GREENHECK
Building Value in Air.

Greenheck Technical Support
DOAS Start-up Report
Data and Analysis

Job Information:

Job Name:	
Unit Sales Order Number:	
Unit Serial Number:	
Unit Tag:	

Technician Information:

Start-Up Company:	
Technician Name:	
Start-Up Date:	

This report consists of recorded data as observed by a Greenheck certified technician on the date indicated. The data is generated by a series of tests of the individual sub-systems within the air handler. The entire system (with all sub-systems functional) is tested to observe proper operation of the standard sequences within the completed air system of the occupied space. The air handler itself has been engineered to meet criteria specified by the owner but field conditions often vary from design specifications. During the course of this start-up, the Greenheck technician will make needed minor adjustments to operating parameters to produce the desired operating characteristics.

The testing of this unit is based upon completed installation of the unit. All associated ductwork is to be intact and completed. A completed Pre Start-Up Checklist is to be furnished by the installer prior to the unit start-up.

Because field conditions may change after the start-up testing of this unit, the recorded data points are subject to change.

As each sub-system is isolated and tested, critical data is observed and recorded. This data should be preserved as a benchmark, to be used by others for purposes of normal maintenance and for possible trouble-shooting of the system. Due to seasonal ambient conditions, it may not be possible to test full operational ranges of all subsystems.

All data is analyzed by the Greenheck technician and anomalies are recorded in the “Notes” portion of each sub-system. The analysis on the final page of this report indicates whether the system operates as intended and may make recommendations regarding potential areas of concern.

☐ **Complete Report** ☐ **Incomplete Report**

By checking a box above and signing below, you acknowledge that the start-up report is either fully complete or will require completion at a later date.

Signature & Date:	

SUBMIT FORM

TABLE OF CONTENTS

AIR HANDLER CABINET INSPECTION	3
SUPPLY POWER INSPECTION	4
CONTROL PANEL DOCUMENTATION	4
DAMPERS/VALVES AND ACTUATORS FUNCTIONAL TEST	5
SUPPLY AIR BLOWER AND MOTOR	6
EXHAUST / RELIEF / RETURN BLOWER AND MOTOR	7
VARIABLE FREQUENCY DRIVE (VFD) MODIFIED PARAMETER SETTINGS	8
INDIRECT GAS FURNACE START-UP	9
INDIRECT GAS FURNACE START-UP (cont.)	10
ELECTRIC HEATER START-UP	11
INTEGRAL AC SYSTEM START-UP	12
INTEGRAL AC DATA RUNS	13
INTEGRAL AC NOTES	14
HOT/CHILLED WATER COILS START-UP	15
ENERGY WHEEL START-UP	16
DDC CONTROLLER	17
DDC SET POINTS	18
SUMMARY / ANALYSIS OF SYSTEM	19

AIR HANDLER CABINET INSPECTION

Exterior Air Handler Inspection

Yes	No	N/A	
☐	☐	☐	Is there shipping damage present?
☐	☐	☐	Do all seams have caulking present?
☐	☐	☐	Do all access doors and handles operate properly?
☐	☐	☐	Are all hoods, louvers, and bird screens secure?
☐	☐	☐	Are all shipping covers removed (shipping wrap, duct covers)?
☐	☐	☐	Are unit clearances adequate for service and operation as stated in IOM?
☐	☐	☐	Is all ductwork connected and sealed properly?
☐	☐	☐	Are drain connections and traps present and fabricated in accordance with the IOM?
☐	☐	☐	Is freeze protection present on drains and traps?
☐	☐	☐	Are all hardware fasteners tightened?

Interior Air Handler Inspection

Yes	No	N/A	
☐	☐	☐	Is there shipping damage present?
☐	☐	☐	Do all seams have caulking present?
☐	☐	☐	Is the interior and drain(s) free of construction debris?
☐	☐	☐	Are all damper seals present?
☐	☐	☐	Are all hardware fasteners tightened?
☐	☐	☐	Do all blower wheels spin freely and smoothly when rotated by hand?
☐	☐	☐	Are all major component hardware tightened?
☐	☐	☐	Are all shipped loose items removed from interior?
☐	☐	☐	Are all air filters present?

☐ Outside Air ☐ Supply Air ☐ Return ☐ Exhaust Air

NOTES:

SUPPLY POWER INSPECTION

☐ Inspect all electrical connections.

☐ Phasing correct.

