



Best Practices for the Retrofit Installation of Heat Pump Water Heaters

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California



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INTRODUCTION

As California works to achieve its ambitious climate goals, there is the need to prioritize energy-efficient technologies that reduce greenhouse gas emissions and meet new code requirements. One such technology is the residential air source heat pump water heater (HPWH). As a replacement for gas or electric resistance water heaters, HPWHs can significantly reduce energy use and costs while providing reliable hot water for homes.

Heat pump water heaters are also inherently safer than their gas counterparts due to the omission of flammable gas and lack of combustion emissions. Because they do not burn gas, they are also better for indoor air quality, leading to healthier homes.

A successful installation of a HPWH is helped by careful consideration of many factors, including prioritizing safety, minimizing errors, complying with regulations, and providing customer education. This document supports the correct installation of HPWHs in the field by providing a comprehensive set of best practices that can be used in the following ways:

- As a checklist for instructors creating new curricula, ensuring standardized training that covers all necessary components for successful installations
- As a guide for those developing guidelines, standards, and certifications, promoting consistency and uniformity in the content taught
- As a resource to be incorporated into manuals, field guides, and job aids, providing just-in-time information for installers working in the field

This document includes the most current best practices for unitary HPWH systems collaboratively developed by industry experts. The best practices are not meant to serve as a comprehensive training tool. Instead, this document was developed to help instructors and others cross-reference existing content to identify potential gaps. While most topics should be familiar to experienced professionals, some newer topics may require further clarification. Additional details on these topics can be found in the Appendices. The Appendices also include any information that may need updating as technologies change, enabling easy amendments. Information on split systems can be found in the Appendices as well.

By following these best practices, stakeholders in the HPWH industry can increase the likelihood of safe, efficient, and effective installations, maximizing benefits for homeowners, the workforce who will install this technology, and the environment. These best practices align with California's climate goals and further the state's commitment to reducing greenhouse gas emissions and promoting sustainable technologies.

OBJECTIVES OF THE DOCUMENT

- **Standardize the process:** This document will make it easier for instructors to develop curricula, certification bodies to develop industry-consistent standards, and organizations to develop clear job aids for installers working in the field.
- **Ensure safety:** This document prioritizes the safety of the installer and homeowner.
- **Maximize efficiency:** This document will support the correct installation of HPWH to optimize energy efficiency and hot water delivery.
- **Support quality installations:** This document provides criteria to allow for high quality installation of HPWHs, reducing the potential for errors.
- **Enhance customer satisfaction:** This document provides clear guidelines for successful installation to meet customers' needs and expectations, including through relevant customer education.
- **Outline the tradeoffs:** This document provides guidance on key choices that need to be made for HPWH installation.
- **Ensure compliance with regulations:** This document will help ensure installation meets all relevant codes and regulations.

Please note: This document is not intended to be a how-to manual for HPWH installations, be used as a code reference manual, or replace manufacturer's instructions. Always refer to applicable building codes and standards.

ORGANIZATION OF THE DOCUMENT

This document includes the:

- **Checklist of best practices** to use when aligning training materials or standards
- **Appendices** covering all key considerations

CHECKLIST OF BEST PRACTICES:

The checklists are organized in order of:

- Walkthrough and design
- Pre-installation
- Installation
- Post-installation

APPENDICES:

The Appendices provide more detail on these key considerations.

- **Tank size:** HPWHs may require more space than traditional water heaters due to their larger size, their required clearances, and the potential upsizing to increase storage capacity.
- **Climate zones and locations:** Different climate zones necessitate varying water heater location approaches.
- **Condensate-handling strategies and options:** HPWHs produce a pH-neutral condensate that needs to be drained to a suitable location.
- **Ventilation:** Additional ventilation may be necessary for smaller spaces.
- **Noise/vibration mitigation:** Installation should minimize operational noise for a quiet user experience.
- **Electrical evaluation:** Installation should suit the power source and capacity or implement a mechanism to accommodate the additional electrical load of a HPWH.
- **Controlled recirculation pumps:** The use of continuously running recirculation pumps is not considered a best practice without controls (timers, on-demand and/or learning logic) and proper insulation on the recirculation piping.
- **Capping a gas line:** Gas lines are potentially hazardous if not correctly handled.
- **Split systems:** These systems have unique requirements, which are addressed.

