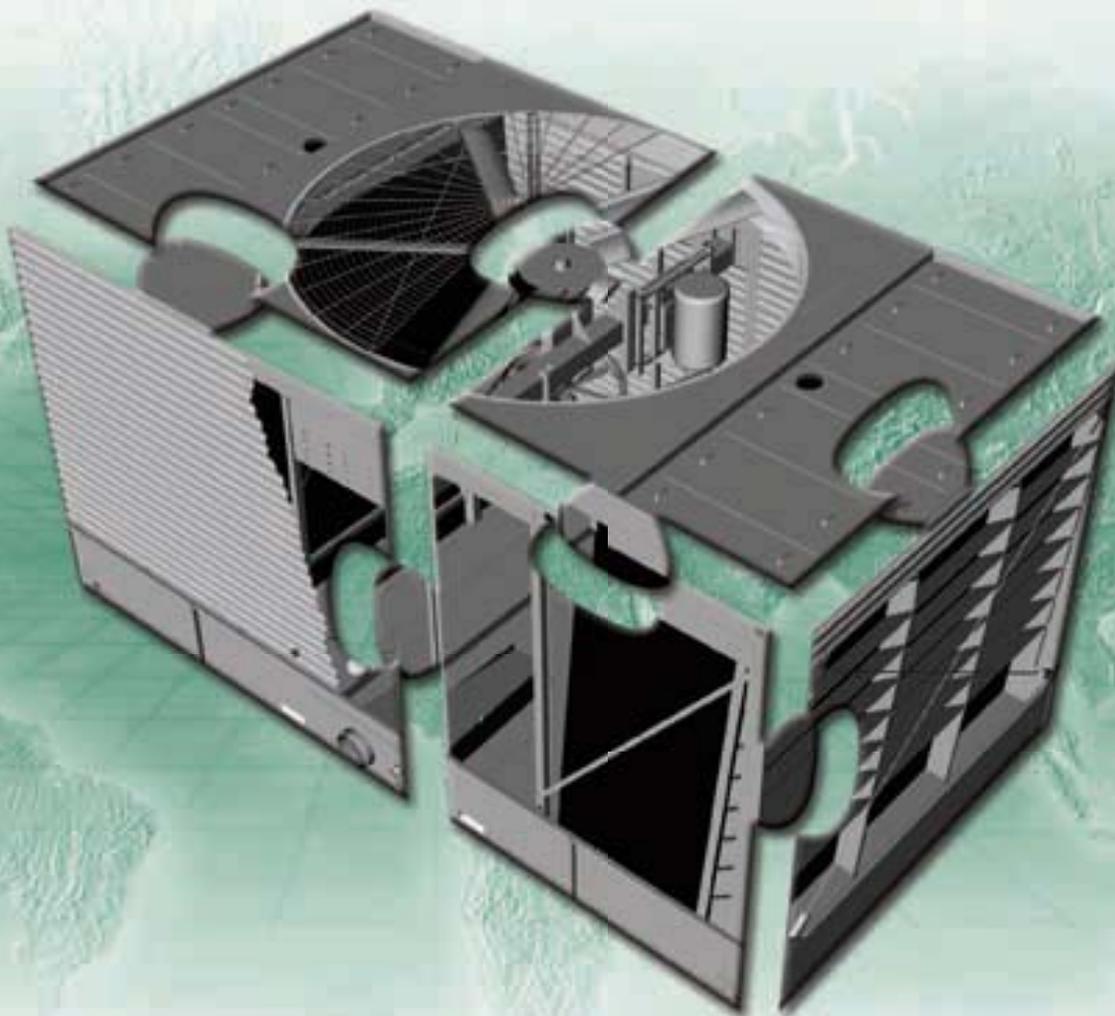


# BAC Parts & Maintenance Guide



Fans and Drives



Water Distribution



Controls



Retrofits



See Inside for...



Caution Tips



Tech Tips



Maintenance Tips



Reference Section

# Welcome

...to the BAC Parts & Maintenance Guide. We are excited about providing you with a vehicle that combines cooling tower "parts" and industry critical maintenance information. This guide reflects our commitment to facilitate maintenance needs for your evaporative cooling equipment.

BAC has a rich history in the design and development of the world's largest array of evaporative cooling and ice thermal storage products.

BAC hopes you find this publication to be a valuable resource.



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# Guide Resources

- **Complete Part Descriptions**

- **Large Product Photos**

- **Maintenance Tips**



- **Tech Tips**



- **Caution Tips**



- **Product Report**

- **Project Report**

- **Maintenance Reference Materials**



- **Pic-Dex**



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# What's New



**Automatic Bearing Greaser**  
See page 3

**Controls**  
See page 16



**new**



**BAC Cooling Tower Service Kit**  
See page 5

**BAC Product & Application Handbook Volume II**  
See page 47



# PLUS

## Reference Material

Recommended Spare Parts	Page 36
Troubleshooting Electronic Vibration Cutout Switches	Page 25
Fan Shaft Bearing Maintenance	Pages 26 - 27
Water Quality	Pages 30 - 31
Maintenance Checklist	Page 35
Maintaining Evaporative Cooling Equipment	Pages 38 - 46

# Table of Contents

## Fans and Drives

Pages 2 - 7

## Water Distribution

Pages 8 - 13

## Controls

Pages 14 - 16

## Project Reports

Pages 17

## Retrofits

Page 18 - 23

## Reference

Pages 25 - 46

## BAC Product and Application Handbook II

Page 47

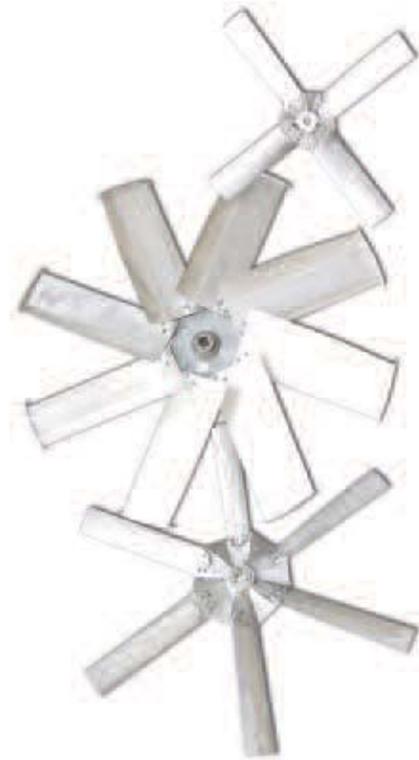
## Picture Index (Pic-Dex)

Page 48 - 49



## Axial Fans

- Rugged, aluminum construction for corrosion resistance and extended life
- Low-sound and Whisper Quiet fan options available for critical sound situations
- Factory-balanced for easy installation and vibration-free operation
- Maintain thermal performance as originally certified by the Cooling Technology Institute (CTI)
- Available in kits that include bushing and special length bolts (see page 21)



Available in sizes from 24" to 156" diameter, 4 blades to 12 blades for economical and quiet operation.

## Centrifugal Fans

- Available in multiple materials of construction to meet various operating conditions
- Designed, manufactured and rated by BAC for optimum performance
- Maintain thermal performance as originally certified by CTI
- Complete installation kit included



Available in 15", 18", 22", and 30" diameters for shafts 1-3/16" to 5" in diameter. Fits BAC and other manufacturers' products.



### BAC Caution Tip

Hub clamp bolts should be tightened gradually to a torque of 30 ft/lbs.  
Tighten bolts evenly around the clamp so that gaps are equal.



## Bearings



### Induced Draft

- Cooling Tower Duty pillow block castings for extended life
- Exclusive BAC slinger/locking collar keeps water off the bearing seals
- Complete installation kit includes all hardware, shims, and instructions

### Forced Draft (ball and sleeve)

- Rated for an average life of 200,000 operating hours
- Split-cartridge sleeve design bearings are available for easy replacement

Call Today  
To Order My  
Bearing Greaser  
800-896-8497



## Automatic Bearing Greaser

- BAC recommended grease, compatible with all BAC bearings
- Positive displacement pump allows installations up to 20 feet away from the bearing
- Variable output, user-settable based on bearing size and type of service
- Labor savings by eliminating monthly bearing maintenance



### BAC Maintenance Tip

If replacing only the top fan shaft bearing on vertical shafts, the locking collar on the bottom fan shaft bearing must be loosened and then retightened after the installation of the new top bearing.

**This is critical because, by design, the top bearing is intended to handle the thrust load.**

## Belts and Powerbands

- Cooling tower duty
- Rated for 150% of unit horsepower
- Neoprene, backed with reinforced polyester, specifically designed for long life under harsh operating conditions



## Fan Shafts

### Hollow Shafts

- BAC shafts are precision manufactured for vibration-free operation
- Epoxy-coated for corrosion resistance
- Journals are ground and polished for an accurate fit and easy bearing installation

### Solid Shafts

- Ground and polished for easy bearing and drive component installation
- Long keyways for multiple drive combinations
- Grooved flats for positive, secure set-screw installation



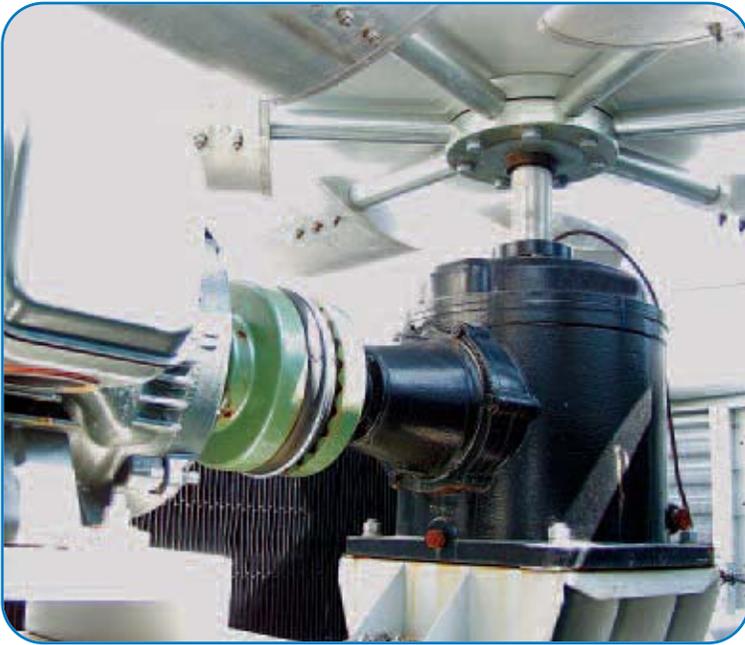
## BAC Maintenance Tip

When installing fan wheels on hollow shafts, remember to apply the adhesive, included in the fan kit, under the fan tabs to prevent the fan wheel from slipping on the shaft.



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## BAC Gear Systems



Horsepower ratings from 7-1/2 to 100 horsepower with mounting and shaft dimensions to fit virtually any make of cooling tower.

- Meet AGMA and CTI standards to ensure reliability
- Constructed of high-strength cast iron for low-sound, vibration-free operation
- Options include low-speed gear drives or a sealed unit with a 5-year service interval
- Gear drives are available for both BAC and other manufacturers' equipment (exact dimensional fit, no modification required)

A  
Great  
Value!

## BAC Cooling Tower Service Kit



This kit contains measuring instruments to cover a full range of service needs, including temperature, air flow, electrical parameters, and water quality measurements.