MAIN VOLTAGE

L1-L2 = ☐ L2-L3= ☐ L1-L3= ☐

STEP-DOWN TRANSFORMER VOLTAGES

TR-1= ☐ TR-2= ☐ TR-3= ☐

☐ Control voltage 120V / 24V

RATED VOLTAGE:

☐

ADDT'L STEP-DOWN TRANSFORMER VOLTAGES

(If Applicable)

TR-4= ☐ TR-5= ☐ TR-6= ☐

TR-7= ☐ TR-8= ☐ TR-9= ☐

☐ Control voltage 120V / 24V

	Yes	No
Does line voltage match Rated Voltage?	☐	☐
Is the line voltage wired correctly into the main disconnect?	☐	☐

***Note to owner*: Although the motors and electronic devices in this unit can tolerate some variation in the actual supplied voltage relative to the rated voltage, these variations are always a concern. Variations in excess of +/- 4% may result in shortened component life, elevated operating temperatures and/or inconsistent performance. Whenever the supplied voltage varies from the rated voltage by more than this amount, preventive maintenance should be enhanced to include an aggressive inspection of VFDs and electric motors. It is recommended, that if the supplied voltage varies by more than this amount, an electrical contractor be engaged to discover the problem and correct it.**

The Supply Voltage in this unit varies from the Rated Voltage by more than +/- 4%:

☐ YES ☐ NO

NOTES:

CONTROL PANEL DOCUMENTATION

***Perform the following inspections with the main disconnect OFF.**

Yes	No	N/A	
☐	☐	☐	Is the remote user terminal display and cable present?
☐	☐	☐	Are all control wiring connections secure?
☐	☐	☐	Are all field wired sensors landed (pressure, fire, temperature, etc.)?
☐	☐	☐	Is wiring schematic on cabinet door?
☐	☐	☐	Is wiring schematic accurate to unit nameplate?

NOTES:

DAMPERS / VALVES AND ACTUATORS FUNCTIONAL TEST

Open Smooth, Close Tight?	Match Control Command?	
☐	☐	Outside Air
☐	☐	Outside Air Heat Exchanger Face and Bypass Dampers
☐	☐	Recirculation Air
☐	☐	Exhaust or Relief Air
☐	☐	Heat Exchanger HX2 Face and Bypass Dampers
☐	☐	Coil Face and Bypass Dampers
☐	☐	
☐	☐	
☐	☐	

NOTES:

Using Manual Overrides to Complete Startup

Enter manual override mode to test individual unit components. To do this, go to Ctrl Variables > Advanced > Login (Enter password 9998 and the controller will auto boot you back to the "Advanced Menu" after a couple of seconds) > Manual Overrides. Before overriding the unit to the On position (Figure 2), make sure that ALL components not currently being tested are set to Manual Off.

