STANDARD COMMISSIONING PROCEDURE FOR PACKAGED HEAT PUMP (AIR-TO-AIR) & AIR CONDITIONING UNITS

BUILDING NAME: _____ **APPLICATION #:** _____
BUILDING ADDRESS: _____
_____

NAME & FIRM OF PERSON(S) DOING TEST: _____
DATE(S) OF TEST: _____

General Notes:

1. This is a generic test procedure for self-contained single zone packaged and split-system heat pumps and air conditioning units less than 20 tons in capacity. For larger, more complex, or built-up units, use the Standard Commissioning Procedure for Air Handling Units. 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 any interventive test procedures prior to execution.

OPERATOR INTERVIEW (Existing Buildings Only):

Determine from a discussion with the building operator whether the heat pump and/or air conditioning units are operating properly to the best of their knowledge. Use the table to note any known problems, and possible solutions. Address each unit. In the 2nd column, write "none" for any units with no known problems. Add sheets as needed.

UNIT SYMBOL & AREA SERVED	PROBLEM DESCRIPTION & EFFECT	PROPOSED SOLUTION

Building Name: _____

INSTALLED CHARACTERISTICS (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/or approved submittals.

SYMBOL DESCRIPTION						
1. Is unit single zone (SZ), multizone (MZ), VAV, dual duct (DD), or other (name)?						
2. Is unit split system, through-wall, rooftop, or other (name)?						
3. Is unit heat pump (HP) or air conditioning (AC)?						
4. If unit is AC, is it equipped with a heating section?						
5. Cooling coil type (chilled water or DX)						
6. Heating coil type (hot water, gas, electric, or other)						
7. Heating coil, # of stages						
8. Other coils: use & type						
9. Does unit have a return, relief, or exhaust fan?						
10. Supply fan motor control (none, VFD, inlet vanes, variable pitch blades, etc.) *						
11. Return/relief/exhaust fan motor control (none, VFD, inlet vanes, variable pitch blades, etc.) *						
12. Is unit equipped with economizer?						
13. Condenser type (air-cooled, evaporative, etc.)						
14. ARI rated EER or SEER (note which, and rating)						
15. For heat pumps, ARI rated COP or HSPF (note which, and rating)						
16. Other sections or accessories						
17.						
18.						

* If the motor is driven by a variable frequency drive (VFD), and if VFDs have been selected for functional performance testing, complete the Standard Commissioning Procedure for VFDs.

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

_____

_____

_____

_____

_____

Building Name: _____

NAMEPLATE DATA (from equipment nameplates, as recorded in field):

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

DESCRIPTION	UNIT #					
Manufacturer (pkgd or outdoor units)						
Model #						
Serial #						
Mfctr, indoor unit, if split						
Model #, indoor unit						
Rated Cooling Cap., tons						
Rated Heating Cap., MBtu						
Supply Fan Motor, hp						
Return/exhaust Fan, hp						
Voltage / ϕ, pkgd or outdoor unit						
Voltage / ϕ, indoor unit						

If any of the equipment nameplate data differ from the design parameters as described in the above equipment description and in the design documents, note data item and unit number, and comment here:

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. Explain comments in the spaces below the checklists. If a motor is driven by a VFD, complete also the Standard Commissioning Procedure for VFDs. If the motor is VFD-driven, make all supply fan electrical measurements upstream of the VFD, unless directed otherwise, and use a true RMS multimeter for all supply fan motor and drive electrical measurements. Items marked “(VFD)” apply only to motors that are equipped with VFDs. For tests that require running VAV system supply fan motors at full speed, verify that the primary dampers on at least one half of the terminal units served by each AHU are fully open, to avoid duct overpressurization.

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.

For all compressor tests, record data as “[left hand compressor] / [right hand compressor]”, where applicable. If a unit contains more than 2 compressors, attach data for extra compressors to this form.

