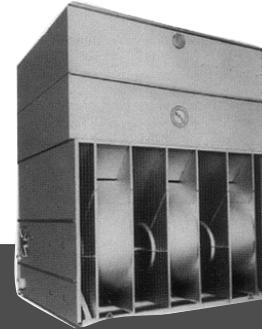




VXT Cooling Towers VXI-S Industrial Fluid Coolers VXC-S Evaporative Condensers



Operating and Maintenance Instructions

Baltimore Aircoil Company VX equipment has been designed to give long, trouble-free service when properly installed, operated and maintained. To obtain optimum performance and maximum service life, it is important that a program of regular inspection and maintenance be developed and carried out. This bulletin is published as a guide to establishing such a program.

Included in the bulletin are the recommended services for start-up, operation, and shutdown and the approximate frequency for each. Note that the recommendations on frequency of service are minimums and where operating conditions are severe, the services should be performed more often. For each required service, follow the procedures outlined under the "Maintenance Procedures" section of this bulletin. The VXT, VXI-S and VXC-S models are illustrated in a cutaway form on page 2 with the major points of inspection and service identified. A copy of the unit certified drawing should also be available for reference. If you do not have a copy of this drawing, or if you need additional information about operation or maintenance not covered in this bulletin, contact the local B.A.C. representative. The name and phone number are on a label at the connection end of the unit, or can be found in Yellow Pages.

Table of Contents

	<u>Page</u>
Construction Details.....	2
Operation and Maintenance Schedule.....	3
Operation and Maintenance.....	4
Initial and Seasonal Start-Up.....	4
After 24 Hours.....	4
Operation.....	4
Seasonal Shutdown.....	4
Cold Weather Operation.....	5
Maintenance Procedures.....	5
Cold Water Sump.....	5
Make-Up Valve.....	5
Fan Shaft Bearings.....	6
Locking Collars.....	6
Adjustable Motor Base.....	6
Fan Belt Adjustment.....	6
Fan Drives.....	7
Spray Nozzles and Heat Transfer Section.....	7
Corrosion Protection.....	7
Water Treatment.....	7
Corrosion and Scale Control.....	7
Re-circulated Water Quality Guidelines.....	8
Biological Control.....	8
Factory Authorised Parts.....	8



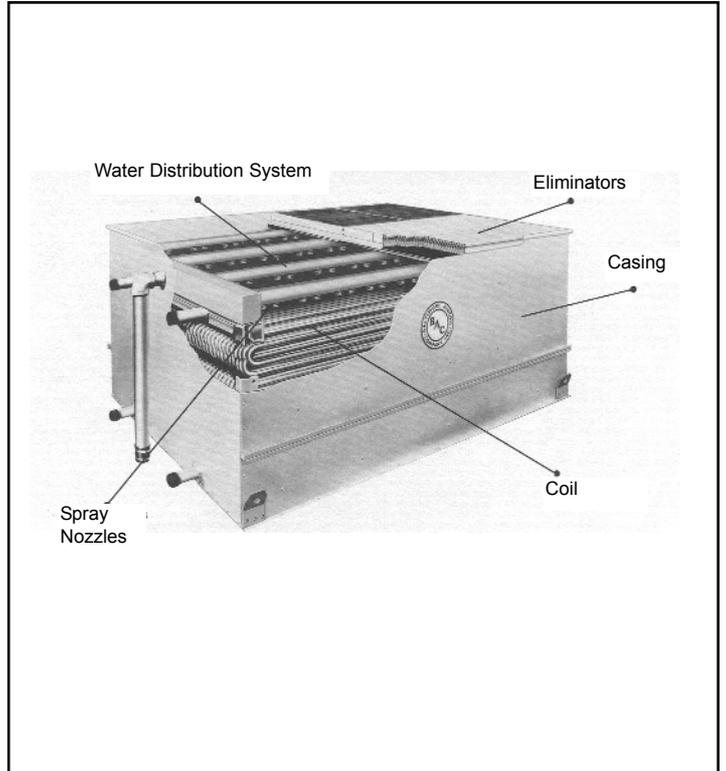
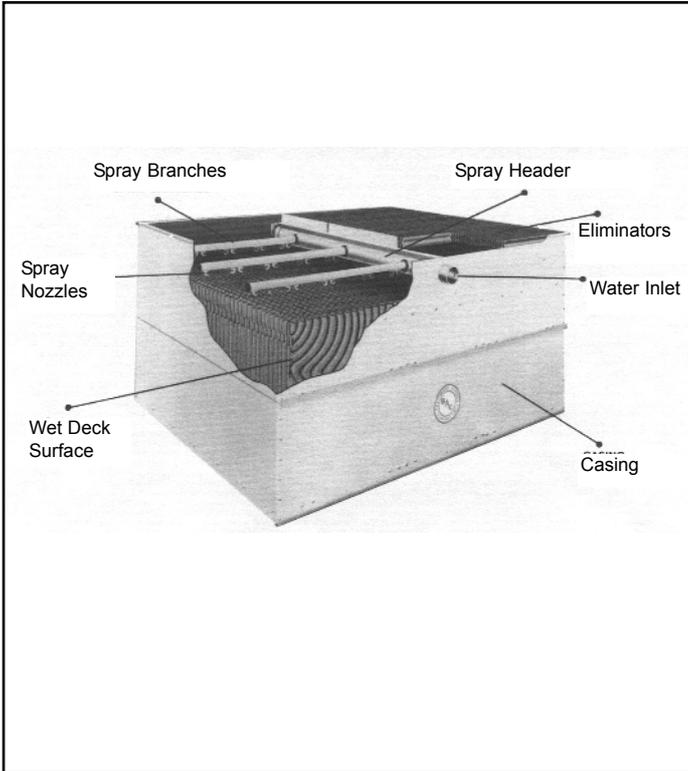
Baltimore Aircoil