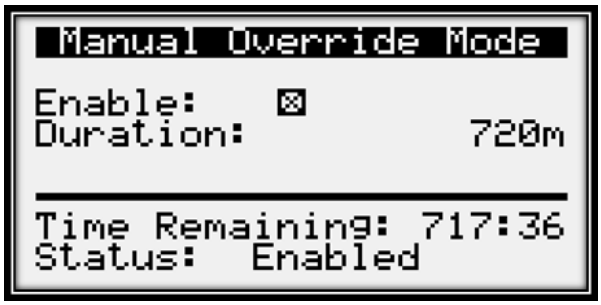

Figure 1.) Enable Manual Override Mode

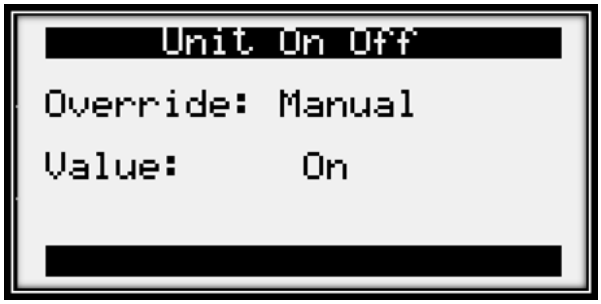

Figure 2.) Manually Override Unit On

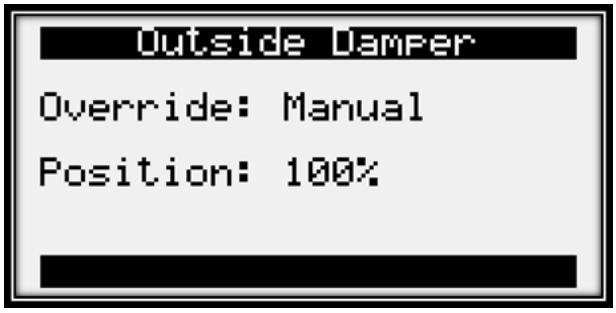

Figure 3.) Manually Override Damper to fully open position

BLOWERS AND BLOWER MOTORS

SUPPLY AIR BLOWER AND MOTOR

Fan 1	Fan 2	Fan 3	Fan 4	
☐	☐	☐	☐	Check all fasteners, set screws and locking collars.
☐	☐	☐	☐	Check bearing alignment and lubrication.
☐	☐	☐	☐	Check for correct rotation direction.
☐	☐	☐	☐	Check for correct belt tension (if applicable).
☐	☐	☐	☐	Check for correct sheave alignment (if applicable).
☐	☐	☐	☐	Shaft grounding ring installed and tagged.
☐	☐	☐	☐	Overloads set to 100-115% of motor nameplate FLA

EC MOTORS

☐	☐	☐	☐	Digital input Start / Stop enable
☐	☐	☐	☐	Analog input speed reference signal
☐	☐	☐	☐	Digital Output Alarm

Voltage Fan 1 _____ _____ _____
Amps Fan 1 _____ _____ _____
S/N Fan 1 _____
HP FLA RPM _____ _____ _____

Voltage Fan 2 _____ _____ _____
Amps Fan 2 _____ _____ _____
S/N Fan 2 _____
HP FLA RPM _____ _____ _____

Voltage Fan 3 _____ _____ _____
Amps Fan 3 _____ _____ _____
S/N Fan 3 _____
HP FLA RPM _____ _____ _____

Voltage Fan 4 _____ _____ _____
Amps Fan 4 _____ _____ _____
S/N Fan 4 _____
HP FLA RPM _____ _____ _____

NOTES:

Record VFD Settings on last page of this checklist

Figure 4.) Manually Overriding the Supply Fan on (Leave the damper overridden to it's open position when testing fans, to avoid pressure issues).

EXHAUST / RELIEF / RETURN BLOWER AND MOTOR

Fan configuration: ☐ Return ☐ Relief ☐ Exhaust

Fan 1	Fan 2	Fan 3	Fan 4	
☐	☐	☐	☐	Check all fasteners, set screws and locking collars.
☐	☐	☐	☐	Check bearing alignment and lubrication.
☐	☐	☐	☐	Check for correct rotation direction.
☐	☐	☐	☐	Check for correct belt tension (if applicable).
☐	☐	☐	☐	Check for correct sheave alignment (if applicable).
☐	☐	☐	☐	Shaft grounding ring installed and tagged.
		EC MOTORS		
☐	☐	☐	☐	Digital input Start / Stop enable
☐	☐	☐	☐	Analog input speed reference signal
☐	☐	☐	☐	Digital output alarm

Voltage Fan 1 ☐☐☐
Amps Fan 1 ☐☐☐

Voltage Fan 2 ☐☐☐
Amps Fan 2 ☐☐☐

Voltage Fan 3 ☐☐☐
Amps Fan 3 ☐☐☐

Voltage Fan 4 ☐☐☐
Amps Fan 4 ☐☐☐

NOTES:

Record VFD Settings on last page of this checklist

VARIABLE FREQUENCY DRIVE (VFD) MODIFIED PARAMETER SETTINGS
(when provided and installed by Manufacturer)

	VFD
Modified parameters from default settings	
Parameter Name and Value	

	VFD
Modified parameters from default settings	
Parameter Name and Value	

	VFD
Modified parameters from default settings	
Parameter Name and Value	

	VFD
Modified parameters from default settings	
Parameter Name and Value	

	VFD
Modified parameters from default settings	
Parameter Name and Value	

	VFD
Modified parameters from default settings	
Parameter Name and Value	

INDIRECT FIRED GAS FURNACE START-UP

☐ I have read and followed the vendor-specific operation manual.

☐ 120 / 24 VAC transformer has 24 VAC out.

