February 1, 2006

Performance Tested Comfort Systems® Air Source Heating Pump Installation Commissioning Procedure

Overview - Several measurements of air source heat pump system performance are required when the system is installed to PTCS® specifications. These measurements assist in assuring the system will operate at the expected capacity and efficiency.

Measurements shall be entered on the accompanying data form. This form includes a page on controls, which focuses on backup (strip) heat, a page on system airflow, and a page on refrigerant charge.

These tests, along with a duct tightness test (which is reported separately), address directly the main concern of home occupants, which is delivery of conditioned air to the inside of the home.

The *controls* section of the commissioning procedure is the most critical, as it evaluates the control of auxiliary heat. The PTCS® specifications require lockout of auxiliary resistance heat at temperatures above 35° F. This lockout can be accomplished in various ways. For example, a sensor can be added that communicates with the indoor thermostat and the cut-in temperature is set at the thermostat. A close-on-fall switch can be installed in series with the auxiliary heat circuit at the outdoor unit. This requires having an extra wire between the indoor and outdoor units that can be used to complete this circuit. A fixed temperature unit meant for refrigeration is much preferred over an adjustable unit because of accuracy. ***Sensor calibration and system lock-out operation must be confirmed***.

For multi-stage systems (variable compressor capacity), outdoor thermostat controls may not be a standard option. In these cases, system sizing and staging might reduce the need for an outdoor thermostat. If a discharge air sensor is used to actuate the second heating stage step, the cut-in temperature should be set as low as possible (typically 85° F). Discharge sensor controls are not recommended and indeed, strongly discouraged for single compressor capacity equipment.

For all types of equipment, auxiliary strip heat elements shall be staged in 5 kW increments. For all types of equipment, the compressor cut-out (if present) cannot be set above 0° F.

Airflow readings should be taken when the system is believed to be in full heating capacity flow. For multiple-stage systems, it may be necessary to test in partial capacity depending on various factors. The preferred method of performing airflow test is with a TrueFlow® plate. If this method cannot be used, a matching duct pressurization fan test can be used. An alternate worksheet is provided for this method.

Refrigerant charge evaluation relies on measurement of operating pressures and comparison to pressures specified by the manufacturer. Refrigerant line set length and any adjustments shall be recorded. The specified pressures correspond to measured ambient (and, perhaps, indoor) temperatures. Occasionally, the outdoor unit arrives improperly charged and a check of operating pressures could indicate a problem.

Instructions for Completing Commissioning Forms - (*Entries to the data form are described by page and from top to bottom).*

Controls Page

Information on the first third of the page identifies the location of the unit, the electric utility jurisdiction, when the unit was installed and tested, and the area served by the unit if there is more than one unit at a site. The Invoice# is meant to give the unit an (almost) unique identifying number; it is assumed the installer will use the Invoice# from their service ticket.

In the two checkboxes below the identity block, the installer is asked to confirm the low-ambient compressor lockout is set to activate at a temperature no warmer than 0° F (PTCS® specification). The installer is also asked to confirm the strip heat is staged in 5 kW increments (if applicable).

The rest of this form is broken into single and multi-stage compressor entries. In each case, the tech should record the type of indoor thermostat/zone control used and how the auxiliary heat is controlled when the outdoor temperature is above 35° F. If the system uses an outdoor sensor for this control, its output must be checked. (These are typically 10k ohm @ 77° F resistors so the measured resistance will correspond to a temperature; a lookup table is usually provided by the equipment manufacturer).

Outdoor thermostat operation must be checked. Unfortunately, it is usually possible only to determine whether or not the system performs a cut-out operation and not the exact temperature where this occurs. However, the technician should explain the procedure used to check out the system. The most commonly used technique is to make a heating call which is at least 2° F above the displayed

thermostat temperature and measure register temperatures to see if they go above expected heat pump delivery temperature (rarely above 95° F except on a very mild day (above 55° F). On days where outdoor temperatures are below 35-40° F, it may be necessary to warm up the outdoor sensor (or decrease the cut-out temperature (if possible) in order to do this test.)

Important note: use of discharge sensors to control backup heat is strongly discouraged on single-stage systems, as it tends to bring on backup heat unnecessarily.

On multi-stage systems, the installer must confirm that the second stage of heating is compressor-only (that is, that strip heat only comes on for the third stage).

