



NXF Modular Hybrid 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 the cooling system, scale, corrosion and biological control must be established and initiated when the system is first filled with water and administered on a regular basis thereafter in accordance with recognized Codes of Practice, (such as EUROVENT 9 - 5/6, ACOP HSC L8, Guide des bonnes pratiques, Legionella et tours aéroréfrigérantes, etc.). Water sampling, test results and corrective actions should be recorded in the cooling system logbook.

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	Weekly	Monthly	Quarterly	Every 6 months	Annually	Shutdown
Cold water basin & strainer	X			X			
Operating level and make-up	X		X				
Blow down	X		X				
Sump heater package	X				X		
Rotation of fan(s) and pump(s)	X						
Motor voltage and current	X					X	
Unusual noise and/or vibration	X		X				

Inspections and monitoring	Start-Up	Weekly	Monthly	Quarterly	Every 6 months	Annually	Shutdown
General condition	X		X				
Heat transfer section	X				X		
Drift eliminators	X				X		
Water distribution	X				X		
Electric water level control package	X				X		
Level or alarm switches				X			
TAB test (dip slides)	X	X					
Circulating water quality	X		X				
System overview	X					X	
Record keeping	as per event						

Cleaning procedures	Start-Up	Weekly	Monthly	Quarterly	Every 6 months	Annually	Shutdown
Mechanical cleaning	X					X	X
Disinfection**	(X)					(X)	(X)
Drain basin							X

** depends on applied code of practice



UV System	Start-Up	Weekly	Monthly	Quarterly	Every 6 months	Annually	Shutdown
Inspect and clean water circulation pump	X			X			
Inspect and clean quartz sleeve	X			X			
Inspect and clean UV intensity sensor	X			X			
Check operation of solenoid drain valve, mechanical make-up valve, and drain valve	X			X			
Replace UV bulb						X	

Notes

1. Water treatment and auxiliary equipment integrated in the cooling system may require additions to the table above. Contact suppliers for recommended actions and their required frequency.
2. Recommended service intervals are for typical installations. Different environmental conditions may dictate more frequent servicing.
3. When operating in ambient temperatures below freezing, the unit should be inspected more frequently (see Cold weather operations in the appropriate Operating and Maintenance Instructions).



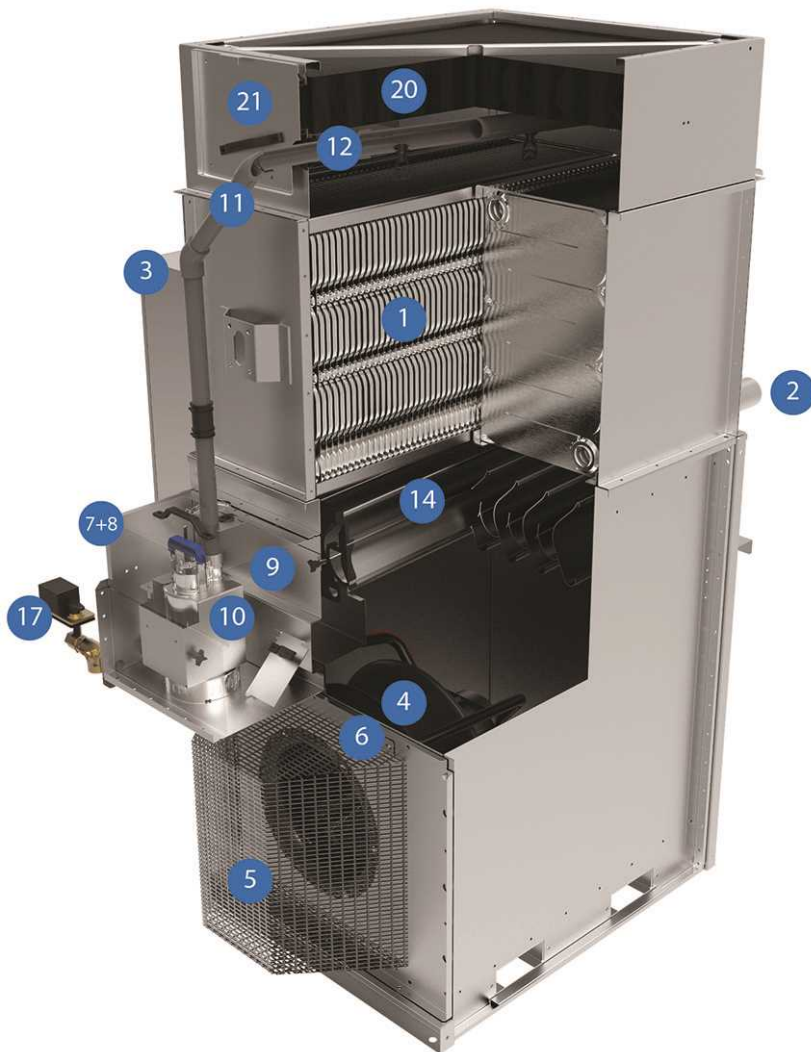
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NXF CONSTRUCTION DETAILS



- 1. hCore® Heat Transfer Technology
- 2. Fluid connection
- 3. iPilot® control system
- 4. EC fan system
- 5. Fan guard
- 6. Hinged EC fan system access panel
- 7. Spray water basin
- 8. Basin access cover
- 9. Basin interior access panels
- 10. Spray pump
- 11. Riser pipe
- 12. Water distribution system
- 13. High and low level switches (not shown)
- 14. Water capture system
- 15. Mechanical make-up valve (not shown)
- 16. Solenoid make-up valve (not shown)
- 17. Drain valve
- 18. Conductivity sensor (not shown)
- 19. Outside air temperature sensor (not shown)
- 20. High efficiency drift eliminators
- 21. Spray distribution access panel



NXF GENERAL INFORMATION

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.

Standard electrical motors are suitable for an ambient temperature range from -25°C to +40°C.

- Design pressure: max. 10 bar
- Fluid inlet temperature: max. 82°C
- Fluid outlet temperature: min. 10°C

Fluids circulated through the inside of the coils must be compatible with the coil construction material, ie.

- black steel, for coated steel common collector (manifold)
- stainless steel AISI 304L or 316L (options)

The installer of BAC closed circuit cooling towers must ensure a proper air purging of the system prior to operation.

Entrained air can restrict the capacity of the cooler, resulting in higher process temperatures.

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.

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

Do not cover units with PVC eliminators with a plastic tarpaulin. Temperature increase due to sun radiation could deform the eliminators.

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.

At no time this equipment should be operated without all fan screens, access panels and access doors in place/closed and properly secured.

When the equipment is operated with a variable fan speed control device, steps must be taken to avoid operating at or near to the fan'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.

LOCATION

All cooling equipment should be located as far away as possible from occupied areas, open windows or air intakes to buildings.

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.

