



Guidelines for Implementation of Residential Heat Pump Initiatives

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Introduction:

- A. The intent of these guidelines is to provide a foundation for implementing a residential heat pump program that will be most beneficial for the participant.
- B. What is a Heat Pump? A heat pump is a device which uses electricity to transfer heat from a cool space to a warm space by transferring thermal energy using a refrigeration cycle. In cold weather a heat pump can move heat from the cool outdoors to warm a house; the pump may also be designed to move heat from the house to the warmer outdoors in warm weather. Because a heat pump generally transfers heat, as opposed to generating heat, they can be a more energy-efficient way of heating and cooling a home
- C. The optimal functioning of a heat pump system depends on its proper application, design, and installation.

- D. ACCA is a national trade association that serves 60,000 professionals across the country—in the heating, ventilation, air conditioning, and refrigeration (HVACR) industry. ACCA is an ANSI accredited standards development organization and provides best-practice support and education, as well as code development representation and legislative advocacy services. ACCA standards are recognized in federal energy efficiency programs and code organizations such as the International Code Council (ICC) and National Fire Protection Association (NFPA) they are adopted in state building codes, and used by HVACR professionals across the country.

ACCA first published its heat pump manual (Manual H) in 1984 for installing heat pumps in residences. ACCA Manual S (Residential Equipment Selection) provides extensive guidance on heat pump selection. Additionally, ACCA produced the nationally-recognized industry-developed standard that provides requirements for quality installation (ANSI/ACCA 5 QI HVAC Quality Installation Specification).

A. Proper Applications for Heat Pump Systems:

The proper functioning of a system to transfer heat or cool from one location to another is dependent upon its application to both locations. An air-to-air heat pump that is not properly designed for cold outdoor climates will not be able to take heat from the outdoor air in order to transfer it to the indoor air. Likewise, an air-to-air heat pump that does not have a proper air distribution system for the internal environment will not be able to transfer the heat or cool to the occupied spaces. Therefore, the proper application of each heat pump system to each unique home located in its own climate region is of paramount importance.

1. **Sufficient electrical supply.** All heat pumps use electricity to transfer heat and cool, therefore adequate electrical supply must be present.
 - a. Service from the utility. Each home that relies on an electric utility to provide power and wishes to use a heat pump system must have sufficient and dependable electric service to the home. Increasing the home's electrical requirements may require the electric utility to provide a larger transformer and or service line to the home.
 - b. Electric utility peak load shedding programs. As a tool for helping to manage the electric utility's load, some electric utilities utilize peak load shedding programs that turn off individual appliances, such as heat pumps and air conditioners, for short period of times during peak load events. Consideration must be given for the sizing of a heat pump system that needs to recover from such events.
 - c. Electric distribution inside the home. When a heat pump and or its associated auxiliary electric heat, requires additional power, the home's internal electrical distribution must be evaluated. Typically, a home's electrical panel will need to be upgraded to provide for the additional power.
2. **Occupied Space Conditions.** The desired interior space temperature(s) and acceptable relative humidity conditions must be established in order to be able to select the type of heat pump system be suited for each home.
3. **Geographical Considerations.** Each heat pump application must account for the home's geographical location. For a home located in a cold climate, an air-to-air heat pump must be designed to be able to extract from the outdoor air the amount of heat

needed to heat the interior space. For homes located near salt water, outdoor units must be designed to operate in such an environment.

4. Existing Buildings.

In existing buildings, always try to ensure any building enclosure issues (insulation, air leaks/bypasses, existing duct disconnects/leaks, etc.) are addressed before installing new equipment. Remember that the load calculation method must account for air leakage in the building, including latent load for cooling.

5. Infiltration and Other Ventilation Issues.

Be cautious when applying infiltration estimates, which are often overstated. Blower door testing is recommended. Note that existing homes that have been reasonably weatherized tend to have natural air change rates at design conditions below 0.4. Efficient new homes are often well under 0.1 air changes/hour. Heating infiltration loads occur mostly on lower floors, and cooling infiltration occurs mostly on upper floors of multi-story homes.

