

Space Heating Heat Pump Technical Requirements: Split Systems

January 2024 (updates noted in red)

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.

Split Systems

- Must meet or exceed NYS Clean Heat requirements.
- Minimum 10-year parts warranty, 1-year warranty on labor.
- **Design requirements**
 - System shall be designed to meet Clean Heat “Full Load” requirements (heat pumps must serve 90% of building heating load and 100% design cooling load). Furthermore, heat pumps shall be used for all spaces, with limited exceptions in select areas (e.g. bathrooms). Heating is discouraged in spaces with limited duration of occupancy (e.g. corridors, stairwells, basements).
 - Locate outdoor units to minimize length of outdoor piping.
 - Electric resistance backup shall not be used for heat pumps.
 - Heat pump shall have a variable speed compressor.
 - Size the heat pump to the heating load, per code requirements.
 - Consider best practices as outlined in HPD/NYSERDA best practices, including:
 - 1. Roof Considerations for Heat Pumps
 - 2. Electrification Space Strategies

These can be found at the following web site: <https://www1.nyc.gov/site/hpd/services-and-information/hpd-nyserda-retrofit-electrification-pilot.page>

- Comply with all relevant codes and standards. Design should use gravity drainage of condensate from indoor units. Where gravity drainage is not possible, pumps are acceptable, but should be concealed to the extent feasible. Ensure that drainage is located such that it does not cause condensate to land on balconies or other appurtenances below. Condensate discharge to building drainage shall be through indirect waste connection by means of an air gap.

- Size systems to an indoor design heating temperature of 72 degrees, as allowed by the Energy Code. Note that NYC requires that systems be capable of ensuring that the indoor temperature is at least 68 degrees.
 - Size systems to a design outdoor temperature of 13 degrees.
 - A 7-day programmable thermostat is required, per the energy code. Controls shall be fixed, wall-mounted, types that are simple and easy to read. Controls shall be mounted 60” above the floor, unless a lower height is required for accessibility (ADA).
 - Drawings shall show the length of each refrigerant pipe (typically on the riser diagram).
 - Radiant or Electric resistance heaters in minor spaces with short occupancy (e.g. bathrooms) shall have timer control to turn off automatically, e.g., a manual crank timer.
 - Electric resistance heaters that are used for freeze protection (e.g. common area spaces with water piping, gas meter rooms, etc.) shall have temperature limits set at 50 degrees maximum.
- **Installation requirements**
 - Contractor shall be an approved Participating Contractor in the Clean Heat program.
 - Outdoor units must be installed 18” above grade to avoid snow
 - 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 to meet the energy code, but this shall be confirmed with energy code requirements specific to each installation. Drawings may show the energy code insulation table, but must also specify the refrigerant temperatures for piping, to allow correct sizing of pipe insulation. **In the absence of manufacturer-specific guidance, the following temperatures shall be used (items in red added January 2024):**
 - 1) Residential split heat pumps, like small ductless or ducted systems, typically have a larger pipe connecting to each indoor unit from the outdoor unit, and a smaller pipe. Pipe insulation requirements are typically ½" thick insulation for the smaller pipe and 1.5" thick insulation for the larger pipe. The reasons for this are as follows:
 - 2) Most (virtually all) residential-size refrigerant piping is smaller than 1” in diameter.
 - 3) Heat pump refrigerant piping generally falls into the following temperature categories:
 - a) **Cooling:** Both the large and small interconnecting pipes are typically cold and in the range of 40 F - 60 F. These would require ½" thick insulation, UNLESS the requirement for insulation in heating is more
 - b) **Heating:** The large interconnecting pipes are in the range of 141 F - 200 F, which requires 1.5” thick insulation, and overrides the ½" thick requirement for cooling. The small interconnecting pipes are in the range of 70-90 F, and so do not require any insulation in heating, so the ½" thick insulation requirement for cooling governs.
 - i) 2. For large VRF heat pumps with “heat recovery” (also known as 3-pipe) systems:
 - 4) Between outdoor unit and "branch selector boxes":
 - a) Cold (low/pressure) gas pipe: 40-60 F.
 - b) Liquid pipe: 105-140 F
 - c) Hot gas pipe: 141-200 F range. (In some instances, this temperature goes above 200 F, in which case the 201-250 F range should be used.)
 - 5) Between "branch selector boxes" and indoor units.

