energy right® **Program**

Heat Pump Inspection Procedures

Heat pump installations in the *energy right*® Heat Pump Plan may receive an inspection following installation. Inspectors shall complete the Heat Pump Installation Inspection Checklist (TVA 6254T) to verify key items involving the heat pump installation and the applicable section of the Work Completion (TVA 6254T-1).

The inspection requirements listed apply to all types of heat pumps. For inspections performed for QCN members, the installing member may typically be requested to attend the inspection.

General Guidelines

NOTICE: For personal safety, be sure to turn the electric power off at the household service box or at the unit disconnect(s) prior to attempting an investigation of items internal to the heat pump section(s) and/or during placement or removal of test equipment at the time of an inspection. Exercise caution AT ALL TIMES when working with or around electrical components (a heat pump either energized or de-energized).

Inspectors inspect installations for compliance with selected Installation Standards. They will not represent themselves as safety or code inspectors and will not indicate to the Customer that an inspection under this program serves the purpose of any required electrical code, building code, fire safety, or other inspection.

If more than one heat pump installation is installed at a dwelling, every attempt should be made to inspect all installations during the initial visit.

Every feasible attempt will be made to identify any and all deficiencies during the initial visit (although equipment operational problems may be identified during a reinspection) to eliminate the need for multiple visits to correct items.

- The inspector, prior to any inspection, shall determine that the applicable paperwork related to the installation and any necessary weatherization work is available and appropriately completed.

General Inspection Requirements

The inspector will perform an inspection using the Installation Inspection Checklist and Work Completion Form, which have both been previously completed by the installing QCN member.

General Criteria

- Equipment sized and selected to meet the requirements of the Installation Standards.
- Insulation prerequisites installed or in the process of being installed prior to heat pump inspection.
- All equipment is checked for Air-Conditioning & Refrigeration Institute listing. If a window heat pump, the Inspector shall verify the heat pump has a Association of Home Appliance Manufacturers label attached indicating the unit is listed with AHAM. The inspector shall verify that SEER and HSPF ratings (EER and COP for water source) meet criteria.
- Calculated cooling load falls within 500-850 square feet (range may be changed at TVA Customer Service Center discretion) of conditioned space per ton of calculated cooling capacity. If the load calculation results are outside the accepted range, attempt to attribute variance to some special characteristic(s) of the structure (high percentage of glass, etc.). Observe structure characteristics and consult with the QCN member.

- Equipment cooling capacities (sensible and latent) are at stated design conditions with the calculated cooling loads (sensible and latent) to ensure minimum of 100 percent of calculated loads (independently) is achieved, and that equipment's sensible capacity does not exceed the calculated sensible load of the structure by greater than 125 percent. Variations to this requirement apply to direct exchange ground source heat pumps and earth coupled heat pumps. See Installation Standards.
- Calculated heating load falls within 5-8 watts per square foot (range may be changed at TVA Customer Service Center discretion) of conditioned space. If calculation is outside the acceptance range, attempt to attribute variance to some characteristic(s) of the structure. (Observe structure characteristics and consult with QCN member.)
- Calculated system balance point temperature is no higher than 35°F (unless allowed greater than 35°F as described in the Installation Standards).
- If in the above review, obvious and significant errors are detected that would cause the installed heat pump's capacity to fall outside the heat pump standards' sizing criteria for cooling and/or heating capacities, the job may fail inspection.

Equipment Selection. Inspector shall verify following items relating to equipment selection:

- Load calculations for proper method (Air Conditioning Contractors of America (Manual J, or approved equal) and required indoor/outdoor design temperatures. Heat loss shall be determined at 70°F dry bulb indoor temperature at the prevailing local outdoor winter design temperature, and heat gain shall be determined at 75°F dry bulb, 50 percent relative humidity, indoor space conditions and at the prevailing local outdoor summer design temperature and humidity.
- Manufacturer's equipment capacities (provided by installing QCN member at time of inspection) compare to QCN member calculated heat loss and heat gain (both sensible and latent) to determine if the system(s) installed meets the sizing requirements in the Installation Standards.
- Ground water source heat pumps sized to maintain the indoor design conditions listed above and meet sensible/latent requirements for an entering water temperature within 10 percent of the ground water temperature of the local area.
- Direct exchange ground source heat pumps and earth coupled heat pumps sized to meet 100 percent of the total heating load at design, but shall not exceed 200 percent of the total (sensible and latent) cooling load at design.
- If a heat pump is installed in a manufactured home using existing manufactured housing ductwork, manufactured ductwork is capable of operating as required by the Installation Standards and installed heat pump is approved for that use by the heat pump manufacturer.
- Load calculations for Business shall also be performed by a proper method (Manual N or an approved method).

Indoor/Outdoor Equipment. Inspector shall verify the following items relating to indoor/outdoor equipment:

- One-piece concrete (or other accepted material) pad must be used as primary support.
- Outdoor air circuit has free air intake and discharge and no short circuiting of outdoor air.
- Installation of outdoor thermostat(s) (or approved equal) if required or present, and proper range and setting. Power distributor may not require outdoor thermostats. If outdoor thermostat is present, setting(s) shall be recorded on *energy right* Heat Pump Plan (Heat Pump Installation Inspection Checklist) TVA 6254T.
- Electrical inspection has been requested and if so a copy of the electrical permit is on site (if applicable).
- Mechanical inspection requested installation has passed, and if so, a copy of the permit is on site (if applicable).
- Proper type and size of overcurrent protection.

- Disconnect is within sight and within 50 feet of each piece of motorized equipment.
- Condensate drain (minimum size of 3/4 inch) is trapped and installed for proper drainage.
- Service space accessible for replacement of any part or entire unit.
- Refrigerant piping (split system) has acceptable length and lift.
- Refrigerant piping (split system) has proper insulation, contact, and support.
- Acceptable shroud, flashing, etc., to protect ductwork from weather (package unit).
- Emergency secondary drain pan installed (if necessary).
- Resistance heater(s) size (if applicable) is minimum for supplementary heating--design heat load minus compressor output at design outdoor conditions, as well as maximum for supplementary heating--less than or equal to 100 percent of design heat load or 10 kW, whichever is larger.

Operation and Controls. Inspector shall verify the following items related to operation and controls:

- Proper CFM (cubic feet/minute) of conditioned air per ton of cooling (12,000 Btuh), if applicable:

  Select method from the following and perform CFM test.

  - Air Flow Determination Funnel Method. While air flow measurement is not an exact science, this method appears to be the most reliable. This requires a square-to-round duct and a Bacharach "Flow- Rite" velocity meter or equivalent.

    Turn the indoor blower-only switch to "ON" or "Continuous" at the wall thermostat. Read each supply register air velocity by placing the funnel over each register. Attempt to center the funnel on the register for the most accurate readings.

    Sum all the register velocities obtained above and multiply the total by 0.267 to calculate the supply system air flow.

  - Air Flow Determination Heat Rise Method. This can be performed when a 10 kW or less resistance electric heater is energized. If possible, disconnect all but the first (W2) heat stage by turning off breakers.

    Energize the resistance heating elements and indoor blower motor only. Read and record the blower motor amps, heater amps, and voltage at the heat pump unit.

    Add the amps and multiply the sum by the volts and by 3.413 to obtain the heater system Btu input.

    Allow time for the temperatures to stabilize and read the average supply air temperature in the supply duct 6'-10' downstream of the electric heater assembly, or at a register close to the heat pump. Read the average return air temperature in the return duct(s) 6'-10' upstream of the unit, or at the return air grille(s).

    Divide the Btu input by the difference in average supply and return air temperatures and by 1.1 to obtain the system air flow volume (cubic feet/minute).

  - Air Flow Determination Return Air Grille Method. Measure velocity of air at return air grille(s) with a velometer. Take readings at 6 or more locations on the face of grille (symmetrically) and average.