About water care

In all cooling equipment, operating in evaporative mode, the cooling is accomplished by evaporating a small portion of the re-circulating water as it flows through the equipment. When this water evaporates, the impurities originally present in the water remain. Unless a small amount of water is drained from the system, known as blow down, the concentration of dissolved solids will increase rapidly and lead to scale formation or corrosion or both. Also, since water is being lost from the system through evaporation and blow down, this water needs to be replenished.

The total amount of replenishment, known as make-up, is defined as:

Make-up = evaporation loss + blow down

In addition to the impurities present in the make-up water, any airborne impurities or biological matter are carried into the equipment and drawn into the re-circulating water. Over and above the necessity to blow down a small quantity of water, a water treatment programme specifically designed to address scale, corrosion and biological control should be initiated when the system is first installed and maintained on a continuous base thereafter. Moreover there must be an ongoing programme of monitoring in place to ensure the water treatment system is maintaining the water quality within the control guidelines.

Check and adjustments of blow down depends on the blow down device actual in use.

To prevent excessive build-up of impurities in the circulating water, a small amount of water must be « bled » from the system at a rate to be determined by the water treatment regime. The amount of blow down is determined by the design cycles of concentration for the system. These cycles of concentration depend on the quality of the make-up water and the design guidelines for the quality of the recirculating water given below.

Make-up water to the evaporative unit should have minimum 30 ppm hardness as CaCO_3 .

Where use of a softener is necessary to achieve this, the supply to the evaporative unit should not be totally softened, but blended with the incoming unsoftened water to achieve the minimum hardness between 30 and 70 ppm as CaCO_3 .

Maintaining a minimum hardness in the make-up water offsets the corrosive properties of totally softened water and reduces the reliance on corrosion inhibitors to protect the system.

To control corrosion and scale, the water chemistry of the circulated water has to be kept within the water quality guidelines of the specific materials of construction used, as listed in the following table(s).



	Baltibond® Hybrid Coating and SST304L
pH	6.5 to 9.2
Total hardness (as CaCO ₃)	50 to 750 mg/l
Total alkalinity (as CaCO ₃)	600 mg/l max.
Total dissolved solids	2050 mg/l max.
Conductivity	3300 µS/cm
Chlorides	300 mg/l max.
Sulfates*	350 mg/l max.*
Total suspended solids	25 mg/l max.
Chlorination (as free chlorine / halogen): continuous	1.5 mg/l max.
Chlorination (as free chlorine / halogen): batch dosing for cleaning & disinfection	5-15 mg/l max. for 6 hours max. 25 mg/l max. for 2 hours max. 50 mg/l max. for 1 hour max.

Circulated water quality guidelines for Baltibond® Hybrid Coating

***Note:** Higher concentration of sulfates is allowed, provided the sum of chlorides + sulfates parameters does not exceed 650 mg/l for Baltibond®/SST304L.

***Note:** In case of a HDG coil, passivation of the coil is required. During this period, both the pH and the hardness of the spray water will have more stringent requirements. The pH must be kept between 7 and 8.2, and the hardness must be kept between 100 and 300 ppm.

	SST316L
pH	6.5 to 9.5
Total hardness (as CaCO ₃)	0 to 750 mg/l
Total alkalinity (as CaCO ₃)	600 mg/l max.
Total dissolved solids	2500 mg/l max.
Conductivity	4000 µS/cm
Chlorides	750 mg/l max.
Sulfates*	750 mg/l max.*
Total suspended solids	25 mg/l max.
Chlorination (as free chlorine/halogen): continuous	2 mg/l max.
Chlorination (as free chlorine/halogen): batch dosing for cleaning & disinfection	5-15 mg/l max. for 6 hours max. 25 mg/l max. for 2 hours max. 50 mg/l max. for 1 hour max.

Circulated water quality guidelines for Stainless Steel

***Note:** Higher concentration of sulphates is allowed provided the sum of chlorides + sulphates parameters does not exceed 1500 mg/l for SST316L.

For Ozone water treatment application:

- Stainless steel 316L execution is required.

- Ozone levels are to be maintained to 0.2 ppm \pm 0.1 ppm for at least 90% of the time, with absolute maximum peaks of 0.5 ppm

Cycles of concentration are the ratio of the dissolved solids concentration in the circulating water compared to the dissolved solids concentration in the make-up water. The blow down rate can be calculated as follows:

Blow down = Evaporation loss / (Cycles of concentration – 1)

The evaporation loss is not only function of the heat load but also depends on climatic conditions, the type of equipment used and the method of capacity control, which is applied. The evaporation loss at summer conditions is approximately 0.431 l/ 1000 kJ heat rejection. This number should be used for blow down valve sizing only and not for the calculation of annual water consumption.

Biological control

The growth of algae, slimes and other micro-organisms, if uncontrolled, will reduce system efficiency and may contribute to the growth of potentially harmful micro-organisms, such as Legionella, in the recirculating water system.

Accordingly a treatment programme specifically designed to address biological control should be initiated when the system is first filled with water and administered on a regular base thereafter in accordance with any regulations (national, regional) that may exist or in accordance with accepted codes of good practice, such as EUROVENT 9-5/6, VDMA Detailsheet 24649 etc.

It is strongly recommended to monitor the bacteriological contamination of the recirculating water on a regular base (for example, TAB test with dip slides on a weekly base) and record all results.

Certain products used for water treatment, particular some dispersant and bio-dispersant additives, might change the properties of the water (such as the surface tension), which can cause excessive drift loss (water passing through the eliminators). In such case we recommend to review the water treatment (product type, dosage) with your water treatment expert.

In case of doubt, a short test can be performed, after cleaning & disinfection, using fresh water without addition of the concerned chemical (within the limits of the local legislation).

Chemical treatment

1. Water treatment chemicals or non-chemical systems need to be compatible with the materials of construction used in the cooling system including the evaporative cooling equipment itself.
2. In case of chemical water treatment, chemicals should be added to the recirculating water by an automatic feed system. This will prevent localised high concentrations of chemicals, which may cause corrosion. Preferably the water treatment chemicals should be fed into the cooling system at the discharge of the recirculation pump. The chemicals should not be fed in concentrated form, nor batch fed directly into the cold water sump of the evaporative cooling equipment.
3. BAC specifically discourages acid dosing as mean of scale control (unless under certain strict circumstances for open circuit cooling towers with very large system volume and remote sump, or constructed from stainless steel).
4. A competent water treatment company should be consulted for the specific water treatment programme to be applied. Next to the supply of dosing and control equipment and chemicals, the programme should include regular monthly monitoring of the circulating and make up water quality.
5. If it is proposed to operate a treatment programme outside the BAC Water Quality Control Guidelines, the BAC factory warranty may be invalidated if the water quality is persistently outside the Control Guidelines, unless specific prior written BAC approval. (Some parameters may be exceeded under certain strict circumstances.)



