VIRGA III® VIRGA X3®

HYBRID PROCESS COOLER

USER GUIDE

NIMBUS™

ADVANCED PROCESS COOLING

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SAFETY PRECAUTIONS

⚠ This is the safety alert symbol. It is used to alert the user to potential hazards that may result in physical injury or death. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER indicates a hazard that, if not avoided, will result in serious injury or death.

WARNING indicates a hazard that, if not avoided, could result in serious injury or death.

CAUTION indicates a hazard that, if not avoided, could result in minor or moderate injury.

NOTICE indicates important information unrelated to safety hazards, such as messages related to property damage.

INTRODUCTION

Your Virga III or Virga X3 hybrid process cooler is designed to cool a process cooling fluid using a combination of fans and an adiabatic cooling spray. The Virga controller monitors the temperature of the process cooling fluid leaving the cooler and compares it against a set point. When the temperature of the process fluid rises above the set point, the fans will start.

For coolers with fan staging controls, the fan closest to the leaving fluid headers will start first. If the fluid temperature remains above the set point, the remaining fans will start in stages, in order of distance from the leaving fluid headers.

For coolers with fan speed controls, the fans will start at a low speed. If the fluid temperature remains above the set point, the fan speed will gradually increase.

If all fans are running at full speed, and the fluid temperature remains above the set point, the Virga will spray water to cool the air around the cooler to provide additional heat rejection.

The Virga hybrid process cooler is suitable for operation in non-hazardous locations with an ambient temperature between -13°F and 104°F (-25°C and 40°C). Nimbus may, upon request, evaluate the suitability for use in other locations.

The Virga features stainless steel construction as standard for superior corrosion resistance.

The Virga heat exchange coils are treated with a coil coating to prevent scale buildup and corrosion from the chemicals found in most city water. The coating has been tested for corrosion resistance per ASTM B117 with no significant corrosion after 25,000 hours of testing and for microbiological growth resistance per ASTM G21.

SHIPMENT AND HANDLING

Before accepting the Virga from the freight carrier, inspect the cooler carefully for signs of shipping damage including but not limited to dented heat exchange coils, bent spray piping, and damaged fan grills. The table below lists the components most commonly damaged during shipment.

	RECOMMENDED INITIAL INSPECTION
☐	Inspect coil surfaces for bent fins.
☐	Inspect spray piping for bent pipe or damaged spray nozzles.
☐	Inspect spray piping manifold for damaged pressure gauge, solenoid valves, or piping.
☐	Inspect temperature sensor in leaving fluid header for broken cable.
☐	Inspect fan grills for dents or broken or missing bolts.
☐	Inspect fan venturi rings for broken or missing rivets.
☐	Inspect fan blades.

Document any damage prior to removing the Virga from the truck. Nimbus assumes no liability for equipment damaged during shipment. Any shipping damage claims should be submitted to the freight carrier.

The Virga is equipped with lifting lugs along the top of the unit. A crane lift using a spreader bar is the preferred unloading and installation method for all models. Refer to the rigging drawing provided in the cooler document pack for rigging dimensions and weights.

NOTICE
Using the coil case, mounting feet, or drain pains as lifting points will damage the cooler. Do not attempt to lift the cooler using the coil case, mounting feet, or drain pains. Use only the lifting lugs to lift the cooler.

Virga X3 models will ship with the top row of spray piping disassembled. The spray piping and hardware required to install it will ship loose with the cooler.

Take special care not to bump, hit, or otherwise stress the coil, fins, headers, tubing, or connections during the lifting or positioning of the unit. Do not walk on the top of the unit. Do not step on the drain pans.

The heat exchange coils consist of a copper tube bundles and aluminum fins. The aluminum fins are easily bent. Bent fins will reduce the Virga's heat rejection capacity. Depending on the severity of the damage, it may be possible to repair bent fins using a fin comb. If the fin damage is severe, Nimbus recommends that the coil be pressure tested with a nitrogen charge to check for potential leaks in the copper tube bundle.

Do not use the spray piping as a handle to guide the cooler during lifting or installation. Do not hang tools from the spray piping. Do not climb on the spray piping. Contact with the spray piping may cause it to bend. Bent spray piping may create low points that prevent water from completely draining. Trapped water may freeze in winter weather and damage the spray piping. Minor bends in the spray piping may be straightened by hand by applying gentle pressure to the piping in the opposite direction of the bend.

Failure to observe the above recommendations may void the warranty.

CLEARANCES

Control Panel
Minimum allowable clearances in front of the control panel are dictated by the U.S. National Electrical Code (NFPA 70) or the Canadian Electrical Code (CSA 22.2) and the user's local electrical codes. A minimum clearance of 3 ft. 6 in. shall be required between the control panel and any grounded parts, including concrete and brick. Refer to any relevant national or local electrical codes to determine if greater clearances are required for the installation location.

Fluid Headers
Nimbus recommends a minimum of 4 ft. of clearance on the fluid header end of the Virga to provide maintenance access to the fluid headers, temperature sensor, and adiabatic cooling spray piping. Increase clearance as needed to facilitate installation and plumbing.

Fans
The Virga fans draw air across the coils and exhaust it vertically upward above the unit. Obstructions above the cooler such as roofs or tall, solid walls may cause warm exhaust air to recirculate across the coils, reducing the cooler's heat rejection capacity. The Virga should not be installed under a roof of any kind. If the Virga will be installed next to a wall that is taller than the cooler, Nimbus recommends elevating the Virga so that the fans are level with the top of the wall. If the cooler cannot be elevated, Nimbus recommends the addition of a baffle between the cooler and the wall to prevent exhaust air recirculation. The baffle should extend the length of the entire Virga coil case. The baffle should be made of a corrosion resistant material such as fiberglass with sufficient stiffness to prevent excessive vibration.

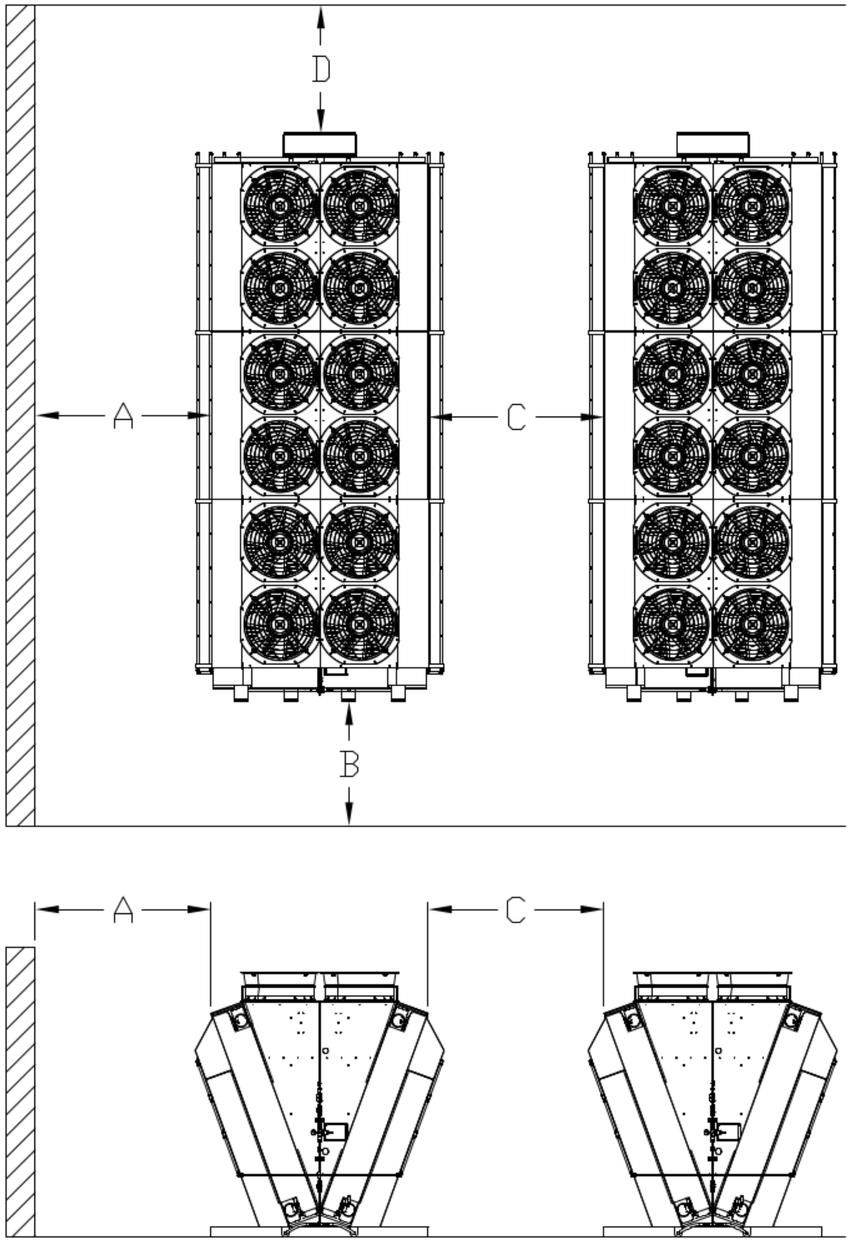
Coils
The air intake space of the heat exchange coils should be kept free of obstructions to ensure proper airflow across the coils. If the recommended clearances cannot be maintained, elevate the cooler to increase air circulation from beneath the cooler. Recommended clearances vary based on the installation conditions, as detailed on the following pages.

The Virga should not be installed near heat sources such as warm air exhaust vents. Warm air drawn into the heat exchange coils will decrease the Virga's heat rejection capacity.

The Virga should not be installed near sources of abrasive airborne particulates such as a sandblaster. Particulates drawn into the heat exchange coils will degrade the coil coating and fins over time.

Standard Installation

The table below lists the recommended minimum clearance between the Virga coils and any solid obstructions such as walls or other process equipment if the Virga is directly mounted on a concrete pad or rooftop.

