BALTIMORE
AIRCOIL AUSTRALIA

Compass Series Cooling Towers

OPERATION & MAINTENANCE MANUAL

Recommended **Maintenance** Service[1]

Inspect and clean as necessary	Start-Up	Monthly	Quarterly	Annually	Shutdown
Inspect general condition of the unit[2] and check unit for unusual noise or vibration	×	×			
Inspect cold and hot water basins / Inspect spray nozzles	×		×		
Drain basin and piping			×		×
Inspect air intake louvers / Combined inlet shields	×	×			
Check and adjust water level	×	×	×		
Check make-up valve	×	×			
Check and adjust bleed rate	×	×			
Inspect unit finish				×	
Mechanical equipment system:	**Start-Up**	**Monthly**	**Quarterly**	**Annually**	**Shutdown**
Check belt condition	×	×			
Adjust belt tension[3]	×		×		
Lubricate fan shaft bearings	×		×		×
Lubricate motor base adjusting screw	×		×		×
Check drive alignment				×	
Clean fan motor exterior	×		×		
Check motor voltage and current	×		×		×
Check general condition of the fan	×		×		
Verify fan blade drain holes are not obstructed			×		
Check fan motor for proper rotation	×			×	
Check fan for uniform pitch			×		
Check fan for rotation without obstruction	×		×		

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

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

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Operation & Maintenance » Compass Series Crossflow Cooling Towers

Safety Precautions & Warnings:

WARNING: Before performing any maintenance or inspection, or performing service on or near fans, drives, motors or inside the unit, make certain that all power has been disconnected and locked in the off position.
WARNING: When the fan speed of the unit is to be changed from the factory set speed, including changes achieved by the use of a variable fan speed device, steps must be taken to avoid operation at or near the fan's "critical speed" which could result in fan failure and possible personal injury or damage. Consult with your local BAC Representative on any such applications.
WARNING: The recirculation water system may contain chemicals or biological contaminants, including Legionella, which could be harmful if inhaled or ingested. Personnel exposed directly to the discharge airstream and the associated drift mists, generated during operation of the water distribution system and/or fans, or mists produced by high pressure water jets or compressed air (if used to clean components of the recirculation water system), must wear respiratory protection equipment approved for such use by governmental occupational safety and health authorities.

Safety Precautions

Only qualified personnel may operate, maintain, and repair this equipment. All such personnel must be thoroughly familiar with the equipment, the associated system and controls, and procedures in this manual. Use proper care, procedure, and tools when handling, lifting, installing, operating, maintaining, and repairing this equipment to prevent personal injury and/or property damage.

CAUTION: Storage

BAC units are typically installed immediately after shipment, and many operate year round. However, if the unit is to be stored for a prolonged period of time either before or after installation, certain precautions should be observed. For instance, covering the unit with a clear plastic tarpaulin during storage can trap heat inside the unit, potentially causing damage to the fill and other plastic components. If units must be covered during storage, an opaque, reflective tarp should be used. Consult with your local BAC Representative for additional recommendations on long-term storage. For normal seasonal shutdowns, refer to the applicable section in this manual.
CAUTION: All electrical, mechanical, and rotating machinery are potential hazards, particularly for those not familiar with their design, construction, and operation. Accordingly, use appropriate lockout procedures. Adequate safeguards (including the use of protective enclosures where necessary) should be taken with this equipment both to safeguard the public from injury and to prevent damage to the equipment, its associated system, and the premises.
CAUTION: This equipment should never be operated without all fan screens, access panels, and access doors in place. For the protection of authorized service and maintenance personnel, install a lockable disconnect switch located within sight of the unit on each fan.
CAUTION: Never use chloride or chlorine based solvents such as bleach or muriatic (hydrochloric) acid to clean stainless steel. It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.
Caution: Follow your local safety regulations when working inside or on top of the unit.It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.

General Maintenance Information

The services required to maintain a cooling tower are primarily a function of the quality of the air and water in the locality of the installation.

Air:

The most harmful atmospheric conditions are those with unusual quantities of industrial smoke, chemical fumes, salt, or heavy dust. Such airborne impurities are carried into the cooling tower and absorbed by the recirculating water to form a corrosive solution.

Water:

The most harmful conditions develop as water evaporates from the cooling tower, leaving behind the dissolved solids originally contained in the make-up water. These dissolved solids may be either alkaline or acidic and, as they are concentrated in the circulating water, can produce scaling or accelerated corrosion.
The extent of impurities in the air and water determines the frequency of most maintenance services and also governs the extent of water treatment which can vary from a simple continuous bleed and biological control to a sophisticated treatment system. (See sections on "Water Treatment" and "Biological Control")