- Psychrometer
- Infrared Thermometer
- Conductivity Meter
- A/C Current Clamp
- pH Meter
- Heavy-Duty Waterproof Flashlight
- Handheld Digital Anemometer
- Megger® Brand Insulation Tester
- Tool Bag

*...because temperature matters™*



### Gear Couplings

- There is no need for maintenance or lubrication
- Installation is quick, easy, and no special tools are needed
- Couplings absorb misalignment caused by shock or vibration
- Not affected by dirt or moisture



### Composite Drive Shafts

- Shipped complete with composite shaft, 316 SST motor and gear end couplings and hardware
- Made from high-strength composite material that allows for higher misalignment tolerance
- Corrosion resistant
- Low weight, which reduces vibration and extends the life of the shaft



Register My  
Cooling Tower @  
[www.BaltimoreAircoil.com/bose24](http://www.BaltimoreAircoil.com/bose24)



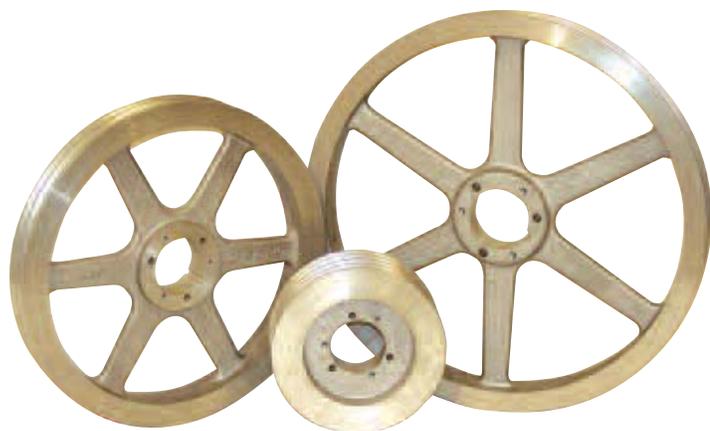
#### BAC Tech Tip

Prior to installing the couplings, it is important to clean the shaft of any lubricants or protective coatings, as well as removing any existing burrs that may damage the coupling.



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## Sheaves



Bushing styles for all standard drive components from 1" to 2-15/16" diameter. Cast iron sheaves for all drive combinations, 1 to 8 grooves.

### Cast Iron

- Factory-balanced for smooth operation
- Fine-grain, high-strength cast iron

### Aluminum

- Corrosion-resistant aluminum alloy for operation in the moist cooling tower environment
- Less corrosion means less wear on sheave grooves and extended belt life

## Cooling Tower Motors

### Hostile Duty

- Cast iron construction ensures vibration-free operation, superior cooling, and long life
- Permanently sealed bearings never require lubrication and eliminate water contamination of the bearing grease

### Hostile/Inverter Duty

- All premium efficiency BAC motors are rated for inverter duty (VFD) and are fully NEMA MG-1 Part 31 compliant
- Heavy-duty solids insulation to protect against voltage spikes



## BAC Caution Tip

When starting up a variable frequency drive (VFD), run the tower through the entire speed range to find and lock out any frequencies that cause unwanted vibrations.

Always select a premium efficiency motor for inverter duty use. All BAC premium efficiency motors are fully compliant with NEMA MG-1 Part 31 Inverter Duty Ratings.

## Spray Pumps

- Cast iron, bronze-fitted construction with mechanical seal, means pumps are industrial quality for a long, trouble-free life
- Impeller and trims have been selected for difficult high-flow, low-head requirements, assuring complete coil wetting to reduce scale and provide maximum thermal capacity
- Supplied with vented seal housing to prevent air binding and to provide a sump bleed connection



High efficiency, high flow/low head pumps 1/3 through 7-1/2 horsepower and 1-1/2" through 4" discharge.

## Pump Parts

- Mechanical seal is constructed with a carbon rotating element and a ceramic stationary element with stainless steel hardware for a long, leak-free life
- Replacement TEFC pump motors are designed for outdoor application
- Complete seal kits available



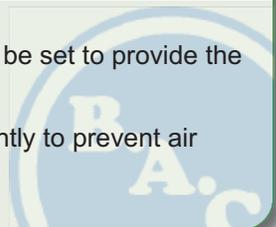
Order replacement parts



### BAC Tech Tip

The pump is supplied with a bleed line and valve connected to the seal vent. This valve can be set to provide the proper bleed rate to minimize impurities in the basin water.

Even if the basin bleed is accomplished by other methods, always leave the valve open slightly to prevent air binding in the pump.



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## Pump Selection - Common pumps

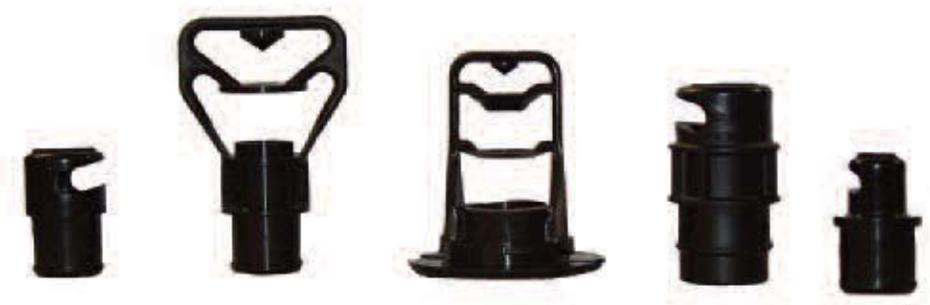
All part #'s are for 230/460 volt pumps  
 Contact your local BAC Representative for other voltages

Product Model	Unit Dimensions (ft)	HP	RPM	Pump #	Seal Kit #
Series V	3 x 3	1/3	3500	300214	300472
	3 x 6	1/2		300213	
	3 x 9	3/4		300212	
	3 x 12	1		300211	
	4 x 12	1 1/2		300210	
	6 x 12	2	1750	300517	300655
	8 x 12	3	1750	300520	300656
	8 x 18	5		300523	
	10 x 12	5		300901	300474
	10 x 18	5		300678	300656
	12 x 12	5		300526	300931
	12 x 18	7 1/2		300931	
VFL & VCL	4 x 3	1/2	3500	300586	300472
	4 x 6	3/4		300587	
	4 x 9	1		300588	
	4 x 12	1 1/2		300605	
	8 x 9	1 1/2	1750	300590	300655
	8 x 12	2	300591		
Single Air-Inlet FXV & CXV	8.5 x 6	1 1/2	1750	300605	300472
	8.5 x 9	2		300517	300655
	8.5 x 12	3		300916	300656
	12 x 12	5		300563	
	12 x 18	7 1/2		300931	
	12 x 24	(2) 5		300563	
Dual Air-Inlet FXV & CXV	12 x 24	(2) 5	1750	300563	300656
	12 x 24	(2) 7 1/2		300931	
	14 x 26	(2) 7 1/2		300931	

For pump motor shaft sleeve use part number 300388.

## Water Distribution Nozzles

- Patented design for pressurized or gravity-feed systems guarantees optimum thermal performance
- Large orifice means non-clogging performance for effective wetting of the heat-transfer surface
- Multiple sizes are available to accommodate all system flow rates
- Complete installation kits included



1/4" through 1-1/8" orifice for properly metered flow.

## Spray Branches

- Constructed of corrosion-resistant schedule 40 PVC
- Ship complete with nozzles selected and installed for the required system flow rate
- Grommeted construction allows spray branches to be easily removed



**Call My  
Local Rep  
For FREE  
Unit Inspection**



## Float Valves

- Rugged bronze body construction
- Rubber seal disc assures a positive shut-off to prevent water waste
- Reliable stainless steel linkage



3/4" to 2" valves for all applications.

**new**



All **NEW** PVC valves are available. These corrosion-resistant valves are strong, reliable, and cost effective.

## Float Balls

- Heavy-duty polypropylene construction resists cracking
- Foam-filled for structural rigidity and additional buoyancy
- Available in many sizes and configurations to assure positive shut-off



4-1/2" to 8" diameter and 10" pancake style for all applications.



### BAC Caution Tip

Many commercially available float balls are hollow, with no foam filling, and are not suitable for the rigors of evaporative cooling equipment. While operating, the inside of your equipment can resemble a hurricane, with high winds, and extreme temperature swings. Without the added structural rigidity from the foam filling, the float ball may easily crack, allowing the float to fill with water, which will cause the system to run improperly.



### BAC Tech Tip

Upon start-up, fill the tower to approximately 1/2" below the overflow level before starting the unit. This will provide enough water to fill the rest of the system without draining the tower on start-up. After the system is running, adjust the water level as shown in your Operation and Maintenance Manual. Monitor the operating level for the first 24 hours of operation to make sure it is set properly.

## Electric Water Level Control

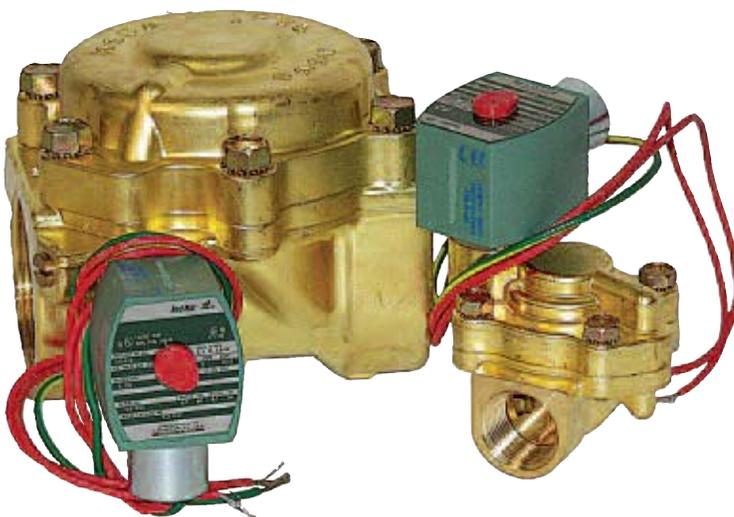
- Universal mounting system fits any tower
- Completely sealed and waterproof
- The control is located inside the unit so no heat tracing is required
- 6 second time delay prevents short-cycling
- Plastic sheath on probes and stilling chamber prevents false-cycling
- Requires solenoid valve for operation



3-probe through 7-probe models for on/off, low water cut-out, low water alarm, high water cut-out, and or high water alarm.

## Solenoid Valves

- Forged brass body for durability and high-pressure applications
- Watertight electrical enclosure for outdoor use
- Slow-closing feature minimizes water-hammer on shut-off



3/8" to 2" with 110 volt normally closed holding coil.



## Suction Strainers

- 3/16" strainer perforations help keep the system clean
- Strainer perforations are spaced to provide maximum strainer free area for low pump suction losses
- Anti-cavitation design prevents air from reaching the system pump



## Cooling Tower Vacuum

- Heavy-duty pump removes up to 50 gallons of water and debris per minute
- Industrial construction for long-life
- In-line sediment filter screens out large debris
- Safe to use while cooling tower is in operation



### BAC Tech Tip

The cooling tower vacuum not only helps control costly chemical and water waste, but also eliminates deposits in the cold water basin that could promote corrosion.

## Basin Heaters

- UL and CSA rated
- Durable copper heating elements for long-life
- 2" MPT connection is easy to retrofit into any cooling tower

BAC stocks a complete line of immersion heaters to prevent cold water basin freeze-up during winter weather. These heaters are selected for cooling tower duty and are constructed with copper heating elements rated at 50 watt/in<sup>2</sup> with a 2" MPT brass connection and conduit box rated NEMA 4/7. Heaters are suitable for use in all makes of cooling towers.



2 – 21 kW ratings, 50 watts/in<sup>2</sup> watt density  
200, 230, 460, and 575 volts.

