

Series V Closed Circuit Cooling Towers and Evaporative Condensers



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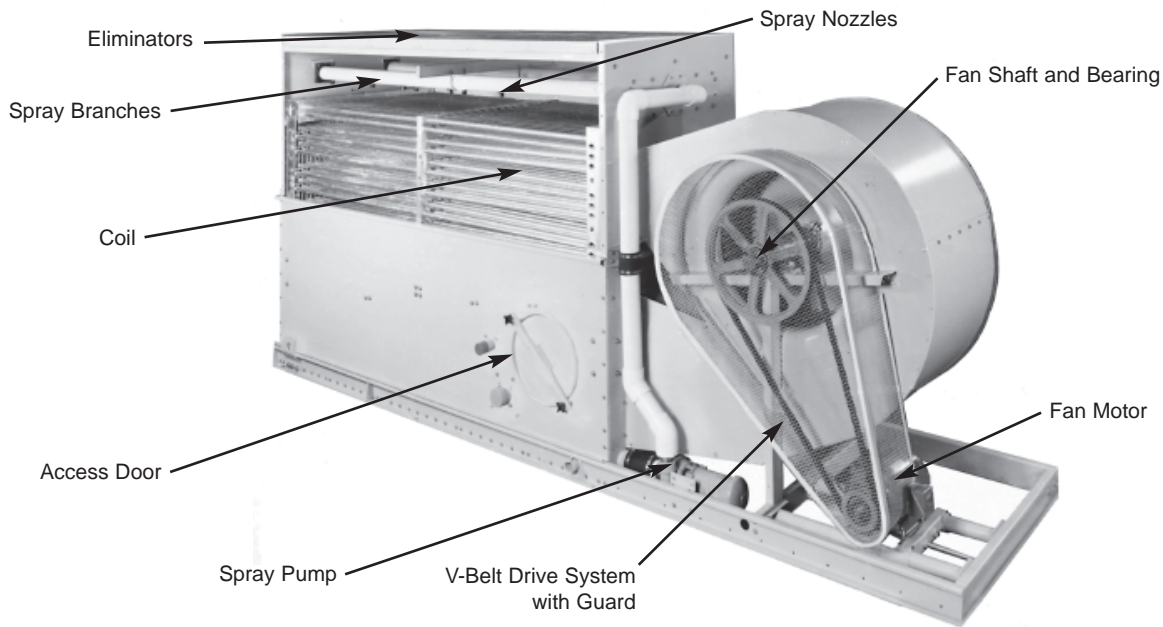


Figure 1 - VFL Closed Circuit Cooling Tower and VCL Evaporative Condenser

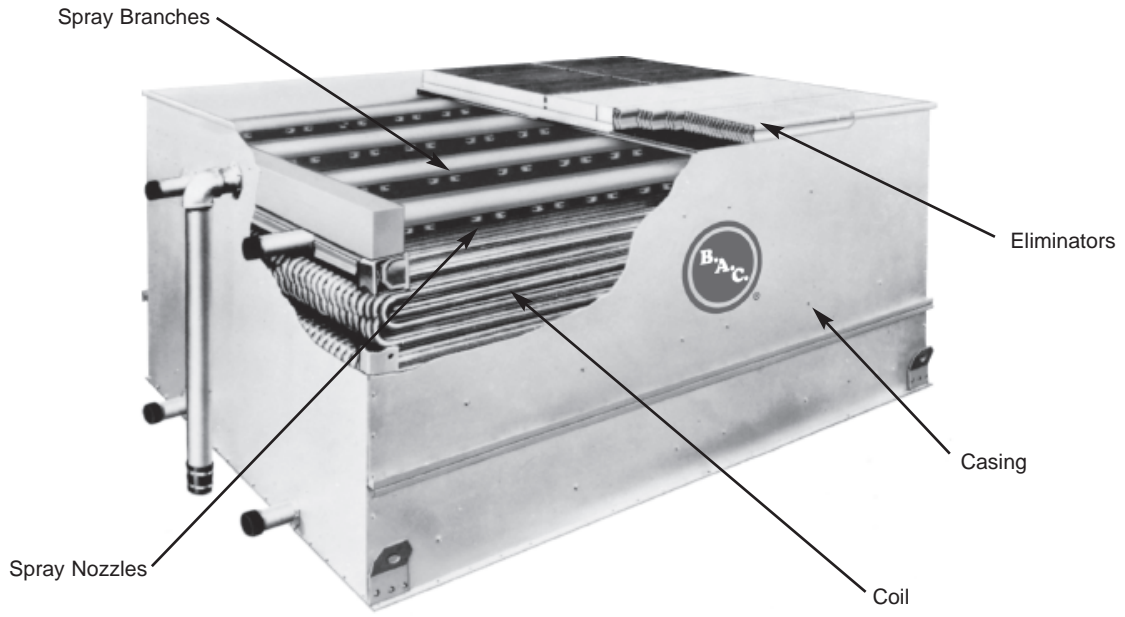


Figure 2a - Heat Transfer Coil Section for VF1 Closed Circuit Cooling Tower and VC1 Evaporative Condenser