Compass Series Crossflow Cooling Towers

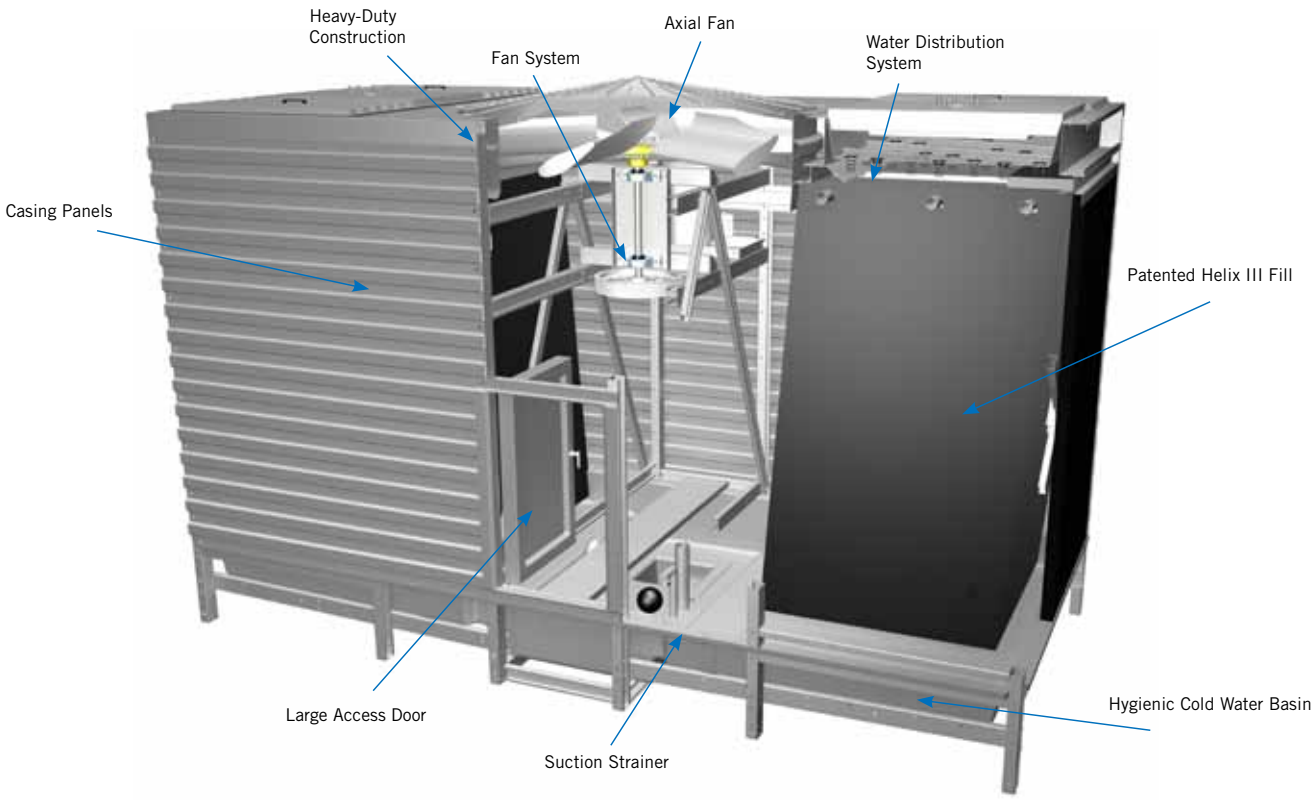
Operation and Maintenance

1

Initial and Seasonal Start-Up

Extended Shutdown

Prolonged Outdoor Storage



Initial and Seasonal Start-Up

Summary

- Ensure the fan and system pump motors have been disconnected and locked out.
- Conduct external inspection of the equipment. Check for leaks, corrosion, and any structural damage.
- Inspect piping and connections.

Cleaning

- Drain the cold water basin (with basin strainers in place).
- Open the hot water basin covers and remove any dirt or debris from the hot water basins.
- Clean and inspect the fan deck.
- Remove dirt and debris from the fan guard(s).
- Inspect and clean all spray nozzles
- Clean and inspect the mechanical components, such as the fan and motor.
- Flush the cold water basin to remove any accumulated dirt and debris.
- Remove the suction strainer, clean and reinstall.

Figure 1. Water Distribution System

Inspection

- Thoroughly inspect the fan for any damage.
- Electrical current should be measured during warm ambient conditions and with a heat load on the tower. After prolonged shutdowns, the motor insulation should be checked with an insulation tester prior to restarting the motor.
- At seasonal start-up, check and adjust the belt tension on the fan drive system.
- Turn the fan(s) by hand to insure rotation without obstruction.
- Bump the fan motor(s) and check for proper fan rotation.
- Check float operated make-up valve to be sure it is operating freely.

Start-Up

- Lubricate the fan shaft bearings prior to seasonal start-up. (See **Page 13** for more details)
- At start-up, when the cold water basin is completely drained, fill the cold water basin with fresh water to the overflow level. For new installations, initiate the biocide water treatment program at this time (See section on “Biological Control”). At seasonal startup, and following a shutdown period of more than 3 days, resume the biocide treatment program or administer a shock treatment of appropriate biocides prior to operating the cooling tower fans to eliminate accumulated biological contaminants (See section on“Biological Control”)

CAUTION:

1. Rapid on-off cycling can cause the fan motor to overheat. It is recommended that the controls be set to allow a maximum of 6 on-off cycles per hour.
2. When using a 2-speed motor, the starter should include a 15-second time delay when switching from high speed to low speed.

