOCKING COLLARS

FAN SHAFT

ACCESS DOOR

LOUVRES AND ELIMINATORS

WATER DISTRIBUTION AND HEAT TRANSFER SECTION

WATER LEVEL CONTROL

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.

Water Levels

Model Number	At Overflow Level (mm)	At Operating Level (mm)
All PCT models except PCT-1111	443	343
PCT-1111	548	448

Table 1. Cold Water Basin Water Levels

- The values shown in **Table 1** are relative to the base of the unit.
- The make-up valve controls the operating level, which is maintained at the levels shown in **Table 1**.
- 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.
- Consult "Water Level Control" on **Page 20** for information on how to set and maintain basin operating level.

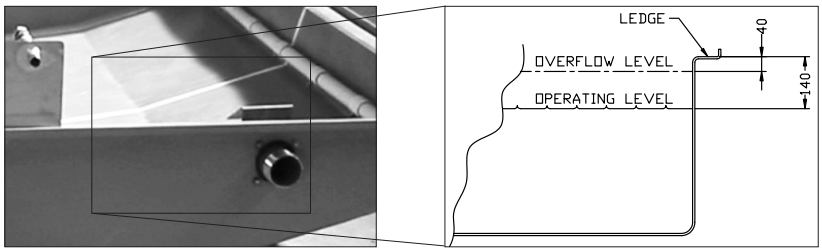

Figure 2. Water Operating Level

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 sediment, which can collect in the basin during operation. If not removed, sediment can become corrosive and cause deterioration of the basin as well as be a potential area for biological growth.
- 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. See **Table 1**.

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 PCT Cooling Tower uses axial fan(s). Thoroughly inspect the fan(s) for damaged or deteriorated fan blades and replace the fan(s) as required.

Inspection & Maintenance

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

- 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 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 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 between 3mm and 13mm.
- **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°.
- **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 13mm band at any single point around the cowl.

WARNING: 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.

- **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 (Belt Drive Units)

Belt Drive Power Train

The drive train consists of SPB belts, a fan sheave and a motor sheave. The high efficiency belts provide the premium quality necessary for evaporative cooling equipment.

Together these components provide a highly reliable system with low maintenance requirements. The drive train should be inspected periodically to check the belt tension, condition of the sheaves and belt, and when necessary adjust the tension. The recommended service intervals are specified elsewhere.

Inspection & Maintenance

The belt drive power train requires a periodic check of belt condition and, when necessary, tension adjustment. The recommended service intervals are as follows:

- **Initial Start-Up:**
  - If the equipment was supplied in assembled major sections, no servicing is required prior to initial startup since the drive has been tensioned and aligned at the factory. If equipment was supplied completely knocked down (CKD) then check drive alignment & belt tensioning as per procedures outlined below.
- **Seasonal Start-Up:** Readjust the tension on the belt.
- **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 three months.
- **Belt tension check:**
  - Place a straight edge along the belt from sheave to sheave as shown in **Figure 3a**, or use a tape measure as shown in **Figure 3b** to measure belt deflection.
  - Apply a moderate force by hand (approximately 2kg) evenly across the width of the belt in the centre of the span between the sheaves.
  - There is adequate belt tension if the belt deflects between 6mm and 9mm as shown in **Figures 3a** and **3b**.

WARNING: No service work should be performed on the drive train without first ensuring the fan and pump motors have been isolated, tagged and locked in the off position.

