Troubleshooting Manual

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Disclaimer

Proper installation and servicing of the Total Green Mfg. Heat Pump is essential to its reliable performance. All Total Green Mfg. systems must be installed and serviced by a qualified HVAC contractor. Equipment sizing, selection and installation are the sole responsibility of the installing contractor.

Installations of equipment on an existing copper earth loop design that does not match a current Total Green Mfg. earth loop design is not permitted, will void all warranties on the equipment, and are the sole responsibility of the installing contractor. Installation must be made in accordance with the instructions set forth in this manual. Failure to provide installation by a qualified HVAC contractor in a manner consistent with this manual will void and nullify the limited warranty coverage for the system.

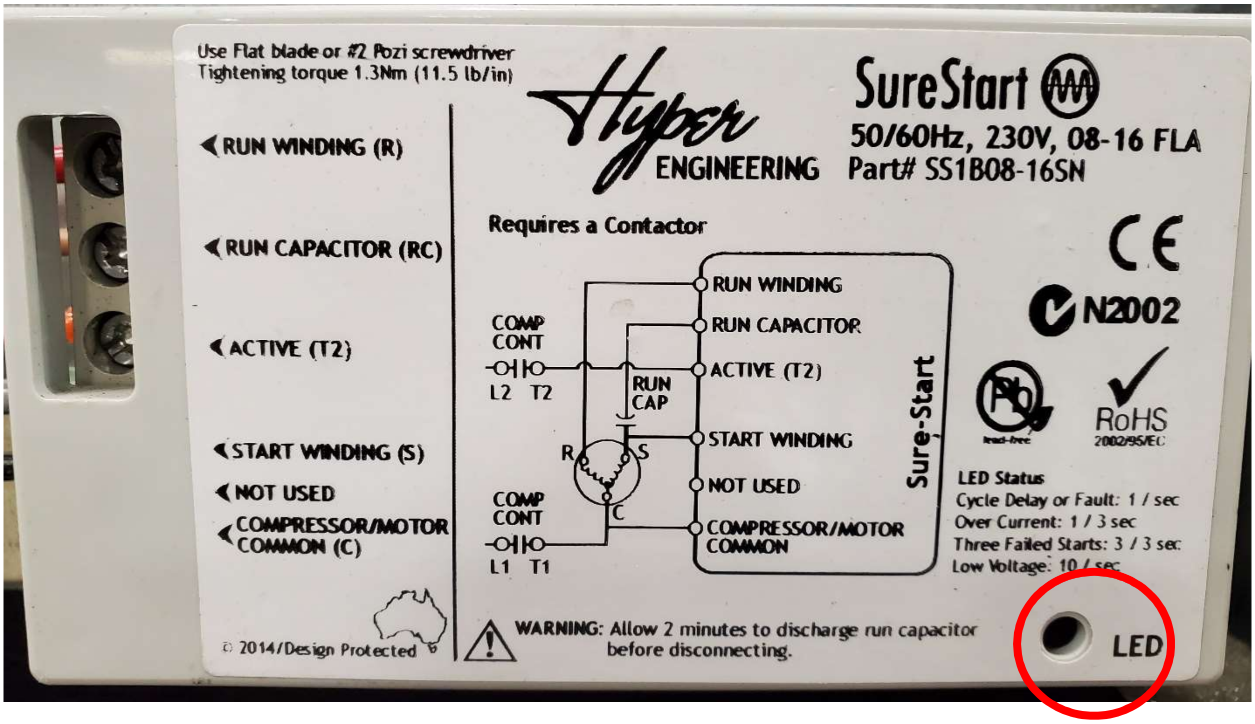
Total Green Mfg. shall not be liable for any defect, unsatisfactory performance, damage or loss, whether direct or consequential, relative to the design, manufacture, construction, application or installation of any field specified components.

All commissioning and registration paper work must be filled out at start up and returned to Total Green Mfg. for full warranty coverage.