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

DESCRIPTION	UNIT #					
General Checklist Items:						
1. Casing condition: dents, cracks, leaks?						
2. Shipping restraints removed?						
3. Unit access per mfctr's instructions?						
4. Drainage under unit per mfctr’s instructions?						
5. No unusual noise or vibration?						
6. Electrical connections tight?						
7. Return, outdoor, relief dampers move freely / close tightly?						
8. Return, outdoor, relief dampers properly linked? (Observe stroke.)						
9. TAB report section for unit reviewed & acceptable (Acceptance: design ±10%)						
10. Air filters clean & tight fitting?						
11. Room thermostat type ("7" for 7-day, "W" for 2-day, "D" for 24 hour, “E” for energy management system sensor) Acceptance: In accordance with approved submittals.						
12. Room thermostat/sensor location is satisfactory.						
13. Ductwork appears tight, with no obvious leaks						
14. Ductwork insulation appears in good condition where visible						
15. O&M manual on site						

Building Name: _____

DESCRIPTION	UNIT #					
Supply Fan Section:						
16. Fan belt tension & condition okay?						
17. Fan rotation correct?						
18. Fan blades clean & in good condition?						
19. Motor contactors in good condition?						
20. Motor overload heaters properly sized?						
21. Fan motor volts, rated						
22. Fan motor volts into motor. Acceptance: ±10% of rating, all phases						
23. Voltage Imbalance into motor, $(V_{max,min} - V_{avg}) / V_{avg}$						
24. Voltage imbalance into motor is <2%?						
25. Fan motor FLA, rated						
26. Fan motor full speed Amps, measured at motor (downstream of VFD)						
27. Fan motor measured Amps < Rated FLA?						
28. Current imbalance at motor is <2%?						
Return/Relief/Exhaust Fan Section:						
29. Fan belt tension & condition okay?						
30. Fan rotation correct?						
31. Fan blades clean & in good condition?						
32. Motor contactors in good condition?						
33. Motor overload heaters properly sized?						
34. Fan motor volts, rated						
35. Fan motor volts into motor. Acceptance: ±10% of rating, all phases						
36. Voltage Imbalance into motor, $(V_{max,min} - V_{avg}) / V_{avg}$						
37. Voltage imbalance into motor is <2%?						
38. Fan motor FLA, rated						
39. Fan motor full speed Amps, measured at motor (downstream of VFD)						
40. Fan motor measured Amps < Rated FLA?						
41. Current imbalance at motor is <2%?						
Refrigeration Section (facing front: data for left hand / right hand compressor):						
42. Refrigerant sightglasses clear of bubbles when compressors loaded?	/	/	/	/	/	/
43. Sightglasses indicate no moisture?	/	/	/	/	/	/
44. Compressor oil level correct? Record level	/	/	/	/	/	/

Building Name: _____

DESCRIPTION	UNIT #					
45. Compressor motor measured Amps < Rated FLA?	/	/	/	/	/	/
46. Record head pressure under load, each compressor. Acceptance: per mfctr.	/	/	/	/	/	/
47. Record suction pressure under load, each compressor.	/	/	/	/	/	/
48. Record suction temperature at TXV bulb, each compressor.	/	/	/	/	/	/
49. Calculate superheat. Acceptance: 8 to 20 degrees F, or per mfctr's instructions.	/	/	/	/	/	/
50. Refrigerant charge okay based on suction & head pressures, superheat, & sightglasses?	/	/	/	/	/	/
51. Thermal expansion valve bulbs attached firmly to suction lines, and adequately insulated	/	/	/	/	/	/
52. Suction line insulated?						
53. Coil clean & in good condition?						
54. Condensate piping trapped properly & drained to outside or floor drain?						
55. For heat pumps: Strip heat locked out during warm-up ("O" for OSA control, "I" for intelligent ramp-up, "N" for no lock-out)						
Heat Section (items marked "G" apply to gas-fired equipment only):						
56. Maintenance access is adequate?						
57. Insulation is complete & undamaged?						
58. Section is clean & airflow is unobstructed?						
59. Adequate clearance from heating elements?						
60. Electrical connections tight?						
61. (G) Pipe fittings & accessories complete?						
62. (G) Gas pilot flame stable when fan is on?						
Condenser:						
63. All fans are operational?						
64. Fan inlet screens are free of debris?						
General Run Test:						
65. Run Test: Observe unit under normal operation & load 2 times in a 12 hour period, at least 3 hours apart. Verify that there is no unusual noise, vibration, cycling, overheating, or other problems at the fan section, damper section, coils, compressors, condenser, electrical, etc.. Note whether under htg (H) or clg (C) load						
Observation #1: Time of Day, H or C / Acceptable?	/	/	/	/	/	/

Building Name: _____

DESCRIPTION	UNIT #					
Observation #2: Time of Day, H or C / Acceptable?	/	/	/	/	/	/