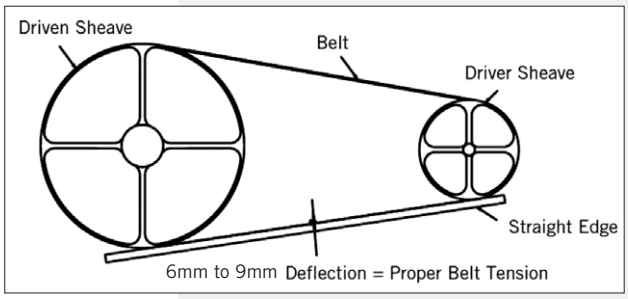

Figure 3a. Belt Tension with a Straight Edge

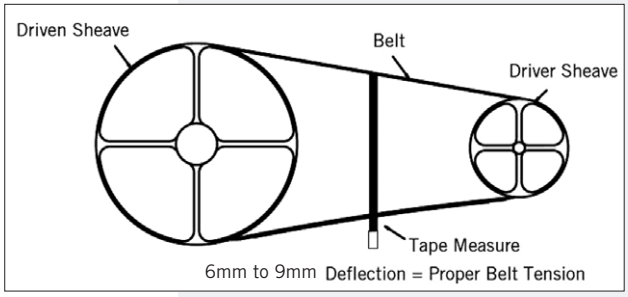

Figure 3b. Belt Tension with a Tape Measure

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

- **Belt tension adjustment (if required):**
  1. Loosen the motor pulley guard retaining nuts.
  2. Loosen the lock nuts on the Motor Base Adjusting Screws.
  3. Turn the Motor Base Adjusting Screws clockwise to tension the belt, or counterclockwise to relieve belt tension. During adjustment of belt tension the drives should be rotated several times by hand to evenly distribute the tension throughout the belt.
  4. When the belt is properly tensioned, retighten the locking nuts on the Motor Base Adjusting Screws.
  5. Tighten guard nuts.

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

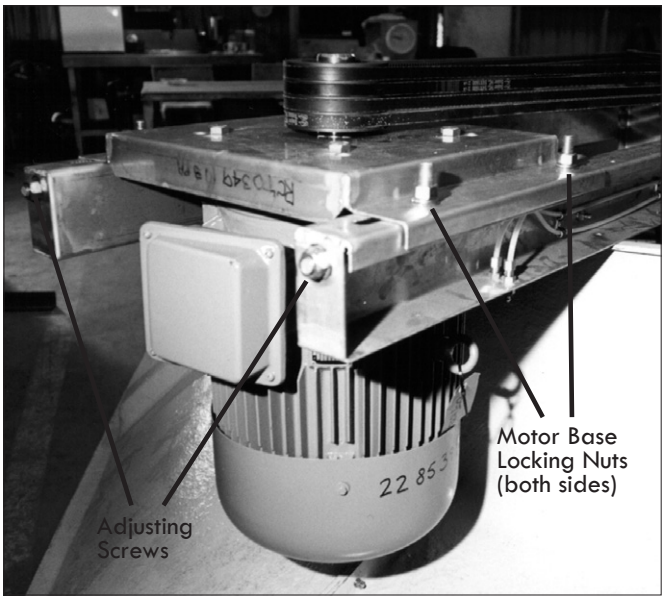

Figure 4. Adjustable Motor Base (cover removed)

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 that the drives are properly aligned.
  - There should be no more than 1.5mm deviation from four points of contact.
  - In case of realignment, loosen the motor sheave and align it with the fan sheave. Allow 6mm for draw-up as the bushing screw is retightened.

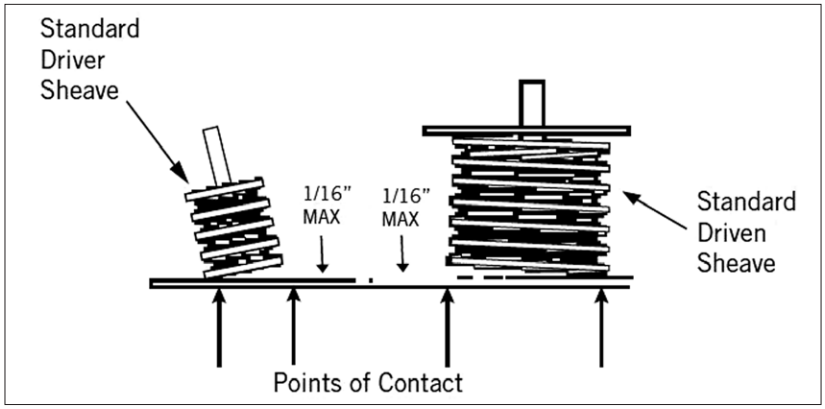

Figure 5. Drive Alignment

Fan Drive System (Direct Drive Units)