- Set the float on the make-up valve to close the valve when the float is approximately 12.7mm below the overflow level.
- Start the system water pump.
- Balance flow to the hot water basins by adjusting the flow balancing valves (provided by others), multi-cell arrangements will require flow balancing between cells to obtain even water distribution.
- Open the valve in the tower bleed line and adjust bleed. (See sections on "Water Treatment Control")
- Check the voltage and current of all three phases of the fan motor. The current should not exceed the nameplate rating.
- Check the optional vibration cut-out switch. (See **Page 28** for more details)

Extended Shutdown

The following services should be performed whenever the cooling tower is to be shut-down for more than 3 days:

- Disconnect, lock out, and tag out all fans and pumps.
- Drain the cold water basin and all piping that will be exposed to freezing temperatures.
- Clean and flush the hot and cold water basins with the basin strainers in place. Leave the cold water basin drain open so rain and melting snow will drain from the tower.
- Clean the basin strainers and reinstall.
- Cover the fan discharge opening to keep out dirt and debris.
- Lubricate the fan shaft bearings and motor base adjusting screw.
- Close the shut-off valve in the make-up water line (supplied by others) and drain all exposed make-up water piping.
- Inspect the integrity of the corrosion protection system on the steel portion of the tower. (See section on "Corrosion and Scale Control")
- Secure the fan motor starting device in the off position. If inspection or repair requires service personnel to work around either the fan or drives during shutdown, a personal safety hazard exists if this precaution is not taken.

After 24 Hours:

After 24 hours of operation under thermal load, the following services should be performed:

1. Check the tower for any unusual noise or vibration.
2. Check the operation water level in the hot and cold water basins and adjust balancing valves.
3. Readjust the belt tension.

DANGER:

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

Routine Start-Up/Shutdown Water System Control

- Start-up

  In view of the cold water basin water storage, do not turn the outlet valve opening to the max at the beginning.Increase the valve opening according to the water level of the cold basin to avoid drawing air through the water pump.Ensure the water level of the cold water basin is approximately below the overflow level.

- Shutdown

  In view of the cold water basin water storage, do not close the outlet valve directly. Decrease the valve opening slow to avoid overflow. Let excess water out from overflow pipe.(addition)

Prolonged Outdoor Storage

Storage Preparation

- Conduct the “Extended Shutdown” procedure on page 6 if the unit is installed.
- Ensure the cold water basin is fully drained and the drain is open.
- For storage prior to installation, all components and accessories, which sometimes ship inside the tower and are not a permanent fixture in the basin, should be removed and stored indoors.
- Remove and store fan belts (if supplied) at room temperature. Tag belts appropriately for future identification.
- Apply a weather-resistant lubricant or heavy grease such as Anti-Seize to all exposed threaded or flanged connections and adjustable motor base threaded rod.
- Inspect the protective finish on the unit. Clean and refinish as required.

ATTENTION:

Covering the unit with a clear plastic tarpaulin during storage can trap heat inside the unit and cause damage to the PVC components. If units must be covered during storage, an opaque, reflective tarp should be used.

Motor Recommendations

BAC standard motors are designed for storage at ambient temperatures of -28.9ºC to 40ºC (-20ºF to 104ºF). Prolonged periods of exposure above or below these specified conditions could degrade components of the motor and cause malfunction or premature failure.

- Motors should be removed and stored inside whenever possible. When indoor storage is not possible the motors must be covered with a tarpaulin. Do not use plastic or plastic film. This cover should extend below the motor and be secured; however, it should not tightly wrap the motor. This will allow the captive air space to breathe, minimizing formation of condensation.
- Care must also be taken to protect the motor from flooding or from harmful chemical vapors.
- The storage area should be free from ambient vibration. Excessive vibration can cause bearing damage.
- Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the motors. In areas where they are prevalent, precautions must also be taken to prevent insects from gaining access to the interior of the motor.
- If not stored indoors in a controlled environment, some form of heating must be utilized to prevent condensation from accumulating in the motor. This heating should maintain the winding temperature at a minimum of -12.8ºC (9ºF) above the ambient temperature of the surrounding environment, keeping it from dropping below the dew point where condensation could form inside the motor. If space heaters are supplied, they should be energized. Request the required voltage and transformer capacity from your local BAC Representative. A third option is to use an auxiliary heat source and keep the winding warm by either convection or blowing warm air into the motor.
- Rotate the motor shaft monthly to redistribute bearing grease.

DANGER:

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

Maintenance Requirements

Rotate all fans and motor shafts monthly by hand. Hand-turning will ensure that the shafts and bearings are free and will redistribute grease within the bearings. Keep hands away from pinch points such as bolts and sheaves.

Inspect the cold water basin monthly to ensure that the drain is open and remove any leaves or debris that may have accumulated in the cold water basin.

Inspect axial fans prior to start-up and at least once annually to ensure that the blades are tight and that there is no obvious corrosion between the hub and the fan blade.

Inspect the rust preventative coating on all motor external machined surfaces including shaft extensions monthly. If necessary, re-coat the surfaces with RUST VETO®.