Problem / Symptom	Likely Cause(s)	Action/Correction
A. System does not run. **Note: Some digital thermostats have a built in time delay ranging from 2 to 5 minutes.**	1. Thermostat fault.	1. Adjust thermostat settings. / Replace thermostat.
	2. Power supply problem (air handler unit (AHU) / compressor unit).	2. Check power supply for adequate phase and voltage. Check wiring to system and external breakers or fuses.
	3. Control voltage problem. Faulty control wiring. Blown AHU or Unit control fuse, control transformer.	3. Check for 24V on terminal strip between R and C terminals at both the compressor and air handler.
	4. Shut off by external thermostat or thermostat is defective.	4. Check operation of thermostat.
	5. System lockout: System off on high pressure / low pressure switches or discharge temperature switch.	5. Reset limit switch. Analyze system for root cause. Check between Common (C) and X terminal for 24V, which also lights the "X" terminal LED indicating a lock-out condition. Reset if necessary by disabling the unit 24V control power momentarily.
	6. Internal component or connection failure.	6. Check for loose wiring. Check components for failure.
	7. Compressor contactor not pulling in.	7. Check for 24V across contactor. Trace 24V circuit and components between "Y" and "C" to locate fault. Repair or replace as necessary.
	8. Faulty run capacitor.	8. See note 1 on page 4. Test and replace as necessary. See notes below.
	9. Compressor windings shorted or grounded.	9. See note 2 on page 5. See compressor diagram/ replace the compressor. Replace filter drier and run capacitor.
	10. Soft Start fault.	10. Check the Soft Start to see if the red LED is flashing. Rapid Flash: Low Voltage, 3min delay. Triple Flash: Lockout on 3 failed starts, 50 min delay. Slow Flash: Lockout on over current, 10 min delay. Steady Flash: cycle delay 3 mins.
	11. PLC fault.	11. Please See Functions and Operating Sequence Manual for your unit model. Verify the inputs and outputs of the PLC following the wiring diagram and PLC function and operation manual. Contact tech support
B. System runs for long period or continuously. Continued on page 4.	1. Thermostat fault.	1. Adjust thermostat settings /thermostat faulty. Replace.
	2. Refrigerant undercharged.	2. Repair leak and replace filter drier. Evacuate and recharge system.
	3. Component failure.	3. Check pressures and electrical circuits for abnormalities.
	4. Outdoor thermostat not connected or failed (heating mode).	4. Check outdoor thermostat and electric supplemental heat operation. Confirm proper wiring.
	5. Reduced air flow.	5. Check air ducts for leaks. Check blower operation. Check for dirty air handler coil. Check air filter(s).

B. System runs for long period or continuously. Continued from page 3.	6. Four-way reversing valve is short circuiting refrigerant and bypassing hot gas to suction.	6. Replace four-way reversing valve and filter drier, evacuate, recharge and start-up system.
	7. Unit undersized.	7. Evaluate Load Calculation and up size the equipment. Upgrade Home's insulation.
C. System blows fuses or trips circuit breaker.	1. Inadequate circuit ampacity.	1. Note electrical requirement and correct as necessary.
	2. Short, lose or improper connection in field wiring.	2. Check field wiring for problems.
D. High Discharge Pressure.	1. Reduced air flow in heating.	1. Check filters and coil for cleanliness. Check blower operation.
	2. Reduced water flow in heating.	2. Check pumps and strainers. Back flush and clean heat exchanger.
	3. Refrigerant flow restriction.	3. Clogged filter/Dryer. Air handler coil on 3.5 ton and larger units not drilled out.
	4. System overcharged	4. Discharge superheat under 25 degrees. Remove refrigerant.
	5. TXV sensing bulb dislodged.	5. Verify TXV sensing bulb is tightly fastened and in the 2 or 10 o'clock position.
E. Low Suction Pressure.	1. Reduced air flow in cooling.	1. Check filters and coil for cleanliness. Check blower operation.
	2. Reduced water flow in cooling.	2. Check pumps and strainers. Back flush and clean heat exchanger.
	3. Refrigerant flow restriction.	3. Clogged filter/Dryer. Air handler coil on 3.5 ton and larger units not drilled out.
	4. System under charged.	4. Discharge superheat over 60 degrees. Add refrigerant.
F. High Discharge Temperature.	1. Reduced air flow in cooling.	1. Check filters and coil for cleanliness.
	2. Reduced water flow in cooling.	2. Check pumps and strainers. Back flush and clean heat exchanger.
	3. Refrigerant flow restriction.	3. Clogged filter/Dryer. Air handler coil on 3.5 ton and larger units not drilled out.
	4. System under charged.	4. Discharge superheat over 60 degrees. Add refrigerant.

SureStart Troubleshooting:



1) Understanding the trouble codes

The LED light circled in red will display different Flash patterns to indicate system status and/or system faults. The LED when flashing does **NOT** indicate a faulty SureStart.

Note: It is typical to replace the run capacitor and standard start components when replacing a failed compressor. The SureStart is not a standard starting device and doesn't need replacing when a compressor is changed out.

A) The LED light flashing steady at a rate of 1 time per second indicates a cycle delay. This occurs after a compressor call is complete. The SureStart delays the compressor restart for 3 minutes.