- a) Liquid pipe: 105-140 F
 - b) The gas pipe is hot in heating and cold in cooling. So, we take the worse of these two conditions (the hot gas one), and call this pipe a 141-200 F range pipe.
 - i) 3. For large VRF heat pumps without heat recovery (also known as 2-pipe):
 - ii) The large (gas) pipe is hot in heating and cold in cooling, and so it should be insulated at the worse of these two conditions, which is a 141-200 F pipe.
 - iii) The small (liquid) pipe is always a hot liquid pipe, so should be insulated as a 105-140 F hot pipe.
 - iv) 4. Should condensate piping be insulated? A strict reading of the code says that it should. There is an exception in the *NY State* version of the code for fluids that are not directly heated or cooled but that exception does not exist in the NYC version of the code. [[Inspectapedia link](#)]. The risks of not insulating condensate piping is lower if the piping is plastic because the surface temperature of the plastic is typically higher than the dewpoint temperature of the air. Metal has a higher risk.
- Pipe insulation shall be insulated the full length of the piping from outdoor units to indoor units, without gaps in the insulation that would allow condensate to form. Insulation shall be protected from UV exposure per code requirements, typically with a metal or plastic cover (as required for exterior walls, see below), or with UV-resistant paint. It should be noted that some jacketed insulations have been found to cause pipe corrosion and leaks – these insulations shall not be used.
 - Condensate tubing shall be minimum ¾" PEX or minimum ¾" PVC or CPVC. Vinyl tubing and corrugated tubing shall not be used. Note that code-approved materials (Mechanical Code 307.2.2) for condensate disposal does not include plain steel, and so abandoned steam piping can generally not be used for condensate disposal on its own.
 - Fastening of condensate tubing shall be hose clamp (worm drive clamp) or approved crimp rings, for PEX or approved connectors or approved adhesive for PVC or CPVC.
 - Pipe and wiring penetrations of walls and roofs shall be sealed on both sides of the penetration. Sealing material used outdoors shall be UV-resistant. Sealing should be around and between all pipes and wires/conduit.
 - Piping and wiring indoors shall be concealed unless otherwise approved. "Concealed" means: In chases, in ceiling or floor cavities, in basements or attics, or in drywall-finished soffits, or other approved means of concealment.
 - Exposed piping and wiring on exterior walls shall be concealed in a cover in a color to match the wall. Cover type and color to be submitted and approved prior to ordering.
 - Piping shall be structurally supported per Mechanical Code requirements, and these code requirements shall be spelled out on the drawings:
 - Mechanical Code 305.3 Structural attachment. Hangers and anchors shall be attached to the building structure.*
 - Mechanical Code 305.4 Interval of support. Piping shall be supported at distances not exceeding the spacing specified in Table 305.4, or in accordance with MSS SP-69.*
 - Contractor shall notify HPD-NYSERDA Technical Assistance Provider (TAP) at electrificationpilot@hpd.nyc.gov after piping is installed and supported, but before

locations such as chases or soffits are sealed, to allow for inspection before these locations are concealed.

- Piping and wiring shall be routed plumb/level and either parallel to or at right angles to buildings lines (wall vertical lines, roof horizontal lines, etc.).

Ground Source Heat Pump Systems

Ground source heat pump (GSHP) systems are permitted in the NYSERDA-HPD Retrofit Electrification Pilot, but detailed technical requirements beyond the Clean Heat program have not yet been developed. Consult the TAP team for requirements if a GSHP system is being considered.

Water Loop Heat Pump Systems

Water loop heat pump systems OTHER than ground source heat pumps are NOT permitted in the NYSERDA HPD Retrofit Electrification Pilot. Examples include boiler/tower water loop heat pump systems, or water loop heat pump systems that use an air source heat pump to heat the water loop.

Refrigerant Charging and Leak Prevention

Comply with refrigerant charging and leak prevention requirements in Appendix A.

System Commissioning

- Program indoor units to 70 F heating and 78 F cooling (occupied mode), unless provided written instructions otherwise.
- Ensure that filters on indoor units are clean and free of construction dust.
- For outdoor temperatures below 60 F, force heat pump into heating at maximum compressor speed (for example, by calling for heat in all zones), and then record outdoor air temperature in the shade, total system electric current (amps), and, for one zone only, return air temperature and supply air temperature .
- For outdoor temperatures above 60 F, force heat pump into cooling at maximum compressor speed (for example, by calling for cooling in all zones), and then record outdoor air temperature in the shade, total heat pump electric current (amps), and, for one zone only, return air temperature and relative humidity (%) and supply air temperature .
- Provide a written report of test results (above), startup tests, and final refrigerant charge (pounds, ounces).
- For further commissioning requirements, refer to the Energy Code and to: https://taitem.com/Commissioning/NYC_Commissioning_Requirements_white_paper.pdf.

Removal of Fossil Fuel Equipment

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

If you have questions or comments, email electrificationpilot@hpd.nyc.gov

If you have questions or comments regarding the Future Housing Initiative Program and Projects, please email futurehousing@hpd.nyc.gov

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.

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:
 - o Have reviewed and certified in writing that they have received and read HPD's Refrigerant Charging and Leak Prevention Requirements (this document).
 - o Be certified to EPA 608 and shall have copies of their certification on-site.
- Drawings shall show the length of each refrigerant pipe (typically on the riser diagram).
- 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 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.
- Deburr 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 5/8” 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 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 causes 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 number (if more than one system), line lengths, pounds/ounces of added refrigerant charge, manufacturer instructions, these instructions signed by all technicians who perform pipe connections and/or refrigerant charging, photographs of bubble testing, photographs of electronic leak tests, and 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.

Appendix C

Thermostats & Controls

Equipment:

- A 7-day programmable thermostat is required, per the energy code. Controls shall be fixed, wall-mounted types that are simple and easy to read.

Thermostat Locations

- 60" above finished floor, on an interior wall, not close to the heat pump indoor unit.

Required Controls Information/Training for Residents

- Easy-to-read instructions must be provided to residents outlining thermostat settings, thermostat use, basic functions including overrides, "away" mode, information about energy savings, etc.
- A widely accepted approach is to "set and forget" temperature settings for indoor units, rather than to program them for occupied and unoccupied modes. This should only be done in situations for rooms in which unoccupied mode is predominantly at night. For rooms where unoccupied mode is during the day, setback can be used. Also, for rooms that are unoccupied for more than 24 hours (for example, a rarely used bedroom, or for periods of vacation), setback should be used. Thermostats should be set to an occupied/unoccupied schedule to be obtained in writing from the owner for each space.