Heat Pump Water Heater (HPWH) Technical Requirements

August 2024

The following practices shall be followed for all projects. These are in addition to all requirements outlined in NYC codes, zoning, NYS/ConEd Clean Heat Program Requirements, and the HPD specifications. In some cases, these requirements are more stringent than required by codes or by the NYS/ConEd Clean Heat requirements, and in those cases, these requirements shall be followed.

Integrated (Hybrid)/Packaged Systems (<120 gallons storage)

- Must meet or exceed Energy Star Residential Water Heater requirements
- Energy Factor (EF) or Uniform Energy Factor (UEF) => 3.3
- Minimum 10-year warranty on parts, 1-year warranty on labor
- Alternate for units with > 30A current rating
    - COP => 4.2
    - Minimum 3-year tank and 1-year parts/compressor warranty, 1-year warranty on labor
- Provides visual notification of need for filter cleaning or replacement
- Design requirements
    - Locate the HPWHs in the basement, not in apartments, and where sound transmission will not be an issue
    - Consider locating HPWHs where they can draw air from spaces with waste heat from other systems (e.g., boilers)
    - Size the hybrid HPWH plant using the capacity of the heat pumps only; do not include capacity of the electric resistance elements
    - Ensure the air temperature of the space the HPWHs will draw air from can be maintained at 40°F or higher all year, including cooling impacts of the HPWHs, and that all manufacturer requirements for room volume and clearances are met
    - Set water storage temperature for 140°F and include a mixing valve in the design
- Installation requirements
    - Spaces from which HPWHs draw air cannot be heated with electric resistance
    - Air intakes must be at least 10' from the exhaust outlets of other units
    - For ducted installations:
        - Ducts must not be run to or from outdoors
    - Cold air exhaust from HPWH must not be delivered directly to a dwelling unit or other areas where the cold air is likely to cause comfort problems or affect the thermostat reading
    - Set the units to operate with heat pump only setting as default

Split Systems

- Must meet or exceed Tier 2 SysCOP for Mild Climate system efficiency standard set by NEEA in their Advanced Water Heating Specification (SysCOP of 2.00).
- Comply with NYC Noise Code
- Minimum 1-year warranty on parts and 5 years on the compressor, 1-year warranty on labor
- Include load calculations in construction documentation. Load calculations shall include:
    - Total heating load & Demand period (I.e. X Btu/hr @4-hour peak)
    - Recirculation (distribution) heat loss
    - Recirculation flow rate
    - Daily DHW draw (gallons per day)
    - Peak DHW flow (gallons per hour)
    - Quantify heater redundancy (I.e. N+1 in winter)
- Methodology and inputs used to be shared with TAP during design review.
    - Ecosizer (ecotope.com) web tool report includes the above requirements.
- Recirculation system shall use thermal balancing valves at each riser for balancing of HW Distribution.
- Include a project specific Sequence of Operations in the construction documentation, detailing performance setpoints and integration of all components of the plant, and indicating:
    - storage tank setpoint(s) and sensor location(s),
    - swing tank setpoint and sensor location, (where applicable)
    - defrost mode operation,
    - freeze protection protocol: provide a freeze protection plan for power outage occurrences, such as including glycol or a drain down system,
    - intended operation during various load scenarios (peak DHW load, low/no DHW load) during design heating and cooling ambient temperatures,
        - Notes on intended operation should sufficiently show that peak load is met by the HPWH during conditions that require frequent use of defrost mode, and that low/no DHW loads do not cause short cycling of the DHW HPWH or excessive use of the Swing Tank electric resistance element.
        - Indicate max/min capacity & COP for Summer & Winter.
    - consideration of maximizing efficiency of system performance,
    - intended plan for reducing risk of legionella,
    - and call for providing a copy of the sequence of operations, including a schematic drawing, framed in mechanical room.
- Provide expansion tanks for all hydraulically separated parts of the system; confirm that all manufacturer's check valves are accounted for.
- Multi-pass heat pump design requirements
    - Minimize the use of electric resistance heating

    - If electric resistance heating is planned as backup or as a redundant system, include in the Sequence of Operations a manual or programmed switchover
- Single-pass heat pump design requirements
    - Minimize the use of electric resistance heating
    - If electric resistance heating is planned as backup or as a redundant system, include in the Sequence of Operations a manual or programmed switchover
    - Design system to minimize EWT to heat pump to maximize efficiency while maintaining good water quality
- Design requirements (multi- and single-pass heat pumps)
    - System (heat pump and storage) must be capable of storing minimum 140°F water at 5°F outdoor air temperature and include mixing valve
    - Include heat traps on both sides of the storage tank in designs where the recirculation load bypasses the storage tanks
    - Storage tank layout must be designed to optimize stratification (e.g., piped in series, not parallel)
    - Locate outdoor units to minimize length of outdoor piping
- Installation requirements (multi- and single-pass heat pumps)
    - Outdoor units must be installed 18" above grade to avoid snow loading.
    - Outdoor units must be located to avoid melting condensate from one unit dripping onto another or from other sources of excessive moisture (e.g., melting snow from roof edge)
    - Outdoor piping must be insulated with minimum 2.5" insulation and covered with continuous metal jacketing with all laps sealed with silicone caulking and pointed down to limit rain intrusion. Heat trace must be included under the insulation on any water piping in exterior and unconditioned spaces.
    - If refrigerant piping is part of the installation, refer to Appendix A and provide as-built shop drawings of refrigerant lines
    - Single-pass systems: Confirm EWT to heat pump is within manufacturer's recommended level.
    - Confirm proper operation of mixing valve temperature control at all operating conditions.
    - Documented System Startup performed by manufacturer-authorized service provider.
    - Documented functional performance testing to include verification of system operation, programmed set points, and programmed alarms, as called for in the Sequence of Operations.