Drive Train

The standard fan motor used on direct driven PCT towers is a TEAO (Totally Enclosed Air Over) motor. The motor has permanently lubricated ball bearings and special moisture protection on the bearings, shaft, and ings. The only servicing required during operation is to clean the outside surface of the motor at least quarterly to ensure proper motor cooling. After prolonged shutdowns, the motor insulation should be checked with a "megger" insulation tester before restarting the motor.

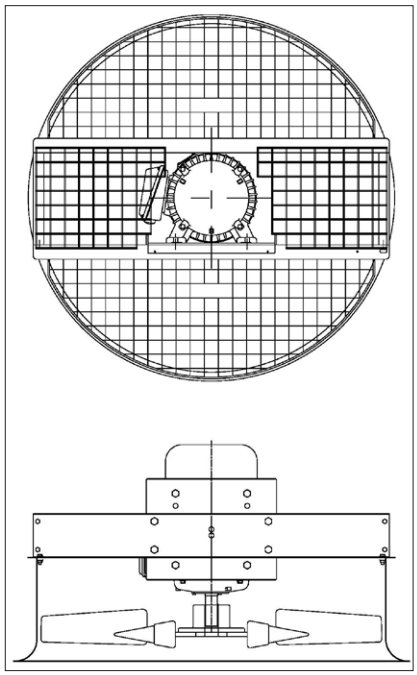

Figure 6. Belt Tensioning

WARNING: 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.

Fan Motors

Fan Drive System Descriptions

Direct Drive Motors: For direct driven units the motor is TEAO epoxy coated IP66.

Belt Drive Motor: The fan motor used on belt driven PCT units is a TEFC motor, with permanently lubricated ball bearings. The motor is installed fully outside of the wet air stream.

Electrical Connection (by others): All electrical connections should be carried out by qualified & approved/licensed electrical personnel and conform to all local authority requirements. All overload devices, fuses or other protective devices must be rated to suit motor running & starting characteristics.

Initial Start-up:

1. Insulation resistance test - minimum value should be 1 Mega Ohm (1,000,000 Ohms).
2. Thermistors, if fitted, should be checked for continuity with a multimetre but never mega-tested.
3. Ensure supply voltage and frequency correspond to the motor nameplate rating.
4. Ensure shaft turns freely.
5. Wire the motor in accordance with the wiring diagram as shown on the motor nameplate and/or in the motor terminal box.
6. Turn on unit and check amp draw does not exceed nameplate rating.

Note: If unit is not run for a prolonged time (or motor is stored with tower in kit form) the motor insulation should be checked with a "megger" insulation tester prior to starting the motor. If motor is stored it should be in a clean, dry place & have the shaft rotated occasionally. Storage areas should not be subject to vibration.

WARNING: Electricity is dangerous and has the potential to cause fatal injury. Work of any nature involving electricity must only be carried out by licensed electricians, who must take all the appropriate/regulated safety precautions prior to commencement of such work.

Inspection and 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 motor voltage and current following start-up and every three months while in operation.

Adjustable Motor Base

Coat the motor base slides and adjusting screws 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.

Fan Shaft Bearings

The fan shaft is supported by two flange mounted ball bearings, each equipped with a lubrication fitting and a slinger/locking collar to keep out moisture. The bearings should be lubricated as follows:

Inspection and Maintenance

- Only lubricate the bearings with a manual grease gun. Do not use high-pressure grease guns since they may rupture the bearing seals.
- Bearings come pre-packed with Castrol EPL2 grease. BAC recommends re-packing only with a compatible water resistant, mineral base grease with a lithium thickener.
- 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 three months while in operation.
  - **Extended Shutdown:** Purge bearings with new grease prior to any prolonged storage or downtime.

