



Performance Tested Comfort Systems - Air-Source Heat Pump System Installation Standards¹

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¹ These standards have been revised from those originally developed by the Umatilla Electric Cooperative .

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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 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 Performance

Site Built Housing - Air Source Heat Pumps shall be either ENERGY STAR labeled, or have an HSPF rating of not less than 8.0 for split systems or 7.6 for package units and SEER ratings of not less than 13.0 for split systems or 12.0 for packaged units, as certified by ARI. Split systems shall have an EER of not less than 11.0 and packaged systems shall have an EER of not less than 10.5. Ground Source Heat Pumps shall have a C.O.P. rating of not less than 3.0 as certified by ARI.

Manufactured Housing - Air Source Heat Pumps shall be either ENERGY STAR labeled, or have an HSPF rating of not less than 8.0 for split systems or 7.6 for package units and SEER ratings of not less than 12.0 for split systems or packaged units, as certified by ARI. Split systems shall have an EER of not less than 11.0 and packaged systems shall have an EER of not less than 10.5. Ground Source Heat Pumps shall have a C.O.P. rating of not less than 3.0 as certified by ARI.

Under the Conservation and Renewables Discount Program, equipment with lower efficiency ratings than those required above may be installed if the "Heat Pump HSPF and SEER Tradeoff and Deemed Savings Calculator" is used to determine the acceptable efficiencies and associated savings value.

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 his salespeople, installers, and service mechanics. These personnel should participate in at least one manufacturer's training session on heat pump application, installation, or service annually or 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, Manual J and Manual S.

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, Manual J, and Manual S.

Each system installed shall be certified by Climate Crafters as a Performance Tested Comfort System in both duct and heat pump installation. This requires testing by a Climate Crafters certified technician in accordance with Climate Crafters protocols.

3.2 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 five 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.

3.3 Extended Warranty

Participating Installer may offer to all consumers the manufacturer's fifth through tenth year extended warranty or service agreement. This offer shall be made in the proposal.

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 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 and Manual S. 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 with the bid. A room-by-room heat loss calculation shall be submitted with the bid.

4.1.6 A blower door test shall be performed to determine the proper air infiltration rate to be used in the sizing calculations.

4.1.7 A duct blaster test shall be performed to make an estimate of duct system efficiency to be made in the 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 6000 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 *Climate Crafters*.

4.3 Central Air Conditioner System Sizing

Central air conditioners shall not be sized greater than 140% of design cooling load.

4.4 Supplemental Heater Sizing and Control

Installed auxiliary heating shall not exceed 150% of the heating design load. All supplemental heaters greater than 5 kW *shall* be staged.

4.5 Outdoor Thermostat

An outdoor thermostat *shall* be installed and set so that auxiliary heating does not engage above 35 °F, or that temperature required by the utility, except when supplemental or emergency heating is required during a defrost cycle or refrigeration cycle failure. A thermostat equipped with an outdoor temperature sensor may be used in place of an outdoor thermostat if programmed so that auxiliary heating does not engage above 35 °F, or that temperature required by the utility, except when supplemental or emergency heating is required during a defrost cycle or refrigeration cycle failure.

4.6 Defrost Controls

The system shall have demand defrost controls.

5.0 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. Secondary drain pan shall be included in attic installations.

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

Participating Installer shall refer to manufacturer's guidelines when charging system and make any needed adjustments for non-standard line set lengths or mismatched coils. **Refrigerant charge shall be checked using Proctor's CheckMe program, Honeywell's ACRx handtool, or other approved Climate Crafters methods.**

Results from refrigerant charge tests shall be submitted to Climate Crafters.

6.0 DUCT WORK

6.1 Design Requirements

All new duct work (including the addition of duct systems to existing housing) **shall** 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. Duct sizing calculations and conclusions **shall** be thoroughly documented and provided to Climate Crafters. Installation of balancing dampers is **required**.

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 new housing, building cavities shall not be used as ducts to convey return or supply air. In retrofit applications, use of building cavities is **not** allowed for return 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 Diffusers and Registers

Proper diffusers and registers shall be selected and installed in the proper locations.

6.1.6 Branch Ducts

Branch out runs should be a minimum of 6 inches in diameter except to bathrooms.

6.1.7 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.

6.1.8 Zonal Pressure Relief

Sufficient return pathways *shall* be provided between axial zones (e.g. bedrooms) and the main body of the dwelling to limit pressurization of these zones to 3 Pa or less when the system is operating at maximum system airflow. Return pathways include return ducts, pass-through grilles, pressure-relief ducts, or similar devices.

