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HEAT PUMPS: GUIDANCE ON CODE & ZONING

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Together, we are working to reduce the barriers to electrification on existing affordable housing projects.

HPD Pilot webpage

NYC Department of Housing Preservation & Development

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Introduction

The intent of this document is to have important code-related requirements for heat pumps all in one place, for convenience. We include both the code language and a plain-English summary, to assist in common applications of the code requirements. It was created to compile answers from relevant codes to common (and a few uncommon) questions regarding heat pump installation, maintenance, and operation. It is primarily intended for use in New York City and New York State, although many requirements are related to the International Code and so are applicable elsewhere. So, the document's main purpose is to pull all these requirements in one place and put offer "plain-English" summaries of them, for convenience and clarity.

Adoption of heat pumps is increasing rapidly around the world as a replacement for fossil fuels. Because they use electricity, and because electricity is increasingly produced by renewable sources (solar, wind, etc.), the electrification offered by heat pumps can dramatically reduce carbon emissions from buildings.

These code requirements are in effect in New York State and/or New York City. Because New York (both State and City) generally follow the codes in the International Code Council (ICC) series of codes (such as the International Energy Conservation Code), as well as other widely recognized codes (such as the National Electric Code), many of these requirements are also applicable outside of New York. But always check with your own state and local codes to make sure these requirements apply to your municipality or jurisdiction, including local Fire Code and Landmark Requirements.

The requirements in this document were checked as of February 2024, looking forward to near-future versions where they are already available. Since codes change—and many on a three-year cycle—it is advisable to check for the latest versions of codes and their requirements. This means checking the NYC DOB Construction, Mechanical, and Electrical Codes, the NYCECC, and Fire Codes.

An important note: Most codes require that manufacturers' instructions be followed. This is an important legal and binding requirement. Furthermore, there might be cases in which the code and manufacturers' requirements conflict. In such cases, check with your local code enforcement officer.

This document references code from the International Code Council, as used in both New York City and New York State. Where there are specific differences, it is noted.

This document focuses on commercial codes, such as the commercial section of the energy conservation code (NY/NYC ECC), which addresses multifamily buildings four stories and higher. Where possibly of interest, reference is made to low-rise residential buildings, and this is clearly identified in the text.

This document uses the following font conventions:

- CODE REQUIREMENT sections include code section numbers that are in **bold,** code text that is *italicized*, and in some cases include summaries of code requirements that are in regular font.
- Each CODE REQUIREMENT section is followed by a SUMMARY section, which is written in plain English and represents the HPD Technical Assistance Provider's interpretations of the code requirements.

Disclaimer

This document is intended as a high-level guide only, for the convenience of design professionals. Final building-specific decisions rest with the design professional and should include building-specific code review. Also, codes change, and so the latest codes should be consulted, in making all design decisions.

The authors make no representation that the use of any summaries in this document will ensure code-compliance, and assume no responsibility for any loss, injury, or damage resulting from, or occurring in connection with the use of information contained, described, disclosed, or referred to in this report.

Definitions

The following are definitions of acronyms used in this document:

A1 refrigerant - Refrigerant identified as having “no flame propagation”

AC – air conditioning

ACCA - Air Conditioning Contractors of America

ACCA Manual J – the heat loss requirement document by ACCA

ACCA Manual S – the sizing requirement document by ACCA

ASHRAE – American Society of Heating, Refrigerating, and Air Conditioning Engineers

BC – Building Code

Btu/hr - British thermal unit per hour

COP – Coefficient of Performance

CO2 – Carbon Dioxide

dB(A) - A-weighted decibels

DB – dry bulb temperature (F)

EC – Electrical Code

ECC – Energy Conservation Code

EER – Energy Efficiency Ratio

HSPF – Heating Seasonal Performance Factor

IEER – Integrated Energy Efficiency Ratio

KW - kilowatt

LL – Local Law (such as New York City’s local laws)

MC – Mechanical Code

MCWB – Mean Coincident Wet Bulb

NEC – National Electric Code (NFPA 70)

NFPA – National Fire Protection Agency

NYC – New York City

NYS – New York State

PTAC – Packaged Terminal Air Conditioner Unit

SEER – Seasonal Energy Efficiency Ratio

VRF – Variable refrigerant flow

WB – Wet Bulb Temperature

410A – Refrigerant 410A

ENERGY

A. REFRIGERANT PIPE INSULATION

CODE REQUIREMENT

- ***NYC ECC Section C403.11.3*** *(Mandatory). Piping serving as part of a heating or cooling system shall be thermally insulated in accordance with table C403.11.3* Table C403.11.3 below shows the required insulation thickness based on fluid temperature and pipe size.

TABLE C403.11.3

MINIMUM PIPE INSULATION THICKNESS (in inches)[a, c]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu • in./(h • ft^2 • °F)[b]	Mean Rating Temperature, °F	< 1	1 to < 1 1/2	1 1/2 to < 4	4 to < 8	≥ 8
> 350	0.32 - 0.34	250	4.5	5.0	5.0	5.0	5.0
251 — 350	0.29 — 0.32	200	3.0	4.0	4.5	4.5	4.5
201 — 250	0.27 — 0.30	150	2.5	2.5	2.5	3.0	3.0
141 — 200	0.25 — 0.29	125	1.5	1.5	2.0	2.0	2.0
105 — 140	0.21 — 0.28	100	1.0	1.0	1.5	1.5	1.5
40 — 60	0.21 — 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 — 0.26	50	0.5	1.0	1.0	1.0	1.5

- ***C403.11.3.1*** *Protection of piping insulation (Mandatory). Piping insulation exposed to the weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.*

SUMMARY

The energy code does not prescribe what temperatures to use for heat pump systems, and these temperatures are not readily available in product literature.

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:

- Most (virtually all) residential-size refrigerant piping is smaller than 1" in diameter.
- Heat pump refrigerant piping generally falls into the following temperature categories:
  - **Cooling**: Both the large and small interconnecting pipes are typically cold and in the range of 40-60°F. These would require ½" thick insulation, UNLESS the requirement for insulation in heating is more.
  - **Heating**: The large interconnecting pipes are in the range of 141-200°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.

For large VRF heat pump systems, pipes should be insulated according to the following temperatures:
For "heat recovery" (also known as 3-pipe) systems:

A. Between outdoor unit and "branch selector boxes":
   1. Cold (low/pressure) gas pipe: 40-60°F.
   2. Liquid pipe: 105-140°F
   3. 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.)

B. Between "branch selector boxes" and indoor units.
   1. Liquid pipe: 105-140°F
   2. The gas pipe is sometimes a hot gas pipe (in heating) and sometimes it's a low pressure/temperature gas (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.

For heat pump systems without heat recovery (also known as 2-pipe) systems:

1. The large (gas) pipe is either a hot gas pipe (in heating) or is a cold gas pipe (in cooling), and so it should be insulated at the worse of these two conditions, which is a 141-200°F pipe.
2. The small (liquid) pipe is always a hot liquid pipe, so should be insulated as a 105-140°F hot pipe.

Hot water piping leaving a heat pump water heater is commonly in the 105-140°F range, and so requires 1" thick insulation for piping smaller than 1.5" in diameter. However, some heat pump water heaters supply hot water at higher temperatures (above 140°F), typically to a mixing valve, in which case these hotter pipes need 1.5" thick insulation for pipes smaller than 1.5" diameter.

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. A good discussion of this issue can be found here: [Inspectapedia link]. There are lower risks of not insulating plastic condensate piping because the surface temperature of the plastic is typically higher than the dewpoint temperature of the air. Metal condensate piping has a higher risk of condensation.

B. INSULATION PROTECTION

CODE REQUIREMENT

- ***NYC ECC C403.11.3.1 (2020):*** *Piping insulation exposed to the weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.*

SUMMARY

Outdoor refrigerant piping will be exposed to UV radiation, so the pipe insulation must be UV-resistant to prevent degradation. This protection can be various UV-protective jackets that come with the insulation; a larger enclosure, typically made of plastic or metal; or a variety of other approaches.

UV-protective paint reportedly requires re-painting every 2-3 years, which is an unrealistic expectation.

It is important that piping be insulated all the way from the outdoor unit to the indoor unit, both to meet code requirements and to prevent the formation of condensate on cold piping.

Some types of insulation have been reported to cause corrosion, resulting in substantial deterioration and leaks in copper piping. Select insulation carefully to avoid these problems. We are tracking this issue and will add information as it becomes available. Current advice is to make sure that the ends of the insulation are well sealed. Resources on this issue: 1. https://hvacrschool.com/ductless-line-sets-and-corrosion/ 2. https://www.pmengineer.com/articles/95874-dave-yates-formic-acid-corrosion-erosion

For buildings using the ASHRAE Standard 90.1 compliance path, ASHRAE Standard 90's pipe insulation requirements are currently identical to those in the ECC.