Locking Collars

Each eccentric locking collar should be checked every six months 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 7**).

1. Loosen the set screw.
2. Using a drift pin, tap the collar (in the hole provided) tangentially in the direction of rotation while holding the shaft.
3. Retighten the set screw.

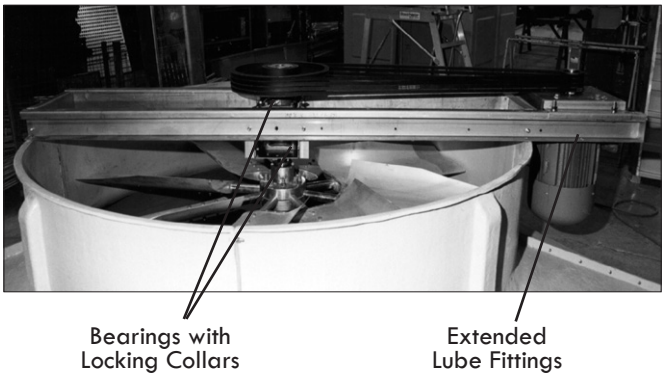

Figure 7. Fan Shaft Bearings

Fan Shaft

The fan shaft is fabricated from stainless steel. The exposed areas of the fan shaft are coated with a soft seal for added corrosion protection. It is recommended that the coating be inspected for continuity quarterly or at least every 6 months. Any signs of surface corrosion must be treated. This involves;

1. Removal of the protective coating with a suitable cleaning medium.
2. The removal of any surface corrosion with emery cloth.
3. The re-coating of the shaft with soft seal.

Access Door

The large access door is easily removed to provide complete access to drift eliminators, spray system and fill.

To remove the door, take out the louvres from door side. Loosen and remove the knobs that hold the door in place. Larger units are provided with convenient anchor points to assist in removing the door and securing the door to the unit when removed.

Figure 8. Access Door Anchor Points

WARNING: The access door should not be removed without first ensuring the fan and pump motors have been isolated, tagged and locked in the off position.

Louvres and Eliminators

WARNING: Damaged or missing drift eliminators will result in excessive drift from the tower. This may constitute a hazard due to biological or chemical contaminants, including Legionella, being discharged from the tower. When such damaged or missing drift eliminators are noticed the tower MUST be stopped and not re-started until the sections are replaced.

Inspect regularly and remove foreign objects that might impair air passage. Replace damaged and/or missing sections as necessary.

Water Distribution System and Heat Transfer Section

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

The inspection procedure is as follows:

- Shut off the fan, lock out, and tag out the fan motor, but leave the system pump running.
- Check to see if the nozzles are all spraying consistently and producing the spray pattern shown in **Figure 9**.
- Clean any nozzles which are clogged. If necessary, the nozzle and/or branch may be removed for cleaning.
- If required replace damaged or defective nozzles/ grommets - replacement nozzles & grommets are available through your local BAC representative.
- The fill should be inspected and cleaned at least quarterly or more regularly if required by local authorities.
    1. To inspect and/or clean remove the access panel.
    2. Inspect and clean thoroughly to remove all debris and deposits such as algae, scale, etc.
    3. Repair or replace damaged or defective bundles. Replacement bundles are available through your local BAC representative.

NOTE: When working on fill section or above fill section, fill bundle edges should be protected from damage by service personnel, tools or debris by placing a temporary cover of plywood, or other suitable material, over the top of the fill bundles.

Heat trace and insulate all exposed water piping including pump piping below the overflow level, external header cleanout, and make-up water lines with electrical heater tape.