Airflow Page

Recommended airflow is at least 350 CFM/ton.

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The middle third of the page asks for air handler type, expected flow at the mode/stage tested, and static pressure readings.

The intention is that the technician will test the system at full capacity in heating mode. In newer systems, attaining full capacity flow may be complicated and can require detailed review of system controls and sensors. Temporary settings and/or sensor jumpering may be required. Also, it may be possible to get to full capacity and flow by using the test mode of the indoor thermostat.

The static pressure test will identify systems that may not achieve their full potential because of increased fan energy usage. Holes shall be drilled in the supply and return plenum and be large enough to be patched with rubber plugs. Care shall be taken to avoid drilling into the indoor coil. (Make sure registers and dampers are open, look for constrictions; if needed, note size of plenums and trunks and overall number of supply and return registers.)

The TrueFlow® calibrated plate is the preferred means of measuring system airflow. The procedure described with the TrueFlow® plate is to be used and results recorded here. In summary, the process requires measurement of system supply static pressure with a static pressure tap; this is the Normal System Operating Pressure (NSOP). The system filter is then replaced with TrueFlow® (spacers added as needed) and the supply static pressure remeasured (this pressure is called the True Flow System Operating Pressure (TFSOP)). The pressure drop across the plate (red and green hoses) is recorded and the raw flow in CFM recorded. If the NSOP and TFSOP differ, a correction is needed. The Trueflow® plate comes with a card that provides correction factors or one can be computed by determining the square root of NSOP divided by TFSOP.

If the TrueFlow® cannot be used because of physical obstacles or other problems, use the Duct Blaster matching method using the procedure described below. If using this method make sure to check supply plenum pressure and correct apparent flow as needed using the correction process described in attached worksheet.

Refrigerant Charge Page

The procedure for checking charge relies on weighing in any needed adjustments based on the length of the line set. This information must be recorded on the form. A reliable refrigerant scale with fresh battery is needed for weigh-in.

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After any adjustments to charge are made, the service technician shall run the system for at least 15 minutes in the mode/stage selected. *(This means the system can be tested in heating or cooling, but the mode and stage shall be specified on the form. Also, it is critical to have measured airflow in the same stage so the operating pressures can be interpreted correctly.)*

After 15 minutes of system operation, measure suction and discharge operating pressures with a calibrated manifold gauge set. Manufacturers' target values shall also be recorded; these are based on unit model numbers, outdoor temperature, and indoor temperature (if needed) and measured system airflow. Note corrections are often required based on outdoor/indoor unit combinations. Measured pressures should agree with manufacturer listings within 10 psig.

[Note: System superheat and subcooling may also be checked in the cooling mode to determine if refrigerant charge is correct. Procedures, such as CheckME!® and the Honeywell Handtool/ACR_x are acceptable alternative methods for performing superheat and subcool testing to verify correct system refrigerant charge.]

Measuring System Airflow Using Duct Blaster "Matching Method"

1. Turn on air handler (by using fan-only switch or by turning on heat/AC). It is best to call for the flow that will be used in heating mode.
2. Drill access hole as needed and point hooked end of static tap into airflow**. Do not drill into the duct at any point where you are concerned with hitting something.** Note if fan is variable speed and note expected flow given size of unit and DIP or other settings on system control board.
3. Record normal system operating pressure (NSOP) as described in flow plate test.
4. Next, install split between supply and return so that all air flowing through Duct Blaster will go into supply side.
5. Install Duct Blaster on furnace. Ingenuity with cardboard and duct tape is often needed.
6. ***Turn on air handler to heating speed.***
7. Turn Duct Blaster on and slowly increase flow until the supply plenum pressure is the same as NSOP.
8. Check to make sure the pressure in the return system is 0 or very close to 0 (to confirm system split is good).
9. Record Duct Blaster flow pressure, ring#, and CFM.

NSOP	_____Pa
Ring #	_____
Flow pressure	_____Pa
Air Handler flow	_____CFM

Note: if highest pressure reached is not NSOP, a correction is needed.

Record highest pressure reached (HPR)_____

Correction: take square root of (NSOP/HPR) _____

And multiply by Air Handler flow (from above) _____

This is the corrected flow: _____CFM

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