Furnace #1	**Furnace #2**	**Furnace #3**	**Furnace #4**
Fuel Type	Fuel Type	Fuel Type	Fuel Type
Natural Gas	Natural Gas	Natural Gas	Natural Gas
Manufacturer	Manufacturer	Manufacturer	Manufacturer
Model #	Model #	Model #	Model #
Serial #	Serial #	Serial #	Serial #

Figure 5.) To enter the Furnace Commissioning Menu go into the Manual Overrides Menu and press enter on the first screen below the title screen. In this mode, the controller will modulate valves and power combustion blowers motors as appropriate and give you direction on which valves to set and what pressure to set them to. Once you've completed the instructions on each page you will have to change "No" to "Yes" to continue.

Furnace #1	Furnace #2	Furnace #3	Furnace #4	Component Operational Checks
☐	☐	☐	☐	Air flow proving switch at High & Low Speed
☐	☐	☐	☐	High temperature limit
☐	☐	☐	☐	Flame rod straight & aligned with burner tray
☐	☐	☐	☐	Venting correctly at high fire
☐	☐	☐	☐	Venting correctly at low fire
☐	☐	☐	☐	Transformer voltage 120V-24V
☐	☐	☐	☐	All gas piping been checked for leaks

Furnace #1	Furnace #2	Furnace #3	Furnace #4	
				Gas pressure at Inlet (burners off)
				Gas Pressure at Train Inlet (high fire)
				Gas Pressure at Burner Manifold (high fire)
				CO2 in Flue Gas (high fire)
				CO in Flue Gas (high fire)
				Flue Gas Temp (high fire)
				Air Temperature Rise (high fire)
				Gas Pressure at Train Inlet (low fire)
				Gas Pressure at Burner Manifold (low fire)
				CO2 in Flue Gas (low fire)
				CO in Flue Gas (low fire)
				Flue Gas Temp (low fire)
				Air Temperature Rise (low fire)

Gas Set Point Guidelines (all gas pressure readings must be taken from the gas manifold)

Natural Gas		**Propane**		**Modulating Control Signal**
High fire manifold	3.5 inches WC	High fire manifold	10.0 inches WC	Low fire = 0 VDC
Low fire (2 - stage)	1.2 inches WC	Low fire (2 - stage)	2.3 inches WC	High fire - 10 VDC
Low fire (modulating)	0.4 inches WC	Low fire (modulating)	1.1 inches WC	

NOTES:

NOTE: TO ENSURE PROPER OPERATION, LEAVE DAMPERS OPEN AND FANS RUNNING WHEN TESTING COOLING/HEATING COMPONENTS

ELECTRIC HEATER START-UP

☐ I have read and followed the vendor-specific operation manual.

Heater Model: _____

Heater Serial #: _____

Yes	No	N/A	Electrical Inspection
☐	☐	☐	Are all fuses present and free of defects?
☐	☐	☐	Are all connections at contactors and heating elements tightened?
☐	☐	☐	Is the resistance from ground to each circuit open?
☐	☐	☐	Is the resistance from phase-to-phase for each circuit correct?

Yes	No	N/A	Operational Inspection
☐	☐	☐	Is there sufficient airflow through heater (per design temperature rise from manufacturer's nameplate)?
☐	☐	☐	Are combustible particles or flammable vapors present in the air tunnel?
☐	☐	☐	Is the air temperature at the outlet of heater less than 151°F?
☐	☐	☐	Is total differential pressure across heater above 0.07" inches of water?

Record the following values at 100% Output:

Entering air temperature: _____

Leaving air temperature: _____

Voltage: **L1-L2:** _____ **L2-L3:** _____ **L1:** _____ **L2:** _____

Amperage: **L1-L3:** _____ **L3:** _____

NOTES:

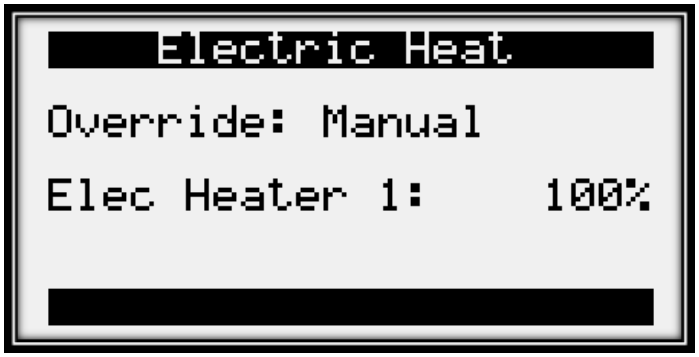

Figure 9.) Electric Heat Override Page. Set override to manual and set to 100% to complete startup.