BEST PRACTICES CHECKLIST

WALKTHROUGH AND DESIGN

HOMEOWNER AWARENESS AND HOT WATER NEEDS

- Discuss noise/vibration, cleaning of filters, potential cold air issues, and condensate drainage.
- Discuss peak water demand and predicted hot water usage. (*Appendix 1*)
- Size the tank appropriately, considering recovery time. (*Appendix 1*)

HPWH LOCATION

- Determine whether the ambient temperature of the installation space is sufficient. (*Appendix 2*)
- Measure the dimensions of the installation space and verify that the location is large enough for the tank, preferably with a 3'x3'x8' volume.
- Ensure that the doors adjacent to the HPWH will be capable of opening a minimum of 90 degrees after installation.
- Ensure clearance is sufficient for tank removal and access to all components and allows for proper placement and removal of the air filter.
- Consider space needs for the future serviceability of the unit.
- Choose a new (better) location if necessary.
- Determine if a stand/pedestal is required by local regulations. Evaluate the possibility of additional height requirements.
- Determine the location for condensate management and termination. (*Appendix 3*)
- Determine the location for the temperature and pressure relief (T&P) valve drain. (*Appendix 3*)
- Take photos of the current unit and location for later reference.

VENTILATION AND NOISE STRATEGIES

- Measure the volume of the installation space. Consult product literature for exact air volume needed as manufacturers vary. (*Appendix 4*)
- If adding an exhaust vent inside the home, consider:
 - Occupant discomfort
 - The impact on nearby thermostats
- Consider the impact of noise on the homeowner. (*Appendix 5*)

ELECTRICAL EVALUATION

- Verify that the wire gauge, circuit breaker, and electrical panel accommodate the nameplate specification. (*Appendix 6*)
- If the installation does not have a 240VAC breaker readily available or limited panel capacity, consider a panel upgrade. Call an electrician for this.
- Verify that the existing wire is grounded. If not, an electrician may be needed.
- As an alternative, consider a 120V HPWH if there is a 120V outlet within 8 feet.
- For 120 V: Check the amperage of circuit per manufacturer and ensure other loads present on the circuit do not conflict. Do not use an extension cord.
- Identify necessary electrical considerations based on the manufacturer's requirements and applicable code.

ADDITIONAL ITEMS

- Check that the existing thermal expansion tank is correctly sized.
- Determine pipe insulation needed between the tank and building envelope.
- Determine whether any existing recirculation line is needed or will need controls. (*Appendix 7*)
- Determine whether a thermostatic mixing valve exists or is beneficial to sizing for the installation.
- If removing a gas water heater that shares a flue with another device, ensure venting meets local codes and consider electrifying the remaining appliance.

PRE-INSTALLATION

STEPS FOR REMOVAL OF THE EXISTING WATER HEATER

- Follow all Occupational Safety and Health Administration (OSHA) requirements and best lifting practices.
- Record the current hot water temperature for comparison after the new unit's installation.
- To prevent triggering the temperature and pressure relief (T&P) valve, note the water pressure measurement to use when setting the air pressure in the expansion tank.
- Set the expansion tank pressure to match the incoming water pressure.
- Shut off water and power to the unit. Confirm the power is off with a voltage tester.
- For gas units:
 - Follow all local Authority Having Jurisdictional requirements including the local Fuel Gas Code notifying the local gas utility.
 - Turn off the gas to the unit and have a licensed technician cap the line. *(Appendix 8)*
 - Cap and seal the exhaust vent at the ceiling.
- Drain the water, using a transfer pump if needed. Caution, hot water can damage plants. Vent the plumbing system to allow air to enter the tank.
- Disconnect the pipes from the tank.
- Store the old unit safely until disposal and recycle as necessary.
- If disposing of an existing HPWH, comply with regulations regarding proper refrigerant recovery.

SETUP

- Follow all OSHA health and safety precautions.
- Follow the ducting/ventilation strategy from the design walkthrough as applicable. *(Appendix 2, Appendix 4)*
- Install a stand, if required by code.
- Install a drain pan if there is a wooden floor, if the tank utilizes leak detection or if required by code.
- If feasible, install an R10 rigid insulation pad underneath the unit, especially if the unit is on concrete.
- Deploy noise mitigation strategies. *(Appendix 6)*

INSTALLATION

UNIT INSTALLATION

- Make sure the unit is level and plumb.
- Refer to and follow the manufacturer's clearance guidelines.
- Ensure the unit control panel accessible to the occupant.
- Ensure easy access to drain the tank.
- Direct cold exhaust air away from the thermostats and areas frequently used by people. Leave at least 1 foot clearance from objects, including walls.
- Add seismic strapping if code requires.
- Add isolation pads and webbing straps to reduce noise/vibration.

CONDENSATE

- Install a condensate pump if gravity flow to a local drain is not available. (*Appendix 3*)
- Install a T-fitting on the condensate outlet and a removable cap to clean out the line.
- Install the condensate drain lines.
- Route the drain lines to an existing drain or to outside directly or use a condensate pump.
- Ensure the condensate drain diameter meets the manufacturer's requirements and drains on a 1/8" per foot slope.
- Ensure the condensate cannot pool, return to the building, or drain onto non-absorbent walkways.

