



**BALTIMORE
AIRCOIL AUSTRALIA**



VX Series

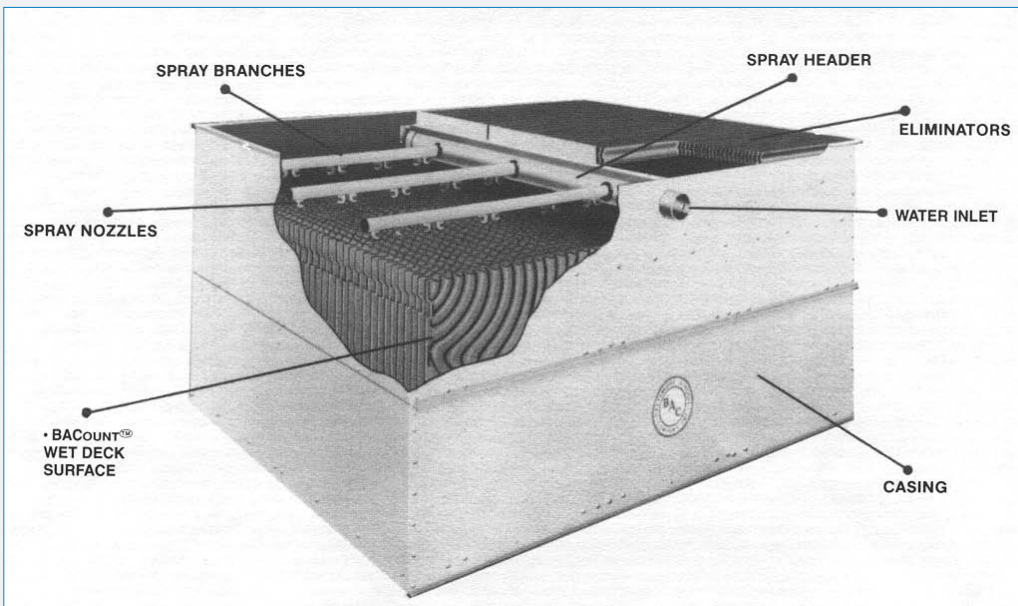
OPERATION & MAINTENANCE MANUAL



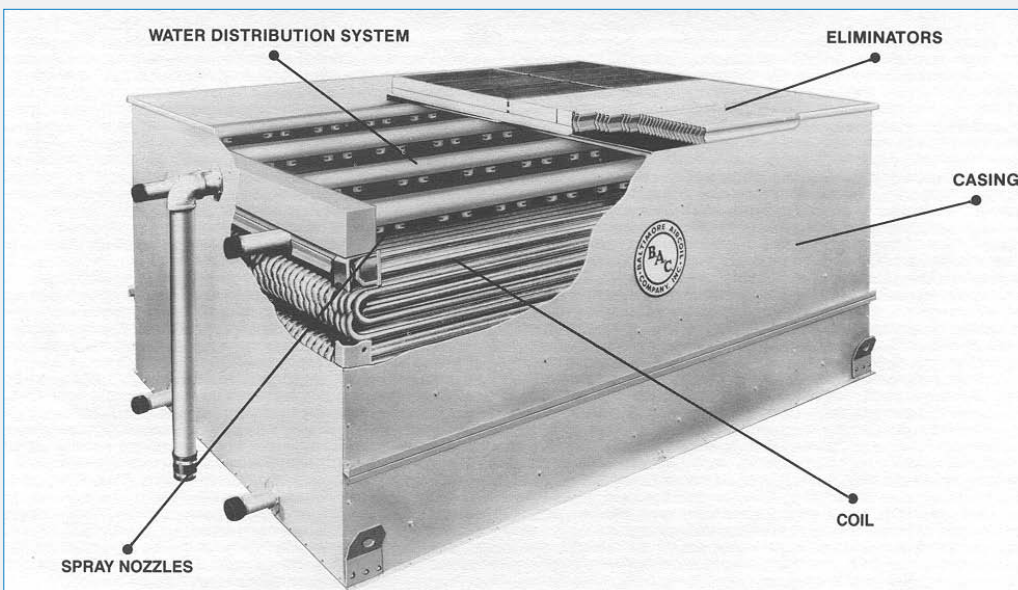
Construction Details

Heat Transfer Section -

VXT Cooling Towers

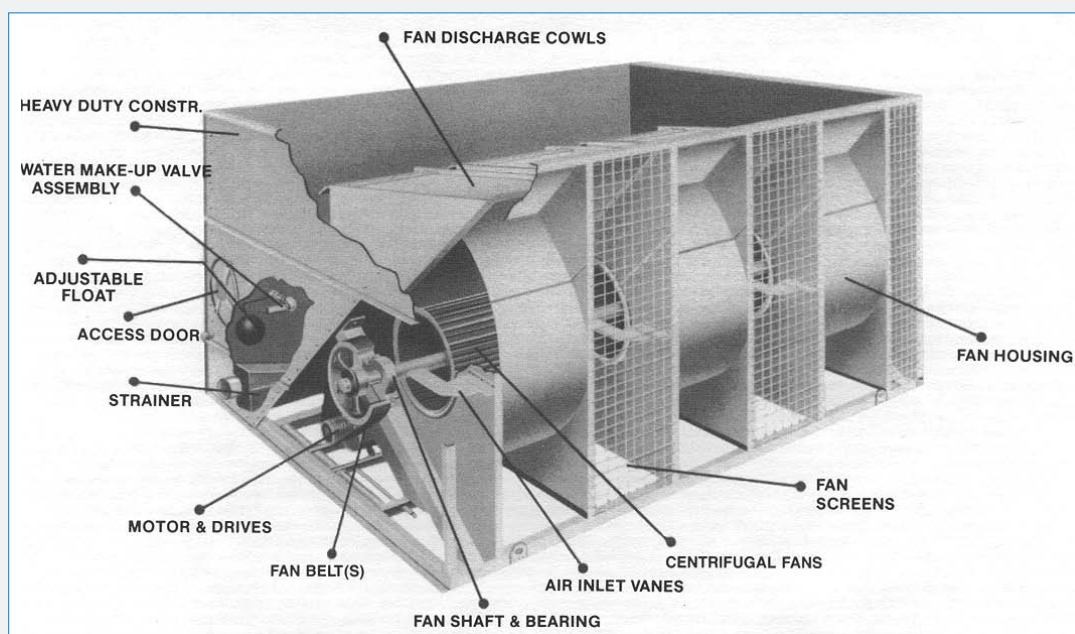


VXI-S Industrial Fluid Coolers VXC-S Evaporative Condensers



Pan Section -

VXT Cooling Towers VXI-S Industrial Fluid Coolers and VXC-S Evaporative Condensers



* VXI-S & VXC-S Only. VXT suction connection located where pump suction shown above.



Warnings

- **THIS EQUIPMENT HAS THE POTENTIAL TO BE A HIGH RISK HAZARD! DO NOT HANDLE, RIG, LIFT, INSTALL, ASSEMBLE, OPERATE, MAINTAIN OR ENTER THIS EQUIPMENT WITHOUT ASSESSING THE RISKS INVOLVED. CONTROL MEASURES MUST BE DEVELOPED TO ELIMINATE OR MINIMISE THE POTENTIAL RISKS.**
- **WARNING:** Only qualified personnel may operate, maintain, and repair this equipment. All such personnel must be thoroughly familiar with the equipment, the associated system and controls, and the procedures in this manual. Use proper care, procedures, and tools when handling, lifting, installing, operating, maintaining and repairing this equipment to prevent personal injury and/or property damage.
- **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:** For the protection of authorised service and maintenance personnel, install each fan and pump motor associated with this equipment with a lockable disconnect switch located within sight of the cooling tower.
- **WARNING:** Do no service work on or near the fans, motors, drives, or inside the unit without first disconnecting and locking out the fan and pump motor.
- **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 the local occupational safety and health authorities.

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:** 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.

Freeze Protection

These products must be protected against damage and/or reduced effectiveness due to possible freeze-up by mechanical and operational methods. Please refer to the product catalogue or contact the local BAC.

