

Guidelines for Integrated, Heat Pump Water Heaters in Multifamily Buildings

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EVERSOURCE

Acknowledgments

These guidelines were developed through a joint effort between Eversource and Steven Winter Associates.

For more information on these guidelines and Energize ConnecticutSM programs, visit: EnergizeCT.com.

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About Energize Connecticut:

Energize Connecticut helps you save money and use clean energy. It is an initiative of the State of Connecticut, the Connecticut Green Bank, Eversource, UI, SCG and CNG, with funding from a charge on customer energy bills.

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Abbreviations

HPWH	Heat Pump Water Heater
dBA	A-weighted Decibels
STC	Standard Test Conditions
CFM	Cubic Feet per Minute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
EF	Energy Factor
GPM	Gallons per Minute
BTU	British Thermal Units



Guidelines for Integrated, Heat Pump Water Heaters in Multifamily Buildings

Purpose

This document outlines the program requirements for using integrated, tank-type heat pump water heaters (HPWHs) in multifamily buildings.

Definition

For the purpose of these guidelines, Multifamily will refer to any property with 5 units or more, occupied by residential end-users.

Disclaimer

Integrated HPWHs can offer substantial energy savings compared to electric resistance water heaters if, and only if, installed appropriately. They have considerable design limitations which severely limit their application in most multifamily buildings. Meeting all the requirements listed in this document will be challenging for most buildings.

Note (1):

- These guidelines do NOT apply to air-to-water heat pumps located outdoors (or where the compressor and evaporator are outdoors),
- These guidelines do NOT apply to single family homes
- These guidelines do NOT apply to integrated HPWHs with heat pumps that operate efficiently with entering air temperatures below 40-50°F. At the time of publication of these Guidelines, no integrated HPWHs available in the US could operate efficiently at these lower temperatures,
- These guidelines were developed for the Northeast. In warmer parts of the country, some requirements listed here may not be relevant or appropriate.

Requirements of All HPWH Installations in Multifamily Buildings

- Locate HPWHs and ducted intakes away from sources of dust (e.g. laundry rooms) or corrosive elements,
- Heat Traps:
 - o Install heat traps at inlet and outlet of HPWH, **OR**
 - o Provide documentation that factory heat traps are present **AND** all installation requirements of these heat traps have been met.
 - o Remove HPWH condensate adequately via gravity drain and/or pump,
- Comply with manufacturer clearances and make accessible for maintenance, filter cleaning/replacement, etc. Plumbing must not block access for HPWH maintenance,
- Many HPWHs are heavier than other water heating appliances; ensure floor can support weight of HPWHs.
- Sound:
 - o HPWHs must have sound ratings of 35 dBA or less, **OR**
 - o HPWHs located within the apartment must be separated from living spaces where noise would cause comfort issues, such as bedrooms, living rooms, offices, and dining areas, by sound-attenuating assemblies with STC 35 or greater. Note that louvered doors do not provide acceptable sound-attenuating separation.
 - o HPWHs located outside the apartment must be separated from dwelling units and other spaces in the building where noise would cause issues, such as offices, by sound-attenuating assemblies with STC 35 or greater.

Note that common recommendations for all scenarios are listed at the end of the document.



Multifamily HPWH Scenarios

Five multifamily scenarios are presented here based on the location of the HPWH. The first four apply to HPWHs that serve only one dwelling unit. If any of the criteria for one scenario cannot be met, that application is not permitted unless otherwise approved by Eversource.

1. HPWH (non-ducted) located in each apartment
2. HPWH (ducted) located in each apartment
3. HPWH located near each apartment; heat drawn from and exhausted to separate space (e.g. corridor)
4. HPWHs for each apartment located in a remote location (e.g. HPWHs located in a shared basement or mechanical room)
5. HPWH “plants” serving an entire building or group of apartments.

1. HPWH (non-ducted) Located in Each Apartment¹

- HPWH must be within the thermal envelope of the apartment,
- HPWH must be in a room with free volume of at least 1,000 ft³ (or other minimum free air volume as listed in product literature)
- HPWH must **NOT** be located in laundry rooms or bedrooms, living rooms, offices, dining areas, bathrooms, or other areas where cold discharge air is likely to cause comfort problems,
- HPWH intake must be at least 10 feet away from cooking appliances,
- HPWH exhaust must be at least 10 feet away from a heating/cooling thermostat.