TEMPERATURE AND PRESSURE

- If appropriate, install a thermostatic mixing valve for additional thermal storage. This is required if the unit will be used in a program with Demand Response. (*Appendix 1*)
- To optimize effective storage, increase the set point temperature to over 120F. Rule of thumb is that for every 10 degrees of temperature increase, the effective storage volume increases by 10 gallons.
Do this only if there is a thermal mixing valve at the tank.
- Hook up the drain line for the T&P valve, using as few elbows as possible.
- Connect the T&P discharge pipe. Consider using a plastic pipe, if allowable by code to reduce thermal losses.
- Ensure the pipe terminates according to code. The termination point must point downwards and drain by gravity.
- Leave the T&P pipe bare or consider insulating the valve body and a few inches of pipe. Leave the handle exposed.

PLUMBING AND INSULATION:

- Install approved manual shut-off valves at the hot water outlet and cold water inlet.
- Connect the pipe for cold water input.
- Once the HPWH is in final position, start filling the tank with water.
- Insulate as much of the piping as feasible. At a minimum, insulate at least the first 5' of hot and cold water pipes from the tank.

VISUAL CHECK AND STARTUP:

- Perform a final visual safety check.
- Consulting the manufacturer's wiring diagram, attach the wires and connect the ground wire.
- Verify the tank is nearly full of water and remove faucet aerators or flow regulators to clear debris.
- Connect hot water output and open the water valves to the house.
- Purge the system. Run water through all hot water fixtures for several minutes until sediment and air has exited the system.
- With the tank full of water, turn on the power at the breaker and follow the manufacturer's start-up sequence.

VERIFY INSTALLATION

- Check for leaks or standing water.
- Check the temperature settings.
- Verify sound levels from the water heater comply with the manufacturer specifications.
- Ensure there is compliant earthquake strapping where applicable.
- When replacing gas heaters, check that the exhaust vent has been sealed. Verify that gas lines have been capped and are not leaking.

FINAL STEPS

- Seal anywhere piping goes through walls.
- Spackle sheetrock holes if any are present. Seal holes if any are present in drywall.
- If required as part of a program, install a Flex-load/Demand Response (DR) module (eg. Ecoport™).
- If a recirculation line currently exists, install a timed or on-demand controller. (*Appendix 7*)
- Only if there is a thermal mixing valve, increase the tank temperature over 120F.
- Clean the work area.

POST-INSTALLATION

CUSTOMER ASSISTANCE AND EDUCATION

- Discuss the warranty information.
- Explain the use of the new unit's control panel, alarms, and maintenance requirements.
- Guide the customer to download any smart app for tracking time of use and demonstrate the app's functionality. Recommend manuals and websites for help.
- Demonstrate how to clean the filter and discuss the frequency.
- Explain the differences in recovery time between the old and new water heater.
- Provide guidance on different modes customers can use (such as vacation mode) and for what occasion they may be helpful.
- Discuss the energy benefits of switching from the factory-set hybrid to heat pump-only mode.
- Discuss the merits of increasing the storage tank temperature to 140 F in conjunction with a thermal mixing valve to effectively increase the storage capacity of the tank. (*Appendix 1*)
- Explain how to reset the unit in the event of a power outage.
- Provide the customer with the user manual, warranty information, and technical support information in a clear envelope, taped to the HPWH. Put your company sticker on the tank for questions and recalls.
- Refer the customer to DR programs where applicable.
- Ask the customer to confirm the temperature with you after the tank has fully recovered. This confirmation may be a couple of hours after installation is complete or the next day, the ensure the system is operating as designed.

CONCLUSION

Greater uptake of energy-efficiency technologies such as the HPWH is critical to reducing emissions and supporting California’s climate goals but will require knowledge of factors specific to the technology. Stakeholders in the HPWH industry are encouraged to use these best practices as a guide to ensure correct installations and continue to innovate and improve their own practices as new technologies emerge. Together, we can work towards an educated workforce that will allow all stakeholders to prosper in the evolving landscape in California.

RESOURCES

- [Advanced Water Heating Initiative](#)
- [AWHI/Hot Water Solutions: Heat Pump Water Heater Technical Guide](#)
- [CA 2019 Building Energy Efficiency Standards for Residential and non-Residential Buildings, Chapter 5](#)
- [CA Title 24 Water Heating requirements](#)
- [Hot Water Solutions NW: Heat Pump Water Heater Installation Best Practices Guide](#)
- [Energy Star](#)
- National Electrical Code manual
- [Northwest Energy Efficiency Alliance \(NEEA\) Advanced Water Heating Specification](#)
- [NEEA Heat Pump Water Heaters in Small Spaces Lab Testing: “The Amazing Shrinking Room”](#)
- Manufacturer equipment manuals
- Occupational Safety and Health Administration (OSHA) safety manual
- Opinion Dynamics, Heat Pump Water Heaters Knowledge Skills and Abilities Market Study
- [Rewiring America](#)
- Uniform Plumbing Code (UPC) codebook – illustrated version