C. CONTROLS

CODE REQUIREMENT

- ***NYC ECC Section C403.4.1.1 (2020) Heat pump supplementary heat (Mandatory).*** *Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation where the heat pump can provide the heating load.*
- ***NYC ECC Section 6.4.3.5*** *Same as above.*
- ***NYC ECC Section C403.4.1.2 Deadband (Mandatory).*** *Where used to control both heating and cooling, zone thermostatic controls shall be configured to provide a temperature range or deadband of not less than 5°F (2.8°C) within which the supply of heating and cooling energy to the Zone, is shut off or reduced to a minimum.*

Exceptions:

- *Thermostats requiring manual changeover between heating and cooling modes.*
- *Occupancies or applications requiring precision in indoor temperature control as approved by the building official.*

- ***C403.4.2 Off hour controls (Mandatory).*** *Each zone shall be provided with thermostatic setback controls that are controlled by either an automatic time clock or programmable control system.*

  Exceptions:
  - *Zones that will be operated continuously.*
  - *Zones with a full HVAC load demand not exceeding 6,800 Btu/h (2 kW) and having a manual shutoff switch located with ready access.*

SUMMARY

Design temperature versus actual setting:

It is important not to confuse the design temperature with the actual setting of the thermostat. For example, the Energy Code allows the indoor temperature to be as high as 72°F for purposes of sizing equipment. We recommend using this maximum temperature of 72°F to size equipment, in order to be conservative and minimize risk of spaces being cold in winter. However, this 72°F should not be confused with the Building Code minimum of 68°Fwhich specific spaces should both follow code requirements and minimize energy use. For example, spaces without sedentary activity, which we interpret as spaces without seating such as corridors and stairwells, require a minimum temperature of 50°F per the Building Code Table 1204.1.

D. SIMULTANEOUS HEATING/COOLING SAME SPACE - HOW TO PREVENT

CODE REQUIREMENT

- ***NYC ECC Section C403.4.1.2*** Requires a deadband of at least 5°F between heating and cooling modes unless switching from heating to cooling is a manual process ….
- ***NYC ECC Section C403.4.1.3*** Requires a mechanical or programmed limit to prevent overlap between heating and cooling setpoints when each is controlled by a separate controller.

SUMMARY

Confirm that manufacturer thermostat has a 5-degree deadband. Also, if the previous heating system is kept, make sure it does not inadvertently heat when the heat pump is in cooling; set controls accordingly, and preferably never run both systems at the same time.

E. EFFICIENCY REQUIREMENTS

CODE REQUIREMENT

- ***NYC ECC Section C403.3.2*** Tables C403.3.2(2) and (3) give minimum efficiency requirements for various heat pump configurations and sizes. In general, efficiency requirements are lower for larger, more centralized systems.

SUMMARY

Residential split system air source heat pumps smaller than 65,000 Btu/hr (cooling capacity) require 14.0 SEER in cooling and 8.2 HSPF heating. These are the most common sizes and requirements for residential mini/multi-split heat pumps.
Larger commercial VRF systems have the following requirements:

- VRF systems >=65,000 and <135,000 Btu/hr (cooling capacity) require 11.0 EER or 12.2 IEER in cooling and 3.3 COP (at 47°F DB/43°F WB outdoor air) and 2.25 COP (at 17°F DB/15°F WB outdoor air) in heating.
- VRF systems >=135,000 and <240,000 Btu/hr (cooling capacity) require 10.4 EER or 11.4 IEER in cooling and 3.2 COP (at 47°F DB/43°F WB outdoor air) and 2.05 COP (at 17 DB/15 WB outdoor air) in heating.
- VRF systems >=240,000 Btu/hr (cooling capacity) require 9.3 EER or 10.4 IEER in cooling and 3.2 COP (at 47°F DB/43°F WB outdoor air) and 2.05 COP (at 17°F DB/15°F WB outdoor air) in heating.

It should be noted that some of these energy code requirements (for example, for products smaller than 65,000 Btu/hr) are also federal equipment efficiency requirements under the National Appliance Energy Conservation Act (NAECA), so it would be unusual for an available product to NOT meet these requirements.

MECHANICAL

A. HEATING AND COOLING LOAD CALCULATIONS

CODE REQUIREMENT

- ***NYC MC 312.1 (2022) Load Calculations:*** *Heating and cooling system design loads for the purpose of sizing systems, appliances and equipment shall be determined in accordance with the procedures described in the ASHRAE ACCA Standard 183. Alternatively, design loads shall be determined by an approved equivalent computation procedure, using the design parameters specified in the New York City Energy Conservation Code. Heating and cooling system design loads for the purpose of sizing systems, appliances and equipment shall also comply with the requirements of Section 1204 of the New York City Building Code.*
- ***NYC ECC C302.1 (2020) Interior design conditions:*** *The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.*
- ***NYC Building Code 1204.1 (2022) Equipment and Systems:*** *Interior spaces intended for human occupancy shall be provided with active or passive space heating systems capable of maintaining an indoor temperature as indicated in Table 1204.1 at a point 3 feet (914.4 mm) above the finished floor. The heating capacity of heat-producing devices and equipment which are contained in the room and in constant use during occupancy may be deducted from the capacity of the heating system. Portable heating systems shall not be considered as contributing to the capacity of the heating system.*

Exception: *Where specific rooms or spaces are not listed, the temperature shall be determined by the requirements of the listed space to which they most nearly conform or as determined by the registered design professional.*

TABLE 1204.1
MINIMUM SPACE TEMPERATURE REQUIREMENTS[a]

ROOMS OR SPACES	MINIMUM TEMPERATURE (F)
Habitable rooms in all buildings	68
Building equipment and machinery rooms	50
Patients' rooms, bathrooms and toilet rooms, stairs and corridors in hospitals and nursing homes	As per the *New York State Health Code*
Bathrooms and toilet rooms except patients' bathrooms and toilet rooms in hospitals and nursing homes	68
Offices, waiting rooms, art galleries, museums, libraries, meeting rooms, houses of worship, classrooms, auditoriums, lecture halls, nightclubs, restaurants, theatres, locker rooms, dressing rooms, and spaces where persons are engaged in sedentary activities	68
Laboratories, light machine work, product inspections, loft buildings, shops, stores, display rooms, show rooms, sales rooms, and spaces where persons are engaged in moderate physical activities	65
Gymnasia, dance halls, skating rinks, bowling alleys, heavy assembly workrooms or shops, and spaces where persons are engaged in vigorous physical activities	60
Automotive repair shops	50
Storage areas, garages, space where work or process requires a low temperature	None
Hospital operating rooms, and recovery, labor, delivery, and nursery rooms	As per the *New York State Health Code*
Swimming pools, bath houses, and shower rooms	75

a. Temperatures listed here are the minimum requirements of the department. However, other jurisdictional authorities may have more stringent requirements.

Exceptions:

1. Heating systems are not required when occupancy is seasonal and the rooms or buildings are not occupied between November 1st and May 1st of the following year.
2. Heating systems are not required when the processes or activities normally conducted in the space will generate sufficient heat to maintain the prescribed temperatures during the time of occupancy.
3. Spaces where strict process requirements mandate temperatures other than those cited above shall be exempt from the minimum requirements listed in Table 1204.1.

- ***NYC Building Code 1204.2 (2022) Air Conditioning:*** *Interior spaces intended for human occupancy that are provided with air conditioning shall be provided with active or passive systems that are capable of maintaining 78°F (26°C) at 50-percent relative humidity when the outdoor air temperature is 89°F (32°C) and the coincident wet bulb temperature is 73°F (23°C). Interior spaces without air conditioning shall be provided with mechanical or natural ventilation in compliance with other subsections of this code.*
- ***NYC Building Code 1204.3 (2022) Freeze Protection:*** *All interior spaces shall be provided with active or passive systems or with methods of construction capable of preventing wet piping systems and vessels from freezing at all times, including permanently installed pipe heat tracing systems.*
- ***NYC Building Code 1204.4 (2022) System Design:*** *The heating system and air-conditioning system, as applicable, shall be designed to provide sufficient capacity to meet the temperature and humidity requirements of Section 1204 when considering the outdoor air ventilation requirements and all losses in the system and ancillary uses, such as domestic hot water, for which the system is used. The system shall be designed and installed to meet all other applicable provisions of this code.*
  Exception: The following spaces within a dwelling unit shall not be considered habitable spaces[1]:

  1. A dining space 55 square feet (5.1 m2) or less located off a living room, foyer or kitchen;

[1] *Definition (per NYC Building Code 1201) of Habitable Space: All rooms and spaces within a dwelling unit in Group R or I-1, including bedrooms, living rooms, studies, recreation rooms, kitchens, dining rooms and other similar spaces.*

2. A kitchenette;
3. A bathroom or toilet room;
4. A laundry room; and
5. A corridor, passageway, or private hall; and a foyer used as an entrance hall in a dwelling unit: not exceeding 10 percent of the total floor area of the dwelling unit; or not exceeding 20 percent of the floor area of the dwelling unit where every habitable room is at least 20 percent larger than the required minimum room sizes established by the New York City Housing Maintenance Code.