It is strongly recommended to check the key parameters of the circulating water quality on a monthly base. See table: "Circulated water quality guidelines". All test results need to be recorded.

Overflow connection

A slight loss of water through the overflow on forced draft units is normal when the fans are in operation, since the unit is in overpressure and some saturated air will be blown out to the unit, carrying several droplets of water.

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NXF COLD WEATHER OPERATIONS

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 sump water freezing

Units exposed to below freezing ambient temperatures, require protection to prevent freezing of the water in the wet sump. During dry operation all water will drain into the wet sump, that is shielded from the air stream. Heaters in the wet sump are sufficiently sized to prevent freezing at temperatures as low as -18°C at full speed of the fan system.

Capacity control

In addition to protecting the sump water, all exposed water piping, in particular make-up water lines should be heat traced and insulated.

It is necessary to prevent the recirculating water from approaching freezing conditions when the system is operating under load.

It is not recommended to cycle the spray pump as a means of controlling the unit capacity.

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 closed circuit cooling tower 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.

If the system must be operated with water, 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 based on -14°C ambient temperature and 20 m/s velocity. 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.

Draining of the coil(s) is not recommended as a normal method of freeze protection unless the coil(s) are constructed from stainless steel or are of the cleanable type. For standard hot dip galvanized coils draining is ONLY acceptable as an emergency method of freeze protection, since draining will lead to internal corrosion of the coil. For this purpose an automatic drain valve and air vent needs to be installed to drain the coil(s) if flow stops or the fluid temperature drops below 10°C when the ambient temperature is below freezing.

Ensure that all coils and/or coil sections (split coils/multi-circuiting) can drain individually.

Model	Minimum flow (l/s)	Appr. min. heat (kW)	Appr. minimum heat loss with PCD (kW)
NXF 0403E-CS2TS-H1	1.5	15	7.5
NXF 0403E-CS2TS-H2	3	30	15
NXF 0403E-CS2TS-H3	4.5	45	20
NXF 0403E-CS2TS-H4	6	60	25
NXF 0403E-CS2TS-H5	7.5	75	35
NXF 0403E-CS2TS-H6	9	90	40
NXF 0403E-CS2TT-H1	1	15	7.5
NXF 0403E-CS2TT-H2	1.5	30	15
NXF 0403E-CS2TT-H3	2.5	45	20
NXF 0403E-CS2TT-H4	3	60	25
NXF 0403E-CS2TT-H5	4	75	35
NXF 0403E-CS2TT-H6	4.5	90	40
NXF 0603E-CS2TS-J1	2.5	25	10
NXF 0603E-CS2TS-J2	4.5	50	20
NXF 0603E-CS2TS-J3	7	75	25
NXF 0603E-CS2TS-J4	9	95	35
NXF 0603E-CS2TS-J5	11.5	120	40
NXF 0603E-CS2TS-J6	13.5	140	45
NXF 0603E-CS2TT-J1	1	25	10
NXF 0603E-CS2TT-J2	2.5	50	20
NXF 0603E-CS2TT-J3	3.5	75	25
NXF 0603E-CS2TT-J4	4.5	95	35
NXF 0603E-CS2TT-J5	5.5	120	40
NXF 0603E-CS2TT-J6	7	140	45

Minimum requirements for water flow and heat load

Nexus® Modular Hybrid Cooler with factory installed control panel

Each unit is equipped with a control panel. The fan speed is controlled and the pumps are activated by a PLC integrated into the electrical panel.

Control logic

When a module works dry, the spray pump is turned off. Heat is now transferred from the process fluid to the ambient air using sensible heat transfer.

The modular construction and exclusive iPilot® Control System of the Nexus® enable multiple modes of operation to tailor water and energy performance to your needs. The embedded intelligence gives you the ability to effectively balance water and energy savings and achieve the lowest possible operating costs.

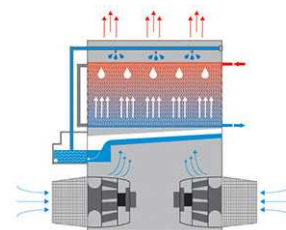
The fan speed is controlled on the basis of the actual process fluid return temperature and the design return temperature, ensuring a minimum electrical consumption and noise levels. Evaporative cooling will be activated and stopped on the basis of a pre-programmed logic.

The control logic is preprogrammed and is ready for operation.

Depending on the actual size of the installation, the controller pre-programmed PI process parameters may need to be adjusted.

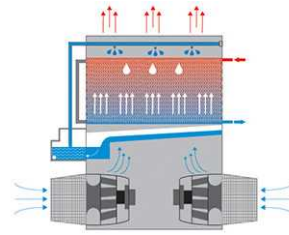
ENERGY SAVER MODE

Energy savings are maximized by leveraging the full power of evaporative cooling. During periods when ambient temperatures or loads from the building or process are relatively high, the Nexus® modular hybrid cooler operates with all spray systems active across all modules. During off-design conditions, the EC Fan System will automatically and intelligently reduce speed whenever possible. As the load is satisfied, the fans and spray pumps will cycle off.



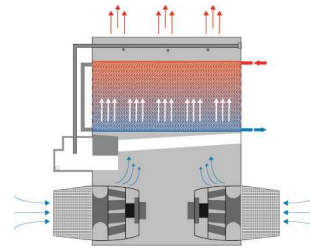
NEXUS® MODE

In the revolutionary Nexus® mode, you can prioritize water and energy savings to achieve the right balance of both. Your climate, cooling load profile and the rates you pay for water and energy will determine your specific settings, which can be easily adjusted as needed. You can specify the importance of water versus energy savings to automatically achieve the right balance for your specific situation.

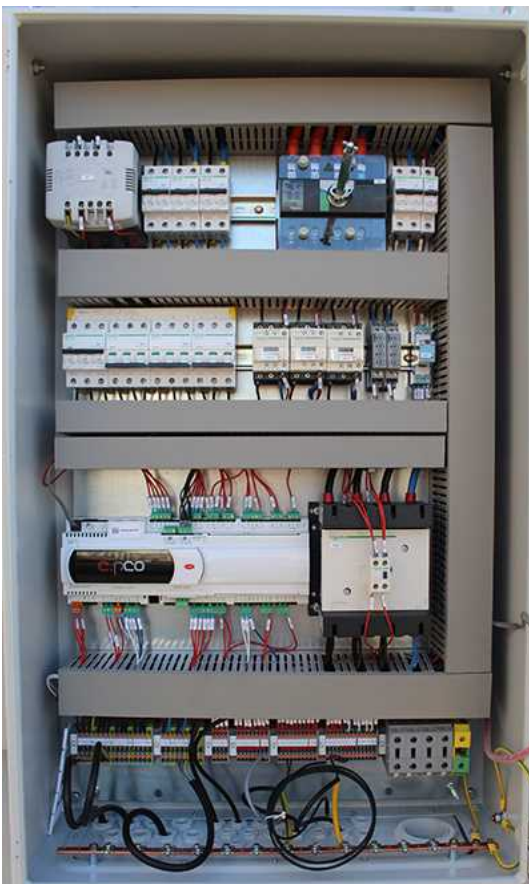


WATER SAVER MODE

In water saver mode, water savings are maximized by applying spray water to the hCore® Heat Exchanger automatically, intelligently and only when absolutely necessary to meet cooling requirements. The iPilot® Control System applies water separately to each module, to minimize water usage and maximize savings.