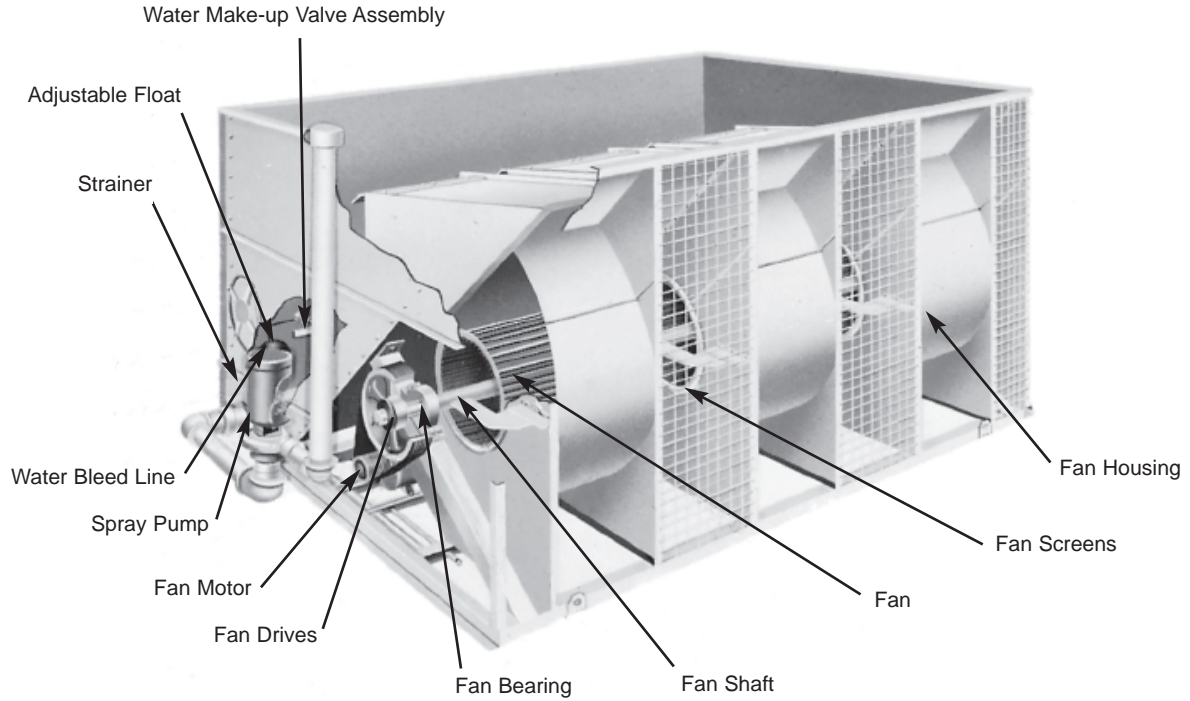


Figure 2b - Basin Section for VF1 Closed Circuit Cooling Tower and VC1 Evaporative Condenser



Table 1: Recommended Maintenance Services^[1]

Type Service	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect and clean as necessary:					
Inspect general condition of the unit ^[2] and check unit for unusual noise or vibration	X	X			
Clean and flush basin	X	X			X
Inspect spray nozzles	X	X			X
Clean basin strainer	X	X			X
Drain basin and piping					X
Check and adjust water level in basin	X	X			
Check operation of make-up valve	X	X			
Check and adjust bleed rate	X	X			
Inspect heat transfer section	X	X			
Inspect protective finish				X	
Mechanical equipment system:					
Check belt condition	X	X			
Adjust belt tension ^[3]	X		X		
Lubricate fan shaft bearings	X		X		X
Lubricate motor base adjusting nut	X		X		X
Check drive alignment				X	
Check motor voltage and current	X		X		
Check fan bearing locking collars	X		X		
Check fan motors for proper rotation	X				
Check fans for rotation without obstruction	X		X		

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 unit should be inspected more frequently. Refer to “Cold Weather Operation” on Page N102 for more details.
3. Tension on new belts must be readjusted after the first 24 hours of operation and quarterly, thereafter.