Construction Details

HEAT TRANSFER SECTION

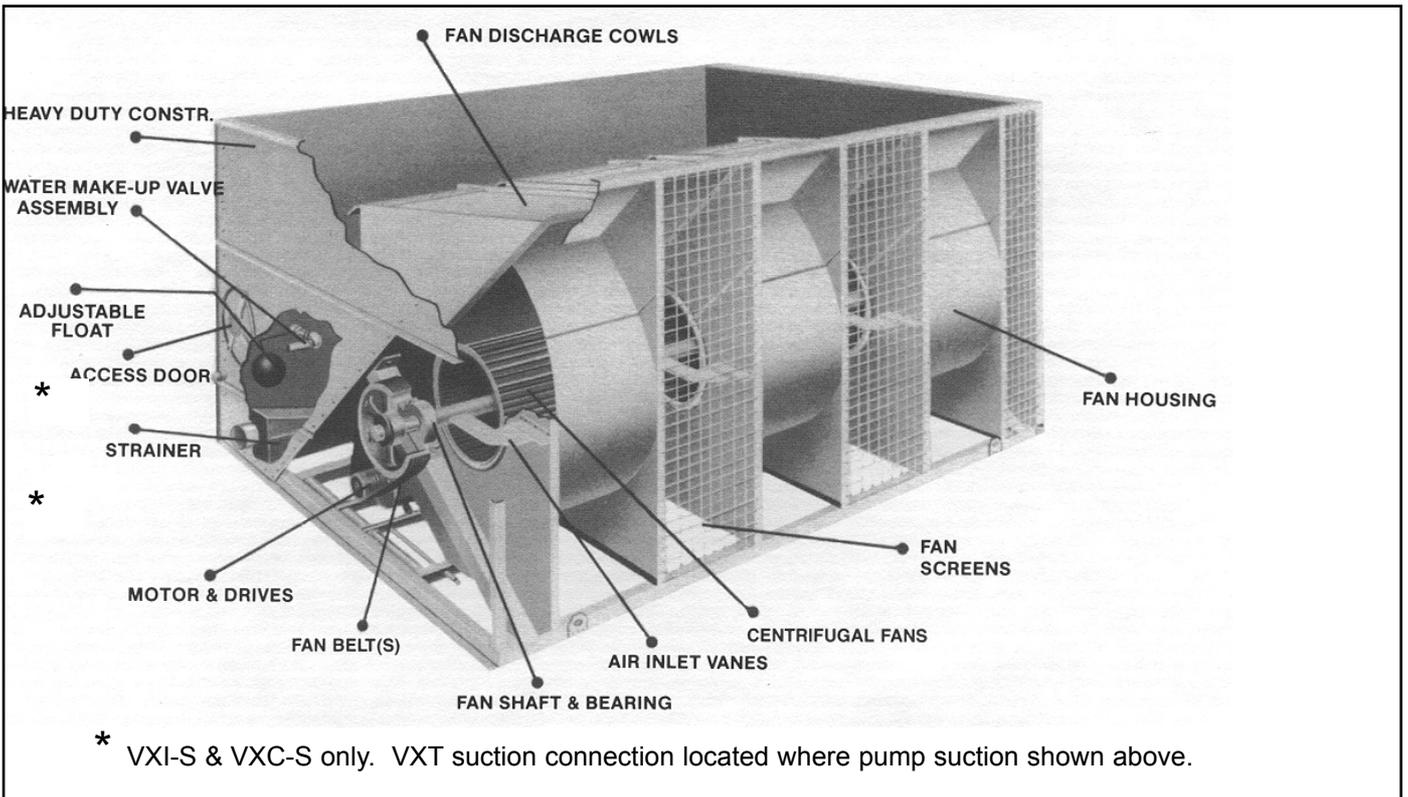
VXT COOLING TOWER

VXI-S INDUSTRIAL FLUID COOLERS
VXC-S EVAPORATIVE CONDENSERS



PAN SECTION

VXT COOLING TOWERS,
VXI-S INDUSTRIAL FLUID COOLERS &
VXC-S EVAPORATIVE CONDENSERS



Operation and Maintenance Schedule

TABLE 1. Recommended Maintenance Services for VX Equipment

TYPE SERVICE	Start-Up	Monthly	Every Six Months	Shutdown	Annually	Ref. Page
Inspect General Condition of Unit	X	X				4
Clean Debris from Unit	X	X		X		4
Clean and Flush Sump	X	X		X		4
Clean Sump Strainer	X	X		X		4
Check and Adjust Sump Water Level	X	X				5
Inspect Heat Transfer Section	X	X				7
Inspect Spray Nozzles	X	X				7
Check and Adjust Fan Belt Tension	X	X				6
Check and Adjust Bleed Rate	X	X				7
Check Operation of Make-Up Valve	X	X				5
Check Unit for Unusual Noise or Vibration	X	X				4
Check Fan Bearing Locking Collars	X		X			6
Check Motor Voltage and Current	X		X			4
Lubricate Fan Shaft Bearings	X		X	X		4
Lubricate Motor Base Adjusting Screw	X		X	X		6
Check Fan for Rotation Without Obstruction	X					4
Check Fan and Pump Motor for Proper Rotation	X		X			4
Drain Sump and Piping	X					4
Inspect Protective Finish				X		7

Before performing any maintenance or inspection, make certain that all power has been disconnected.

<p>Safety Adequate precautions should be taken to safeguard the equipment and the premises from damage and the public from possible injury as appropriate for the installation and location of these products. Air inlet bottom screens or solid bottom panels may be desirable or necessary for safety and other reasons depending on the location and conditions at the installation site.</p> <p>Notice Operation, maintenance and repair of this equipment should be undertaken only by personnel qualified to do so. Proper care, procedures and tools must be used in handling, lifting, installing, operating, maintaining and repairing this equipment to prevent personal injury and/or property damage.