    Total air (CFM) = velocity (Feet per minute average) x area of grille (nominal dimensions) (gross square feet) x .75 (effective area constant).

- Proper heating operation:
  - First Stage Heating.

Energize first stage heating at the indoor thermostat and check by removing indoor thermostat cover, turning on first stage heating until first bulb is closed. If compressor only operates, check amperage to resistance heaters or observe heater relays for open position to determine that the resistance heat is off.

- Second Stage Heating (Outdoor temperature above outdoor thermostat setting—above balance point).

  Energize first and second stage heating at the indoor thermostat, and check by removing indoor thermostat cover, turning on first and second stage heating until both bulbs are closed. If compressor only operates, check amperage to resistance heaters or observe heater relays for open position to determine resistance heat is off.

- Second Stage Heating (Outdoor temperature is below outdoor thermostat setting—below balance point).

  Energize first, then second stage heating at the indoor thermostat, and check by removing indoor thermostat cover, turning on first stage heating until first heating bulb closes. If compressor only operates, check amperage to resistance heaters or observe heater relays for open position to determine resistance heat is off, closing first and second bulbs of indoor thermostat.

  Verify that only one bank (maximum of 10 kW) of resistance heat comes on to supplement the compressor. If more than one outdoor thermostat is used (if required by distributor), determine that the additional outdoor thermostat(s), or approved equivalent properly controls the additional bank(s) of the supplemental heat.

- Emergency Heating.

  Set indoor thermostat to emergency heat position, then operate thermostat so both heating bulbs close. Verify that compressor does not operate and that all supplementary heat (controlled by outdoor thermostats) are energized. (This may be checked by the temperature rise method or ammeter reading at the equipment).

- Check for Proper Cooling Operation. Energize system in the cooling mode at the indoor thermostat. Check to see if compressor is energized and that outlet air temperature is approximately 50°F to 70°F dry bulb.
- Check System for Proper Capacity:
  - Check capacity by ONE of the following methods:

    Heating Capacity (compressor only) When the Outside Air Temperature is Below 75°F.

    Turn all auxiliary heating power switches to the off position, place unit in the heating mode (first bulb closed only) and allow the unit to run in the heating mode for at least 10 minutes. Allow time for the temperatures to stabilize and read the average supply air temperature in the supply duct or at a register close to the heat pump. Read the average return air temperature in the return duct(s) 6'-10' upstream of the unit, or at the return air grille(s). Estimate the compressor heat output using the following formula: Btuh = temperature difference x 1.1 x CFM (CFM will come from one of the three methods detailed earlier). Check outdoor temperature and refer to manufacturer's catalog data for rated output of unit at this outdoor air temperature. Verify that system capacity is within ± 10% of the equipment manufacturer's rating at the test conditions.

    Cooling Capacity When the Outside Air Temperature is Above 75°F.

    Place system in the cooling mode, record intake air temperature to outdoor unit. At supply air outlet and inlet indoors record wet bulb and dry bulb temperatures. From Enthalpy Table (Figure E-1), record heat content values that correspond to supply and return air wet bulb temperatures, h1 and h2, respectively. Estimate total heat removed from space by:

    Btuh = (h2 - h1) x 4.5 x CFM (Note: h1 = heat content of air from Table A-1 corresponding to supply air wet bulb temperature)

h2 = heat content of air from Enthalpy Table, corresponding to return air wet bulb temperature

CFM = measured or calculated air flow of system.

Check outdoor temperature and refer to manufacturer's catalog data for rated output of unit at this outdoor air temperature. Verify that system capacity is ± 10% of the equipment manufacturer's rating at the test conditions.

Conditioned Area Components. Inspector shall verify the following relating to conditioned area components:

- Proper thermostat for the installation.
- Location of thermostat prevents external heat or cold influence.
- Thermostat is level.
- Mercury bulbs (if so equipped) have no cracks and discoloration.
- Thermostat wiring connections accurate and tight.
- Thermostat temperature indicator (if so equipped) compared against a reliable source.
- Thermostat securely attached to stud or other building component and free from drafts from stud space behind thermostat.
- Thermostat has emergency heat switch (unless waived by other sections of these guidelines).
- Return air (RA) grille(s) at proper location(s) and proper size(s).
- Measure velocity of air at RA grille(s) with a velometer. Take readings at 6 or more locations (symmetrically) on face of grille(s) and average. Maximum speed of returning air shall be less than 500 feet per minute (fpm).
- Filter location(s) are accessible so filter(s) can be replaced easily.
- Proper location of supply outlets.
- Supply outlets have acceptable supply capacity to distribute system air volume at acceptable speeds.
- Several supply outlets checked as necessary for maximum discharge velocity range of 400-700 FPM. Take readings at 3 or more locations on face of grille and average.
- Check the average temperature difference between any room or space within the conditioned structure (single level) for a maximum difference of not more than 4°F.

Air Distributor System. Inspection shall verify the following relating to air distributor system:

- Duct system has proper design and installation per ACCA, SMACNA, or ASHRAE criteria.
- Duct system has minimum of 400 CFM/12,000 Btuh air flow across the indoor coil based on the equipment's ARI cooling capacity (if applicable).
- Proper aspect ratio for rectangular duct work.
- All seams and joints airtight and properly sealed/taped.
- Proper vibration isolation connectors (if necessary).
- Verify that duct system does not contact ground.
- Acceptable duct material utilized.
- Proper support and hanging material.
- Proper sizing of branch ducts (minimum of 4", maximum of 8", round, or equivalent).
- Return duct work sized to return the design CFM capacity of the supply system.
- Proper duct work insulation levels (if applicable).

Additional Requirements for Specific Heat Pump Types

Following these general requirements are listings of additional requirements for specific heat pump types:

- Split-Type Dual-Fuel Heat Pump System
- Package-Type Dual-Fuel Heat Pump System
- Manufactured Home Heat Pump System
- Free-Delivery Split Heat Pump
- Packaged Terminal Heat Pump
- Self-Contained Through-the-Wall Heat Pump
- Window Heat Pump System
- Ground Water Source Heat Pump
- Earth Coupled Heat Pump
- Direct Exchange Ground Source Heat Pump

Split-Type Dual-Fuel Heat Pump Inspection Procedures

Inspection shall verify the dual-fuel heat pump (DFHP) equipment and duct system(s) adheres to installation standards (latest revision) with the following exceptions.

Air Flow Determination. Air flow determination shall be performed as follows. Blower speed shall be as used for heat pump operation by either of the following:

- Heat pump shall be operating in either cooling or heating mode (first stage heating only). Fan switch shall be in the "on" position and system switch in "off" position.
- CFM measurement shall be determined by the funnel method. If measurement cannot be made by the funnel method, use the return air grille velocity method.

Proper Control Setting. Proper control setting (including any temperature differential as may be required by the manufacturer)

Proper Heat Pump/Furnace Operation

- If outdoor temperature (ODT) is below 75°F, check the following:
  - Perform compressor heating capacity check
  - If ODT is above structure's theoretical balance point:

    First stage thermostat - heat pump only operates

    Second stage thermostat - furnace only operates until second stage is satisfied
  - If ODT is below structure's theoretical balance point and above the economic balance point:

    First stage thermostat - heat pump only operates

    Second stage thermostat - furnace only operates until second stage is satisfied (compressor is off during this time); after second stage is satisfied, compressor energizes
  - If ODT is below structure's theoretical balance point and below the economic balance point: First and/or second stage thermostat - furnace only operates
  - Emergency heat operation - There are no provisions for emergency heat mode for DFHP. In the event of the heat pump compressor or associated refrigeration equipment becoming inoperative, the furnace shall provide all required heating controlled from the second stage of the indoor thermostat in the heating mode.
- If outdoor temperature is above 75°F, check the following:
  - Perform compressor cooling capacity check

- Check furnace only in heating operation
- First and/or second stage thermostat - furnace only operates

  NOTE: A QCN member representative will have to temporarily field wire to "close" control setting.
- Emergency heat operation - furnace only operates

Package-Type Dual-Fuel Heat Pump System Inspection Procedures

Inspector shall verify dual-fuel heat pump packaged system and duct system(s) adheres to Installation Standards with the following exceptions:

Air Flow Determination. Air flow determination shall be performed as follows: Blower speed shall be used for heat pump operation by either of the following:

- Heat pump shall be operating in either cooling or heating mode (first stage only) or
- Fan switch shall be in the "On" position and the system switch in the "Off" position.