Start-Up Preparation After Prolonged Storage

Keep in mind that start-up procedures after long periods of storage are just as important as pre-shutdown procedures.

- Motors should be thoroughly inspected and cleaned and restored to pre-storage condition.
- Inspect the axial fan prior to start-up to ensure that the blades are tight and that there is no obvious corrosion between the hub and the fan blades. Do not energize the fan if there is obvious corrosion of fan components. Loose fan blades could result in fan failure and possible injury or damage.
- Reinstall all fan belts, motors, door gaskets, and drain plugs (as applicable), and remove all protective coverings.
- For units stored prior to installation, conduct rigging procedures as directed in the unit's *Rigging and Assembly Instructions*, available by contacting your local BAC Representative.
- Perform an insulation test of motor windings to ensure satisfactory insulation resistance.
- Conduct full start-up procedure as stated in the "Start-Up Procedure" on **page 4**. Be especially thorough for cleaning and inspection prior to start-up.

DANGER:

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

2

Compass Series Crossflow Cooling Towers

Detailed Component Maintenance Procedures

Water Distribution System

The system water enters the cooling tower through the hot water basin(s). At design flow, the operation level should not be less than 89mm and not greater than 140mm deep. Quarterly, or more often as required, remove any dirt or debris which may clog the nozzles. Seasonally clean and flush the hot water basin with fresh water.

Cold Water Basin and Suction Strainer

As the water circulating though the tower is cooled, it collects in the cold water basin and passes through the suction strainer into the system. The operating water level is controlled by the make-up valve and should be maintained at the operation water level shown in **Table 1**.

Table 1. Cold Water Basin Operation Level

Model	CWB Operation Level (mm)
CPS-0716*	250
CPS-0817*	250
CPS-1020*	300
CPS-1222*	300
CPS-1424*	300

NOTE: The CWB Operation Level is measured from center sump floor.

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

The cold water basin should be inspected regularly. Any debris which may have accumulated in the basin or on the strainer should be removed.

Quarterly, or more often if necessary, drain, clean, and flush the entire cold water basin with fresh water. This will remove the sediment, which can collect in the basin during operation.

When flushing the basin, leave the strainer in place to prevent debris from entering the system. Remove the strainer after the basin has been flushed. Clean and replace the strainer before refilling the basin with fresh water.

Water Level Control

A float-operated mechanical water make-up assembly is furnished as standard equipment on the cooling tower.

The make-up assembly should be inspected monthly and adjusted as necessary. The valve itself should be inspected annually for leakage and the valve seat replaced if necessary. The make-up water supply pressure should be maintained between 0.1 MPa-0.34MPa for proper operation of the valve.

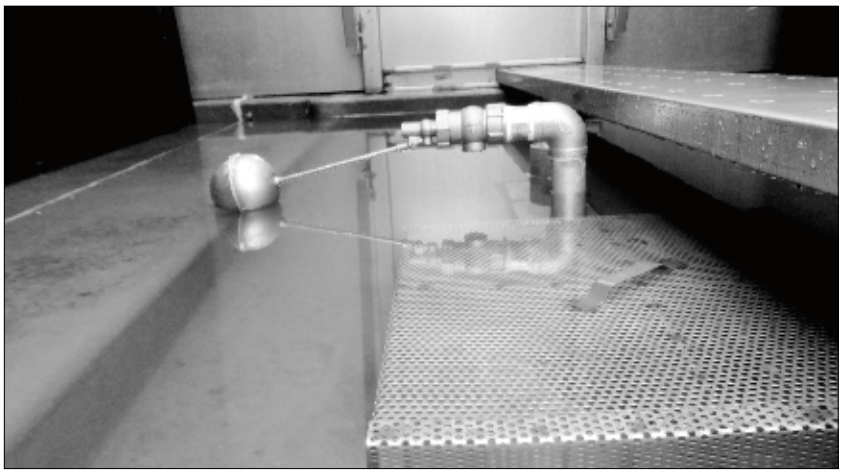


Figure 2. Make-Up Valve

Fan Motors

The motors used on Compass Series Tower are cooling tower duty TEAO motors, (Totally Enclosed, Air Over) with special moisture protection on the bearing, shaft, and windings.

The motors smaller than 45KW are permanently lubricated; the only servicing required during operation is to clean the outside surface of the motor at least quarterly to ensure proper motor cooling. For motors larger than 45KW, please contact your local BAC Representative for lubrication requirements.

Additionally, after prolonged shutdowns, the motor insulation should be checked with an insulation tester prior to restarting the motor.

Fan Shaft Bearings

Two pillow block ball bearings support the fan shaft. Each bearing is equipped with a lubrication fitting and a slinger/locking collar to keep out moisture.

Inspection & Maintenance

Only lubricate the bearings with a manual grease gun or BAC's optional Automatic Bearing Greaser. Do not use high-pressure grease guns since they may rupture the bearing seals.

Only lubricate the bearings with one of the following compatible water resistant greases which are suitable for ambient temperatures ranging from -53.9ºC (-65ºF) to + 121.1ºC(+250ºF).