✓ Recommended Maintenance Service

Type Service	Start-Up	Monthly	Every 6 months	Shutdown	Annually
Inspect general condition of the unit	✓	✓			
Clean Debris from Unit	✓	✓		✓	
Clean and Flush Sump	✓	✓		✓	
Clean Sump Strainer	✓	✓		✓	
Check and adjust Sump Water Level	✓	✓			
Inspect Heat Transfer Section	✓	✓			
Inspect Spray Nozzles	✓	✓			
Check and Adjust Fan Belt Tension	✓	✓			
Check and Adjust Bleed Rate	✓	✓			
Check Operation of Make-Up Valve	✓	✓			
Check Unit for Unusual Noise or Vibration	✓	✓			
Check Fan Bearing Locking Collars	✓		✓		
Check Motor Voltage and Current	✓		✓		
Lubricate Fan Shaft Bearings	✓		✓	✓	
Lubricate Motor Base Adjusting Screw	✓		✓	✓	
Check Fan for Rotation Without Obstruction	✓				
Check Fan and Pump Motor for Proper Rotation	✓		✓		
Drain Sump and Piping	✓				
Inspect Protective Finish				✓	

Table 1. Recommended Maintenance Services for VX Equipment



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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VX SERIES

Operation and Maintenance

INITIAL AND SEASONAL START -UP

AFTER 24 HOURS

OPERATION

SEASONAL SHUTDOWN

Initial and Seasonal Start-Up



Before initial start-up or after a long shut-down period, the unit should be thoroughly inspected and cleaned:

1. Clean any debris from inlet air screens, fans, water basin.
2. Flush the cold water sump (with sump strainers in place) and drain to remove accumulated dirt.
3. Remove, clean, and replace sump strainers.
4. Turn the fan by hand to ensure rotation without obstruction.
5. Check and, if necessary, adjust the fanbelt tension.
6. Prior to seasonal start-up, lubricate the fan shaft and motor bearings. The ball bearings are factory lubricated, but should be relubricated if the unit has been sitting on site for more than a year before start-up.
7. Check float operated make-up valve to be sure it is operating freely.
8. Fill cold water sump with fresh water to the overflow level.
9. Set the float on the make-up valve to shut off the valve when the float is approximately 10mm below the overflow level.
10. On VXI-S Industrial Fluid Coolers and VXC-S Evaporative Condensers, start the pump and check for the proper rotation as indicated by the arrow on the pump cover. On installations where the unit pump was not furnished by the factory, a globe valve should be installed in the pump discharge line and the pump flow rate adjusted to the correct water flow. Do not run pump dry.
11. Inspect spray nozzles and heat transfer section.
12. Check the locking collar on each fan bearing assembly and tighten as required.
13. Start the fan and check for the proper rotation as indicated by the arrow on the fan housing.
14. Check the voltage and current of all three legs of the fan and pump motors. The current should not exceed the nameplate rating. After prolonged shutdowns, the motor insulation should be checked with a megger insulation tester prior to re-starting the motor.
15. Open the bleed line valve (must be furnished by others on cooling tower models VXT-N215 through VXT-4800) and adjust bleed to the recommended rate (See "Water Treatment").

Operation and Maintenance

Initial & Seasonal Start-Up



WARNING: Rapid on/off cycling can cause the fan motor to overheat. Controls should be set to allow a maximum of six on/off cycles per hour.

After 24 Hours

After 24 hours of operating under load, the following services should be performed.

1. Check the unit for any unusual noise or vibration.
2. Check the operating water level in the cold water sump. Adjust the make up float valve if necessary.
3. Readjust the belt tension.
4. Inspect spray nozzles and heat transfer section.



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.

Operation

During operation, the unit should be inspected, cleaned, and lubricated on a regular basis, as per the 'Recommended Maintenance Service Table' in this bulletin.