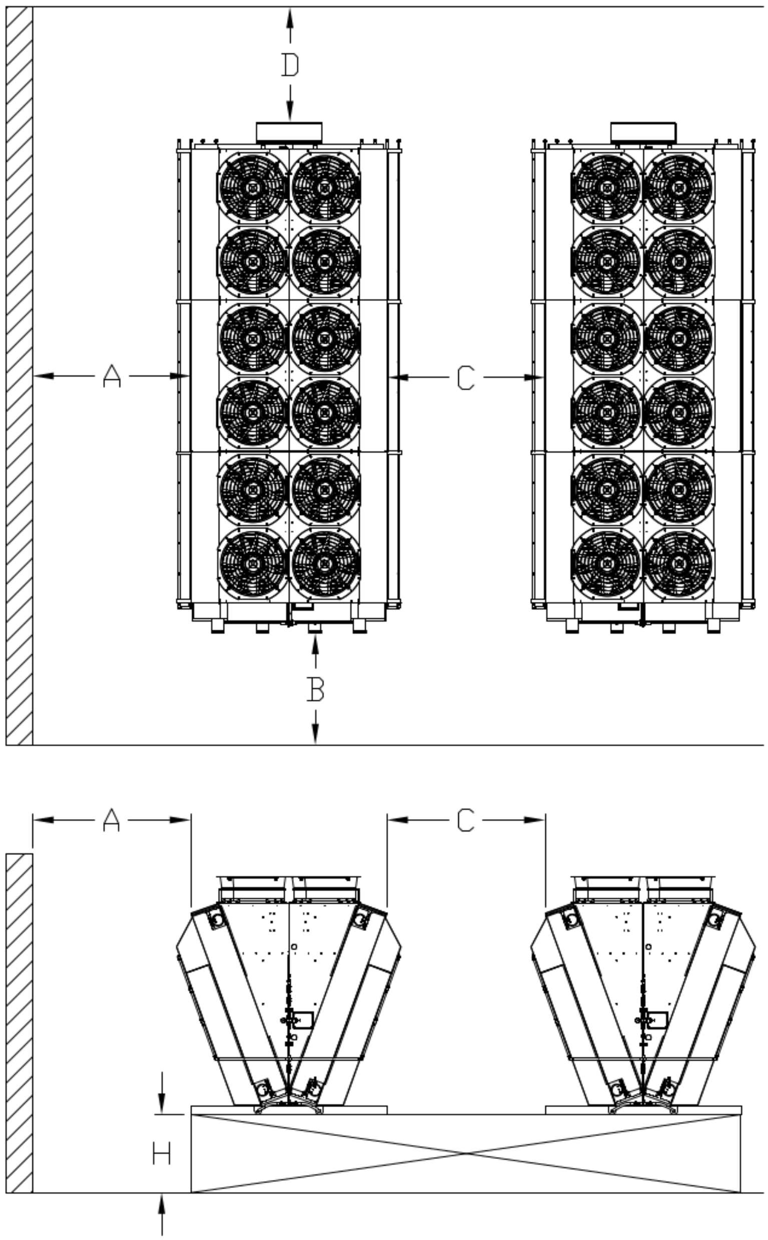


Coolers with standard installation.

Recommended Minimum Clearances for Standard Installation				
	Dimension			
Model	A	B	C	D
VRGA00X	6 ft.	4 ft.	5 ft.	3 ft. 6 in.
VRGA01X	6 ft.	4 ft.	6 ft.	3 ft. 6 in.
VRGA02X	6 ft.	4 ft.	7 ft.	3 ft. 6 in.

Elevated Installation

If the minimum clearances on the previous page cannot be maintained due to space limitations, Nimbus recommends installing the Virga on an elevated structure to improve airflow from below the cooler. The table below lists the recommended minimum clearances if the coolers will be elevated.



Coolers with elevated installation.

Recommended Minimum Clearances for Elevated Installation					
	Dimension				
Model	A	B	C	D	H
VRGA00X	4 ft.	4 ft.	4 ft.	3 ft. 6 in.	3 ft.
VRGA01X	4 ft.	4 ft.	4 ft.	3 ft. 6 in.	3 ft.
VRGA02X	4 ft.	4 ft.	4 ft.	3 ft. 6 in.	3 ft.

INSTALLATION

Installation of the Virga X3 should be performed by a licensed electrical and mechanical contractor or by qualified and experienced members of your staff.

Mounting

The Virga is provided with mounting feet that run perpendicular to the coil case. Holes are provided in the mounting feet for anchor bolts to secure the cooler to a concrete pad or steel structure. Any anchor bolts used must be capable of withstanding a minimum upward force of 600 lbs. Virga X3 models with model numbers beginning with VRGA02- require a minimum of two (2) bolts per base per side. Refer to the mechanical drawing provided with the cooler for the number and location of the mounting holes.

Welding is not an approved equipment attachment method. Do not weld the Virga mounting feet to a steel structure.

The cooler must be supported at each mounting foot on both sides of the cooler. Steel beams running parallel to the coil case or a concrete pad are acceptable means of support. The support structure must be level. Do not attempt to level the cooler on an unlevel surface through the use of shims.

Nimbus does not recommend the use of wooden supports due to the possibility of warping or rot.

Depending on the support structure or local building code requirements, it may be necessary to install the cooler on vibration isolators. Vibration isolators should be selected by a qualified and experienced engineer. Nimbus does not select or supply vibration isolators.

Plumbing

The process cooling fluid must enter the cooler at the top and leave from the bottom.

Install process piping so as not to place strain on the headers and connections. Follow local building regulations regarding backflow prevention.

Flush welding debris and other foreign material from the piping before startup. Take precautions to prevent debris from entering the heat exchange coils. If the cooler cannot be isolated from the piping system during the flushing process, use a strainer to capture any debris. Any chemicals used in the flushing process must be compatible with copper and silver.

Electrical Installation

The Virga requires a connection to three-phase power. Refer to the electrical drawing supplied with the Virga for voltage, frequency, full load amperage (FLA), minimum conductor ampacity (MCA), and maximum branch overcurrent protection device (MOP) ratings.

Standard Virga coolers require only a connection to three-phase power. All other wiring is completed by Nimbus in the factory. Options such as Modbus or BACnet communications may require additional field wiring. Refer to the electrical drawing supplied with the control panel for any necessary field wiring connections.

All wiring must comply with the current edition of the U.S. National Electric Code (NFPA 70) or the Canadian Electrical Code (CSA 22.1) and any relevant local electric codes.

Variable frequency drives and EC motors may produce harmonic distortion of the incoming three-phase power. Harmonics are unwanted distortions of the alternating current waveform. Depending on the configuration of the electrical system and the acceptable level of harmonic distortion, it may be necessary to provide a harmonics filter between the Virga and your electrical system.

Considerations for the Adiabatic Cooling Spray
The Virga requires a connection to a clean water source for the adiabatic cooling spray. Nimbus recommends a solid pipe connection to a city water source.

The coils are treated with a coating to protect the aluminum fins against scale buildup and corrosion by the chemicals found in most city water. Water treatment or softening may be required if the mineral content exceeds the recommended levels in the table below.

Spray Water Quality Recommendations	
pH	7.0 - 7.8
Hardness	< 120 ppm
Suspended Solids	< 10 ppm
Total Dissolved Solids	< 250 ppm

Drain pans are provided below the heat exchange coils. The drain pains are designed to catch spray water that does not evaporate before it reaches the coils.

On Virga III models with model numbers beginning with VRGA00- and VRGA01-, threaded ports are provided at the ends of each drain pan so that the pans may be piped to a drain. A drain pipe is provided below the drain valve that allows water to drain from the spray piping when the spray is not in use.

On Virga X3 models with model numbers beginning with VRGA02-, the threaded ports are located at the control panel end of the unit. Hoses below the drain valve connect the spray piping drain to the drain pans.

Alternative Water Sources
Reclaimed water (gray water) or collected rainwater may be used for the adiabatic cooling spray only if permitted by local building codes and health and safety regulations. Follow all relevant regulations regarding water treatment and pathogen control. Contact Nimbus to review specifications of the reclaimed water prior to installation.

Reclaimed water or collected rainwater must meet the minimum quality requirements in the Spray Water Quality Recommendations table on the previous page. Special attention should be paid to the pH level. Rainwater is acidic, with a typical pH between 5.0 and 5.5. Acidic spray water will damage the coil coating and aluminum fins. Collected rainwater should be treated to increase the pH to the range specified the Spray Water Quality Recommendations Table. Gray water should be treated to remove any oils or detergents.

Consideration for Winter Conditions
If the process cooling fluid is allowed to freeze in the heat exchange coils, the copper tubes may be damaged. Nimbus recommends the use of propylene or ethylene glycol for freeze protection in the process cooling loop. Glycol-based antifreeze lowers the freezing point of the process cooling fluid and prevents the fluid from freezing in the coils. The concentration of glycol required to prevent fluid from freezing depends on the local climate. Ensure your glycol concentration is appropriate for your climate before the onset of freezing weather.

An automatic fluid make-up system is a common feature of closed-loop cooling systems. Typically, if pressure is lost in the closed loop, the make-up system will automatically add fluid to the loop from a tank or city water source. If water is added to the closed loop, the glycol concentration in the loop will be lowered. If the cooling system has an automatic city water make-up system, Nimbus recommends measuring the glycol concentration before winter and frequently throughout the winter.

Nimbus does not recommend gravity draining the coils as the only means of freeze protection. Depending on the coil configuration, it may not be possible to drain all fluid from the coils, and any remaining fluid may freeze and damage the copper tubes.

Nimbus does not advise using heat from the process equipment as the only means of freeze protection.

NOTICE
Insufficient freeze protection may result in the bursting of the heat exchange coil tubing. Depending on the location and severity of the damage, it may not be possible to repair the affected coil or coils.

Nimbus recommends that all outdoor city water piping between the user's facility and the Virga be heat traced and insulated to prevent pipe bursts.

RECOMMENDATIONS FOR EXTENDED DOWNTIME

Nimbus recommends the user take special precautions to maintain the Virga if it will remain idle for a period greater than eight (8) weeks. Examples of extended downtime include but are not limited to extended storage before installation, a delay between installation and startup, and extended process downtime.

Do not allow the heat exchange coils to remain empty for extended periods of time. If the cooler will remain in storage for an extended time prior to installation, Nimbus recommends charging the coils with nitrogen. The coils should be filled with nitrogen to a pressure between 60 psi and 120 psi.

If the cooler will remain idle after installation in the process cooling loop, ensure that the loop is filled with process cooling fluid, and ensure that the glycol concentration is correct for your local climate. Check the glycol concentration prior to the onset of freezing weather and at least monthly when freezing weather is likely. Adjust the glycol concentration as needed.

If the fan motors are allowed to remain idle for extended periods of time, the bearing grease may become unevenly distributed, which may lead to bearing damage. Rotate each fan at least fifteen (15) full rotations per month to ensure the motor bearings remain evenly greased. If the cooler is not connected to power, remove the fan grills and turn the fans by hand. If the cooler is connected to power, use the controller to force the fans to run for at least five minutes per month.

Test the fan motor insulation prior to energizing the fan motors after an extended downtime. Do not energize any fan motors with lowered phase-to-ground resistance.

If the Virga is provided with a variable frequency drive (VFD), follow the drive manufacturer's instructions for long-term storage. Most VFD manufacturers recommend that a VFD remain de-energized for no longer than one year. If the VFD will remain de-energized for more than one year, follow the drive manufacturer's instructions for returning the drive to service prior to starting up the VFD.

If the Virga is provided with electronically commutated (EC) fans, follow the manufacturer's instructions for long-term storage. The EC fans used by Nimbus should not remain de-energized for a period longer than one year. If the EC fans will remain de-energized for more than one year, follow the fan manufacturer's instructions for returning the EC fans to service prior to starting up the fans.

Failure to observe the above recommendations may void the warranty.

SYSTEM STARTUP – SYSTEM FILLING

The process of filling a closed-loop cooling system depends on the individual system design. The following steps apply to Nimbus BlueDrive circulation modules. If Nimbus did not supply your circulation module, the following procedure may provide general recommendations for filling a closed-loop system, but always refer to the manufacturer's instructions for more specific guidance.

Nimbus recommends a pressure expansion tank in closed-loop cooling systems. As the fluid temperature increases in a closed-loop system, the fluid expands, increasing the total fluid volume in the system. The increased volume results in a higher system pressure. The expansion tank compensates for the temperature and volume change by allowing fluid to expand into the expansion tank, keeping the system pressure stable.

Nimbus recommends the inclusion of automatic air vents in closed-loop cooling systems. Air trapped in closed-loop systems can reduce heat rejection and damage the pump or process equipment. An automatic air vent automatically evacuates air from the circulation system. An air vent is most effective when installed at the highest point in a piping system.