SUMMARY

To be conservative and ensure adequate heating by heat pumps through winter, equipment sizing for habitable spaces, such as inside dwelling units, should be designed to 72°F indoor temperatures. We recommend sizing equipment based on 99.6% dry bulb heating design temperatures (NYC Central Park condition is 13°F DB) This exceeds the NYSERDA Clean Heat requirement of using the 99% dry bulb (17°F) but meets the NYSERDA Clean Heat requirement of the outdoor temperature being within 5°F of 17°F for NYC. Equipment sizing should also use 0.4% dry bulb cooling design temperatures and mean cooling wet bulb temperatures (NYC Central Park conditions are 91°F DB and 78.7°F MCWB, respectively).

What temperature should we keep spaces outside of habitable spaces? Spaces outside of habitable spaces do not need to be kept at 68°F (except where there are sedentary activities, such as lobby waiting areas), but shall be provided with freeze protection (per Building Code 1204.3). These spaces, such as stairwells with standpipes, frequently use electric resistance heat in electrified buildings in order to reduce construction costs. To minimize the use of inefficient electric resistance heat, we recommend sizing and setting these systems not to exceed 50°F (consistent with the Building Code's Table 1204.1 "Building equipment and machinery room" requirement, shown above, and to prevent pipes from freezing).

For spaces within dwelling units that are not habitable spaces, such as bathrooms, where it is unusual to put indoor heat pump units, electric resistance heat is also commonly used. We recommend using timer controls (such as mechanical crank timers) for these spaces, again to minimize the use of inefficient electric resistance heat. If a space has no wall/ceiling/floor in contact with the outdoors, it does not need heat, per Exception 2 to the Building Code section 1204.1.

ACCA Manual J and ASHRAE 183 do not mandate indoor temperatures for any spaces.

In summary, the following spaces are interpreted as needing the following minimum temperature requirements (per Building Code Table 1204.1):

Space	**Min. Temp.(°F)**	**Energy-Efficient Control Options***	**Notes**
Bedrooms and living rooms	68	7-Day Programmable Thermostat	Thermostat required by Energy Code

Bathrooms in apartments	68	Crank timer	Crank timer allows temporary heating without unnecessary heating during unoccupied periods. Note: If bathroom is entirely interior, no heat is needed, per Exception 2 to Table 1204.1 of the building code.
Areas that are not habitable spaces and that have seating (lobby with seating, vestibule with seating, corridor with seating, stairwell with seating, basements with seating, etc.).	68	68	Seating is interpreted as "sedentary" activity, seating is interpreted as "waiting room", in Table 1204.1.
Areas with transient (short-term) activity that are not habitable spaces and that do NOT have seating (spaces without seating; i.e. lobby, vestibule, seating, corridor, stairwell, basements, etc.).	50	Temperature-limiting thermostat to maintain temperature at 50 (e.g. minimum 50 to prevent freezing, but also locked at 50 to prevent unnecessary heating).	With no sedentary activity, we interpret that there are no requirements so set it at minimum to prevent pipe freezing.
Laundry Room, Workshops for repair	65	7-day thermostat, with 55 unoccupied temperatures	Interpreted to be "moderate physical activity"
Elevator machine rooms, meter rooms	50	Temperature-limiting thermostat to maintain temperature at 50 (e.g. minimum 50 to prevent freezing, but also locked at 50 to prevent unnecessary heating).	Interpreted to be covered by "Building equipment and machinery room" section of Building Code Table 1204.1
Storage areas, garages, space where work or process requires	50		Freeze protection required by NYC Building Code 1204.3. 50°F

a low temperature, that have pipes at risk of freezing			is our Summary of a temperature that will prevent freezing of pipes. Pipe heat tracing is another option.
Storage areas, garages, space where work or process requires a low temperature, that do not have pipes at risk of freezing	None		

***** These energy-efficient control options are offered as suggestions, working within the bounds of interior temperatures required by code.

Note that the building code states: ***NYC Building Code 1204.1 (2022) Equipment and Systems:*** *Interior spaces intended for human occupancy shall be provided with active or passive space heating systems capable of maintaining an indoor temperature as indicated in Table 1204.1 at a point 3 feet (914.4 mm) above the finished floor.*

By sizing to 72°F indoor temperature, as allowed by the energy code, we are ensuring that the space can be heated to the temperatures in 1204.1. We do not recommend sizing to the temperatures in table 1204.1, for multiple reasons:

a. These are minimum temperatures that must be maintained. If we size exactly to these temperatures, we risk not delivering these minimum temperatures.
b. These temperatures are measured 3 feet above the finished floor. However, a typical thermostat or temperature control is located 5 feet above the finished floor, which will typically be 1-2°F warmer than 3 feet above the finished floor.
c. Sizing to 72°F is more conservative, to ensure comfort through the coldest days.

B. EQUIPMENT SIZING

CODE REQUIREMENT

- ***NYC ECC Section C403.1.1*** Requires that heating/cooling loads be "determined in accordance with ANSI/ASHRAE/ACCA Standard 183 or ... an approved equivalent computational procedure."
- ***NYC ECC Section C403.3.1*** Requires that heating/cooling equipment capacity "shall not be greater than ... the smallest available equipment size that exceeds the loads."

SUMMARY

ACCA Manual S is used for sizing equipment. As of this writing (December 2022), the latest version is ACCA Manual S, 2nd edition (2014). This edition presumes that heat pumps require backup heat in order to meet building heat loss at design conditions in cold climates OR that buildings are in mild climates where cooling dominates heating, and so for either of these two conditions the standard requires sizing to the cooling load.

ACCA Manual S also requires sizing each indoor unit to its zone's requirements (one size larger than the indoor zone requirement), and then sizing the outdoor unit to match the sum of the peak indoor load.

Most, if not all, cold climate heat pumps today do not require inclusion of backup heat. Backup heat can be used but is not required. This approach/condition of not including backup heat is not directly addressed by ACCA Manual S. We infer from the standard that for this approach/condition (i.e., compressor capacity sufficient at conditions to meet the design load) that no backup heat is required.

From the combination of ACCA Manual S and NYS ECC 403.3.1, we further interpret:

a. Sizing should be to whichever is larger, the heating load or the cooling load.
b. The indoor unit capacity must be larger than the peak heat loss of its zone.
c. The outdoor unit capacity must be the smallest capacity that both meets the largest simultaneous peak load AND be approved by the manufacturer for use with the chosen indoor units. In other words, if the smallest-capacity outdoor unit that meets the largest simultaneous peak loads is not approved by the manufacturer for use by the indoor units, then a larger outdoor unit must be used.

C. REFRIGERANT RELEASE

CODE REQUIREMENT

- ***NYC Mechanical Code Chapter 11 (Refrigeration): 1102.1 General***
  The system classification, allowable *refrigerants, maximum quantity, enclosure requirements, location limitations, and field pressure test requirements shall be determined as follows:*

  1. *Determine the refrigeration systems classification, in accordance with Section 1103.3.*
  2. *Determine the refrigerant classification in accordance with Section 1103.1.*
  3. *Determine the maximum allowable quantity of refrigerant in accordance with Section 1104.based on type of refrigerant, system classification and occupancy.*
  4. *Determine the system enclosure requirements in accordance with Section 1104.*
- The most common refrigerant used in heat pumps today in the U.S. is 410a. This is classified as an A1 refrigerant.
- ***NYC MC 1103.1*** Allows for 26 lb of R-410A per 1,000 ft^3 of indoor space as defined in 1104.4. 4.5 lb / 1,000 ft^3 is the threshold for R-744 (CO_2).
- ***NYC MC 1104.4*** Details volume calculations for determining refrigerant handling requirements. In general, the smallest enclosed space with refrigerant components inside is to be used to calculate the total volume of refrigerant allowed in the system. When ductwork is used, the smallest room served by that ductwork is used, even if there are no other refrigerant components in that room.

SUMMARY

This provision relates to what happens if all of a system's refrigerant leaks into a small room, specifically the smallest room on the system, and so displaces the oxygen. The code requirement is 26 pounds per 1000 cubic feet of space for Refrigerant 410a. So, we take the smallest space on the system, which would typically be a bedroom. Let's say the smallest bedroom in an apartment is 100 square feet with a 9-foot-high ceiling; i.e., 900 cubic feet. That would mean that this system would not be able to have more than (900/1000) x 26 = 23.4 pounds. Most residential multi-split heat pumps have way less than 23.4 pounds, so meeting this code requirement is likely only a challenge with large commercial VRF systems.

If there is ever a problem meeting this requirement, possible solutions include:

- Ducting two or more rooms together. Then the volume used is the total volume of the rooms served by the ducted system.
- Using a larger number of smaller, distributed systems rather than fewer, larger centralized systems (e.g., by using smaller multi-split systems rather than larger VRF systems, or smaller VRF systems.)

In the future, we expect other refrigerants to become more commonly used, for which the calculation will be different.