CFM Measurement. CFM measurement shall be determined by the funnel method. If measurement cannot be made by the funnel method, use the return air grille velocity method.

Proper Control Setting. Proper control setting (including any temperature differentials as may be required by the manufacturer.

Proper Heat Pump/Furnace Operation.

- If outdoor temperature (ODT) is below 75°F, check the following:
  - Perform compressor heating capacity check
  - If an outdoor thermostat is utilized, check to ensure that the setting is at the structure balance point and:
  - If ODT is above the setting of the outdoor thermostat:

    First stage of indoor thermostat - heat pump only operates.

    Second stage of indoor thermostat - furnace only operates until second stage is satisfied (this could occur upon heat pump compressor failure)
  - If ODT is below the setting of the outdoor thermostat:

    First stage of indoor thermostat - furnace only operates (no second stage)
  - If an outdoor thermostat is not utilized:

    First stage of indoor thermostat - heat pump only operates.

    Second stage of indoor thermostat - furnace only operates until second stage is satisfied.
  - There are no provisions for emergency heat mode for DFHP packaged systems. In the event of the heat pump compressor or associated refrigeration equipment becoming inoperative, the furnace shall provide all required heating controlled from the second stage of the indoor thermostat in the heating mode.

Manufactured Home Heat Pump System Inspection Procedures

Inspector shall verify the manufactured home heat pump equipment and duct system(s) adheres to installation standards (latest revisions). (See Installation Standards for certain sections that do not apply.) In addition, inspector shall verify the following:

- Heat pumps installed in manufactured homes use field installed supply and/or return ductwork section, and it is installed in compliance with Installation Standards.
- The heat pump applied to manufactured housing ductwork is capable of operating within manufacturer's specifications and is approved for that use.
- The manufactured home was made after 1976.
- The heat pump/manufactured duct system provides the manufacturer's recommended air flow across the indoor coil.

Free-Delivery Split Heat Pump, Packaged Terminal Heat Pump, Self-Contained Through-the-Wall Heat Pump, Window Heat Pump System Inspection Procedures

Inspector shall verify the free-delivery split heat pump, packaged terminal heat pump, self-contained through-the-wall heat pump, and window heat pump adhere to installation standards. (See Installation Standards for certain sections that do not apply.) In addition, inspector shall verify the following:

- Air flow is as recommended by the manufacturer.
- Integral auxiliary electric heat is provided by the manufacturer within the unit cabinet or fan coil section as part of the heat pump.
- Integral auxiliary heaters are controlled by the heat pump indoor thermostat.
- Installing QCN member has met manufacturer's instructions for the complete installation of the system, including any recommended parts and accessories and any necessary wall/window case.
- The joint around the unit case (between the case and wall or window) to ensure weathertight seal with caulk, seals, or gaskets, as provided by the manufacturer.
- Cabinets are checked for proper alignment and any unnecessary holes. Holes allowed are for the manufacturer's approved internal condensate drain system (condensate drain lines shall be sized in accordance with the manufacturer's recommendations and all instances at least as large as the heat pump's drain connection).

Ground Water Source Heat Pump and Earth Coupled Heat Pump Inspection Procedures

Inspector shall verify the ground water source heat pump and earth couple heat pump adhere to installation standards. (See Installation Standards for certain sections that do not apply.) In addition, inspector shall do the following:

- Check ground water source heat pump and earth coupled heat pump for installation of pressure/temperature (P/T) test ports installed in the "water-in" and "water-out" piping runs at the unit. The P/T test ports shall be as close as possible to the heat pump.
- Check system heating capacity as follows:
  - Allow heat pump system to operate for at least 15 minutes.
  - Measure water pressure drop between water-in and water-out test plugs at heat pump. (Use same instrument to measure both to reduce error).
  - Measure entering water temperature at water-in test plug.

- Using manufacturer's performance data, determine the water flow rate (gallons per minute) and the heating capacity of the installation using the measured pressure drop and the measured entering water temperature.
- Determine heating capacity by using the following formula:

  Btuh = TD x 1.1 x CFM

  TD = temperature difference between supply air and return air

  1.1 = air properties constant

  CFM = Cubic feet per minute air calculated, from funnel, temperature rise, or return air method
- Verify that system capacity is + 10 percent of the equipment manufacturer's rating at the test conditions.

- Check system cooling capacity as follows:
  - Allow system to operate for at least 15 minutes
  - Measure water pressure drop between water-in and water-out test plugs at heat pump. (Use same instrument to measure both to reduce error).
  - Measure entering water temperature at water-in test plug.
  - Using manufacturer's performance data, determine the water flow rate (gallons per minute) and the cooling capacity of the installation using the measured pressure drop and the measured entering water temperature.
  - Determine cooling capacity by using the following formula:

    Btuh = (h2 - h1) x 4.5 x CFM

    h1 = heat content of air from Enthalpy Table corresponding to supply air wet bulb temperature.

    h2 = heat content of air from Enthalpy Table corresponding to return air wet bulb temperature.

    At supply air outlet and inlet indoors record wet bulb and dry bulb temperatures.

    4.5 = air properties constant

    CFM = Cubic feet per minute air calculated, from funnel, temperature rise, or return air method

    (From Enthalpy Table record heat content values that correspond to supply and return air wet bulb temperatures, h1 and h2, respectively)
  - Verify that system capacity is $\pm$ 10 percent of the equipment manufacturer's rating at the test conditions.

Direct Exchange Ground Source Heat Pump Inspection Procedures

Inspector shall verify the direct exchange ground source heat pump (DXGS) and duct system(s) adhere to installation standards. (See Installation Standards for certain sections that do not apply.) In addition, inspector shall do the following:

- Verify the distances between the compressor and the ground coil and compressor to air handling blower unit as required by DXGS manufacturer. Both vertical height and total line distance shall be within limits as specified by manufacturer. Insure all linesets, both vapor and liquid, are insulated with rubatex, or similar insulation non-corrosive to copper.
- Determine system heating capacity. System inspection should never be conducted within 48 hours of completion of soaker hose operation, and should not be conducted within one week of completion

of soaker hose operation if the DXGS system is installed during the heating season. Consult with the QCN member to determine appropriate inspection time during heating season. For heating capacity tests, the return air temperature should be between 65 degrees F. and 70 degrees F.

- Measure the compressor run current while in the heat mode. The expected current readings should fall within the ranges as specified by the manufacturer.
- The air flow shall be between 400 and 450 CFM per ton of capacity.
  - Determine heating capacity by using the following formula:

    Btuh = TD x 1.1 x CFM

    TD = temperature difference between supply air and return air

    1.1 = air properties constant

    CFM = cubic feet per minute air calculated, from funnel, temperature rise, or return air method
  - Verify that system capacity is ± 10% of the equipment manufacturer's rating at the test conditions.