NOTE: TO ENSURE PROPER OPERATION, LEAVE DAMPERS OPEN AND FANS RUNNING WHEN TESTING COOLING/ HEATING COMPONENTS

INTEGRAL AC SYSTEM START-UP

NOTE

Start-up of any compressorized system is to be done only by a EPA-608 certified technician.
To see Manual Overrides associated with this startup see Pg.12

Unit Tag: _____ Ambient Temp: _____

Condenser Fan Motor Amp Draw

	Amps		Amps
Fan Motor #1		Fan Motor #9	
Fan Motor #2		Fan Motor #10	
Fan Motor #3		Fan Motor #11	
Fan Motor #4		Fan Motor #12	
Fan Motor #5		Fan Motor #13	
Fan Motor #6		Fan Motor #14	
Fan Motor #7		Fan Motor #15	
Fan Motor #8		Fan Motor #16	

Check all fans for correct rotation direction.

☐ Fans are rotating in correct direction.

Compressor Readings

Voltage			
Amps			
Voltage			
Amps			
Voltage			
Amps			
Voltage			
Amps			
Voltage			
Amps			
Voltage			
Amps			
Voltage			
Amps			
Voltage			
Amps			

Complete data runs as shown on the following page. Acquired data is to become part of the permanent unit records and function as a benchmark.

For water-cooled heat pumps:

- Both stages of any tandem circuit should be ON while testing.
- Record ambient conditions at time of test (dry bulb and RH or dew point)
- Circuit Enable should be set at 100% Cooling.
- Circuit Enable should be set at 100% Cooling with 100% Reheat.
- Circuit Enable should be set at 100% Cooling with 50% Reheat (as required).
- Circuit Enable should be set at 100% Heating.
- Digital Circuit should be set to enable at 50% to verify Unloading is operational.

	Data Run #1	Data Run #2	Data Run #3	Data Run #4	Data Run #5	Data Run #6	Data Run #7	Data Run #8
Compressors Active (Compressor # and Circuit)								
Circuit								
% Reheat								
HGB Active (Y / N)								
Discharge (psi)								
Liquid (psi)								
Liquid (°F)								
Liquid Subcooling								
Suction (psi)								
Suction (°F)								
Suction Superheat								
Compressor Discharge (°F)								
Oil Level (%)								
Receiver (% full)								
Time (duration of run prior to measurement)								
OA (°F)								
SA (°F)								
DX (°F)								

Standard Operating Parameters

	Value	Range	Optimal		Value	Range	Optimal
Suction Pressure:	107-145 PSI		125 PSI	**Superheat:**	10-18 °F		12 °F
Discharge Pressure:	250-460 PSI		375 PSI	**Subcooling:**	8-20 °F		15 °F

Notes Regarding AC Data (to include piping, wiring, compressors, etc.):

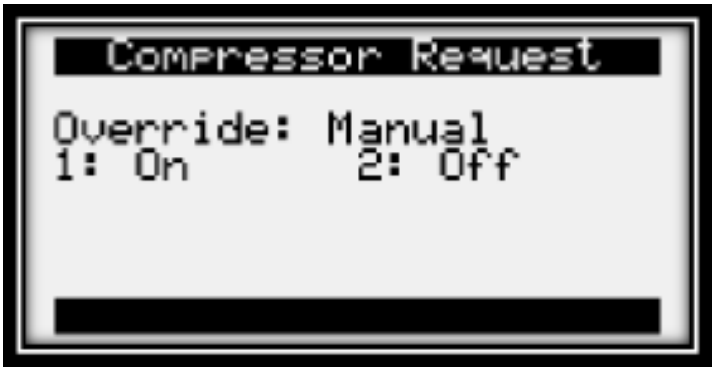

Figure 6.) Start/Stop signal to each compressor. Run each compressor individually and then run compressors that share circuits together. Record refrigeration numbers for each of these runs.