COMMENTS ON INSTALLATION VERIFICATION CHECKLIST ITEMS (add more sheets if needed):

ITEM #	UNIT #	COMMENT

Building Name: ________________________

CONTROLS CALIBRATION:

Instructions: All control points listed under each unit refer to sensors and stats that are dedicated to that unit, and for the most part physically located close to or in the unit, not global (building-level) points. For thermostats and humidistats, slowly adjust the setpoint until the controlled response begins (i.e. contact make or break). Note the setpoint when that occurs and the simultaneous measured value on a calibrated instrument held in close proximity to the sensing bulb. If sensor location is improper, explain in comments. If the unit serves more than one zone, check calibration of zone temperature for two sample zones only. Enter other control points that are critical to the control sequence in the blank spaces for each unit, as appropriate. It is not necessary to repeat any calibration that was documented in the Standard Commissioning Procedure for EMSs, but refer to that document where relevant.

Criteria for Acceptance: Temperature sensors, EMS or contact make/break values ± 2 F degrees from measured values. Static pressure sensors, less than ± 0.1" from measured values. Relative humidity sensors, less than ± 10% from measured values.

CONTROL TYPE	SENSOR / STAT LOCATION	CONTROL LOCATION OK?	MEASURED VALUE	EMS VALUE or MAKE/BRK VALUE	ACCEPTABLE? / COMMENTS
Outdoor air temp., global (EMS)					
Outdoor air % RH, global (EMS)					
Unit # -__________:					
OSA temp or enthalpy					
Discharge air temp.					
Mixed air temp.					
Return air temp.					
Static pressure					
Zone temp.					
Zone temp.					
Unit # -__________:					
OSA temp or enthalpy					
Discharge air temp.					
Mixed air temp.					
Return air temp.					
Static pressure					
Zone temp.					
Zone temp.					
Unit # -__________:					
OSA temp or enthalpy					
Discharge air temp.					
Mixed air temp.					
Return air temp.					
Static pressure					
Zone temp.					
Zone temp.					

Building Name: ________________________

CONTROL TYPE	SENSOR / STAT LOCATION	CONTROL LOCATION OK?	MEASURED VALUE	EMS VALUE or MAKE/BRK VALUE	ACCEPTABLE? / COMMENTS
Unit # -__________:					
OSA temp or enthalpy					
Discharge air temp.					
Mixed air temp.					
Return air temp.					
Static pressure					
Zone temp.					
Zone temp.					
Unit # -__________:					
OSA temp or enthalpy					
Discharge air temp.					
Mixed air temp.					
Return air temp.					
Static pressure					
Zone temp.					
Zone temp.					
Unit # -__________:					
OSA temp or enthalpy					
Discharge air temp.					
Mixed air temp.					
Return air temp.					
Static pressure					
Zone temp.					
Zone temp.					

CONTROLS CALIBRATION COMMENTS:
Unit # / Control Point / Comment

FUNCTIONAL PERFORMANCE VERIFICATION:

The following sections are a series of field tests that are intended to verify that the heat pumps and/or air conditioning units operate as they were intended to operate by the manufacturer and designer. For each test, first determine and record the design operation, and then record the actual field observation. Following each test, in parentheses, are the appropriate response choices or units. If the field observation 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 applicable. If you were not able to complete a test, write "ND" for not done, and explain in a comment.

If the standard test procedures are not applicable or adequate, document the sequences, tests, and results on the pages that follow the standard procedures. First describe the control sequences for each unit for each applicable sequence type: start/stop, warm-up mode, fan capacity, temperature control, safeties, and other. Next describe in detail what tests you plan to do to verify each control sequence. Finally, describe your test results and conclusions, including any deficiencies found. **See the attached example for the level of detail required.** Add sheets as necessary. It is not necessary to repeat any tests that were documented in the Standard Commissioning Procedure for EMSs, but refer to that document where relevant.

Attach to this form all relevant field data, monitored data, graphs, trend logs, and so forth. Annotate any data and graphs so that it is clear what the data are proving. EMS trend logs of EMS outputs, program print-outs, or schedule and setpoint print-outs are not acceptable as proof of operation, unless the information is first verified to be accurate and documentation is attached. Trend logs of sensor inputs to the EMS are acceptable.