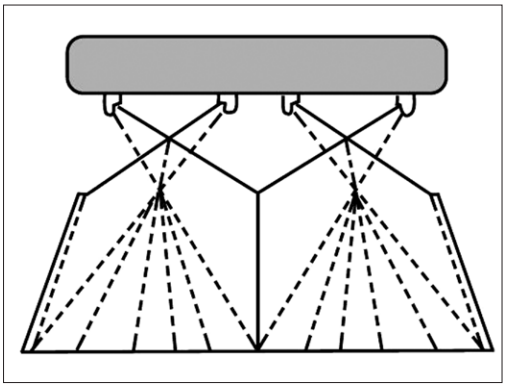

Figure 9. Nozzle Spray Pattern

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

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 polystyrene-filled plastic float. 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.
- Maintain the make-up water supply pressure between 100 and 350 kPa for proper operation. BAC recommends a surge protector (provided by others) for pressures over 350 kPa.
- 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 operating level.
- With the design thermal load and the average water pressure (100 to 350 kPa) at the valve, the above setting will produce operating water levels as stated in **Table 1** on **Page 9**.
- 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 1**. 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 pulldown 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.

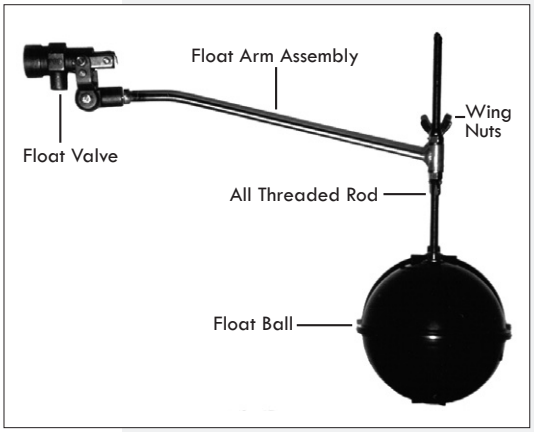

Figure 10. Water Make-Up Valve Assembly

CAUTION: Do not use steam or high pressure water to clean PVC eliminators or materials other than steel.

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 in order to fill the unit to the overflow connection.

Water Level Control

- Mechanical Make-up Valve Assembly
- Optional Electric Water Level Control Package

3

PCT COOLING TOWER

Water Treatment

BLEED RATE

BLEED LINE CALCULATIONS

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.

Bleed Rate

1. In evaporative cooling, evaporation of a small portion of the re-circulating spray water as it flows through the equipment causes the cooling effect. As this water evaporates, the impurities originally present remain in the re-circulating water. The concentration of the dissolved solids increases over time and can reach unacceptable levels. In addition, airborne impurities are often introduced into the re-circulating 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.
2. The degree to which dissolved solids and other impurities build up in the re-circulating water may be defined as the cycles of concentration. Specifically, cycles of concentration is the ratio of the concentration of dissolved solids (for example - chlorides, sulphates, etc.) in the re-circulating water to the concentration of the same material in the make-up water.
3. In order to optimise heat transfer efficiency and maximise equipment life, “bleed” or “blow-down” a small amount of re-circulating water from the system. This controls the cycles of concentration to maintain the quality of the re-circulating water within the guidelines given on Page 28.
4. Replenish the “bleed” water with fresh make-up water, thereby limiting the build-up of impurities.
5. Bleed/blowdown: Accomplish the bleed automatically through a solenoid valve controlled by a conductivity meter. The conductivity meter set point is the water conductivity at the desired cycles of concentration and should be determined by a competent water treatment expert. (Note: The solenoid valve and conductivity meter may be supplied by BAC or others).
6. Alternatively, use a bleed line with a valve to continuously bleed from the system. In this arrangement, adjust the rate of bleed using the valve in the bleed line. Measure the rate of bleed by filling a container of known volume while noting the duration. Check the bleed rate and water quality periodically to ensure that adequate control of the water quality is being maintained.