- Amoco - Rycon Premium #3
- Chevron - SRI
- Mobil Grease®- #28
- Mobil Grease®- SHC32
- Shell - Alvania #3
- Shell - Dolium "R"
- Texaco – AFB2

Lubricate the bearings as follows:

- Initial Start-up: Normally, no lubrication is required since the bearings have been lubricated at the factory prior to shipment. However, if the cooling tower has been stored at the job site or more than three months, both bearings should be lubricated with new grease before initial operation. When lubricating, purge the old grease from the bearing by gradually adding grease until a bead of new grease appears at the seal on the underside of the bearing.
- Seasonal Start-up: Purge the bearings with new grease prior to start-up.
- Operation: Purge the bearings with new grease every three months while in operation, or 2,000 hours, whichever comes first.
- Extended Shutdown: Purge the bearings with new grease before and after any prolonged storage or downtime.

CAUTION: Do not use grease which contains detergent. Graphite of the bearing sleeve will be taken away and bearing will lose its effectiveness. Do not screw the well-turned adjusting screw or you will break the coaxiality of the bearing.

Heat Transfer Section

Fill & Drift Eliminator

The Compass Series has PVC fill with integral drift eliminators.

Inspection & Maintenance

Inspect and clean the fill with the integral eliminators at least quarterly.

The inspection procedure is as follows:

- Shut-off the fan and the system pump.
- Inspect the fill for obstructions, damage and fouling.

Remove any obstructions from the fill.

Remove any minor fouling chemically. Contact your local water treatment consultant for advice.

Major fouling requires cleaning and flushing.

Extended Lubrication Lines

Extended lubrication lines with grease fittings are available for lubrication of the fan shaft bearings. Fittings are located inside the plenum area next to the access door.

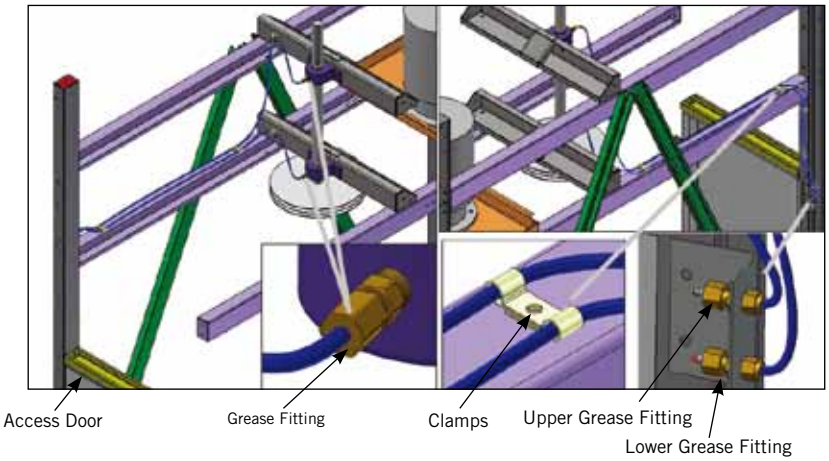


Figure 3. Extended Lubrication Lines

Adjustable Motor Base

The motor base slides and adjusting screws should be coated twice a year using a good quality grease such as those recommended for lubricating the fan shaft bearings.

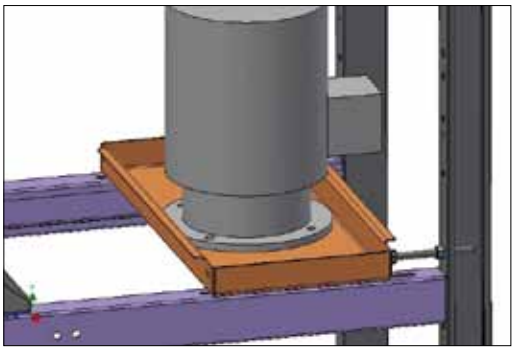


Figure 4. Adjustable Motor Base

Drive System

Initial Start-Up & Seasonal Start-Up

Check and re-adjust the belt tension prior to initial start-up or seasonal start-up.

Operation

After the initial tower start-up or the installation of a new belt, the tension must be readjusted after the first 24 hours of operation. Thereafter, the condition of the belt should be checked monthly and the tension adjusted as necessary, but at least once every three months.

To check the belt tension, place a straight edge along the belt from sheave to sheave as shown in **Figure 5a** or use a tape measure as shown in **Figure 5b** to measure belt deflection. Apply a moderate force by hand (approximately 18.1kg/40lbs) evenly across the width of the belt in the center of the span between the sheaves. If the belt deflects between 6.35mm and 9.52mm as shown in **Figure 5a** and **5b**, the belt is adequately tensioned.