Sampling: If there are more than 10 units of a given model, you may select a sample for the following performance tests. The sample should be at least 10% of the total number of that model units, or 4 units, whichever is greater. If there is failure of any test for more than 10% of the sampled units, or 2 units, whichever is greater, then the project heat pump and/or air conditioning unit installation shall be considered to be not in conformance. In that case, follow the contractual procedures for reporting and correcting deficiencies.

Building Name: _____

Scheduled Start/Stop and Unoccupied Setback/Setup Test: Perform the following tests by monitoring and/or observing each piece of controlled equipment under actual operation. It is permissible to adjust the schedules and/or setpoints for easier testing. If this is done, reset to the original schedules and setpoints, or as directed by the building operator, at the conclusion of testing. If the original values are not consistent with energy efficient operation, discuss with the building operator. Use of dataloggers or trend logs of EMCS input channels over a 2 or 3 day period is recommended. Annotate any logger data and graphs so that it is clear what the data are proving, and attach these to this form. (See attached example of an annotated graph.) EMCS trend logs of EMCS output signals are not acceptable as proof of operation unless you have first verified and documented (attach) that the output signals accurately represent actual operation.

Criteria for Acceptance: The following shall be considered deficiencies: 1) Equipment doesn't start and/or stop within 15 minutes of the scheduled times, 2) Occupied space temperatures fall more than 2 F degrees below the heating setpoint or rise more than 2 F degrees above the cooling setpoint, 3) Unoccupied space temperatures go more than 3 degrees F below (above) the setback (setup) temperature setpoints, 4) Unoccupied space temperatures are maintained more than 3 degrees F above (below) the setback (setup) setpoints, 5) Equipment that is to be interlocked with the unit doesn't operate on the same schedule.

UNIT #						
1. Start time setting. *(For the following tests, select 1 typical day from the observed data.)*						
2. Observed (or monitored) start time						
3. Occupied setpoints, heating / cooling (°F)	/	/	/	/	/	/
4. Observed (or monitored) stabilized space temperature range.	/	/	/	/	/	/
5. Stop time setting						
6. Observed (or monitored) stop time						
7. Unoccupied setpoints, heating / cooling (°F)	/	/	/	/	/	/
8. Observed (or monitored) minimum / maximum unoccupied space temperature	/	/	/	/	/	/
9. If observed minimum (maximum) temperature is higher (lower) than the unoccupied heating (cooling) setpoint, does equipment operate to maintain that temperature? If "yes", this is a deficiency.						
10. List all interlocked equipment by symbol. Include pumps, fans, etc. as relevant.						
11. Does all interlocked equipment as listed in #10 start & stop on the same schedule as the unit?						
12. Are final schedules consistent with energy efficient operation? If "no", comment.						
13. Are final occupied & unoccupied setpoints consistent with energy efficient operation? If "no", comment.						

COMMENTS ON SCHEDULED START/STOP AND SETBACK TEST ITEMS (add more sheets if needed):

ITEM # COMMENT

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

Building Name: _____

Economizer & Compressor Staging Tests:

Test Conditions: Force cooling staging by either changing room thermostat and economizer controller setpoints slowly or slowly warming and/or cooling temperature sensors and thermostats.

Criteria for Acceptance: All items require answers of "Y" (or "NA", where relevant) except where other criteria are noted.

UNIT #						
1. Economizer (Y/N). Acceptance: per approved submittals						
2. Economizer control, design ("D1" for 1 stage, dry bulb; "E1" for 1 stage, enthalpy; "D2" for 2 stage, dry bulb; "E2" for 2 stage, enthalpy; "R2" for 2 stage, differential).						
3. Economizer control, as installed (D1/D2/E1/E2/R2). Acceptance: per design or approved submittals.						
4. Economizer control setpoint, as set (°F or enthalpy). Acceptance: 60 to 80°F for dry bulb control, >25Btu/lb dry air, up to 80°F for enthalpy control						
5. Is economizer integrated with mechanical cooling? (i.e. is economizer enabled if control conditions are met, even though the compressor is on for 2nd stage cooling?) Acceptance: per design or approved submittals.						
6. Controlled dampers ("O" for OSA, "R" for return/relief). Acceptance: per design or approved submittals.						
7. Mixed air control (°F setpoint, or "NA" for not applicable). Acceptance: 50 to 60°F.						
8. OSA damper opens below setpoint (Y/N)						
9. Return air damper closes below setpoint (Y/N)						
10. When mechanical cooling is off, do the dampers modulate to maintain the mixed air or supply air at setpoint? Note temperature at control point. Acceptance: Dampers must modulate unless design calls for 2-position damper. Mixed air or supply air temperature must be within ±2 F degrees of setpoint or OSA temperature, whichever is higher.						
11. Approximate OSA damper minimum position, %. Acceptance: 5-20% OSA, or per design.						
12. Compressor locked out below setpoint with D1 or E1 control (Y/N)						
13. Compressor (1st stage) on as 2nd stage with D2, E2, or R2 control (Y/N)						
14. Compressor (2nd stage) on as 3rd stage if called for by design or approved submittals (Y/N)						
15.						