D. REFRIGERANT PIPING SUPPORT

CODE REQUIREMENT

- ***NYC Mechanical Code 305.2*** *Materials. Pipe hangers and supports shall have sufficient strength to withstand all anticipated static and specified dynamic loading conditions associated with intended use. Pipe hangers and supports that are in direct contact with piping shall be of materials that are compatible with the piping and that will not promote galvanic action.*
- ***NYC Mechanical Code 305.3*** *Structural attachment. Hangers and anchors shall be attached to the building structure. Post installed anchors shall be subject to special inspection in accordance with Section 1705.37 of the New York City Building Code*
- ***NYC 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.*
- ***NYC Mechanical Code Table 305.4*** Provides maximum horizontal and vertical spacing distances for many different kinds of piping.

SUMMARY

Make sure to use pipe hangers or anchors that are compatible with the copper refrigerant piping, or use a spacer or dielectric material, to avoid corrosion.

Most (virtually all) refrigerant piping is copper and is smaller than 1” in diameter. So most refrigerant piping will require supports every 6’ horizontally and 10’ vertically.

E. COMMISSIONING

CODE REQUIREMENT

- ***NYC Energy Code C408.2 (2020)*** *Mechanical Systems and Service Water-Heating Systems Commissioning and Completion Requirements*

  Prior to the final mechanical and plumbing inspections, the registered design professional or approved agency shall provide evidence of mechanical systems commissioning and completion in accordance with the provisions of this section.

  Construction document notes shall clearly indicate provisions for commissioning and completion requirements in accordance with this section and are permitted to refer to specifications for further requirements. Copies of all documentation shall be given to the owner or owner's authorized agent and made available to the building official upon request in accordance with Sections C408.2.4 and C408.2.5.

Exceptions: *The following systems are exempt:*

- *Mechanical systems and service water heater systems in buildings where the total mechanical equipment capacity is less than 480,000 Btu/h (140.7 kW) cooling capacity and 600,000 Btu/h (175.8 kW) combined service water-heating and space-heating capacity.*
- *Systems included in Section C403.5 that serve individual dwelling units and sleeping units.*

SUMMARY

Heat pumps in anything but small buildings must be commissioned. Assuming 24,000 Btu/h cooling capacity for a typical apartment, or 30,000 Btu/h combined water-heating and space-heating capacity per apartment, this means that buildings over 20 units (roughly) must be commissioned.

F. EQUIPMENT ON ROOFS OF ELEVATED STRUCTURES

CODE REQUIREMENT

- **NYC MC 306.5** *is entitled* ***"Equipment and Appliances on Roofs of Elevated Structures."*** This section is fairly self-explanatory, so is not reproduced here.

SUMMARY

This section of the code specifies minimum requirements for accessing equipment installed on elevated structures exceeding 16 feet in height. It calls for providing access to the equipment by a permanent approved means of access such as permanent ladders with cages, for example. It also addresses the safety requirements for elevated structures with a sloped roof. It has detailed safety requirements for installation of ladders and their extensions.

G. VIBRATION ISOLATION

CODE REQUIREMENT

- ***NYC MC 313.3 (2022) Minimum Structure-Borne Noise and Vibration Isolation Requirements:*** *All isolators shall comply with the requirements of Sections 313.3.1 through 313.3.10. Where vibration isolation of equipment and appliances is employed, supplemental restraint shall be used to accomplish the support and restraint.*
- ***313.3.3 Piping:*** *Equipment piping shall be installed as follows:*

1. *Metal piping connected to power driven equipment shall be resiliently supported from or on the building structure for a distance of 50 pipe diameters from the power-driven equipment. The resilient isolators shall have a minimum static deflection of 1 inch (25.4 mm) for all piping with a 4 inch (101.6 mm) or larger in actual outside diameter and 1/2 inch (12.7 mm) for piping with less than 4 inches (101.6 mm) in actual outside diameter. Piping connected to fluid pressure-reducing valves shall be resiliently isolated for a distance of 50 pipe diameters from pressure-reducing valves and isolators shall provide a minimum static deflection of 1/2 inch (12.7 mm).*

2. *Equipment such as heat exchangers, absorption refrigeration machines, or similar equipment, that is located on any floor or roof other than a floor on grade, and that is not power driven but is connected by metal piping to power driven equipment, shall be resiliently supported from or*

on the building structure, for a distance of 50 pipe diameters from the power-driven equipment. The resilient supports shall be vibration isolators having a minimum static deflection of 1 inch (25.4 mm) and shall incorporate approved resilient pads having a minimum thickness of 1/4 inch (6.4 mm).

- ***313.3.4 Fans:*** *All fan equipment with motors in excess of 1/2 horsepower (0.37 kW), located on any roof or floor other than a floor on grade shall be mounted on or from vibration isolators. Fan equipment with motor drives separated from the fan equipment shall be supported on an isolated integral rigid structural base supporting both the fan and motor. Fan equipment with motor drives supported from the fan equipment shall be mounted directly on vibration isolators. Each isolator shall have provision for leveling. Isolators shall incorporate resilient pads having a minimum thickness of 1/4 inch (6.4 mm). The vibration isolators shall provide a minimum isolation efficiency of 90 percent at fan rotor rpm with a maximum deflection of 2 inches (50.8 mm). Fans and compressors assembled in unitary containers may meet this requirement with isolators internal to the container providing the isolators meet the above minimum isolator efficiencies.*
- ***313.3.6 Compressors:*** *Compressors and drives located on a floor other than a floor on grade shall be mounted on vibration isolators having a minimum isolation efficiency of 90 percent at the lowest disturbing frequency. Each isolator shall incorporate a leveling device and a resilient pad having a minimum thickness of 1/4 inch (6.4 mm).*
- ***313.3.9 Duct Connections to Fans:*** *Flexible connections shall be installed between fan equipment and connecting ductwork.*
- ***313.3.10 Ceiling Suspended Packaged HVAC Units with Compressors:*** *Equipment such as heat pumps, air-conditioning units, or similar equipment, that is suspended from a structure shall be resiliently supported from or on the building structure. Vibration isolators shall have a minimum isolation efficiency of 90 percent at the lowest disturbing frequency.*

SUMMARY

Variable speed compressors mean excitation over many frequencies and a greater chance of hitting harmonic vibration. Compressors should be mounted to structurally firm structures and care should be exercised when mounting to structures that are more prone to vibrating, such as wood frame structures.

The following are summaries for specific equipment related to heat pump systems.

313.3.3.1 Piping: The key requirement relating to split system heat pumps is:

"*Metal piping connected to power driven equipment shall be resiliently supported from or on the building structure for a distance of 50 pipe diameters from the power driven equipment. The resilient isolators shall have a minimum static deflection of... 1/2 inch (12.7 mm) for piping with less than 4 inches (101.6 mm) in actual outside diameter."*

We assume that heat pumps are a type of "power driven equipment," from the definition of condensing units in Chapter 2 of the mechanical code:

CONDENSING UNIT. A specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers and, where required, liquid receivers, and the regularly furnished accessories.

We further make the leap from condensing unit to heat pump, because the outdoor section of heat pumps is derivative from the traditional air conditioning condensing unit.

There are no split system pipes larger than 4" in diameter, so the only requirement of interest to us is for pipes smaller than 4" in diameter.

We use the following definition of "minimum static deflection:":

*"Vibration isolators are described in terms of the "minimum static deflection". Static deflection is simply **the amount that a spring compresses under the weight of the equipment**. If a spring is 2" long when unloaded, and compresses to 1" when carrying the weight, we say that it has 1" of static deflection."*[2]

313.3.3.2 Heat Exchangers: Heat exchangers (in our area of interest, this would be heat pump indoor units) connected by metal piping (in our area of interest, the copper piping between heat pump outdoor and indoor units) to power driven equipment (in other words, heat pump outdoor units) also need to have vibration supports for 50 pipe diameters from the power driven equipment.

It is not immediately clear if the requirement is for vibration isolation for the heat exchanger or for the piping. In other words, does the heat exchanger need to be hung with vibration isolation or does the interconnecting piping need to be hung with vibration isolation? However, since piping is covered in item 1 of 13.3.3, immediately above, we infer that the vibration isolation is for the heat exchanger (in other words the indoor unit). Specifically, our summary is that the indoor unit needs to have vibration isolation only if the indoor unit is within 50 pipe diameters of the outdoor unit. It would be highly unusual for a heat pump indoor unit to be located within 50 pipe diameters from a heat pump outdoor unit. **So, in general, because most indoor units are located more than 50 pipe diameters from outdoor units, this requirement for vibration isolation for indoor units does not apply.** The only instance in which this might be required is where the outdoor unit is hung on a wall immediately outside the location where the indoor unit is hung on the inside of the same outdoor wall, or very close by. **So, we do importantly also conclude that for this specific (and not typical) case, where an outdoor unit is within 50 pipe diameters of an indoor unit, the indoor unit must be mounted with code-compliant vibration isolation, regardless of whether the indoor unit is ceiling-suspended, wall-hung, or floor-mounted.**

313.3.4 Fans:

Ductless heat pump indoor fan motors are typically smaller than the ¼ HP code threshold above which vibration isolation is required, so do not require vibration isolation. Fan motors in *ducted* indoor units in heat pumps and in heat pump outdoor units may well go above this ¼ HP threshold, especially for larger heat pumps. However, these units typically come with internal vibration isolation assemblies. To be

[2] http://www.mullinsacoustics.com/vibrate.html#:~:text=Vibration%20isolators%20are%20described%20in,has%201%22%20of%20static%20deflection.

safe, the design professional or contractor should confirm with the manufacturer (a) if fan motors in any of the equipment is greater than ¼ HP; AND, if so, whether (b) the assembly complies with this code requirement for vibration isolation. If any fan motors are larger than ¼ HP AND if their internal vibration isolation does not comply with the code requirement, then the design professional should require external vibration isolation that complies with code requirements wherever the equipment itself is mounted.