Seasonal Shutdown



The following services should be performed when the unit is to be shutdown for a prolonged period:

1. Drain the cold water sump and all piping that will be exposed to freezing temperatures.
2. Clean and flush the cold water sump with the sump strainers in place. Leave the drain open so rain and melting snow will drain from the unit.
3. Clean the sump strainers and re-install.
4. Lubricate the fan shaft and motor bearings, motor base and motor base adjusting screw.
5. Close shut-off valve in water make-up line and drain all exposed make-up piping.
6. Inspect the protective finish on the unit. Clean and refinish as required.
7. If operating VXI-S coolers in cold climates see section on cold weather operation and consult your B.A.C. representative about protection against coil freezing.

Operation and Maintenance

After 24 Hours

Operation

Seasonal Shutdown



VX SERIES

Maintenance Procedures

COLD WATER SUMP

MAKE-UP VALVE

FAN SHAFT BEARINGS

BALL BEARINGS

SPRAY NOZZLES AND HEAT TRANSFER SECTION

CORROSION PROTECTION

LOCKING COLLARS

ADJUSTABLE MOTOR BASE

FAN DRIVES

Cold Water Sump

BAC

The cold water sump should be inspected regularly. Any trash or debris which may have accumulated in the sump or on the strainers should be removed.

Each month, the entire cold water sump should be drained, cleaned, and flushed with fresh water to remove the silt and sediment which normally collects in the sump during operation. If not removed periodically, this sediment can become corrosive and cause deterioration of the protective finish. When flushing the sump, the strainers should be left in place to prevent the sediment from reentering the system. After the sump has been flushed, the strainers should be removed, cleaned, and replaced before refilling the sump with fresh water. The strainers can be removed by pulling the handle up and away from the outlet connection.

Maintenance Procedures

Cold Water Sump

Make-Up Valve



NOTE: Do not use acid to clean the strainers.

Make-Up Valve

A float operated water make-up (See Figure 1) is furnished as standard equipment on all units unless the unit has been ordered with an electric water level control or for remote sump application. The float controlling the valve is mounted on a threaded rod, held in place by wing nuts to facilitate adjustment of the operating water level.

To make the initial setting, adjust the wing nuts so that the make-up valve is completely closed when the water level in the cold water sump is 10mm below the overflow level. This will ensure that the tower sump contains enough water volume to prevent air entrainment in the circulating pump during system start-up. Under normal thermal load and with average city water pressure at the valve (15 to 50 psig), this setting should produce an operating water level as shown in Table 2 and Figure 1A.

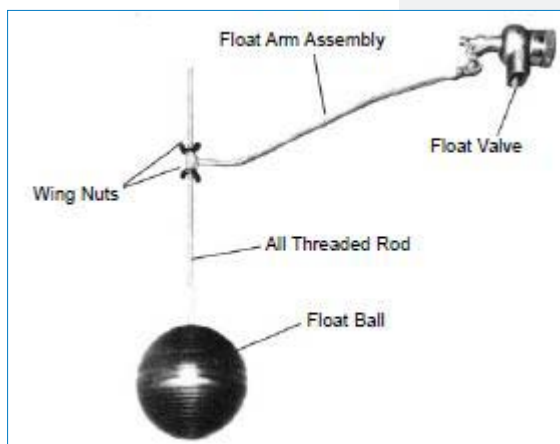


Figure 1 - Water Make-up Valve Assembly

Model Number	Operating Level (mm) measured from the pan (bottom)
VXT-10 TO 135	327mm
VXI-S9, 18, 27, 36	343MM
VXC-S14 to S135	343mm
VXT-150 to 185	394mm
VXI-S50	419mm
VXC-S150 to S205	419mm
VXT-N215 to N535	432mm
VXI-S70, 95, 145, 190, 290	432mm
VXC-S221 to 265 & VXC-S288 to 1010	432mm
VXT-315 to 4800	457mm
VXI-S180, 360	457mm
VXC-S357 to 1360	457mm
VXC-S495 to 1608	356mm
VXI-S144, 215, 288, 430	356mm

Table 2 - Operating Water Level

The water level in the cold water sump will vary as a function of the system load (evaporation rate), bleed rate, supply water pressure, and the quantity of water suspended in the tower during pump operation plus that contained in the water distribution system, external piping, and any heat exchangers which could drain to the tower sump when the circulating pump is shut down. Because the typical winter load is less than the summer load, the winter evaporation rate is frequently less than the summer evaporation rate. With this reduced evaporation rate in the winter, the water level in the cold water sump will increase unless the float is readjusted.

