**Comment/Explanation\*:***Include your justification for your proposed change to the draft standard below.*
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1. Definitions. There are two categories of heat pump water heaters, with two types in each.
	1. Integrated (unitary) – In this category, the heat pump and the tank are integrated into one package. The hybrid type includes electric resistance elements in the storage tank. The heat pump only type does not have resistance elements in the tank.
	2. Decoupled – In this category, the heat pump is separated from the storage tank. The monobloc type contains the evaporator and condenser in one package. Field installed water piping transfers the energy to the storage tank. The split type separates the evaporator from the condenser. Field installed refrigeration piping transfers the energy to the storage tank.
	3. Given that any one of these could be installed in the residential buildings covered by this standard, I recommend that definitions for each type are included, or that one definition be used that covers all types of air-source HPWH.
	4. The airflow and condensation prevention conditions apply to all air-source HPWH, so I think that one definition can suffice.
2. Acronyms. Acronyms should be developed for each type of HPWH that has a definition.
	1. iHPWH. The words next to the acronym do not include the fact that it applies only to the hybrid type. At present, the provisions in the rest of the standard are written to apply only to the hybrid type of integrated HPWH. This does not make sense to me, but that is where it stands.
	2. If the proposed changes to the definitions are accepted, the acronyms used elsewhere need to be updated.
3. Add new footnote to table. No comment
4. Modify footnote u in the table. No comment
5. Modify the footnote ‘v’ in Table 4.2.2(1). This comment makes sense. The intent of the last sentence in v.2 does not seem to be carried through to the provisions in footnote ‘ac’.
	1. The COP of a HPWH shall also be adjusted for the temperature of its supply air intake and the tank heat transfer shall be adjusted for the temperature of the space
6. Add new footnote ‘ac’
	1. Where a Hybrid Integrated Heat Pump Water Heater is installed, the rated UEF shall be used if one of the following conditions is met for each water heater
	2. If the COP of the HPWH is required to be adjusted due to the temperature of the intake air, then the UEF also needs to be adjusted. This is independent of the air flow or space requirements in footnote ‘ac’.
	3. Footnote ‘ac.i’. Yes, the ducts need to take air from and exhaust air back to the same pressure zone.
		1. It is also necessary for this to be true for each HPWH that is installed. It is possible to combine the airflow requirements of the HPWH in the space, and provide ductworks that can handle the combined air flow. The airflow for the majority of the HPWH sold in the US today have compressors of about 300 watts and fans of about 120 cfm. This means about 40 cfm per 100 watts. The airflow can be met by either forced or natural ventilation, or a combination of the two.
		2. To keep the COP high (more efficient) the temperature of the intake air needs to be at or above 65F. It is also necessary to prevent the short circuiting of the exhaust air back to the intake.
		3. To minimize the risks of condensation on surfaces, it is critical to bring the temperature of the air exhausting from the HPWH to above the dew point as quickly as possible.
	4. Footnote ‘ac.ii’. The free area requirement needs to be proportional to both the size of the HPWH’s compressor, and the number of each HPWH located in a space. It would be better if the free area requirement was 80 square inches per 100 watts of compressor power. This recommendation is based on the research done in the Amazing Shrinking Room tests sponsored by NEEA. The figure shows that a full louver door and grilles located near the ceiling and the floor resulted in a COP above 3.0. The net free area is about 240 square inches for HPWH with 300-watt compressors. Or 80 square inched per 100 watts.



Source: NEEA REPORT #E22-334 Heat Pump Water Heaters in Small Spaces Lab Testing: “The Amazing Shrinking Room”