    Note: If the heating capacity is low, this may be due to an unadjusted heating valve. The QCN member can adjust the heat valve before re-calculating the heating capacity.
- Determine system cooling capacity. For cooling capacity tests, the return air temperature should be between 75 degrees F. and 80 degrees F.
- Measure the compressor run current while in the heat mode. The expected current readings should fall within the ranges as specified by the manufacturer.
- The air flow shall be between 400 and 450 CFM per ton of capacity.
  - Determine cooling capacity by using the following formula:

    Btuh = (h2 - h1) x 4.5 x CFM

    h1 = heat content of air from Enthalpy Table corresponding to supply air wet bulb temperature.*

    h2 = heat content of air from Enthalpy Table corresponding to return air wet bulb temperature.*

    4.5 = air properties constant

    CFM = cubic feet per minute air calculated, from funnel, temperature rise, or return air method

    * At supply air outlet and inlet indoors record wet bulb and dry bulb temperatures.

    (From Enthalpy Table record heat content values that correspond to supply and return air wet bulb temperatures, h1 and h2, respectively)
  - Verify that system capacity is ± 10% of the equipment manufacturer's rating at the test conditions.

Procedures for Notifying Customer and QCN member of Failed Inspections

When a program required inspection of an installation is made and the installation is not in compliance with program standards, the Inspector will indicate on the Heat Pump Installation Inspection Checklist (TVA 6254T) and on the Work Completion/ Form (TVA 6254T-1) (where applicable) the reason(s) for the failure to pass the inspection. The QCN member may be allowed to correct minor deficiencies while the inspector is on-site. Customer and QCN members must receive a copy of Heat Pump Installation Inspection Checklist.

All deficiencies must be corrected and be in compliance within 10 business days. Following corrections by the QCN member, the inspector shall be notified, after which a reinspection shall be scheduled and performed. If, during this

reinspection, other items not previously identified are shown to be in violation of the installation standards, the QCN member shall have 10 additional business days to correct the deficiencies, after which the third and final reinspection shall occur.

energy right® **Program**

Heat Pump Major Minor Inspection Criteria

Heat Pump Inspection Procedures

a. General Inspection Requirements

Utilizing Heat Pump Plan Heat Pump Installation Inspection Checklist and Work Completion Form, which have both been previously completed by the installing **Quality Heat Pump Contractor**, the **Inspector** will perform a **Inspection** using the following criteria as a general guide.

1) Equipment shall be sized and selected to meet the requirements of the **Standards.** ***(Major)***

2) The Inspector shall verify insulation prerequisites are installed or in the process of being installed prior to heat pump inspection. ***(Major)***

3) All equipment shall be checked for Air-Conditioning and Refrigeration Institute (ARI) listing. If a window heat pump, the Inspector shall verify the heat pump has a AHAM label attached indicating the unit is listed with AHAM. The Inspector shall verify that SEER and HSPF ratings (EER and COP for water source) meet criteria. ***(Major)***

4) Check that the calculated cooling load falls within 500-800* square feet of conditioned space per ton of calculated cooling capacity. If the load calculation results are outside the accepted range, attempt to attribute variance to some special characteristic(s) of the structure (high percentage of glass, etc.). Observe structure characteristics and consult with the **Quality Heat Pump Contractor.** ***(Major)***

   * This range may be changed at TVA Customer Service Center discretion.

5) Compare selected equipment cooling capacities (sensible and latent) at stated design conditions with the calculated cooling loads (sensible and latent) to assure minimum of 100 percent of calculated loads (independently) is achieved, and that equipment's sensible capacity does not exceed the calculated sensible load of the structure by greater than 125%. Variations to this requirement apply to Direct Exchange Ground Source Heat Pumps (DXGS). See **Standards**. ***(Major)***

6) Check that the calculated heating load falls within 5-8 watts* per square foot of conditioned space. If calculation is outside the acceptance range, attempt to attribute variance to some characteristic(s) of the structure. Observe structure characteristics and consult with **Quality Heat Pump Contractor**. ***(Major)***

   * This range may be changed at TVA Customer Service Center discretion.

7) Check that the **Quality Heat Pump Contractor** calculated system balance point temperature is no higher than 35°F (unless allowed greater than 35°F as described in the **Standards**). ***(Major)***

8) If in the above review, obvious and significant errors are detected which would cause the installed heat pump's capacity to fall outside the heat pump standards' sizing criteria for cooling and/or heating capacities, the job may fail inspection. ***(Major)***

b. Equipment Selection

1) Check load calculations for proper method (ACCA Manual J or approved equal) and required indoor/outdoor design temperatures. Heat loss shall be determined at 70°F DB indoor temperature at the prevailing local outdoor winter design temperature, and heat gain shall be determined at 75°F DB, 50% RH, indoor space conditions and at the prevailing local outdoor (95 degrees) summer design temperature and humidity. ***(Major)***

2) Compare the manufacturer's equipment capacities (provided by installing **Quality Heat Pump Contractor** at time of inspection) to **Quality Heat Pump Contractor** calculated heat loss and heat gain (both sensible and latent) to determine if the system(s) installed meets the sizing requirements in the **Standards**. ***(Major)***

3) Ground Water Source Heat Pumps (GWSHP) shall be sized to maintain the indoor design conditions listed above and meet sensible/latent requirements for an entering water temperature (EWT) within 10% of the ground water temperature of the local area. ***(Major)***

4) Earth Coupled Heat Pumps (ECHP) shall be sized to maintain the indoor design conditions listed above. System shall be sized to meet sensible/latent requirements for an EWT of 90°F. ***(Major)***

5) Direct Exchange Ground Source Heat Pumps (DXGS) shall be sized to meet 100 percent of the total heating load at design, but shall not exceed 200 percent of the total (sensible and latent) cooling load at design. ***(Major)***

6) If a heat pump is installed in a Manufactured Home using existing manufactured housing ductwork, check to determine if the manufactured ductwork is capable of operating as required by the **Standards** and if the installed heat pump is approved for that use by the heat pump manufacturer.

c. Equipment (outdoor/indoor)

1) Check for a one piece concrete (or accepted) pad (must be used as primary support). ***(Major)***

2) Check the outdoor air circuit for free air intake and discharge and no short circuiting of outdoor air shall occur. ***(Major)***

3) Check for the installation of outdoor thermostat(s) (or approved equal) if required or present, and for proper range and setting. ***(Major)*** Power distributor may not require outdoor thermostat on first 10 kW of auxiliary heat. Outdoor thermostat (or approved equal) shall be used to control auxiliary heat over 10 kW. Setting(s) should be recorded on Energy Efficient Heat Pump Plan (Heat Pump Installation Inspection Checklist) TVA 6254T.

4) Verify if an electrical inspection has been requested and the installation has passed, and if so, that a copy of the permit is on site (if applicable). ***(Major)***

5) Verify if a mechanical inspection has been requested and the installation has passed, and if so, that a copy of the permit is on site (if applicable). ***(Major)***

6) Check for proper type and size of overcurrent protection. ***(Major)***

7) Check that disconnect is within sight and within 50 feet of each piece of motorized equipment. ***(Major)***

8) Check for approved grounding of equipment. ***(Major)***

9) Check for condensate drain (minimum size of 3/4 inch) which is trapped and installed for proper drainage (if applicable).

10) Check service space for accessibility for replacement of any part or entire unit. ***(Major)***

11) Check refrigerant piping (split system) for acceptable length and lift. ***(Major)***

12) Check refrigerant piping (split system) for proper insulation, contact, and support.

13) Verify the existence of acceptable shroud, flashing, etc., to protect duct work from weather (package unit).