Required System Testing

- Single-pass systems: Confirm EWT to heat pump is within manufacturer's recommended level.
- Confirm proper operation of mixing valve temperature control at all operating conditions.
- Documented System Startup performed by manufacturer-authorized service provider.
- Documented functional performance testing to include verification of system operation, programmed set points, and programmed alarms, as called for in the Sequence of Operations.

Removal of Fossil Fuel Equipment

Where existing fossil fuel equipment is being removed, comply with Appendix B.

Appendix A - Refrigerant Charging and Leak Prevention Requirements

Introduction

Refrigerant charging and leak prevention is critical for several reasons:

1. Refrigerant leaks contribute substantially to climate change. The beneficial effects of electrification can be lost if refrigerant leaks.
2. Refrigerant leaks can harm system energy efficiency, further contributing the climate change, and increasing the cost of electricity to the building.
3. Refrigerant leaks can cause poor comfort, including inadequate heating in winter and inadequate cooling in summer, resulting in substantial health risks and also in potential code violations for indoor temperature control.
4. Refrigerant overcharging increases compressor wear & tear and energy use.

General

- Digital pressure and vacuum gauges shall be used for pressure and vacuum measurement.
- Minimize refrigerant pipe lengths (locate outdoor unit as close as possible to indoor units), to minimize refrigerant quantity.
- Use continuous line sets unless the length of refrigerant piping is longer than standard line sets.
- Use brazed joints in less accessible locations.
- Protect line sets from damage during transportation and storage, before installation.
- Allow for pipe expansion, and properly support and protect line sets both inside and outside the structure.
- Avoid enclosing line sets in wall cavities, where they cannot be inspected and where they may be inadvertently punctured.
- Avoid joints in hidden locations such as wall cavities, where leaks are harder to find and repair. Where joints must be located in such locations, provide an access panel at each joint to allow finding and repairing leaks at joints.
- All technicians working with refrigerant charging and connecting refrigerant piping shall:
  - Have reviewed and certified in writing that they have received and read Appendix A - Refrigerant Charging and Leak Prevention Requirements (this document).
  - Be certified to EPA 608 and shall have copies of their certification on-site.
- Contractor shall confirm pipe lengths by field measurements of refrigerant piping (line sets), the total length of one pipe only (not the total length of both pipes), from the connection at the outdoor unit to the connection at all indoor units. Calculate the refrigerant charge to add using manufacturer requirements. Submit this record of measured pipe lengths and refrigerant charge calculation with the charging report (see Quality Control below).

Flare Joints

- Cut tubing, leaving a few inches of slack in case a flare is defective and must be re-made.
- Use a good quality tubing cutter, work gradually to avoid deforming the tubing, and inspect to make sure that the cut is square.
- Debur to remove the thin lip of copper inside the tubing but be careful not to gouge or thin the tubing wall
- Some line sets come shipped from the factory pre-flared. Inspect carefully for damage in transport. If damaged, cut tubing and make new flares.
- Use good quality flaring tools that have the following features:
  - A gauge or stop that ensures that tubing is positioned at the correct depth
  - An "eccentric" cone that rolls around the interior of the tubing, forming it into shape
  - A clutch that disengages the cone when the flare is complete
  - Use battery-powered flaring tools to anneal the copper and make it less brittle.
  - Check the size and roundness of the flare using a flare sizing gauge.
- Prior to assembly, inspect the flare to ensure that it is symmetrical and that contact surfaces are clean, shiny, and free of scratches.
- Apply a thin coat of refrigeration oil or an approved assembly lubricant to the contact surface to improve the seal and to the back of the flare nut to keep it from binding.
- Align the cones and hand-tighten the flare nut.
- Tighten the flare nut to the manufacturer-recommended torque using a torque wrench. If the assembly is too loose, the surfaces will not form a good seal; if it is too tight, the flare will crack or split. Torque specs are found in manufacturers' instructions and range from around 13 ft-lbs for ¼" tubing to around 56 ft-lbs for ⅝" tubing. Use a torque wrench with a digital gauge.
- Only use flare nuts supplied with the equipment. Manufacturers' torque specs are for OEM flare nuts, which tend to be longer (with more threads) and of better quality than aftermarket ones.
- If subsequent testing reveals a leak at any flare connection, do not attempt to tighten it further; cut out the defective flare and make a new flare.

