



TDFS TrilliumSeries™ Dry Cooler

OPERATING AND MAINTENANCE INSTRUCTIONS





Recommended maintenance and monitoring programme

Baltimore Aircoil Company equipment needs to be properly installed, operated and maintained. Documentation of the equipment used, including a drawing, technical data sheet and this manual should be kept on record. To achieve long, trouble-free and safe operation, it is necessary to establish an operating plan including a programme of regular inspection, monitoring and maintenance. All inspections, maintenance and monitoring actions should be recorded in a cooling system logbook. The operating and maintenance instructions published here can be used as a guide to achieve these goals.

In addition to establishing the operating plan and the cooling system logbook it is recommended to conduct a cooling system risk analysis, preferably by an independent third party.

For more specific recommendations on keeping your cooling system efficient and safe, contact your local BAC service provider or representative. Name, e-mail and phone number can be found on the website www.BACService.eu.

Checks and adjustments	Start-Up	Every month	Every 3 months	Every 6 months	Shutdown
Tighten electrical connections	X			X	
Rotation of fan(s)	X				
Motor voltage and current	X		X		
Unusual noise and/or vibration	X		X		
Check belt tension		X			
Adjust belt tension	X		X		
Lubricate fan shaft bearings	X		X		X
Lubricate motor base adjusting screw	X		X		X
Check drive alignment				X	
Check fan motor exterior	X		X		
Check fan motor for proper rotation	X		X		
Check fan for uniform pitch			X		
Check fan for rotation without obstruction	X		X		
Verify the fan guard is properly installed	X			X	
Check and recoat steel shafts with RUST VETO	X		X		X
Check vibration cutout switch	X			X	

Inspections and monitoring	Start-up	Every month	Every 3 months	Every 6 months	Shutdown
General condition of the equipment	X		X		X
Heat transfer coil	X			X	
General condition of the fans	X		X		
Check the insulation of fan wires for damage				X	
Tightness of fan screwed cable glands				X	
Check condensate holes for clogging				X	
Radar sensor	X				
Verify fan blade drain holes are not obstructed (hollow blade fans)			X		



Auxiliary equipment integrated in the cooling system may require additions to the table above. Contact suppliers for recommended actions and their required frequency.



- Recommended service intervals are the minimum for typical installations. Harsh environmental conditions may dictate more frequent servicing.
- When operating in ambient temperatures below freezing, the unit should be inspected more frequently.
- Tension on new belts must be readjusted after the first 24 hours of operation, and quarterly thereafter.
- Lubricate fan shaft bearings quarterly or every 2000 hours of operation, whichever occurs first.



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TDFS CONSTRUCTION DETAILS



1. Fan
2. Dry coils
3. Controls enclosure
4. External access platform, ladder and safety gate
5. Access door

Operating conditions

BAC cooling equipment is designed for the operating conditions specified below, which must not be exceeded during operation.

- **Wind Load:** For safe operation of unshielded equipment exposed to wind speeds above 120 km/h installed at a height above 30 m from the ground, contact your local BAC representative.
- **Seismic Risk:** For safe operation of equipment installed in moderate and high hazard area's contact your local BAC representative.

Ambient temperature at continuous full speed; full load operation ranges from -10°C to + 45°C. For cold climates, if optional thermostatically controlled heaters are employed, the temperature range can be extended from -40°C to + 45°C.

HEAT EXCHANGER COIL

- Design pressure: 10 bar
- Maximum fluid inlet temperature: 60 °C
- Fluids circulated through the inside of the coils must be compatible with the coil construction material.

CIRCULATED WATER QUALITY

The standard heat exchanger coils are made of black steel and are galvanized on the outside only. They are intended for application on closed, pressurized systems which are not open to the atmosphere in order to prevent internal corrosion of the coil and possible leaks.

The circulating water quality needs to remain within the following limits:

	Black steel galvanized
pH	7 - 10.5
Hardness (as CaCO ₃)	100 - 500 mg/l
Alkalinity (as CaCO ₃)	100 - 500 mg/l
Conductivity	< 3000 µS/cm
Chlorides	< 200 mg/l
Total suspended solids	< 10 mg/l
COD	< 50 ppm

Above values are general guidelines for pressurized closed systems closed systems with a leak rate lower than 15% of system volume per year. If the annual make-up of the closed system is greater than 15% yearly or if highly corrosive water such as water with very low hardness or alkalinity is used, it is recommended to consider alternative stainless steel material or implement a proper water treatment program to prevent steel corrosion.

Stainless steel coil are available to cool corrosive fluids or water and ethylene/propylene glycol solutions in systems open to the atmosphere. In case of stainless steel heat exchanger coils the circulating water quality needs to remain within the following limits:

	SST304L	SST316L
pH	6.5 - 10.5	6.5 - 10.5
Hardness (as CaCO ₃)	0 - 500 mg/l	0 - 500 mg/l
Alkalinity (as CaCO ₃)	0 - 500 mg/l	0 - 500 mg/l
Conductivity	< 3300 µS/cm	< 4000 µS/cm
Chlorides	< 250 mg/l	< 750 mg/l
Total suspended solids	< 10 mg/l	< 10 mg/l
COD	< 50 ppm	< 50 ppm

In all cases, regardless of the material of construction of the coil a competent water treatment company should be consulted for the specific water treatment to be applied, suitable for all the materials of construction used in the entire system.

The standard heat exchanger coils are made of copper and use CuP 181 and CuP 284 (ISO 17672) as a brazing material. They are intended for application on closed; pressurized system which are not open to the atmosphere in order to prevent excessive fouling and/or internal corrosion of the coil and possible leaks.

The circulating water quality needs to remain within the following limits:

	Copper
pH	6.5 - 10.5
Hardness (as CaCO ₃)	0 - 500 mg/l
Alkalinity (as CaCO ₃)	0 - 500 mg/l
Conductivity	< 3300 µS/cm
Chlorides	< 250 mg/l
Total suspended solids	< 10 mg/l
COD	< 50 ppm

In any case, a competent water treatment company should be consulted for the specific water treatment to be applied, suitable for all materials of construction used in the entire system. For higher pH levels, it is recommended to add a specific copper corrosion inhibitor such as TT or BZT with a target residual concentration of above 2 ppm (multiple dosages might be required).

Connecting pipework

All piping external to BAC cooling equipment must be supported separately.



In case the equipment is installed on vibration rails or springs, the piping must contain compensators to eliminate vibrations carried through the external pipework.

Suction pipe sizing should be done according to good practice, which may for larger flows require larger pipe diameters than the outlet connection. In such cases adapter pieces need to be installed.

Safety precautions

All electrical, mechanical and rotating machinery constitutes a potential hazard, particularly for those not familiar with its design, construction and operation. Accordingly, adequate safeguards (including use of protective enclosures where necessary) should be taken with this equipment both to safeguard the public (including minors) from injury and to prevent damage to the equipment, its associated system and the premises. If there is doubt about safe and proper rigging, installation, operation or maintenance procedures, contact the equipment manufacturer or his representative for advice.

When working on operating equipment, be aware that some parts may have an elevated temperature. Any operations on elevated level have to be executed with extra care to prevent accidents.



CAUTION

Surface of coil/piping can be hot.

AUTHORIZED PERSONNEL

The operation, maintenance and repair of this equipment should be undertaken only by personnel authorized and qualified to do so. All such personnel should be thoroughly familiar with the equipment, the associated systems and controls and the procedures set forth in this and other relevant manuals. Proper care, personal protective equipment, procedures and tools must be used in handling, lifting, installing, operating, maintaining and repairing this equipment to prevent personal injury and/or property damage. Personnel must use personal protective equipment where necessary (gloves, ear plugs, etc...)