2. HPWH (ducted) Located in Each Apartment¹

- HPWH must be within the thermal envelope of the apartment,
- If in a room/closet with free volume less than 1,000 ft³ (or other minimum free air volume as listed in product literature), at least one side of the HPWH (intake or exhaust) must be ducted outside of the room/closet,
- If air is drawn from or delivered to an enclosed space within the apartment, that enclosed space must meet the same free volume requirements above,
- Ducts must **NOT** be run to or from outdoors,
- If only one side of the HPWH is ducted, free area of at least 2 ft² per 100 cfm of air flow rate must be provided to the room/closet where HPWH is located (e.g., if a HPWH in a closet moves 200 cfm, louvered doors with 4ft² of free area can meet this requirement). Where air flow is unknown, assume 400 cfm,
- Cold air from HPWH exhaust must NOT be delivered directly to bedrooms, living rooms, offices, dining areas, bathrooms, kitchens, or other areas where cold air is likely to cause comfort problems,
- HPWH intake must be at least 10 feet away from cooking appliances,
- HPWH exhaust must be at least 10 feet away from a heating/cooling thermostat.

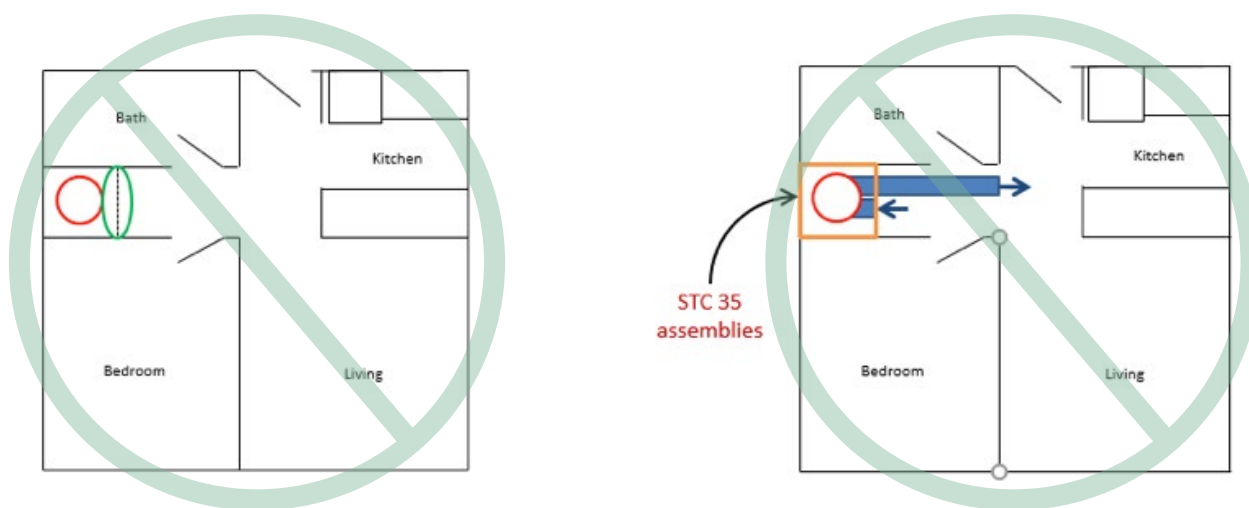


Figure 1. Example of two ducted HPWH installations that do NOT meet the criteria. The image on the left (ducting not shown), while providing a louvered door with sufficient free area (dotted line), cannot meet the STC 35 rating. The image on the right removes the louvered door to meet the sound requirement, but the 200-400 cfm of cold exhaust air is likely to cause comfort problems.

1. Typical apartments will be unable to meet all the criteria listed. An example that may work is a garden-style or multi-story apartment/townhouse with a large utility closet or a basement without ceiling insulation.

3. HPWH Located Near Each Apartment; Heat Drawn from and Exhausted to Separate Space (e.g. corridor)

In this scenario, each apartment has its own HPWH, but the HPWH is located outside the apartment envelope. A closet accessed from a common corridor is a possible configuration (e.g. Figure 2).