B) The LED light flashing at a slow rate of 1 time every 3 seconds indicates overcurrent when the compressor attempts to start. This can be caused by a faulty run capacitor and/or compressor. Overcurrent can also be the result of faulty wiring and/or loose terminal connections in the compressor unit, at the contactor, disconnect or breaker panel. If overcurrent is detected, the SureStart will lock the unit out for 10 minutes before attempting to restart

C) Rapid flashing of the LED light indicates low voltage. Low voltage can be the result of faulty wiring and/or loose terminal connections in the compressor unit, at the contactor, disconnect or breaker panel. This can also occur during a brownout. Brownout is when the homes incoming power falls below 200 volts. Should this condition exist, contact the utility company. If low voltage is detected, the SureStart will lock the unit out for 3 minutes before attempting to restart.

D) The LED is flashing 3 times every 3 seconds. If low voltage or overcurrent is detect after 3 compressor start up attempts, the SureStart will lock the unit out for 50 minutes.

When troubleshooting the compressor unit, any lockout can be reset by turning the high voltage off to the compressor unit at the disconnect or breaker for 10 seconds.

2) When to Replace the SureStart

Replacing the SureStart should only occur if its casing or terminals are melted and/or burnt indicating and obvious failure or, only after the contactor, run capacitor, compressor, wiring, terminations, disconnect and breakers have been verified good.

Checking the Run Capacitor:

Symptoms of a weak or bad run capacitor are; The unit's RLA (Rated Load Amps) are in excess of the unit's rating, circuit breaker to the unit tripping, homeowner complains of higher than usual electric bills and/or flickering lights on unit start up, compressor shuts off on internal over load and/or mimics LRA (Locked Rotor Amps) when attempting to start. A faulty run capacitor is the primary cause of miss-diagnosis of a faulty compressor and should always be properly tested before condemning the compressor. Follow the steps below to check/test for a faulty run capacitor.

1) Visually examine the capacitor. Look for signs of bulging of the capacitor body, especially the ends and/or leakage. If any of these visible signs are noted, it should be replaced with a high quality capacitor. If the capacitor shows no signs of bulging or leakage, continue to the next steps.

2) Shut off the line voltage (240 volts) at the disconnect or circuit breaker to the compressor unit. Verify the line voltage is off by checking for 240 volts at the line side (incoming power) of the compressor contactor with your multi-meter.

3) Using a screwdriver with an insulated handle, touch both terminals across the capacitor creating short to discharge it. This is an important step as failure to do so may result in an electrical shock.

4) Disconnect the wires from the capacitor's terminals making a note as to which wires are connected to which terminal.

5) Check the capacitor label. You will need to know the rating and the tolerance %.

6) Set your multi-meter to micro-farads and check the reading across the capacitor terminals. If it is within its tolerance % rating, it is good. Outside its tolerance rating, it is bad and should be replaced with a high quality capacitor.

   Example: Your capacitor rating as per its label is 80 MFD with a tolerance of +/- 5%. This would be 80 x .05 = 4 or 80 x 5% = 4. This capacitor is good if your reading is between 76 and 84 MFD. Anything outside of that range, the capacitor is bad.

7) Replacement, if required, should be made with a high-quality capacitor.

8) Replace or re-install your capacitor assuring the wires are attached back to their original locations.

Testing Compressor Windings:

A faulty run capacitor, bad contactor, faulty line voltage or faulty wiring are the primary causes of miss-diagnosis of a faulty compressor. These items should always be checked and the capacitor properly tested before condemning the compressor. Since the compressor is a motor, it has windings just like any other motor. These windings can be checked for shorts, grounds, or opens. Use the following steps to check the compressor windings.

1) Shut off the line voltage to the unit by turning off its breaker or disconnect. Use a multi-meter and check for line voltage across the line side of the contactor to verify the power is off.

2) Remove the compressor pigtail. This is the plug on the side of the compressor with 3 heavy gauge wires attached. Once the pigtail is unplugged, you will see the terminations of the windings where they enter the compressor. Whether the unit is single phase or three phase, there should be three terminals from inside the compressor. These terminals will be marked (C) common, (S) start, and (R) run on a single-phase unit or T1, T2, and T3 on a 3 phase unit. CAUTION: On a 3 phase SCROLL compressor, the rotation must be checked to verify proper rotation when finished with electrical checks. This is done by assuring discharge and suction pressure upon restart.

3) With the wires removed, set your multi-meter to the R X 1000 scale. Take one probe from the meter and find a good ground. You may need to scratch the paint on the compressor or scrape the copper tubing at the compressor to assure a good connection. Take the other probe and touch it to each terminal of the compressor. Your meter should remain "infinite" meaning no reading. Any reading to ground from any terminal indicates a short to ground and the compressor must be replaced.