MECHANICAL SAFETY

Mechanical safety of the equipment is in accordance with the requirements of the EU machinery directive. Depending upon site conditions it also may be necessary to install items such as bottom screens, ladders, safety cages, stairways, access platforms, handrails and toe boards for the safety and convenience of the authorized service and maintenance personnel.

Since the equipment operates at variable speeds, steps must be taken to avoid operating at or near the installation's "critical speed".

For more information consult your local BAC representative.

ELECTRICAL SAFETY

All electrical components associated with this equipment should be installed with a lockable disconnect switch located within sight of the equipment.

In the event of multiple components, these can be installed after a single disconnect switch but multiple switches or a combination thereof are also allowed.

No service work should be performed on or near electrical components unless adequate safety measures are taken. These include, but are not limited to the following:

- Isolate the component electrically
- Lock the isolation switch in order to prevent unintentional restart
- Measure that no electrical voltage is present any more
- If parts of the installation remain energized, make sure to properly demarcate these in order to avoid confusion

Fan motor terminals and connections may have residual voltage after unit shut-down. Wait five minutes after disconnecting the voltage at all poles before opening the fan motor terminal box.

LOCAL REGULATIONS

Installation and operation of cooling equipment may be subject to local regulations, such as establishment of risk analysis. Ensure regulatory requirements are consistently met.

Disposal requirements

Dismantling of the unit and treatment of refrigerants (if applicable), oil and other parts must be done with respect to the environment whilst protecting workers from potential risks related to exposure to harmful substances.

National and regional legislation for material disposal and protection of workers should be taken into account with regard to:

- Appropriate handling of construction and maintenance materials when dismantling the unit. In particular when dealing with materials that contain harmful substances, such as asbestos or carcinogenic substances.
- Appropriate disposal of the construction and maintenance materials and components such as steel, plastics, refrigerants and waste water according to local and national requirements for waste management, recycling and disposal.

Non-walking surfaces

Access to and maintenance of any component needs to be performed in accordance with all local applicable laws and regulations. If the proper and required access means are not present, temporary structures need to be foreseen. Under no circumstance can one use parts of the unit, that are not designed as an access mean, unless measures can be taken to mitigate any risks that might occur from doing so.

Modifications by others

Whenever modifications or changes are made by others to the BAC equipment without written permission of BAC, the party who has done the modification becomes responsible for all consequences of this change and BAC declines all liability for the product.



Warranty

BAC will guarantee all products to be free from manufactured defects in materials and workmanship for a period of 24 months from the date of shipment. In the event of any such defect, BAC will repair or provide a replacement. For more details, please refer to the Limitation of Warranties applicable to and in effect at the time of the sale/purchase of these products. You can find these terms and conditions on the reverse side of your order acknowledgement form and your invoice.



TDFS FAN MOTOR COMMUNICATION

Introduction

The basis for the air movement system of a TDFS unit are axial fans, driven by AC motors, all equipped with individual VFD's.

For the relevant instruction to operate the VFD, please refer to Danfoss' specific manuals:

Description	Document
FC-102 HVAC control program Firmware Manual	VLT®HVAC Drive FC 102-Programming Guide
Quick installation and start-up guide FC-102 drives	VLT®HVAC Drive FC 102 - Operating Instruction

About cold weather operation

BAC cooling equipment can be operated in sub freezing ambient conditions provided the proper measures are taken. Listed below are general guidelines which should be followed to minimize the possibility of freeze-up. As these guidelines may not include all aspects of the anticipated operation scheme, system designer and operator must thoroughly review the system, location of the equipment, controls and accessories to ensure reliable operation at all times.

Protection against coil freezing

The best protection is the use of glycol or other anti freeze solutions in appropriate concentrations. The use of such solutions influences the thermal performance of the cooler and this should be taken into account, when selecting the model(s). The table below indicates the freeze protection range for various ethylene glycol concentrations (% by volume).

% Ethylene	Freeze protection
20%	-10°C
30%	-16°C
40%	-25°C
50%	-39°C

Freeze protection of ethylene glycol solutions



Glycol systems require specific inhibitors compatible with the materials of construction they come into contact with. These inhibitors generally come pre-mixed with the glycol additive for the cooling circuit.

MINIMUM OPERATION

If the system must be operated with water, both of the following conditions must be met simultaneously:

1. Ensure a turbulent flow through the unit at all times.
2. Maintain a minimum heat load, so that the temperature of the water leaving the coil(s) will not fall below 10°C.

If the process load is extremely light or shut off, it may be necessary to apply an auxiliary heat load during freezing conditions. Consult your local BAC representative for advice.

EMERGENCY COIL DRAIN

Do not drain the coils as a regular method of freeze protection. Draining should not be used as an emergency method of freeze protection. Allowing the coils to freely drain via gravity is insufficient and cannot be relied upon to protect the coils from damage due to freezing. The use of compressed air or an air dryer must be used to ensure all fluid is removed from the coil.

Protection of electrical components

To protect the electrical components from cold weather, the controls enclosure is equipped with a heater to prevent the temperature inside the enclosure from dropping below design minimum dry bulb temperature. This heater is sized for ambient temperatures down to -28°C.

Control logic

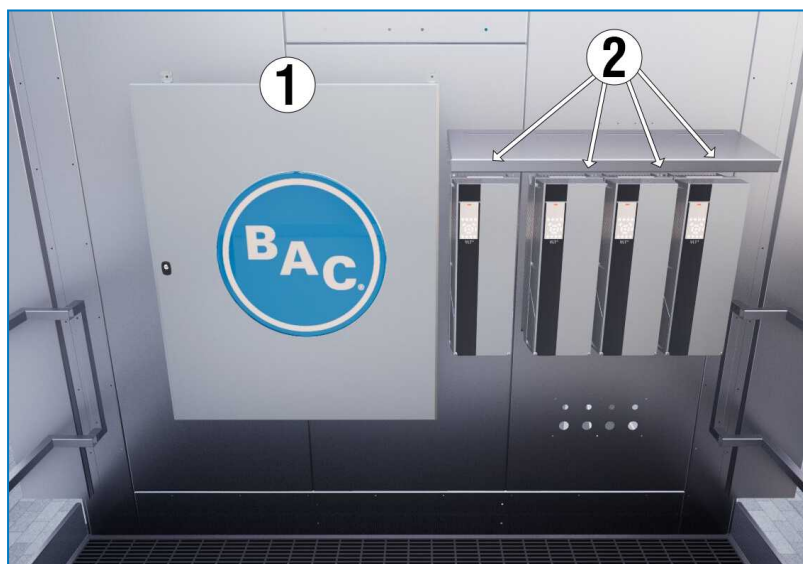
The fan speed is controlled on the basis of the actual process fluid return temperature and the design return temperature, ensuring a minimum electrical consumption and noise levels.

Controlling the fan speed will have a direct impact on the heat transfer of the unit. A low fan speed will lower the airflow through the unit, resulting in a low heat transfer. A high fan speed will result in a higher heat transfer.

OPERATIONAL SAFETY

If BAC does not deliver the controls, this is the customer's responsibility. The unit's controls are - in part - responsible for the proper operational safety of the unit as a whole. Hence, these controls need to be designed to make sure that no unsanitary situation can present itself due to a poor operation of the unit.