## Basin Heater Controls

- UL and CSA rated
- BAC thermostats and low water cutouts are designed to ensure long-life and proper operation
- Individual components or complete kits available



## Damper Controls



- Modulate airflow to save energy and maintain close capacity control
- Pre-engineered system is easy to retrofit into any centrifugal fan unit
- End switch kits ensure proper operation on multiple shaft units

A modulating capacity control damper system is available for all BAC centrifugal fan evaporative cooling equipment. They are used when close control of the leaving fluid temperature is required and/or the unit will operate under varying loads. Automatic control of the dampers can be achieved by installation of a BAC electric damper control package.

**The damper control package consists of:**

- 1) Damper actuator(s)
- 2) Damper actuator end switch kits
- 3) Temperature controller
- 4) Voltage transformer

## Vibration Cutout Switches

- Protect your unit from damage resulting from excessive vibration
- Mechanical or electronic operation with multiple options for alarms and reset
- Electronic switches are compatible with building management systems



## BAC Equipment Controls: A Single-Source Solution



*Save operating costs and energy with BAC Equipment Controls! All equipment controls are custom-engineered to operate your new or existing evaporative cooling equipment.*

BAC offers the following for all units:

- Enclosed Controls
- Variable Frequency Drives (VFD)
- Safety Disconnect Switches
- Universal Mounting Brackets

Benefits of Equipment Controls:

- Water and Energy Savings
- NEMA-Rated Enclosures for Indoor/Outdoor Applications
- Industrial Grade Components
- UL Listed and CSA/CUL certified
- Single-Source Solution
- Easy Installation



Contact your local BAC Representative to upgrade your BAC, Marley, or Evapco unit with BAC Equipment Controls!

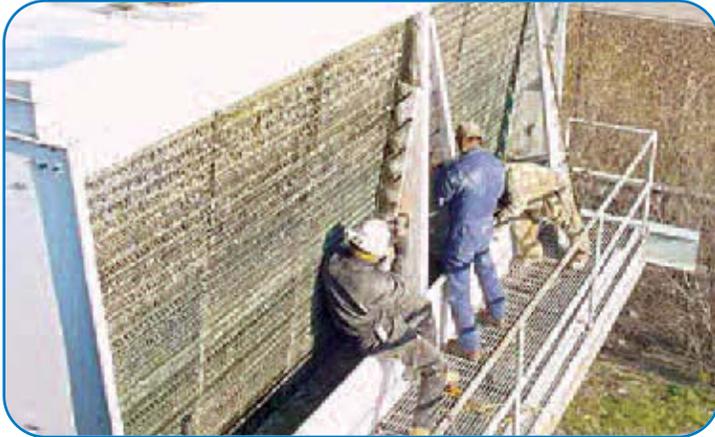


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# Project Report

## VersaCross™ Replacement Fill 3 Towers in 36 Hours!



Before: Day 1, 8:50 AM



After: Day 2, 11:30 AM

Recently, a large plastic bottle manufacturing plant located in Dallas, Texas was scheduled for plant shutdown. During this shutdown, three Series 3000 cooling towers were to undergo major overhauls which would include repairing and coating the cold water basins and replacing the fill.

### Here's the hitch:

Due to production considerations, all work had to be completed in 36 hours! The next scheduled shutdown would not occur for another year, so the job had to be done right the first time!

After discussing the options of glued bundles, the original fill, and a VersaCross™ Replacement Fill Kit with the local BAC Representative, the owner chose VersaCross™ fill based on the following reasons:

- Shipment in 2 weeks or less - compared to 4 to 6 weeks
- Complete pre-engineered kit with all supports, hardware, and instructions
- BAC promise of increased thermal performance
- Quicker installation time and low total cost of materials & labor

The contractor was prepared to work around the clock with a crew size of 3-4 men per cell. But, by dinner time the first day, the existing fill had been removed, the towers were cleaned, inspected, and corrosion issues were addressed, and the new VersaCross™ fill supports were already installed. The only thing left to do was install the fill. In fact, the job was so far ahead of schedule, the crews were sent home for a good night's rest!

Work resumed the following morning at 7:00 AM. The fill was quickly installed and the towers were in operable condition by noon! The owner was back in production as scheduled and the contractor had generated great savings against his projected budget.

Another successful VersaCross™ Replacement Fill Kit installation!



### BACross<sup>®</sup> Crossflow Fill Kits

For FXT, Series 1500 and Series 3000  
BAC Cooling Towers

- Maintains thermal performance as originally certified by CTI
- Maintains FM insurance approval
- Available for both normal and high temperature applications



### VersaCross<sup>™</sup> Replacement Fill Kits

- Outstanding thermal performance, will meet or exceed the performance of any OEM fill
- Fits both BAC and Marley towers
- Unique method for quick and easy field installation, saves labor
- Nested shipment requires smallest fill staging area and low shipping costs
- Model-specific kits contain everything needed for an efficient installation, including detailed instructions, supports, hardware, and fill
- 2-week standard lead time
- DVD installation video included



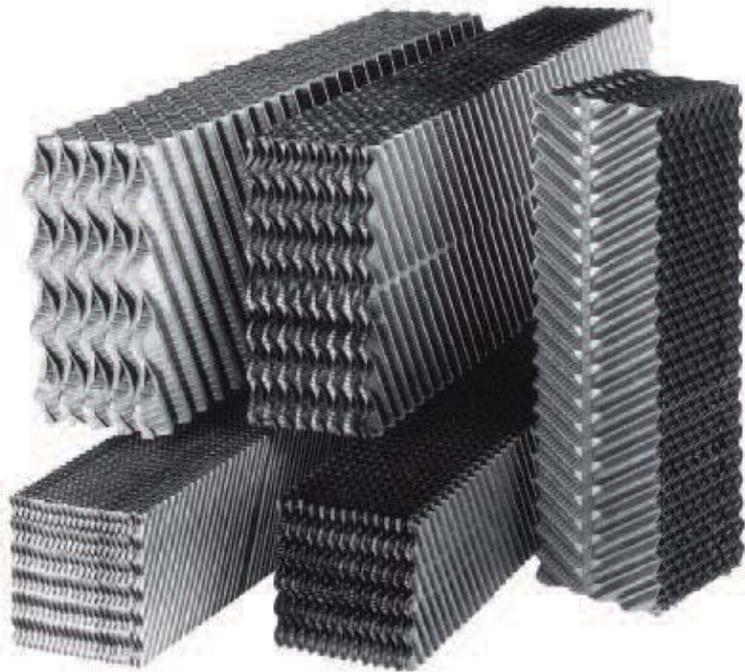
**BIG  
\$\$\$\$  
Saver**



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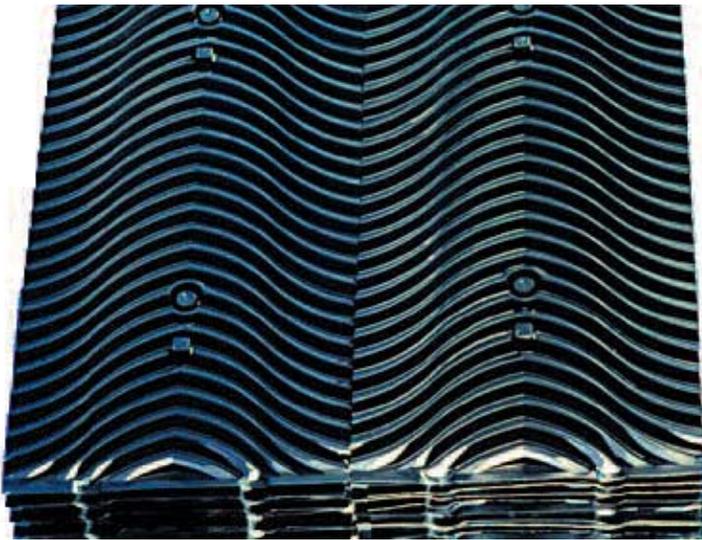
## VersaPak™ Replacement Fill Kits

- Pre-engineered kits to fit any cooling tower
- Easy to install; all hardware and supports included
- Available for both normal and high temperature applications



## BACount® Counterflow Fill Kits

- Maintains the thermal performance as originally certified by CTI
- Maintains FM insurance approvals
- Single-source responsibility, providing quality materials and a guaranteed fit
- Available for both normal and high temperature applications



### BAC Maintenance Tip

Maintain or increase thermal capacity in all BAC counterflow cooling towers with BACount® Fill Kits. They offer the same efficient heat transfer surface as currently supplied in new BAC towers, in an easy-to-install bundled configuration.

# Add Redundancy & Capacity Control

- ENERGY-MISER® Fan System maximizes up-time
- Saves energy
- Utilizes standard, “off the shelf” motors for easy replacement: no two-speed or special motors required
- Utilizes the control and switch-gear of a two-speed, two-winding motor while providing the safety and economy of a redundant motor.
- BALTIGUARD PLUS™ Fan System builds on the above advantages of the ENERGY-MISER® Fan System by adding a variable frequency drive to either the main or pony motor.
- This system maximizes energy savings while providing a redundant motor.

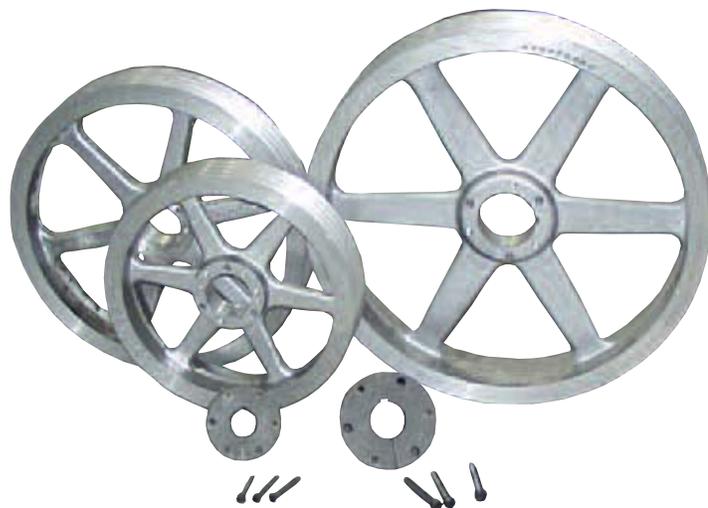


# Service Platforms and Catwalks

- OSHA-compliant
- Simplify maintenance
- Available in complete engineered kits for internal and external applications



## Aluminum Sheave & Bushing Kits



- Complete with bushing and special bushing bolts
- Require special torque requirements and installation techniques
- Corrosion resistant aluminum allows for operation in the moist cooling tower environment
- Available exclusively from BAC

Register for  
My FREE  
Handbook  
see pg 47



## Aluminum Fan & Bushing Kits

- Complete with bushing and special bushing bolts
- Require special torque requirements and installation techniques
- Corrosion resistant aluminum allows for operation in the moist cooling tower environment
- Available exclusively from BAC
- See page 29 for fan and bushing kit installation instructions



### BAC Tech Tip

Proper installation of aluminum sheaves also requires the bolts to be tightened to the specific torque values as shown in the chart on page 28. This chart also indicates the proper bushing type for each sheave.

# Large Orifice Spray Distribution Retrofits

- Optimized fill or coil wetting prevents dirt and scale build-up
- Grommetted installation makes it easy to remove, clean and replace
- Non-clogging, large-orifice nozzles
- Available in pre-engineered kits for your equipment



## BAC Tech Tip

Proper spray water distribution is important for the long-term efficiency of your cooling tower. A fully wetted coil or fill surface will resist scaling and dirt build-up while maintaining peak thermal efficiencies.

# Low Sound Alternatives

- Fully factory-tested and rated
- Low sound fan options
- Intake and discharge sound attenuation



## BAC Tech Tip

Many replacement towers utilize axial fans instead of the original equipment centrifugal fans. Axial fans produce higher sound levels than centrifugal fans. Contact your local BAC Representative for sound ratings and sound solutions if noise becomes an issue. Consult the BAC website for more information on sound.