Electrical panel



Electrical panel for unit with EC fans



At the outside of the panel, the following components can be found:

- Emergency stop
- Reset button
- ON/OFF switch
- Display for digital controller

Operating instructions digital controller

There are different menu's:

- Main Loop
- User
- Point overview
- System information
- Clock
- Alarm Logs



Please refer to the Software Instructions Manual (SI-NXF) 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.

Monitoring of process information

DRY CONTACTS AT TERMINAL STRIP IN ELECTRICAL PANEL

- Input:
 - Remote start/stop
 - Customer input for fan speed control
- Output:
 - General Alarm (NO)

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 card can be installed in the controller.

6

NXF MAINTENANCE PROCEDURE

Checks and adjustments

COLD WATER BASIN AND BASIN STRAINERS

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

To remove this debris, the entire cold water basin should be drained, cleaned and flushed with fresh water to remove the silt and sediment which normally collects in the basin during operation.

When flushing the basin, the strainers should be left in place to prevent the sediment from re-entering the unit system. After the basin has been flushed, the strainers should be removed, cleaned, and replaced before refilling the basin with fresh water.

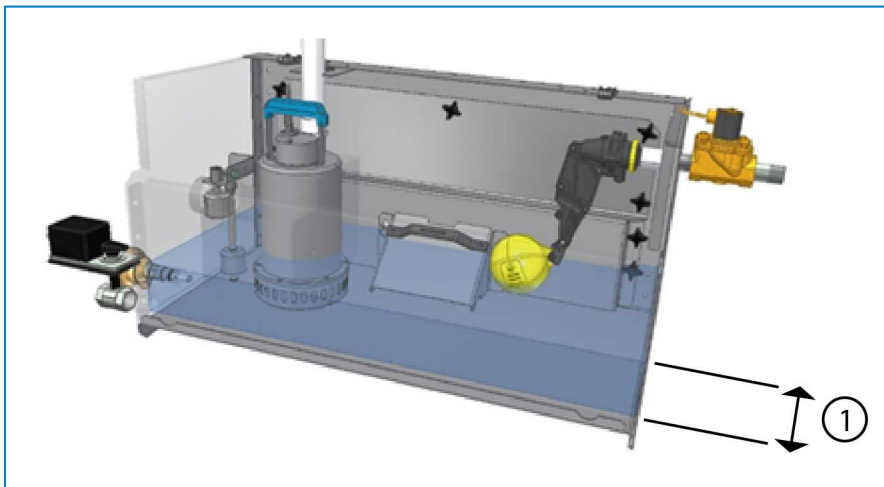


CAUTION

Do not use acid to clean the strainers.

OPERATING LEVEL AND MAKE-UP

Before initial start up the straps, that prevent the float ball from moving during transport, as well as the protective bag around this ball, need to be removed.



Operating water level

1. Operating height

Model	Operating height (measured from pan bottom) (mm)
NXF 0403E-****_**	90
NXF 0603E-****_**	100

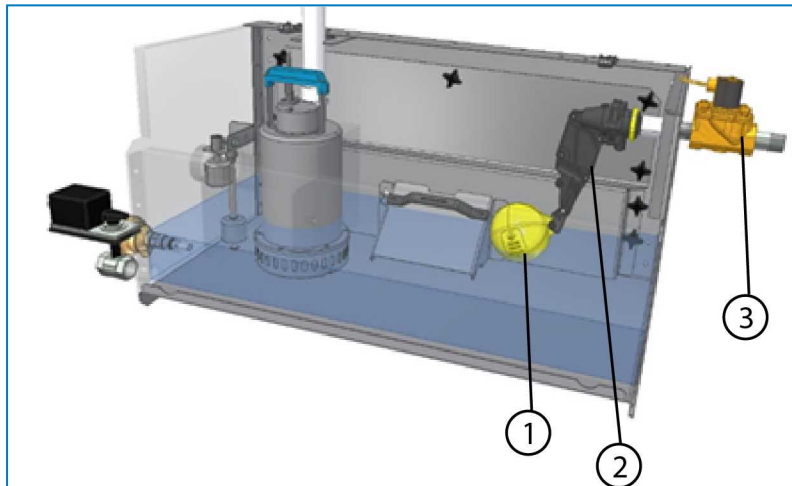
Operating heights

To check the operating level, proceed as follows:

1. Keep pump(s) running.
2. Open the basin access cover at the make-up valve side.
3. Measure height from sump bottom to water level and compare with face value from table.
4. Check valve for leakage and replace valve, if necessary.
5. Check that float arm can move freely and that float ball floats and closes valve.
6. Ensure that make-up water supply is adequate.

If a float operated water make-up is used, initial setting and regular adjustments are needed.

The float controlling the make-up valve is mounted on a threaded rod, held in place by wing nuts. (see figure below)



1. Float ball
2. Float arm assembly
3. Float valve



CAUTION

Supply pressure for mechanical make-up valves should be between 1 and 3,5 bar.

To make the initial basin water level setting, fill the sump with water until 2 cm above operating level. Adjust the wing nuts of the float ball so, that the make-up valve is completely closed.

Under normal load conditions this setting should produce the correct operating level. At low load conditions the operating level will rise and needs to be adjusted.

The unit basin should be closely monitored and water level adjusted as necessary during the first 24 hours of operation.

BLOW DOWN

For automatic blow down using conductivity control, ensure that the conductivity probe is clean and that the blow down solenoid valve is operational. Unless you have a specific adjustment procedure, your water treatment company should check and adjust set points.

SUMP HEATER PACKAGE

Sump heaters must only operate in the winter to prevent the sump water from freezing, when the water pump(s) and the fan(s) are shut off.

Under no circumstances should sump heaters operate at other times as they could potentially heat the water to temperature levels, which are favourable to bacteriological growth. Ensure every six months the heater thermostat is properly set and clean. Also ensure that control and safety devices, such as low level cut out switches, are operational, clean and properly incorporated into the control circuit.



CAUTION

Sump heaters can be hot.