APPENDICES

[Appendix 1: Tank Size](#)

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APPENDIX 1: TANK SIZE

It is important to size the tank correctly based on the customer's needs. This Appendix will help you determine the right tank size for a household, ensuring optimal performance and energy efficiency. Larger tanks perform better, deliver more hot water as needed, and allow more energy use to be shifted into low-cost periods, but cost more and take up more space. Consider and compare both of the following two sizing strategies:

- **Strategy 1: Evaluate household hot water usage:** Start by discussing the hot water usage with the customer. Consider factors such as the number of bedrooms and bathrooms in the home, the home's square footage, the number of occupants in the home and whether there is a large soaking tub. Long plumbing runs can also impact sizing considerations.
- **Strategy 2: Consider household occupancy:** Most HPWHs are available in three sizes:
 - Small (40 and 50 gallons): Suitable for households with up to two adults.
 - Medium (66 gallons): Ideal for homes with three adults or two adults and two children.
 - Large (80 gallons): Recommended for households with five or more people.
- **Discuss potential limitations with the customer:** Communicate the potential limitations of choosing a tank that is too small for their needs. Inform the customer that an undersized water heater may not provide enough hot water when multiple sources are used simultaneously (e.g., shower and dishwasher).
- **Size up when in doubt:** If the customer is uncertain about the appropriate size, recommend opting for a larger tank. Explain that larger HPWHs can be more efficient overall, as they are less likely to rely on backup electric resistance heating, which consumes more energy.
- **Install a thermal mixing valve:** Increase thermal storage by installing a thermal mixing valve at the point of distribution if one is not already integrated in the unit. This effectively increases the storage capacity of the tank. It allows for greater savings by decreasing the unit's dependence on the electric resistance element when in hybrid mode, or allows the homeowner to switch to heat pump only mode if they choose to. Storing water at 140F will also satisfy current industry consensus with regards to Legionella Risk Reduction in water heater storage tanks.
- **Consider a larger tank with a lower power draw:** Inform customers that a larger tank with a lower power draw (120 volts or 15 amps) leaves the most options for future whole-house and vehicle electrification. Recovery times need to be carefully considered.
- **Check jurisdiction for expansion tank requirements:** Many California jurisdictions require expansion tanks in retrofits.

It can be helpful to create a consumer draw pattern table to display the number of hot water events, their duration, and the volume of hot water used during these events. This information will help homeowners and installers understand the typical hot water usage patterns and select an appropriately sized HPWH. An example of what this table might look like is included in Table 1 below.

BEST PRACTICES FOR THE RETROFIT INSTALLATION OF HPWH

Table 1: Consumer Draw Pattern Table

Time of Day	Event Type	Duration (minutes)	Hot Water Volume (gallons)	Number of Users
6:00-8:00	Morning Showers			
8:30-9:00	Dishwasher			
12:00-12:30	Handwashing/Lunch Cleanup			
18:00-18:30	Handwashing/Dinner Cleanup			
20:00-22:00	Evening Showers/Baths			
22:30-23:00	Dishwasher			

APPENDIX 2: CLIMATE ZONES AND LOCATIONS

HPWHs work in all climate zones, but not in all locations. Climate zones play a significant role in determining the optimal location for installing HPWHs in a home. Several factors, such as temperature, humidity, and regional weather patterns, affect the performance and efficiency of HPWHs. Figure 1 and Figure 2 provide guidance on the optimal and possible installation locations for HPWHs based on different climate zones.

Note: The maps below reflect recommendations for 240V HPWHs. Once research is completed on newer 120V HPWHs, maps with those recommendations will be included in updated versions of these Best Practices.

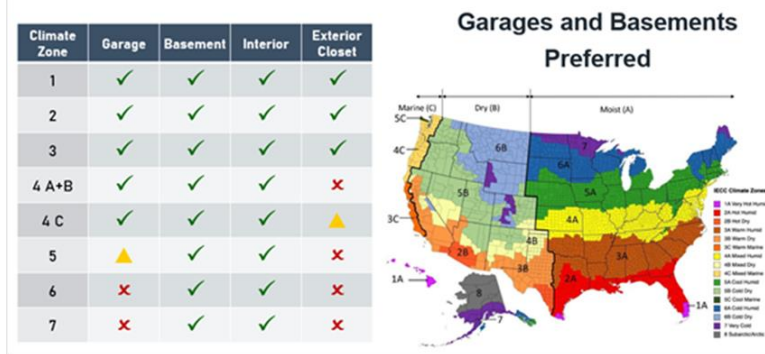
(Yellow triangle = consult with manufacturer as less than ideal location)