Indoor Air Quality (IAQ) refers to the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants. Increasing the amount of outdoor air coming into the building helps to control pollutant levels, odors, temperature, humidity and other factors that can impact the health and comfort of building occupants.

The rate at which outdoor air replaces indoor air is described as the air exchange rate. ASHRAE (formerly called the American Society of Heating, Refrigerating and Air-Conditioning Engineers) recommends in its Standard 62.2-2016, "Ventilation and Acceptable Indoor Air Quality in Residential Buildings") that homes receive 0.35 air changes per hour but not less than 15 cubic feet of air per minute (cfm) per person. as the minimum ventilation rates in residential buildings in order to provide IAQ that is acceptable to human occupants and that minimizes adverse health effects. ASHRAE also suggests intermittent exhaust capacities for kitchens and bathroom exhaust to help control pollutant levels and moisture in those rooms. ASHRAE also notes that "dwellings with tight enclosures may require supplemental ventilation supply for fuel-burning appliances, including fireplaces and mechanically exhausted appliances.

6. Heat Pump applications:

Heat pumps may be applied in numerous residential situations to improve the energy efficiency of a home. Here are the typical heat pump applications:

- a. Air-to-Air – An air-to-air heat pump is typically used when transferring heat from indoors to outdoors and or heat from outdoors to indoors. Consideration must be given in to the lowest outdoor design temperature when selecting an air-to-air heat pump for heating.
- b. Air-to-Water – An air-to-water heat pump is typically used for heating domestic water, where the heat is transferred from the air where the water heater is located to domestic water located in the tank.

- c. Water-to-Air – A water-to-air heat pump is typically used for geothermal systems or closed loop systems where the heat is transferred from water, either closed loop or open loop, to the air serving the interior space.
- d. Water-to-Water – A water-to-water heat pump is typically used for geothermal systems or closed loop systems where the heat is transferred from water, either closed loop or open loop, to the water typically heating the interior space.

B. Design of Heat Pump Systems:

It is crucial to understand the importance of designing a well-functioning heat pump system. System design is an essential component of modern heating and cooling and designing a system that is tailored to a building's needs can significantly impact its efficiency and performance. If you take the time to comprehensively understand a property's heating and cooling requirements, correctly calculating heating and cooling losses within the home, and projecting the heating and cooling demands, then the heat pump model most suitable for the job can be selected and installed.

The ACCA Manuals listed below can be used together to achieve an optimal heat pump system. They are so essential that they are required in the International Code Council's (ICC) International Residential Code, the residential provisions of the ICC International Energy Conservation Code, and the IAPMO Uniform Mechanical Code. These Manuals are approved and published as American National Standards Institute (ANSI) standards, in accordance with ANSI-accredited procedures. Always verify with the local authority having jurisdiction as to which codes are enforced and the specific edition.

1. ANSI/ACCA Manual J, Residential Load Calculation

This manual gives you the loads for single-family detached homes, small multi-unit structures, condominiums, town houses, and manufactured homes. Proper load calculation, as it is defined by this manual, is required by national building codes and by most states and municipalities.

2. ANSI/ACCA Manual S, Residential Equipment Selection

Manual S requirements help in choosing the appropriate heating and cooling equipment for a home based on the local climate and construction specifications. It covers 11 types of heating and cooling equipment and explains how to use the manufacturer's performance data in selecting and sizing the equipment.

3. ANSI/ACCA Manual D, Residential Duct Design

Manual D contains requirements and procedures for proper design and sizing of residential duct systems

C. Installation Contractor – Things to Look for:

- 1. Licensed contractor (where applicable)
- 2. Experienced contractor – preferably in heat pump installation and air distribution systems but at a minimum in air conditioning and air distribution systems
- 3. ACCA Quality Assured (QA) accredited contractors.
- 4. Use of smart connected tools to verify system performance with an ACCA Quality Installation (QI) certificate, or similar third-party verification
- 5. Certified technicians (NATE, manufacturer, etc.)
- 6. Training for properly installing heat pumps
- 7. Manufacturer's training
- 8. ACCA Contractor Training

D. Efficient Operation of a Heat Pump System Depends on Quality Installation:

Efficient operation of a heat pump system is more than just using high-efficiency rated equipment. Once the proper application and design of a heat pump system is determined, the proper and efficient operation of a heat pump system depends on the actual installation of the heat pump in accordance with the manufacturer's instructions.