Electrical panels



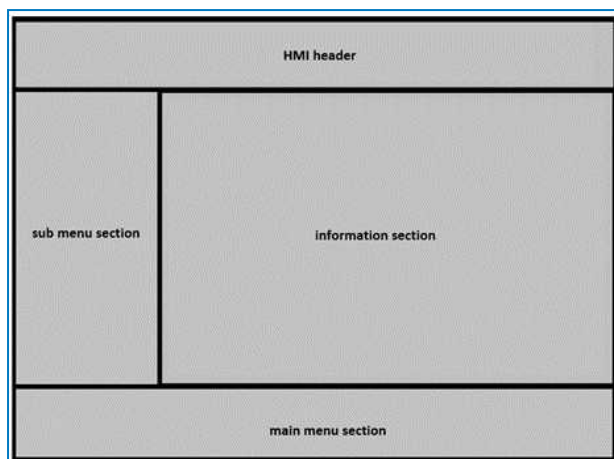
1. Power and control panel
2. (4) VFD's

Operating instructions PLC

There are 4 main parts on the screen:

- HMI header, at the top of the screen
- Main menu section, at the bottom of the screen
- Sub menu section, at the left of the screen

- Information, at the right of the screen



The Main menu section contains the following items:

- Home
- Fans
- Setpoints
- Input/Output
- Alarms
- Settings



Please refer to the Software Instructions Manual (SI-TDFS) and the units specific parameter settings in your submittal package.



CAUTION

Changing the controller's parameters may result in an undesired operation of the unit such as a 'hunting' phenomenon, premature activation of pre-cooling (hence increased water consumption) or in late pre-cooling activation resulting in fluid outlet temperatures exceeding the design temperature.



Monitoring of process information

DRY CONTACTS AT TERMINAL STRIP IN ELECTRICAL PANEL

- Input:
 - Run authorization (NO)
 - Water enable (NO)
- Output:
 - General Alarm (NO+NC)

DIGITAL BUS SYSTEM

A bus connection from the digital controller for monitoring can be wired to the terminal strip. Depending on the required communication protocol, a different optional communications module can be added.

Checks and adjustments

ELECTRICAL CONNECTIONS

Check and tighten electrical contacts if required before commissioning the unit. Transport may loosen some of the contacts, posing a risk for overheating or voltage drops. Also during operation, half-yearly checks are recommended.

ROTATION OF FANS

Fans must rotate without obstruction in the direction indicated by arrows on the equipment.

MOTOR VOLTAGE AND CURRENT

Check the voltage and the current of all three legs of the fan motors. The current should not exceed the nameplate rating.

After prolonged shutdown the motor insulation should be checked with a Megger insulation tester prior to restarting.

The voltage must not fluctuate more than $\pm 10\%$ and the imbalance between phases must not be greater than $\pm 2\%$.



CAUTION

Do not run/start the fan motor(s) when there is no heat load.

UNUSUAL NOISE AND VIBRATIONS

Unusual noise and/or vibration are the result of malfunctioning of mechanical components or operational problems (e.g. unwanted ice formation). If this occurs, a thorough inspection of the entire unit followed by immediate corrective action is needed. If required, consult your local BAC representative for assistance.

Inspections and corrective actions

General Condition of the Equipment

Once a year the general condition of the equipment should be inspected.

The inspection should focus on:

- Signs of corrosion



- Accumulation of dirt and debris

Smaller damages of the corrosion protection **MUST** be repaired as soon as possible to prevent the damage from getting bigger. For Baltibond® hybrid coating use kit (part number 160550). Larger damages should be reported to the local BAC representative.

Finned coil heat exchanger

- The finned heat exchanger coil is susceptible to corrosion and entrapment of airborne particulates (coil fouling). Inspect the coil surface. Any corrosion, damage or obstructions must be corrected.
- To manually clean the coils, use standard garden hose. Never use a brush or pressure washer. Do not use harsh chemicals or extreme water pressure.
- Additional cleaning steps than can be used to dislodge clogged coils include high pressure air, vacuum-Shop-Vac®, or a mild detergent such as Nu Calgon Cal-Green MX coil cleaner (use as per manufacturers' instructions)
- Coated coils: inspect coil coating. Touch up blemished areas, use a Red Epoxy Repair Kit.

The heat exchanger coil requires periodic cleaning to maintain the highest operating efficiency possible under the environmental conditions in which the dry unit operates. Regularly scheduled coil cleaning makes a significant contribution to extending equipment lifetime and is an excellent source of energy conservation.

- Periodic cleaning of the heat exchanger coil can be accomplished by a vacuum cleaner and/or pressurised air stream.
- In polluted environments cleaning will require commercially available coil cleaning agents.
- Cleaning coils by spraying them with water may remove large deposits but do little to remove pollutants.
- Removing dirt and salts requires a detergent to break the bond between the soil and the surface of the heat exchanger.
- However, if water spray is applied, the water pressure must never exceed 2 bar and the water jet must never be applied at an angle to the surface of the fin, but only in parallel to it.

Selecting a coil cleaner is important since the cleaner must neutralise and remove deposits on the surface of the coil. BAC does not recommend the use of alkaline and acidic coil cleaners.

- These coil cleaners can cause foaming action (oxides or hydroxides of aluminium) resulting in the stripping away of minute layers of the base alloy and the attached soil.
- Most of these foaming cleaners are harsh and known as reactive cleaning products.
- One way to recognise this type of cleaner is that normally it will be labelled as corrosive.
- The base ingredient of a coil cleaner should not be so harsh that it attacks the metal, coil coating or the personnel applying the cleaner.
- An important concern when applying coil cleaners is rinse-ability.
- Most hydroxides tend to cling the surface unless sufficient wetting agents have been added to the formula to reduce surface tension of the solution.
- If the solution does not have enough wetting agents and is not rinsed thoroughly from the surface, the residual material can settle at the fin/tube interface and continue to attack the fin.

BAC recommends the use of the more sophisticated cleaners, known as a "surfactant system". They reduce surface tension, penetrate, emulsify, and dissolve the soils without the base alloy. Surfactant systems are safe for the coil alloy, they are free rinsing, they lift and remove deposits better than alkaline cleaners, and they are environmentally safe, as well as safe and easy to apply and rinse. Surfactant systems are almost always non-corrosive.

Replacing a finned coil heat exchanger



Read all instructions for coil replacement thoroughly before beginning any work.



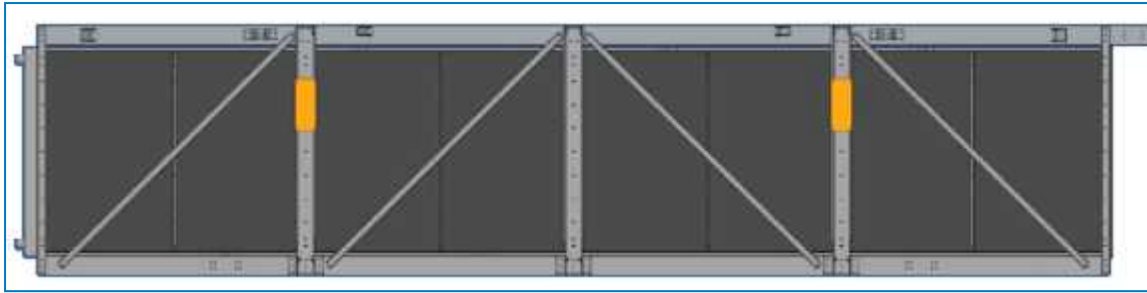
CAUTION

If you are removing the coil from the lower section, then the upper coil must be removed first. The upper section does not need to be removed to replace the coil in the lower section.