14) Check to see if an emergency, secondary drain pan is installed, (if necessary). ***(Major)***

15) Check resistance heater(s) size (if applicable):

a) Minimum for supplementary heating - design heat load minus compressor output at design outdoor conditions.

b) Maximum for supplementary heating - less than or equal to 100% of design heat load or 10 kW, whichever is larger.

d. Operation and Controls

1) Check for proper CFM (cubic feet/minute) of conditioned air per ton of cooling (12,000 Btuh), if applicable: ***(Major)***

Select method from the following and perform CFM test. Where possible, use the procedure which was performed by the **Quality Heat Pump Contractor** during the **Quality Heat Pump Contractor** Inspection.

a) Air Flow Determination Funnel Method

While air flow measurement is not an exact science, this method appears to be the most reliable. This method, however, should be compared to the following two methods to confirm results (within $\pm$ 10%). This requires a square-to-round duct and a Bacharach "Flow- Rite" velocity meter or equivalent.

Turn the indoor blower **only** switch to "ON" or "Continuous" at the wall thermostat. Read each supply register air velocity by placing the funnel over each register. Attempt to center the funnel on the register for the most accurate readings.

Sum all the register velocities obtained above and multiply the total by 0.267 to calculate the supply system air flow.

b) Air Flow Determination Heat Rise Method

This can be performed when a 10 kW or less resistance electric heater is energized. If possible, disconnect all but the first (W2) heat stage by turning off breakers.

Energize the resistance heating elements and indoor blower motor only. Read and record the blower motor amps, heater amps, and voltage at the heat pump unit.

Add the amps and multiply the sum by the volts and by 3.413 to obtain the heater system Btu input.

Allow time for the temperatures to stabilize and read the average supply air temperature in the supply duct 6'-10' downstream of the electric heater assembly, or at a register close to the heat pump. Read the average return air temperature in the return duct(s) 6'-10' upstream of the unit, or at the return air grille(s).

Divide the Btu input by the difference in average supply and return air temperatures and by 1.1 to obtain the system air flow volume (cubic feet/minute).

c) Air Flow Determination Return Air Grille Method

Measure velocity of air at return air grille(s) with a velometer. Take readings at 6 or more locations on the face of grille (symmetrically) and average.

Total air (CFM) = velocity (Feet per minute average) x area of grille (nominal dimensions) (gross square feet) x .75 (effective area constant).

2) Check for proper heating operation: *(Major)*

a) First Stage Heating

Energize first stage heating at the indoor thermostat and check by the following:

(i) Remove indoor thermostat cover

(ii) Turn on first stage heating until first bulb is closed - compressor only operates

(iii) Check amperage to resistance heaters or observe heater relays for open position to determine that the resistance heat is off.

b) Second Stage Heating-outdoor temperature is above outdoor thermostat setting (above balance point)

Energize first and second stage heating at the indoor thermostat, and check by the following:

(i) Remove indoor thermostat cover

(ii) Turn on first and second stage heating until both bulbs are closed - compressor only operates

(iii) Check amperage to resistance heaters or observe heater relays for open position to determine resistance heat is off.

c) Second Stage Heating - outdoor temperature is below outdoor thermostat setting (below balance point)

Energize first, then second stage heating at the indoor thermostat, and check by the following:

(i) Remove indoor thermostat cover

(ii) Turn on first stage heating until first heating bulb closes - compressor only operates

(iii) Check amperage to resistance heaters or observe heater relays for open position to determine resistance heat is off.

(iv) Close first and second bulbs of indoor thermostat. Verify that only one bank (maximum of 10 kW) of resistance heat comes on to supplement the compressor.

(v) If more than one outdoor thermostat is used (if required by Distributor), determine that the additional outdoor thermostat(s), or approved equivalent properly controls the additional bank(s) of the supplemental heat.

(vi) d) Emergency Heating

Set indoor thermostat to emergency heat position. Operate thermostat so both heating bulbs close. Verify that compressor does not operate and that all supplementary heat (controlled by outdoor thermostats) are energized. (This may be checked by the temperature rise method or ammeter reading at the equipment).

3) Check for Proper Cooling Operation: *(Major)*

Energize system in the cooling mode at the indoor thermostat. Check to see if compressor is energized and that outlet air temperature is approximately 50°F to 70°F dry bulb.

4) Check System for Proper Capacity: *(Major)*

a) Check capacity by <u>ONE</u> of the following methods:

i) Heating Capacity (compressor only) When the Outside Air Temperature is Below 75°F

Turn all auxiliary heating power switches to the off position.

Place unit in the heating mode (first bulb closed only) and allow the unit to run in the heating mode for at least 10 minutes.

Allow time for the temperatures to stabilize and read the average supply air temperature in the supply duct or at a register close to the heat pump. Read the average return air temperature in the return duct(s) 6'-10' upstream of the unit, or at the return air grille(s).

Estimate the compressor heat output using the following formula:

Btuh = temperature difference x 1.1 x CFM (CFM will come from one of the three methods detailed earlier).

Check outdoor temperature and refer to manufacturer's catalog data for rated output of unit at this outdoor air temperature.

Verify that system capacity is <u>±</u> 10% of the equipment manufacturer's rating at the test conditions.

ii) Cooling Capacity When the Outside Air Temperature is Above 75°F

Place system in the cooling mode.

Record intake air temperature to outdoor unit

At supply air outlet and inlet indoors record wet bulb and dry bulb temperatures.

From Table A-1, record heat content values that correspond to supply and return air wet bulb temperatures, h1 and h2, respectively.

Estimate total heat removed from space by:

Btuh = (h2 - h1) x 4.5 x CFM

Note: h1 = heat content of air from Table A-1 corresponding to supply air wet bulb temperature.

h2 = heat content of air from Table A-1 corresponding to return air wet bulb temperature.

CFM = measured or calculated air flow of system.

Check outdoor temperature and refer to manufacturer's catalog data for rated output of unit at this outdoor air temperature.

Verify that system capacity is ± 10% of the equipment manufacturer's rating at the test conditions.

iii) Capacity verification by Quality Heat Pump Contractor representative utilizing pressure/temperature gauges.

Have **Quality Heat Pump Contractor** representative attached refrigerant gauges to the heat pump refrigeration circuit and record suction and discharge pressures.

Compare findings to equipment specification at the observed ambient and air flow (cfm).

Have representative make any necessary additions or evacuations (utilizing proper refrigerant recover equipment) to the refrigerant circuit.

Record capacity before and after modifications.

e. Conditioned Area Components

1) Check for proper thermostat for the installation. ***(Major)***

2) Check location of thermostat for external heat or cold influence. ***(Major)***

3) Check thermostat to assure that it is level. ***(Major)***

4) Visually inspect mercury bulbs (if so equipped) for cracks and discoloration.

5) Check thermostat wiring connections for accuracy and tightness.

6) Check the thermostat temperature indicator (if so equipped) against a reliable source.

7) Check for security of thermostat to stud or other building component and for drafts from stud space behind thermostat.

8) Check thermostat for emergency heat switch (unless waived by other sections of these guidelines). ***(Major)***

9) 9) Check return air (RA) grille(s) for proper location(s) and proper size(s).

10) Measure velocity of air at RA grille(s) with a velometer. Take readings at 6 or more locations (symmetrically) on face of grille(s) and average. Maximum speed of returning air shall be less than 500 feet per minute (fpm).

11) Check filter location(s) for accessibility so that filter(s) can be replaced easily.

12) Check supply outlets for proper location.

13) Check supply outlets for acceptable supply capacity to distribute system air volume at acceptable speeds.

14) Check SEVERAL supply outlets as necessary for maximum discharge velocity range of 400-700 FPM. Take readings at 3 or more locations on face of grille and average.

15) Check the average temperature difference between any room or space within the conditioned structure (single level) for a maximum difference of not more than 4°F. ***(Major)***

f. Air Distribution System

1) Check duct system for proper design and installation per ACCA, SMACNA, or ASHRAE criteria.

2) Check duct system design to assure a minimum of 400 cfm/12,000 Btuh air flow across the indoor coil based on the equipment's ARI cooling capacity (if applicable). ***(Major)***

3) Check rectangular duct work for proper aspect ratio.