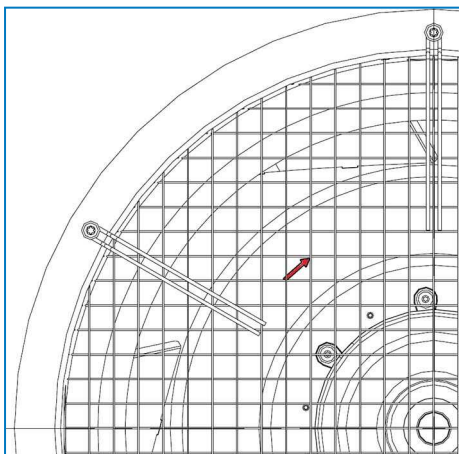
ROTATION OF FAN(S) AND PUMP(S)

Fans must rotate without obstruction and both fans and pumps must rotate in the correct direction, which is indicated by arrows on the equipment. Do not start in opposite direction as indicated. Check proper functioning as follows:

1. Stop fan(s) and pump(s).
2. Turn the fan by hand to ensure rotation without obstruction. Remove obstruction, if present.
3. Start the pump(s) and check for the proper rotation as indicated by the arrow on the pump cover. If rotation is wrong, stop pump and correct electrical wiring.
4. Start the fan(s) and check for proper rotation as indicated by the arrow on the fan housing. If rotation is wrong stop fan(s) and contact BAC.



If the fan(s) and/or motor(s) are standing still, the shaft must rotate occasionally and a check by hand must be done to ensure they are not blocked during stand still. When blocked, the pump or fan has to be loosened before start up.



Fan rotation direction should be checked during commissioning, but also after every software update.

MOTOR VOLTAGE AND CURRENT

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

When motor is stored with unit in kit form, the motor insulation should be checked with a Megger insulation tester prior to restarting.

1. Insulation resistance test – minimum value should be 1 Mega Ohm (1.000.000 Ohms).
2. Thermistors, if fitted, should be checked for continuity with a multi-meter but never Megger-tested.
3. Ensure supply voltage and frequency correspond to the motor nameplate rating.
4. Ensure shaft turns freely.
5. Wire the motor in accordance with the wiring diagram as shown on the motor nameplate and/or in the motor terminal box.
6. Turn on unit and check amp draw does not exceed nameplate rating.



If motor is stored, it should be in a clean, dry place & have the shaft rotated occasionally. Storage areas should not be subject to vibration.



CAUTION

Rapid on-off cycling can cause the fan motor to overheat.

It is recommended that controls be set to allow a maximum of 6 on/off cycles per hour.

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

The inspection should focus on following areas:

- damage of corrosion protection
- signs of scale formation or corrosion
- accumulation of dirt and debris
- presence of biofilms

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.

If there is evidence of scale formation (more than 0,1 mm) or corrosion, water treatment regime must be checked and adjusted by the supplier.

Any dirt and debris need to be removed following the "Cleaning procedures" on page 24 .

If there is evidence of biofilms the system, including piping should be drained, flushed and cleaned of slimes and other organic contamination. Refill system with water and apply biocide shock treatment. Check pH value and functionality of ongoing biocide treatment.

HEAT TRANSFER SECTION

The inspection procedure is as follows:

1. Shut off fan(s) and pump(s).
2. Remove the spray distribution access panel.
3. Inspect the heat exchanger for
 - obstructions
 - damages
 - corrosion
 - fouling
4. After inspection, install eliminators and access panel and start pump(s) and fan(s).

Remove any obstructions from heat transfer section(s).

Any damages or corroded areas need to be repaired. Call your local BAC representative for assistance.

Minor fouling can usually be removed chemically or by temporary changes to the water treatment programme. Contact your water treatment supplier for advice. Major fouling requires cleaning and flushing according to the "Cleaning procedures" on the next page .

Regular checking of the total aerobic bacteria count (TAB) and maintaining it within acceptable levels are the key to prevent fouling.

DRIFT ELIMINATORS

The inspection procedure is as follows:

1. With fan(s) and pump(s) running visually check for areas with excessive drift loss.
2. Shut off fan(s) and pump(s) and visually check eliminators for
 - obstructions
 - damages
 - cleanliness
 - proper fit
3. If any of the above problems have been observed, stop fan(s) and pump(s) and remove eliminators.
4. Clean eliminators from debris and foreign matter. Remove dirt and obstructions. Replace damaged or ineffective eliminators.
5. Install eliminators and ensure they fit tightly with no gaps.



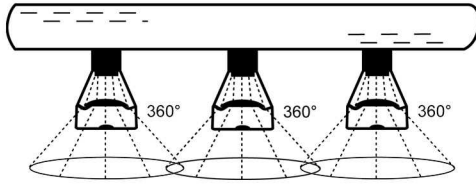
CAUTION

Do not step on eliminators.

WATER DISTRIBUTION

The inspection procedure is as follows:

1. Shut off the fan(s), but leave the pump(s) running.
2. Check and adjust spray pressure, if required. (not applicable for coil models with standard pumps)
3. Remove the eliminators.
4. Check to see if the nozzles are producing the spray pattern shown in figure(s) below
5. Shut off pump(s) and clean water distribution from dirt and debris. Ensure spray branches and nozzles are in place and clean. Replace damaged or missing nozzles.
6. Install eliminators and ensure they fit tightly with no gaps.
7. Start fan(s) and pump(s).



Nozzle spray distribution type

FAN MOTOR

During operation it is required to clean the outside surface of the motor at least every 6 months (or more often depending on site conditions) to ensure proper motor cooling. Do not wash down the motor unless it is IP 66 rated. On a quarterly or six monthly basis check:

- Electric connections
- Motor protection devices
- Check amp draw
- Motor bearings for noise/overheating
- Motor holding bolts
- External surface of motor for corrosion

Cleaning procedures

MECHANICAL CLEANING

Keeping your evaporative cooling equipment (and the associated system) clean will maintain its efficiency and help to prevent uncontrolled bacteriological growth. The recommended cleaning procedures are described below:

1. Disconnect fan and pump motor(s) and shut off make-up supply.
2. Remove screens, eliminators, access panels, doors and drain system. Do not remove sump strainer.
3. Clean debris from exterior and fan(s) with soft brush, if necessary use water and soap.
4. Clean interior with (soap) water and soft brush, if necessary use high pressure water jet.
5. Remove any debris from water distribution system and clean any nozzles if clogged. If necessary nozzle and grommet may be removed for cleaning.
6. Remove debris from heat transfer section.
7. Flush with clean water and drain to remove accumulated dirt.
8. Remove, clean and replace sump strainer(s).
9. Clean debris from screens and eliminators with water jet and install.
10. Remove debris from access doors and panels with soft brush and (soap) water and install.
11. Close drain and open make-up supply. Fill system up to overflow level with clean water.

DISINFECTION

Disinfection of your cooling system may be needed in case of high concentration of aerobic bacteria and/or Legionella. Disinfection is also recommended for evaporative cooling systems with known or suspected high bacteriological levels, prior to a cleaning procedure.