</p> <p>Warranties Please refer to the Limitation of Warranties applicable to and in effect at the time of the sale/purchase of these products.</p>	<p>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 Cold Weather Operation guidelines (page 4) or contact the local B.A.C. Representative for recommended protection alternatives.</p> <p>WARNING: The recirculating water system may contain chemicals or biological contaminants including Legionella, which could be harmful if inhaled or ingested. Accordingly, personnel who may be exposed directly to the discharge airstream and the associated drift mists generated during operations of the water distribution system and/or fans, or mists produced by high pressure water jets or compressed air should these be used to clean portions or components of the recirculating water system, should wear respiratory protection equipment approved for such use by local occupational safety and health authorities.</p>
---	---

Operation and Maintenance

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 1/2" 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").

AFTER 24 HOURS

After 24 hours of operation 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 if necessary.
3. Readjust the fan belt tension.
4. Inspect spray nozzles and heat transfer section.

OPERATION

During operation, the unit should be inspected, cleaned, and lubricated on a regular basis. The required services and recommended frequency for each are summarized in Table 1 on page 3 of 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.

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.

Maintenance Procedures

COLD WATER SUMP

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 re-entering 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.

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.

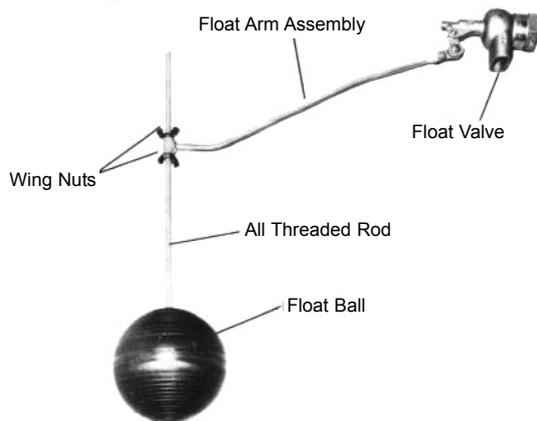


Figure 1 - Water Make-Up Valve Assembly

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 1/2" 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.