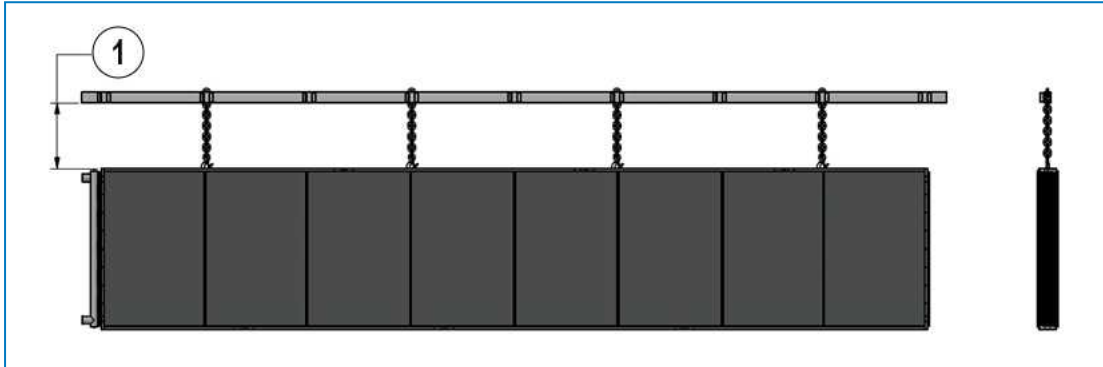
The replacement of a finned coil heat exchanger follows the same process for both the upper and lower sections.

- Follow lockout / tagout procedures.
- Drain coils and remove external piping from coil connections.
- Remove external covers (see pictures below) from both ends of the coil that you are removing
 - (26) blunt nose screw when fastening toward coils (per coil 5/16 x 3/4")
 - (18) tappers into end walls (per coil 5/16 x 3/4")

<i>External covers - coil connection end</i> 1. Screws 2. Tappers	<i>Side view</i>
<i>External covers - end opposite coil connections</i> 1. Screws 2. Tappers	<i>Side view</i>



Remove internal labels (yellow/orange in above picture - 2 per coil), inside the unit by removing (8) 5/16 x 3/4" tapping screws per coil.

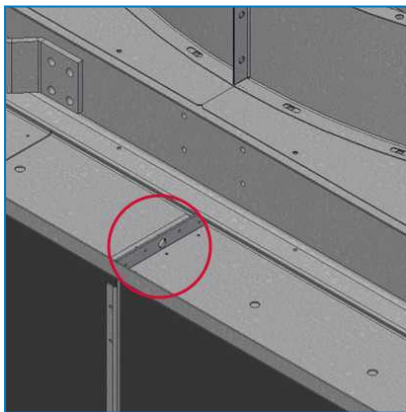


Lifting points and dimensions

1. 610 - 915 mm

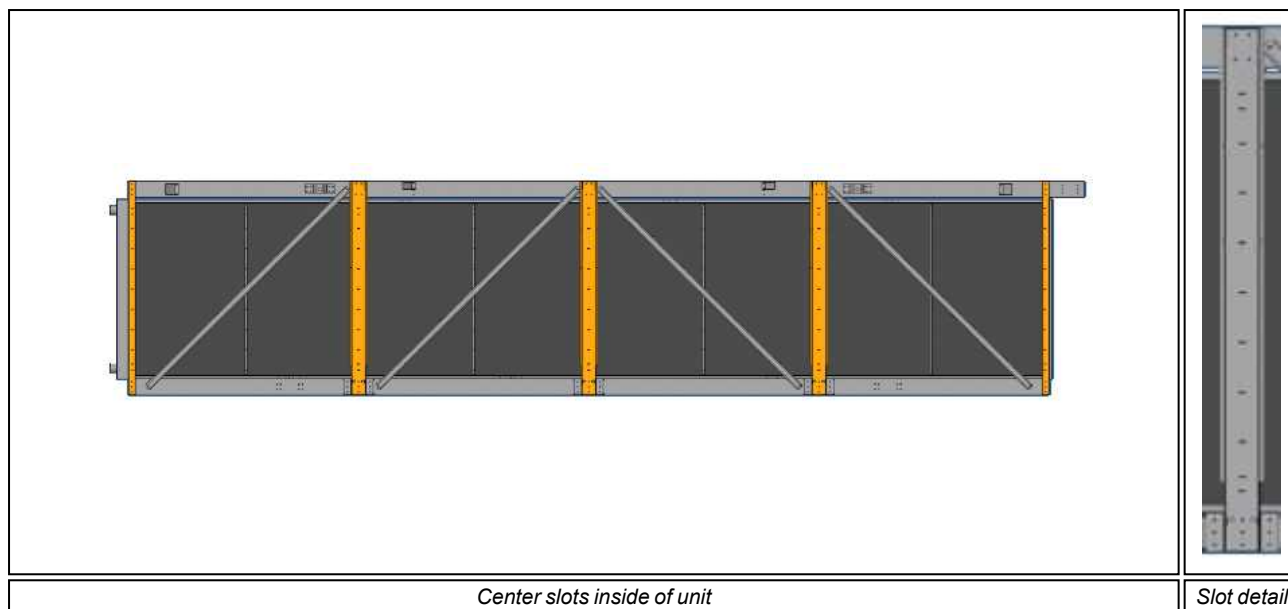
Lift the coil as shown in the figure above

- Connect lifting chains to coil at 4 individual lifting points. Lifting points are 3/4" holes.



Lifting hole detail

- Beam should be 610-915 mm above the coil
- Chains must not have any angle to coil while lifting
- Take up any slack in lifting chains prior to removing any hardware
- Remove hardware, (55) blunt nose screws and (55) fender washers, from center slots in channels inside of unit (see picture below)