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## Drift Eliminators

- Engineered for maximum performance and corrosion resistance
- Available in PVC or steel construction
- Complete kits available



## Coil Construction

- Industrial grade construction, ASME B31.5 compliant
- Materials of construction provide compatibility with virtually any refrigeration, air conditioning, or process fluid system
- Construction options include:
  - ASME "U" construction for special applications
  - Extended surface finned coils for plume reduction and water savings
  - Cleanable tubes or cleanable headers for dirty fluid applications



## Parts for Other Manufacturers' Towers

- Gears for Marley cooling towers
- Full range of drive components
- Fill and eliminators
- Electric water level and make-up controls
- Motors
- Vibration cutout switches



## Evaporator Parts

- Parts available for BAC Aircoil™ Evaporators, and other manufacturers' evaporators
- Motors designed for "Arctic Duty" with special low temperature grease-filled bearings
- Aluminum paddle fans and cast aluminum fans range from 22" to 44" diameter
- Fan motors available for quick delivery



### BAC Tech Tip

Don't accept a standard "off-the-shelf" motor. Make sure that evaporator motors are filled with "Arctic Duty" grease and are rated for low temperature (-40°) applications.



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# Basic Operation and Troubleshooting of BAC Electronic Vibration Cutout Switches (VCOS)

## A. Checking the Installation

The electronic VCOS used by BAC, is rated for 5 amps continuous-duty and for an in-rush current of 25 amps for 1 sec or 50 amps for 16 msec. This is ideal when wiring the switch to a motor starter system, since the bigger the motor, the higher the current draw on the starter.

A computerized Building Management System (BMS) works on a very low current draw. Therefore, some additional measures must be taken when wiring the VCOS to a BMS. For the VCOS to turn on and stay on, it needs to be connected to a load that draws a minimum of 50mA. Without this current draw, the switch may not stay closed or “pulled in”. In this case, a 2000 ohm, 10 watt resistor can be wired in parallel with the BMS input. An interposing relay (SPDT, class C) can also be installed to draw 50mA.

## B. Reset and Lockout Circuits

BAC supplies the switch prewired with 7 feet of 20 gauge, UV resistant shielded cable. When this cable is removed and other wiring is supplied to the switch by the customer, make sure that the reset and lockout terminals (terminals 5, 6, and 7) are shielded from the rest of the wires.

The switch comes from the factory with terminals 5 and 6 connected together with a wire nut, which enables the local reset circuit. This means that when the switch trips, the pushbutton on the side of the switch must be used to reset it. If this wire nut is removed, and nothing is connected to terminals 5 and 6, the switch is not latched. This means that when the switch trips due to excessive vibration, the switch will automatically reset itself once the vibration level drops. This will cause the fans to restart automatically. *When a remote reset is desired, terminals 5 and 6 are wired to a pushbutton at the desired remote location.*

## C. Mounting

The vibration switch must be mounted rigidly to the unit, ensuring that the mounting brackets are stiffened to avoid any resonant builds that could cause nuisance trips.

## D. Testing Basic Operation

The switch can be bench-tested or tested after it is mounted on the unit. For safety reasons, the cooling system must be off. The time delay is adjustable from 1 to 15 seconds and is factory set to approximately 3 seconds.

1. Connect 110 or 220 volts to terminals 1 and 2 as per the appropriate wiring diagram.
2. Jumper terminals 1 and 3 together.
3. Connect a 25 watt light bulb to terminals 2 and 4.
4. With the slide switch in the N/C position, the light bulb should turn on. Set slide switch to the N/O position. The light bulb should turn off. Return the slide switch to the N/C position.
5. Turn the set point control knob counterclockwise to the test position. The LED above the knob should turn on immediately. After approximately 3 seconds, the triac changes state and the light bulb should turn off.
6. Return the set point control knob to the normal setting (0.45 in/sec).
7. Reset the switch if it is not wired to automatically reset.
8. To increase or decrease the time delay, turn the adjustment screw that is located directly below the set point control knob. One full turn equals approximately 1/2 second.

**Contact your local BAC Representative for more information.**



## Fan Shaft Bearing Maintenance

### Ball Bearings:

#### Seasonal shutdown and start-up:

When shutting your unit down for an extended period and before starting up after an extended shutdown, always purge the fan shaft bearings with new grease.

#### Lubrication Schedule:

Induced draft products – Lubricate the bearings at least every 3 months

Forced draft products – Lubricate the bearings every 2000 hours of operation or every 6 months, whichever occurs first.

#### Greasing:

Bearings should only be lubricated with a hand grease gun, or the automatic bearing greaser. When lubricating, purge the old grease from the bearing by gradually adding grease until a bead of new grease appears at the bearing seal.

#### Type of Grease:

Only use one of the following greases, as they are compatible with the grease installed at the factory:

Amoco - Rycon Premium #3	Mobil - Mobilgrease® AW2
Chevron - SRI	Shell - Alvania RL3™
Citgo - Polyurea MP2™	Shell - Alvania #3
Conoco - Polyurea 2™	Shell - Dolium "R"
Exxon - Polyurex® EM	SKF - LGHP2™
Exxon - Unirex N™	Unocal 76 - Unilife Grease™



### Sleeve Bearings:

#### Start-up:

Prior to start-up and during the first week of operation, the bearing oil cup must be refilled with an industrial-type mineral oil to saturate the wick in the bearing reservoir. After the initial start-up, fill the bearing oil cup every 1000 operating hours or every 6 months.

#### Type of Oil:

0°F (-18°C) to 110°F (43°C) - BAC # 582628P1, normal temperature range

-25°F (-32°C) to 30°F (-1°C) - BAC # 582627P1, low temperature range



### BAC Caution Tip

**Ball Bearings:** Do not use high pressure grease guns, as they may rupture the bearing seals.

**Sleeve Bearings:** Do not use oils containing detergents. Detergent oils will remove the graphite in the bearing sleeve and cause bearing failure.





## Belt Tensioning

After initial tower start-up or the installation of a new belt, the belt tension must be readjusted after the first 24 hours of operation. The condition of the belt and belt tension should then be checked and adjusted quarterly.

To check the belt tension, place a straight edge along the belt from sheave to sheave or, alternatively, use a tape measure as shown in figure 6a or figure 6b.

Apply a moderate force by hand (approximately 40 lbs) evenly across the width of the belt in the center of the span between the two sheaves. If the belt deflects between 1/4" and 3/8" as shown, the belt is adequately tensioned.

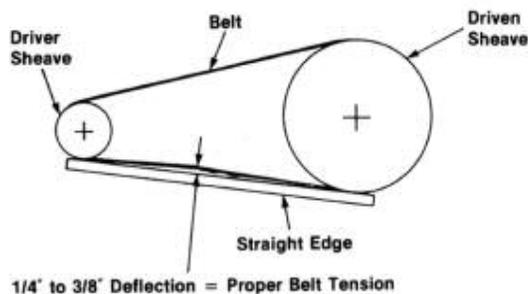


Figure 6A

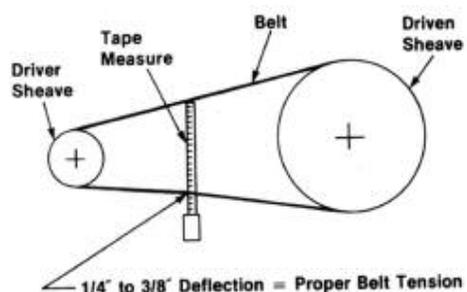


Figure 6B

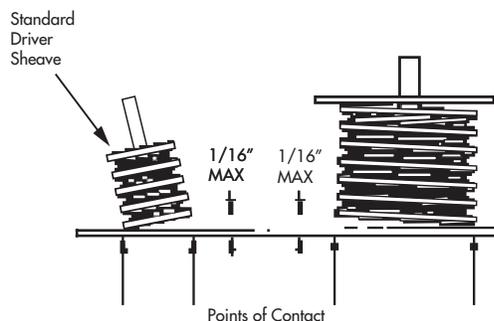


Figure 7A - Standard Drives

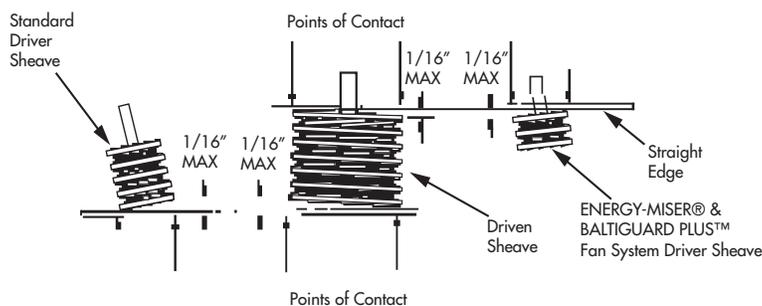


Figure 7B - ENERGY-MISER® and BALTIGUARD PLUS™ Fan System Drives

## Sheave Alignment

As with proper belt tensioning, good sheave alignment will result in both maximum performance and maximum belt life. Therefore, sheave alignment should be checked at least annually.

To check alignment, place a straight edge across the driver and driven sheaves as shown in figure 7A below for standard drive systems or figure 7B for ENERGY-MISER® or BALTIGUARD PLUS™ Fan Systems.

When the drives are properly aligned, the straight edge will contact all points as indicated. There should be no more than 1/16" deviation from the four points of contact.

If realignment is necessary, loosen the motor sheave and align it with the fan sheave and be sure to allow approximately 1/4" for draw-up as the bushing screws are retightened.



# Aluminum Sheave Bushing Installation Instructions

## Read complete instructions before proceeding:

1. Wipe the shaft, bushing bore, bushing taper, and aluminum sheave bore with a cleaning solvent to remove any dirt or oil.
2. Tighten each bolt a little at a time so that the bushing draws evenly into the sheave hub without cocking to one side or the other. Torque the bolts as specified on the chart below. Rotate the sheave to verify that it does not wobble.
3. **Do not attempt to bottom-out the bushing in the aluminum sheave. After proper bolt torque is applied, there should still be a gap between the bushing flange and the sheave hub.**
4. Follow belt tensioning and sheave realignment instructions from page 27.

Sheave Size	Bushing Type	Bolt Torque (ft-lbs)
2B3.6 thru 2B4.4	SH	6
2B4.6 thru 2B6.8	SDS	6
2B7.0, 2B16.0	SK	13
2B20.0	SF	22
4B4.2 thru 4B6.6	SD	6
4B6.8 thru 4B9.4	SK	13
4B16.0, 4B20.0	SF	19
4B25.0, 5B25.0	E	35
6B5.0 thru 6B5.4	SD	6
6B5.6 thru 6B6.8	SK	13
6B7.0, 6B7.4, 6B9.4	SF	22
6B30.0, 6B38.0	E	35
8B5.6	SK	13
8B7.4 thru 8B8.2	SF	22
8B8.8 thru 8B9.4	E	35
8B38.0, 8B50.0	F	55



## BAC Caution Tip

Failure to follow these instructions may result in a cracked sheave!

Do not use an anti-seize product or any lubricant on the bolts!