Due to these variables the operating water level should be checked monthly and the float adjusted as necessary to maintain the desired operating level. The valve itself should be inspected annually for leakage and the valve seat replaced if necessary.

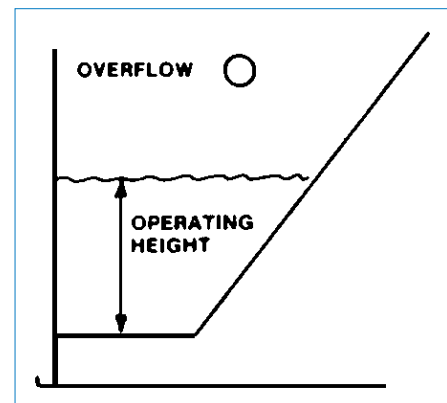


Figure 1a - Operating Water Level

Fan Shaft Bearings



The fan shaft is supported at each end by ball bearings (See Figure 2), each equipped with a lubrication fitting and locking collar. Models VXT-65 through 135, VXI-S27 and 36, and VXCS-72 through 135 also have intermediate ball bearing(s) located midway on the shaft.

Ball Bearings

Under normal operating conditions, the bearings should be greased every 2,000 operating hours or at least every six months. The bearings should also be greased at seasonal start-up and shutdown. Lubricate the bearings only with one of the following water resistant inhibited greases which are good for ambient temperatures ranging from -54°C to 120°C

- American - Rycon Premium #3
- Exxon - Beacon #325
- Shell - Aeroshell #17
- Mobil - Mobilgrease #28
- Chevron - SRI #3
- Keystone - 84 EP Light

The bearings should be lubricated only with a hand grease gun. Do not use high pressure grease guns since they may rupture the 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.

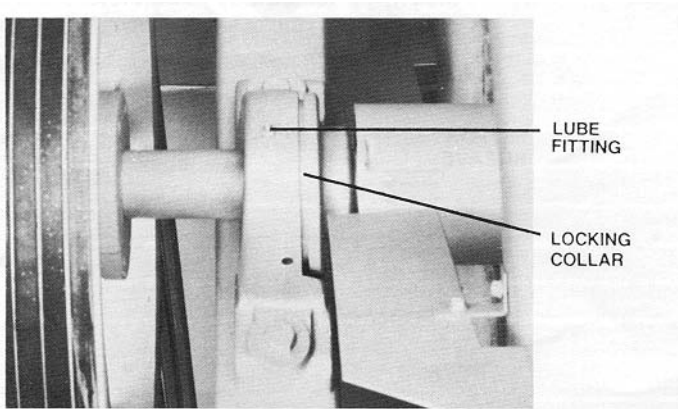


Figure 2 - Ball Bearing

Maintenance Procedures

Make-Up Valve (cont.)

Fan Shaft Bearings

Ball Bearings



WARNING: Do not use oils containing detergents for bearing lubrication. Detergent oils will remove graphite in the bearing sleeve and cause bearing failure. Also, do not disturb bearing alignment by tightening bearing cap adjustment on a new unit as they are torque adjusted at the factory.

Spray Nozzles And Heat Transfer Section

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

1. Shut off the fan, but leave the pump running.
2. Remove the eliminators.
3. Check to see if the nozzles are producing the spray pattern shown in Figure 8.
4. Clean any nozzles which are clogged. If necessary, the nozzle and rubber grommet may be removed for cleaning.
5. Inspect the coil or wet deck surface. Any corrosion, damage, or obstructions must be corrected.

NOTE: Do not use steam or high pressure water to clean cooling tower wet deck surface other than steel.