- HPWH must be within the conditioned, thermal envelope of the building,
- If not ducted, HPWH must be in a room with free volume of at least 1,000 ft³ (or other minimum free air volume as listed in product literature),
- If in a room/closet with free volume less than 1,000 ft³ (or other minimum free air volume as listed in product literature), at least one side of the HPWH (intake or exhaust) must be ducted outside of the room/closet,
 - o If ducted, cold air from HPWH exhaust must NOT be delivered directly to dwelling units or areas where cold air is likely to cause comfort problems,
 - o Ducts must NOT be run to or from outdoors,
 - o If only one side of the HPWH is ducted, free area of at least 2 ft² per 100 cfm of air flow must be provided to the room/closet where HPWH is located. e.g., if a HPWH in a closet moves 200 cfm, louvered doors with 4ft² of free area can meet this requirement. Where air flow is unknown, assume 400 cfm.
- If several HPWHs share an intake and exhaust volume (e.g., a corridor):
 - o The volume of the shared space must be at least 1,000 ft³ per HPWH (or other minimum free air volume as listed in product literature),
 - o A given HPWH must effectively draw air from and deliver air back to the same space,
 - o HPWH air intake registers must be at least 10 feet from other HPWH exhaust outlets,
 - o Designer/contractor must demonstrate that air temperature of the space from which a HPWH draws air can be maintained at 50°F or higher all year (including cooling impacts of HPWHs),
 - o Spaces from which HPWHs draw air must NOT be heated with electric resistance,
- Cold air from HPWH exhaust must NOT be delivered directly to dwelling units or areas where cold air is likely to cause comfort problems.

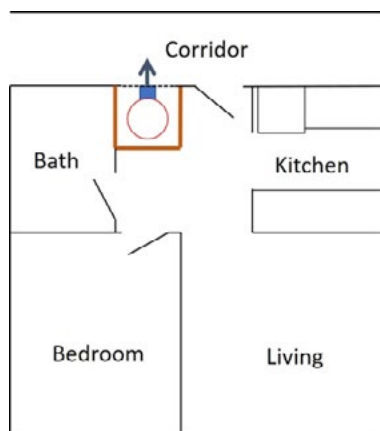


Figure 2. Example of HPWH configuration for scenario 3. HPWH exhaust is ducted to the corridor; air is replaced via a louvered door with sufficient free area. All assemblies separating HPWH from dwelling unit are sound rated (STC 35). Corridor must have adequate volume and space heating for all HPWHs drawing heat from the corridor.

4. HPWHs for Each Apartment Located in a Remote Location (e.g. Many HPWHs in a shared basement or mechanical room)

- HPWHs must be within the conditioned, thermal envelope of the building,
- The volume of the space must be at least 1,000 ft³ per HPWH (or other minimum free air volume as listed in product literature),
- HPWHs must effectively draw air from and deliver air back to the same space,
 - If ducted, cold air from HPWH exhaust must NOT be delivered directly to dwelling units or areas where cold air is likely to cause comfort problems,
 - Ducts must NOT be run to or from outdoors,
 - If ducts run to separate rooms or spaces, free area of at least 2 ft² per 100 cfm of rated air volume must be provided back to the room/closet where HPWH is located for each HPWH. e.g., if each HPWH moves 200 cfm, louvers with 4ft² of free area for each HPWH can meet this requirement. Where rated volume is unknown, assume 400 cfm per HPWH.
- HPWH air intake registers must be at least 10 feet from other HPWH exhaust outlets. This could be accomplished by spacing out the HPWHs or ducting (see Figure 3),
- Designer/contractor must demonstrate that air temperature of the space from which a HPWH draws air can be maintained at 50°F or higher all year (including cooling impacts of HPWHs),
- Spaces from which HPWHs draw air must NOT be heated with electric resistance

