Performance Tested Comfort Systems - Air-Source Heat Pump System Installation Standards[1]

April 15, 2007

[1] These standards have been revised from those orginally developed by the Umatilla Electric Cooperative.

1.0 INTRODUCTION

1.1 "Should and Shall" will be interpreted as follows:

1.1.1 Where shall or shall not is used for a provision, that provision is mandatory if compliance with the standard is claimed.

1.1.2 Where should is used it will indicate provisions which are not mandatory but which are desirable as good practice.

2.0 NEW EQUIPMENT REQUIREMENTS

2.1 Approved Manufacturer

Equipment shall be manufactured by a company appearing in the ARI Unitary Directory.

2.2 Ratings

Heat pump equipment shall meet the performance, safety, and rating requirements as given in the latest revision of Air Conditioning and Refrigeration Institute (ARI) Standard 240. Units shall be listed by Underwriters' Laboratories, or equal, and shall display the ARI symbol of certification.

2.3 ARI Certified Performance

Air Source Heat Pumps shall have an HSPF rating of not less than 8.5 and SEER ratings of not lelss than 14.0, as certified by ARI.

Exceptions:
1. A minimum SEER rating of 13.5 shall be acceptable when HSPF is at least 8.6

2. A minimum SEER rating of 13.0 shall be acceptable when HSPF is at least 8.7

2.4 Protective Devices

Equipment should be provided with a crankcase heater and a liquid-line filter drier. Delay timers to protect against damage from short cycling of the compressor and compressor motor start-assist kits shall be installed when recommended by the manufacturer. The compressor shall be protected from abnormal operating pressures, temperatures, and loss of refrigerant by suitable pressure or temperature overload devices.

If a low ambient temperature compressor cutout option is installed, it shall not cutout the compressor at temperatures above 0°F.

To prevent floodback of liquid refrigerant to the compressor, a suction line accumulator shall be installed, unless not recommended by the manufacturer.

3.0 PARTICIPATING INSTALLER REQUIREMENTS

3.1 Training

Participating Installer shall be responsible for the technical competence and qualifications of all salespeople, installers, and service mechanics. These personnel should participate annually in at least one manufacturer's training session on heat pump application, installation, or service or receive equivalent training. At least one fourth of all the Participating Installer's installers should be Refrigeration Service Engineers Society (RSES) or North American Technical Excellence (NATE) heat pump certified or have equivalent certification. At least one System Installer or Technician on each HVAC Contractor job shall be certified in Air Conditioning Contractors of America (ACCA) Manual D. System Designers shall be certified in ACCA Manual D and Manual J.

Alternately, duct design, heat pump sizing, and installations may be certified by the utility if the utility has staff that is certified in ACCA's Manual D and Manual J.

3.2 Certification

Each heat pump system installed shall be certified as a "PTCS Commissioned Heat Pump." This requires testing and documentation of auxiliary heat controls (Section 4.4), airflow across indoor coil (Section 6.3), and refrigerant charge (Section 5.4) by an RTF approved PTCS Service Provider certified "Heat Pump Technician."

Where heat pump systems are installed in houses with a substantial amount of ductwork in unconditioned space, the duct system shall be certified as a "PTCS Duct System." This requires duct testing and documentation (Section 6.2.2) by an RTF approved PTCS Service Provider certified "Duct Technician" and may require sealing.

Applicable heat pump commissioning and duct system PTCS certifications shall be submitted to the utility. The utility shall maintain record of certifications and make the records available to BPA, the RTF, or the RTF approved PTCS Service Provider upon request.

3.3 New System Warranty

The participating Installer shall provide to the consumer in writing the manufacturer's warranty. Heat pump equipment shall be warranted by the manufacturer against defects in material and workmanship for a minimum of 5 years from the date of start-up of the equipment. In addition, the compressor shall be warranted by the manufacturer against defects in material and workmanship for a minimum of five years from the date of start-up. Warranties shall cover parts and labor. Participating Installers may offer to consumers the manufacturer's extended warranty or service agreement to comply with the warranty requirements. This warranty should not be considered to cover equipment failure caused by failure to perform normal maintenance, abuse, or external causes beyond the control of the installing Participating Installer.

3.4 Consumer Instruction

Participating Installer shall instruct the consumer in proper operation and maintenance of the heat pump system. Participating Installer shall provide the consumer with the manufacturer's owner's manual, demonstrate filter replacement (or cleaning), and demonstrate the operation of all indoor thermostat controls and indicator lights to the consumer. Participating Installer shall explain to the consumer the different operating modes of the heat pump system (e.g., heating, emergency heat, defrost, and the effects of obstructing registers). All this information shall be provided in an operation manual given to the owner.