Nimbus recommends the inclusion of a pressure relief valve in closed-loop cooling systems. If the system pressure exceeds the relief valve set point, the valve opens and relieves the pressure, preventing damage to process equipment.

1. Before filling the system, ensure that the ball valve on the inlet of the expansion tank is closed. The expansion tank should be isolated from the system so that fluid does not enter it.

2. Before filling the system, if the circulation module includes a city water make-up manifold, ensure that all valves on the manifold are closed before filling the system.

3. Before filling the system, jog the pump motor to ensure the proper rotation direction. Check the rotation direction against the arrow on the face of the pump.

NOTICE
Do not allow the pump to run for extended periods of time without fluid in the system.
Allowing the pump to run for extended periods of time without fluid in the system may damage the pump.

NOTICE
Do not allow the pump to run in reverse for an extended period of time.
Allowing the pump to run in reverse may damage the pump.

4. If the pump rotation is incorrect, turn off and lock out the system power and swap any two phases of the incoming three-phase power.

5. Bypass the process equipment and flush the system with clean water for 30 minutes to remove debris.

6. After flushing the system, use compressed air to blow the system out.

7. Remove, clean, and reassemble any strainers in the system.

8. Estimate the total liquid volume of the cooling system and prepare enough water/glycol solution to fill it. Refer to the quick reference sheet provided with the cooler for the recommended glycol concentration for your location. Combine the water and glycol in a mixing tank to the recommended percentages. Use only industrial-grade glycol without rust inhibitors.

9. Open the automatic air vent on the circulation module and any other air vents installed in the system. If possible, attach a temporary hose to each air vent, and direct the hose to clean, empty container for fluid reclamation.

10. Connect a mixing pump from the glycol mixing tank to the maintenance valve located in the circulation module discharge piping. Start the mixing pump, and fill the system with the water/glycol solution.

11. Close the air vents when they begin discharging liquid. Continue filling the system until the static pressure is approximately 10-15 psi. Stop the mixing pump, and close the maintenance valve.

12. Reopen the automatic air vent(s). Start the main circulation pump and allow the fluid to circulate for at least 15 minutes. Air will bleed from the system through the automatic air vent(s). Allow air to bleed until the pump achieves consistent flow. Air trapped in the system will reduce heat rejection and could damage the pump.

13. When all air is evacuated from the system and the pump discharge pressure is stable, the system is ready for operation.

14. Allow the system to run for 24 hours. Inspect the piping for leaks.

15. Remove, clean, and replace the strainers again.

16. Once the system has achieved consistent flow, note the pressure on the suction side of the pump. The expansion tank should be set ½ psi. to 1 psi. higher than the pump suction pressure. Apply a tire pressure gauge to the air valve at the top of the expansion tank to check the air pressure in the tank. Press the valve stem for short intervals to let a small amount of air out of the tank at time. Continue to check the pressure and let air out of the tank until the air pressure is ½ psi. to 1 psi. higher than the pump suction pressure.

17. Open the valve at the base of the expansion tank to allow fluid into the tank.

18. If the system includes an automatic city water make-up manifold, open the two valves on the top branch of the manifold. Verify that the valve on the bottom branch of the city water make-up manifold, which bypasses the regulator, remains closed.

19. Measure and record the pump running currents. Measure the current on each phase of each pump. Measure the phase-to-phase voltage for all phases of each pump.

SYSTEM STARTUP – COMMISSIONING

1. Fill the system with water or a solution of water and glycol. If Nimbus supplied a BlueDrive circulation module with your cooling system, refer to the system filling recommendations on Page 11. If Nimbus did not supply your circulation module, refer to the manufacturer's instructions.

2. Vent all air from the system piping. Inspect the piping for leaks.

3. With the cooler de-energized, inspect the main control enclosure.

    a. Check for loose wire connections. Wires may have loosened during transportation or installation.

    b. Ensure that all branch circuit breakers are in the ON position and that all fuses are intact.

    c. Ensure that the motor protection circuit breakers (MPCBs) are in the ON position.

    d. Ensure that the MPCBs are set to the full load current of the fan motors.

4. With the cooler de-energized, inspect the junction box on the fluid header end of the cooler for loose wire connections.

5. Turn on the city water supply to the spray piping, unless freezing temperatures are likely to occur during or shortly after commissioning. If freezing temperatures are likely, the city water should remain off until the danger of freezing weather passes.

NOTICE
Do not activate the adiabatic cooling spray if freezing temperatures are likely.
Water trapped in the spray piping may freeze and damage the spray piping or spray nozzles.

WARNING
Arc flash and shock hazard.
Any work on any energized equipment should be performed only by qualified personnel wearing appropriate PPE.
Refer to NFPA 70E for minimum recommended electrical safe work practices.

6. Energize the Virga by turning on the main disconnect switch or main circuit breaker.

7. Depending on the fluid temperatures, the fans may start automatically. Check the rotation direction. The fans should rotate in a counterclockwise direction, and air should be drawn into the coil and exhausted from the top of the cooler. A strong current of air should be felt above the fans. If the fans don't start automatically, use the controller to lower the set point to below the leaving fluid temperature.

8. If the rotation direction is incorrect, disconnect and lock out power, then switch any two of the incoming power conductors.

9. After verifying the fan rotation direction, lower the set point until the fans start. Verify that the fan staging or fan speed control functions as expected.

10. Measure and record the fan running currents. With the fans running at full speed, measure the current on each phase of each motor. Measure the phase-to-phase voltages on all phases of each motor.

11. Return the set point to its normal operating point.

12. If the cooler includes communications such as BACnet or Modbus, verify that the controller can communicate with the building management system (BMS).

INSTALLATION AND COMMISSIONING CHECKLIST	
INSTALLATION	
☐	Install cooler on concrete pad or steel structure. Secure to structure with anchor bolts
☐	Remove any packaging such as shrink wrap on fan grills
☐	Install top row of spray piping (Virga X3 models only)
☐	Complete all cooling loop piping connections
☐	Complete city water piping connection to spray manifold
☐	Complete utility power connection
☐	Complete any other required field wiring connections
☐	Install heat trace on city water piping if required by local climate conditions
☐	Inspect control panel and junction box for loose wire connections
☐	Inspect control panel to ensure branch circuit breakers are in the ON position
☐	Inspect fin surfaces. Remove any debris. Use fin comb to repair minor fin damage
☐	Fill system with water or water/glycol solution
☐	Vent all air from cooling loop piping
☐	Inspect piping for leaks
☐	Check water/glycol solution for glycol concentration. Adjust as needed
STARTUP	
☐	Energize the cooler
☐	Check fans for proper rotation direction
☐	Check temperature sensor for accuracy
☐	Lower set point to test fan staging or fan speed control
☐	Lower set point to test adiabatic cooling spray
☐	With spray running, verify that incoming city water pressure is 40 psi.
☐	With spray running, inspect spray nozzles to verify that all nozzles are clear
☐	Measure and record line voltage and motor running currents
☐	Verify communications with building management system, if applicable

CONTROLS – DIGITAL FAN STAGING OPTION

About

Virga coolers with basic digital fan staging controls are provided with a digital temperature controller. The controller measures the temperature of the fluid leaving the cooler and starts or stops fans as needed to maintain the fluid temperature at or below the set point. Communications protocols such as Modbus or BACnet are not possible with the digital fan staging controller.

The controller will arrive pre-programmed with your recommended settings, and additional setup is not required. Fine-tuning and system monitoring are possible using the display on the front of the controller. To access basic programming functions such as set point or throttle range, briefly press MENU to reach the basic programming menu. To access more advanced settings such as the number of fans, integral, derivative, or fan on/off delay, press and hold the MENU button to reach the SETUP screen.

System Settings

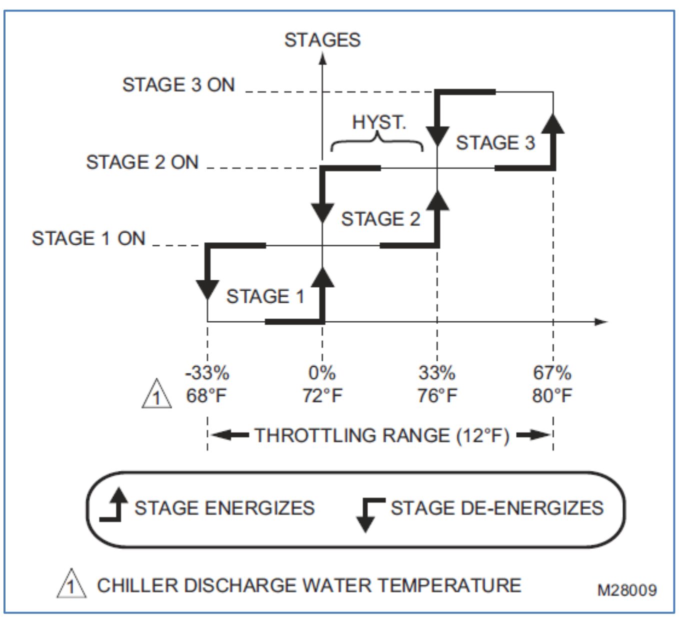
Set Point

The set point is the desired temperature of the water leaving the tower. The first fan will always start when the water temperature reaches the set point. To adjust the set point:

1. Briefly press MENU.
2. Select PROGRAM. Press RIGHT.
3. Select LOOP 1. Press RIGHT
4. Select SETPOINT. Press RIGHT.
5. Adjust the set point using the UP or DOWN arrows. To confirm the new setting, press RIGHT.

Throttle Range

The throttle range determines at what temperatures the remaining fans and spray will start and stop. The controller divides the output stages evenly along the throttle range. The staging diagram below demonstrates the fan staging for a cooler with two (2) fans (Stages 1 and 2) and adiabatic cooling spray (Stage 3), with a set point of 72°F and a throttle range of 12°F.



Fan staging example. Image courtesy of Honeywell.

Increasing the throttle range will result in a slower response to a given change in temperature. Decreasing the throttle range will result in a faster response to a given change in temperature. To adjust the throttle range:

1. Briefly press MENU.
2. Press PROGRAM. Press RIGHT.
3. Select LOOP 1. Press RIGHT.
4. Select THROT RNG. Press RIGHT.
5. Adjust the range using the UP or DOWN arrows. To confirm the new setting, press RIGHT.

Fan On Delay and Fan Off Delay

The fans are programmed to wait for a short delay after being called to turn on or off before switching. This delay prevents multiple fans from starting at the same time, which could cause large inrush currents. By default, the delay is set to 10 seconds. To adjust the fan on/off delay:

1. Press and hold MENU until the SETUP menu appears.
2. Select OUTPUTS. Press RIGHT.
3. Select LOOP1. Press RIGHT.
4. Select ON DELAY or OFF DELAY. Press RIGHT.
5. Adjust the delay in 10-second intervals using UP or DOWN. To confirm the new setting, press RIGHT.

Remote Disable Input

The digital temperature is provided with a digital input terminal that may be connected to a remote disable input. When the remote disable input is closed, all fans will be disabled. When the remote disable input is open, the fans will automatically stage on and off as needed.

NOTICE
The remote disable input must be a dry contact only.
Do not apply voltage to the temperature controller digital input terminal.
Applying voltage to the controller digital input terminal will damage the temperature controller.