313.3.6 Compressors:

Check with the heat pump manufacturer if the equipment has code-compliant vibration isolation for compressors, inside the equipment. If not, the design professional should require such isolation outside the unit, where the outdoor unit is mounted.

313.3.9 Duct Connections to Fans:

Indoor units require flexible connection to ducts. Note that this obviously only applies to ducted indoor units, and not to ductless indoor units.

313.3.10 Ceiling Suspended Packaged HVAC Units with Compressors

The main products that are currently ceiling-suspended AND that have compressors are water-to-air heat pumps in boiler-tower water loop heat pump systems. These are not recommended for multifamily buildings that are electrifying because they use fossil fuels.

H. SERVICE ACCESS

CODE REQUIREMENT

- ***NYC MC Section 306.1*** Access for maintenance and replacement. A level working space at least 30 inches deep and 30 inches wide (762 mm by 762 mm) shall be provided in front of the control side to service an appliance. Clearance shall also be provided as required by the Electrical Code.

SUMMARY

Note the requirements for service clearance are in addition to clearances required by manufacturers for airflow. Manufacturers may also have service access requirements and, if so, MC 304.2 states that where there are conflicts between the code and manufacturer's requirements, the more restrictive of the two shall govern.

ELECTRICAL

A. RECEPTACLE CLOSE TO THE OUTDOOR UNIT

CODE REQUIREMENT

- ***NEC Section 210.63*** Requires a "125-volt, single phase, 15- or 20-ampere rated receptacle outlet ... at an accessible location ... on the same level and within 7.5 m (25 ft)" of the equipment (typ. outdoor unit). Furthermore, the outlet "shall not be connected to the load side of the equipment disconnecting means."

SUMMARY

NEC Section 210.63 An outlet is required within 25 feet of outdoor units. This requirement was developed about a decade ago to ensure that technicians had access to power for equipment, such as vacuum pumps to allow proper refrigerant charging. The "load side" requirement means that the outlet needs to be powered even with the equipment powered off. Note that an outlet can serve multiple outdoor units within 25 feet.

B. ELECTRICAL SIZING

CODE REQUIREMENT

- ***NEC 440*** Covers heat pumps under air-conditioning and refrigerating equipment. Detailed code requirements for sizing of electrical devices are not covered in this document.

SUMMARY

Without going into code requirements, we offer a few suggestions about electrical sizing:

a. Proper sizing of heat pumps for existing buildings involves examining multiple existing components:
    a. The size of the sub-panel, typically in each apartment.
    b. The size of the wires ("feeders") to the sub-panel in the apartment.
    c. The size of the breaker serving the sub-panel, which can either be in the sub-panel itself or in a main panel that serves the sub-panel.
    d. The size of the main panel, if any.
    e. The size of the service from the utility to the building.
b. In general, a 100-amp subpanel in an apartment is sufficient to handle a heat pump alone (plus traditional lighting and convenience receptacles) but may not be enough if the apartment gas stove, gas water heater, and/or gas dryer are converted to electric.
c. Sizing and code compliance should be done by a qualified professional.

C. DISCONNECTING MEANS

CODE REQUIREMENT

- ***NEC Section 440.14*** Requires an electrical disconnect "within sight from, and readily accessible" to the equipment.

SUMMARY

The disconnect can be installed on the equipment, or nearby. Note that there is a difference between "readily accessible" and "accessible" – "readily accessible" means that it cannot require tools to access.

Do heat pump indoor units need to have their own disconnects?

The answer to whether indoor units need to have their own disconnects depends on a few factors.

1. Some indoor units are on their own circuits, separate from the outdoor unit. For these, NEC 422.31 indicates that a permanently connected appliance rated at not over 1/8 HP can use its breaker as a disconnect if the panel is within sight from the indoor unit or if a locking breaker is used. Most ductless indoor units, and smaller ducted indoor units, have motors that are smaller than 1/8 HP and so can use this approach. However, larger ducted indoor units with motors bigger than 1/8 HP need their own disconnects.

2. Many indoor units get their power from the outdoor unit. This is more of a gray area. In general, the indoor units are treated as part of a single piece of equipment along with the outdoor unit, and so the usual disconnect at the outdoor unit meets the letter of the code requirement. However, some building inspectors have been reported to require disconnects at each indoor unit. And we point out that, when servicing an indoor unit, it is typically not convenient to go outdoors (on the roof, etc., wherever the outdoor unit is located) to shut the disconnect.

Can heat pumps have two separate power supplies, in order to allow residents to pay for cooling in summer?

It appears that nothing prohibits heat pumps from having two separate (switchable) power supplies, but strong safety precautions must be taken.

Recently, a practice has begun to provide two power supplies to heat pumps, one from the house (landlord) panel/meter and one from the apartment (resident) panel/meter. The reason for this is to allow the power supply to be switched in the summer to the apartment panel/meter, for the resident to pay for summertime cooling, and vice versa in winter for the landlord to pay for the heating.

This approach does not appear to be prohibited by the electric code. We point out that it may present a hazard: A service technician may turn off power to the unit at one location, for example the apartment breaker, and not realize that the heat pump still has power to it from the landlord/house panel. Appropriate disconnects at the unit and visible caution labels are likely required. We point out further that this may not be as simple as it seems.

a. The disconnect needs to cut BOTH power supplies.
b. Many, but not all, heat pump indoor units are supplied with power from the outdoor units. A common practice is to treat both the indoor unit and outdoor units as one piece of equipment, for which there is only one disconnect at the outdoor unit.
c. Some heat pump indoor units have their own power supply. A technician unfamiliar with this arrangement could think that power cut at the outdoor disconnect has cut power to the indoor units.

Further, we have not heard whether the Fire Department has weighed in on this approach, formally or informally.

In short, caution is advised when taking the approach of dual power supplies, and in general it is not advisable at this time.

PLUMBING

A. CONDENSATE HANDLING REQUIREMENTS

CODE REQUIREMENT

- ***NYC PC 802***

802.1.5 Nonpotable clear-water waste*. Where devices and equipment such as process tanks, filters, drips and boilers discharge nonpotable water to the building drainage systems, the discharge shall be through an indirect waste pipe by means of an air break or an air gap.*

SUMMARY

Air conditioner condensate should be regarded as non-potable, even though it is primarily distilled water. But its contact with condensate pans, where mold might grow, makes it non-potable. It should be drained through an air break or air gap.

B. CONDENSATE – PLACE OF DISPOSAL

CODE REQUIREMENT

- ***NYC LL14 Section 314.2.1 (2020)*** Requires discharge of condensate to an "approved place of disposal." They only define places that are not approved – "street, alley, or other area so as to cause a nuisance." In addition, a slope of 1/8 inch per foot is the minimum slope required for drain piping.
- ***NYS MC Section 307.2.1*** Same as Above
- ***NYC BC Section 3201.4*** states that condensate "shall not flow over a public walking surface."

SUMMARY

Do not route condensate to where it could potentially drip on people, cause a slipping hazard on walkways, or cause a nuisance in any other way. It is also important to recognize that "condensate" represents both condensation in the summer from the indoor units and defrost meltwater in winter from the outdoor units.

C. DRAINAGE PIPING CLEANOUT REQUIREMENTS

CODE REQUIREMENT

- ***NYC PC Section 708*** Requires cleanouts of drainage pipes.
- ***NYC MC 307 (New: November 2022)***

307.2.5 Drain line maintenance. *Condensate drain lines shall be configured to permit the clearing of blockages and performance of maintenance without requiring the drain line to be cut.*

SUMMARY

We interpret this requirement for cleanouts to apply to condensate pipes for heat pumps. This is i because condensate pipes can clog which will result in water overflow into finished spaces. A summary of requirements is:

a. Provide cleanout every 100' of horizontal pipe, at every change of direction greater than 45°F, and at the bottoms of risers.

b. Cleanouts shall be in the direction of flow or at right angles.
c. Cleanouts shall be the same size as the pipe.
d. Cleanouts require access.