Figure 1: California-Specific Map



Graphic credit: RHA / NEEA

Figure 2: National Map



Graphic credit: NEEA

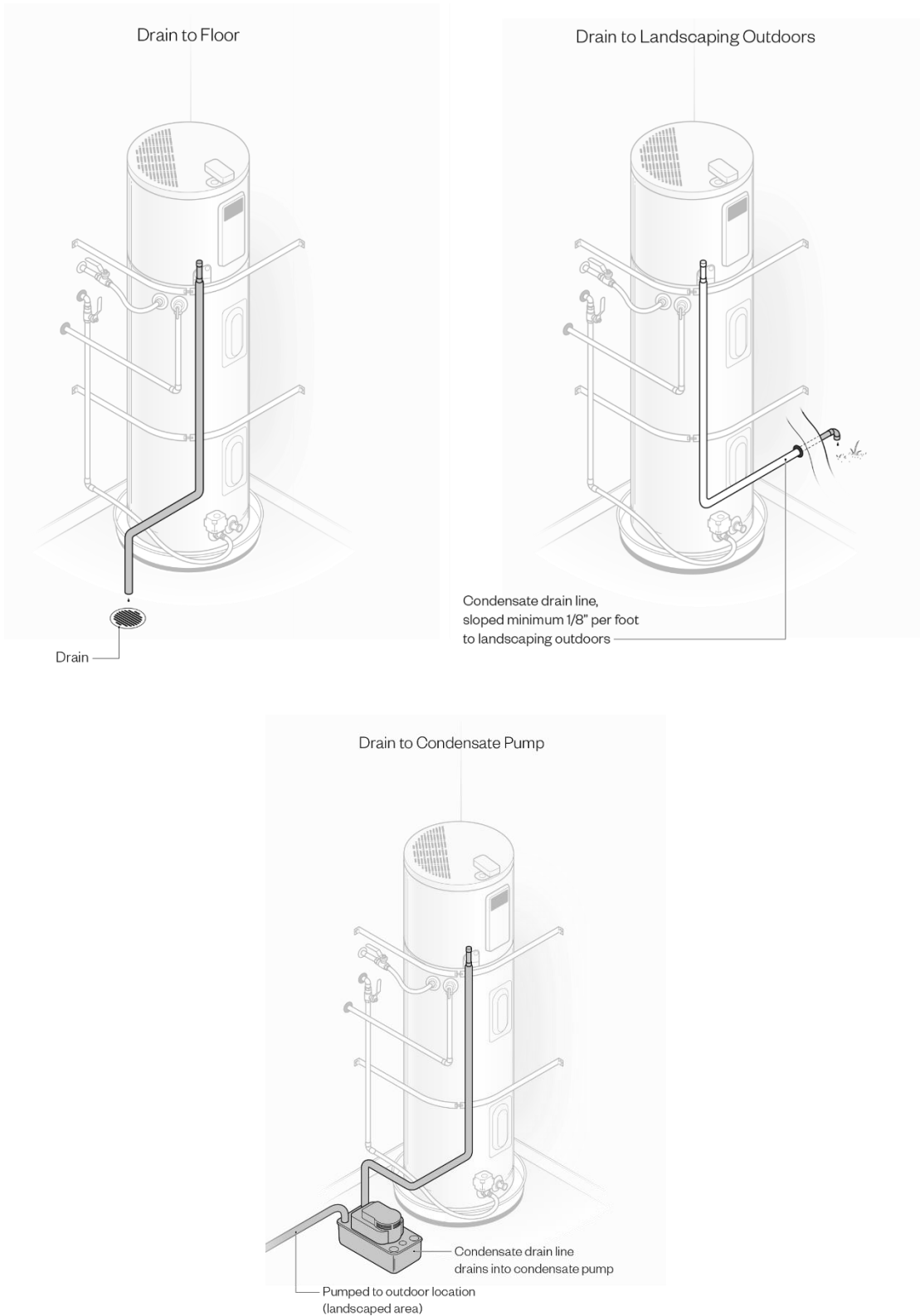
APPENDIX 3: CONDENSATE-HANDLING STRATEGIES

HPWHs produce a pH-neutral condensate that needs to be drained to a suitable location. The condensate is not toxic or corrosive; it is just water. Below are some strategies to consider, in order of highest to lowest preference.

Figure 3 includes visual representations of condensate drain examples.

1. **Direct gravity drain:** Connect a drain line to a suitable drainage point, for example a utility sink, or clothes washer drain line port. This method relies on gravity to carry the condensate away from the unit, to ensure the drain line has a continuous downward slope of at least 1/8" per foot.
2. **Outside drainage:** If draining outside, ensure the pipe will not freeze. Consult the installation manual.
3. **Condensate pipe:** Install the condensate pipe so it can be cleaned without cutting.
4. **Condensate pump:** Use a condensate pump to remove the condensate from the HPWH when a clear gravity drain location is not available. The pump collects the condensate in a reservoir and automatically pumps it to a suitable drainage point when the reservoir is full. Condensate pumps shall be connected to the HPWH electrical system when installed in attics or conditioned spaces such that if the condensate pump fails, the unit will not operate. This avoids possible flooding and is required by many jurisdictions.