CONTROLS – PLC FAN STAGING OPTION

About

Virga coolers with PLC fan staging controls are provided with a programmable logic controller (PLC). The controller measures the temperature of the fluid leaving the cooler and starts or stops fans as needed to maintain the fluid temperature below the set point. Communications protocols such as Modbus or BACnet are possible with the programmable logic controller.

The controller will arrive pre-programmed with your recommended settings, and additional setup is not required. Fine-tuning and system monitoring are possible through the human-machine interface (HMI) located on the front of the controller. If communications are enabled, the settings may also be adjusted using Modbus or BACnet.

Sequence of Operations

1. The PLC measures the temperature of the fluid leaving the Virga.

2. Fan control is based on PID. If the fluid temperature rises above the set point, the PID output will begin to increase. The greater the difference between the fluid temperature and the set point, the faster the PID output will increase. The longer the fluid temperature has been above the set point, the faster the PID output will increase.

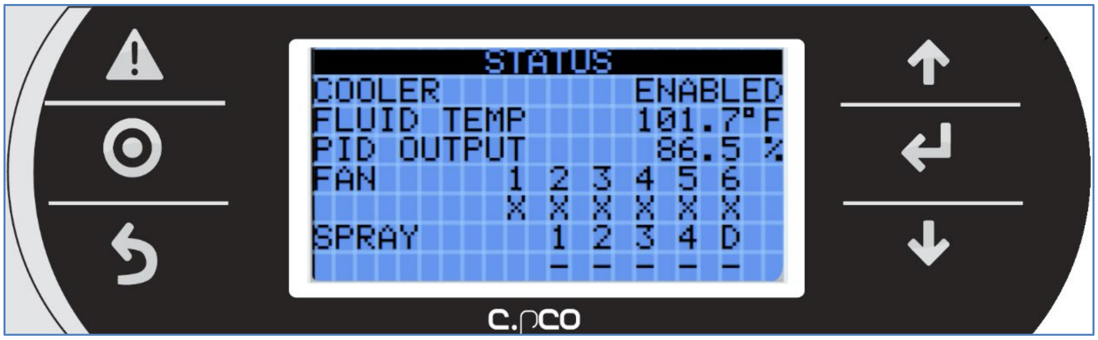
3. If the PID output reaches the first fan stage point, the fan closest to the leaving fluid header will start.
    a. If the leaving fluid temperature drops below the set point, the fan will stop.

    b. If the leaving fluid temperature continues to increase, the second fan will start.

    c. If the leaving fluid temperature continues to increase, the remaining fans will start in order of distance from the fluid headers. The fan closest to the control panel will be the last to start.

4. If all fans are running, and the fluid temperature remains above the set point, the cooling spray will activate.
    a. For coolers with basic spray control, all rows of spray nozzles will start at the same time. If the fluid temperature drops below the set point, and the PID output decreases, the spray will stop.

    b. For coolers with spray staging control, the top row of spray nozzles will start first.
        i. If the top row of spray nozzles is not sufficient to cool the fluid to below the set point, the second row of spray nozzles from the top will start after a delay.
        ii. The remaining rows of spray nozzles will start order from top to bottom.
        iii. If the fluid drops below the set point, the cooling spray will stop, beginning with the last row of spray nozzles to start.



System Status Page – PLC Fan Staging Option

System Status
COOLER indicates whether the system is enabled or disabled.

FLUID TEMP shows the temperature of the fluid leaving the Virga.

PID OUTPUT indicates the output of the PID function, which determines the number of fans running.

SPRAY indicates which rows of spray nozzles are currently active. A "-" indicates that the spray row is off. An "X" indicates that the spray row is currently spraying.

From the status screen, press the ⦿ button to access the system settings.

System Settings Page – PLC Fan Staging Option

System Settings

Cooler Enable/Disable

The system can be enabled or disabled. If the system is disabled, the fans will remain off regardless of the leaving fluid temperature. If the system is enabled, the fans will speed up or slow down as required to cool the leaving fluid temperature to below the set point. The cooler may be enabled using the HMI using the Local Enable (LOC ENABLE) setting or by closing a contact connected to the remote enable input.

Remote Enable (REM ENABLE)

The cooler may be enabled or disabled using a contact connected to the PLC's digital input. If the contact is open, the system will be disabled. If the contact is closed, the system will be enabled. The status of the Remote Enable input will be displayed on the HMI for informational purposes only. It cannot be changed using the HMI.

Local Enable (LOC ENABLE)

The cooler may be enabled using a variable in the PLC's memory, Local Enable. If Local Enable is set to Disabled, the cooler will be enabled or disabled using the remote enable input. If Local Enable is set to Enabled, the fans and spray will be enabled regardless of the status of the remote enable input. The cooler will override the remote enable input and remain in the enabled state. The Local Enable variable can be changed using the HMI or using the BACnet protocol, if enabled.

Set Point

The current system set point is displayed for informational purposes only. It cannot be changed directly.

Set Point Source

The set point is the temperature at which the Virga will attempt to maintain the fluid temperature. If the leaving fluid temperature rises above the set point, the system will start fans to cool it to below the set point. The Set Point Source determines how the controller selects the set point.

Local Set Point

If the Set Point Source is set to Local, the set point will be controlled by a variable in the PLC's memory, Local Set Point. The Local Set Point variable may be changed using the HMI on the front of the control panel.

Remote Set Point

If the Set Point Source is set to Remote, the set point will be controlled by a 0-10VDC analog input. By default, the set point will be 40°F when the analog input is 0VDC and 140°F when the analog input is 10VDC. The minimum and maximum set point values can be changed by adjusting the Remote Set Point Minimum and Maximum settings. The Remote Set Point will be displayed on the HMI for informational purposes only. It cannot be changed using the HMI.

Remote Set Point Minimum
The Remote Set Point Minimum defines the remote set point when the analog input is 0VDC.

Remote Set Point Maximum
The Remote Set Point Maximum defines the remote set point when the analog input is 10VDC.

PID Proportional Gain(Kc)
The Proportional Gain determines how much the controller will respond to a given difference between the leaving fluid temperature and the set point.

PID Integral Gain(Ti)
The Integral Gain determines how the controller will respond to a difference between the leaving fluid temperature and the set point that persists over time.

Fan On Delay and Fan Off Delay
There is a delay between the PID output rising to a stage at which a fan will start or stop and that fan starting or stopping. This is intended to keep sudden swings in fluid temperature from causing multiple fans to start or stop at once, which would cause large inrush currents.

Spray On Delay and Spray Off Delay
For coolers with spray staging controls, there is a delay between the system calling for a row of spray nozzles to start and that row starting. Depending on the available pressure and volume of spray water, it may take several seconds for the spray piping to fill with water and begin spraying. The delay gives each row time to fill before the next row in the sequence begins to spray.

Hight Temp Alarm Set Point
If the leaving fluid temperature rises above the high temperature alarm set point, the system will show a high fluid temperature alarm.

BACnet Instance
For coolers with BACnet communications enabled, the BACnet instance is a unique address used to identify it on a BACnet network. The valid range is 0 to 4,194,303.

BACnet Baud Rate
For coolers with BACnet MS/TP communications, the baud rate is the speed of data transfer to and from the PLC's RS-485 fieldbus port. The baud rate must match the baud rate of any device with which the cooler will communicate. The baud rate may be set to 1200, 1400, 4800, 9600, 19200, or 38400 bps.

Press the ⦿ key to switch between settings pages. Press the ⮌ key to return to the status screen.

Adjusting System Settings
To adjust any system setting, press the ↵ key to cycle between settings. Select the setting that will be adjusted.

Press the ↑ or ↓ keys to change the value of a setting.

Press the ↵ key to confirm the change to the setting.

CONTROLS – VARIABLE FREQUENCY DRIVE OPTION

About

Virga coolers with variable frequency drive (VFD) controls are provided with a programmable logic controller (PLC). The controller measures the temperature of the fluid leaving the cooler and adjusts the fan speed as needed to maintain the fluid temperature below the set point. Communications protocols such as Modbus or BACnet are possible with the programmable logic controller.

The controller will arrive pre-programmed with your recommended settings, and additional setup is not required. Fine-tuning and system monitoring are possible through the human-machine interface (HMI) located on the front of the controller. If communications are enabled, the settings may also be adjusted using Modbus or BACnet.

Sequence of Operations

VFD Control

1. The system is placed in VFD Control mode.

2. The PLC measures the temperature of the fluid leaving the Virga.

3. Fan control is based on PID. The greater the difference between the fluid temperature and the set point, the faster the PID output will increase. The longer the fluid temperature has been above the set point, the faster the PID output will increase.

4. If the leaving fluid temperature is greater than the set point, and the PID output is great than 5%, all fans will start at a low speed.
    a. If the leaving fluid temperature remains above the set point, the fan speed will increase until the fans are running at the maximum allowable speed. By default, the maximum fan speed is 100% of the fan motor nameplate speed. The maximum allowable speed can be adjusted.

    b. If the leaving fluid temperature decreases to below the set point, the fan speed will decrease. If the fluid temperature remains below the set point long enough for the PID output to drop to 0%, the fans will stop.

5. If the fans are running at or above the adjustable speed limit, and the fluid temperature remains above the set point, the cooling spray will activate.
    a. For coolers with basic spray control, all rows of spray nozzles will start at the same time. If the fluid temperature drops below the set point, and the PID output decreases, the spray will stop.

    b. For coolers with spray staging control, the top row of spray nozzles will start first.
        i. If the top row of spray nozzles is not sufficient to cool the fluid to below the set point, the second row of spray nozzles from the top will start after a delay.
        ii. The remaining rows of spray nozzles will start order from top to bottom.
        iii. If the fluid drops below the set point, the cooling spray will stop, beginning with the last row of spray nozzles to start.

Staging Control

1. The system is placed in Staging Control mode in one of the following ways:
    a. The user manually selects Staging Control, or

    b. The system is in VFD Control mode with the automatic bypass enabled, and the VFD experiences a fault for any reason. The system will automatically switch from VFD to Staging Control.

2. In Staging Control mode, the VFD will be bypassed, and the fans will run direct on line power at 100% of the fan motor nameplate speed.

3. The PLC measures the temperature of the fluid leaving the Virga.

4. Fan control is based on PID. If the fluid temperature rises above the set point, the PID output will begin to increase. The greater the difference between the fluid temperature and the set point, the faster the PID output will increase. The longer the fluid temperature has been above the set point, the faster the PID output will increase.

5. If the PID output reaches the first fan stage point, the fan closest to the leaving fluid header will start.
    a. If the leaving fluid temperature drops below the set point, the fan will stop.

    b. If the leaving fluid temperature continues to increase, the second fan will start.

    c. If the leaving fluid temperature continues to increase, the remaining fans will start in order of distance from the fluid headers. The fan closest to the control panel will be the last to start.

6. If all fans are running, and the fluid temperature remains above the set point, the cooling spray will activate.
    a. For coolers with basic spray control, all rows of spray nozzles will start at the same time. If the fluid temperature drops below the set point, and the PID output decreases, the spray will stop.

    b. For coolers with spray staging control, the top row of spray nozzles will start first.
        i. If the top row of spray nozzles is not sufficient to cool the fluid to below the set point, the second row of spray nozzles from the top will start after a delay.
        ii. The remaining rows of spray nozzles will start order from top to bottom.
        iii. If the fluid drops below the set point, the cooling spray will stop, beginning with the last row of spray nozzles to start.