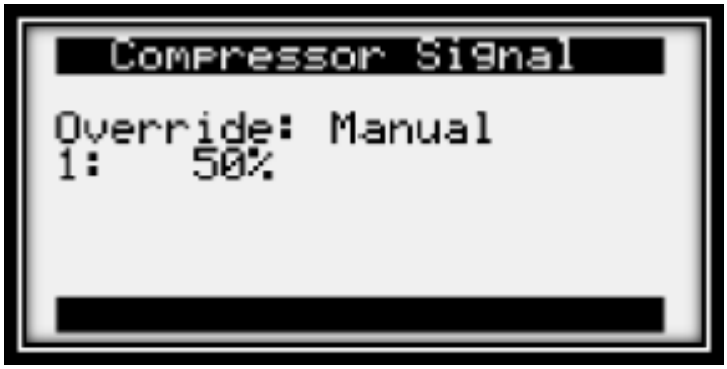

Figure 7.) Compressor Modulation signal. In order to run, digital scroll compressors require a start signal as well as a modulation signal of at least 10%.

NOTE: TO ENSURE PROPER OPERATION, LEAVE DAMPERS OPEN AND FANS RUNNING WHEN TESTING COOLING/HEATING COMPONENTS

WATER COILS START-UP

Yes	No	N/A	System Inspection
☐	☐	☐	Is the water valve installed and operating properly?
☐	☐	☐	Is the water system free of air?
☐	☐	☐	Is glycol present in the system?

System glycol type (if applicable): _____

System glycol percentage (if applicable): _____

Water valve fail position: _____

Entering air temperature at 100% water valve: _____

Leaving air temperature at 100% water valve: _____

Entering water temperature at 100% water valve: _____

Leaving water temperature at 100% water valve: _____

Notes:

NOTE: TO ENSURE PROPER OPERATION, LEAVE DAMPERS OPEN AND FANS RUNNING WHEN TESTING COOLING/HEATING COMPONENTS

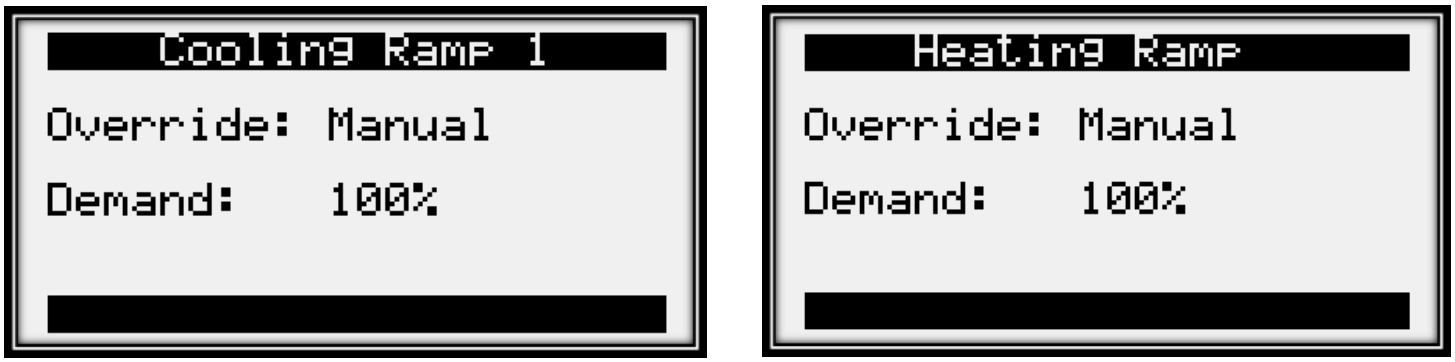

Figure 10.) To manually override cooling/heating coil valve position set override to manual and demand to 100% in cooling or heating ramp manual override pages, respectively.

ENERGY WHEEL START-UP

☐ I have read and followed the vendor-specific operation manual.

Wheel Model: _____

Wheel Serial #: _____

Voltage			
Amps			

Inspection

☐ Casette is securely mounted.

☐ Rotor is centered within the casette frame.

☐ Seals lightly contact the full perimeter of the rotor.

☐ Rotor turns freely.

☐ Drive motor and pulley securely mounted.

☐ Drive belt is aligned properly and has sufficient tension.

☐ Verify correct supply voltage to the drive motor.

Start-Up

☐ Rotor turns in proper direction.

☐ Drive motor controller properly set up.

☐ System controls operate properly.

☐ Establish design airflow through Supply and Exhaust Air streams.

☐ Verify rotor is centered and has proper seal contact.

NOTE

Recheck drive belt tension after 100 hours of operation and adjust.