Brazed Joints

- Use brazed joints in locations recommended by the heat pump manufacturer, and in difficult-to-access locations for example, those enclosed in walls or high off the ground.
- Flow nitrogen through the tubing while brazing to prevent formation of copper oxide scale, and safety concerns around open flames

Pressure Testing

- Inspect lines sets for damage such as kinking.
- Fill the system with nitrogen for a standing pressure test. Once the system is pressurized, isolated, and allowed to stabilize, it must hold steady for a specified period. Pressurization should be done gradually so that catastrophic leaks are caught with minimal waste. The target pressure, specified by the manufacturer, is typically 500-550 psig.
- Test for a minimum of one hour.

- Use a digital pressure gauge with a resolution of maximum 0.1 psi. Do not use analog pressure gauges. A drop in pressure indicates a leak, which should be repaired.
- Measure the outdoor air temperature in the shade at the beginning and end of the test. Correct for the air temperature by 1 psi for each degree Fahrenheit change in temperature. Note that if the outdoor air temperature increases, an increase in pressure could still indicate a leak. For example, if outdoor air temperature increases by 6 degrees, we would expect an increase in pressure of 6 psi. A smaller increase, for example 3 psi, indicates a likely leak. If any deviation from expected pressures is found, a leak should be suspected, investigated, and repaired.
- Apply an approved leak-testing solution (not household dish detergent) to all flares and other site-made connections. Check each fitting for bubble formation, using a flashlight and inspection mirror when necessary to inspect areas that are hidden.
- Make a record of test results using the standard test record card, below (fill out the card and include it in the photo).

Drawing and Vacuum and the Vacuum Test

- Once the system has been successfully pressure-tested, evacuate the system.
- Use a correctly sized vacuum pump. If a vacuum pump is oversized, it can draw a vacuum too quickly and create ice from humidity in the system. If a vacuum pump is undersized, it will not draw a vacuum quickly enough. The purpose of evacuation is to remove air and moisture from the system, and as a secondary leak check.
- Use a digital vacuum gauge. Do not use an analog vacuum gauge.
- Once the system is pulled down into a deep vacuum of maximum 200 microns, isolate the system from the vacuum pump, and observe changes in vacuum pressure. If the system remains below a decay target of 500 microns after 10 minutes or more of isolation, the system passes. If the system fails, it may be because air is entering through a leak or because excess moisture remains in the system. If the initial deep vacuum or decay target vacuum specified by the manufacturer are less than 200 and 500 microns, respectively, use the manufactured-required vacuums. This best practice does not require a triple vacuum. If the heat pump manufacturer requires a triple vacuum, use the triple vacuum procedure, and use this procedure for the final of the three vacuums.
- Use a bluetooth-enabled vacuum gauge, paired with a mobile app, to provide a time-stamped record of the vacuum test result. Or take a photo of the measurements using the standardized test record card below (fill out the card and include it in each photo).

Standardized Test Record Card		
Date:	Time:	Technician:
Test type (check one): ___ Nitrogen ___ Vacuum		Check one: ___ Beginning of Test __ End of Test
Air temperature: _____ degrees F		

Charging the System and Final Leak Checks

- Charge the system with refrigerant. Use a digital scale to accurately measure the required refrigerant into the system.
- Once the system has been charged with refrigerant, make a final leak check on the service valves and charging ports, with both an approved bubble solution and an electronic leak detector.
- Write the total measured liquid line lengths and final total charge in permanent marker on the outdoor unit and inside the control access panel of the outdoor unit.
- To minimize risk of tampering or refrigerant theft, install locking caps on charging ports.
- Do not use refrigerant gauges/hoses to charge systems for which the manufacturer does not require a superheat/subcool test. In most cases, for variable speed heat pumps, they are not required. Using gauges will cause unnecessary release of refrigerant that is trapped in the gauge hoses.

Quality Control

- Provide a refrigerant charging report, including:
  - the name of the project
  - address
  - heat pump tag (if more than one system)
  - measured line lengths
  - pounds/ounces of added refrigerant charge
  - a copy of manufacturer instructions
  - a copy of this Appendix A signed by all technicians who perform pipe connections and/or refrigerant charging
  - photographs of bubble testing
  - photographs of electronic leak tests
  - time-stamped reports of vacuum decay tests generated by mobile apps.
- Provide a sheet to the owner that allows the facility manager to track leak occurrences by heat pump.

Appendix B - Removal of Fossil Fuel Equipment

- Permanently seal the bottom and top of chimneys/vents and outdoor air combustion intake openings, and air-seal and insulate these penetrations per energy code. Permanently seal, ridged as with plywood or masonry, air sealed, waterproofed, insulated, and with a vapor barrier. If a chimney is being reused, for example for a smaller hot water flue, the sealing should occur around new flue at top and bottom.
- Permanently cap abandoned gas piping. Do not simply close shutoff valves.
- Remove oil tanks and oil piping and accessories
- For the removal of existing oil tank(s), GC to submit all DEP and FDNY decommissioning documents of the oil tank(s) to HPD. Tanks 1100 Gallons or larger must comply with NYC DEC Requirements.