1. Manufacturer's Installation Instructions.

Most manufacturers of residential heat pumps spend significant amounts of resources designing and testing their heat pumps to perform at the stated efficiency levels under specific operating parameters. These operating parameters are provided in the manufacturer's installation instructions so that the end-user of the heat pump actually gets what they paid for. Another important aspect of following the manufacturer's installation instructions is that the heat pump warranty is contingent upon compliance with the manufacturer's installation instructions.

2. Permitted and Inspected Installations.

Some states and or jurisdictions have adopted regulations and codes that require certain heat pump installations to apply for and obtain a permit for the installation of a heat pump and the inspection of the installation by a third party to help ensure that the work done meets a minimum safety level and or efficiency level.

In addition, ACCA offers its *Residential Plans Examiner Review Form for HVAC System Design (Loads, Equipment, Ducts)*. This form provides code officials and contractors with a quick and easy review of the HVAC system design to verify compliance with Manuals J, S, and D required by the mechanical codes.

3. Establish a Quality Installation Standard for the Complete Heat Pump System.

Installing an efficiently operating heat pump system is not as simple as bolting solar panels to a roof and hooking up some wires. The complete heat pump system must be designed, applied, and installed properly for its efficient operation. Without attention to the quality installation of the complete heat pump system, there's a very real risk that consumers will be left with systems that *raise* their energy bills while making their homes *less* comfortable. A 2014 NIST study found that about half of HVAC systems have significant installation faults, costing as much as 40 percent of their design efficiency. As generous incentives attract thousands of inexperienced companies and installers to this field, verification of the quality installation will be essential to maximizing efficiency programs and consumers get what they pay for.

ANSI/ACCA 5 QI, HVAC Quality Installation Specification, identifies what is the minimum needed for the proper installation of residential HVACR equipment and systems.

E. Verifying the Efficiency of the Installed Heat Pump and System:

Once a heat pump system is properly installed, the verification of the overall efficiency is recommended to provide assurance to the customer that the system is performing optimally and to provide feedback to the heat pump program administrator. With the advancement in smart diagnostic tools and the measureQuick® app, ACCA can provide a QI Certificate for either the heat pump equipment or the overall system.

Verified Equipment Operation (VEO) certificate is earned when a new HVAC installation meets high standards in areas including:

- Airflow

- Refrigerant charge (for air conditioners and heat pumps)
- On-rate combustion (for furnaces and boilers)
- Electrical

Verified System Performance (VSP) certificate takes things a step further. The entire HVAC system is considered, including everything required for VEO certification plus:

- Ventilation
- Manual J load calculation
- Manual S equipment selection
- AHRI matched system
- Tight ductwork
- Balanced airflow

A VSP certified system that uses qualifying ENERGY STAR equipment may also earn an [ENERGY STAR Verified HVAC Installation](#) (ESVI) certificate. Learn more about this program and certificate options at: www.acca.org/qa/prove-it.

Submission of ACCA Quality Installation certificates could be included as a consumer protection and quality control requirement or prioritization tool within any government or utility efficiency program. For an example of how ACCA proposed including QI certificates as a Program Element in implementing the Inflation Reduction Act's rebate programs, please see the attached [submission to the National Association of State Energy Officials](#) (NASEO).

F. Inspecting and Maintaining HVAC Systems:

It is essential that residential HVAC systems support a comfortable, healthy indoor environment and operate efficiently throughout their lifecycle. Mechanical systems require routine monitoring, adjustments, periodic cleaning, and eventual replacements of components. Original equipment manufacturers (OEMs) recommend that HVAC systems be properly maintained. Conducting regular scheduled inspections, maintenance, and remediation of HVAC systems prolongs equipment efficiency, promotes healthy clean air, supports lower utility costs, guards against unexpected failures, and prolongs equipment life.

