STANDARD COMMISSIONING PROCEDURE FOR EVAPORATIVE COOLING SYSTEMS

BUILDING NAME: ____ **APPLICATION #:** ________________
BUILDING ADDRESS: ____
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NAME & FIRM OF PERSON(S) DOING TEST: ____
DATE(S) OF TEST: __________________________________

General Notes:

1. This is a generic test procedure for evaporative cooling systems. If the complexity, configuration, or other aspects of a specific project require substitute tests or additional tests, explain on the comments sheets, and attach the additional test procedures and field data. Attach all relevant functional performance verification sheets, and always attach the final signed and dated procedure certification page.
2. In all test sections, circle or otherwise highlight any responses that indicate deficiencies (i.e. responses that don't meet the criteria for acceptance). Acceptance requires correction and retest of all deficiencies, as defined in each test section under "Criteria for Acceptance" or "Acceptance". Attach all retest data sheets. Complete the Deficiency Report Form for all deficiencies.
3. This Commissioning Procedure does not address fire and life safety or basic equipment safety controls.
4. To ensure that this Commissioning Procedure will not damage any equipment or affect any equipment warranties, have the equipment manufacturer's representative review all test procedures prior to execution.

OPERATOR INTERVIEW (Existing Buildings Only):

Determine from a discussion with the building operator whether the evaporative cooling systems are operating properly to the best of their knowledge. Note any known problems, and possible solutions.

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INSTALLED CHARACTERISTICS:

Enter answers from field inspection. Note under response if the feature as installed differs in any way from the design documents. If an item does not apply, write "NA" for not applicable.

Criteria for Acceptance: Installed characteristics must be in accordance with design intent documentation and approved submittals.

DESCRIPTION	RESPONSE (add sheets as necessary to adequately describe)
1. Type of system (direct, indirect, indirect/direct, other . If other, describe.)	
2. Do indirect section(s) have outside air or exhaust air secondary stream?	
3. Is system equipped with a mechanical cooling stage? If yes, describe. If mechanical cooling is by a chiller, and if chiller is part of a FinAnswer energy efficiency measure (EEM), attach completed chiller commissioning procedure.	
4. Is system equipped with an air-side economizer?	
5. Is system equipped with a heating coil? If yes, state type (hot water, gas, electric, etc.)	

Building Name: ______________________

SYSTEM COMPONENT NAMEPLATE DATA (From equipment nameplates, as recorded in field. Attach other sheets as necessary. If the system is built-up of component equipment, enter the individual components in the blank spaces.):

Criteria for Acceptance: Nameplate data must be in accordance with submittals as approved by Designer.

EQUIPMENT TYPE	UNIT #	MANUFACTURER	MODEL #	CFM/TOT.TONS	COMMENTS
1. Packaged evaporative cooler				/	
2. Packaged evaporative cooler				/	
3. Packaged evaporative cooler				/	
4. Supply fan (if not part of cooler package)					
5. Exhaust fan (not part of pkg)					
BUILT-UP SYSTEMS:					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

COMMENTS ON INSTALLED CHARACTERISTICS & NAMEPLATE DATA ITEMS (item #, unit #, comment). Add more sheets as needed:

Building Name: ______________________

INSTALLATION VERIFICATION:

Instructions: Under each unit write "Y" for yes, "N" for no, "NA" for not applicable, or a number to refer to any needed comments. If other information is requested such as temperature, write the appropriate values. For fan data, enter values for both supply and exhaust fans. Use additional sheets for additional fans.

Current and voltage imbalance is defined as the greatest difference between the measurement for any of the 3 phases and the average of the 3 phases, that quantity divided by the average of the 3 phases. As an example, if the voltage measurements are 451, 461, and 463, then the average is 458.3 volts. The greatest difference between any measurement and the average is 451-458.3, or 7.3 volts. Then, the voltage imbalance is 7.3 volts / 458.3 volts, or 0.016. As a percentage, this is 1.6%, and would be acceptable by the criteria below.

Criteria for Acceptance: All items in this section require answers of “Y” (or “NA”, where relevant) except where other criteria are noted.