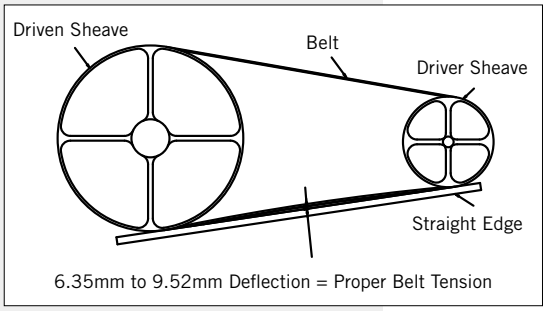


Figure 5a. Belt Tension with a Straight Edge

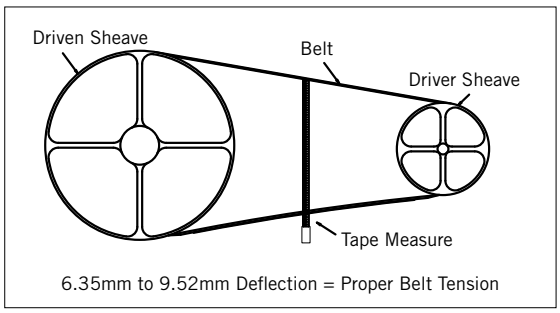


Figure 5b. Belt Tension with a Tape Measure

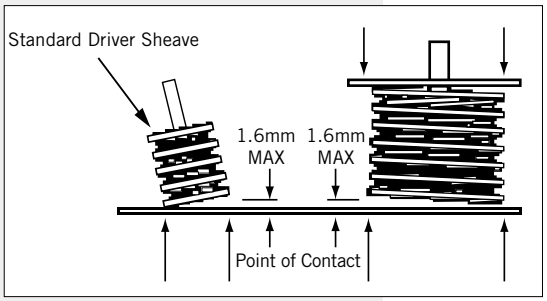


Figure 6. Standard Drive Alignment

If belt tension is required, proceed as follows:

- Loosen the lock nut on the motor base adjusting screw.
- Turn the motor base adjusting screw clockwise to tension the belt or counterclockwise to relieve belt tension. During adjustment of belt tension, the drives should be rotated several times by hand to evenly distribute the tension throughout the belt.
- When the belt is properly tensioned, retighten the locking nut on the motor base adjusting screw.

The drive alignment should be checked annually to ensure maximum belt life. This can be done by placing a straight edge across the driver and driven sheaves as shown in **Figure 6**. When the drives are properly aligned, the straight edge will contact all four points as indicated. There should be no more than 1.6mm deviation from four points of contact. If realignment is necessary, loosen the motor sheave and align it with the fan sheave. Allow approximately 6.4mm for draw-up as the bushing screw is retightened.

Fan Operation

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

- If the unit is already in operation, check while the fan is running for any unusual noise or vibration.
- With the fan off and the motor locked out and tagged:
  a. Inspect for any loose or missing bolts in the fan shaft bushing, the fan hub and the fan shaft bearings.
  b. Check the fan blades for looseness, first by twisting the blade by hand and then by moving the blade tip up and down. There should be no play or slippage whatsoever.
  c. Inspect along each blade for excessive scale build-up that could cause vibration and for any signs of cracking.
  d. Check the fan blades for crack. If there are cracks, close the motor and consult with your local BAC Representative.
- Tip Clearance – Check the clearance between the tip of the blade and the fan cowl. The clearance should be sufficient to prevent fan blades from contacting the fan cowl during operation. See **Table 2** for measurements.

Table 2. Tip Clearance

Model	Tip Clearance (mm)
CPSC-0716*	11±6
CPSC-0817*	13±6
CPSC-1020*	13.5±6
CPSC-1222*	18.5±9
CPSC-1424*	19±9

- Drain Holes – On hollow blades, the drain hole in the blade tip should be unobstructed. (Tip: Use a piece of wire to probe the hole).
- Blade Pitch – Check to ensure that the blades are all at the same pitch. If uncertain, measure the pitch with an inclinometer. Fan blade data is available in assembly instruction. The tolerance is as **Table 3**:

Table 3. Fan Blade Pitch Tolerance

Model	Blade Pitch Tolerance
CPSC-0716*	+0°/-0.3°
CPSC-0817*	+0°/-0.3°
CPSC-1020*	+0°/-0.3°
CPSC-1222*	+0°/-0.3°
CPSC-1424*	+0°/-0.3°

- Rotation – Turn the fan by hand to ensure that it moves freely without rough spots, blinding or other malfunctions that could cause vibration or fan motor overload. While rotating the fan, check the blade tracking. All blades should be within a 25.4mm band at any single point around the cowl.
- Direction of Rotation – On initial start-up, or if the fan motor has been rewired for some reason, bump the fan motor and note the direction of rotation. It should rotate in the direction indicated by the arrow on the fan cowl.
- Operation – On initial start-up, run the fan in the manual position for several minutes and check for any unusual noises or vibration.
- VFD Operation
  Applications utilizing variable frequency drives(VFDs)for fan motor control must use inverter duty motors built in compliance with IEC standard.
  Operation of the unit at a speed which resonates with components of the drive system or support structure may result in vibrations which could damage the components or structure, and/or create objectionable noise. Therefore, these resonant speed ranges should be identified at start-up and locked out to prevent operation of the motor at these resonant speeds.Please contact with your local BAC Representative for testing the resonant speed.
  Please refer to the manufacturer's variable frequency drive recommended start-up procedure for further information or consult with your local BAC Representative for any VFD applications.