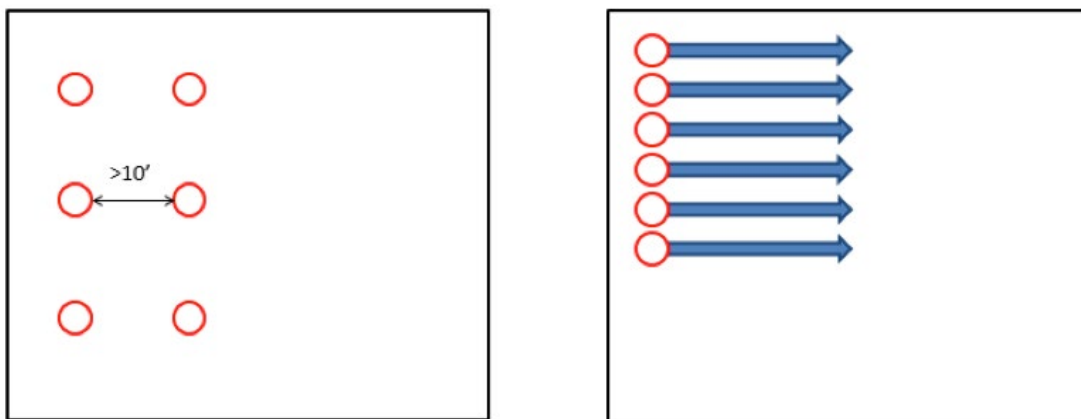


Figure 3. Examples of possible mechanical room plans for Scenario 4 or 5.

5. HPWH “Plants” Serving an Entire Building or Group of Apartments

In this scenario, each apartment does not have an individual HPWH. Several HPWHs are plumbed together in parallel to deliver hot water to an entire building or group of apartments.

- HPWHs must be within the conditioned, thermal envelope of the building,
- The volume of the room/space must be at least 1,000 ft³ per apartment served (or other minimum free air volume as listed in product literature),
- HPWHs must effectively draw air from and deliver air back to the same space:
 - o If ducted, cold air from HPWH exhaust must **NOT** be delivered directly to dwelling units or areas where cold air is likely to cause comfort problems,
 - o Ducts must **NOT** be run to or from outdoors,
 - o If ducts run to separate rooms or spaces, free area of at least 2 ft² per 100 cfm of air flow must be provided back to the room/closet where HPWH is located for each HPWH. e.g., if each HPWH moves 200 cfm, louvers with 4ft² of free area for each HPWH can meet this requirement. Where air flow is unknown, assume 400 cfm per HPWH.
- HPWHs air intake registers must be at least 10 feet from other HPWH exhaust outlets. This could be accomplished by spacing out the HPWHs or ducting (see Figure 3) ,
- Designer/contractor must demonstrate that air temperature of space(s) from which HPWHs draw air can be maintained at 50°F or higher all year (including cooling impacts of HPWHs),
- Spaces from which HPWHs draw air must **NOT** be heated with electric resistance,
- When sizing and selecting equipment, use guidelines in ASHRAE Applications or comparable method. Size the HPWH plant using the capacity of the heat pumps only; do not include capacity of electric resistance.

Recommendations for All Systems

- Consider locating HPWHs where they can draw air from rooms with waste heat from other systems (e.g. elevator equipment, PV inverters, other mechanical equipment). Do not draw air from rooms with dust (e.g. laundry rooms) or corrosive elements.
- Insulate hot water piping to at least R-4 ft²h°F/Btu,
- Install ENERGY STAR certified dishwashers and clothes washers,
- Install WaterSense® certified bathroom faucets/aerators and showerheads, and kitchen faucets less than or equal to 2.0 gpm,
- Design compact hot water distribution plumbing,
- Use demand-controlled recirculation where appropriate,
- Consider air-to-water heat pumps with compressors and evaporators located outdoors. Several types and sizes are available, but be mindful of capacity and efficiency limitations (especially in cold weather).

Electric Resistance Storage Water Heaters

With the integrated HPWH products currently available in the U.S., it is not always possible or practical to use HPWHs in many multifamily buildings. In such situations, electric resistance storage water heaters may be a practical solution. When using electric resistance storage water heaters follow these guidelines:

- Install water heaters with energy factor (EF) of at least 0.95 (UEF ≥ 0.93),
- Insulate all hot water piping (minimum R-4 ft²h°F/Btu),
- Install ENERGY STAR certified dishwashers and clothes washers,
- Install WaterSense® certified bathroom faucets/aerators and showerheads, and kitchen faucets less than or equal to 2.0 gpm.

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