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## Aluminum Fan & Bushing Installation Instructions

### Read complete instructions before proceeding:

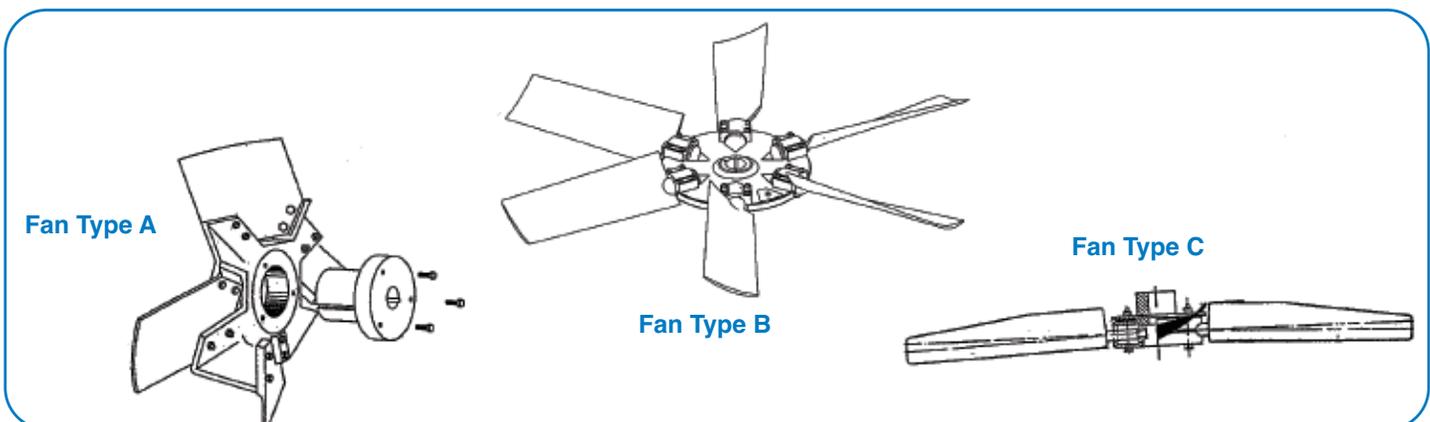
BAC aluminum fans are installed using a standard cast iron bushing with special length bolts. The proper bolts are provided with each bushing kit.

Proper installation also requires the bolts to be tightened to the specific torque values for each fan and bushing type, as shown on the chart below.

Fan Type	Bushing Type	Bolt Torque (ft-lbs)
A	H	6
A	P	13
A	Q	22
B	SF	22
C	Q1	29
C	Q2	29

### Bushing Installation Instructions:

1. Failure to follow these instructions may result in a cracked fan hub.
2. Do not use an anti-seize product or any lubricant on the bolts.
3. Do not attempt to bottom out the bushing in the aluminum fan hub. After proper bolt torque is applied, there should be a gap between the bushing flange and fan hub.
4. Use the longest bolts provided with the bushing kit.
5. Wipe the shaft, bushing bore, bushing taper, and fan hub bore with a cleaning solvent to remove any dirt and oil.
6. Tighten each bolt a little at a time so that the bushing draws evenly into the fan hub without cocking to one side or the other. Torque the bolts as specified on the chart above. Rotate the shaft to verify that the fan does not wobble.





## Water Quality Guidelines

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.

In evaporative cooling products, cooling is accomplished by evaporating a small portion of the recirculating water as it flows through the unit. As this water evaporates, the dissolved solids originally present in the water remain behind and, if not controlled, their concentration will increase rapidly. This can lead to corrosion, scale or biological fouling which may negatively affect heat transfer as well as the longevity of the unit and other system components.

- **Corrosion – Red rust on steel components and “white rust” on galvanized surfaces will affect the longevity of the unit.**
- **Scale formation – Scale not only reduces heat transfer and system efficiency, but may lead to under deposit corrosion.**
- **Biological fouling – Slime and algae formations may reduce heat transfer, promote corrosion, and harbor pathogens such as Legionella.**

Each of these aspects of water quality is discussed in greater detail below. 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 agency prior to the initial start-up of the evaporative cooling equipment. Additionally, to protect against the risk of Legionella contamination, the cooling equipment should never be operated without adequate biological control.**

### Corrosion and Scale Control

To control corrosion and scale, the water chemistry of the recirculating water must be maintained 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 recirculating water, and the temperatures at which the system will be operating. Bleed/blowdown, the continuous flow of a small portion of the recirculating water to a 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.

Chemically treated water should be kept within the guidelines given in Table 1, or within the limits provided by your water treatment specialist. In cases where bleed/blowdown alone is being used for corrosion and scale control, without chemical treatment, your water treatment specialist may recommend more conservative limits than those shown in Table 1.

**Table 1 - Circulating water quality guidelines for chemically treated water**

Property of Water	Range
pH	6.5 to 9.01*
Hardness as CaCO <sub>3</sub>	30 to 750 ppm
Alkalinity as CaCO <sub>3</sub>	500 ppm maximum
Total Dissolved Solids (TDS)	1500 ppm maximum
Conductivity	2400 micromhos**
Chlorides	250 ppm maximum as Cl
	410 ppm maximum as NaCl
Sulfates	250 ppm maximum
Silica	150 ppm maximum

\* Galvanized steel surfaces must be passivated before operating at pH levels of 8.3 and higher. See “Passivation” on next page for details.

\*\* The conversion factor used to determine conductivity is 0.625 (TDS = 0.625 \* Conductivity)

### Chemical treatment programs must meet 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 should not exceed 1 ppm. Exceeding this limit may accelerate corrosion.





**4. Closed Circuit Cooling Towers and Condensers only:** Unless a common remote sump is utilized, each cell of a multi-cell coil product must be treated as a separate entity, even if the cold water basins are flumed together or equalized.

## Passivation

When new systems are first commissioned, special measures should be taken to ensure that galvanized steel surfaces are properly passivated to provide maximum protection from corrosion. Passivation is the formation of a protective, passive, oxide layer on galvanized steel surfaces. To ensure the galvanized steel surfaces are passivated, the pH of circulating water should be kept between 7.0 and 8.2 for 4 to 8 weeks after start-up, or until new zinc surfaces turn dull gray in color. If white deposits form on galvanized steel surfaces after the pH is returned to normal service levels, it may be necessary to repeat the passivation process.

**Note:** Stainless steel units, units protected by a thermosetting hybrid polymer, or units built with the EVERTOUGH™ Construction option do not require passivation.

## Biological Control

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 promote the growth of potentially harmful organisms such as Legionella. **To avoid biological contamination and minimize the risk of Legionella, a biocide treatment program should be initiated at start-up, and administered on a regular basis thereafter in accordance with the treatment supplier's instructions. Bleed/blowdown or chemical treatment used for corrosion and scale control alone is not adequate for control of biological contamination.**

Solid or granular biocides should be introduced through a chemical "pot" feeder installed in parallel with the system circulating pump(s). Dilute liquid biocides may be added directly to the cold water basin. If ozone water treatment is used, ozone concentrations should not exceed 0.5 ppm.

## Start-up, Initial and Following a Shut-down Period

To minimize 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(s) and prior to operating the unit fans:

1. 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 period of time (residual and time will vary with the biocide) as recommended by the water treatment supplier. Only after this treatment period is completed should the fan(s) be started.
2. Check the pH of the circulating water and, if necessary, adjust it to 7.0 to 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 Cl<sub>2</sub>) over a six (6) hour period. Test kits that can be used to measure the free residual of chlorine are commercially available. Only after this treatment period is completed should the fan(s) be started.

When it is not practical to drain the system during shut-down periods, a by-pass line with shut-off valves should be installed to permit the recirculating water to be circulated throughout the system, including the unit basin, while bypassing the fill section of the evaporative cooling equipment (fans should remain off). The system should be treated per one of the two methods described above prior to restarting the unit.

## System Cleaning for Coil Products

This section is applicable to BAC Closed Circuit Cooling Towers and Evaporative Condensers only.

The outside surface of the heat exchanger coil may require occasional cleaning. The chemicals used for cleaning must be compatible with the materials being treated (the outside of a standard coil is galvanized steel). For specific recommendations on coil cleaning, consult a qualified water treatment specialist.

With proper precautions, prior to start-up circulate alkaline solution can be used to clean condenser water systems through a closed circuit cooling tower. The necessary precautions include:

1. Limit the duration of the cleaning to 1, or at the most 2 days.
2. The temperature of the solution should never exceed 100°F (37.8°C)
3. The maximum concentration of chemicals in the circulation solution should not exceed any of the following:

5% Sodium Hydroxide	0.5% Trisodium Phosphate
5% Sodium Metasilicate	0.5% Sodium Nitrate
2% Sodium Carbonate	5-10% Butyl Cellosolve
2% Tetra Sodium Pyrophosphate	

## Evaporative Condensers

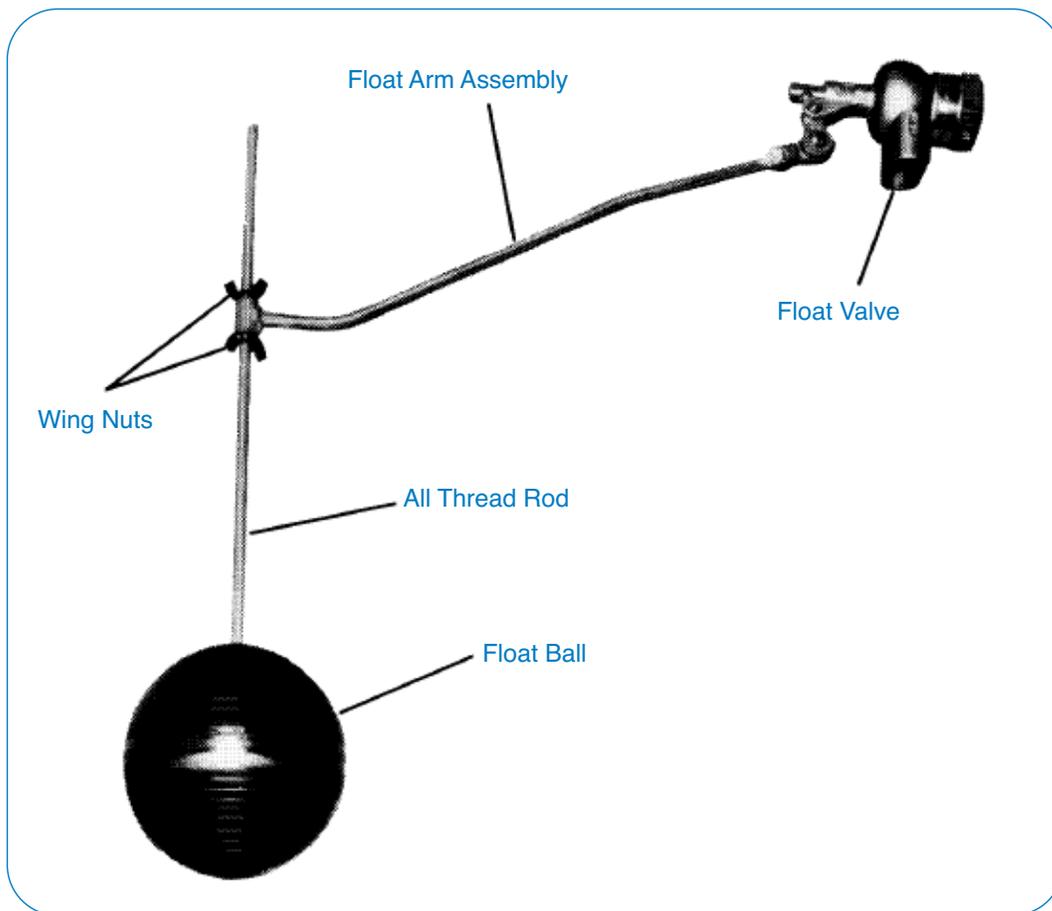
The installation and manufacturing processes commonly used for field-assembled steel-piped refrigeration systems leave weld byproducts inside coils and connecting piping. It is common practice to install filters and/or strainers that remove contaminants during initial system operation. Shortly after system startup, the filters and/or strainers should be cleaned or replaced.