TABLE 2. OPERATING WATER LEVEL

MODEL NO.	OPERATING HEIGHT (Measured from 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

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.

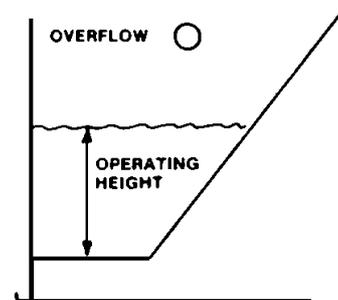


Figure 1A - Operating Water Level

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 -65°F to 250°F.

- 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.

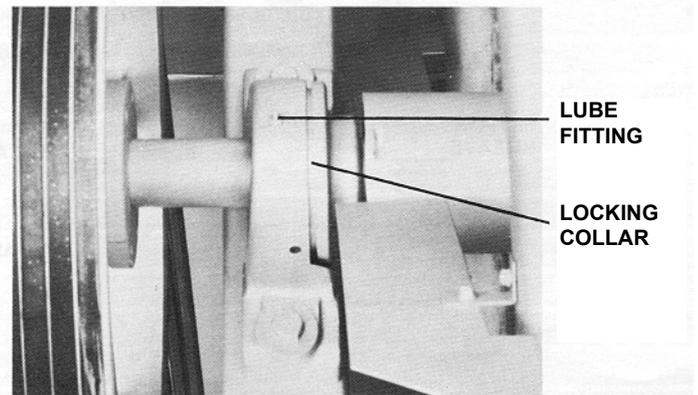


Figure 2 - Ball Bearing

Maintenance Procedures

BALL BEARINGS cont.

Caution: 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.

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 4).

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

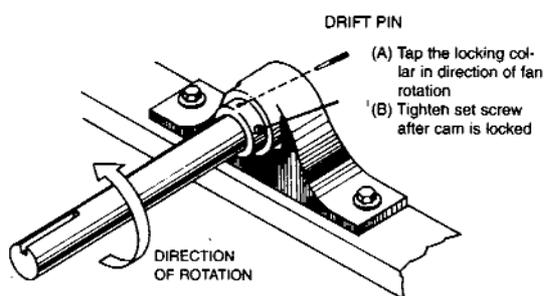


Figure 4 - Locking Collar Assembly

ADJUSTABLE MOTOR BASE

The motor base slides and adjusting screw (See Figure 5) 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 (See Page 5).

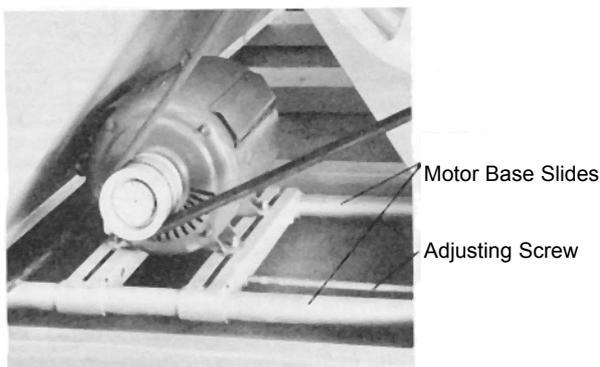


Figure 5 - Adjustable Motor Base

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 1/2" when moderate pressure of one finger is applied midway between the sheaves (See Figure 6). The position of the fan motor can be changed by rotating the motor base adjusting screw which extends through the bottom frame angle.

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

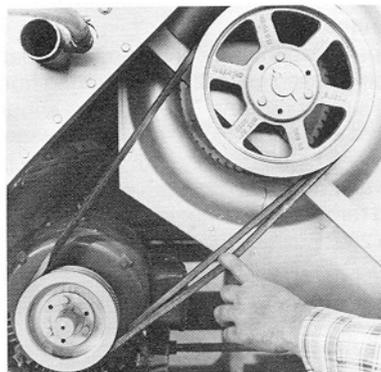


Figure 6 - Fan Belt Adjustment

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 1/4" for draw-up as the motor sheave is pulled tight on the bushing; then retighten the bushing screw.