Operation and Maintenance

Initial and 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 spray 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 strainers in place.
- Remove all dirt and debris from the fan guards.
- Clean all mechanical components, such as the fans and motors.
- Flush the cold water basin interior to remove any accumulated dirt and debris.
- Remove, clean, and replace the strainers.



Inspection

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.

- 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 motors and check for proper fan rotation.
- Run the fans in manual mode for several minutes to check for any unusual noise or vibrations.
- Check that the float operated make-up valve is operating freely.

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

Start-up

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 the pumps are disconnected and locked out.

- Prior to seasonal start-up, lubricate the motor base adjusting screws (see Figure 6 on Page N77) 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 make-up valve.
 - Water treatment for new installations: Initiate the biocide water treatment program at this time. Refer to “Biological Control” on Page N106 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 N106 for more details.
- Set the make-up valve float so the water shuts off at the overflow level.
- Start the spray pump. See “Water Distribution System” on Page N78 for more details.
- Open the valve in the unit bleed line, and adjust the bleed by closing or opening the valve.
- Once the unit is operating, check the current and voltage of all three phases (legs) of the fan motors with a heat load on the unit under warm ambient conditions. The current must not exceed the nameplate ratings.
- Check the operation of the optional vibration cutout switch.

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.

Extended Shutdown

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 the pumps are disconnected and locked out.

Perform the following services whenever the unit is shutdown in 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 (excluding the coils) that will be exposed to freezing temperatures. Heat trace and insulate all exposed piping.



Figure 3 - Water Make-up Valve Assembly



- 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 strainers in place.
- Leave the cold water basin drain open so rain and melting snow will drain from the unit.
- Clean the basin strainer and re-install.
- Lubricate the fan shaft bearings, motor base, and motor base adjusting screw.
- 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.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to “Corrosion Protection” on Page N104 for more details.
- Secure the fan motors starting device(s) in the “OFF” position to ensure personal safety in case of future inspection or service.

Detailed Component Maintenance Procedures

Cold Water Basin

The fluid to be cooled is circulated inside the tubes of the unit's heat exchanger. Heat flows from the process fluid through the coil to the spray water outside which is cascading over the tubes. The spray water collects in the cold water basin, passes through the suction strainer and is pumped back to the distribution system. The cold water basin is constructed from one of the following materials of construction:

- Galvanized steel
- Thermosetting Hybrid Polymer
- Type 304 stainless steel

Water Levels

Table 2: Cold Water Basin Water Levels

Model Number	At Overflow Level (in.)	At Operating Level (in.)
VFL, VCL	10"	5-1/2"
VF1-009 thru VF1-036, VC1-10 thru 135	18-1/2"	13-3/8"
VF1-048, VC1-150 thru 205	21-1/2"	16-5/8"
VF1-072, VC1-N208 thru N230	31"	17"
VF1-096, VF1-144N, VF1-192, VF1-288N, VC1-N243 thru N470, VC1-C216 thru C469	31"	17"
VF1-1012, VF1-1018, VF1-1024, VF1-1036	24"	18"
VF1-144, VF1-216, VF1-288, VF1-432, VC1-386 thru 1608	24-1/2"	14"

- The make-up valve controls the operating level, which is maintained at the levels shown in Table 2.
- 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 and Maintenance

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

- 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 strainers in place to prevent the sediment from re-entering the system.



- Remove the strainers after the basin has been flushed.
- Clean and replace the strainers before refilling the basin with fresh water.
- Adjust the float to maintain the design operating level. See Table 2: "Cold Water Basin Water Levels".

Fan

Series V Closed Circuit Cooling Towers and Evaporative Condensers use centrifugal fans. Thoroughly inspect the fans for damaged or deteriorated fan blades and replace the fan as required.

Inspection and Maintenance

- If the unit is already in operation, while the fans are still running, check for any unusual noise or vibration.
- With the fans off and the motor locked out and tagged, check the general condition of the fans:
 - Inspect for any loose or missing bolts in the locking collar and fan shaft bearings.
- **Rotation:** Turn the fan shaft by hand to ensure that the shaft moves freely with no rough spots, binding or other malfunctions that could cause vibration or fan 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.
- **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

Inspection and 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 unit 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 tape measure as shown in Figure 4b, to measure belt deflection.
 - Apply a moderate force by hand (approximately 15 lbs/6.8 kg) evenly across the width of the belt in the center of the span between the sheaves.