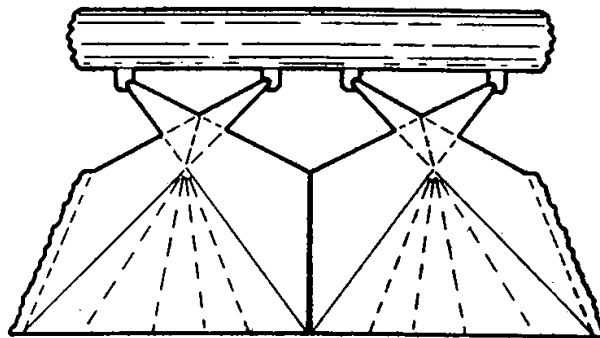


Figure 8. Nozzle Spray Distribution

Corrosion Protection



VX units are constructed entirely of corrosion resistant materials. The wet deck surface is made of an inert synthetic material which requires no protection against rot, decay, rust or biological attack.

Standard

The standard VX unit has steel components of heavy gauge galvanized steel. The exterior of the cooling tower is finished with an etch primer covered with a heavy duty fast drying enamel after fabrication. These units should be inspected annually.

Inspect the inside of the tower for blemishes or corrosion on the galvanized steel. Affected areas should be thoroughly wire brushed and recoated with ZRC (zinc-rich compound).

The outside of the tower can be touched up if necessary. ZRC is available from your local B.A.C. Representative.

Optional

As an option, the VX unit can have 304SST components substituted for galvanized steel everywhere. Various configurations of SST substitution are available.

Please consult your local B.A.C. representative for details.

Maintenance Procedures

Spray Nozzles and Heat Transfer Section

Corrosion Protection

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 9):

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

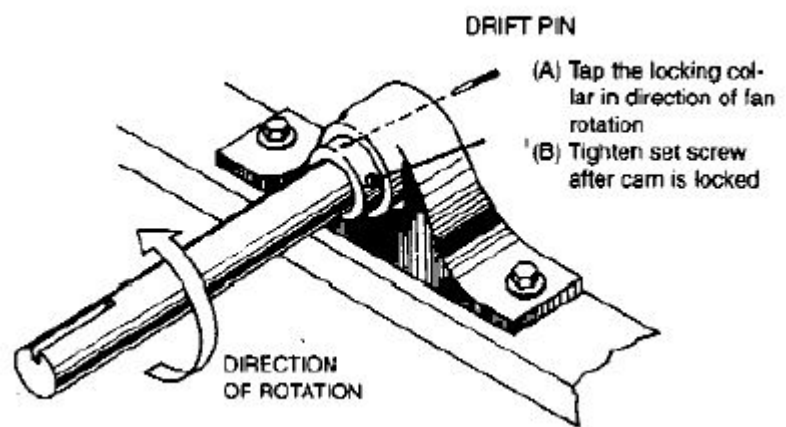


Figure 9. Locking Collar Assembly

Adjustable Motor Base

The motor base slides and adjusting screw (See Figure 10) should be coated twice a year using a good quality corrosion inhibiting grease, such as one of those recommended for lubricating the fan shaft bearings.

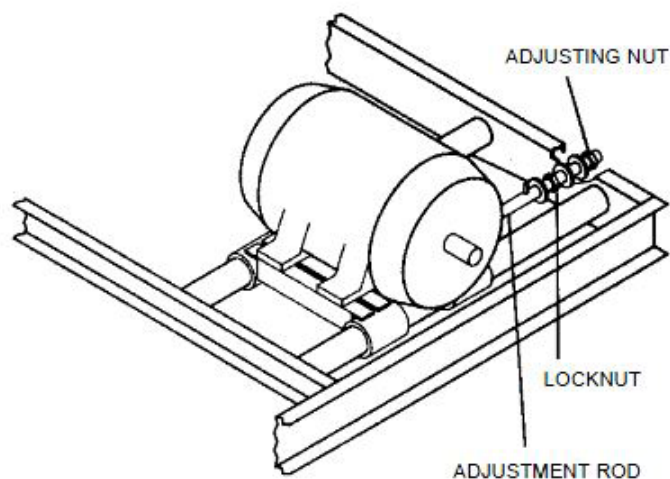


Figure 10. Adjustable Motor Base

Fan Drives



The fan belt should be checked and adjusted every month. To properly adjust the belt tension, position the fan motor so that a single belt will deflect 10mm when moderate pressure of one finger is applied midway between the sheaves (See Figure 12). The position of the fan motor can be changed by rotating the motor base adjusting screw which extends through the bottom frame angle.