System Status Page – VFD Control Option

System Status
COOLER indicates whether the system is enabled or disabled.

FLUID TEMP shows the temperature of the fluid leaving the Virga.

PID OUTPUT indicates the output of the PID function, which determines the fan speed and spray staging.

FAN SPEED indicates the speed at which the fans are currently running. All fans will run at the same speed.

SPRAY indicates which rows of spray nozzles are currently active. A "-" indicates that the spray row is off. An "X" indicates that the spray row is currently spraying.

MODE indicates whether the fans are running in VFD Mode or Bypass Mode.

From the status screen, press the ↶ key to switch between status screens. Press the ⦿ button to access the system settings.

System Settings Page – VFD Control Option

System Settings

Control Mode

The system is capable of running in VFD Mode or Bypass Mode. In VFD Mode, the fans will speed up or down as needed on VFD power. All fans will run at the same speed and at the same time. In Bypass Mode, the VFD will be bypassed, and the fans will stage on and off as needed directly on line power. In Bypass Mode, the fans will run at full speed.

Automatic Bypass

If the automatic VFD bypass is enabled, the system will automatically bypass the VFD in the event of a VFD fault, and the fans will stage on and off as needed in Bypass Mode. If the automatic VFD bypass is disabled, the system will take no action in the event of a VFD fault.

Cooler Enable/Disable

The system can be enabled or disabled. If the system is disabled, the fans will remain off regardless of the leaving fluid temperature. If the system is enabled, the fans will speed up or slow down as required to cool the leaving fluid temperature to below the set point. The cooler may be enabled using the HMI using the Local Enable (LOC ENABLE) setting or by closing a contact connected to the remote enable input.

Remote Enable (REM ENABLE)

The cooler may be enabled or disabled using a contact connected to the PLC's digital input. If the contact is open, the system will be disabled. If the contact is closed, the system will be enabled. The status of the Remote Enable input will be displayed on the HMI for informational purposes only. It cannot be changed using the HMI.

Local Enable (LOC ENABLE)

The cooler may be enabled using a variable in the PLC's memory, Local Enable. If Local Enable is set to Disabled, the cooler will be enabled or disabled using the remote enable input. If Local Enable is set to Enabled, the fans and spray will be enabled regardless of the status of the remote enable input. The cooler will override the remote enable input and remain in the enabled state. The Local Enable variable can be changed using the HMI or using the BACnet protocol, if enabled.

Set Point

The current system set point is displayed for informational purposes only. It cannot be changed directly.

Set Point Source

The set point is the temperature at which the Virga will attempt to maintain the fluid temperature. If the leaving fluid temperature rises above the set point, the system will start fans to cool it to below the set point. The Set Point Source determines how the controller selects the set point.

Local Set Point
If the Set Point Source is set to Local, the set point will be controlled by a variable in the PLC's memory, Local Set Point. The Local Set Point variable may be changed using the HMI on the front of the control panel.

Remote Set Point
If the Set Point Source is set to Remote, the set point will be controlled by a 0-10VDC analog input. By default, the set point will be 40°F when the analog input is 0VDC and 140°F when the analog input is 10VDC. The minimum and maximum set point values can be changed by adjusting the Remote Set Point Minimum and Maximum settings. The Remote Set Point will be displayed on the HMI for informational purposes only. It cannot be changed using the HMI.

Remote Set Point Minimum
The Remote Set Point Minimum defines the remote set point when the analog input is 0VDC.

Remote Set Point Maximum
The Remote Set Point Maximum defines the remote set point when the analog input is 10VDC.

PID Proportional Gain (Kc)
The Proportional Gain determines how much the controller will respond to a given difference between the leaving fluid temperature and the set point.

PID Integral Gain (Ti)
The Integral Gain determines how the controller will respond to a difference between the leaving fluid temperature and the set point that persists over time.

Fan On Delay and Fan Off Delay
In Bypass Mode, there is a delay between the PID output rising to a stage at which a fan will start or stop and that fan starting or stopping. This is intended to keep sudden swings in fluid temperature from causing multiple fans to start or stop at once, which would cause large inrush currents.

Spray On Delay and Spray Off Delay
For coolers with spray staging controls, there is a delay between the system calling for a row of spray nozzles to start and that row starting. Depending on the available pressure and volume of spray water, it may take several seconds for the spray piping to fill with water and begin spraying. The delay gives each row time to fill before the next row in the sequence begins to spray.

Hight Temp Alarm Set Point
If the leaving fluid temperature rises above the high temperature alarm set point, the system will show a high fluid temperature alarm.

BACnet Instance
For coolers with BACnet communications enabled, the BACnet instance is a unique address used to identify it on a BACnet network. The valid range is 0 to 4,194,303.

BACnet Baud Rate
For coolers with BACnet MS/TP communications, the baud rate is the speed of data transfer to and from the PLC's RS-485 fieldbus port. The baud rate must match the baud rate of any device with which the cooler will communicate. The baud rate may be set to 1200, 1400, 4800, 9600, 19200, or 38400 bps.

Nightly Slowdown Settings Page

Nightly Slowdown Settings

Virga coolers with VFD controls feature a nightly slowdown feature. If the slowdown feature is enabled, the maximum fan speed will automatically lower every night and return to normal every morning. This is designed to reduce fan noise for applications where nighttime noise levels may be a concern.

Nightly Slowdown

If the nightly slowdown feature is enabled, the Virga will automatically adjust the maximum allowable fan speed twice a day according to a schedule. If the nightly slowdown feature is disabled, the maximum allowable fan speed will remain constant unless manually changed by the user.

Start Time

The nightly slowdown start time is the time at which the maximum fan speed is lowered to the nighttime speed. The time is written in 24-hour format. For example, 10:00 PM should be written as 22:00.

Stop Time

The nightly slowdown stop time is the time at which the maximum fan speed returns to the normal maximum speed. The time is written in 24-hour format. For example, 6:30 AM should be written as 06:30.

Night Speed

The night speed is the maximum allowable fan speed when the nightly slowdown feature is active.

Normal Speed

The normal speed is the maximum allowable fan speed whenever the nightly slowdown feature is not active.

Manual Start

The nightly slowdown feature can be manually activated. When manually activated, the Virga will immediately enter nightly slowdown mode regardless of the current time. The maximum fan speed will return to normal at the scheduled stop time.

Press the ⊙ key to switch between settings pages. Press the ↶ key to return to the status screen.

Adjusting System Settings

To adjust any system setting, press the ↵ key to cycle between settings. Select the setting that will be adjusted.

Press the ↑ or ↓ keys to change the value of a setting.

Press the ↵ key to confirm the change to the setting.

CONTROLS – EC FAN OPTION

About

Virga coolers with electronically commutated (EC) motors are provided with a programmable logic controller (PLC). The controller measures the temperature of the fluid leaving the cooler and adjusts the fan speed as needed to maintain the fluid temperature below the set point. Communications protocols such as Modbus or BACnet are possible with the programmable logic controller.

The controller will arrive pre-programmed with your recommended settings, and additional setup is not required. Fine-tuning and system monitoring are possible through the human-machine interface (HMI) located on the front of the controller. If communications are enabled, the settings may also be adjusted using Modbus or BACnet.

Sequence of Operations

1. The PLC measures the temperature of the fluid leaving the Virga.

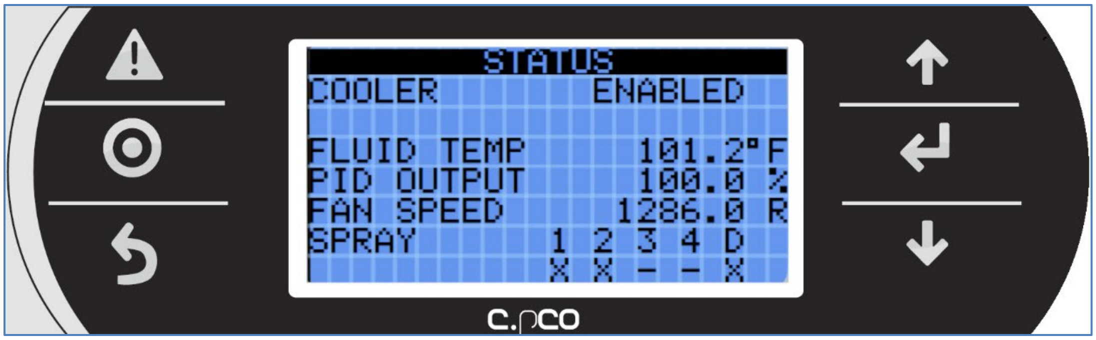
2. Fan control is based on PID. The greater the difference between the fluid temperature and the set point, the faster the PID output will increase. The longer the fluid temperature has been above the set point, the faster the PID output will increase.

3. If the leaving fluid temperature is greater than the set point, and the PID output is greater than 5%, all fans will start at a low speed.
    a. If the leaving fluid temperature remains above the set point, the fan speed will increase until the fans are running at the maximum allowable speed. By default, the maximum fan speed is 100% of the fan motor nameplate speed. The maximum allowable speed can be adjusted.

    b. If the leaving fluid temperature decreases to below the set point, the fan speed will decrease. If the fluid temperature remains below the set point long enough for the PID output to drop to 0%, the fans will stop.

4. If the fans are running at or above the adjustable speed limit, and the fluid temperature remains above the set point, the cooling spray will activate.
    a. For coolers with basic spray control, all rows of spray nozzles will start at the same time. If the fluid temperature drops below the set point, and the PID output decreases, the spray will stop.

    b. For coolers with spray staging control, the top row of spray nozzles will start first.
        i. If the top row of spray nozzles is not sufficient to cool the fluid to below the set point, the second row of spray nozzles from the top will start after a delay.
        ii. The remaining rows of spray nozzles will start order from top to bottom.
        iii. If the fluid drops below the set point, the cooling spray will stop, beginning with the last row of spray nozzles to start.



System Status Page – EC Fan Option

System Status
The Status page displays information about the Virga X3 system.

COOLER indicates whether the system is enabled or disabled.

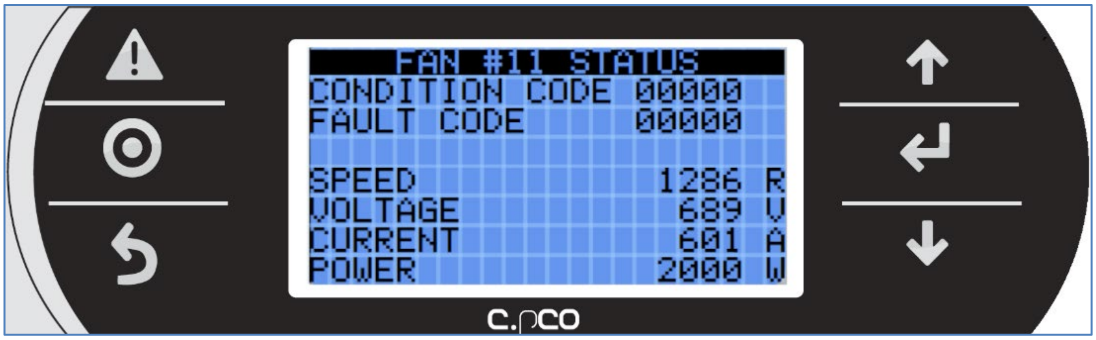
FLUID TEMP shows the temperature of the fluid leaving the Virga.