Figure 3: Condensate Drain Examples



Graphic credit: RHA

APPENDIX 4: VENTILATION STRATEGIES FOR SMALL SPACES

HPWHs take heat from air in the surrounding space to heat water. For small spaces under 700 cubic feet (or as recommended by manufacturer), there may not be enough surrounding air to ensure effective heat exchange for the HPWH to work efficiently. Here are strategies to ensure sufficient ventilation for small spaces:

- Ducted intake or exhaust to adjacent conditioned or unconditioned space with a short, smooth duct run and makeup air provided. Exhaust ducting to conditioned spaces increases the home's heating load but provides additional cooling in hot weather. Consider the prevailing climate and location of the exhaust vent termination when ducting to conditioned space. If in doubt, duct the exhaust to outdoors.
- Outside intake paired with exhaust to conditioned space is strongly discouraged. This can provide a pass-through for air to enter the home from unconditioned space.
- A louvered door, full or half
- Wall grilles or door grilles, high and low (250 square inches total Net Free Area), separated by at least 5 feet.
- Vent gaps in the door, high and low (250 square inches total Net Free Area), separated by at least 5 feet.

Please note that the specific ventilation strategy will depend on available space, installation location, and homeowner preferences. Always consult the homeowner. For more information on venting, follow manufacturer guidelines for optimal installation and performance. See [The Incredible Shrinking Room Study](#) for more information.

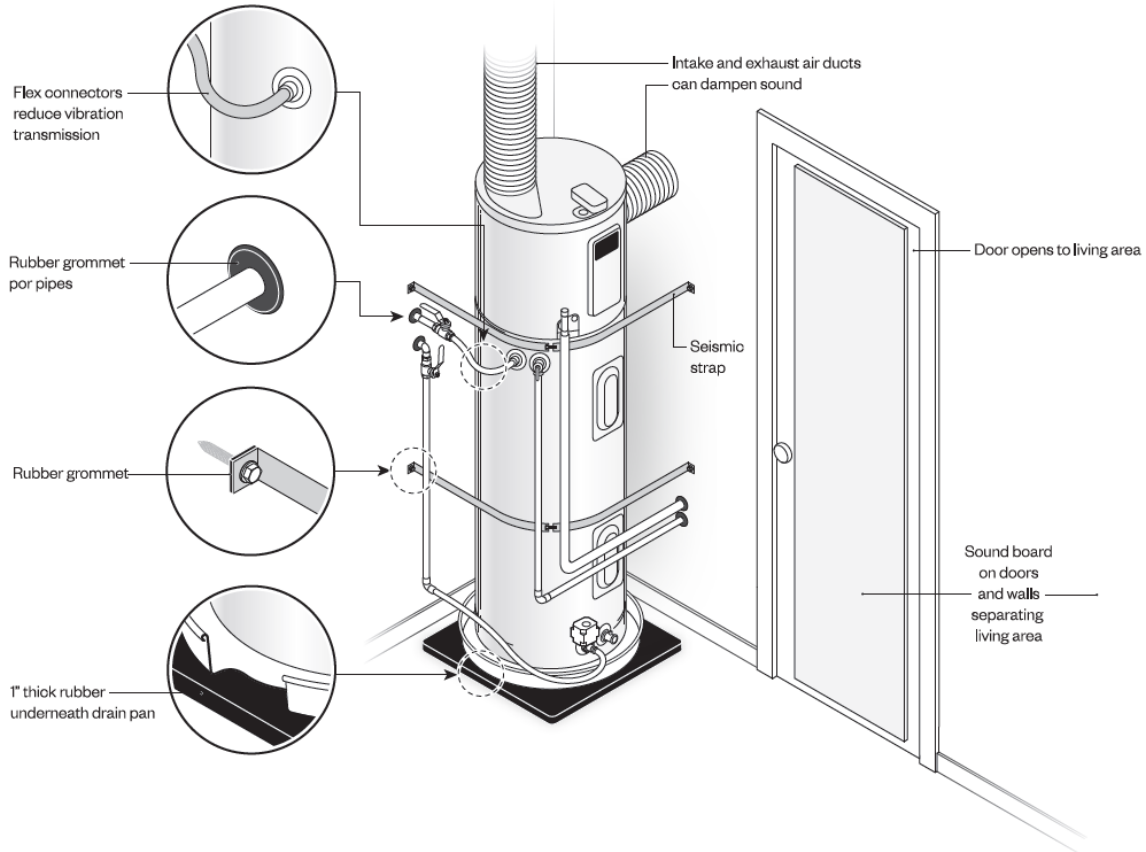
APPENDIX 5: NOISE/VIBRATION MITIGATION

HPWHs may produce a different noise level compared to gas-fired or electric resistance storage water heaters, which can be a concern for some customers. It is important to address noise mitigation to promote customer satisfaction. This Appendix outlines the key steps to minimize noise during installation, which is visually represented in Figure 4.