The drive alignment should be checked annually to ensure maximum belt life. This can be done by placing a straightedge across both sheaves as shown in Figure 7.

When the drive is properly aligned, the straightedge will contact all four points as indicated. If realignment is necessary, loosen the motor sheave and align it with the fan sheave. Allow approximately 6mm for draw-up as the motor sheave is pulled tight on the bushing; then retighten the bushing screw.



Figure 11. Fan Belt Adjustment

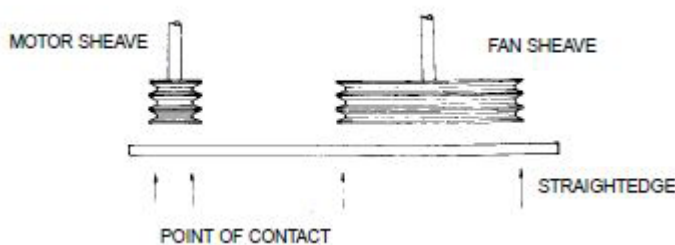


Figure 12. Checking Sheave Alignment

Detailed Component Maintenance Procedures

Locking Collars

Adjustable Motor Base

Fan Drives



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



VX SERIES

Water Treatment

BLEED OFF

BIOLOGICAL CONTROL



Water Treatment

Re-Circulated Water Quality Guidelines

In cooling towers, cooling is accomplished by evaporation of a portion of the process water as it flows through the tower. As this water evaporates, the impurities originally present remain in the recirculating water. The concentration of the dissolved solids increases rapidly and can reach unacceptable levels. In addition, airborne impurities are often introduced into the recirculating water, intensifying the problem. If these impurities and contaminants are not effectively controlled, they can cause scaling, corrosion, and sludge accumulations which reduce heat transfer efficiency and increase system operating costs.

The degree to which dissolved solids and other impurities build up in the recirculating water may be defined as the cycles of concentration. Specifically, cycles of concentration is the ratio of dissolved solids (for example: TDS, chlorides, sulfates) in the recirculating water to dissolved solids in the make-up water.

For optimal heat transfer efficiency and maximum equipment life, the cycles of concentration should be controlled such that the recirculating water is maintained within the guidelines listed below:

Re-Circulated Water Quality Guidelines

	Z600 Galv. Steel	SST or SST WTP
pH	7.0 to 9.0	6.5 to 8.5
Hardness as CaCO ₃	30 to 500 ppm	30 to 500 ppm max.
Alkalinity as CaCO ₃	500 ppm max.	500 ppm max.
Total Dissolved Solids	1000 ppm max.	1200 ppm max.
Chlorides	125 ppm max.	250 ppm max.
Sulfates	125 ppm max.	250 ppm max.

Bleed Off

In order to control the cycles of concentration such that the above guidelines are maintained, it will be necessary to “bleed” or “blowdown” a small amount of recirculating water from the system. This “bleed” water is replenished with fresh make-up water, thereby limiting the build-up of impurities.

Typically the bleed is accomplished 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 must be supplied by others.) Alternatively a bleed line with a valve can be used to continuously bleed from the system. (Note: the bleed line and valve must be supplied by others.) In this arrangement, the rate of bleed can be adjusted using the valve in the bleed line and measured by filling a container of known volume while noting the time period. The bleed rate and water quality should be periodically checked to ensure that adequate control of the water quality is being maintained.

The required continuous bleed rate may be calculated by the formula.

$$\text{Bleed rate} = \frac{\text{Evaporation rate}}{(\text{number of cycles of concentration} - 1)}$$

where the evaporation rate can be determined by one of the following:

1. The evaporation rate is approximately 1.5 litres/hour for each kW of operating Total Heat of Rejection (THR).

Example 1: VXC-S with operating THR of 4200kW

Evaporation Rate (l/hr) = 1.5 x 4200 = 6300 l/hr.