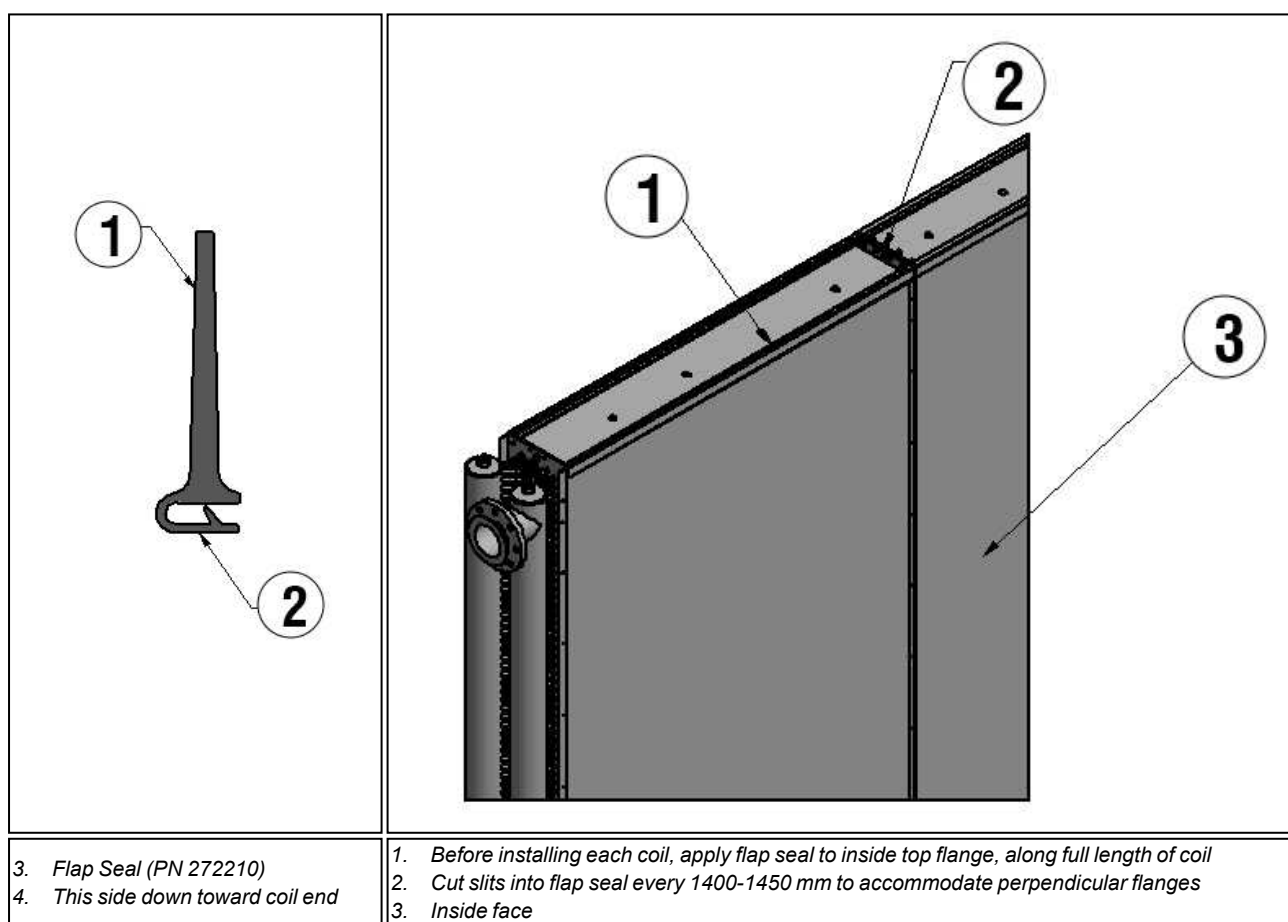


Center slots inside of unit

Slot detail

Important: do not remove bolts above and below slots.

- Lift coil and remove it from section.
- On new coil, install flap seal as per figures below.
 - Inspect flap seal for damage, and replace as needed
 - Before installing the new coil on the unit, apply the flap seal to the full length of the inside coil face



3. Flap Seal (PN 272210)
4. This side down toward coil end

1. Before installing each coil, apply flap seal to inside top flange, along full length of coil
2. Cut slits into flap seal every 1400-1450 mm to accommodate perpendicular flanges
3. Inside face

- Install new coil
 - Connect lifting chains to coil and follow lifting procedure per figure Lifting points and dimensions
 - Lift coil into place

- Install blunt nose screws and fender washers from inside unit through slots. Center slots inside of unit to secure coils in frame
- Re-install internal label plates
- Re-install external end covers as per figures above
- Re-connect external piping to coil connections.

Electronic vibration cutout switch

The electronic vibration cutout switch (EVCOS) protects the fan from failure due to excessive vibration. The shutdown setpoint is factory set at 0.45 in/sec. The alarm setpoint will not be used, because the analog output signal from each EVCOS is connected to the PLC for continuous vibration monitoring. For each EVCOS, the shutdown relay is wired to a digital input on its corresponding VFD. When vibration exceeds the setpoint for 3 seconds continuously, the corresponding fan will stop, and an alarm will appear on the controls interface. Additional details, including a wiring schematic and datasheet can be found in the submittal package.



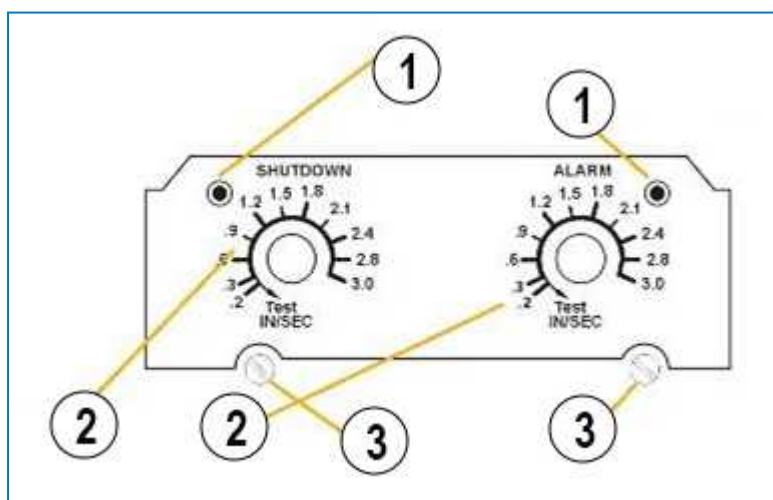
CAUTION

Before performing an adjustment or inspection of the EVCOS, make certain that all fan motor power has been disconnected and locked in the off position.

Moisture inside the switch can lead to switch failure. Care must be taken when replacing the cover on the vibration switch to ensure that the proper watertight seal is obtained.

Testing

- Set test position at the minimum set point so that any vibration will cause a trip condition.
 - The light will come on immediately, and the trip will occur after the duration of the time delay, proving the system is operational.
 - If the test position is maintained for less than the duration of the time delay, the trip will not occur.
- After testing has been completed, move shutdown setpoint back to factory setting of 0.45 in/sec.



Electronic vibration cutout switch shutdown setpoint (alarm setpoint not used)

1. LED illuminates when vibration exceeds setpoint (but alarm or shutdown discrete outputs will change state only after time delay).
2. Calibrated setpoint controls enable operator to set specific velocity alarm/shutdown levels.
3. Adjustable time delay of 2-15 seconds. Factory set at 3 seconds.

Fan & Drive System

General

Fans are driven by a one-piece multi-groove, neoprene/polyester belt designed specifically for evaporative cooling equipment service. The motor is mounted on an adjustable motor base. Motor sheaves are non-corrosive cast aluminum.

Fans and steel fan shafts are supported by heavy-duty, self-aligning, grease-packed, relubricatable ball bearings with special seals for protection against dust and moisture.

- 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 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 RUSTVETO®.



CAUTION

**Never step on the fan guard or subject the fan guard to load.
Do not place any objects on the fan guard.**

Fan

TDFS dry cooler uses an axial fan. Thoroughly inspect the fan for damaged or deteriorated fan blades and replace the fan as required.

- If the unit is already in operation, while the fan is running, check for any unusual noise or vibration.
- With the fan off and the motor disconnected, locked out and tagged out, check the general condition of the fan:
 - Inspect for any loose or missing bolts in the fan shaft bushing, the fan hub, and the fan shaft bearing(s).
 - 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.
 - Inspect each blade for excessive scale build-up that could cause vibration.
 - Check each blade for cracks. If cracks are found, the fan motor should be locked out until the fan is replaced.
 - During first week of operation, the blades shall be inspected at least once to ensure that all the nuts are tightened to the torque value listed in table Fan tightening torque below.
 - After the first week of operation, the blades shall be inspected at regular intervals, a minimum of once every month for deposits and damage. To remove deposits, use steel wool as an abrasive along with a mild detergent or very mild form of solvent. Lye must not be used because it attacks aluminum readily.
 - At regular intervals, the hub shall be inspected for damage, including bending and twisting.
 - To ensure optimal functioning and operational safety of the impeller, it is necessary to at least once a year check the tightening torque of the bolt connection and replace corroded bolts and nuts.

Fan type	Allen Head Bolt type	Tightening torque
Whisper Quiet™	12 mm	70 Nm



CAUTION

Do not use power tools on the Whisper Quiet™ fan.