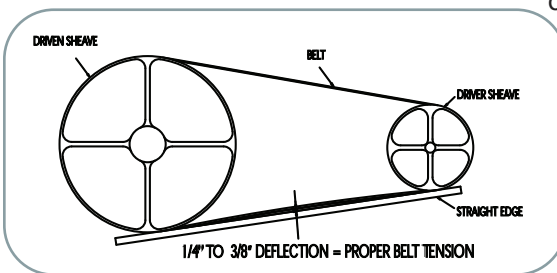


Figure 4a

◦ There is adequate belt tension if the belt deflects between 1/4" and 3/8" as shown in Figures 4a

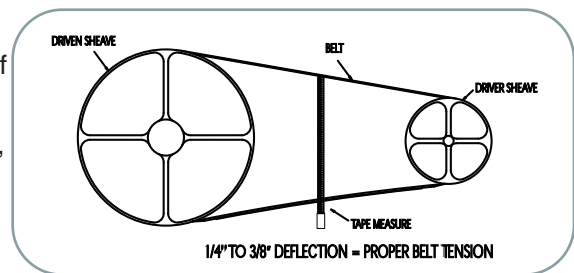


Figure 4b

and 4b.



- Belt tension adjustment (if required):
 - Loosen the lock nut on the motor base adjusting screw.
 - Turn the motor base adjusting screw clockwise to tension the belt, or counterclockwise to relieve belt tension. During adjustment of belt tension, rotate the drives several times by hand to evenly distribute the tension throughout the belt.
- When the belt is properly tensioned, retighten the lock nut on the motor base adjusting screw.

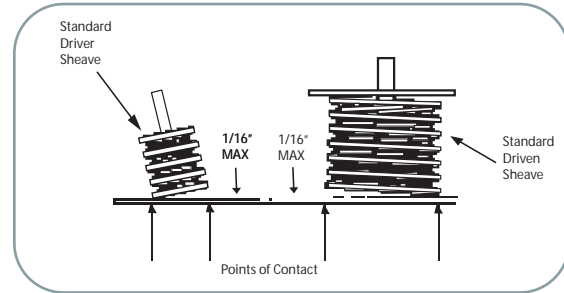


Figure 5 - Standard Drive Alignment

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 1/16” deviation from four points of contact.
 - In case of realignment, loosen the motor sheave and align it with the fan sheave. Allow 1/4” for draw-up as the bushing screw is retightened.

Fan Motors

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

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.

Adjustable Motor Base

Coat the motor base slides and adjusting screws (see Figure 6) every 3 months using good quality corrosion inhibiting grease such as one recommended for lubricating the fan shaft bearings.

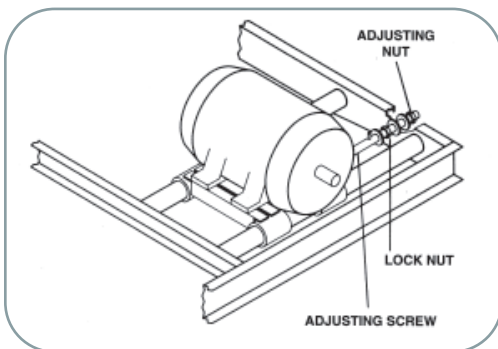


Figure 6 - Adjustable Motor Base

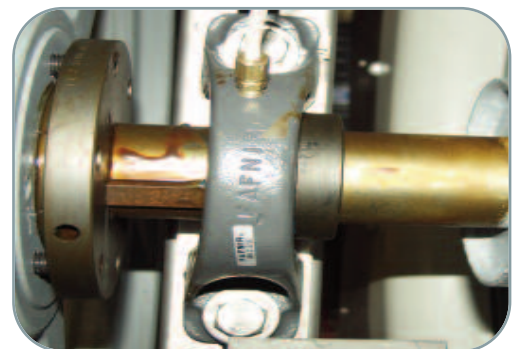


Figure 7 - Ball Bearing

Fan Shaft Bearings

The fan shafts are supported by ball bearings (see Figure 7). Each bearing is equipped with a lubrication fitting and locking collar.