Bleed Line Calculations

Bleed rate is determined by the following formula;

Bleed Rate = B = E/(n-1) Where:

B = Bleed Rate (L/S)

E* = Evaporation Rate (L/S)

Q = Process Fluid Flow Rate (L/S)

R = Range = Entering – Leaving Fluid Temperature (°C)

n = Number of Cycles of Concentration = CR/CM

CR = Concentration in Re-circulating Water

CM = Concentration in Make-Up Water

*The evaporation rate (E) can be determined by any one of the following methods: 1. The evaporation rate is approximately 1.5 L/hr for each kW of operating Total Heat Rejection (THR). 2. The evaporation rate (L/hr) is = 6.3 x R (°C) x water flow.

The following example illustrates a bleed rate calculation:

Closed Circuit Cooling Tower Process Fluid Flow Rate = 50 L/S

Range = 5.5°C

Maximum Allowable Chloride Concentration = 250 ppm

Concentration of Chlorides in Make-Up Water = 45 ppm

Solution:

E = 6.3 x R x flow = 6.3 x 5.5 x 50 = 1732.5 L/hr

n = CR/CM = 250/45 ppm = 5.55

Bleed Rate = B = E/(n-1) = 1732.5/(5.55-1) = 381 L/hr

Therefore in this case we must bleed 0.159 L/S to limit the concentration of impurities. This example focuses on a single parameter (chloride concentration) of water only. The bleed rate required for a system (when evaluating more than one parameter) is the highest bleed rate required to keep all parameters within recommended limits.

4

PCT COOLING TOWER

Corrosion and Scale Control

CORROSION AND TREATMENTS

CORROSION AND SCALE CONTROL

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

1. Galvanised Steel Components: Inspect the galvanised steel components for blemishes or corrosion. Wire brush and recoat the affected areas with a cold galvanising compound such as Zinc Rich Compound (ZRC).
2. Stainless Steel Components: Inspect stainless steel components for signs of blemishes or corrosion. Clean with stainless steel wool as necessary. If more extensive corrosion is prevalent, contact your local BAC Representative.
3. Fibreglass Reinforced Polyester (FRP) Components: FRP components should be inspected for accumulation of dirt and cleaned with soap and water as necessary. Also, FRP components should be inspected for any penetration of gel coat or UV veil. Such penetrations should be repaired immediately.

Corrosion and Treatments

1. **Corrosion** – Red rust on steel components and "white rust" on galvanised surfaces will affect the longevity of the unit.
2. **Scale formation** – Scale not only reduces heat transfer and system efficiency, but also may lead to under deposit corrosion.
3. **Biological Fouling** – Slime and algae formations may reduce heat transfer, promote corrosion, and harbour pathogens such as Legionella.

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 competent 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.

Corrosion and Scale Control

1. To control corrosion and scale, maintain the water chemistry of the re-circulating water within certain parameters. 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 re-circulating water and the temperatures at which the system will be operating.
2. Bleed/blowdown, the continuous flow of a small portion of the re-circulating water to drain, is used to control the concentration of dissolved solids. On rare occasions, this may be adequate to control scale and corrosion. More often, however, chemical scale and corrosion inhibitors are necessary, which raise the allowable level of dissolved solids without the risk of scale and corrosion.
3. Keep the chemically treated water within the guidelines given in the below table. Your water treatment specialist may recommend more conservative limits than those shown in the table.

Quality Guidelines for Chemically Treated Circulating Water. Galvanised steel units require passivation in order to prevent white rust. Refer to passivation on the following page. Hardness and alkalinity limits may be exceeded under certain circumstances. Consult your water treatment specialist for recommendations. The conversion factor used to determine conductivity is 0.625 (TDS=0.625* Conductivity).