## Float Valve Adjustment

To set the initial basin water level, adjust the wing nuts so the make-up valve is completely closed when the water level is 1/2" below the overflow level. This setting should produce operating levels as shown in your Operation and Maintenance Manual. See your Operation & Maintenance Manual for the manufacturers' suggested operating level to adjust make-up assembly. Set the bleed rate for desired cycles of concentration and begin operation. Allow 24 hours of operation, check and readjust operating level, if required.

Remember, supply pressure must be maintained at 15 to 50 psig for proper float valve operation. If the supply pressure is greater than 50 psig install a pressure reducing valve.



### BAC Caution Tip

Remember, supply pressure must be maintained at 15 to 50 psig for proper float valve operation.



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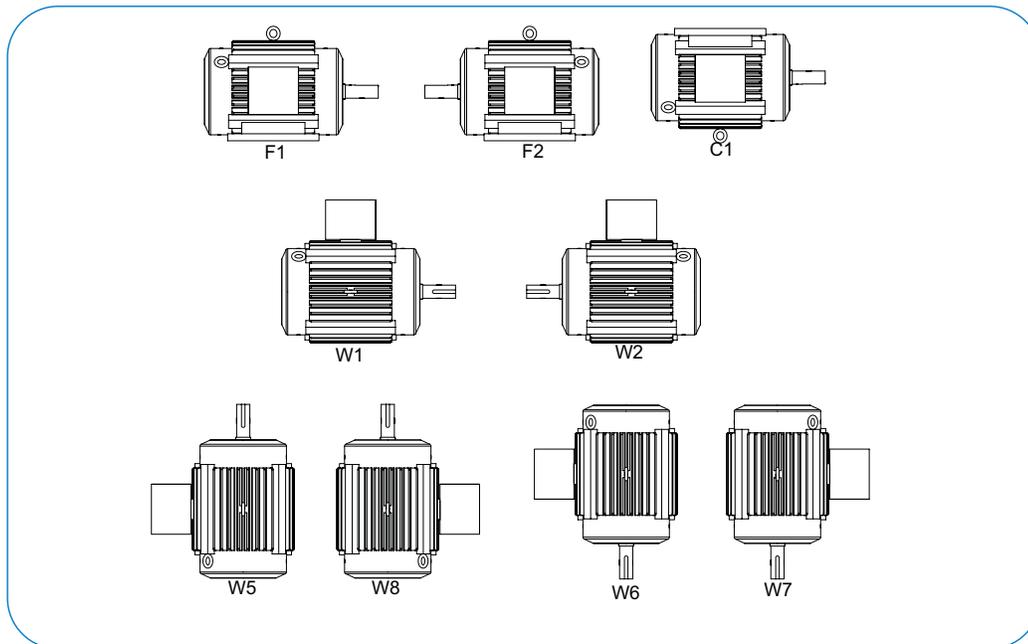


# Motor Orientation

BAC motors come in a variety of orientations as shown in the table below. Use this table to determine the standard motor configuration in your unit and use the chart below to confirm this is what has been supplied.

Model	Motor Type	Motor Orientation, Right-Hand Configuration	Motor Orientation, Left-Hand Configuration
Series V	TEFC	F2-Standard, F1-Pony	F1-Standard, F2-Pony
VTL, VFL, VCL	TEFC	F2-Standard, F1-Pony	F1-Standard, F2-Pony
VC2	TEFC	C1-Standard W1 & W2-Independent Fans	C1-Standard W2 & W1-Independent Fans
FXT	TEFC	Contact Your Local Representative	
CFT	TEAO	W7	
1500, FXV, CXV	TEAO	W8-Standard W5-Pony or Independent Fans	
3000	TEAO ( TEFC with ext. motor)	W6-Belt Drive F1-Gear Drive	N/A
PT2	TEAO ( TEFC with ext. motor)	W8-Internal Direct Drive and External W6-Internal Belt Drive	W8-Internal Direct Drive and External W6-Internal Belt Drive

Note: For models not listed, contact your local BAC Representative.



## BAC Tech Tip

TEAO - Totally Enclosed, Air Over. These motors are mounted in, and cooled by, the air stream of the unit.

TEFC - Totally Enclosed, Fan Cooled. These motors are outside the air stream of the unit; therefore, a cooling fan is required on the motor to prevent overheating.





## Gear Lubrication

Please refer to your Operation & Maintenance Manual for complete information.

### Lubrication:

Use only rust and oxidation inhibited gear oils in accordance with AGMA Standard 9005-D94. For general operating conditions, AGMA lubricant number and corresponding viscosity range should be as shown in the table below.

### Oil Change Interval:

With a new gear, the oil should be replaced after 500 hours or 4 weeks of operation, whichever comes first. See your Operation & Maintenance Manual for the proper procedures

During normal operation, the oil should be changed every 2500 hours or every 6 months of operation, whichever comes first. Shorter intervals may be required as stipulated in your Operation & Maintenance Manual.

Recommended Mineral Oils	
Ambient Temperature at Gear Drive:	20°F to 120°F (-7°C to 49°C)
AGMA Lubricant Number:	5
ISO Grade:	220
Manufacturer	Oil Type*
Atlantic Richfield Co.	Duro 220
Chevron Oil Co.	Machine Oil A W 220
Cities Service Oil Co.	Citgo Pacemaker 220
Conoco	Hydroclear Multipurposes R & O Oil 220
Exxon Co.	Teresstic 220
Gulf Oil Corp.	Harmony 220
Mobil Oil Corp.	DTE Oil BB
Penzoil	Pennzbell R & O 220
Phillips Petroleum Co.	Magnus 220
Shell Oil Co.	Morlina 220
Sun Oil Co.	Sunvis 999
Texaco Inc.	Regal 220 R & O, Code 1531
Total	Carter 220

Recommended Synthetic Lubricants	
Ambient Temperature at Gear Drive:	-20°F to 150°F (-29°C to 66°C)
AGMA Lubricant Number:	5S
ISO Grade:	220
Manufacturer	Oil Type*
Chevron Oil Co.	Clarity 220 Synthetic
Conoco	Syncon 220 - R & O Oil
Mobil Oil Corp.	SHC 630

\* List of brand names is for purpose of identifying types and is not to be construed as exclusive recommendations.





## Quick Reference

### Maintenance Checklist for:

### Cooling Towers, Evaporative Condensers and Closed Circuit Cooling Towers<sup>1</sup>

Type Service	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect general condition of the tower <sup>(2)</sup> and check unit for unusual noise or vibration	X	X			
<b>Inspect and clean as necessary:</b>					
Cold and hot water basins/spray nozzles	X		X		
Air inlet louvers	X	X			
Check and adjust water level in basins	X		X		
Check operation of make-up valve	X	X			
Check and adjust bleed rate	X	X			
Inspect heat transfer surface	X	X			X
<b>Mechanical equipment system:</b>					
Check Belt Condition	X	X			
Adjust Belt Tension <sup>(3)</sup>	X		X		
Lubricate Fan Shaft Bearings	X		X		X
Lubricate Motor Base Adjusting Screw	X		X		X
Check and Lubricate Optional Gear Drive	See Operation & Maintenance Manual for detailed instructions and schedule				
Check Drive Alignment				X	
Check General Condition of the Fan			X		
Check & Unplug Fan Drain Holes (Hollow Blade Fans)			X		
Check Fan for Uniform Pitch			X		
Check Fan for Rotation without Obstruction	X		X		
Check Fan Motor for Proper Rotation	X				
Check Motor Voltage and Current	X		X		X
Clean Fan Motor Exterior	X		X		
Drain Basins and Piping			X		X
Inspect Tower Finish				X	

#### Notes:

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



## 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 Depot<sup>SM</sup> 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





# Parts Depot<sup>SM</sup>

- Thousands of parts in-stock for immediate shipment!



- Orders received before 2 PM EST ship the same day for in-stock items



- Rush orders received before 5 PM EST ship the same day for in-stock items

*...because temperature matters<sup>TM</sup>*





## The Value of Maintaining Evaporative Cooling Equipment

Cooling tower maintenance and upgrades ... what's in it for you? How about savings in time, money, energy, and longer life?



An evaporative heat rejection device enables building owners and operators to take advantage of the operating cost savings inherent in water-cooled systems. A well-maintained tower enables the entire cooling system to perform at optimum efficiency by conserving both energy and water.

A cooling tower is selected to provide a fluid (usually water) to a system at a specific design temperature and specific flow rate (GPM). If the delivered temperature of the fluid to the system is higher than desired, system performance suffers.

Owners gain operating cost benefits when they implement a regular, comprehensive cooling tower maintenance program.

Today's building owners are constantly challenged to keep operating costs down and are anxious to learn ways to get the most out of their systems with the least expense. Therefore, owners are motivated to purchase system equipment that is energy-efficient, reliable, and maintenance-friendly. When properly maintained, water-cooled systems meet these objectives.

The cooling tower is often the forgotten component of the system when it comes to maintenance. It's a good example of the phrase "out of sight, out of mind". A newly installed cooling tower reliably delivers the design fluid temperature and flow rate. However, since its heat transfer operation creates a "hurricane-like" environment and is a natural "air-washer", the cooling tower needs routine inspection and maintenance to continue performing as designed.

### A Cost-Saving Opportunity

Owners and operators who have a working knowledge of cooling tower preventive maintenance and upgrade technology will get the most out of their cooling towers.

Their efforts can yield beneficial results, including:

- keeping them running smoothly and reliably
- increasing cooling tower life expectancy
- maintaining and potentially improving performance

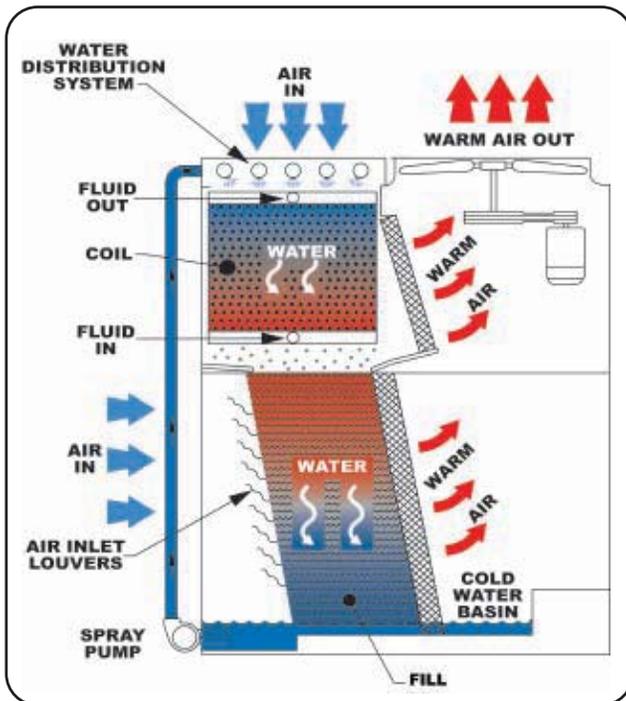
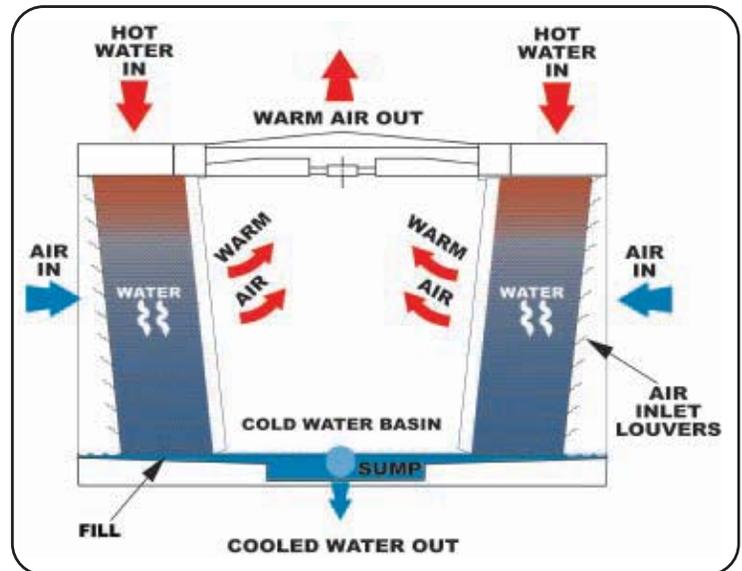
This article will take a look at routine maintenance and suggest ways of improving cooling tower performance.