Ball Bearings

Under normal operating conditions, the bearings should be greased every 2,000 operating hours or at least quarterly. The bearings should also be greased at seasonal start-up and shutdown. **Only lubricate the bearings with one of the following water resistant inhibited greases which are good for ambient**

temperatures ranging from -65°F (-53.9°C) to 250°F (121.1°C):

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™

Only lubricate the bearings with a hand grease gun. Do not use high pressure grease guns since they may rupture the

Temp Ambient	BAC P/N	Texaco	EXXON
70°F to 100°F 30°F to 70°F	582628PI	Regal R & O 320 Regal R & O 150	Teresstic 220 Teresstic 100
5°F to 30°F -25°F to 5°F	582627PI	Regal R & O 32 Capella 32	Teresstic 32

bearing seals. When lubricating, purge the old grease from

the bearing by gradually adding grease until a bead of new grease appears at the seal.

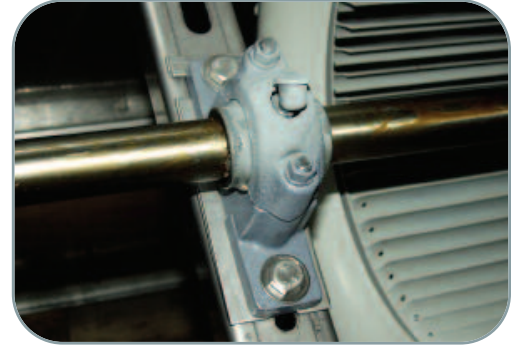


Figure 8 - Sleeve Bearing

Sleeve Bearings

Prior to start-up and during the first week of operation, the bearing oil cup (see Figure 8) must be refilled with an industrial-type mineral oil (see Table 3) to saturate the felt wick in the bearing reservoir. After the initial start-up, fill the bearing oil cup every 1,000 operating hours or at least every six months. When ambient temperatures below 0°F are expected, a light oil must be used. With such light oils, the bearing oil cup should be checked and refilled several times during the first several hours of operation until the bearings reach operating temperature.

Table 3: Sleeve Bearing Lubricants

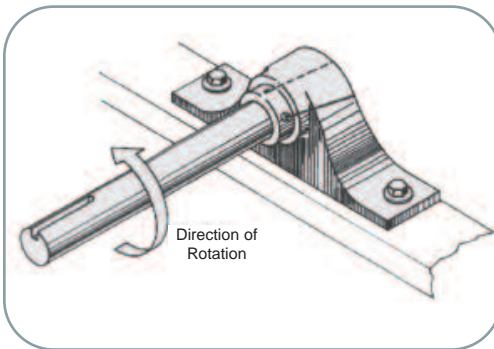


Figure 9 - Locking Collar Assembly

do not disturb bearing alignment by tightening bearing cap adjustment on a new unit as it is

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, the

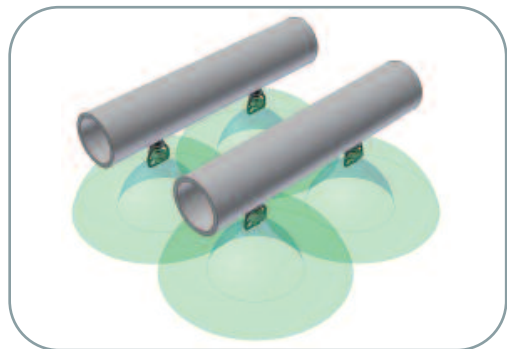


Figure 10 - Nozzle Spray Pattern

adjusted at the factory.

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 9):

- 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.



- Inspect the coil surface. Any corrosion, damage, or obstructions must be corrected.
- Some VF1, VFL, VC1, and VCL units are provided with an extended surface finned coil. During the winter season, when the ambient temperature is well below design, units can operate with the spray pump off. 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.

Water Level Control

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

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

The unit water make-up valve assembly is located within easy reach from the access door at the connection end of the unit.

Mechanical Make-up Valve Assembly

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 cold water basin operating water level can be adjusted by repositioning the float and all-thread rod using the wing nuts provided.

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.

Inspection and Maintenance:

- 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 surge protector (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 cold water basin is at the overflow connection.
- 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 2 on Page N75.
- 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 2. 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 spray pump during system start-up.

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.

Inspection and Maintenance:

- 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, by-pass the control unit in order to fill the unit to the overflow connection.

Recommended Spare Parts

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 Parts DepotSM and can ship other parts, often overnight, from any of our three manufacturing facilities strategically located in California, Delaware, and Illinois. 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 minimize 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)

Powerband or set of belts

Spray nozzle kit with grommets

Basin heater and low water cut out

Door gasket

Strainer (inlet and suction)

Fan and sheave bushings

Pump seal and gasket kit for coil products

Automatic bearing greaser refill kit



Parts to Consider if Extended Downtime is a Concern

Spray pump for coil products

Fan or fan wheel

Fan shaft

Sheave set

Fan motor