3

Compass Series Crossflow Cooling Towers

Corrosion Protection

Water Treatment

Corrosion and Scale Control

Biological Control

Chemical Treatment Requirements

Passivation

BAC products are constructed of corrosion-resistant materials. The fill is made of a polyvinyl chloride (PVC), which is not susceptible to rot, decay, rust or biological attack. Other materials listed below are used in the equipment construction:

- **Fiberglass Reinforced Polyester (FRP) Components:** Compass Series Cooling Towers are provided with FRP cold water basins, fan cowls, and various other components as standard. Inspect the cold water basins for accumulation of dirt and clean them with soap and water as necessary.

Water Treatment

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 the water evaporates, the dissolved solids, originally present in the water, remain behind and if not controlled, the concentration of dissolved solids will increase rapidly. This can lead to corrosion, scale, or biological fouling which may negatively affect heat transfer as well as the longevity of system components. A water treatment program must control the following situations:

- **Corrosion** – Any form of corrosion may affect the longevity of system components.
- **Scale Formation** – Scale not only reduces heat transfer and system efficiency, but also may lead to under deposit corrosion. If scale is not controlled, it may continue building on critical components such as the fill and severely impact thermal performance.
- **Biological Fouling** – Slime and algae formations may reduce heat transfer, promote corrosion, and harbor pathogens such as Legionella.

NOTE: Since the quality of the ambient air and make-up water varies significantly from job site to job site, BAC strongly recommends obtaining the services of a competent water treatment specialist prior to the initial start-up of the evaporative cooling equipment. Additionally, to protect against the risk of Legionella contamination, never operate the cooling equipment without adequate biological control.

Corrosion and Scale Control

To control corrosion and scale, maintain the water chemistry of the recirculating water within the parameters listed in **Table 4.** 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, chemical scale and corrosion inhibitors are necessary, which raise the allowable level of dissolved solids without the risk of scale and corrosion.

In cases where bleed/blowdown alone is being employed for corrosion and scale control without chemical treatment your water treatment specialist may recommend more conservative limits than those shown in **Table 4.**

Property of Water	Recommended Level
pH	6.5 to 9.0[1]
Hardness as $CaCO_3$	30 to 750 ppm[2]
Alkalinity as $CaCO_3$	500 ppm maximum[2]
Total Dissolved Solids (TDS)	1500 ppm maximum
Conductivity	2400 micromhos[3]
Chlorides	250 ppm maximum Cl
	(410 ppm maximum as NaCl)
Sulfates	250 ppm maximum
Silica	150 ppm maximum

Table 4. Quality Guidelines for Circulating Water

Note:

1. Galvanized steel units require passivation in order to prevent white rust (refer to "Passivation" on **page22**).
2. Hardness and alkalinity limits may be exceeded under certain circumstances. Consult your water treatment specialist for recommendations.
3. The conversion factor used to determine conductivity is 0.625 (TDS = 0.625 x Conductivity).

Biological Control

The warm, oxygen and nutrient rich environment inside evaporative cooling equipment provides an ideal environment for 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, initiate the biocide treatment program at start-up and continue on a regular basis thereafter in accordance with the treatment supplier's instructions.

Introduce solid or granular biocides through a chemical "pot" feeder installed in parallel with the system circulating pump. Diluted liquid biocides may be added directly to the cold water basin.

If ozone water treatment is used, at no point should concentrations exceed 0.5 ppm to avoid corrosion.

Chemical Treatment Requirements

Chemical treatment programs must meet the following requirements:

The chemicals must be compatible with the unit materials of construction as well as other materials used in the system (pipe, heat exchanger, etc.).

Chemical scale and corrosion inhibitors, particularly acid (if used), should be introduced into the circulating water through automatic feeders. This should be done 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.

When chlorine is added to the system, free residual chlorine should not exceed 1 ppm, except during start-up if biological shock treatment is utilized during treatment. Refer to "Start-Up" on **page 4** for limits. Exceeding this limit may accelerate corrosion.

Passivation

Passivation is the formation of a protective, passive, carbonate layer on galvanized steel surfaces.

To provide maximum protection from corrosion on newly installed units take special measures to passivate galvanized steel surfaces.

To ensure proper passivation of the galvanized steel, keep the PH of the circulating water between 7.0 to 8.2 for four to eight weeks after start-up, or until new zinc surfaces turn dull gray in color.

If white rust forms on galvanized steel surfaces after the PH is returned to normal service levels, it may be necessary to repeat the passivation process.

Compass Series Crossflow Cooling Towers

Cold Weather Operation

4

Inspection and Maintenance

Fan Section Icing Protection

Basin Water and Internal Piping Freeze Protection

Inspection and Maintenance

BAC products can be operated at subfreezing ambient temperatures provided proper operating methods are established and diligently followed.

- Carry out frequent visual inspections and routine maintenance services during operation in subfreezing weather.
- Ensure all controls for capacity and freeze protection are set properly and functioning normally.
- Prevent excessively high water levels and possible overflow of the cold water basin due to over pumping, clogged strainers, or make-up valve malfunction.
- Some unit icing can be expected in very cold weather. Usually this will not effect the operation of the unit. Resolve any icing conditions that may damage the unit or the supports, impair the system performance, or create a safety hazard.