## Cooling Tower Basics

In an open circuit cooling tower, warm water from the heat source is evenly distributed via a gravity or pressurized nozzle system directly over a heat transfer surface called “fill” or “wet deck”, while air is simultaneously forced or drawn through the tower, causing a small percentage of the water to evaporate. The evaporation process removes heat and cools the remaining water, which is collected in the tower’s cold water basin and returned to the heat source (typically a water-cooled condenser or other heat exchanger).



Similarly, in a closed circuit cooling tower or evaporative condenser, the heat is rejected indirectly from a fluid or vapor flowing through the coil section by spraying recirculated water over the coil section, again evaporating a small percentage of the water in the process.

The temperature at which the cooled fluid is returned to the system measures tower performance. This temperature can vary depending upon the actual cooling load, water flow, airflow, and the entering air conditions.

## Preventive Maintenance

Performing routine preventive maintenance is paramount for consistently achieving the desired temperature and flow rate, and plays an important role in maximizing cooling tower operating life. Today, those manufacturers conscious of the importance of maintenance offer many features which simplify these procedures, saving time and money.

To perform properly, all tower components must be kept clean and free of obstructions. The following sections describe standard maintenance procedures for optimized operation. These procedures can prevent loss of efficiency in the heat transfer section by maintaining proper water and air flow, as well as preventing corrosion in the cooling tower.



Maintenance frequency will depend largely upon the condition of the circulating water, the cleanliness of the ambient air used by the tower, and the environment in which the tower is operating. More detailed information is provided by BAC's Operating & Maintenance Manual.

## Strainer

Fundamentally important to the performance of a cooling tower is a method to minimize contact between air and water-borne debris and the system components. This is accomplished with strainers. Strainers in the tower provide a means of keeping debris out of the condenser water loop. Strainers in the cold water basin outlet prevent debris from reaching the pump. Some towers feature low-pressure drop pre-strainers upstream of the hot water basin to prevent clogging of distribution nozzles. This added feature eliminates the need to access the distribution nozzles. Both strainers should be routinely inspected and cleaned as necessary. Some tower designs allow external access to the strainers, which enables maintenance to take place without the need to turn off the unit.



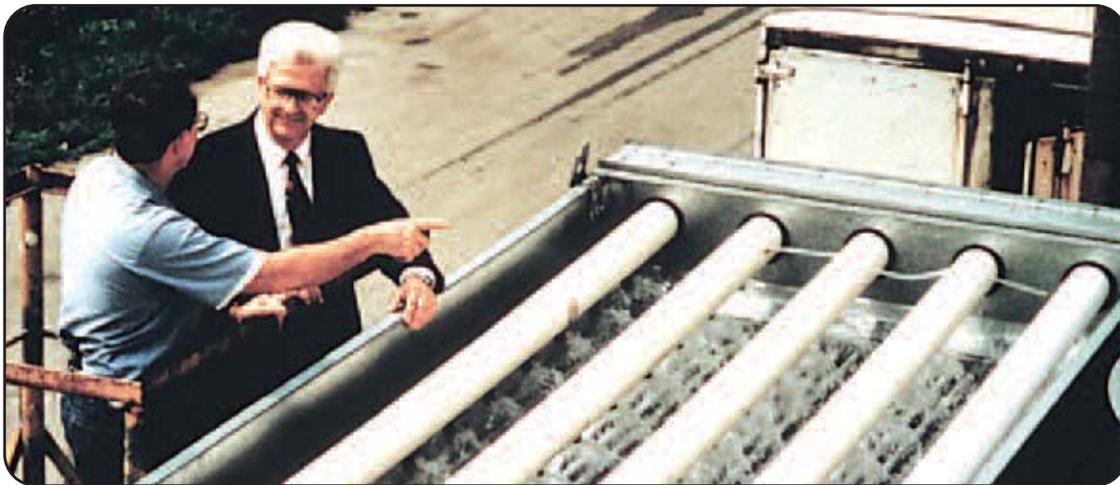
Inspecting cold water basin strainer



Hot water basin strainer cleaning

## Water Distribution

The water distribution system should evenly distribute water over the fill section or coil section via either a gravity distribution system or a pressurized spray system. If the water distribution is found to be uneven, the nozzles need to be checked. Clogged nozzles should be cleaned in accordance with the manufacturer's recommendations.



Pressurized spray water distribution





In a gravity distribution system, the nozzles can be externally accessed, visually inspected, and cleaned by removing the hot water basin covers on the fan deck. Most pressurized spray distribution systems use nozzles and branches held in place by snap-in rubber grommets, which allow easy removal to clean and flush debris.



**Hot water basin with gravity water distribution**

## Cold Water Basin

Since some debris will eventually make its way into the cooling tower, the unit design should facilitate debris removal. A well-designed cold water basin is sloped toward the strainer to keep dirt (which can accelerate corrosion) from accumulating throughout the cold water basin. The basin should be kept clean by occasionally flushing the dirt out of the system through the tower drain. Another way to accomplish this is to install basin sweeper piping in conjunction with water filtration or separator devices. Water filtration saves maintenance costs by reducing the dirt in the cooling water system, which in turn reduces the time required to clean the cold water basins. It also reduces water treatment cost, as water treatment chemicals tend to work more effectively in clean water. Foreign particles in dirty water can absorb treatment chemicals, thus requiring the distribution of even more chemicals to properly treat the tower water.



**Cold water basin with sweeper piping**



**Basin sweeper piping**

## Make-up

Though most of the water in the system is recirculated, some water must be added to replace what is lost by evaporation and bleed. Bleed is defined as the water that is discharged to prevent the accumulation of solids in the recirculated water. The make-up water system provides the means to replace the water via a mechanical float ball and valve assembly or an electronic water level probe assembly (with solenoid valve), which measures water depth in the cold water basin. The make-up water supply pressure should typically be maintained between 15 psig and 50 psig to ensure proper valve shut-off and avoid “chatter”. If the supply pressure is higher than 50 psig, install a pressure reducing valve.



**Mechanical water level control**

The operating water level of the cooling tower will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure. Some tower designs offer access to the make-up assembly external to the cooling tower, which allows easy basin water depth inspection and adjustment without the need to turn off the unit. The tower water level should be set in accordance with the BAC's recommendations to ensure no air enters the pump suction, but not so high that water is wasted through the overflow when the tower is shut down.



**Electronic water level control**

## Bleed

To prevent the accumulation of solids in the recirculating water, the tower should be equipped with a bleed line (including a metering connection and globe valve) connected to a nearby drain. In a closed circuit cooling tower or evaporative condenser with a circulating pump, a metering valve to control the bleed rate should be provided at the pump discharge. While a manually adjusted bleed valve is the simplest system, getting the proper bleed rate can be a problem, as cooling tower loads vary throughout the day. A conductivity meter connected to a solenoid valve solves this problem by maintaining the proper cycles of concentration at all times. Also, it is recommended that a separate meter is installed to measure bleed volume, since less water is discharged to drain than supplied to the cooling tower. This can reduce sewer water charges.

The bleed rate should be adjusted to prevent an excessive build-up of impurities in the recirculating water. This is largely dependent upon the local water quality and the evaporation rate. Constant bleed and replacement with fresh water will prevent the accumulation of impurities. To obtain specific recommendations, contact a competent water treatment professional for your area.





## Mechanical Drive System

The mechanical fan drive system has several components which should be checked regularly. Many of these components operate at high speed. Follow proper lock-out/tag-out procedures, including locking out all motor disconnect switches before working on the mechanical system.

Cooling tower fans are typically driven by belt or gear drive systems. Both require routine maintenance to ensure reliable, trouble-free performance. Belt drive systems are popular, yet reliable, offer single point adjustment, and have no limit on turndown capabilities for variable speed applications. If a problem does occur, a simple change of the belt is usually all that is required, and replacement components are readily available.



**Mechanical belt drive system**

Gear drives provide reliable operation, when properly maintained. If a problem occurs, resolution may be more involved if a gear box rebuild or replacement is required. Some manufacturers offer both systems to meet user needs or preferences. To ensure proper operation of a belt drive system, tighten drive belts to manufacturer's specifications. In gear drive systems, the oil level and quality, as well as shaft alignment should be checked regularly in accordance with the manufacturer's recommendations.

When starting up a new unit, lubrication for the fan shaft bearings is typically not necessary, since most units leave the factory already greased. However, for seasonal start-up, purge the fan shaft bearings with new grease (per manufacturer's recommendations). Fan shaft bearings should be lubricated after every 2,000 hours of operation or every 3 months (whichever occurs sooner). Motor bearings should be lubricated as recommended by the manufacturer's instructions. For maximum life, it is best to install motors with a "cooling tower duty" rating.

## The Importance of Clean Operation

Cooling tower components must be kept clean and free of obstructions. Neglecting the cooling tower will lead to higher than desired return water temperatures to the system, which will result in higher energy usage from two perspectives. First, the system (chiller) will consume more energy because it must operate at a higher than necessary condensing pressure (head) to satisfy the load. Due to the higher fluid temperatures provided by the cooling tower. As little as 2°F (1°C) higher temperature can result in 6% more energy being consumed by the chiller. Second, the tower must operate longer at higher fan horsepower while trying to attain the design cold water temperature.

## Common Problems: Causes, Effects, and Solutions

Regardless of how often routine maintenance is performed, like any other mechanical component, problems with cooling towers may sometimes materialize unexpectedly. These include elevated leaving water temperatures, drift, and corrosion. Should any of these problems occur, follow the actions listed and contact the cooling tower manufacturer's representative or water treatment supplier for assistance.

**Check Cooling Load:** If the actual cooling load exceeds the design load for which the tower was selected the leaving water temperature will exceed the design specification.

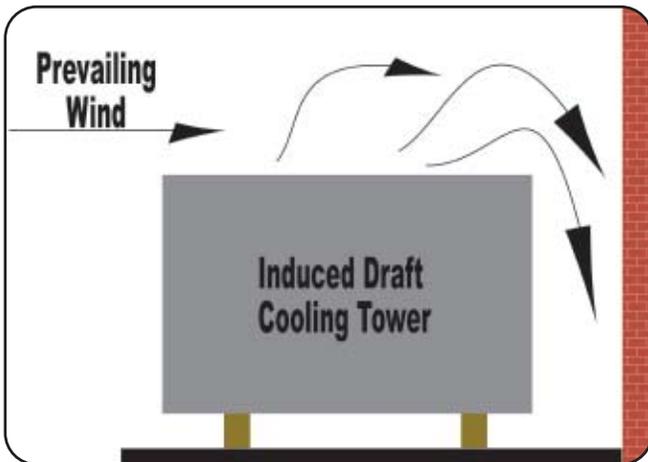


**Check Water Flow & Distribution:** Visually inspect the water distribution system to ensure the spray distribution nozzles are clean and correctly installed and are distributing a uniform spray pattern over the fill. In counterflow towers, measure the pressure at the cooling tower inlet connection and compare it to the design pressure provided by BAC. For towers with a gravity distribution system, the operating level in the hot water basin (typically between 2 and 5 inches) can be correlated to a specific flow rate.