Some local or national guidance also recommends disinfection prior to initial start up, after a prolonged shut down, after routine cleaning operations or when significant alterations have been made to the cooling system. Disinfection must be carried out in accordance with a proper procedure and take into account the safety of the cleaning and disinfection staff.

Typically disinfection is achieved using a sodium hyper chloride solution to maintain a residual value of 5 - 15 mg/l of free chlorine and circulate this around the system for up to 6 hours. Higher chlorine levels for a shorter period are possible, but require a higher level of corrosion protection than galvanized steel only. Consult your BAC representative for further information.

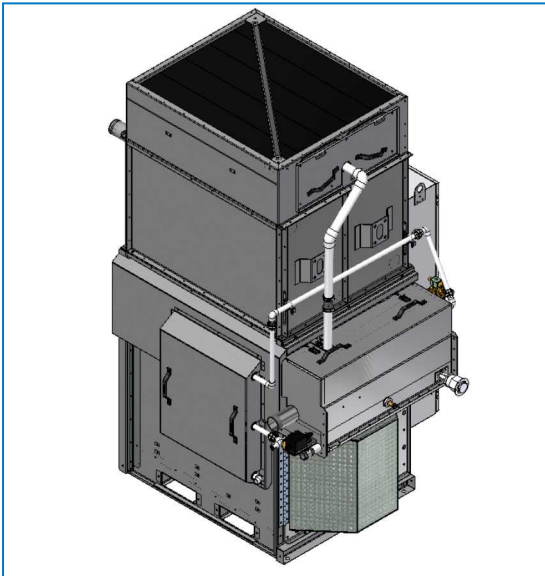
Excessive levels of chlorine must be avoided as this quickly can lead to corrosion and damage to your system. Chlorinated water should be de-chlorinated before draining and after disinfection the system must be thoroughly flushed through with clean water.



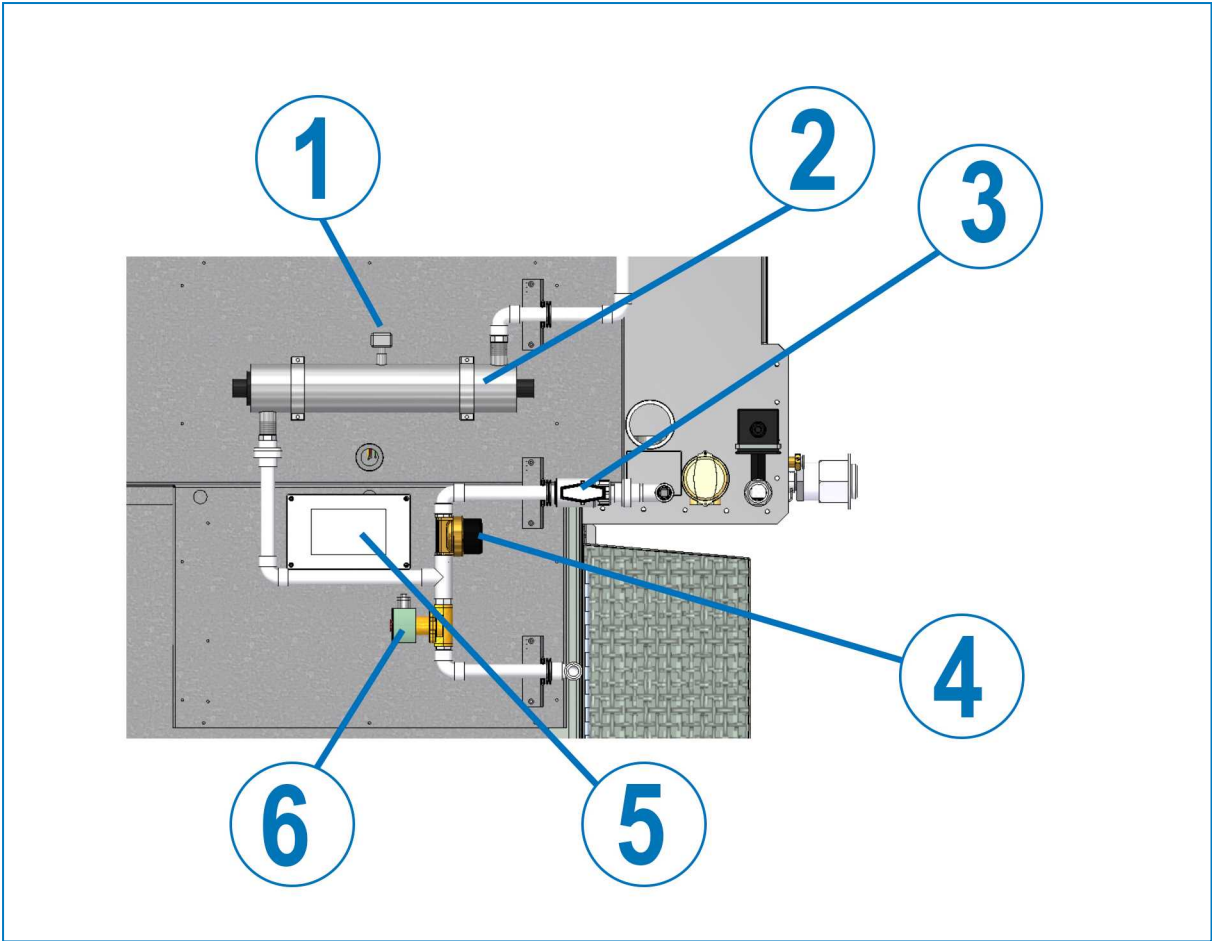
A proper regularly monitored biocide programme reduces the need for cleaning and disinfection actions significantly.

Optional UV System

The optional UV system is designed to reduce bacterial growth, and it is fully integrated into the Nexus® modular hybrid cooler and iPilot® Control System. Before performing any maintenance, follow the proper lockout / tagout procedures.



Nexus® cooler with Optional UV System



UV System components

1. Intensity sensor
2. UV reactor (quartz sleeve and bulb inside of reactor)
3. Ball valve
4. Circulation pump
5. Terminal box
6. Drain valve

Water circulation pump

- Quarterly, ensure that the water circulation pump remains clean and free of dirt or debris