4) Check all seams and joints for airtight integrity and proper sealing/taping.

5) Check for proper vibration isolation connectors (if necessary).

6) Verify that duct system does not contact ground. ***(Major)***

7) Verify that acceptable duct material is utilized.

8) Check for proper support and hanging material.

9) Check branch ducts for proper sizing (minimum of 4", maximum of 8", round, or equivalent). ***(Major)***

10) 10) Verify that return duct work is sized to return the design cfm capacity of the supply system. ***(Major)***

11) Check duct work for proper insulation levels (if applicable).

g. Dual-Fuel Heat Pump (DFHP) Split System Inspection Procedures

Inspect DFHP equipment and duct system(s) for adherence to Standards (latest revision)

The preceding inspection procedures shall apply to all DFHP split systems:

1) See **Standards** for sections that do not apply to DFHPs.

2) Air flow determination shall be performed as follows: ***(Major)***

a) Blower speed shall be as used for heat pump operation by either of the following:

i) Heat pump shall be operating in either cooling or heating mode (first stage heating only)

OR

ii) Fan switch shall be in the "on" position and system switch in "off" position.

b) CFM measurement shall be determined by the funnel method. If measurement cannot be made by the funnel method, use the return air grille velocity method.

3) Inspect for proper control setting (including any temperature differential as may be required by the manufacturer). ***(Major)***

4) Inspect for proper heat pump/furnace operation. ***(Major)***

a) Outdoor temperature (ODT) is below 75°F, check the following:

i) Perform compressor heating capacity check

ii) If ODT is above structure's theoretical balance point:

- First stage thermostat - heat pump only operates
- Second stage thermostat - furnace only operates until second stage is satisfied iii) If ODT is below structure's theoretical balance point and above the economic balance point:
- First stage thermostat - heat pump only operates
- Second stage thermostat - furnace only operates until second stage is satisfied (compressor is off during this time); after second stage is satisfied, compressor energizes

iv) If ODT is below structure's theoretical balance point and below the economic balance point:

- First and/or second stage thermostat - furnace only operates

v) Emergency heat operation - There are no provisions for emergency heat mode for DFHP. In the event of the heat pump compressor or associated refrigeration equipment becoming inoperative, the furnace shall provide all required heating controlled from the second stage of the indoor thermostat in the heating mode.

b) Outdoor temperature is above 75°F, check the following:

i) Perform compressor cooling capacity check

ii) Check furnace only in heating operation

First and/or second stage thermostat - furnace only operates

NOTE: A **Quality Heat Pump Contractor** representative will have to temporarily field wire to "close" control setting.

iii) Emergency heat operation - furnace only operates

h. Dual-Fuel Heat Pump (DFHP) Packaged System Inspection Procedures

Inspect DFHP packaged system and duct system(s) for adherence to Standards.

The preceding inspection procedures shall apply to all DFHP packaged systems with the following exceptions:

1) See **Standards** for sections that do not apply to DFHPs.

2) Air flow determination shall be performed as follows: ***(Major)***

a) Blower speed shall be used for heat pump operation by either of the following:

i) Heat pump shall be operating in either cooling or heating mode (first stage only)

OR

ii) Fan switch shall be in the "On" position and the system switch in the "Off" position.

b) CFM measurement shall be determined by the funnel method. If measurement cannot be made by the funnel method, use the return air grille velocity method.

3) Inspect for proper control setting (including any temperature differentials as may be required by the manufacturer. ***(Major)***

4) Inspect for proper heat pump/furnace operation. ***(Major)***

a) Outdoor temperature (ODT) is below 75°F, check the following:

i) Perform compressor heating capacity check

ii) If an outdoor thermostat is utilized, check to assure that the setting is at the structure balance point and:

If ODT is **above** the setting of the outdoor thermostat:

First stage of indoor thermostat - heat pump only operates.

Second stage of indoor thermostat - furnace only operates until second stage is satisfied (this could occur upon heat pump compressor failure)

If ODT is **below** the setting of the outdoor thermostat:

First stage of indoor thermostat - furnace only operates (no second stage)

iii) If an outdoor thermostat is not utilized:

First stage of indoor thermostat - heat pump only operates.

Second stage of indoor thermostat - furnace only operates until second stage is satisfied.

iv) There are no provisions for emergency heat mode for DFHP packaged systems. In the event of the heat pump compressor or associated refrigeration equipment becoming inoperative, the furnace shall provide all required heating controlled from the second stage of the indoor thermostat in the heating mode.

i. Manufactured Home Heat Pump Inspection Procedures

Inspect Manufactured Home heat pump equipment and duct system(s) for adherence to **Standards**

The preceding inspection procedures shall apply to all Manufactured Home heat pump systems except as follows:

1) See **Standards** for certain sections that do not apply to Manufactured Home heat pump equipment.

2) Verify that when heat pumps installed in manufactured homes use field installed supply and/or return ductwork section, and it is installed in compliance with **Standards**. ***(Major)***

3) Check to see that the heat pump applied to manufactured housing ductwork is capable of operating within manufacturer's specifications and is approved for that use. ***(Major)***

4) Verify that the manufactured home was made in 1976. ***(Major)***

5) Verify that the heat pump/manufactured duct system provides the manufacturer's recommended air flow across the indoor coil. ***(Major)***

j. Free-Delivery Split Heat Pump (FDSHP), Packaged Terminal Heat Pump (PTHP), Self Contained Through-The-Wall Heat Pump (SCTTWHP), and Window Heat Pump (WHP) Inspection Procedures

Inspect FDSHP, PTHP, SCTTWHP, and WHP equipment and duct system(s) for adherence to Standards.

The preceding inspection procedures shall apply to all FDSHP, PTHP, SCTTWHP, and WHP systems except as follows:

1) See **Standards** for certain sections that do not apply.

2) Air flow shall be as recommended by the manufacturer. ***(Major)***

3) Check to see if integral auxiliary electric heat is provided by the manufacturer within the unit cabinet or fan coil section as part of the heat pump. ***(Major)***

4) Verify that any integral auxiliary heaters are controlled by the heat pump's indoor thermostat. ***(Major)***

5) Verify that installing **Quality Heat Pump Contractor** has met manufacturer's instructions for the complete installation of the system, including any recommended parts and accessories and any necessary wall/window case. ***(Major)***

6) Inspect the joint around the unit's case (between the case and wall or window) to assure weathertight seal with caulk, seals, or gaskets, as provided by the manufacturer. ***(Major)***

7) Check cabinets for proper alignment and any unnecessary holes. Holes allowed are for the manufacturer's approved internal condensate drain system (condensate drain lines shall be sized in accordance with the manufacturer's recommendations and all instances at least as large as the heat pump's drain connection**).** ***(Major)***

k. Ground Water Source Heat Pump (GWSHP) and Earth Coupled Heat Pump (ECHP) Inspection Procedures

Inspect GWSHPs and ECHPs and duct system(s) for adherence to **Standards**

The preceding inspection procedures shall apply to both GWSHPs and ECHPs except as follows:

1) Check GWSHP and ECHP for installation of pressure/temperature (P/T) test ports installed in the "water-in" and "water-out" piping runs at the unit. The P/T test ports shall be as close as possible to the heat pump. ***(Major)***

2) Check system heating capacity as follows: ***(Major)***

a) Allow heat pump system to operate for at least 15 minutes.

b) Measure water pressure drop (PD) between water-in and water-out test plugs at heat pump. (Use same instrument to measure both to reduce error).

c) Measure entering water temperature at water-in test plug.

d) Using manufacturer's performance data, determine the water flow rate (GPM) and the heating capacity of the installation using the measured PD and the measured EWT.

e) Determine heating capacity by using the following formula:

Btuh = TD x 1.1 x CFM

TD = temperature difference between supply air and return air

1.1 = air properties constant

CFM = Cubic feet per minute air calculated, from funnel, temperature rise, or return air method

f) Verify that system capacity is $\pm$ 10% of the equipment manufacturer's rating at the test conditions.