For the complete requirements, refer to ***NYC PC Section 708.***
The new 2022 mechanical code requirement 307.2.5 affirms this requirement.

D. CONDENSATE PIPE MATERIAL REQUIREMENTS

CODE REQUIREMENT

- ***NYC MC Section 307.2.2 and NYC PC 314.2 Drain pipe materials and sizes.*** *Components of the condensate disposal system shall be cast iron, galvanized steel, copper, cross-linked, polyethylene, polyethylene, ABS, CPVC, or PVC pipe or tubing. Components shall be selected for the pressure and temperature rating of the installation. Joints and connections shall be made in accordance with the applicable provisions of Chapter 7 relative to the material type. Condensate waste and drain line size shall be not less than 3/4-inch (19.1 mm) internal diameter and shall not decrease in size from the drain pan connection to the place of condensate disposal. Where the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with Table 307.2.2 (314.2.2 in PC).*

TABLE 307.2.2
CONDENSATE DRAIN SIZING

EQUIPMENT CAPACITY	MINIMUM CONDENSATE PIPE DIAMETER
Up to 20 tons of refrigeration	¾ inch
Over 20 tons to 40 tons of refrigeration	1 inch
Over 40 tons to 90 tons of refrigeration	1¼ inch
Over 90 tons to 125 tons of refrigeration	1½ inch
Over 125 tons to 250 tons of refrigeration	2 inch

For SI: 1 inch = 25.4 mm, 1 ton = 3.517 kW.

SUMMARY

Our summary is that plain carbon steel pipes (typical of steam systems) are not a code permissible condensate drain pipe material. Existing pipes may be used as sleeves for running new condensate drain pipes, though.

The HPD Pilot Electrification program does not allow vinyl or corrugated tubing, per HPD Space Heating Heat Pump Technical Requirements.[3]

[3] https://www1.nyc.gov/assets/hpd/downloads/pdfs/services/space-heating-heat-pump-technical-requirements.pdf

OTHER

A. NOISE

CODE REQUIREMENT

- ***NYC Noise Control Code Section 24-227 Circulation devices.***

(a) No person shall operate or permit to be operated a circulation device in such a manner as to create a sound level in excess of 42 dB(A) when measured inside a receiving property dwelling unit. The measurement shall be taken with the window or terrace door open at a point of three feet from the open portion of the window or terrace door.

(b) On and after the effective date of this section, when a new circulation device is installed on any building lot or an existing device on any building lot is replaced, the cumulative sound from all circulation devices on such building lot owned or controlled by the owner or person in control of the new device being installed or the existing device being replaced shall not exceed 45 dB(A), when measured as specified in subdivision a of this section. For a period of two years after the effective date of this section, this subdivision shall not apply to the replacement of a circulation device that was installed on any building lot prior to the effective date of this section by a device of comparable capacity.

(c) Except as otherwise provided in subdivision b of this section, with respect to circulation devices installed on any building lot prior to the effective date of this section, the sound level limit of 42 dB(A) referred to in subdivision a of this section shall apply to each individual device except that if the cumulative sound from all devices owned or controlled by the same person on a building lot exceeds 50 dB(A), when measured as specified in subdivision a of this section, the commissioner may order the owner or person in control of such devices to achieve a 5 dBdA) reduction in such cumulative sound level within not more than 12 months after the issuance of such order.

SUMMARY

Noise control code specifies the following HVAC equipment noise limits:

- 42 dB(A) for a single air circulating device.
- 45 dB(A) for the cumulative noise level of multiple air circulating devices.

Both limits apply to noise levels measured within the receiving property at a distance of 3 feet from the open portion of a window.

Exterior HVAC should not exceed 45 dB(A) close to an adjacent property's open window.

As noted in the DEP Noise Control for Building Exterior Heating, Ventilation and Air Conditioning Equipment Guidance Sheet, additional options to reduce or avoid excessive noise from HVAC systems include:

- Do not place HVAC equipment near noise-sensitive receptors
- Place HVAC equipment in a separate mechanical room with massive walls/ceiling
- Select HVAC equipment with lower noise ratings
- Select fans to operate at peak efficiency
- Select fan sizes to allow lowest possible motor RPM

- Attach rooftop HVAC equipment to stiff/massive structural elements
- Avoid duct break-out noise with lagging cover or chaseway (>2 lbs/SF)
- Use flexible collars between all major elements
- Use acoustical louvers for air intake from outdoors
- Mount HVAC equipment on inertial blocks/rails/curbs
- Use vibration isolation springs/pads under rotating equipment
- Use silencers - dissipative/absorptive, reactive/muffler, active electronic Use silencers for air intake and discharge pathways with straight/smooth approach
- Place silencers as close to noise source as possible
- Beware silencer pressure drop (do not exceed 0.3 inchH2O) and self-generated noise
- Enclose rooftop HVAC equipment in a noise enclosure (provide for adequate airflow)
- Install a noise barrier or parapet wall between the HVAC equipment and the receptor(s)
- A barrier must break the line-of-sight, have no gaps, and be sufficiently massive (>4 lbs/SF)
- Use acoustical absorptive materials on the source side of a barrier or enclosure (noise reduction coefficient > 0.7)

The Department of Environmental Protection (DEP) generally uses the metric of "A-weighted decibel levels" - dB(A) - levels, which mimic human hearing. Sometimes DEP measures low frequency noise as well. When buildings are near elevated train lines or major vehicular roadways, then testing ambient noise levels may prove that more robust acoustic measures are required to avoid exceeding acceptable Db levels on equipment used.

B. CODE RESTRICTIONS FOR PLACEMENT OF HEAT PUMPS

CODE REQUIREMENT

There are a variety of clearance requirements that restrict the location/placement of heat pump outdoor units.

- ***NYC Mechanical Code 2022***
- ***304.11*** *Guards*
- ***304.13*** *Rooftop Access and Obstructions*
- ***306.1*** *Access*
- ***306.5*** *Equipment and Appliances on Roofs or Elevated Structures*
- ***NYC Fire Code 2022***
- ***504.4*** *Rooftop Access and Obstructions*
- ***504.4.1*** *Rooftop Access*
- ***504.4.4*** *Rooftop Clear Path*
- ***504.4.5*** *Rooftop Clear Path Protection*
- ***504.4.6*** *Required Rooftop Clearances*
- ***504.4.7*** *Rooftop Conduits and Piping*
- ***504.5*** *Rooftop Access on Buildings More Than 100 Feet in Height*
- ***1027.7*** *Fire Escapes*
- ***1027.7.1*** *Maintenance*
- ***1027.7.2*** *Window Gates*
- ***1027.7.3*** *Air Conditioners*

- ***1027.7.4*** *Fire Escape Ladders*

SUMMARY

NYC Mechanical Code 2022

- 304.11 Guards: (Fall) Guards are required for any equipment located within 10’ of a roof edge, or if any of the access path is within 10’.
- 304.13 Rooftop Access and Obstructions: Comply with fire code requirements and specifically do not obstruct windows, doors, fire escapes, or other egress.
- 306.1 Access: Clearance of at least 30”x30” must be provided in front of the control side of an appliance/equipment.
- 306.5 Equipment and Appliances on Roofs or Elevated Structures: Permanent access (no portable ladders) is required for equipment mounted over 16’ above grade/roof or floor level.