Pump body and volute



CAUTION

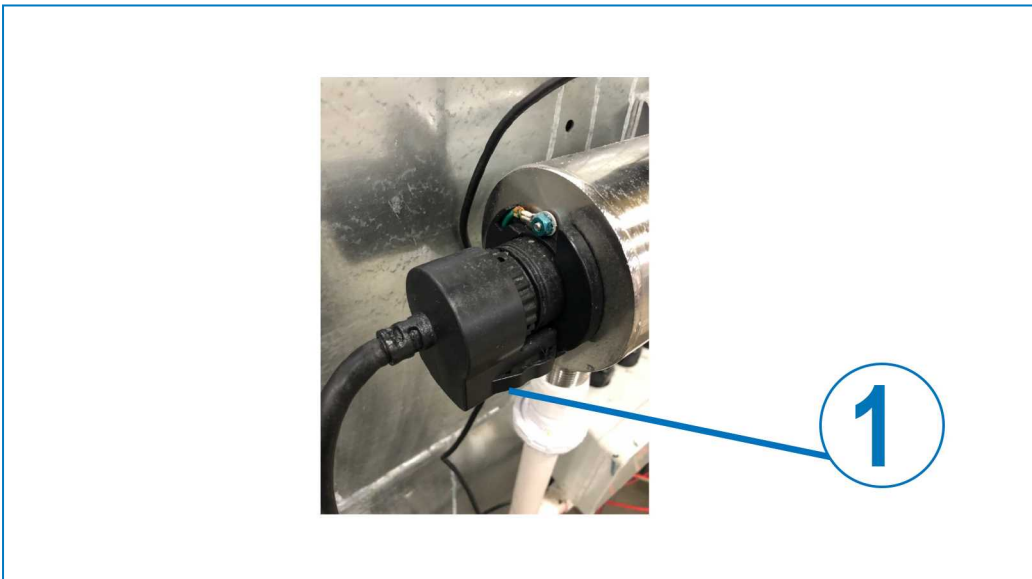
When disassembling any component of the UV system, the power to the system must be disconnected and the Nexus® basin must be fully drained.

- The pump body and volute can be separated by unscrewing the brass collar that joins the pump and volute sections.
- Inspect the impeller for damage and debris.
- Lift the rotor/impeller unit to ensure it is free of foreign matter.
 - Be sure to lift the rotor/impeller unit straight out of the motor cavity to prevent damage to the bearing support.
 - There will be a magnetic force resisting removal of the rotor/impeller.
 - Use gentle, but steady lifting forces, and use fingers only. Do not pry up rotor/impeller unit with a screwdriver.

UV Bulb

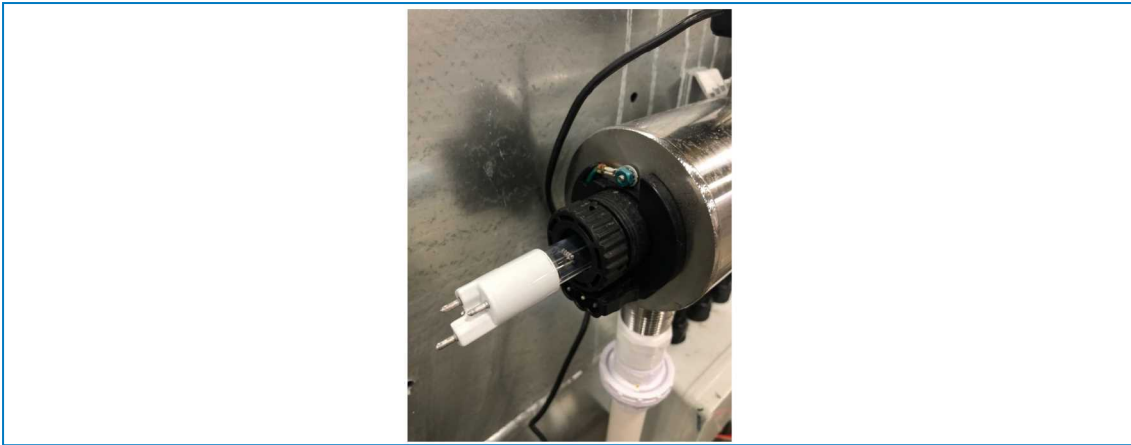
Bulb replacement is a quick and simple procedure requiring no special tools. The UV bulb must be replaced after 9000 hours of continuous operation (approximately one year) in order to ensure adequate disinfection. When disassembling any component of the UV system, the power to the system must be disconnected. To inspect or replace the UV bulb, follow the procedure below:

- Close the ball-valve in the UV system suction line.
- Remove the UV system enclosure.
- Remove the bulb connector by squeezing the plastic locking tabs on the side of the connector.



UV Bulb connector assembled

1. Locking tabs
- Remove the bulb from the chamber and bulb connector base.



UV bulb removal



CAUTION

Do not touch the glass portion of the bulb with bare hands. Always hold it at the ceramic ends.

- Insert the new bulb fully into the chamber leaving about 50 mm of the bulb protruding from the chamber.
- Attach the connector to the bulb and note that the connector will only allow correct installation in one position.
- Push the lamp connector against the bulb connector base together until an audible click is heard.



Bulb replacement

- Replace the UV system enclosure
- Open the ball-valve in the UV system suction line
- Verify the UV system is operating correctly by resuming normal unit operation. Alarms will notify the user within 1 minute of there is a UV intensity or pump operation issue.
 - If UV intensity or UV pumps alarms are activated, consult "Troubleshooting" on page 32.

Ultraviolet (UV) quartz sleeve

Quarterly, and when indicated by the low UV intensity alarms, ensure that the quartz sleeve located inside of the UV chamber is clean and free of dirt or scaling. Throughout normal operation, minerals in the water will slowly form a coating on the lamp sleeve. This coating may not be visible and must be removed because it reduces the amount of UV light reaching the water, thereby reducing disinfection performance. If the sleeve cannot be cleaned, it must be replaced.



CAUTION

When disassembling any component of the UV system, the power to the system must be disconnected and the Nexus® basin must be fully drained.

To clean or replace the quartz sleeve, follow the procedure below:

- Close the ball-valve in the UV system suction line.
- Remove the UV system enclosure.
- Remove the lamp connector by squeezing the plastic locking tabs on the side of the connector.
- Remove the lamp from the chamber and lamp connector base.



CAUTION

Do not touch the glass portion of the bulb with bare hands. Always hold it at the ceramic ends.

- Remove the bottom retaining nut, floating spring, and O-ring.



UV quartz sleeve removal

- Remove the top retaining nut and O-ring.
- Remove the quartz sleeve.



- Clean the quartz sleeve with a cloth soaked in decalcifier, vinegar or some other mild acid and then rinse with water.



If the sleeve cannot be cleaned completely or it is scratched or cracked, then replace the sleeve.

- Reinstall the quartz sleeve in the chamber allowing the sleeve to protrude an equal distance at both ends of the chamber.
- Reinstall the O-rings onto each end of the quartz sleeve.
- Reinstall the top and bottom retaining nuts and floating spring.
- Insert the new lamp fully into the chamber leaving about 50 mm of the lamp protruding from the chamber.
- Attach the connector to the lamp and note that the connector will only allow correct installation in one position.
- Push the lamp connector against the lamp connector base together until an audible click is heard.
- Replace the UV system enclosure.
- Open the ball-valve in the UV system suction line.
- Verify the UV system is operating correctly by resuming normal unit operation. Alarms will notify the user within 1 minute of there is a UV intensity or pump operation issue.
 - If UV intensity or UV pumps alarms are activated, consult "Troubleshooting" on page 32.