- **Inform the customer about noise levels:** Begin by discussing the potential noise level of the HPWH with the customer. Explain that it may sound like a quieter version of clothes dryer, which can help them anticipate the noise level they can expect.
- **Choose the right location:** To minimize noise, isolate the HPWH from frequently used spaces whenever possible. If possible, choose a location separate from bedrooms and living areas, reducing the impact of noise on daily life.
- **Use vibration isolation:** Installing vibration isolation pads beneath the water heater can help reduce noise and vibration. Be sure to use the appropriate pads for the specific HPWH model you are installing.
- **Apply sound-dampening materials:** To further reduce noise transmission, apply sound-absorbing materials to the walls surrounding the installation area. The materials can include acoustic panels or other insulation materials designed for noise mitigation.
- **Insulate ductwork:** If the HPWH installation includes sheet metal ductwork, wrap it with insulation to minimize noise transmission. The insulation helps dampen the noise produced by air movement within the ducts.
- **Install anti-vibration brackets:** Anti-vibration brackets can secure the HPWH and further minimize noise and vibration. These brackets isolate the unit from the mounting surface, reducing the transmission of vibrations to the surrounding structure.
- **Use rubber grommets:** Rubber grommets and flex connectors can deaden the sound.
- **Use seismic strapping (if applicable):** In regions where seismic activity is a concern, and when allowed by the authority having jurisdiction, install webbing straps as part of the seismic strapping process. Adding cushions to these straps can help reduce noise by preventing the HPWH from vibrating against the mounting surface during normal operation.

BEST PRACTICES FOR THE RETROFIT INSTALLATION OF HPWH

Figure 4: Strategies for Noise Mitigation



Graphic credit: RHA

APPENDIX 6: ELECTRICAL EVALUATION

Before installing a retrofit HPWH, it is essential to perform an electrical evaluation to ensure the home’s electrical system can support the new appliance. This Appendix outlines the key steps to assess the electrical requirements and provides additional options for accommodating the installation in various situations. The ideal situation is to use 240VAC 30-amp products if the electrical panel will allow.

Where appropriate, consider selecting a heat pump water heater with less costly and complex upgrade requirements, such as the shared circuit 120V model(s) that can plug into existing shared circuits, or a 15-amp version of a 240V hybrid if it is going in a space that might drop below 37F for more than a day.

Table 2: Types of HPWHs (2023) & Requirements

	Volts	Poles or Spaces	Watts	Circuit Amps	Mode when <37F
Shared Circuit 120V	120	1 existing	450	15 or 20 OK	Systems is off until temp >37F
Dedicated Circuit 120V	120	1 repurpose	900	15 or 20 OK	System is off until temp >37F
Hybrid 15-Amp	240	2 new	2,300	15	Resistance
Hybrid 30-Amp	240	2 new	4,600	30	Resistance
Split System 240V	240	2 new	1,600	15	Heat pump

1. **Check for available slots in the electrical panel:** Ensure that there are at least two available slots in the electrical panel for the new HPWH circuit breakers. If there are not enough slots, discuss the following options with the homeowner:
 - a. **120V plug-in HPWHs:** Using a 120V plug-in HPWH simplifies the electrical requirements. A shared circuit model can share an existing circuit.
 - b. **Circuit sharers:** Solutions such as simpleSwitch 240 can help save panel space by allowing two 240V loads to share a single circuit breaker.
 - c. **Circuit pausers:** Solutions such as simpleSwitch 240M, Thermolec DCC9, or Emporia Smart Charger can temporarily pause one load while another is in use, allowing multiple loads to share a single circuit.
 - d. **Tandem breakers:** These narrow breakers fit twice as many circuits per pole space.
2. **Determine the panel amp rating:** Identify the panel’s amp rating listed on the panel or in the documentation. This information is crucial to determine if the panel can handle the additional load from the HPWH.
3. **Determine amp adequacy:** Add up the amperage of all the existing circuit breakers in the panel. Compare this number to the panel’s amp rating to ensure enough capacity to accommodate the additional load from the HPWH. Overall panel size is often smaller than the total of all breakers as energy use is not occurring simultaneously. Some over percentage of panel ampacity is allowable. CA electrical code allows alternative calculation methods for retrofits, which may provide greater flexibility in calculating available panel capacity.