3) Check system cooling capacity as follows: ***(Major)***

a) Allow system to operate for at least 15 minutes

b) Measure water pressure drop (PD) between water-in and water-out test plugs at heat pump. (Use same instrument to measure both to reduce error).

c) Measure entering water temperature at water-in test plug.

d) Using manufacturer's performance data, determine the water flow rate (GPM) and the cooling capacity of the installation using the measured PD and the measured EWT.

e) Determine cooling capacity by using the following formula:

Btuh = (h2 - h1) x 4.5 x CFM

h1 = heat content of air from Table A-1 corresponding to supply air wet bulb temperature.*

h2 = heat content of air from Table A-1 corresponding to return air wet bulb temperature.*

4.5 = air properties constant

CFM = Cubic feet per minute air calculated, from funnel, temperature rise, or return air method

* At supply air outlet and inlet indoors record wet bulb and dry bulb temperatures.

(From Table A-1, record heat content values that correspond to supply and return air wet bulb temperatures, h1 and h2, respectively)

f) Verify that system capacity is ± 10% of the equipment manufacturer's rating at the test conditions.

I. Direct Exchange Ground Source Heat Pump (DXGS) Inspection Procedures

Inspect DXGS and duct system(s) for adherence to **Standards**.

The preceding inspection procedures shall apply to DXGS:

1) Verify the distances between the compressor and the ground coil and compressor to air handling blower unit as required by DXGS manufacturer. Both vertical height and total line distance shall be within limits as specified by manufacturer. Insure all linesets, both vapor and liquid, are insulated with rubatex, or similar insulation non-corrosive to copper. ***(Major)***

2) Determine system heating capacity. System inspection should never be conducted within 48 hours of completion of soaker hose operation, and should not be conducted within one week of completion of soaker hose operation if the DXGS system is installed during the heating season. Consult with the Quality Heat Pump Contractor to determine appropriate inspection time during heating season. For heating capacity tests, the return air temperature should be between 65 degrees F. and 70 degrees F. ***(Major)***

3) 3) Measure the compressor run current while in the heat mode. The expected current readings should fall within the ranges as specified by the manufacturer. ***(Major)***

4) The air flow shall be between 400 and 450 CFM per ton of capacity. ***(Major)***

a) Determine heating capacity by using the following formula:

Btuh = TD x 1.1 x CFM

TD = temperature difference between supply air and return air

1.1 = air properties constant

CFM = Cubic feet per minute air calculated, from funnel, temperature rise, or return air method

b) Verify that system capacity is ± 10% of the equipment manufacturer's rating at the test conditions.

Note: If the heating capacity is low, this may be due to an unadjusted heating valve. The **Quality Heat Pump Contractor** can adjust the heat valve before re-calculating the heating capacity.

5) Determine system cooling capacity. For cooling capacity tests, the return air temperature should be between 75 degrees F. and 80 degrees F. ***(Major)***

6) Measure the compressor run current while in the heat mode. The expected current readings should fall within the ranges as specified by the manufacturer. ***(Major)***

7) The air flow shall be between 400 and 450 CFM per ton of capacity. ***(Major)***

a) Determine cooling capacity by using the following formula:

Btuh = (h2 - h1) x 4.5 x CFM

h1 = heat content of air from Table A-1 corresponding to supply air wet bulb temperature.*

h2 = heat content of air from Table A-1 corresponding to return air wet bulb temperature.*

4.5 = air properties constant

CFM = Cubic feet per minute air calculated, from funnel, temperature rise, or return air method

* At supply air outlet and inlet indoors record wet bulb and dry bulb temperatures.

(From Enthalpy Table, record heat content values that correspond to supply and return air wet bulb temperatures, h1 and h2, respectively)

b) Verify that system capacity is $\pm$ 10% of the equipment manufacturer's rating at the test conditions.

Procedures for notifying Customer and QCN member of Failed Inspections

When a program-required inspection of an installation is made and the installation is not in compliance with program standards, the inspector will indicate on the Heat Pump Installation Inspection Checklist (TVA 6254T) and on the Work Completion Form (where applicable) the reasons(s) for the failure to pass the inspection. The QCN member may be allowed to correct minor deficiencies while the inspector is on-site. Customer and QCN members must receive a copy of Heat Pump Installation Inspection Checklist.

All deficiencies must be corrected and be in compliance within 10 business days. Following corrections by the QCN member, the inspector shall be notified, after which a reinspection shall be scheduled and performed. If, during the reinspection, other items not previously identified are shown to be in violation of the installation standards, the QCN member shall have 10 additional business days to correct the deficiencies, after which the third and final reinspection shall occur.

energy right® Program

Heat Pump Installation Inspection Checklist (Sheet 1 of 2)

Legal Customer Name:

_____Date: _____/_____/_____

To operate at maximum efficiency, it is important that the system be installed correctly. The following checklist provides a simple means to check and verify key items involving the heat pump installation to assure efficient system operation and compliance with Program Standards. These items do not relieve the contractor from compliance with the standards in their entirety.

Place a check next to the number after assurance that heat pump system item(s) listed meets stated criteria.

NOTE: 5 point deduction from Quality Performance Index for each item not in compliance with Program Standards.

Contractor Checks Below:		Inspector Checks Below:
	Equipment	
_____	1. Heat pump meets minimum energy efficiency ratings.	_____
_____	2. Equipment properly sized to match required load calculation (provided by installing contractor).	_____
_____	3. Installation complies with all codes and ordinances; permit number(s): _____ _____	_____
_____	4. Outdoor equipment placed on level, one-piece concrete pad, or approved equal.	_____
_____	5. Equipment meets manufacturer's specified minimum clearances.	_____
	6. System operation: a. cooling ____ b. heating (2nd) _____ c. heating (1st) _____ d. emergency heat_____ e. fan _____ f. off _____	
_____	7. System capacity acceptable at outdoor ambient conditions observed during inspection.	_____
	Installation	
_____	8. Outdoor thermostats (as required) properly installed. (o) Setting(s): _____ F _____ F _____ Maximum 10 kW (nominal) per stage	
_____	9. Condensate line(s) properly installed, trapped, insulated (as required), and condensate drain pan installed (as necessary).	_____
_____	10. Refrigerant piping properly sized, sealed, and supported.	_____
_____	11. Minimum air flow of 400 cfm per 12,000 Btuh of the equipment's ARI certified cooling capacity. Air flow less than 400 cfm per 12,000 Btuh only accepted when ARI certified at lower rate.	_____
	Air Distribution	
_____	12. Duct design and installation as recommended by ACCA, etc., including proper sizing.	_____
_____	13. Ductwork properly supported.	_____
_____	14. Ductwork installed to avoid ground contact.	_____
_____	15. Return and supply air ducts, supply boots, return air pans sealed as required.	_____
_____	16. Opening(s) sealed where ductwork traverses foundation walls.	_____
_____	17. Duct system properly insulated and sealed with vapor barrier.	_____
_____	18. Adequate number of return air grilles, sufficiently sized, and equal to supply CFM.	_____
	Weatherization / Other	

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Heat Pump Installation Inspection Checklist (Sheet 2 of 2)

Heat Pump Brand _____ **Heat Pump Model(s)** _____

Total Cooling Capacity _____ **Total Sensible Capacity** _____

At ACCA/TVA Design Conditions **At ACCA/TVA Design Conditions**

Air Distribution Information

CFM Calculation - Sheet Metal Hood Method (Method #1)

Outlet Room I.D.												Total
Outlet Size												
Cone CFM (Note 1)												
Velometer FPM (Note 2)												
Manuf. Ak Factor												
Ak CFM (Note 3)												

Note 1: (Avg. FPM) x (0.267) (using 7-inch dia. cone) Note 2: Measured on grille face (symmetrically) Note 3: Ak CFM equals (Ak factor) x (Avg. FPM)

CFM Calculation - Temperature Rise Method (Method #2)

Place heat pump in *Emergency Heat Mode.*

Supply Air Temperature (SA) = _____ Return Air Temperature (RA) = _____

(SA) - (RA) = Temperature Difference (TD) = _____ (TD) x (1.1) = Temperature Range (TR) (TR) = _____

Volts = _____ Amps = _____ (Volts) x (Amps) = Watts = _____ (Watts) x (3.413) = (BTUH) = _____

(BTUH) / (TR) = CFM: _____ BTUH / _____ TR = CFM **CFM =** _____

CFM Calculation - Return Air Grille Method (Method #3)

Readings (FPM measured 1-inch off grille face symmetrically, take a minimum of 16 readings.)