UV Intensity sensor

Quarterly, and when indicated by the low UV intensity alarms, ensure that the intensity sensor located on the top exterior of the UV chamber is clean and free of dirt or scaling. Throughout normal operation, minerals in the water will slowly form a coating on the intensity sensor window. This coating may not be visible and must be removed, because it reduces the amount of UV light reaching the sensor, thereby giving a false indication of lower disinfection performance.



CAUTION

When disassembling any component of the UV system, the power to the system must be disconnected and the Nexus® basin must be fully drained.

To clean or replace the intensity sensor, follow the procedure below:

- Close the ball-valve in the UV system suction line.
- Remove the UV system enclosure.
- Unscrew the intensity sensor from the top of the UV chamber.



Intensity sensor removal

- Clean the intensity sensor window with a cloth soaked in decalcifier, vinegar or some other mild acid and then rinse the water.
- Reinstall the intensity sensor.
- Replace the UV system enclosure.
- Open the ball-valve in the UV system suction line
- Verify the UV system is operating correctly by resuming normal unit operation. Alarms will notify the user within 1 minute of there is a UV intensity or pump operation issue.
 - If UV intensity or UV pumps alarms are activated, consult "Troubleshooting" on the next page.

UV System solenoid drain valve

The UV system solenoid drain valve should be inspected quarterly. However, the interval between cleaning will vary depending on water quality and service conditions. If the voltage to the solenoid is correct, then sluggish valve operation, excessive noise, or leakage will indicate that cleaning is required. The valve is normally open, but faulty valve operation may cause it to fail either open or closed.



Drain solenoid valve

Troubleshooting

Problem	Possible cause	Solution
Fan does not run	No power to the fans	<p>Cycle power on/off the unit.</p> <p>Confirm that power is applied to the unit at the main disconnect.</p> <p>Confirm that power is applied to each fan by checking terminals.</p> <p>Check all terminals for tightness.</p> <p>Check power wires at fan housing.</p> <p>Check all terminals at Modbus module for tightness.</p>
	Fan internal fault	<p>Check for the fan alarm on the controls user interface for fan internal fault.</p>
	Control signal issue	<p>Check with a meter the control voltage at the terminals -V, 10V or mA depending on control signal.</p> <p>Ensure fan speed control signal is being sent to the unit.</p>
Fan spins backwards	Fan is off / faulty	<p>Turn the unit off. Allow all fans to stop completely. Check all breakers and power connections. Restart the unit and ensure all fans are operational and make sure the fan spins in right direction. If it does not, contact your local BAC representative.</p>

Problem	Possible cause	Solution
Fan does not respond to the control signal	Communications fault	<p>Ensure the communications cable is connected to the controller on port J26.</p> <p>Ensure the communications cable is not cut or damaged.</p> <p>Ensure the communications cable is properly connected at the fan motor.</p>
No spray water or Pump does not run	<p>Incorrect set point</p> <p>No water supply</p> <p>Pump fault</p> <p>Pump strainer fault</p> <p>Water distribution system clogged</p>	<p>Check the leaving process fluid temperature set point on the controller and the operating mode. The spray pump will only run when the ambient temperature is above 1,6°C. For additional details, see "Cold Weather Operations" on page 13</p> <p>Ensure water is being supplied to the solenoid make-up valve. Inspect solenoid make-up valves, and clean as required.</p> <p>Check mechanical make-up valve and float assembly by manually raising and lowering the float.</p> <p>Check pump voltage, and confirm that pump operates correctly in Manual mode.</p> <p>Clean the pump strainer quarterly.</p> <p>Clean the spray branches and the nozzles.</p>
Low performance	<p>Not performing maintenance intervals</p> <p>Equipment is not operating</p>	<p>Inspect the water distribution system, EC fan system, and process fluid flow.</p> <p>Ensure that leaving fluid temperature setpoint is at the desired value. Ensure that the system is not in manual smode and Out of State value status for all the components is "NO".</p>
Scale formation on hCore® Heat Transfer Technology	<p>Hard water</p> <p>Faulty drain valve</p>	<p>Ensure that conductivity set point is at the the desired value. Ensure that the system is not in manual smode and Out of State value status for all the components is "NO".</p> <p>Increase the frequency or duration of bleed by adjusting it in either time-based bleed or conductivity-based bleed mode.</p> <p>Ensure the drain valve opens and closes 100% in response to the iPilot® Control System.</p>
Unit does not run in any operating mode OR system doesn't go live	<p>BMS communication</p> <p>Manual mode is enabled. Components Out of Status Value is "YES".</p>	<p>Ensure the BMS wiring and configuration.</p> <p>Turn off the manual mode. Ensure the Out of Status Value for all the components is "NO".</p>

7

NXF 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.

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

- Water make-up valve
- Spray nozzles and grommets
- Spray distribution branch grommets
- Baltibond® repair (touch-up) kits

Insist on factory authorised parts to avoid loss of efficiency or an operational risk, which may occur when non authorised parts are used.

Prolonged outdoor stay

Should the unit(s) be stored outside for approximately one month (shelf life) or longer, or stored in severe climates, it is imperative that certain actions be performed by the installing contractor in order to maintain the unit in "as shipped" condition. These actions include but are not limited to:

- Rotate the fan(s) once per month, at least 10 revolutions.
- Rotate the motor shaft of all motors installed on the unit(s) once per month, at least 10 revolutions. This includes the pump motor.
- Add desiccant bags to control panel interiors to absorb moisture.
- Keep drains open on the cold water basins.
- Ensure unit(s) is stored on level ground surface and free from ambient vibration.
- Ensure hot water basins are covered.
- Remove and store fan belts and access door gaskets.
- Purge old bearing grease by new grease at start of storage period and repeat before start-up.
- Protect all black steel components with RUST VETO or equivalent corrosion protective material.
- 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). 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. BAC motors are standard duty motors designed for storage at ambient temperatures of -25°C to 40°C. Prolonged periods of exposure below or above these specified conditions could degrade components of the motor and cause malfunction or premature failure.



- Hot dip galvanized and stainless steel coils of BAC closed circuit cooling towers are filled with a low pressure inert gas at the factory before shipping, to ensure an optimal internal corrosion protection. It is recommended to check the overpressure every six months (connect a manometer to the valve).
- Purge old bearing grease by new grease at start of storage period and repeat before start-up.
- Protect all black steel components with RUST VETO or equivalent corrosion protective material.

For complete instructions, please contact your local BAC representative.



NXF

FURTHER ASSISTANCE & INFORMATION

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
Uniclîma	www.uniclîma.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

ICE THERMAL STORAGE

EVAPORATIVE CONDENSERS

HYBRID PRODUCTS

PARTS, EQUIPMENTS & SERVICES

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