Building Name: _____

Supply air CFM (full flow), measured: For all units, use air balance report if available and approved. **For units less than 5 tons, if there is no verified air balance report:** use either the design value or manufacturer's rating. **For units 5 tons or greater, if there is no verified air balance report:** either 1) use a velocity grid and manometer, 2) read all grilles with a flowhood, or 3) lock out compressor and use either unit's resistance heat or external resistance heat source inserted in air stream. Enter the CFM value in #17 below. Items #13-16 apply only if method #3 is used. If method #3 is used, energize resistance heat and measure amps, volts, and temperature before and after heat source, in well-mixed locations. CFM=(volts x amps x C x 3.413)/(1.08 x (T_{out} - T_{in})). C is 1.0 for 1 phase, and 1.732 for 3 phase. Note that "1.08" in this formula applies to sea level altitude only. Adjust for significantly different altitudes.

UNIT #						
1. Resistance heat volts (and phase), measured (Items 13-16 required only if the resistance heat method, #3, of calculating CFM is used.						
2. Resistance heat amps, measured						
3. Temperature upstream of resistance heat, measured						
4. Temperature downstream of resistance heat, measured						
5. CFM, per TAB report or as calculated						
6. CFM, design (if available)						
7. Is measured CFM within ±20% of design? Acceptance: Measured CFM must be within ±20% of design.						
8.						
9.						

Cooling (compressor) tests: Do the following tests with the unit in full cooling mode, with all heating locked out, and with the economizer disabled. Lower the cooling setpoint 5 degrees below space temperature. Run the unit in cooling mode for 3 minutes before recording readings. For each unit, test and record all items within a 5 minute period. If both the delta (SAT - MAT) temperature and the compressor kW are within the tolerances noted, the unit is accepted as operating near its rated efficiency.

UNIT #						
1. Outside air temperature (OSAT)						
2. Mixed air temperature (MAT), avg over duct or opening area (°F)						
3. Supply air temperature (SAT), avg over duct or opening area (°F)						
4. Delta (SAT - MAT), calculated						
5. Delta (SAT - MAT), design. (See attached example on how to calculate from manufacturer's data. Append mfctr's data sheet.)						
6. Is calculated "SAT-MAT" value within ±20% of design? Acceptance: Calculated value must be within ±20% of design.						
7. Compressor power (kW), measured. Note: if test person isn't equipped to measure true power, measure volts and amps. kW is approximately equal to volts x amps x 0.75 x C / 1000, where 0.75 is an assumed power factor and C is 1.0 for 1 phase and 1.732 for 3 phase.						
8. Compressor kW, design, at above conditions.						
9. Is measured kW less than or equal to design kW? Acceptance: Measured kW ≤ design kW.						
10. Fan mode, design ("O" for always on, "C" for cycles, "S" for occupied ventilation schedule)						
11. Fan mode, tested (O/C/S)						
12.						

Building Name: _____

Heating Section Performance: (Note: This section applies to air conditioning units with heat sections only. For heat pumps, skip to the next section, "Heating Performance, Heat Pumps".

Most of these tests can be done by slowly adjusting the controlling thermostat setpoints above the actual sensed temperatures, and noting the results. Alternatively, use of dataloggers or EMS trend logs to monitor actual performance can be effective.

Criteria for Acceptance: All items require answers of "Y" (or "NA", where relevant) except where other criteria are noted.

UNIT #						
1. Are compressors off whenever any stage of heating is on?						
2. Does resistance/gas/other heat come on in response to a call for 1st stage heating?						
3. Is the OSA damper at minimum position & the RA damper full open when heating is staged on?						
4. Do subsequent steps of heating stage on properly as setpoint is raised further?						
5.						