4.0 NEW EQUIPMENT SELECTION

4.1 Heating and Cooling Calculations

4.1.1 Heating loss and cooling gain calculations shall be made using 70°F indoor design temperature for heating and 75°F for cooling.

4.1.2 The recommended ASHRAE winter design temperature and cooling design temperature for the nearest weather station representative of the installation shall be used.

4.1.3 The recommended method and form for calculations is available in the Air Conditioning Contractors of America (ACCA) Manual J. Alternate computer or manual methods of calculating heating and cooling loads may be used if approved in advance by the utility.

4.1.4 Component U-values and F-values used in the heat loss and heat gain coefficients shall reflect the actual construction of the building and be generally consistent with those found in ACCA Manual J 7th Edition, or later.

4.1.5 A copy of the whole house heating and cooling load calculations shall be submitted to the utility. The utility shall hold the calculations on file and make them available to BPA, the RTF, or the RTF approved PTCS Service Provider upon request**.**

4.1.6 An infiltration rate of 0.5 or 0.8 air changes per hour shall be used for houses built in or after 1980 or before 1980, respectively, in sizing calculations unless a house (de)pressurization test has been performed and an estimate is made using the result.

4.1.7 Where available, the results of duct pressurization testing shall be used to estimate the duct system efficiency used in sizing calculations. If a duct pressurization test has not been performed on the house, a default duct system loss of 25 percent shall be used. Exception: If the air handler and all ductwork are within the thermal envelope of the house, 0 percent shall be used as the duct system loss in sizing calculations.

4.2 Heat Pump System Sizing

The heat pump system shall be sized using either of the following methods, rounding up or down to the nearest 6,000 Btu/hr capacity at ARI rating conditions:

1. Heat pumps shall be sized using a 30°F Balance Point.
2. Heat pumps shall be sized in accordance with the sizing method specified by the utility.

However, in no case shall the Balance Point used for sizing be higher than 35°F. A Balance Point Worksheet shall be submitted to the utility. The utility shall hold the Balance Point Worksheet on file and make it available to BPA, the RTF, or the RTF approved PTCS Service Provider upon request.

4.3 Auxiliary Heat Sizing

Installed auxiliary heat capacity shall not exceed 125 percent of the heating design load.

4.4 Control of Auxiliary Heat

New system installations and systems serviced in accordance with PTCS specifications shall employ control strategies that minimize the unnecessary use of auxiliary heat. In all systems, auxiliary heat shall not operate during a first stage heating call (unless system is switched to emergency heat). Auxiliary heat shall be controlled in the following manner depending on system type:

1. For systems with a single stage of compression and for systems with multiple stages of compression but without supply air temperature sensor control: Auxiliary heat shall be controlled in such a manner that it does not engage when the outdoor air temperature is above 35°F, except when supplemental heating is required during a defrost cycle or when emergency heating is required during a refrigeration cycle failure. Exception: If the minimum setting available for auxiliary cutout on the indoor thermostat is 40°F, 40°F may be used.

2. For systems with a single stage of compression and the option of supply air temperature sensor control, supply air temperature sensor shall not be allowed to bring on auxiliary heat when the outdoor air temperature is above 35°F, except when supplemental heating is required during a defrost cycle or when emergency heating is required during a refrigeration cycle failure.

3. For systems with multiple stages of compression and supply air temperature sensor control:

    a. Auxiliary heat shall be controlled in such a manner that it engages only after all stages of compression have been engaged and the supply air temperature falls below 85° F, OR

    b. If the staging temperature is set higher than 85°F, the system shall be equipped with an outdoor thermostat or equivalent control that prevents auxiliary heat from operating when outdoor temperatures are above 35°F, except when supplemental heating is required during a defrost cycle or when emergency heating is required during a refrigeration cycle failure.

Method of controlling auxiliary heat shall be documented by the certified heat pump Technician and submitted to the RTF-approved PTCS Service Provider.

5.0 NEW EQUIPMENT INSTALLATION

5.1 Access

Equipment shall be located to allow easy service access and adequate working space for servicing any component without removal of piping, duct work, or other permanently installed fixtures. Special care shall be taken in locating components which require frequent attention, such as filters.

5.2 Location and Support of Indoor Units

Indoor units shall be located to permit smooth duct transitions and shall be adequately supported or placed in a suitable platform in accordance with manufacturer's instructions and recommendations.