Return Air Grille No. 1 Return Air Grille No. 2 (if applicable)

_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

Length (inches) = _____ Width (inches) = _____ Length (inches) = _____ Width (inches) = _____

Average FPM = _____ ***Note: Average FPM must be less than or equal to 500 FPM with filter in place.*** Average FPM = _____

Return Air Grille No. 1: (Average FPM) x (0.75) x (Length x Width) / 144 = CFM **CFM =** _____

Return Air Grille No. 2: (Average FPM) x (0.75) x (Length x Width) / 144 = CFM **CFM =**

Capacity

Heating

Heating (First Stage) ODT = _____

Supply Air Temp. (SA) = _____

Return Air Temp. (RA) = _____

(SA) - (RA) = (TD) = _____

BTUH = (CFM) x (1.1) x (TD) **BTUH =** _____

Cooling

Cooling ODT = _____

Return Air Wet Bulb Temp. = _____

Supply Air Wet Bulb Temp. = _____

Return Air Enthalpy (RAE) = _____

Supply Air Enthalpy (SAE) = _____

(RAE) - (SAE) = H = _____

BTUH = (H) x (CFM) x (4.5) = _____

Distribution of Copies: Copy 1: Power Distributor Copy 2: QCN Member Copy: 3: Customer

TVA 6254T (7/97)

Enthalpy in BTU per Pound of Dry Air

Wet Bulb Temperature F	Tenths of a Degree F									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
35	13.01	13.05	13.10	13.14	13.18	13.23	13.27	13.31	13.35	13.40
36	13.44	13.48	13.53	13.57	13.61	13.66	13.70	13.75	13.79	13.83
37	13.87	13.91	13.96	14.00	14.05	14.09	14.14	14.18	14.23	14.27
38	14.32	14.37	14.41	14.46	14.50	14.55	14.59	14.64	14.68	14.73
39	14.77	14.82	14.86	14.91	14.95	15.00	15.05	15.09	15.14	15.18
40	15.23	15.28	15.32	15.37	15.42	15.46	15.51	15.56	15.60	15.65
41	15.70	15.75	15.80	15.84	15.89	15.94	15.99	16.03	16.08	16.13
42	16.17	16.22	16.27	16.32	16.36	16.41	16.46	16.51	16.56	16.61
43	16.66	16.71	16.76	16.81	16.86	16.91	16.96	17.00	17.05	17.10
44	17.15	17.20	17.25	17.30	17.35	17.40	17.45	17.50	17.55	17.60
45	17.65	17.70	17.75	17.80	17.85	17.91	17.96	18.01	18.06	18.11
46	18.16	18.21	18.26	18.32	18.37	18.42	18.47	18.52	18.58	18.63
47	18.68	18.73	18.79	18.84	18.89	18.95	19.00	19.05	19.10	19.16
48	19.21	19.26	19.32	19.37	19.43	19.48	19.53	16.59	19.64	19.70
49	19.75	19.81	19.86	19.92	19.97	20.03	20.08	20.14	20.19	20.25
50	20.30	20.36	20.41	20.47	20.52	20.58	20.64	20.69	20.75	20.80
51	20.86	20.92	20.97	21.03	21.09	21.15	21.20	21.26	21.32	21.38
52	21.44	21.50	21.56	21.62	21.67	21.73	21.79	21.85	21.91	21.97
53	22.02	22.08	22.14	22.20	22.26	22.32	22.38	22.44	22.50	22.56
54	22.62	22.68	22.74	22.80	22.86	22.92	22.98	23.04	23.10	23.16
55	23.22	23.28	23.34	23.41	23.47	23.53	23.59	23.65	23.72	23.78
56	23.84	23.90	23.97	24.03	24.10	24.16	24.22	24.29	24.35	24.42
57	24.48	24.54	24.61	24.67	24.74	24.80	24.86	24.93	24.99	25.06
58	25.12	25.19	25.25	25.32	25.38	25.45	25.52	25.58	25.65	25.71
59	25.78	25.85	25.92	25.98	26.05	26.12	26.19	26.26	26.32	26.39
60	26.46	26.53	26.60	26.67	26.74	26.81	26.87	26.94	27.01	27.08
61	27.15	27.22	27.29	27.36	27.43	27.50	27.57	27.64	27.71	27.78
62	27.85	27.92	27.99	28.07	28.14	28.21	28.28	28.35	28.43	28.50
63	28.57	28.64	28.72	28.79	28.87	28.94	29.01	29.09	29.16	29.24
64	29.31	29.39	29.46	29.54	29.61	29.69	29.76	29.84	29.91	29.99
65	30.06	30.14	30.21	30.29	30.37	30.45	30.52	30.60	30.68	30.75
66	30.83	30.91	30.99	31.07	31.15	31.23	31.30	31.38	31.46	31.54
67	31.62	31.70	31.78	31.86	31.94	32.02	32.10	32.18	32.26	32.34
68	32.42	32.50	32.59	32.67	32.75	32.84	32.92	33.00	33.08	33.17
69	33.25	33.33	33.42	33.50	33.59	33.67	33.75	33.84	33.92	34.01
70	34.09	34.18	34.26	34.35	34.43	34.52	34.61	34.69	34.78	34.86
71	34.95	35.04	35.13	35.21	35.30	35.39	35.48	35.57	35.65	35.74
72	35.83	35.92	36.01	36.10	36.19	36.29	36.38	36.47	36.56	36.65
73	36.74	36.83	36.92	37.02	37.11	37.20	37.29	37.38	37.48	37.57
74	37.66	37.76	37.85	37.95	38.04	38.14	38.23	38.33	38.42	38.52
75	38.61	38.71	38.80	38.90	38.99	39.09	39.19	39.28	39.38	39.47
76	39.57	39.67	39.77	39.87	39.97	40.07	40.17	40.27	40.37	40.47
77	40.57	40.67	40.77	40.87	40.97	41.08	41.18	41.28	41.38	41.48
78	41.58	41.68	41.79	41.89	42.00	42.10	42.20	42.31	42.41	42.52
79	42.62	42.73	42.83	42.94	43.05	43.16	43.26	43.37	43.48	43.58
80	43.69	43.80	43.91	44.02	44.13	44.24	44.34	44.45	44.56	44.67
81	44.78	44.89	45.00	45.12	45.23	45.34	45.45	45.56	45.68	45.79
82	45.90	46.01	46.13	46.24	46.36	46.47	46.58	46.70	46.81	46.93
83	47.04	47.16	47.28	47.39	47.51	47.63	47.75	47.87	47.98	48.10
84	48.22	48.34	48.46	48.58	48.70	48.83	48.95	49.07	49.19	49.31
85	49.43	49.55	49.68	49.80	49.92	50.05	50.17	50.29	50.41	50.54

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