PID OUTPUT indicates the output of the PID function, which determines the number of fans running.

FAN SPEED indicates the speed at which the fans are currently running. All fans will run at the same speed.

SPRAY indicates which rows of spray nozzles are currently active. A "-" indicates that the spray row is off. An "X" indicates that the spray row is currently spraying.

Press the ↵ key to open the FAN STATUS page. Press the ⊙ key to view the system settings.



Fan Status Page

Fan Status

The Fan Status page will show a more detailed status of each individual fan. The values are read directly from each fan's Modbus registers.

CONDITION CODE is a decimal representation of several status flags for each fan. The most typical codes are 1 for normal operation/stopped and 0 for normal operation/running.

FAULT CODE is a decimal representation of several fault flags for each fan. The most typical codes are 0 for no fault, 2 for a ground fault, and 64 for a line fault.

SPEED is the fan's current speed in RPM.

VOLTAGE is the fan's peak line voltage in volts, V_{PEAK}.

CURRENT is the fan's peak line current in amps, I_{PEAK}.

POWER is the fan's power consumption in watts.

Press the ↑ or ↓ keys to cycle between the individual fans.

Press the ⦿ key to view the system settings. Press the ↺ key to return to the system status screen.

System Settings Page – EC Fan Option

System Settings

Cooler Enable/Disable

The system can be enabled or disabled. If the system is disabled, the fans will remain off regardless of the leaving fluid temperature. If the system is enabled, the fans will speed up or slow down as required to cool the leaving fluid temperature to below the set point. The cooler may be enabled using the HMI using the Local Enable (LOC ENABLE) setting or by closing a contact connected to the remote enable input.

Remote Enable (REM ENABLE)

The cooler may be enabled or disabled using a contact connected to the PLC's digital input. If the contact is open, the system will be disabled. If the contact is closed, the system will be enabled. The status of the Remote Enable input will be displayed on the HMI for informational purposes only. It cannot be changed using the HMI.

Local Enable (LOC ENABLE)

The cooler may be enabled using a variable in the PLC's memory, Local Enable. If Local Enable is set to Disabled, the cooler will be enabled or disabled using the remote enable input. If Local Enable is set to Enabled, the fans and spray will be enabled regardless of the status of the remote enable input. The cooler will override the remote enable input and remain in the enabled state. The Local Enable variable can be changed using the HMI or using the BACnet protocol, if enabled.

Set Point

The current system set point is displayed for informational purposes only. It cannot be changed directly.

Set Point Source

The set point is the temperature at which the Virga will attempt to maintain the fluid temperature. If the leaving fluid temperature rises above the set point, the system will start fans to cool it to below the set point. The Set Point Source determines how the controller selects the set point.

Local Set Point

If the Set Point Source is set to Local, the set point will be controlled by a variable in the PLC's memory, Local Set Point. The Local Set Point variable may be changed using the HMI on the front of the control panel.

Remote Set Point

If the Set Point Source is set to Remote, the set point will be controlled by a 0-10VDC analog input. By default, the set point will be 40°F when the analog input is 0VDC and 140°F when the analog input is 10VDC. The minimum and maximum set point values can be changed by adjusting the Remote Set Point Minimum and Maximum settings. The Remote Set Point will be displayed on the HMI for informational purposes only. It cannot be changed using the HMI.

Remote Set Point Minimum
The Remote Set Point Minimum defines the remote set point when the analog input is 0VDC.

Remote Set Point Maximum
The Remote Set Point Maximum defines the remote set point when the analog input is 10VDC.

PID Proportional Gain (Kc)
The Proportional Gain determines how much the controller will respond to a given difference between the leaving fluid temperature and the set point.

PID Integral Gain (Ti)
The Integral Gain determines how the controller will respond to a difference between the leaving fluid temperature and the set point that persists over time.

Spray On Delay and Spray Off Delay
For coolers with spray staging controls, there is a delay between the system calling for a row of spray nozzles to start and that row starting. Depending on the available pressure and volume of spray water, it may take several seconds for the spray piping to fill with water and begin spraying. The delay gives each row time to fill before the next row in the sequence begins to spray.

Hight Temp Alarm Set Point
If the leaving fluid temperature rises above the high temperature alarm set point, the system will show a high fluid temperature alarm.

Vibration Alarm Set Point
The EC fan motors are provided with factory-installed vibration sensors. If the vibration in the X, Y, or Z direction exceeds the Vibration Alarm Set Point, the system will show a fan vibration alarm.

BACnet Instance
For coolers with BACnet communications enabled, the BACnet instance is a unique address used to identify it on a BACnet network. The valid range is 0 to 4,194,303.

BACnet Baud Rate
For coolers with BACnet MS/TP communications, the baud rate is the speed of data transfer to and from the PLC's RS-485 fieldbus port. The baud rate must match the baud rate of any device with which the cooler will communicate. The baud rate may be set to 1200, 1400, 4800, 9600, 19200, or 38400 bps.

Nightly Slowdown Settings Page

Nightly Slowdown Settings
Virga coolers with VFD controls feature a nightly slowdown feature. If the slowdown feature is enabled, the maximum fan speed will automatically lower every night and return to normal every morning. This is designed to reduce fan noise for applications where nighttime noise levels may be a concern.

Nightly Slowdown
If the nightly slowdown feature is enabled, the Virga will automatically adjust the maximum allowable fan speed twice a day according to a schedule. If the nightly slowdown feature is disabled, the maximum allowable fan speed will remain constant unless manually changed by the user.

Start Time
The nightly slowdown start time is the time at which the maximum fan speed is lowered to the nighttime speed. The time is written in 24-hour format. For example, 10:00 PM should be written as 22:00.

Stop Time
The nightly slowdown stop time is the time at which the maximum fan speed returns to the normal maximum speed. The time is written in 24-hour format. For example, 6:30 AM should be written as 06:30.

Night Speed
The night speed is the maximum allowable fan speed when the nightly slowdown feature is active.

Normal Speed
The normal speed is the maximum allowable fan speed whenever the nightly slowdown feature is not active.

Manual Start
The nightly slowdown feature can be manually activated. When manually activated, the Virga will immediately enter nightly slowdown mode regardless of the current time. The maximum fan speed will return to normal at the scheduled stop time.

Press the ⊙ key to switch between settings pages. Press the ⮌ key to return to the status screen.

Adjusting System Settings
To adjust any system setting, press the ↵ key to cycle between settings. Select the setting that will be adjusted.

Press the ↑ or ↓ keys to change the value of a setting.

Press the ↵ key to confirm the change to the setting.

BACNET COMMUNICATIONS

Virga coolers with PLC controls are capable of communicating with a building management system through the controller's Ethernet port using the BACnet IP communications protocol or through the controller's Fieldbus port using the BACnet MS/TP communications protocol. Only one protocol may be active at a time.

The tables below provide the default network settings for the Virga controller. Tables on the following pages provide a list of typical objects for each control option.

Default Network Settings, BACnet IP	
IP Address	192.168.42.141
Subnet Mask	255.255.255.0
Default Gateway	192.168.42.1
Port	47808
BACnet Instance	41

Default Network Settings, BACnet MSTP	
Baud Rate	19,200 bps
Data Length	8
Parity	Even
Stop Bits	1
MSTP Station Number	41
BACnet Instance	41

Typical BACnet Objects – Fan Staging Option				
Object Name	**Object Type**	**Description**	**Units**	**Read/Write**
Fluid_Temp	Analog Input	Leaving fluid temperature	°F	Read Only
PID_Output	Analog Input	PID loop output, used to determine fan staging	%	Read Only
Set_Point	Analog Input	Present leaving fluid temperature set point	°F	Read Only
Remote_Set_Point	Analog Input	Set point determined by 0-10VDC analog input, used when Set_Point_Control is set to REMOTE.	°F	Read Only
Local_Set_Point	Analog Value	Set point used when Set_Point_Control is set to LOCAL.	°F	Read/Write
Remote_Set_Point_Min	Analog Value	Value of remote set point when analog input is 0V.	°F	Read/Write
Remote_Set_Point_Max	Analog Value	Value of remote set point when analog input is 10V.	°F	Read/Write
PID_Proportional_Gain_Kc	Analog Value	Proportional gain, Kc		Read/Write
PID_Integral_Gain_Ti	Positive Integer	Integral gain, Ti		Read/Write
Fan_On_Delay_Preset	Analog Value	Delay between fan being called to start and fan starting	sec.	Read/Write
Fan_Off_Delay_Preset	Analog Value	Delay between fan being called to stop and fan stopping	sec.	Read/Write
Spray_On_Delay_Preset	Analog Value	Delay between spray row being called to start and spray row starting	sec.	Read/Write
Spray_Off_Delay_Preset	Analog Value	Delay between spray row being called to stop and spray row stopping	sec.	Read/Write
Fan_X_Output	Binary Input	Relay output for fan contactor; X indicates fan number		Read Only
Spray_Row_X_Output	Binary Input	Relay output for spray solenoid valve; X indicates spray row		Read Only
Drain_Output	Binary Input	Relay output for drain solenoid valve		Read Only
Fan_X_Fault.Active	Binary Input	Fan overload or short circuit fault alarm; X indicates fan number		Read Only
High_Temp_Alarm.Active	Binary Input	Leaving fluid high temperature alarm		Read Only
General_Alarm	Binary Input	General fault alarm; TRUE when any other alarm is TRUE		Read Only
Cooler_Enable	Binary Input	Cooler enabled when 1; Cooler disabled when 0		Read Only
Cooler_Enable_Remote	Binary Input	Status of remote enable input; 0 = Cooler disabled, 1 = Cooler enabled		Read Only
Cooler_Enable_Local	Binary Value	0 = Cooler disabled, 1 = Cooler enabled		Read/Write
Set_Point_Control	Binary Value	Source of cooler set point. 0 = Local set point, 1 = Remote set point		Read/Write

Typical BACnet Objects – Variable Frequency Drive Option				
Object Name	**Object Type**	**Description**	**Units**	**Read/Write**
Fluid_Temp	Analog Input	Leaving fluid temperature	°F	Read Only
PID_Output	Analog Input	PID loop output, used to determine fan speed (VFD Mode) or staging (Bypass Mode)	%	Read Only
Current_Fan_Speed	Analog Input	Present fan speed	%	Read Only
Max_Fan_Speed	Analog Input	Current maximum allowable fan speed	%	Read Only
Set_Point	Analog Input	Present leaving fluid temperature set point	°F	Read Only
Remote_Set_Point	Analog Input	Set point determined by 0-10VDC analog input, used when Set_Point_Control is set to REMOTE.	°F	Read Only
Local_Set_Point	Analog Value	Set point used when Set_Point_Control is set to LOCAL.	°F	Read/Write
PID_Proportional_Gain_Kc	Analog Value	Proportional gain, Kc		Read/Write
Fan_On_Delay_Preset	Analog Value	Delay between fan being called to start and fan starting	sec.	Read/Write
Fan_Off_Delay_Preset	Analog Value	Delay between fan being called to stop and fan stopping	sec.	Read/Write
Spray_On_Delay_Preset	Analog Value	Delay between spray row being called to start and spray row starting	sec.	Read/Write
Spray_Off_Delay_Preset	Analog Value	Delay between spray row being called to stop and spray row stopping	sec.	Read/Write
Daytime_Max_Speed	Analog Value	Maximum fan speed during normal daytime operation	%	Read/Write
Nightly_Slowdown_Speed	Analog Value	Maximum fan speed when nighttime slowdown feature is active	%	Read/Write
High_Temp_Alarm_Set_Point	Analog Value	Leaving fluid high temperature alarm set point	°F	Read/Write
PID_Integral_Gain_Ti	Positive Integer	Integral gain, Ti		Read/Write
Slowdown_Start_Hour	Positive Integer	Start time for nighttime slowdown feature, hour, in 24-hour format		Read/Write
Slowdown_Start_Minute	Positive Integer	Start time for nighttime slowdown feature, minute		Read/Write
Slowdown_Stop_Hour	Positive Integer	Stop time for nighttime slowdown feature, hour, in 24-hour format		Read/Write
Slowdown_Stop_Minute	Positive Integer	Stop time for nighttime slowdown feature, minute		Read/Write