INSPECTION ITEM	UNIT # __	UNIT # __	UNIT # __
1. Relevant sections of test & balance report reviewed?			
2. Primary CFM per design? Acceptance: Design ±10%, based on TAB report			
3. No unusual noise or vibration, fans and pumps			
4. Adequate access for cleaning indirect section			
5. Adequate access for cleaning direct section			
6. Adequate maintenance access to other system components			
7. If OSA airstream is unusually dirty, is unit equipped with a suitable secondary air filter?			
8. Piping & ductwork configuration is correct			
9. If exhaust air is used for secondary air, does primary air section have a condensate drain?			
10. Condensate drain unobstructed & trapped			
11. Inlet screen on primary air			
12. Fan belt tension & condition okay? (supply / exhaust)	/	/	/
13. Fan rotation correct?	/	/	/
14. Fan blades clean?	/	/	/
15. Motor contactors in good condition?	/	/	/
16. Motor overload heaters properly sized?	/	/	/
17. Fan motor volts, rated	/	/	/
18. Fan motor volts into motor. Acceptance: ±10% of rating, all phases	Supply: / / Exhaust: / /	Supply: / / Exhaust: / /	Supply: / / Exhaust: / /
19. Voltage Imbalance into motor, $(V_{max,min} - V \quad) / V$			
20. Voltage Imbalance into motor is < 2%?	/	/	/
22. Fan motor full speed Amps, measured at motor (downstream of VFD)	Supply: / / Exhaust: / /	Supply: / / Exhaust: / /	Supply: / / Exhaust: / /
23. Fan motor measured Amps < Rated FLA?	/	/	/
24. Current imbalance at motor is < 2%?	/	/	/
25. Airflow directions correct, both primary & secondary?			

	UNIT # __	__	UNIT # __

The following sections are a series of field tests that are intended to verify that the evaporative cooling systems, as installed, operate as they were intended to operate by the manufacturer and designer. For each test, first

does not correspond to the intended design operation, also write a comment number that refers to an explanatory comment in the comments section or on attached comments sheets. If a test does not apply, write "NA" for not

Controls calibration tests: Perform the following calibration verifications by slowly adjusting the setpoint of each thermostat, humidistat, etc. until the controlled response begins. Note the setpoint when that occurs, and note the reading on a calibrated thermometer (or other instrument as required) held in close proximity. If the units are controlled by a building energy management system (EMS), compare the sensor input to the EMS to the simultaneous field measurement made on a calibrated thermometer (or other instrument as required) held in close proximity. Use the blank lines for other sensors and stats such as exhaust or return air thermostats, 2nd stage temperature differentials, etc.

If a single system serves multiple zones, select a sample of at least 10% of the zones, or 4 zones, whichever is greater, for calibration checks of the room temperature and humidity sensors (or stats). If there is failure to meet acceptance criteria for more than 10% of the sampled room sensors or stats, or 2, whichever is greater, then all such sensors and stats serving that system shall be considered to be not in conformance.

Criteria for Acceptance: If sensor or stat is out of calibration by more than ± 3 degrees F or 5% relative humidity, note that as a deficiency.

UNIT #			
1. Outdoor air sensor or thermostat, computer input signal or setpoint when control action occurs (°F). This is applicable only if the cooler is equipped with an economizer or if OSAT is otherwise referenced in the evaporative cooling control sequence.			
2. Outdoor air temperature, measured (°F)			
3. Discharge air sensor or stat, computer input signal or setpoint when control action occurs (°F)			
4. Discharge air sensor, measured (°F)			
5. Room thermostat or temperature sensor, computer input signal or setpoint when control action occurs (°F)			
6. Room air temperature, measured (°F)			
7. Room humidistat or humidity sensor, computer input signal or setpoint when control action occurs (%RH)			
8. Room humidity, measured (%RH)			
9.			
10.			
11.			
12.			
13.			
14.			

COMMENTS ON CALIBRATION ITEMS (add more sheets if needed):

UNIT # COMMENT

_____ ____
_____ ____
_____ ____
_____ ____

Basic performance tests: With the system in the full outdoor air mode (i.e. no mixing of return air), and with mechanical cooling locked out, record the following. The design line in each test set refers to the design condition as reflected in catalog data, drawings, design intent document, etc. The measured line refers to your test results.

Test Conditions: The outdoor air temperature should be greater than 55°F during the testing period. The zones served should be under a significant cooling load.

Criteria for Acceptance: Calculated efficiency (items #5 and 11) must be within ±15% of nominal efficiency.

Symbols: PEDB = primary air entering dry bulb temp.; PEWB = primary air entering wet bulb temp.; PLDB = primary air leaving dry bulb temp.; PLWB = primary air leaving wet bulb temp; SEDB = secondary air entering dry bulb temp.; SEWB = secondary air entering wet bulb temperature; DEDB = direct section entering dry bulb temp.; DEWB = direct section entering wet bulb temp.; DLDB = direct section leaving dry bulb temp.; DLWB = direct section leaving wet bulb temp. Note that if outdoor air is used for the secondary air stream, SEDB = PEDB, and SEWB = PEWB.

UNIT #			
INDIRECT SECTION			
1. Nominal efficiency, design (or mfctr's data)			
2. PEDB / PEWB (°F), measured	/	/	/
3. PLDB / PLWB (°F), measured	/	/	/
4. If secondary air is building exhaust, SEDB / SEWB (°F), measured	/	/	/
5. Calculated operating efficiency. Efficiency = (PEDB - PLDB) / (SEDB - SEWB) Acceptance: ±15% of nominal			
6.			
7.			
DIRECT SECTION			
8. Nominal efficiency, design (or mfctr's data)			
9. DEDB / DEWB (°F), measured	/	/	/
10. DLDB / DLWB (°F), measured	/	/	/
11. Calculated operating efficiency. Efficiency = (DEDB - DLDB) / (DEDB - DEWB) Acceptance: ±15% of nominal			
12.			
13.			