Heating Performance, Heat Pumps: Most of these tests can be done by slowly adjusting the controlling thermostat setpoints above or below the actual sensed temperatures, and noting the results. The design line in each test set refers to the design condition as reflected in catalog data, drawings, design intent document, etc. The tested line refers to your test results.

Criteria for Acceptance: In each test pair, tested operation must be the same as the design, except where other criteria are noted.

UNIT #						
1. Compressor on and resistance/gas heat off as 1st stage of heating, design (Y/N)						
2. Compressor on and resistance/gas heat off as 1st stage of heating, tested (Y/N)						
3. Resistance/gas heat on as 2nd stage, design (Y/N) By OSA thermostat? (°F setpoint) By differential from room thermostat setpoint? (delta F°)						
4. Resistance/gas heat on as 2nd stage, tested (Y/N) By OSA thermostat? (°F setpoint) By differential from room thermostat setpoint? (delta F°)						
5. Resistance/gas heat locked out during warm-up, design (Y/N) By OSA thermostat? (°F setpoint) By intelligent ramp-up or optimal start? (Y/N)						
6. Resistance/gas heat locked out during warm-up, tested (Y/N) By OSA thermostat? (°F setpoint) By intelligent ramp-up or optimal start? (Y/N)						
7. Resistance heat current, design (Amps)						
8. Resistance heat current, measured (Amps). Acceptance: Measured full load current should be within ±20% of design.						
9. Compressor locked out during 2nd stage heating, design (Y/N)						
10. Compressor locked out during 2nd stage heating, tested (Y/N)						
11. Defrost type, design ("M" for mechanical, "O" for time off) Verified (by monitoring coil temperature)? (Y/N/ND)						
12.						
13.						

Other Control, Unit # _____:

Describe the control sequence:

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

Conclusions:

Other Control, Unit # _____:

Describe the control sequence:

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

Conclusions:

Building Name: _____

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

TEST / ITEM # / UNIT #	COMMENT

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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CALCULATIONS FOR DETERMINING DELTA TEMPERATURE (SAT-MAT) ACROSS DX COIL

1. Find the manufacturer's data sheet for the appropriate unit, or combination of indoor and outdoor sections.
2. Determine the actual operating conditions, as tested. For this example, using the data sheet excerpt below, let's assume that you measured the air flow at 2000 CFM, the wet bulb temperature of the air entering the DX coil at 62°F, and the dry bulb temperature of the air entering the outdoor condenser at 75°F. (If the operating conditions don't correspond to the manufacturer's rating values, it will be necessary to interpolate between the manufacturer's values, apply manufacturer's adjustments if available, or carefully extrapolate.)
3. The unit(s) should be in full return.
4. Read the value for sensible cooling capacity at the operating conditions. In this example, we see that the sensible cooling capacity is 54.0 MBtuh, or 54,000 Btu/hr.
5. Calculate the temperature differential, or delta T, as: Delta T = Btu/hr / (1.08 x CFM). In this example, we get: Delta T = 54,000 Btu/hr / (1.08 x 2000 CFM) = 25.0°F. Note that the value 1.08 applies to locations near sea level only. For higher elevations, adjust the air density value.
6. To determine whether the measured delta T is within ±20% of the rated delta T, subtract the rated value from the measured value and divide that answer by the rated value. In this example, if we had measured the delta T at, say 23.5°F, we can calculate the percentage difference as: (23.5 - 25.0) / 25.0 = -0.060, or -6.0%.

COOLING CAPACITIES FOR THE COOL-RITE AXT2000:

		CONDENSER ENTERING AIR TEMPERATURE, F					
EVAPORATOR AIR		***75***			85		
		Capacity, MBtuh			Capacity, MBtuh		
CFM	EWB	Total	Sensible	Total kW	Total	Sensible	Total kW
	72	55.8	32.5	4.95	63.8	31.9	5.44
	67	56.2	42.3	4.89	58.7	41.4	5.35
1800	63	56.6	41.2	4.84	54.4	40.1	5.29
	62	56.0	51.4	4.82	53.5	50.2	5.27
	57	54.4	54.4	4.79	52.4	52.4	5.25
	72	66.4	33.5	5.06	64.4	33.0	5.55
	67	61.9	44.4	5.00	59.3	43.4	5.47
2000	63	57.6	43.1	4.95	55.0	42.0	5.40
	62	56.8	***54.0***	4.93	54.4	52.8	5.39
	57	55.9	55.9	4.92	53.9	53.9	5.37