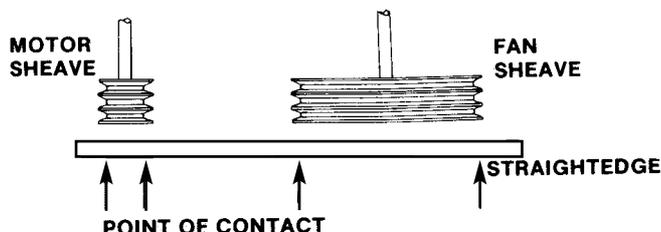


Figure 7 - Checking Sheave Alignment

Maintenance Procedures

Water Treatment

SPRAY NOZZLES AND HEAT TRANSFER SECTION

The spray nozzles and heat transfer section should be inspected 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.

CORROSION PROTECTION

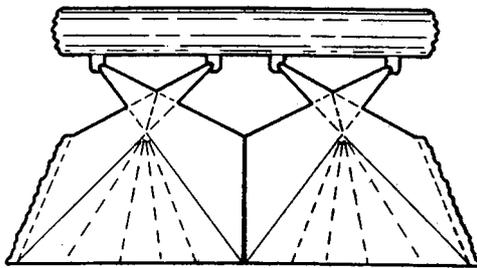


Figure 8 — Nozzle Spray Distribution

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 the Z600. Various configurations of SST substitution are available.

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

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:**

RECIRCULATED 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.

In order to control the cycles of concentration such that the above guidelines are maintained, it will be necessary to "bleed" or "blow-down" 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

Water Treatment

Factory Authorised Parts

RECIRCULATED WATER QUALITY GUIDELINES cont.

If the site conditions are such that constant bleed-off will not control scale or corrosion and maintain the water quality within the guidelines, chemical treatment may be necessary. If a chemical water treatment program is used, it must meet the following requirements:

1. The chemicals must be compatible with all materials used in the cooling tower as well as all other material used in the system (pipes, heat exchanger, etc.)
2. Chemicals to inhibit scale and corrosion should be added to the recirculating water by an automatic feed system on a continuously metered basis. This will prevent localised high concentrations of chemicals which may cause corrosion. It is recommended that the chemicals be fed into the system as the discharge of the recirculating pump. They should not be batch fed directly into the cold water basin.
3. Acid water treatment is not recommended.

BIOLOGICAL CONTROL

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.

FOR SPECIFIC RECOMMENDATIONS ON ALL TREATMENT FOR SCALE, CORROSION, AND BIOLOGICAL CONTROL, CONSULT A COMPETENT WATER TREATMENT SUPPLIER.



Worldwide Manufacturing and Sales Facilities in:

BALTIMORE AIRCOIL (AUSTRALIA) PTY. LTD., 120 Wisemans Ferry Road, Somersby NSW 2250

BALTIMORE AIRCOIL INTERNATIONAL N.V., Industriepark, B-2220 Heist-op-den-Berg, Belgium

BALTIMORE AIRCOIL LTD., Princeswood Road, Corby, Northants, NN17 4AP, U.K.

BALTIMORE AIRCOIL ITALIA S.R.L., 23030 Chiuro (Sondrio), Italy

BALTIMORE AIRCOIL IBERICA, S.A., 28036 Madrid, Spain

BAC COOLING TECHNOLOGY SDN. BHD. 20A, Jalan Perusahaan, 13600 Prai, Penang, Malaysia.

BALTIMORE AIRCOIL COMPANY, S.A. (PTY) LTD., PO BOX 88, Philippi 7881, Cape Province, Rep. of South Africa

BALTIMORE AIRCOIL COMPANY, PO Box 7322, Baltimore, Maryland 21227, U.S.A.

BALTIMORE AIRCOIL COMPANY, PO Box 960, Madera, California 93639, U.S.A.

BALTIMORE AIRCOIL COMPANY, MIDWEST DIVISION, PO Box 317, Paxton, Illinois 60957, U.S.A.

BAC JAPAN CO. LTD., 2-27-4 Shin-machi, Setagaya-ku, Tokyo 154, Japan.

DALIAN BINGSHAN BALTIMORE AIRCOIL REFRIGERATION COMPANY, No 4 Lian Shan St, Dalian, Liao Ning Province 116021, P.R. China

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 authorised parts, contact your local Baltimore Aircoil Company 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
- Fan Shaft
- Spray Nozzles and Grommets
- Spray Distribution Branch Grommet
- Access Door Gasket