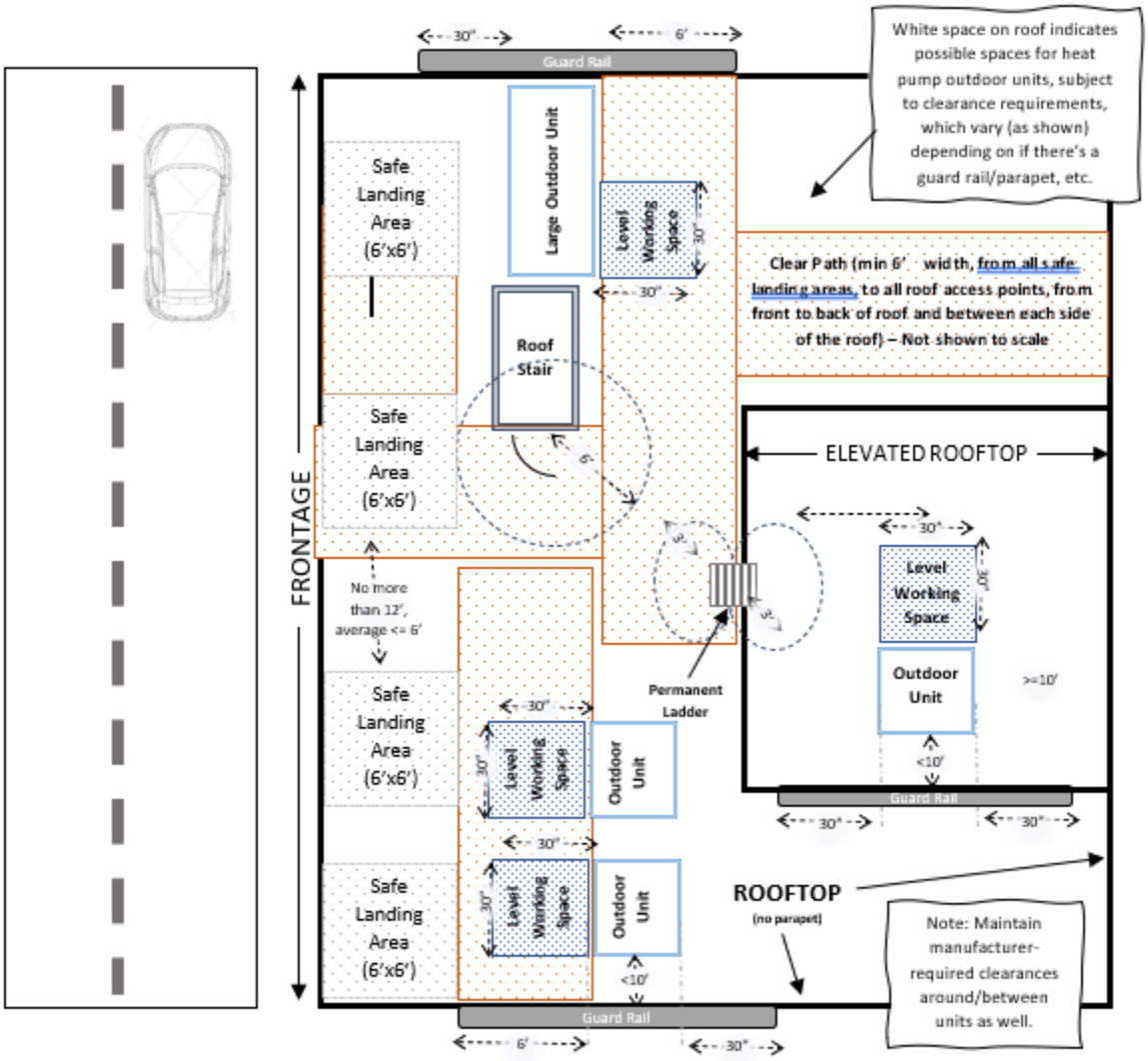
NYC Fire Code 2022

- 504.4 Rooftop Access and Obstructions: for buildings <100’ high, installations must minimize obstructions to firefighters for the purposes of a) roof access, b) surveillance of enclosed yards, c) vertical ventilation of heat/smoke.
- 504.4.1 Rooftop Access: For each 12 linear feet of perimeter accessed from the front there must be a minimum 6’x6’ landing area. These shall generally be within 12’ of each other. No moving parts (fan blades, etc.) shall be located within 3’ of these rooftop access areas.
- 504.4.4 Rooftop Clear Path: a clear path, minimum 6’ wide, 9’ tall must be provided from the front to back of building, and side to side for each 100 linear feet of roof perimeter, so that each access point (from 504.4.1) is connected and there is no more than 100’ distance between any two paths at any point. No moving parts (fan blades, etc.) shall be located within 3’ of these rooftop clear path areas.
- 504.4.5 Rooftop Clear Path Protection: railing shall be provided for any change in elevation greater than 6’ adjacent to the clear path.
- 504.4.6 Required Rooftop Clearances: Minimum clearance of 6’ in all directions is required from entry to roof from occupied space or means of egress. 3’ in all directions is required from fire escape or roof access ladder.
- 504.4.7 Rooftop Conduits and Piping: avoid obstructing clear paths and access. Ramps and platforms are required for objects greater than 1’ high, or more than 24” wide.
- 504.5 Rooftop Access on Buildings More Than 100 Feet in Height: Clear paths should be provided to and from rooftop penetrations and sides of the buildings which contain windows.
- 027.7 Fire Escapes: Maintain fire escapes so they are safe and operational with no obstructions or impediments to immediate use.
- 1027.7.1 Maintenance: Fire escapes shall be painted and protected, moving parts kept in working order.
- 1027.7.2 Window Gates: Bars, grilles, grates, or similar devices placed over windows or other openings onto fire escapes must be maintained in good working order.
- 1027.7.3 Air Conditioners: cannot be installed in windows providing access to a fire escape unless there is another window in the same room that is not obstructed and meets the full

egress requirements without consideration of the first window. AC systems installed in windows adjacent to fire escapes must not obstruct the path of egress.

- 1027.7.4 Fire Escape Ladders: nothing should prevent operation of moving parts in a fire escape ladder. In the event of construction on or adjoining a fire escape ladder, alternate provisions for safe egress must be made.

The following figure illustrates these requirements



Drawing is schematic only, not to scale, and used for the purposes of demonstrating certain typical applications of code-required clearances and considerations. This is not intended to be an exhaustive review of code requirements. Always consult a design professional for building-specific requirements.

See next section also.

C. ZONING AND HEAT PUMP OUTDOOR UNIT PLACEMENT

ZONING REQUIREMENT

New York City zoning requirements were changed on December 6, 2023, with the intention of supporting building improvements that reduce carbon emissions. ***Relevant sections include 26-60, 23-10, 23-40, 23-62, 23-80, 23-87, 37-20, 54-50, 64-30, 73-65***

SUMMARY

Relevant provisions include allowing accessory mechanical equipment (such as heat pump outdoor units) within open spaces, such as rear and side yards, as long as certain requirements are met, such as: 1. Being within 18" of a wall; OR 2. Being more than 5' from a lot line 3. If more than 25 SF in area, being screened on all sides: "Such screening may be opaque or perforated, provided that where perforated materials are provided, not more than 50 percent of the face is open. Previously, outdoor units would not have been allowed in areas such as within 30' of a rear lot line. Please refer to the most up-to-date guidance on equipment screening, as the Department of City Planning (DCP) is contemplating updates to the current language around screening at the time of writing this document. (DCP Link Here)

D. HPD POLICY ON ELECTRIC HEAT

REQUIREMENT

HPD Electric Heating Policy (link here)

SUMMARY

This document outlines policies around electric heating to ensure that efficient systems are encouraged, poorly performing systems are not allowed, and tenants are protected. It outlines which equipment is allowed, the very limited cases where residents may pay for certain utilities, and which utility allowances must be used.

Note that with some exception electric resistance heat is not permitted. Similarly, some use restrictions apply to packaged cold-climate heat pumps.

E. ARE PERMITS REQUIRED FOR ELECTRIFICATION WORK?

CODE REQUIREMENTS

Code References: NYC General Administrative Provisions 2022

- ***§28-105.2 Classification of Work Permits***
  For the purposes of this code, work permits shall be classified as follows:

1. *New building permits: for the construction of new buildings, including as provided for in section 28-101.4.5.*
2. ***Alteration permits**: for the alteration of buildings or structures, including new and existing sign structures and partial demolition in conjunction with such buildings or structures.*
3. ***Foundation and earthwork permits:** for the construction or alteration of foundations, including earthwork, excavation, fill, and foundation insulation.*
4. ***Earthwork permits:** for work solely involving earthwork, excavation, or fill operations.*

5. ***Full demolition permits****: for the full demolition and removal of buildings or structures*.
6. ***Plumbing permits:*** *for the installation or alteration of plumbing and plumbing systems, including gas piping. Such permits shall include permits for limited plumbing alterations.*
7. **Sign permits**: *for the erection, installation, display or alteration of signs.*
8. ***Service equipment permits:*** *for the installation or alteration of service equipment, including but not limited to air conditioning and ventilating systems, boilers, elevators, escalators, moving walkways, dumbwaiters, mobile boilers and mobile oil tanks. Such permits shall include permits for limited oil-burning appliance alterations.*

- **§28-105.4 Work Exempt from Permit*

  Exemptions from permit requirements of this code shall not be deemed to grant authorization for any work to be done in any manner in violation of the provisions of this code, the zoning resolution or any other law or rules enforced by the department. Such exemptions shall not relieve any owner of the obligation to comply with the requirements of or file with other city agencies. Unless otherwise indicated, permits shall not be required for the following:

1. *Emergency work, as set forth in section 28-105.4.1.*
2. *Minor alterations and ordinary repairs, as described in section 28-105.4.2.*
3. *Certain work performed by a public utility company or public utility corporation, as set forth in section 28-105.4.3.*
4. *Ordinary plumbing work, as set forth in section 28-105.4.4.*
5. *Permits for the installation of certain signs, as set forth in section 28-105.4.5.*
6. *Geotechnical investigations, as set forth in section 28-105.4.6.*
7. *The installation, alteration or removal of alternative automatic fire extinguishing systems, including but not limited to fire extinguishing systems for commercial cooking equipment, subject to the approval of the fire department in accordance with section 105 of the New York city fire code.*
8. *The installation, alteration or removal of fire alarm systems, emergency alarm systems and fire department in-building auxiliary radio communication systems, subject to the approval of the fire department in accordance with the requirements of this code. Such work shall be submitted in accordance with the rules and regulations of the fire department.*
9. *Other categories of work as described in department rules, consistent with public safety.*

**Section 28-105.4 was amended by Local Law 195 of 2018. This law has an effective date of May 30, 2019.*

- ***§28-105.4.2 Minor Alterations and Ordinary Repairs***

  A permit shall not be required for minor alterations and ordinary repairs.