Typical BACnet Objects – Variable Frequency Drive Option (Continued)				
Object Name	**Object Type**	**Description**	**Units**	**Read/Write**
Nighttime_Slowdown_Active	Binary Input	Indicates whether nighttime slowdown is active or inactive		Read Only
VFD_Contactor_K11	Binary Input	Relay output for VFD contactor K11		Read Only
Bypass_Contactor_K12	Binary Input	Relay output for bypass contactor K12		Read Only
Fan_X_Output	Binary Input	Relay output for fan contactor; X indicates fan number		Read Only
Spray_Row_X_Output	Binary Input	Relay output for spray solenoid valve; X indicates spray row		Read Only
Drain_Output	Binary Input	Relay output for drain solenoid valve		Read Only
Fan_X_Fault.Active	Binary Input	Fan overload or short circuit fault alarm; X indicates fan number		Read Only
VFD_Fault.Active	Binary Input	VFD short circuit, overload, phase loss, undervoltage, or overvoltage alarm		Read Only
High_Temp_Alarm.Active	Binary Input	Leaving fluid high temperature alarm		Read Only
General_Alarm	Binary Input	General fault alarm; TRUE when any other alarm is TRUE		Read Only
VFD_Control_Enabled	Binary Input	Indicates whether cooler is in VFD or Staging mode; TRUE = VFD, FALSE = Staging		Read Only
Cooler_Enable	Binary Input	Cooler enabled when 1; Cooler disabled when 0		Read Only
Cooler_Enable_Remote	Binary Input	Status of remote enable input; 0 = Cooler disabled, 1 = Cooler enabled		Read Only
Cooler_Enable_Local	Binary Value	0 = Cooler disabled, 1 = Cooler enabled		Read/Write
Set_Point_Control	Binary Value	Source of cooler set point. 0 = Local set point, 1 = Remote set point		Read/Write
VFD_or_Staging	Binary Value	System control mode; TRUE = VFD, FALSE = Staging		Read/Write
Automatic_Bypass_Enabled	Binary Value	Automatic VFD bypass enabled when TRUE, disabled when FALSE		Read/Write
Nightitme_Slowdown_Enabled	Binary Value	Nightly slowdown enabled when TRUE, disabled when FALSE		Read/Write

Typical BACnet Objects – EC Fan Option				
Object Name	**Object Type**	**Description**	**Units**	**Read/Write**
Fluid_Temp	Analog Input	Temperature of fluid leaving the cooler	°F	Read Only
PID_Output	Analog Input	Output of the PID function; Determines fan speed	%	Read Only
Set_Point	Analog Input	Current system set point	°F	Read Only
Current_Fan_Speed_RPM	Analog Input	Present fan speed	RPM	Read Only
Max_Fan_Speed_RPM	Analog Input	Current maximum fan speed	RPM	Read Only
Remote_Set_Point	Analog Input	Set point determined by 0-10VDC analog input, used when Set_Point_Control is set to REMOTE.	°F	Read Only
Local_Set_Point	Analog Value	Set point used when Set_Point_Control is set to LOCAL.	°F	Read/Write
Remote_Set_Point_Min	Analog Value	Value of remote set point when analog input is 0V.	°F	Read/Write
Remote_Set_Point_Max	Analog Value	Value of remote set point when analog input is 10V.	°F	Read/Write
PID_Proportional_Gain_Kc	Analog Value	PID Proportional gain, Kc		Read/Write
Daytime_Max_Speed_RPM	Analog Value	Maximum allowable fan speed when nightly slowdown is not on	RPM	Read/Write
Nighttime_Max_Speed_RPM	Analog Value	Maximum allowable fan speed when nightly slowdown is on	RPM	Read/Write
High_Temp_Alarm_Set_Point	Analog Value	Leaving fluid high temperature alarm set point	°F	Read/Write
Spray_On_Delay_Preset	Analog Value	Delay between spray row being called to start and spray row starting	sec.	Read/Write
Spray_Off_Delay_Preset	Analog Value	Delay between spray row being called to stop and spray row stopping	sec.	Read/Write
PID_Integral_Gain_Ti	Positive Integer	PID Integral gain, Ti		Read/Write
Slowdown_Start_Hour	Positive Integer	Nightly slowdown start time, hour, in 24-hour format		Read/Write
Slowdown_Start_Minute	Positive Integer	Nightly slowdown start time, minute		Read/Write
Slowdown_Stop_Hour	Positive Integer	Nightly slowdown stop time, hour, in 24-hour format		Read/Write
Slowdown_Stop_Minute	Positive Integer	Nightly slowdown stop time, minute		Read/Write
Vibration_Set_Point	Positive Integer	Fan vibration alarm set point	mm/s	Read/Write
Fan_XY_Power	Positive Integer	Fan power draw; typical each fan; X indicates fan cell, Y indicates fan number within cell		Read Only

Typical BACnet Objects – EC Fan Option (Continued)				
Object Name	**Object Type**	**Description**	**Units**	**Read/Write**
Spray_Row_X_Output	Binary Input	Relay output for spray row; X indicates the spray row number, beginning from top of unit		Read Only
Drain_Output	Binary Input	Relay output for drain solenoid valve		Read Only
Fan_XY_Fault.Active	Binary Input	Fan fault alarm; typical each fan; X indicates fan cell, Y indicates fan number within cell		Read Only
Fan_XY_Vibration_Alarm	Binary Input	Fan vibration fault; typical each fan; X indicates fan cell, Y indicates fan number within cell		Read Only
High_Temp_Alarm.Active	Binary Input	Leaving fluid high temperature alarm		Read Only
General_Alarm	Binary Input	General fault alarm		Read Only
Cooler_Enable	Binary Input	Cooler enabled when 1; Cooler disabled when 0		Read Only
Cooler_Enable_Remote	Binary Input	Status of remote enable input; 0 = Cooler disabled, 1 = Cooler enabled		Read Only
Cooler_Enable_Local	Binary Value	0 = Cooler disabled, 1 = Cooler enabled		Read/Write
Set_Point_Control	Binary Value	Source of cooler set point. 0 = Local set point, 1 = Remote set point		Read/Write
Nightly_Slowdown_Enabled	Binary Value	Enables or disables nightly slowdown; 0 = Slowdown disabled, 1 = Slowdown enabled		Read/Write
Nightly_Slowdown_Manual_Start	Binary Value	Manually starts nightly slowdown; 1 = Slowdown start		Read/Write

ETHERNET CONFIGURATION

Virga hybrid process coolers with BACnet IP communications are capable of communicating with a building management system using the controller's Ethernet port. Nimbus will provide the controller with default network settings. The IP address, subnet mask, default gateway, and primary DNS may be changed through the PLC's system menus.

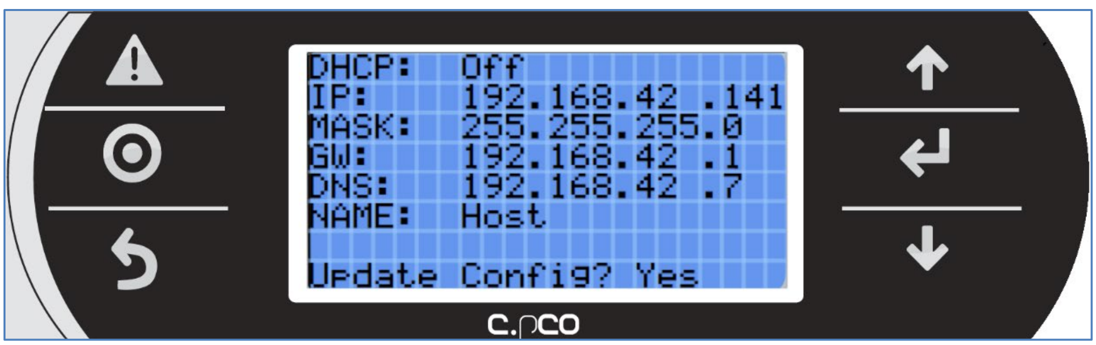
Adjusting System Settings

1. Press and hold the ⦿ key and ↵ key at the same time until the system menu appears.

Controller System Menu

2. Select SETTINGS and press the ↵ key.

3. Select TCP/IP SETTINGS and press the ↵ key.



Network Settings Screen

4. Adjust the IP address, subnet mask, gateway (GW), and primary DNS settings as needed. Press the ↵ key until the cursor selects the "Update Config?" setting. Change the setting to YES. Press the ↵ key to save all changes.

5. Press the ⮌ key until the HMI displays the Virga status screen, or leave the controller alone. The system menu will time out and automatically return to the Virga status screen.

WARNING
Arc flash and shock hazard.
Any work on any energized equipment should be performed only by qualified personnel wearing appropriate PPE.
Refer to NFPA 70E for minimum recommended electrical safe work practices.

Minimum Routine Maintenance Recommendations

Monthly

Rotate all fans for at least five minutes per month to prevent uneven wear on motor bearings. If the fans remain idle for extended periods of time, the motors may seize and fail to start. If fans are not rotated regularly during normal operation, Nimbus recommends lowering the set point to force all fans to run.

Clean coil surfaces as needed. Remove debris or light buildup using a soft brush while coils are dry. Heavier dirt or scale buildup can be cleaned with warm water, mild detergent, and a soft brush.

NOTICE
Do not clean the coil surfaces with high-pressure water spray or an air compressor.
High pressure water or air will bend the aluminum fins and reduce heat rejection capacity.

Inspect spray nozzles for scale buildup. Obstructed nozzles may have a narrow or irregular spray pattern or reduced spray volume. Clean or replace obstructed nozzles. Soaking the nozzle or nozzles in a weak acid solution, such as vinegar, can help dissolve scale buildup. The nozzles may need to be inspected and cleaned more frequently depending on the installation site conditions and spray water hardness.

Every Six Months

Check electrical connections to ensure that no loose wires are present. Tighten loose terminals as needed.

Inspect fan motors for signs of bearing wear or damage. Measure and record fan motor running currents to check for abnormalities. Elevated or unbalanced currents can indicate or predict motor problems.

Measure and record resistance of motor phases from phase to ground and from phase to phase.