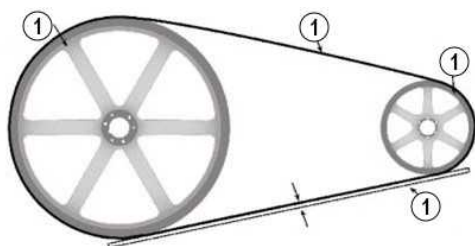
- With the fan off and the motor disconnected, locked out and tagged out, check:
 - Tip clearance: check the clearance between the tip of the blade and the fan cowl. The clearance should be sufficient to prevent the fan blades from contacting the fan cowl during operation.
 - Drain holes: on hollow blades, the drain hole in the blade tip should be unobstructed. Tip: use a piece of wire to clear the drain hole.
 - Blade pitch: check to ensure that the blades are all at the same pitch. If uncertain, measure the pitch with an inclinometer. All blades should be within 1/2° of each other.
 - Rotation: turn the fan by hand to ensure that it moves freely with no rough spots, binding or other malfunctions that could cause vibration or fan motor overload. While rotating the fan, check the blade tracking. All blades should track within a 25 mm band at any single point around the cowl.
 - Direction of rotation: on initial start up, or if the fan motor has been rewired, briefly energize the fan motor and note the direction of fan 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.

Fan Drive System

The power train consists of a solid-backed, multi-groove, neoprene/polyester belt rated for cooling tower service, and corrosion-resistant sheaves. These components provide high reliability with low maintenance requirements. These drives require a periodic check of the belt condition and, when necessary, tension adjustment.

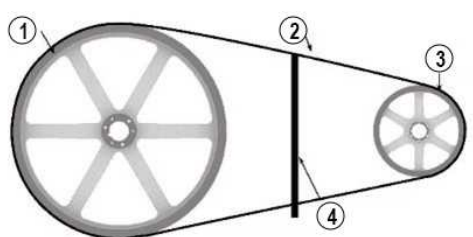
The recommended service intervals are as follows:

- Initial Start-Up: The drive has been tensioned and aligned at the factory; however, prior to initial startup, check belt tension.
- Seasonal Start-Up: Readjust the belt tension (if required).
- Operation: After the first 24 hours of operation, readjust the belt tension on a new unit start-up or installation of a new belt. Thereafter, check the belt condition monthly, and adjust tension as necessary. Readjust tension at least once every three months.
- Belt tension check:
 - Place a straight edge along the belt from sheave to sheave or use a tape measure as shown in figures to measure belt deflection below.
 - Apply a moderate force by hand (approximately 20 kg) evenly across the width of the belt in the center of the span between the sheaves.
 - There is adequate belt tension if the belt deflects between 6 - 10 mm as shown in figures below.



Belt tension with a straight edge

1. Driven sheave
2. Belt
3. Driver sheave
4. Straight edge



Belt tension with a tape measure

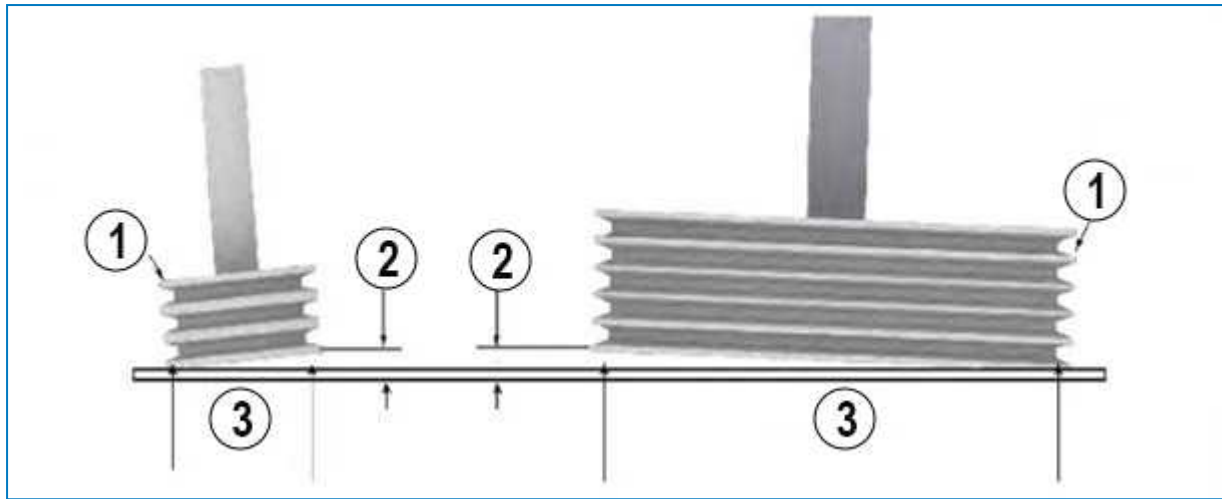
1. Driven Sheave
2. Belt
3. Driver sheave
4. Tape measure



CAUTION

If belt are properly tensioned, there should be no "chirp" or "squeal" when the fan motor is started.

- Belt tension adjustment (if required)
 - Loosen the lock nut on the motor base adjusting screw.
 - Turn the motor base adjusting screw clockwise to tension the belt or counterclockwise to relieve belt tension. During adjustment of the belt tension, rotate the drives several times by hand to evenly distribute the tension throughout the belt.
 - When the belt is properly tensioned, retighten the locking nut on the motor base adjusting screw.
- Drive alignment check and adjustment:
 - Check the drive alignment annually to ensure maximum belt life.
 - Place a straight edge across the driver and the driven sheaves as shown in figure below.
 - The straight edge should contact all four points as shown in figure below indicating that the drives are properly aligned.
 - There should be no more than 2 mm deviation from the four points of contact.
 - In case of realignment, loosen the driver sheave, and align it with the driven sheave. Allow 6 mm for draw-up as the bushing screws are retightened.



Drive alignment

1. Standard Driver Sheave(left side) / Standard Driven Sheave (right side)
2. 2 mm max
3. Point of contact

Fan Motors

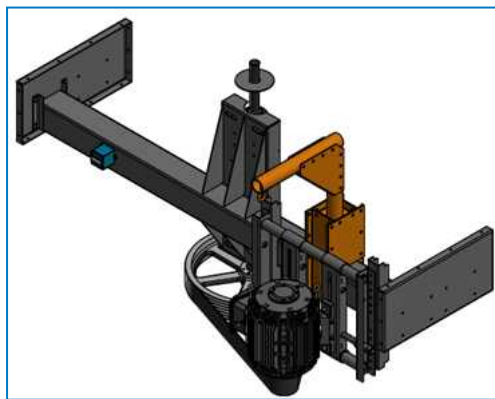
TDFS dry coolers use cooling tower duty, premium efficient, totally enclosed motors.

- Clean the outside of the motor at least quarterly to ensure proper motor cooling.
- After prolonged shutdowns, check the motor insulation with an insulation tester prior to restarting the motor.
- Check the motor voltage and current following start-up and every three months while in operation.

Fan Motor Replacement

Motor removal

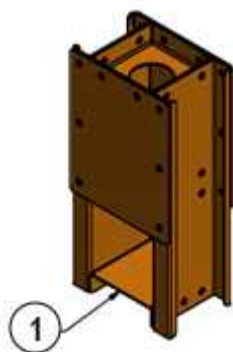
To facilitate motor removal for replacement, a davit can be installed on the mechanical support, as shown in figure below.