Some HVAC contractors offer annual maintenance agreements to their customers. A maintenance agreement can include a number of visits to check that the equipment is functioning properly, that components/drains are clean, an offer for discounts on any needed repairs, filter changes, and priority service when things are busy.

Maintenance agreements benefit building owners in a number of ways:

1. Reducing energy consumption. Clean heat transfer surfaces in your heating and cooling system are more efficient.
2. Avoiding costly repairs and inconvenient breakdowns. Failing system components can be identified and eliminated.
3. Extending the life of the equipment. Properly tuned HVAC systems can last longer than neglected systems. HVAC equipment manufacturers recommend that routine maintenance be performed to keep the unit operating at factory fresh conditions.

4. Increased comfort – properly tuned HVAC will enhance occupant comfort levels.

G. Disbursement of Program Funds to Streamline Adoption and Prevent Fraud:

From the HVAC contractor perspective, these programs need to be easy to understand, easy to administer, and paid in a timely manner. If there are too many rules and regulations, contractors will leave the program and utilize their labor resources where there is less hassle.

For the IRA programs to be effective, contractor compensation needs to be as painless as possible. Contractors should be able to simply invoice the state and receive their money without jumping through a bunch of red tape. Funds should be ACH transferred in a timely manner.

1. State to qualify homeowner candidates' income eligibility
2. State issues work order to contractor to verify work needed
3. State pays contractor to provide estimate
4. Contractor uploads estimate to State – load, equipment specs, etc.
5. State issues work order to contractor
6. State needs to qualify the contractor to make sure they meet certain requirements
7. Consumer feedback program for contracted work - incentives for accurate and timely work performed
8. Contractor performs work and gets paid when QI certificate is sent to States online payment portal

References

The Consortium for Energy Efficiency
Boston, Massachusetts

From 2003 to 2007, ACCA partnered with The Consortium for Energy Efficiency (CEE) on the Residential Central Air-conditioning and Heat Pump Initiative; an industry effort that incorporates OEM instructions, applicable building and energy codes, documentation of system commissioning elements, and customer education. For each defined attribute, specific metrics, tolerances, approved test/measurement procedures, and acceptable documentation were identified for ensuring that unitary HVAC equipment is properly designed and installed for residential and light commercial applications. With the support of CEE, the ANSI/ACCA 5 QI (*Quality Installation Specification*) and the ANSI/ACCA 9

QIvp (*QI Verification Protocols*) standards were developed and published in 2007 and 2009, respectively. The ACCA QI Standard is now used by CEE in lieu of an older CEE document of similar purpose.

Environmental Protection Agency
Washington, District of Columbia

Effort 1: EPA assisted ACCA and provided financial support during the initial development of the ANSI/ACCA 5 QI and the ANSI/ACCA 9 QIvp Standards. These two nationally-recognized standards were the basis for a 2018 launch of an EPA ENERGY STAR Program for existing residential HVAC installations.

Effort 2: EPA's ENERGY STAR New Homes Program (ver 3) calls for a directory of accredited contractors. This program uses the ANSI/ACCA 5 QI Standard to ensure proper equipment sizing, duct sealing, balanced airflows, and refrigerant charges. Implemented in 2011, a growing number of utilities are embracing this ENERGY STAR program. Additionally, ACCA is recognized by EPA under this program as an accrediting body that recognizes HVAC contractors for listing onto a national directory.

National Institute of Standards and Technology
Gaithersburg, MD

NIST, Oak Ridge National Laboratory (ORNL; a U.S. DOE laboratory), and ACCA are serving as co-Operating Agents on an International Energy Agency (IEA) IEA Annex 36 on HVAC Quality Installation and Quality Maintenance. Established in 2010, the U.S. focus in this research effort is on the ANSI/ACCA 4 QM (quality maintenance) and the ANSI/ACCA 5 QI Standards. The purpose of Annex 36 is to evaluate how deficiencies in the installation and/or maintenance of heating and cooling systems can cause inefficient performance and energy waste. The Annex is scheduled to run through November 2013 with meetings planned throughout. Annex 36 participating countries are France, Sweden, United Kingdom, and the United States.