5.3 Location and Support of Outdoor Units

Outdoor units shall be located to avoid restrictions in the outdoor airstream. Units shall be mounted on an adequate, solid, secure pad which provides proper drainage and prevents a buildup of water, snow, or ice. A minimum clearance shall be provided as per manufacturer's instructions and recommendations. In any installation there shall be a minimum of 3 inches of free and clear area under the outdoor coil drainage area. Condensate shall not drain onto areas where ice formation may create a hazard (e.g., walkways).

5.4 Refrigerant Charge

5.4.1 Technician shall follow manufacturer's guidelines when charging a new system and make any needed adjustments for non-standard line set lengths or mismatched coils.

5.4.2. Technician shall perform a refrigerant charge verification test on all systems installed or serviced in accordance with PTCS specifications. Refrigerant charge testing shall include at least one of the following:

a. discharge and (if needed) suction pressure(s) compared to manufacturer's table of expected pressures at various outdoor and indoor temperatures
b. heat pump system capacity in heating mode compared to expected capacity at outdoor conditions
c. superheat, subcooling, or (Lennox) Approach temperature compared to manufacturer's targets

Refrigerant charge test shall be performed and documented using one of the following:

a. Proctor Engineering's CheckMe® program
b. Honeywell's ACRx hand tool

c. “PTCS Heat Pump Startup Form”.
d. other approved Performance Tested Comfort Systems methods

5.4.4. Results from refrigerant charge test or documentation of refrigerant charge shall be submitted to the RTF-approved PTCS Service Provider.

6.0 DUCT WORK

6.1 Design Requirements

This section applies to all new duct work, including the addition of duct systems to existing housing or significant alterations to existing duct systems. All new duct work (including the addition of duct systems to existing housing) should be designed and installed in accordance with recommended practice as outlined in Air Conditioning Contractors of America (ACCA) Manual G, “Selection of Distribution Systems”; Manual E, “Room Air Distribution Consideration” and Manual D, “Residential Duct Design and Equipment Selection” or Sheet Metal and Air Conditioning Contractors National Association (SMACNA) “HVAC Duct System Design” or American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) handbooks. Installation of balancing dampers is recommended in order to easily adjust distribution of air to rooms.

6.1.1 Flex Duct

Flex duct shall not be used for main supply trunks in crawl spaces or areas that could be subject to physical damage from normal occupant activities, weather or animals. When flex duct is used for main trunks or run outs the size shall be determined by using the “Wire Helix Flexible Duct” scale on an ACCA Duct Sizing Slide Rule, or equivalent and all other requirements in Section 6.0 of these specifications shall be met.

6.1.2 Building Cavities and Ducts

In newly installed ductwork, building cavities shall not be used as ducts to convey return or supply air.

6.1.3 Static Losses

Supply and return ducts shall be designed on the basis of not more than 0.10 and 0.08 inches loss per 100 feet, respectively. Supply and Return Ducts shall be designed so that the total system static pressure does not exceed the available static pressure provided by the air handler at design CFM. Flex duct shall be supported in a manner that does not create restrictions in air flow and located to minimize bending.

6.1.4 Maximum Velocities

New duct work shall be designed so air velocities do not exceed the following:

Supply Ducts

Main Ducts	900 FPM
Branch Ducts	600 FPM
Supply Outlet Face Velocity	700 FPM
Return Grills Face Velocity	500 FPM
Filter Grille Face Velocity	300 FPM

Velocity shall not create unacceptable noise levels and return air shall be sufficient size to meet requirements of installed systems.

6.1.5 Duct Connections

All new and all readily accessible existing duct joints, plenum drives, metal joints to include all slips and drives shall be mechanically fastened with screws. Flexible ducts shall be attached using nylon/plastic straps tightened with a manufacturer approved tool (hand tightening is not acceptable) or stainless steel worm drive clamps. Mastic and/or tape shall not be used as mechanical fasteners.

6.1.6 Zonal Pressure Relief

In new system construction, sufficient return pathways shall be provided between axial zones (e.g. bedrooms) and the main body of the dwelling. Return pathways include return ducts, pass-through grilles, pressure-relief ducts, or similar devices. Return pathways should limit absolute pressurization of axial zones to 3 Pa or less with reference to the main body of the house when the system is operating at maximum system airflow, tested with all doors closed. (That is, axial zone must be within ±3 Pa of main body of house with air handler operating at maximum system airflow.)