  §28-105.4.2.1 Definitions

  The following words and terms shall, for the purposes of section 28-105.4.2 and as used elsewhere in this code, have the meanings shown herein.

  MINOR ALTERATIONS. *Minor changes or modifications in a building or any part thereof, excluding additions thereto, that do not in any way affect health or the fire or structural safety of the building or the safe use and operation of the service equipment therein. Minor alterations*

shall not include any of the work described as "work not constituting minor alterations or ordinary repairs."

***ORDINARY REPAIRS**. Replacements or renewals of existing work in a building, or of parts of the service equipment therein, with the same or equivalent materials or equipment parts, that are made in the ordinary course of maintenance and that do not in any way affect health or the fire or structural safety of the building or the safe use and operation of the service equipment therein. Ordinary repairs shall include the repair or replacement of any plumbing fixture, piping or faucets from any exposed stop valve to the inlet side of a trap. Ordinary repairs shall not include any of the work described as "work not constituting minor alterations or ordinary repairs."*

***WORK NOT CONSTITUTING MINOR ALTERATIONS OR ORDINARY REPAIRS**. Minor alterations or ordinary repairs shall not include:*

1. *The removal or cutting away of any load bearing or required fire rated wall, fire door, floor, or roof construction, or any portion thereof;*
2. *The removal, cutting, or modification of any beams or structural supports;*
3. *The removal, change, or closing of any required exit;*
4. *The addition, rearrangement, relocation, removal or replacement of any parts of the building affecting loading or exit requirements, or light, heat, ventilation, or elevator requirements or accessibility requirements, or any fire suppression or fire protection system;*
5. *Additions to, alterations of, or rearrangement, relocation, replacement, repair or removal of any portion of a standpipe or sprinkler system, water distribution system, house sewer, private sewer, or drainage system, including leaders, or any soil, waste or vent pipe, or any gas distribution system;*
6. *Any plumbing work other than the repair or replacement of plumbing fixtures, piping or faucets from the exposed stop valve to the inlet side of a trap;*
7. *The alteration or repair of a sign for which a permit is required; or*
8. *Any other work affecting health or the fire or structural safety of the building or the safe use and operation of the service equipment therein.*

- *§28-105.4.4 Ordinary Plumbing Work*

The following ordinary plumbing work may be performed without a permit, provided that the licensed plumber performing such work: (i) provides a monthly report listing completed work and work in progress during the preceding month, including the block, lot and address of each job, a description of the work performed or in progress at each address, and the location in each building where the work was performed or is in progress; (ii) pays the fees for such work in accordance with this code; and (iii) submits to the department a certification that the work was performed in accordance with this code and all applicable laws and rules. Ordinary plumbing work shall include:

1. *The removal of a domestic plumbing system not connected to a fire suppression or fire protection system, or the removal of a portion of such system.*
2. *The relocation of up to two plumbing fixtures within the same room to a maximum of 10 feet (3048 mm) distant from the original location, except in health care facilities.*

3. *The installation, replacement or repair of a food waste grinder (food waste disposal) or secondary back flow preventer and the replacement or repair of a sump pump.*
4. *The replacement of closet bends.*
5. *In buildings in occupancy group R-2 occupied by fewer than six families or in buildings in occupancy group R3, the replacement of a gas water heater or a gas fired boiler with a capacity of 350,000 BTU (103 kW) or less where the existing appliance gas cock is not moved, provided that the plumber has inspected the chimney and found it to be in good operational condition.*
6. *The repair or replacement of any non-gas, non-fire suppression piping not longer than 10 feet (3048 mm) inside a building, or connected piping previously repaired or replaced under this provision.*
7. *The repair or replacement of non-fire suppression branch piping after the riser shutoff valve, including the replacement of fixtures, limited to two bathrooms and one kitchen per building per monthly reporting period.*
8. *The replacement of flexible gas tubing no greater than 4 feet (1219 mm) in length located downstream of the existing gas cock to an appliance, provided such gas tubing does not penetrate a wall.*

SUMMARY

Historically (prior to July 1, 2008), New York City used to require "Special Use Permits" for major heating renovation work. However, these Special Use Permits appear to have been superseded in NYC General Administrative Provisions (latest version 2022), which requires a "Service Equipment Permit."

Per *§28-105.2 of New York City Construction Codes, item 8, any work impacting service equipment (which includes air conditioning and ventilation systems) would require at a minimum a Service Equipment Permit. There are exceptions for 'Minor alterations and ordinary repairs' [*§28-105.4, item 2], but per *§28-105.4.2 item 4 a minor alteration explicitly does not encompass any work that involves the addition, rearrangement, relocations, removal, or replacement of any parts of the building affecting light, heat or ventilation requirements. Note – this would also appear to require permits for gas to electric water heater replacement projects [*§28-105.4, item 4 and *§28-105.4.4] and appliance electrification which impacts gas distribution systems [*§28-105.4.2.1 exceptions item 4]

F. ARE SPECIAL INSPECTIONS REQUIRED FOR ELECTRIFICATION WORK?

CODE REQUIREMENTS

- ***NYC General Administrative Provisions 2022 §28-116.4.1 Issuance of Certificate of Compliance***

  The following types of service equipment shall not be operated until the department issues a certificate of compliance after submission of a satisfactory report of inspection and testing of such equipment in accordance with this code and all required submittal documents:

  1. *Air-conditioning, ventilation and exhaust systems.*
  2. *Elevators, escalators, moving walkways and dumbwaiters.*
  3. *Fuel burning and fuel-oil storage equipment.*
  4. *Refrigeration systems.*
  5. *Heating systems.*

6. *Boilers.*

Exception: A certificate of compliance shall not be required in connection with work specifically exempted from permit requirements in accordance with this code or department rules.

NYC Building Code Chapter 17. Requirements for special inspections are set forth in the NYC Building Code Chapter 17.

SUMMARY

Electrification projects do require special inspections, because heat pumps are a type of air-conditioning system (item (1) above), and they are also a refrigeration system (item (4) above), and they are also a heating system (item (5) above).

Importantly, a Certificate of Compliance is required before the equipment is operated.

It should be noted that a current interpretation does appear to allow the installation of common window AC units (<3 ton/36 kBtuh) without requiring a permit.[4] This opens the possibility that heat pumps smaller than 3 tons that are vented through windows might not require a permit, but this should be confirmed with DOB.

Important requirements for special inspections (from NYC BC Chapter 17) include:

1. Cannot be performed by the contractor.
2. Can be performed by the design professional.
3. Must report compliance with the construction documents.
4. Discrepancies must immediately be brought to the attention of the contractor.
5. Hazardous conditions must immediately be reported to the commissioner.
6. Records of inspections shall be kept for 6 years, by the special inspector.
7. The permit holder must notify the special inspector at least 72 hours before the commencement of work.
8. Construction must remain accessible and exposed for special inspection.

G. ARE ECONOMIZERS REQUIRED FOR HEAT PUMPS

The question has been raised, "Are economizers required for heat pump systems?" Economizers bring in cooling from outdoors when outdoor conditions are cool enough, but cooling is still needed indoors, for example in the late afternoon. The energy required requires them in some situations, typically for large commercial buildings with large chilled water systems with air handlers. In almost all instances, multifamily heat pumps are exempt from requiring economizers. Exemptions derive from typical heat pump systems being too small to fall within the code requirement for economizers (see C403.5) or typical heat pump systems being adequately efficient (more than 20% efficient than required by code) to be exempt from the economizer requirement (Table C403.5 (2)).

[4] https://portal.311.nyc.gov/article/?kanumber=KA-02551

References

NYC Building Code 2022
https://up.codes/viewer/new_york_city/nyc-building-code-2022

National Electric Code 2017 of NYS (NFPA 70)
https://up.codes/viewer/new_york/nfpa-70-2017

NYC Energy Code 2020
https://up.codes/viewer/new_york_city/nyc-energy-conservation-code-2020

NYC Fire Code 2022
https://up.codes/viewer/new_york_city/nyc-fire-code-2022

NYC Mechanical Code 2022
https://up.codes/viewer/new_york_city/nyc-mechanical-code-2022

NYC Plumbing Code 2022
https://up.codes/viewer/new_york_city/nyc-plumbing-code-2022

NYC Zoning Resolution
https://up.codes/viewer/new_york_city/nyc-zoning-resolution

ASHRAE 90.1

Noise code
https://www1.nyc.gov/assets/dep/downloads/pdf/air/noise/noise-code-full-version.pdf
https://www1.nyc.gov/assets/dep/downloads/pdf/environment/education/nyc-noise-code-fact-sheet.pdf