Example 2: VXT cools 10 l/s water by 10°C

THR = 4.2 x 10 l/s x 10°C = 420kW

Evaporation Rate (l/hr) = 1.5 x 420 = 630 l/hr.

2. VXT & VXI-S Only

The evaporation rate in litres/hour = 6.3 x range (°C) x water flow (l/s)

Example: A VXI-S cools 10 l/s water by 10°C

Evaporation rate (l/hr) = 6.3 x 10 x 10 = 630 l/hr.

Note: for VXI-S water flow is the flow through the coil

Biological Control

BAC

Bleed-off with or without chemical treatment for scale and corrosion control is not adequate for control of biological contamination. The growth of algae, slimes, and other micro-organisms, if unchecked, will reduce system efficiency and may contribute to the growth of potentially harmful micro-organisms, including Legionella, in the recirculating water system.

Accordingly, a biocide treatment program specifically designed to address biological control should be initiated when the system is first filled with water and administered on a regular basis thereafter in accordance with the supplier's instructions. Liquid biocides may be added to the basin of the cooling tower in dilute form. If a solid form of biocide is used, it should be added to the system via a pot feeder. If ozone water treatment is used, ozone concentrations should not exceed 3-4 ppm in order to ensure maximum system equipment life.

For specific recommendations on biological control, consult a competent water treatment supplier. All biological control treatments must be carried out so as the installation meets the requirements of AS-3666. Particular attention should be paid to;

1. Initial start up.
2. Shut down periods.
3. Start up after shut down periods.

Water Treatment

Bleed Off

Biological Control



NOTE: For specific recommendations on all treatment for scale, corrosion, and biological control, consult a competent water treatment supplier.



VX SERIES

Cold Weather Operation



VX equipment can be operated in subfreezing ambient conditions provided the proper measures are taken:

1. Protection against pan water freezing when the unit is idle.
2. Capacity control to prevent ice formation in heat transfer sections during operation.
3. Protection against coil freezing (VXI-S Industrial Fluid Coolers). Cold weather applications should be reviewed with the B.A.C. representative in your area to ensure that the unit selection, location, control, and accessories are adequate to ensure reliable operation.

Cold Weather Operation



NOTE: For more detailed information on winter operation and for recommended operating procedures on specific installations, contact your local BAC representative.



VX SERIES

Factory Authorised Parts



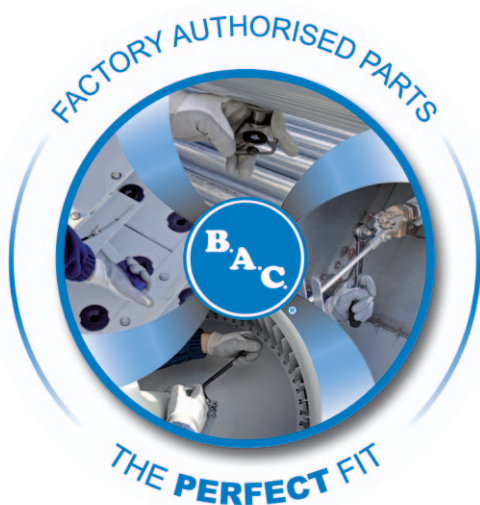
Factory Authorised Parts

Baltimore Aircoil maintains a stock of replacement parts at each of its manufacturing facilities.

Shipment of these parts is normally within four days after receipt of an order. In emergency situations, shipment can usually be made within twenty-four hours. To order factory authorized parts, contact your local Baltimore Aircoil representative. Be sure to include the unit serial number when ordering any parts.

To facilitate servicing the unit, it is suggested that the following parts be carried on hand:

- Make-Up Float Ball
- Valve Seat for Make-Up Valve
- Fan Shaft Bearings
- Fan Wheel
- Spray Nozzles and Grommets
- Spray Distribution Branch Grommet
- Access Door Gasket



COOLING TOWERS

CLOSED CIRCUIT COOLING TOWERS

ICE THERMAL STORAGE

EVAPORATIVE CONDENSERS

HYBRID PRODUCTS

PARTS & SERVICES



w w w . B a l t i m o r e A i r c o i l . c o m . a u

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