NOTES:

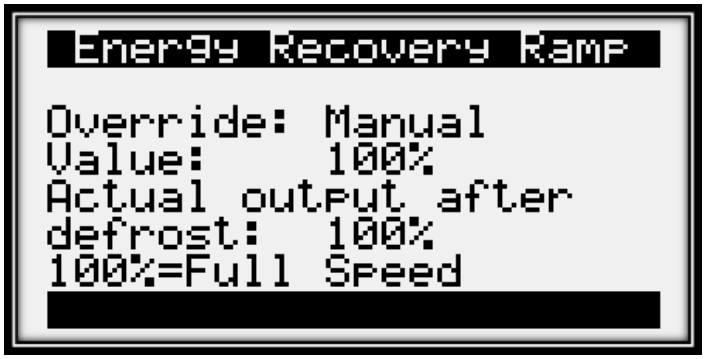

Figure 8.) Manual Overrides page for Energy Recovery Wheel. The "actual outputafter defrost" line shows the percent of full speed the wheel should actually be spinning at. Defrost ramp slows the wheel down.

DDC CONTROLLER

Controller Serial Number (UID): _____

To Find Controller S/N:
Hold ⚠ and ↵ to access the System Menu. Then select INFORMATION then PCO INFO to find the UID

Yes	No	N/A	
☐	☐	☐	Do all wires landed on controller inputs match the wiring schematic?
☐	☐	☐	Do all Analog Inputs in the IO Config menu match the wiring schematic?
☐	☐	☐	Do all Digital Inputs in the IO Config menu match the wiring schematic?
☐	☐	☐	Do all Analog Outputs in the IO Config menu match the wiring schematic?
☐	☐	☐	Do all Digital Outputs in the IO Config menu match the wiring schematic?
☐	☐	☐	Are all field mounted Analog Input sensors installed and operating properly? (i.e. space or duct static pressure, space or supply temperature, space humidity)
☐	☐	☐	Are all field mounted Digital Inputs wired and operating properly? (i.e. Fire/Smoke Contact, Remote Start/Stop, Remote Purge Enable)
☐	☐	☐	Are all field mounted Outputs wired to external devices and operating properly?
☐	☐	☐	Are all expansion controllers communicating with main board?

To Find Controller I/O Configuration: Ctrl Variables ↵ Advanced ↵ I/O Config

Yes	No	N/A	
☐	☐	☐	Does Heating mode operate as defined in the sequence? *(Set temperature sensor offset down to bring temperature below the set point.)*
☐	☐	☐	Does Cooling mode operate as defined in the sequence? *(Set temperature sensor offset up to bring temperature above the set point.)*
☐	☐	☐	Does Economizer mode operate as defined in the sequence? (*Set outside air temperature/humidity sensor offset down to bring T/H below set point.)*
☐	☐	☐	Does Defrost mode operate as defined in the sequence? *(Set the exhaust air sensor offset down to bring temperature below set point.)*
☐	☐	☐	Does dehumidification mode operate as defined in the sequence? *(Set the humidity sensor offset up to bring humidity above the set point.)*
☐	☐	☐	Does Reheat mode (dehumidification) operate as defined in the sequence? *(While Dehumidification mode is enabled, set the supply air sensor offset down to bring the supply temperature below set point.)*
☐	☐	☐	Does Supply Fan Control mode operate as defined in the sequence?
☐	☐	☐	Does Exhaust/Return Fan Control mode operate as defined in the sequence?

To Find Controller IO Staus/Offset: Ctrl Variables ↵ Advanced ↵ IO Status/Offset

NOTES:

DDC SET POINTS

Parameter	Default	Active
Temperature Set Point		
Supply: ☐ Return: ☐ Space: ☐ Outside: ☐		
Humidity Set Point		
Supply: ☐ Return: ☐ Space: ☐ Outside: ☐ Dew Point: ☐ RH%: ☐		
Economizer Set Point		
Comparative Dry Bulb: ☐ Comparative Enthalpy: ☐ Outside Dry Bulb: ☐ Outside Enthalpy: ☐		
Supply Fan Control Set Point		
Constant Volume: ☐ Duct Static: ☐ Space Static: ☐ CFM Control: ☐ Hardwired Input: ☐ SZVAV: ☐		
Exhaust/Return Fan Control Set Point		
Constant Volume: ☐ Duct Static: ☐ Space Static: ☐ CFM Control: ☐ Hardwired Input: ☐ Track Supply: ☐		

Additional Parameters	Default	Active

NOTES:

SUMMARY / ANALYSIS OF SYSTEM

When the form is completed, please submit to DOAS@greenheck.com by clicking the "Submit Form" button below.

SUBMIT FORM