4. **Identify unused or repurposable circuits:** Check if an existing 240V circuit, such as an old furnace circuit, is no longer in use and can be repurposed for the HPWH installation. Repurposing an unused circuit can save time and reduce installation costs. Additionally, consider converting a 120V circuit to a 240V circuit if it is no longer required and the panel allows.
5. **Assess attics or crawlspaces:** Determine if there is an attic above or a crawlspace below the intended installation area. These spaces can be useful for running new electrical wiring or adjusting the existing wiring during installation.
6. **Engage an electrician:** Never guess. Consider engaging a certified electrician when in doubt!

APPENDIX 7: CONTROLLED RECIRCULATION PUMPS

Use of uncontrolled recirculation pumps is not considered a best practice because they can lead to standby energy losses and compromise the efficiency of the HPWH. Check local code for any requirements. The following guidelines can help installers address existing recirculation pumps during installation:

1. **Assess the current system:** Before retrofitting, carefully examine the existing water heater and recirculation pump setup. Document the type of recirculation pump, its location, and how it is connected to the plumbing system. Does it have controls? Are pipes insulated?
2. **Educate the homeowner:** Discuss with the homeowner the potential drawbacks of using an uncontrolled recirculation pump, including increased energy usage and decreased efficiency of the HPWH.
3. **Upgrade existing uncontrolled pump.** Add controls to the existing system to upgrade it to a smart system.
4. **Install a smart recirculation pump:** If a recirculation pump is added, install controls in the form of an on-demand, learning algorithm or timer-based recirculation system that reduces energy waste by only activating when hot water is needed.
5. **Install compatible components:** Ensure that any new or replacement recirculation pumps are compatible with the HPWH system. Consult manufacturer guidelines for recommendations on compatible pumps and accessories.

APPENDIX 8: CAPPING A GAS LINE

It is important to follow guidelines when capping a gas line during the removal of a gas water heater. Gas lines are potentially hazardous if not correctly handled. Improper capping or sealing of the gas line can lead to gas leaks and potentially serious consequences such as health problems, explosions, or fires. It is recommended to have a licensed professional perform this task to ensure the safety of the home and its occupants.

1. **Check with the authority having jurisdiction:** Are there any permit requirements for removing a gas connection and replacing the current gas appliance with an electrical equivalent?
2. **Disconnect the existing gas appliance:**
 - a. Locate and close the gas shutoff valves that feed the entire house/unit and the appliance to be removed.
 - b. Depressurize the house gas line by running the gas water heater or running another gas device like the stove to consume the gas pressure. Turn off the gas device after it has gone out due to lack of gas pressure.
 - c. Detach the gas appliance from the feeding gas pipeline.
3. **Eliminate the gas pipe.** A licensed technician must eliminate the gas pipe back to the next branch.
4. **Check for leaks:**
 - a. Turn the gas back on.
 - b. Spray the gas cap with a mixture of equal parts water and liquid soap. Check if bubbles form. Wait several minutes and spray again. If bubbles form, repeat the capping process until no bubbles form.
5. **Label the pipe termination**
6. **Determine if there are remaining gas appliances**
 - a. Follow the Local Distribution Company (Utility) and Fuel Gas Code procedures for purging a system into service which has been taken out of service for repair or alteration.
 - b. If other gas appliances are remaining in the house/unit, relight the pilot light.
 - c. If all gas appliances are being removed from the house/unit, contact the local gas utility provider for removal of the gas meter and service, which saves the customer money from recurring costs.

APPENDIX 9: SPLIT SYSTEMS

A split system HPWH differs from a unitary system in that the heat pump is usually outside the home and the water storage tank is inside. Check the manufacturer's instructions for placement. This design has its own advantages and challenges, and the installation process is different from a unitary system.

1. **Space requirements:** Split systems have the advantage of taking up less indoor space, as only the water tank is installed inside. This can be a significant benefit in properties where indoor space is at a premium.
2. **Ventilation:** Because a split system's heat pump component is outdoors, it does not require the same level of ventilation consideration as a unitary system. It does not extract heat from the indoor air, so it will not have a cooling effect on the home's interior, and there is no need to consider the size of the indoor space.
3. **Noise:** The compressor, the primary source of noise in a heat pump water heater, is outside in a split system. This means that split systems are generally quieter from the perspective of those inside the home. However, do consider the location of the compressor in relation to operable windows and living space. Check local code requirements and property set-backs.
4. **Installation complexity:** Split system heat pump water heaters are typically more complex and to install than unitary systems. They require water lines to be run between the outdoor and indoor units, and the outdoor unit needs to be properly installed and secured. The CO2 split HPWHs require power at the heat pump outside and their water lines need insulating in a climate where freezing temperatures occur.
5. **Condensate drain:** The outdoor location of the heat pump in a split system usually makes condensate drainage less of an issue than it is with a unitary system. However, proper drainage should still be ensured.

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