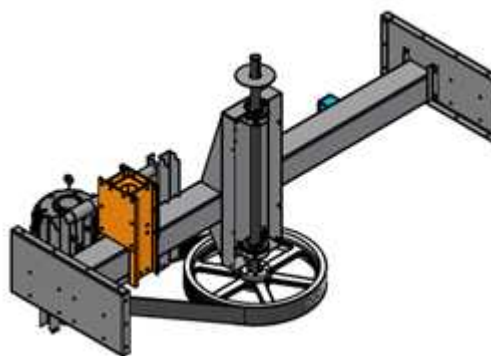
Motor removal davit

The davit arm and socket ship to the jobsite pre-assembled. To replace a motor:

- Remove the quantity (4) M12 bolts to unfasten the lower plate shown in figure below left, and place the socket on the beam as shown in figure below right.

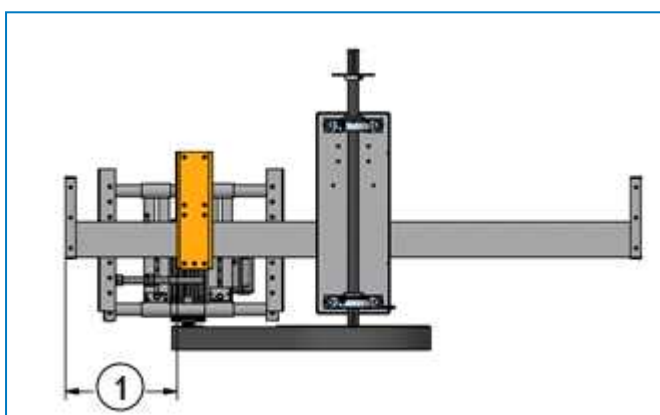


1. Lower plate



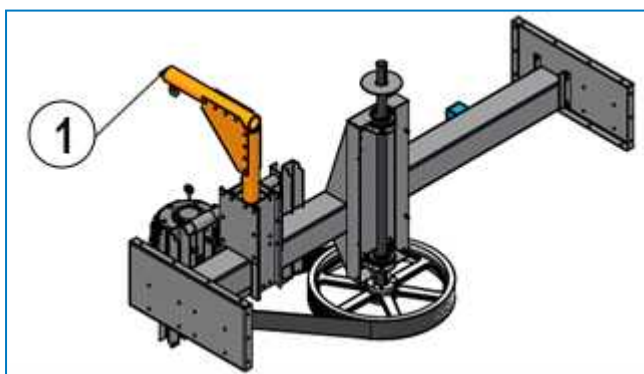
Socket installation

- Move the socket 560 mm away from the end of the support as shown in figure below, and reattach the lower plate using the bolts that were removed.



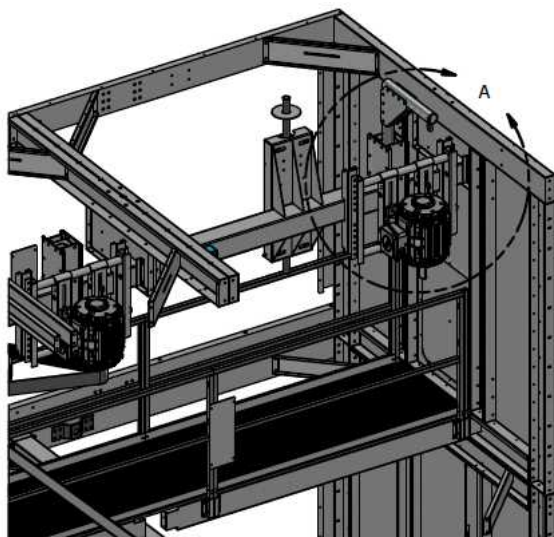
Socket location - 1. 560 mm

- Insert the davit arm into the socket as shows in figure below.

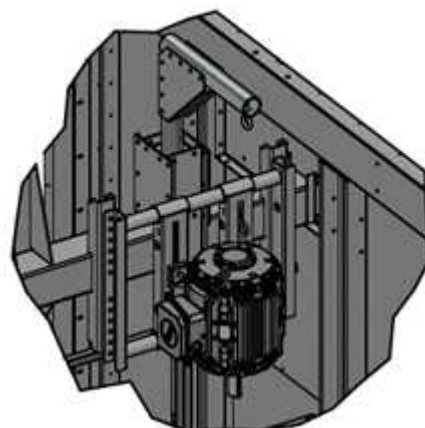


1. Davit arm

- Place chain through davit and motor eye bolts as shown in figures below.

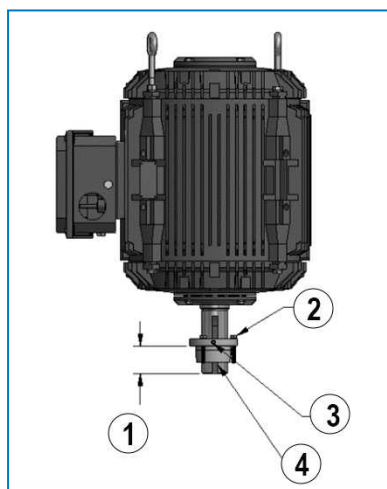


Eye bolts for chain



Detail of A

- Remove the (4) M16 bolts from the motor to the motor base so that the motor can be lifted away.
- Lower the motor into the lower section. When removing the motor from the unit, please note that the maximum weight of the motor can be up to 295 kg, and the motor size is approx. 406 x 533 x 660 mm. The access door (width 689 mm) is sized so that the motor can be removed through the access door.
- If you will re-use the driver sheave on a replacement motor, remove the sheave bushing bolts shown in figure below.



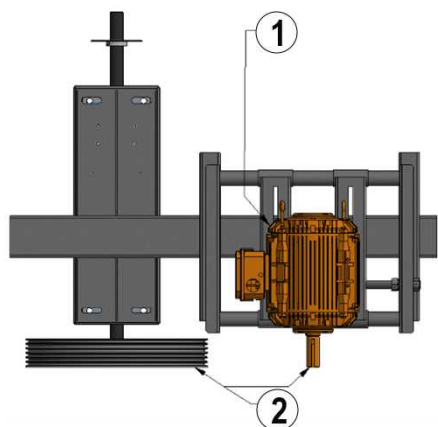
Bushing installation

- Reference location 50 mm
- Driver sheave bushing, bolt required torque (20 Nm)
- Side bolt
- Use 0.5" x 0.5" x 3.125" key

Reinstallation of Motor

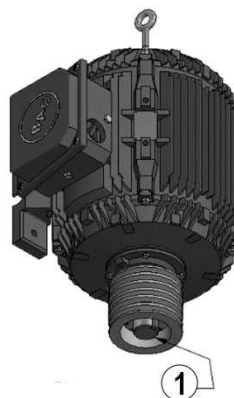
- Place chain through the davit arm and motor eye bolts and lift the motor onto the motor base.
- Install (4) M16 bolts to secure the motor to the motor base.
- Remove the davit arm and socket per the instructions in the Motor Removal section.
- If there is no driver sheave on the motor shaft, install the sheave as follows:

- Wipe the shaft bushing bore, bushing taper, and sheave bore with a cleaning solvent to remove any dirt or oil.
- Place the driver sheave bushing on shaft, and place M8 x 60 (8.8) bolts through the bushing bolt holes.
- Align the bottom of the bushing flange so that it is 2" above the bottom of the shaft per figure Bushing installation above. Install the 0.5" x 0.5" x 3.125" key in the keyway and tighten the set screw.
- Push the sheave onto the bushing and tighten each bolt shown in Figure 11 a little at a time so that the bushing draws evenly into the sheave hub without tilting. Torque the bolts to 20 Nm.
- Rotate the sheave to verify that it does not wobble.
- The bottom of the driven sheave on the fan should be flush with the bottom of the driver sheave on the motor shaft per figures below. If not, adjust the sheave bushing locations accordingly.