Fan Section Icing Protection

There are two basic operational methods which can be used to provide the system's required cooling: temperature setting and fan control. The method of control employed on a given application depends upon the climatic extremes which are expected, the variations in heat load that will be encountered, and the compatibility of the control system with other portions of the installation.

In subfreezing ambient temperatures, effective icing control may require a combination of these two methods. Operate each unit with the highest thermal load it can handle, rather than evenly dividing the total heat load across all cells. During prolonged cold weather periods, bypass the idle units and drain the basins.

Temperature Setting

Low leaving fluid temperatures promote ice formation. During operation in subfreezing ambient temperatures, maintain the leaving water temperature as high as possible. Ensure the unit operates with the maximum possible heat load. The recommended minimum process fluid temperature 6.1°C.

Fan Control

The following are fan control methods to reducing icing:

- **Multi-Speed Motors:** If the unit is equipped with 2-speed motors, operation at a lower speed may be sufficient to prevent icing. The motor starter should include a minimum 15 second time delay when switching from high to low speed.
- **Fan Cycling:** Set the controls to allow a maximum of six on-off cycles per hour. Cycle the fan off for five minutes every 15 to 20 minutes for each cell. If ice continues to build on the air intake, decrease the on-time. Observe the air intake of the unit at least every four to eight hours.
- **Fan Reversal:** This procedure should be used only after the other methods of fan control fail. If utilized, the fans should be run in reverse for no longer than 20 minutes at no more than 50% speed, and the cooling tower should be observed during this time. Before returning to normal operation, visually inspect the fan blades for ice formation.

NOTE: Modulating the water flow rate to the unit is NOT a recommended method of controlling cooling capacity.

Basin Water and Internal Piping Freeze Protection

Cold Water Basin Protection

It is important to protect the basin and internal piping. The basin water could freeze when the unit is shut-down and exposed to subfreezing ambient temperatures.

- **Basin Heaters:** On applications without a remote sump, heat must be provided to the cold water basin. Electrical immersion heaters can provide the required function. Contact your local BAC Representative for details.

Compass Series Crossflow Cooling Towers

5 Operation Considerations for Accessories

Basin Heater (Optional)

Low Water Level Switch (Optional)

Thermostat (Optional)

Vibration Cutout Switch (Optional)

Recommended Spare Parts

Basin Heater (Optional)

One or more electric immersion heaters prevent the cold water basin from completely freezing over and damaging the unit during shutdown or standby. The heaters are sized for the specific unit. The heating element has an enclosure that is suitable for outdoor use. Annually, inspect the basin heater prior to the risk of reaching freezing operating conditions.

Operation

Ensure that the heating element is completely submerged before energizing the main disconnect.

Low Water Level Switch (Optional)

Low water lever switch must be used in conjunction with heater. The heater is cut off automatically when the cold basin has a low water level.

Thermostat (Optional)

Low water lever switchmust be used in conjunction with heater. The heater is cut off automatically when the water temperature is higher than the setting.

Attention: The basin heater is not designed to prevent icing during unit operation.

Vibration Cutout Switch (Optional)

The Mechanical Vibration Cutout Switch should be tested and field adjusted at start-up and yearly thereafter.

Set Point Adjustment When Installed:

- For safety, turn off, then lock and tag-out the electrical supply to the fan motor(s).
- Turn adjustment screw counterclockwise 1/8 turn at a time until you hear the control trip.
- Once tripped, rotate adjustment screw 1/4 turn clockwise. Push in the manual reset button.
- Start up the fan(s) to determine if the start-up will cause the cut-out switch to trip.
- If the VCOS does not trip, start and stop the fan two more times. If the VCOS still does not trip, then calibration is complete.
- If the VCOS trips,turn off, then lock and tag out the electrical supply to the fan motor(s). Adjust the set point screw an additional 1/4 turn clockwise, and push in the manual reset button. Start up the fan motor(s) to determine if the start-up will cause the VCOS to trip. Repeat this adjustment process until the VCOS no longer trips when the unit is operated. Make sure to lock out and tag out the electrical supply to the fan motor(s) before entering the unit or re-setting the switch, each time an adjustment to the VCOS is made. After the final adjustment has been made, start and stop the fan motor(s) two more times to ensure that the VCOS is properly set.

Recommended Spare Parts

BAC's Factory Authorized Parts are manufactured to meet rigourous cooling tower duty specifications and are guaranteed to fit your unit and perform as original equipment.

BAC is proud to introduce Cooling Tower World, the only place to purchase BAC Factory Authorized Parts online. All Cooling Tower Parts are shipped second day and carry a full 1-year warranty backed by BAC.

BAC Factory Authorized Parts can also be ordered through your local BAC Representative. In addition, most BAC Representatives maintain a local inventory of commonly used parts. For a free unit inspection, call your local BAC Representative today.

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
- belts
- Spray nozzle kit
- Basin heater and heater controls (low water level switch, thermalstat)
- Strainer
- Fan and sheave bushings
- Extended lubrication lines

Parts to Consider if Extended Downtime is a Concern

- Axial fan
- Fan shaft
- Sheave set
- Fan motor

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