6.2 Duct Installation

6.2.1 Insulation

6.2.1.1 All newly installed rigid ducts and plenums and accessible uninsulated existing rigid ductwork outside the heated space shall be insulated to an installed value of at least R-8. A vapor barrier meeting a flame spread rating of 25 or less and smoke developed rating of 50 or less (in accordance with ASTM E-84) shall be installed on the outside surface of the insulation.

6.2.1.2 All newly installed flexible HVAC ducts outside the heated space shall have an Air Diffusion Council (ADC) certified minimum R-value of R-8.

6.2.1.3 All newly installed HVAC ducts routed within exterior wall cavities shall be insulated to a minimum installed value of R-8 between the duct and the exterior wall sheathing.

6.2.1.4 All duct insulation shall be installed and supported using mechanical fasteners such as permanent plastic straps or nylon twine. Tape is not a mechanical fastener. Approved tape may be used at insulation seams to provide a continuous barrier.

6.2.2 Air Tightness – Where a substantial amount of ductwork is in unconditioned space, duct air tightness shall be certified by a PTCS Certified Duct Technician to meet PTCS standards and duct test results recorded and submitted to an RTF approved PTCS Service Provider.

6.2.2.1 Duct leakage in new construction shall not exceed 0.06 CFM50 x floor area served by the system (in square feet), or 75 CFM50, whichever is greater when tested in accordance with the PTCS duct leakage measurement protocol for "Total Leakage Testing" or "Leakage Testing to Exterior." If the air handler is located completely within conditioned space, it is not required to be in place during the test. If the air handler is located in unconditioned space, and it is not in place during the test, the leakage limit shall be decreased to 0.04 x floor area served by the system (in square feet) or 50 CFM50, whichever is greater.

6.2.2.2 Duct leakage in existing homes with new ducts shall not exceed 0.10 CFM50 x floor area served by the system (in square feet), or 75 CFM50, whichever is greater.

6.2.2.3 Duct leakage in existing homes with existing ducts shall not exceed 0.10 CFM50 x floor area (in square feet) served by the system; or it shall be documented that a 50 percent reduction* in leakage to the exterior has been achieved by comparing duct leakage to the outside before and after sealing when tested in accordance with the PTCS duct leakage measurement protocol for "Leakage Testing to Exterior."

Exception: Where return ducts are inaccessible, compliance with either 0.10 CFM50 x floor area or a 50 percent reduction in leakage to the exterior (whichever is less) may be accomplished by testing the supply side only.

6.2.2.4 Duct leakage in manufactured homes shall either:

i. not exceed 100 CFM50 for single wide homes or 150 CFM50 for double wide or larger homes; or

ii. be documented to have experienced a 50 percent reduction in leakage to the outside by comparing duct leakage to the outside before and after sealing.

6.3 System Air Flow

6.3.1 All existing ductwork shall be inspected by the HVAC Contractor for conditions which will affect the efficiency or proper operation of the new heat pump

system. It is the Participating Installer's responsibility to ensure existing ductwork is compatible with the equipment that is installed.

6.3.2 The air distribution system design and installation shall be such that air flow across the indoor coil is as specified in the heat pump manufacturer's literature, or is between 350 and 425 cubic feet per minute (CFM) per 12,000 BTU/hr output at ARI rating conditions if the manufacturer's literature is not specific.

6.3.3 After installation and start-up, total airflow in the heat pump mode (in cubic feet per minute, or CFM) across the heat pump coil shall be measured using a TrueFlow plate or using duct pressurization fan matching method per plate or fan manufacturer's instructions. This shall be reported to the RTF approved PTCS Service Provider using the "PTCS Heat Pump Startup Form".

6.3.4 The total external static pressure acting on the system air handler shall be tested with approved instruments and recorded at time of startup and submitted to the RTF approved PTCS Service Provider using the "PTCS Heat Pump Startup Form" or RTF approved equivalent form. A measured external static pressure of more than 0.8" (200 Pa) should cause installer to consider taking corrective measures with system ductwork.

7.0 FILTERS

7.1 Location

Air filters shall be installed in the return air system in a location that will be easily accessible to the user for filter servicing and in a position where all return air and outside air will pass through the filters before crossing the indoor coil. Filters should not be installed in crawl spaces or attics.

7.2 Type and Size

Filter types and sizes shall meet the standard manufacturer's instructions and recommendations. Filters and/or air cleaners that are not an integral part of the equipment and selected by the manufacturer shall be accepted if the total CFM is within the range as specified by the manufacturer. Any filter that exceeds 0.22 inches pressure drop as installed shall not be allowed.