6.2 Duct Installation

6.2.2 Insulation

- 6.2.2.1 All new rigid metal ducts and plenums and accessible existing rigid metal 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-84-88) shall be installed on the outside surface of the insulation.
- 6.2.2.2 All new ducts and plenums that are internally lined with insulation outside the heated space shall be installed in accordance with SMACNA's Duct Liner Application Standard, Second Edition. The total R-value of this duct work shall be no less than R-8.
- 6.2.2.3 All flexible HVAC ducts outside the heated space shall have an Air Diffusion Council (ADC) certified minimum R-value of R-8.
- 6.2.2.4 All HVAC ducts routed within exterior wall cavities shall be insulated to a minimum of R-14 between the duct and the exterior wall sheathing.
- 6.2.2.5 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.

6.2.3 Air Tightness

All new and all accessible existing HVAC supply and return ducts, air handlers, and plenums inside and outside the heated space shall be sealed at all joints and corners, including prefabricated joints, with approved mastic. UL181A-M or UL181B-M mastic shall be used on rigid metal ducts. UL 181B-M mastic shall be used on flex ducts. It is unnecessary to seal longitudinal seams unless they are damaged. Tape is not allowed except for use on operable doors in the system such as on the air handler.

Duct leakage shall be tested using a duct blaster and a blower door in accordance with Climate Crafters protocols. Ductwork shall be sealed to at least one of the following standards:

Retrofit

- 1. The duct leakage to the outside (in CFM) at a duct pressure of 50 Pascals shall be less than 10% of the conditioned floor area.**
- 2. A reduction in duct leakage to the outside (in CFM) at a duct pressure of 50 Pascals of 50% or greater shall be achieved.**

New Construction

- 1. The duct leakage to the outside (in CFM) at a duct pressure of 50 Pascals shall be less than 6% of the conditioned floor area.**

Duct leakage tests shall be documented and documentation shall be provided to Climate Crafters.

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.

6.3.1 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 375 and 425 cubic feet per minute (CFM) per 12000 BTU/hr output at ARI rating conditions if the manufacturer's literature is not specific.

6.4 Start-up Tests and Measurements

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 per Climate Crafters protocol***. This, along with the temperature difference across the coils and outdoor ambient air temperature at the outdoor coil, ***shall be reported to Climate Crafters***.

Airflow to each room shall be tested using a _____ and reported to Climate Crafters. Adjustments in room airflow shall be made, if necessary, according to the room by room calculations, using the balancing dampers.

7.0 FILTERS

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. Filter types and sizes shall meet the standard manufacturer's instructions and recommendations. Filters that are not an integral part of the equipment and selected by the manufacturer shall not exceed 400 FPM face velocity. Electronic air cleaners 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. Filter types and sizes shall meet the standard manufacturer's instructions and recommendations. No more than 400 feet per minute (FPM) face velocity shall be allowed. Filters should not be installed in crawl spaces.

8.0 NOISE AND VIBRATION ABATEMENT

8.1 Indoor Unit

Permanent means shall be provided to prevent transmission of objectionable noise or vibration generated by the indoor unit in accordance with the manufacturer's instructions and recommendations. Supply and return shall be sound lined a minimum of 4 feet from the air handler, with the exception of manufactured homes.

8.2 Outdoor Unit

Outdoor units shall be located to avoid transmission of objectionable noise to adjacent properties, sleeping areas, or other areas where noise control is critical. Where outdoor units are found to be in violation of state and local noise control ordinances, the Participating Installer shall be responsible for any modifications necessary to reduce noise. Unit base shall not be connected to the foundation.

9.0 REFRIGERANT PIPING

9.1 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.

9.2 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.

9.3 Support

Refrigerant piping shall be properly supported in accordance with manufacturer's specifications, ARI, and UMC (Uniform mechanical Code).

9.4 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.

9.5 Insulation

Suction lines shall be insulated with a minimum of 1/2" 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.

9.6 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.

9.7 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 and the latest edition of ARI Standard 260-75, 3.5-3.7.

10.0 CONDENSATE PIPING

10.1 Manufacturer's Recommendations

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

10.2 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 shall include a secondary drain pan to collect condensate when a problem exists in the primary drain line. The secondary drain pan shall be connected to a drain line that will drip at a location that will draw attention to the problem in the primary drain line.

10.3 Condensate Pump

Condensate drain lines shall be pitched in the direction of flow to prevent backup or 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 shall be installed. A check valve shall be installed if pump is not equipped with one.

11.0 ELECTRICAL

11.1 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.

12.0 INDOOR THERMOSTATS

12.1 Installation

Indoor thermostats should 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.

12.2 Thermostat Staging

The first stage of resistance electric heat (“auxiliary stage”) shall be controlled by the second stage of the indoor thermostat. Thermostat indicator lights **shall** provide a visible indication when the auxiliary stage or emergency heat are operating.

12.3 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.

12.4 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) when the compressor or refrigerant system is inoperative.

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

13.1 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 Uniform Mechanical Code. (UMC).

13.2 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.

13.3 Emergency Heat Operation

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

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