SYSTEM CONTROLS VERIFICATION:

Since there are many variations on the controls sequences for evaporative cooling systems, it is difficult to write a generic test for system controls. In each of the following sections, first describe the controls sequences, then describe what tests were done to verify each, and finally describe your conclusions from the tests, including any deficiencies. Attach to this test sheet all relevant field data, monitored data, graphs, trend logs, etc. Annotate any data and graphs so that it is clear what the data are proving. Energy Management System (EMS) trend logs of EMS outputs, program print-outs, or schedule and setpoint print-outs are not acceptable as proof of operation unless you have first verified that these data accurately reflect actual operation and you attach detailed documentation of that verification. Trend logs of sensor inputs to the EMS are acceptable. See the attached example for the level of detail expected. Add sheets as necessary.

Criteria for Acceptance: The actual control sequence must be in accordance with the equipment submittal as approved by the Designer. Acceptance is based on thorough documented verification of each control mode.

Start/Stop Control (include interlocks, time-of-day control, outside temperature lockout, etc.)**:**
Describe the control sequence:

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Describe the tests that were done to verify the control sequence:

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Conclusions:

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Capacity Control (e.g. air bypass around evaporative section, valving off spray to media sections, mixing cooled outside air with return air, staging of mechanical cooling, etc.)**:**
Describe the control sequence:

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Describe the tests that were done to verify the control sequence:

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Conclusions, capacity control tests:

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Building Name: ________________________

Freeze Protection Control:

Describe the control sequence:

Describe the tests that were done to verify the control sequence:

Conclusions:

Other Control:

Describe the control sequence:

Describe the tests that were done to verify the control sequence:

Conclusions:

COMMENTS ON FUNCTIONAL PERFORMANCE VERIFICATION ITEMS (add more sheets as needed):

I certify that the data and test results as recorded herein are accurate.

_______________________________________ ____________

Signature, Commissioning Agent Date

_______________________________________ ______________________________

Firm Name (Area Code) Phone Number

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SAMPLE CONTROLS VERIFICATION SHEET

Start/Stop Control (include interlocks, time-of-day control, outside temperature lockout, etc.)**:**

Describe the control sequence:

Evaporative cooling packaged unit is enabled by a time-of-day signal from the building EMS. During unoccupied mode, the outside air (OSA) damper is closed, the return air (RA) damper is open, both direct and indirect section pumps are off, and the indirect secondary air fan is off. The supply fan may cycle on by night low limit. For OSA temperature lockout, see "Capacity Control" below.

Describe the tests that were done to verify the control sequence:

We observed the units (dampers, fans, pumps) during the occupied and unoccupied modes. We also adjusted the night low limit setpoint so we could observe what happens when the space temperature falls below the low limit.

Conclusions:

When we raised the night low limit setpoint, we observed the supply fan to start, while no change occurred to damper or pump status. The OSA damper was closed during the unoccupied mode and opened at the start of occupancy. (RA damper did the reverse.) The secondary fan and all spray pumps were off during the unoccupied mode. Field notes are attached.

Capacity Control (e.g. air bypass around evaporative section, valving off spray to media sections, mixing cooled outside air with return air, staging of mechanical cooling, etc.):

Describe the control sequence:

Capacity control is by means of a mixed air section with dampers, and by staging the indirect and direct sections. When there is no call for cooling, the return air (RA) damper is full open and the OSA damper is closed. On a call for 1st stage cooling, the OSA damper is modulated open, subject to low limit thermostat in the discharge duct. When the OSA temperature is above setpoint (60°F, adjustable), the indirect unit fan and pump are started. On a call for 2nd stage cooling, the direct section pump is started. On a call for 3rd stage cooling, the valve to the chilled water coil is modulated open.

Describe the tests that were done to verify the control sequence:

We very slowly lowered the space thermostat cooling setpoint to simulate an increasing cooling load, while recording entering and leaving dry bulb temperatures for the direct and indirect sections, and the chilled water coil. We also tested air-side economizer operation by varying the OSAT lockout setpoint between 60°F and 70°F, and observing secondary fan and pump operation. (The OSAT during testing was about 65°F.)

Conclusions:

When the OSAT was below the OSAT lockout setpoint, and there was a call for 1st or 2nd stage cooling, the secondary fan and all pumps were off. When we set the OSAT setpoint back to 60°F, and simulated a call for 1st stage cooling, the secondary air fan and indirect section pump started. When we increased the load to call for 2nd stage cooling, the direct section pump started. When we lowered the space cooling setpoint 6 degrees below actual space temperature, the chilled water valve modulated open. Field notes are attached.