8.0 REFRIGERANT PIPING

This section applies to new piping and repairs made to existing piping.

8.1 Materials

Field-supplied refrigerant piping shall be clean, dehydrated, and sealed Types K and L seamless copper tubing or the manufacturer's pre-charged tubing. Fittings shall be wrought copper. Field supplied tubing shall be evacuated to 500 microns and purged and pressure tested as per manufacturer's recommendation; soft solders shall not be permitted.

8.2 Sizing

To maintain oil return to the compressor and avoid inefficiency and capacity loss, refrigeration piping or refrigeration line set shall be sized and installed in accordance with the manufacturer's instructions and recommendations. Piping between the two sections of split units shall not exceed the manufacturer's maximum recommended length, horizontally or vertically, and shall be run parallel to building lines and in a straight and workmanlike manner to prevent oil traps.

8.3 Support

Refrigerant piping shall be properly supported in accordance with manufacturer's specifications, ARI, and IMC (International Mechanical Code).

8.4 Penetrations

Refrigerant piping passing through openings in the unit cabinet or the building structure shall be installed to prevent wear or sound generation due to contact with the cabinet or building structure. All penetrations shall be properly sealed.

8.5 Insulation

Suction lines shall be insulated with a minimum of 1/2-inch-thick continuous closed-cell foam rubber. Where insulation is exposed to the elements, it should have a weatherproof covering. Vapor and liquid lines shall be separated so that heat exchange does not take place. Factory insulated pre-charged lines will be accepted.

8.6 Exposed Piping

All refrigerant piping exposed to possible damage from foot traffic around or near an outdoor unit shall be protected or buried in PVC or other corrosion-resistant pipe, in accordance with the manufacturer's instructions, to prevent damage to piping or pipe insulation or injury to people, and to permit replacement if necessary.

8.7 Leak Testing, Evacuation, and Charging

Factory, as well as field joints, shall be checked and any leaks found shall be repaired. Evacuation and charging shall be done in accordance with the manufacturer's instructions and recommendations.

9.0 CONDENSATE PIPING

9.1 Manufacturer's Recommendations

Condensate drain piping shall meet IMC and should be copper, plastic, or other corrosion-resistant material.

9.2 Drains

Condensate drain lines shall be trapped and run to an open drain or outside of the building foundation. Under no circumstances may condensate be drained into a crawl space or direct connected into a sewer line. When indoor units are located in attics, the installation should include a secondary drain pan to collect condensate when a problem exists in the primary drain line. The secondary drain pan should be connected to a drain line that will drip at a location that will draw attention to the problem in the primary drain line.

9.3 Condensate Pump

Condensate drain lines shall be pitched in the direction of flow to prevent backup of overflow of water in the drain pan. If the indoor unit is lower than the floor drain or dry well, a condensate pump shall be installed to pump condensate to the level of the drain or dry well. An automatic control to shut down system in case of pump failure should be installed. A check valve shall be installed if pump is not equipped with one.

10.0 ELECTRICAL

10.1 Field Wiring

All field wiring, line and low-voltage, shall comply with the manufacturer's recommendations, the National Electrical Code, and all local codes and ordinances.

11.0 INDOOR THERMOSTATS

11.1 Installation

Indoor thermostats shall be located and installed according to the manufacturer's instructions and recommendations. Thermostats generally are installed 5 feet off the floor on an inside wall in the return airflow pattern, and where they are not in the sun or any other heat source at any time.

11.2 Auxiliary Heat Indicator

Thermostat shall provide a visible indication when the auxiliary stage or emergency heat are operating.

11.3 Heating and Cooling

Thermostats used for both heating and cooling shall have a manual changeover feature or heating/cooling lockout to prevent cross-cycling between heating and cooling.

11.4 Emergency Heat Relay

All indoor thermostats shall include a manual selector switch to permit all supplemental heaters or the furnace to be energized under control of the indoor thermostat (with the compressor and outdoor thermostats bypassed).

12.0 ADD-ON HEAT PUMP TO GAS, PROPANE OR OIL FURNACE

12.1 Indoor Coil

For an add-on heat pump, the indoor coil shall be installed in the downstream air from the heat exchanger according to the International Mechanical Code.

12.2 Furnace Operation

The furnace shall lock out the heat pump when it operates on second-stage heat, unless heat pump manufacturer's special add-on heat pump control permits operation of both.

12.3 Emergency Heat Operation

Emergency heat switch shall activate the furnace and bypass the heat pump.

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