Driven sheave alignment

1. Mount to motor base with shaft and driven sheave flush, required motor mount torque: 80 Nm
2. Flush



Driver sheave alignment

1. Sheave flush with bottom of shaft

- Install belt per the instructions.

Adjustable Motor Base

Coat the motor base slides and adjusting screws prior to start-up, every three months while in operation, and following shutdown. Use good quality corrosion inhibiting grease such as one of those recommended for lubricating the fan shaft bearings here below.

Compatible greases

Amoco - Rycon Premium #3
 Chevron - SRI
 Citgo - Polyurea MP2™
 Conoco - Polyurea 2™
 Exxon - Polyrex® EM
 Exxon - Unirex N™
 MobilGrease® - AW2
 Shell - Gadus S2 V100 3
 Shell - Gadus S3 T100 2
 SKF - LGHP2™
 Unocal 76 - Unilife Grease™

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.

- 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 -53.9°C to 121.1°C.
- 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.



TDFS COMPREHENSIVE MAINTENANCE

About comprehensive maintenance

In order to ensure maximum efficiency and minimum downtime of your evaporative cooling system, it is recommended to establish and execute a programme of preventive maintenance.

Your local BAC representative will assist you in establishing and implementing such programme. The preventive maintenance programme must not only avoid that excessive downtime occurs under unforeseen and unwanted conditions, it also ensures that factory authorized replacement parts are used, which are designed to fit and for their purpose carry the full factory warranty. To order factory authorized parts, contact your local BAC representative. Make sure you include the unit serial number when ordering any parts.

Unit operation & Storage

If the unit is going to remain in outdoor storage in excess of three months prior to installation, remove the stretch wrap (if supplied) and follow the prolonged outdoor storage recommendations listed in the Dry Fluid Cooler - TDFS Rigging & Assembly Instructions.

If you start-up the unit within three months of delivery, follow the instructions below:

General

- Use appropriate lockout procedures. Do not perform any service on or near the unit without first ensuring the unit is de-energized.
- Verify the unit has been installed according to the Dry Fluid Cooler – TDFS Rigging & Assembly Instructions.

Corrosion Protection

BAC products are constructed of corrosion-resistant materials. Materials listed below are used in the equipment construction:

- Galvanized Steel Components: Inspect the galvanized steel components for blemishes or corrosion. Wire brush and recoat the affected areas with a cold galvanizing compound such as zinc rich compound (ZRC).

Inspection

- Conduct external inspection of the equipment. Check for leaks, corrosion, and any structural damage.
- Conduct internal inspection of the equipment. Check for anything unusual such as structural or mechanical component damage.
- Inspect piping and connections.
- Thoroughly inspect the fans for any mechanical or physical damage.
- Verify proper fan tip clearance.
- At seasonal start-up or after prolonged shutdown, check the motor insulation with an insulation tester prior to the motor start-up.
- Check and adjust the belt tension.



Cleaning

- Clean and inspect the fan deck.
- Remove all dirt and debris from the fan guard(s).
- Clean all mechanical components, such as the fan and motor.
- If necessary, clean the coil.
- After installation, remove any steel shavings from inside the unit. This will prevent shavings from rusting onto the surface of the thermosetting hybrid polymer, which may affect the coating's integrity over extended time.

Start-up

Prior to seasonal start-up, lubricate the motor base adjusting screw and the fan shaft bearings. At initial start-up, bearings are factory lubricated prior to shipment. However, if the unit has been idle for more than three months, re-lubricate the bearings.

- Apply RUST VETO® to steel shafts.
- For initial start-up, briefly energize the fan motor(s) and note the direction of rotation. The fan should rotate in the direction indicated by the arrow on the fan cowl.
- Run the fan in manual mode for several minutes to check for any unusual noise or vibrations.
- Check the operation of the Electronic Vibration Cutout Switch.
- Once the cooling tower is operating, check the current and voltage of all three phases (legs) of the fan motor with a heat load on the tower under warm ambient conditions. The current must not exceed the motor nameplate rating.

Control Panel

1. Verify the correct voltage to the control panel with a meter.
2. Before power has been provided to the unit, turn all breakers to the On position inside the control panel.
3. Close the control panel and ensure locks are fully engaged by rotating 90 degrees on each bolt.
4. Turn on the breaker or other power supply that supplies power to the unit.
5. Turn the control panel main disconnect switch to the On position.

Extended Shutdown

Perform the following services whenever the unit is shutdown more than three days:

- Disconnect, lock-out, and tag-out the unit.
- To minimize the risk of biological contamination during shutdown, it is recommended the entire system be drained.
- Coils must be empty and closed off. For extended shutdown periods coils should be charged with nitrogen at 15 psig in the field and capped by adding a welded cap. Upon start-up, the coil connections will require cutting.
- Insert desiccant bags into the control panel to absorb moisture. Seal the control panel for storage.
- Clean all debris, such as leaves and dirt, from the interior and exterior of the unit.
- Cover the fan discharge to keep out dirt and debris.
- Inspect the protective finish on the unit. Clean and refinish as required.
- Start-up and operate fan motors at full speed for at least three hours once a month to move the bearings and allow any condensate that may have ingressed to evaporate.



CAUTION

Do not use steam, high-pressure water or high-pressure air to clean any component.

The service expert for BAC equipment

We offer tailored services and solution for BAC cooling towers and equipment.

- Original spare parts and fill -for an efficient, safe and year round reliable operation.
- Service solutions - preventive maintenance, repairs, refurbishments, cleaning and disinfection for reliable trouble-free operation.
- Upgrades and new technologies - save up energy and improve maintenance by upgrading your system.
- Water treatment solutions - equipment for controlling corrosion scaling and proliferation of bacteria.

For more details, contact your local BAC representative for further information and specific assistance at www.BACservice.eu

More information

REFERENCE LITERATURE

- Eurovent 9-5 (6) Recommended Code of Practice to keep your Cooling System efficient and safe. Eurovent/Cecomaf, 2002, 30p.
- Guide des Bonnes Pratiques, Legionella et Tours Aéroréfrigérantes. Ministères de l'Emploi et de la Solidarité, Ministère de l'Economie des Finances et de l'Industrie, Ministère de l'Environnement, Juin 2001, 54p.
- Voorkom Legionellose. Ministerie van de Vlaamse Gemeenschap. December 2002, 77p.
- Legionnaires' Disease. The Control of Legionella Bacteria in Water Systems. Health & Safety Commission. 2000, 62p.
- Hygienische Anforderungen an raumluftechnische Anlagen. VDI 6022.

INTERESTING WEBSITES

Baltimore Aircoil Company	www.BaltimoreAircoil.com
BAC Service website	www.BACservice.eu
Eurovent	www.eurovent-certification.com
European Working Group on Legionella Infections (EWGLI)	EWGLI
ASHRAE	www.ashrae.org
Uniclimate	www.uniclimate.fr
Association des Ingénieurs et techniciens en Climatique, Ventilation et Froid	www.aicvf.org
Health and Safety Executive	www.hse.gov.uk

ORIGINAL DOCUMENTATION



This manual is originally made in English. Translations are provided for your convenience. In the event of discrepancies, the English original text shall prevail over the translation.





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COOLING TOWERS

CLOSED CIRCUIT COOLING TOWERS

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