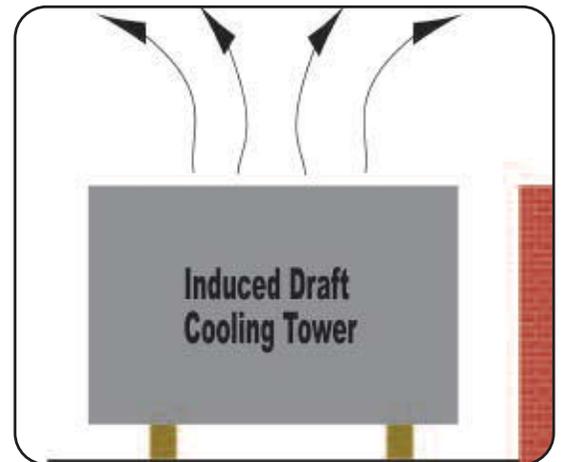
**Check Air Flow:** Cooling towers should be located where an unimpeded supply of fresh air is available to the air inlets. The cooling tower air discharge should also be at least as high as any surrounding walls to reduce the possibility of hot, moist discharge air being recirculated into the air inlets, creating artificially elevated entering wet-bulb and leaving water temperatures. To insure full design air flow, the cooling tower drive system must be adjusted according to the BAC's Operating and Maintenance Manual.



**Inspecting spray distribution nozzles**



**Incorrect orientation of tower and neighboring walls**



**Proper orientation of tower and neighboring walls**

The cooling tower and surrounding area should be examined for air flow restrictions which may cause blockage of the air inlets. Check for clogging or improper distribution of water across the tower fill, and check for proper operation of capacity control dampers in centrifugal fan towers to ensure proper air flow. The dampers, airfoil blades located in the discharge of the fan housing, help achieve tight temperature control and energy savings by matching cooling tower airflow to actual load requirements.

Though you may encounter dampers in older existing units, today's towers tend to take advantage of variable frequency drive technology (VFD's) to control capacity. VFD's help save energy, do a better job of following the load, and help reduce wear and tear on the drive system.





**Check Ambient Conditions:** Cooling towers are selected to produce the required leaving water temperature at the design cooling load and entering wet-bulb temperature. Whenever the actual entering wet-bulb temperature is higher than design conditions, the leaving water temperature will also be higher. The result is decreased energy efficiency.

Drift occurs as air flows through the cooling tower and carries water droplets out of the tower. Drift eliminators are installed in the discharge stream to remove water droplets from the air. In a properly maintained system, efficient eliminators will reduce drift loss to a negligible percentage of the design flow rate.

If excess drift occurs, check drift eliminators for proper installation, spacing, and overall condition. Examine the fill for even spacing, to insure there is no clogging or blockage, and check water and air flow as described above. Repair or replace eliminators as necessary.



**Inspecting coil**



**Inspecting drift eliminator**

Corrosion is always a concern with cooling towers because of their ability to wash the air of impurities. These impurities cause scale, corrosion, and eventually damage to system components after long-term exposure.

If a constant bleed of the system is ineffective to combat scale or corrosion, chemical treatment may be necessary. A successful chemical or water treatment program should satisfy the specific guidelines set by the manufacturer, provide effective microbiological control, and be compatible with the system's materials of construction as an integral part of the total water treatment program.

Potential airborne impurities and biological contamination (such as Legionella) should be controlled through the use of biocides, and such treatment should be initiated at system start-up and continued regularly. ASHRAE has taken proactive steps to understand and deal with Legionella through its popular publication, ASHRAE Guideline 12 – 2000, entitled “Minimizing the Risk of Legionellosis Associated with Building Water Systems”. Contact ASHRAE to secure a copy of this important document. To obtain specific recommendations of water treatment programs, contact a competent water treatment supplier.

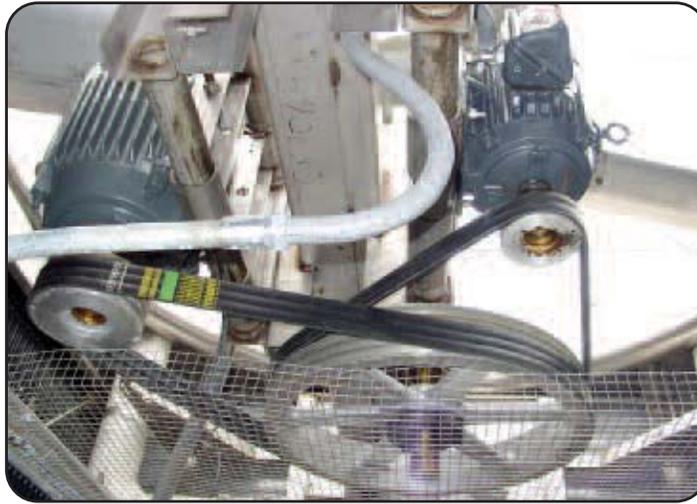
## Performance Improvements

Older, structurally sound cooling towers can be retrofitted with upgrade kits to:

- conserve energy
- restore or improve performance
- facilitate maintenance

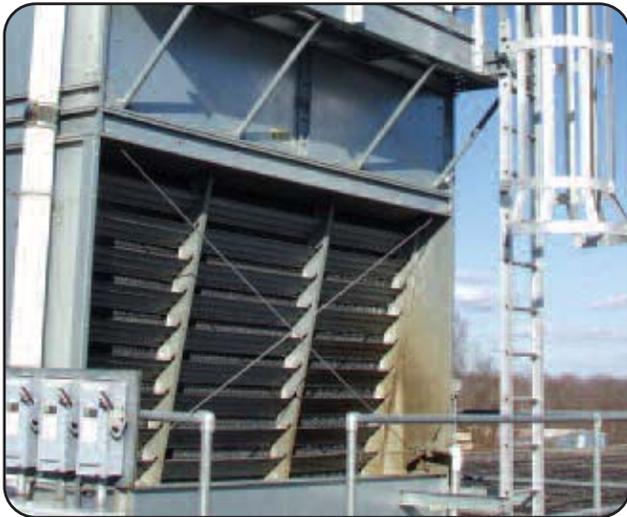


To conserve energy, two-speed motors, variable frequency drives (VFD's) or the ENERGY MISER® Fan System can be added to the mechanical drive system. VFD's offer a wide range of speeds to closely parallel operating requirements, and pony motors provide the added benefit of redundancy in the event of a motor failure. A popular energy conservation approach employs a pony motor system with a VFD controlling the lower horsepower motor.



**ENERGY-MISER® Fan System**

To improve performance on water distribution systems, kits are available to replace older, smaller nozzles or troughs with large-orifice, clog-free design. Retrofit fill kits now exist that easily replace the original fill that may be clogged with scale or airborne debris. Access platforms can also be added to existing cooling towers to facilitate maintenance.



**Access platforms and ladder**



**Installing a retrofit kit**

## Conclusion

Paying regular attention to the forgotten system component, the cooling tower, through a regular, comprehensive maintenance program can save time, money and energy while increasing the tower's life expectancy. A well-maintained tower is a candidate for retrofit kits designed to enhance performance and lengthen its life. Owners and operators save money through preventative maintenance technology. If you are not regularly performing routine maintenance on your cooling tower, implement a comprehensive maintenance program today.

For more information on how to get started, contact your local BAC Representative.



**FIND** your Representative @ [BaltimoreAircoil.com/repfinder](http://BaltimoreAircoil.com/repfinder) or **CALL: 800.896.8497**

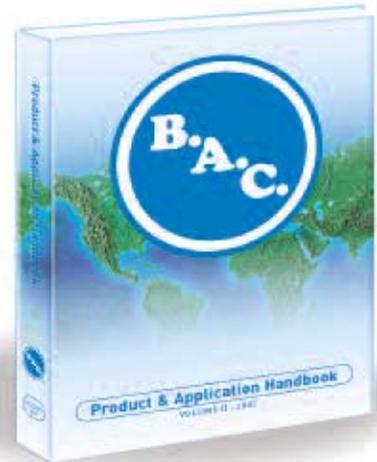


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# BAC Reference Guide Pic-Dex



**Aluminum Fan & Bushing Kits**  
Page 21



**Aluminum Sheave and Bushing Kits**  
Page 21



**Axial Fans**  
Page 2



**BAC Equipment Controls**  
Page 16



**Bearing Greasers**  
Page 3



**Bearings**  
Page 3



**Belts**  
Page 4



**Centrifugal Fans**  
Page 2



**Coil Construction**  
Page 23



**Composite Drive Shafts**  
Page 6



**Table of Contents**  
Page 1



**Cooling Tower Vacuum**  
Page 13



**Damper Controls**  
Page 15



**Drift Eliminators**  
Page 23



**ENERGY-MISER® Fan System**  
Page 20



**Evaporator Parts**  
Page 24



**Electric Water Level Control**  
Page 12



**Fill**  
Pages 18-19



**Float Valves**  
Page 11



**Floats**  
Page 11



**Gear Couplings**  
Page 6



**Gear Systems**  
Page 5



**Heater Controls**  
Page 14



**Heaters**  
Page 14



**Large Orifice Spray Distribution Retrofits**  
Page 22



**Low Sound Alternatives**  
Page 22



**Motors**  
Page 7



**Nozzles**  
Page 10



**Parts for Other Manufacturers' Towers**  
Page 24



**Service Platforms and Catwalks**  
Page 20



# BAC Reference Guide Pic-Dex



**Shafts**  
Page 4



**Sheaves**  
Page 7



**Solenoid Valves**  
Page 12



**Spray Branches**  
Page 10



**Spray Pumps**  
Page 8



**Strainers**  
Page 13



**Vibration Cut out Switch**  
Page 15



**What's New?**  
Page 1

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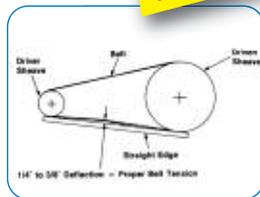
**Reference**  
page 25



**Aluminum Fan & Bushing  
Installation Instructions**  
Page 29



**Aluminum Sheave Bushing  
Installation Instructions**  
Page 28



**Belt Tensioning**  
Page 27



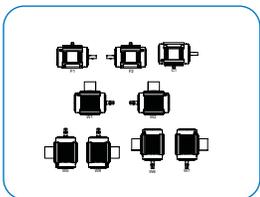
**Float Valve Adjustment**  
Page 32



**Gear Lubrication**  
Page 34



**Maintenance Checklist**  
Page 35



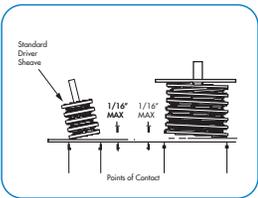
**Motor Orientation Chart**  
Page 33



**Recommended Spare Parts**  
Page 36



**Fan Shaft Bearing Maintenance**  
Page 26



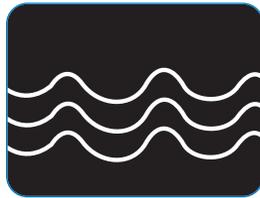
**Sheave Alignment**  
Page 27



**Maintaining Evaporative  
Cooling Equipment**  
Pages 38-46



**Basic Operation and  
Troubleshooting:  
Vibration Cutout Switch**  
Page 25



**Water Quality Guidelines**  
Page 30 - 31



**BAC Product & Application  
Handbook**  
Page 47

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