Clean coils with a fin cleaner if necessary. Ensure fin cleaner is compatible with copper, aluminum, stainless steel, and coated fins. Ensure the fin cleaner pH is between 6.0 and 8.0. Approved cleaners include ComStar Evaporator Coil Cleaner, ComStar Coil Safe™, and Nu-Calgon Evap Pow'r®-C. Follow the manufacturer's application instructions. Contact Nimbus to review the specifications of any other fin cleaners.

NOTICE
Do not clean the coil surfaces with a strongly acidic or strongly alkaline cleaning solution.
Acidic or alkaline products will degrade the fin coating and damage the aluminum fins.

Check the temperature sensor calibration. Remove the sensor from the thermowell and insert the sensor tip into a container of equal parts ice and cold water. The LEAVING FLUID TEMP on the HMI should read 32°F, ± 2°F.

Inspect pipes, valves, and fittings for leaks, cracks, or scaling.

Test the spray water source for pH, hardness, and total dissolved solids. Adjust water treatment as necessary if the results exceed the recommended levels in the table on Page 8.

Annually

Before the onset of freezing weather, drain the spray pipes to prevent pipe bursts. Nimbus recommends closing the ball valve on the spray piping inlet manifold and blowing out each row of spray piping with an air compressor.

City water piping between the building and Virga may be heat traced and insulated. If using heat tracing, inspect it before the onset of freezing weather to ensure proper operation. Ensure the heat tracing is plugged in and turned on.

Before the onset of freezing weather, sample the water/glycol process fluid and measure the glycol concentration. Check the glycol concentration at least once per month while freezing weather is likely. Adjust the concentration of glycol as needed to ensure proper freeze protection for the local climate.

NOTICE
Insufficient freeze protection may result in bursting of the heat exchange coil tubing. Depending on the location and severity of the damage, it may not be possible to repair the affected coil or coils.

Recommended Maintenance				
	Monthly or As Needed	Preparation for Spray Season	Preparation for Winter Weather	Semi-Annually
Inspect fin surfaces. Remove debris, dirt, or scale buildup	X	X		
Ensure spray nozzles are clear and directed toward coils	X	X		
Clean coils with fin cleaner				X
With power off, inspect the controls enclosure for any loose wire connections				X
Visually inspect connections for leaks		X		X
Open city water valve to enable spray		X		
Test spray water source for pH, hardness, and total dissolved solids		X		
Check temperature sensor for accuracy				X
Check glycol concentration to ensure adequate freeze protection			X	
Winterize spray piping by shutting off city water and draining pipes			X	
Ensure city water heat trace is powered and working as expected			X	
Rotate fans for at least five minutes	X			
Measure and record fan motor running current				X
Check fan motors for bearing wear or damage				X
Ensure motor mounts and pipe fittings are secure				X

TROUBLESHOOTING – GENERAL

The fans turn on before the water temperature is at the set point. They turn on even when the process is not running.

Depending on the installation location, the temperature sensor may be exposed to heat from sources outside the system. For example, a temperature sensor in direct sunlight on a black asphalt rooftop may read slightly higher than the process fluid. In this case, Nimbus recommends insulating the thermowell, such as with foam insulation wrap.

Water is leaking from a valve in the bottom of the spray pipe once the water spray ceases.

This is a normal function of the Virga. After the water spray stops and the spray valve closes, a drain valve below it will open and allow any water remaining in the pipes to drain, eliminating standing water in the system.

One or more fans have stopped running. The motor protection circuit breakers (MPCBs) are constantly tripping.

Check the settings on the MPCBs and ensure that they are not set too low. Each MPCB should be set at the rated full load amps (FLA) of the motor. The motor FLA can be found on the control panel nameplate, fan motor nameplate, or electrical schematic supplied with the Virga.

If the overload trips as soon power is applied to the motor, the most likely cause is a short circuit. There may be an internal short in the motor, or there may be a phase-to-phase or phase-to-ground short on one of the wires between the MPCB and the motor.

If the motor is able to run for a moment before the MPCB trips, the most likely cause is an overload. The fan may be blocked. If the fan is not blocked, the motor may be single-phasing due to a loose wire or internal failure. Measure the running current on each motor phase. If the motor is single-phasing, the current on one phase will be very low or zero, and the current on the other two phases will be higher than the nameplate full-load amp rating. If the motor is single-phasing, de-energize and lock out power and check for loose wire connections in the control panel and in the terminal box on the side of the motor.

If the MPCB is set properly, and there are no faults with the motor wiring, the motor may require maintenance, repair, or replacement.

The adiabatic cooling spray does not activate as expected.

Nimbus provides a manual shut-off valve on the spray piping manifold. Ensure that the valve is open. Ensure that any other valves in the city water supply piping are open.

The spray and drain solenoid valves are provided with a circuit breaker in the control panel. Ensure that the circuit breaker is not tripped. Refer to the electrical drawing supplied with the cooler to identify the circuit breaker that protects the solenoid valves. If the breaker is tripped, remove the coil of either the spray or drain solenoid valve. Reset the circuit breaker and observe as the system calls for spray. If the circuit breaker trips, the connected valve is likely shorted. If the circuit breaker does not trip, the disconnected valve is likely shorted. Contact Nimbus for assistance with repair or replacement.

The controller does not display the correct fluid temperature. The temperature appears as a symbol instead of a number.

If the temperature controller displays the fluid temperature as **-- --** (digital control option) or **######** (PLC control option), check the temperature sensor wiring for short or open circuits. Check the wiring between the controller and sensor for loose wires. If there are no problems with the sensor wiring, the sensor may be damaged and may require replacement.

TROUBLESHOOTING – VARIABLE FREQUENCY DRIVE OPTION

The Virga is noticeably louder when the fans run at certain speeds. The fans, fan grills, or sheet metal tops vibrate excessively.

Check for loose bolts. Ensure the cooler is correctly installed on a solid foundation using all available anchor bolt holes. Refer to the installation recommendations on Page 7 for recommended mounting practices.

If the unit is correctly and securely mounted, and no bolts are loose, the vibrations may be caused by resonance. Resonance is an unwanted vibration introduced into a system when a fan operates at the system's natural frequency. It is a rare problem typically characterized by excessive noise and vibration of the fan blades, fan grills, or sheet metal tops. The system's resonant frequency depends on the cooler configuration, support structure, and how the cooler interacts with the structure.

Resonance may be mitigated by disabling the VFD output frequencies at which the vibration occurs. The VFD will be prevented from running at the resonant frequency for an extended time. Locking out a frequency range requires the user to access the VFD while the system is in operation and should only be performed by personnel qualified for live electrical work. Contact Nimbus for assistance before attempting to lock out frequencies.

TROUBLESHOOTING – EC FAN OPTION

One or more fans are running unexpectedly, such as when the fluid temperature is below the set point.

The EC fans communicate with the PLC using Modbus RTU. If the Modbus signal to a fan is interrupted for sixty (60) seconds, the fans will automatically speed up to full speed. The fans will run at full speed until communications are restored. Check for loose wires in the control panel. Ensure that the PLC is not faulted. Ensure that none of the fans are faulted. Clear any faults. Turn off power to the control panel and turn it on again; this will reset communications between the PLC and fans.

The fan speed increases and decreases too quickly. The fans are constantly cycling between low speed and full speed.

Check the PID settings. Start by lowering the PID proportional gain. If there are no other problems, lowering the PID proportional gain will slow down the rate at which the fans cycle between low speed and full speed.

Check the Modbus RTU wiring between the controller and fans for loose wires.

If the PID settings have no effect on the fan oscillation, and no loose wires are present, measure the Virga's full load current with all fans running at full speed. Compare the measured full load current to the cooler's nameplate full load current. If the measured current is significantly higher than the nameplate current, the problem may be caused by harmonics. Harmonics are unwanted currents that may be fed back into the electrical distribution system by devices such as VFDs or EC motors. Depending on the amount of resistance in the electrical system, the number of fans, the size of the transformer supplying the Virga, and other conditions, harmonics that may be produced by the EC fans may affect the electrical system's ability to deliver consistent voltage. It may be necessary to increase the transformer size, increase resistance in the system, or install a harmonics filter between the Virga and the rest of the electrical system.

WARRANTY

Nimbus warrants to the original Buyer that the equipment, service, software, repair or parts supplied shall conform to the description in the quotation. In the event that any part or parts, excepting expendable items such as, but not limited to spray nozzles, fuses, and other similar consumable items, that fail due to defects in material or workmanship within the first twenty-four (24) months of startup of equipment or thirty (30) months after shipment, whichever occurs first, Nimbus shall, at its option, repair or replace EXW (Ex works), such defective part or parts. The warranty obligations of Nimbus with respect to equipment not manufactured by Nimbus shall conform to and be limited to the warranty actually extended to Nimbus by its suppliers. Notice of a claim for alleged defective equipment must be given within fifteen (15) days after Buyer learns of the defect. The defective part or parts shall be returned to Nimbus, freight prepaid, unless otherwise directed by Nimbus. THIS WARRANTY SHALL BE EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTIES AND NIMBUS MAKES NO WARRANTY OF MERCHANTABILITY OR WARRANTIES OF ANY OTHER KIND EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE WHICH EXTEND BEYOND THE WARRANTY AS SET FORTH ABOVE. NIMBUS'S LIABILITY FOR ANY AND ALL LOSSES AND DAMAGES TO BUYER RESULTING FROM DEFECTIVE PARTS OF EQUIPMENT SHALL IN NO EVENT EXCEED THE COST OF REPAIR OR REPLACEMENT, EXW OF DEFECTIVE PARTS OR EQUIPMENT. This warranty shall not apply to products which have been abused, altered, misused in application, improperly maintained or repaired, or operated other than in accordance with Nimbus's operating instructions.

This warranty section is designed to keep the Buyer informed and facilitate the Buyer's understanding of Nimbus's sales and warranty policy and procedures. Warranty claims will not be valid unless all policies are adhered to. This warranty covers parts only, excluding labor and operational costs associated with the claim. Buyer must receive approval from Nimbus prior to starting any on-site work to repair or replace the Goods. Failure to obtain such approval before starting work may void warranty.

Nimbus assumes no responsibility for the accuracy or reliability of design conditions, specifications, data, or other items supplied, selected or furnished by Buyer. This warranty does not apply to: freeze damage, cosmetic issues such as chipped paint or surface rust, or goods that have been subject to misuse, neglect, or failure to follow operating, maintenance, and IOM manuals.

Unless otherwise agreed by Nimbus in writing, said Warranty runs only to Buyer and is not transferrable or assignable.

In the event that a failure is attributed to a fault of Nimbus's manufacturing process, repairs must be approved and authorized by Nimbus' US Manufacturing Headquarters, in Anniston, Alabama, prior to making repairs. Upon agreement a fair estimate detailing labor costs and hours should be submitted and approved in writing. Failure to follow this process may make warranty claim null and void.

All replacement warranty parts will be shipped prepaid by normal ground shipping. Other shipping methods will have to be approved and may be limited by size, weight and location. Nimbus makes no representation about availability of replacement warranty parts. This warranty does not represent any form of regular maintenance or failure to perform such as a warrant claim. This warranty does not include physical shipping or unloading damage.

Nimbus accepts no liability for the direct or indirect consequences of any modifications of or repairs to the units made by Buyer of their contractor. Nimbus reserves the right to inspect the equipment for customer neglect or abuse during the warranty period should claims arise.

VIRGA III® VIRGA X3®

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