4) Next, we want to check for an open winding in the compressor. Again, with your meter set on R X 1000, take the probes and go between pairs of terminals. If an "infinite" reading is obtained between pairs of terminals, there is an open winding in the compressor. This does not necessarily mean the compressor is bad. Compressors have internal overloads that open due to temperature or high amperage. Feel the compressor. If it is hot, chances are the internal overload may be open. Please note that on a single-phase compressor, if the open is reading between the start and run winding, the compressor is bad as the internal overload opens the common. If the compressor is hot and an open winding was found between common and run or common and/or common and start, it may take up to a couple of hours for the compressor to cool down and the overload to reset. Please allow at least 2 hours for the compressor to cool before ruling it bad.

5) While waiting for the overload to reset, check the contactor for pitted or worn points. Check the capacitor on a single-phase unit and make sure it is good. Check all wiring connections for loose terminations. Check the air handler or cased coil to make sure it is clean. Verify that the unit has proper line voltage present at the contactor L side. All of these things can cause the internal overloads to trip as well as a low charge which would need to be checked and corrected upon restart.

6) Set your meter to its R X 1 scale and check the windings for internal shorts. On a single-phase compressor, the windings should always “add-up” by pairs. What this means is when reading the resistance between windings on a single phase compressor, Common (C) to Start (S) plus Common (C) to Run (R) should always equal Start (S) to Run (R). (C-S) + (C-R) = (S-R). Common to run should be the lowest reading. Common to start should be the mid-range reading. Start to run should be the highest reading. For example: (C-S)= 3 ohms and (C-R)= 1 ohm then (S-R) should = 4 ohms. If these readings cannot be obtained, chances are there is an internal short in the windings of the compressor. Please note that on 3 phase compressors only, all the windings should read nearly the same. If there is a significant variance in the readings, there could be a short in the windings.

7) If all of the above checks out, including having checked all the items listed in step 5, and having waited a minimum of 2 hours for a hot compressor to cool, if the compressor attempts to start but doesn’t before the internal overload or breaker trips, the rotor is most likely locked and is pulling RLA (Locked Rotor Amp) which can be verified by reading the common wire (black) on the pigtail as the compressor attempts to start. Keep in mind that a failed run capacitor or a fault in the wiring can mimic RLA.

8) Grinding or knocking noises by the compressor is usually an indication of a lack of oil or oil return and compressor failure is eminent. The cause, typically a refrigerant leak, needs to be found and repaired before a new compressor is installed.

9) Weak or no pumping action as indicated by both the discharge and suction pressures being low provided the unit has a full charge of refrigerant, the evaporator coil is clean, air flow checks and the reversing valve is not leaking by or stuck mid position. This will also be accompanied by an amp draw much lower than the RLA (Rated Load Amps) and may or may not be accompanied by the noises described in step 8. This would indicate a bad compressor.

System faults: Forced Air and Hydronic

System Faults	Mode	Discharge Pressure	Suction Pressure	Discharge Super Heat	Suction Super Heat	Air Temp Difference	Water Temp Difference	Compressor AMPS
1) Under Charged	Heat	Low	Low	High	High	Low	Low	Low
	Cool	Low	Low	High	High	Low	Low	Low
2) Over Charged	Heat	High	High	Low	Low	Hi/Norm	Hi/Norm	High
	Cool	High	High	Low	Low	Hi/Norm	Hi/Norm	High
3) Low Air Flow	Heat	High	Hi/Norm	Hi/Norm	Norm	High	N/A	High
	Cool	Low	Lo/Norm	Hi/Norm	Low	High	N/A	Lo/Norm
4) Low Water Flow to Buffer Tank	Heat	High	Hi/Norm	Hi/Norm	Norm	N/A	High	High
	Cool	Low	Lo/Norm	Hi/Norm	Low	N/A	High	Lo/Norm
5) Refrigerant Restriction	Heat	High	Low	High	High	Low	Low	High
	Cool	High	Low	High	High	Low	Low	High
6) TXV Stuck Open	Heat	Low	Low	Low	Low	Low	Low	Low
	Cool	Low	Low	Low	Low	Low	Low	Low
7) TXV Sensing Blub Loose	Heat	Erratic	Erratic	Erratic	Erratic	Erratic	Erratic	Erratic
	Cool	Erratic	Erratic	Erratic	Erratic	Erratic	Erratic	Erratic

System fault causes:

1) **Under Charged**. Indicates a refrigerant leak or, if during startup, the charge is incomplete. Refer to charge procedures.
2) **Over Charged.** System has too much refrigerant in it and the excess has to be removed. Refer to charge procedures.
3) **Low Air Flow.** Can be caused by dirty air filters, dirty AHU/Cased Coil, faulty blower motor and undersized or restricted duct systems.
4) **Low Water Flow.** Can be caused by fouled heat exchangers, fouled strainers, faulty pump and undersized or restricted piping systems.
5) **Refrigerant Restriction**. Can be cause by a clogged filter/dryer, TXV or check valve stuck closed, 3.5 ton and larger air handler coil not drilled out or, a crushed refrigerant line.
6) **TXV Stuck Open**. Faulty TXV cartridge, faulty TXV sensing blub and diaphragm.
7) **TXV Sensing Bulb Loose**. This will produce erratic and excessive hunting, especially suction super heat.

Testing a Filter Drier:

- ❑Attach a temperature clamp to the bottom pipe, the inlet of the filter/drier.
- ❑With the unit running in either heating or cooling mode, wait for the temperature reading to stabilize and record the number.

- ❑Attach a temperature clamp to the top pipe, the outlet of the filter/drier.
- ❑With the unit running in either heating or cooling mode, wait for the temperature reading to stabilize and record the number.

Inlet and Outlet temperature readings are to be taken in both the heating and the cooling modes. Refrigerant temperatures will differ between heating and cooling mode and a restriction may not be seen in one mode or the other, especially if the restriction is caused by moisture in the system. Testing in both modes is critical for an accurate diagnosis.

If the outlet temperature is lower than the inlet temperature in either heating or cooling mode, the filter/drier is restricted and should be replaced. This temperature drop is cause by a pressure drop across the filter/drier causing metering of the refrigerant prior to entering the actual metering device.

Some equipment manufacturers consider a 2° to 4° temperature drop acceptable. With a Waterless® Geothermal system, any temperature drop is detrimental to proper performance as it will interfere with proper functioning of the unit’s metering device.

A good filter/drier on any system will show 0°temperature drop across the inlet and outlet.

Moisture in a system/Triple Evacuation:

Change drier. (This may need to be done more than once to dehydrate the POE oil)

Triple Evacuation.

Change oil in vacuum pump after each evacuation.

Consider pulling, draining and replacing the compressor oil.

Contact Total Green Mfg. technical support for assistance with badly contaminated or water flooded systems 419-678-2032.

1) After having prepared the system for vacuum, start vacuuming until 4000 micron is achieved. Break this vacuum by pressurizing the system to 10 P.S.I. of dry nitrogen.

2) Change your vacuum pump oil. Release the nitrogen from the low side of the system while sending nitrogen into the high side of the system and purge for about 20 seconds then, allow the remaining nitrogen to escape. NEVER purge by sending nitrogen through the low side of the system. Vacuum again to 2000 micron. Break this vacuum by pressurizing the system to 10 P.S.I. of dry nitrogen.

3) Change your vacuum pump oil and repeat step 2 except now vacuum to 1000 micron.

4) Change your vacuum pump oil and repeat step 2 except now vacuum to 400 micron or less and DO NOT break this vacuum.

5) Once 400 micron or less has been achieved, close the isolation valve between the micron gauge and vacuum pump and wait 5 minutes. Vacuum should not rise above 500 micron during that 5 minute period. If it does, continue the vacuum to remove any remaining non-condensable within the system. A dry system will hold under 500 micron for 5 minutes.

Ideal Operating Conditions:

Note: The information below are averages. Varying conditions may place some system configurations outside of these ranges and may not indicate a problem with the equipment. Contact Total Green Mfg. technical support with any questions or concerns. All readings for 2 stage equipment should be taken in second stage operation. Return air temperature should be between 65 and 75 degrees.

* Indicates no limit.

Heating/Cooling Mode Checkpoints	Heating		Cooling	
	Min	Max	Min	Max
1) Return Air Temp	65	75	65	75
2) Air Temp Diff.	25	35	15	25
3) Suction Pressure (in P.S.I.)	80	*	100	125
4) Discharge Pressure (in P.S.I.)	300	400	225	400
5) Discharge Superheat	25	50	25	50
6) Suction Superheat	2	12	2	12
7) Accumulator sight glass status	bottom	top	empty	Middle
8) Side of compressor temp @ suction	cool	cool	cool	cool
9) Line Voltage to Unit	208	245	208	245
10) Unit amp draw (based on compressor model)	*	RLA	*	RLA

To contact Total Green Technical Support call 419-678-2032.