	SST	ZAM / Galvanised Steel
PH	6.5 to 8.5	7.0 to 9.0
Hardness as CaCO3	300 to 500 ppm	300 to 500 ppm
Alkalinity as CaCO3	500 ppm max.	500 ppm max.
Total Dissolved Solids	1200 ppm max.	1000 ppm max.
Chlorides	250 ppm max.	125 ppm max.
Sulphates	250 ppm max.	125 ppm max.

Table 2. Recirculated Water Quality Guidelines

Chemical Treatment Programs Must Meet or Exceed the Following Requirements:

1. The chemicals must be compatible with the unit materials of construction as well as other materials used in the system (pipe, heat exchanger, etc.).
2. Chemical scale and corrosion inhibitors, and particularly acid (if used) should be introduced into the circulating water through automatic feeders 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 cold water basin or water distribution system, as this can severely damage areas directly contacted.
3. When chlorine is added to the system, free residual chlorine should not exceed 1 ppm, except as noted in start-up and shutdown section. Exceeding this limit may accelerate corrosion.

Passivation:

1. Passivation is the formation of a protective, passive, carbonate layer on galvanised steel surfaces.
2. On the newly installed units, to provide maximum protection from corrosion, take special measures to passivate galvanised steel surfaces.
3. To ensure proper passivation of the galvanised steel, keep the pH of the circulating water between 7.0 to 8.2 for four to eight weeks after start-up, or until new zinc surfaces turn dull gray in colour.
4. If white deposits form on galvanised steel surfaces after the pH is returned to normal service levels, it may be necessary to repeat the passivation process.

Biological Control

1. 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 the growth of potentially harmful organisms such as Legionella. To avoid biological contamination and minimise 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.
2. Bleed/blowdown or chemical treatment used for corrosion and scale control alone is not adequate for control of biological contamination.
3. 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 cold water basin.
4. If ozone water treatment is used, at no point should concentrations exceed 0.5 ppm.
5. Initial Start-up & Start-up following a Shutdown Period.
    - To minimise the risk of biological contamination during a shut-down period of three days or more, it is recommended that the entire system (evaporative cooling equipment, system piping, heat exchangers, etc.) be drained.
    - To resume operation of a drained system and at initial start-up, clean all debris from the cold water basin and fill the system with fresh water. Then, 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. Then run 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. 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.
- When it is not practical to drain the system during shut-down periods, install a by-pass line with shut-off valves to permit the re-circulating water to circulate throughout the system, including the unit basin, while bypassing the Prime Surface Coil section of the evaporative cooling equipment (fans should remain off).
- Treat the system as per one of the above described methods prior to restarting the unit.

5

PCT COOLING TOWER

Factory Authorised Parts

THE PERFECT FIT

The Perfect Fit

To Ensure Perfect Performance

Your evaporative cooling equipment is only as good as the sum of its parts. Baltimore Aircoil factory authorised replacement parts and accessories are engineered and manufactured to original equipment specifications and are guaranteed to be The Perfect Fit. These high quality components can eliminate unnecessary, costly and time consuming problems caused by non factory authorised parts. They are fully warranted to ensure long, trouble free operation. BAC original equipment parts also help maintain the thermal performance of CTI Certified models of BAC evaporative cooling equipment. In addition, BAC quality parts and accessories are fully compatible with other manufacturers' equipment.

For Service and Preventative Maintenance

BAC products are designed for long, trouble-free operation and BAC factory authorised parts provide everything you need to service and maintain your evaporative equipment with confidence. To ensure optimum performance and maximum service life, it is important that a program of regular inspection and maintenance be completed. Your experienced BAC sales & service office and/or BAC appointed representative is factory trained and available to assist you.

For Performance Enhancement

Baltimore Aircoil's ongoing research and development programs result in continual product performance and system durability improvements. As new developments are incorporated into our equipment designs, they are made available for retrofit on existing units to improve efficiency and reduce operating cost. Upgrade and retrofit kits are also available to improve the serviceability of existing installations or other manufacturers' equipment.

COOLING TOWERS

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