* 1. Footnote ‘ac.iii’. The Hybrid iHPWH is within an enclosed space that has a volume equal to or greater than 700 ft3 .
		1. The size of the room is not relevant. A heat pump water heater installed indoors needs access to all the thermal resources within the building (e.g. space conditioning system, internal sensible and latent gains, solar heat gains, ventilation gains, air infiltration gains). An air source HPWH needs access to air with as much energy as possible to achieve its rated efficiency.
		2. Installations should ensure unrestricted access to the full set of thermal resources available. Restricting access to new “warm” air, causes the recirculated air inside the space to cool down, lowering the COP and increasing the risk of condensation.
	2. Footnote ‘ac’ equation
		1. Recommend removing Relative Volume from the equation.
	3. Recommend that footnote ‘ac’ only allow for the use of the rated UEF if:
		1. the intake air is above 65F.
			1. Where the intake air is colder, the COP needs to be adjusted for temperature in accordance with footnote v.2.
		2. there is unrestricted access to new thermal resource
		3. if the exhaust air is prevented from short circuiting into the intake
		4. if the airflow is proportional to the number of HPWH and the size of the compressor installed in a space.
		5. the exhaust air is discharged to the same space from which the intake air is supplied (really the same pressure zone).
1. Modify ‘Service Hot Water Equipment’ section from ‘Table 4.5.2(1).
	1. The volume of the space where the HPWH is installed should be documented. Regardless of the size of that space.
	2. The net free area should documented. As should the type (full louvered, half louvered door, grilles, location of grilles, large openings). And whether the exhaust air is discharged to the same space from which the intake air is supplied (really the same pressure zone).
	3. Ducts need to be inspected to ensure that:
		1. the diameter and the elbows do not restrict the airflow.
		2. they are insulated to prevent condensation. Exhaust ducts and ducts that transfer air between unconditioned and conditioned spaces need to be insulated to not less than R-8 and installed with a vapor barrier to prevent the accumulation of condensation on interior and exterior duct surfaces.
		3. the exhaust air is discharged to the same space from which the intake air is supplied (really the same pressure zone).
2. Modify ‘Building Element: Service Hot Water (SHW) Equipment’ table within Normative Appendix B
	1. As written, it is only necessary to document if a Hybrid Integrated Heat Pump Water Heater has been installed. As mentioned above, there are two types of integrated HPWH. What happens if someone installs the type that is not hybrid? Does it get rated?
	2. Recommend that the type of air-source heat pump water heater be documented. Since it is possible to have more than one standalone water heater serve a single dwelling unit, the number of water heaters and the characteristics of each should be recorded.

**Please read the testimony submitted for the 2027 IECC comments IRCE3-24 and RE76-24 for additional discussion behind the recommended changes below.**

**Proposed Change to the Draft Standard\***
*Use “strikethrough” and “underline” formatting to indicate all proposed changes. Changes must be shown with “hard-formatting” strikethrough and underline, not “track changes”.*

*Use a color other than red to indicate proposed changes to the draft.*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Definitions
	1. If the existing definitions are kept.
		1. ***Heat Pump Water Heater (HPWH)***- A water heater that transfers thermal energy from one temperature level to another temperature level for the purpose of heating water, including all ancillary equipment such as fans, storage tanks, or controls necessary for the device to perform its function.
		2. ***Hybrid Integrated Heat Pump Water Heater (iHPWH)*** - A Heat Pump Water Heater where the air-source heat pump is integrated into the unitary water heater~~, usually above the storage tank~~; there are electric resistance elements in the storage tank allowing hybrid water heating by the heat pump or electric resistance elements or both simultaneously.
	2. Proposed.
		1. ***Heat Pump Water Heater (HPWH), Air-Source.*** A water heating system containing a heat pump and a storage tank, where the heat pump extracts thermal energy from the air and transfers it to the water.
		2. ***~~Heat Pump Water Heater (HPWH)~~***~~- A water heater that transfers thermal energy from one temperature level to another temperature level for the purpose of heating water, including all ancillary equipment such as fans, storage tanks, or controls necessary for the device to perform its function.~~
		3. ***~~Hybrid Integrated Heat Pump Water Heater (iHPWH)~~***~~- A Heat Pump Water Heater where the air-source heat pump is integrated into the unitary water heater, usually above the storage tank; there are electric resistance elements in the storage tank allowing hybrid water heating by the heat pump or electric resistance elements or both simultaneously.~~
2. Acronyms
	1. Existing
		1. ***HPWH –*** Heat pump water heater
		2. ***iHPWH*** – Hybrid integrated heat pump water heater
	2. Proposed
		1. ***HPWH –*** Heat pump water heater
		2. ***~~iHPWH~~*** ~~–Integrated heat pump water heater~~
3. No comment
4. No comment
5. No comment
6. Modify new Footnote ‘ac’

ac. Where a ~~Hybrid Integrated~~ Heat Pump Water Heater is installed, the rated UEF or COP, as applicable shall be used as the starting point for the simulation if one of the following conditions is met for each water heater:

* + 1. A ducted intake and exhaust is installed and the incoming air is drawn from the same space as the space to which the exhaust is discharged. The diameter of the ducts and the elbows do not restrict the airflow below the unrestricted cfm of the HPWH’s fan. The airflow is proportional to the number of HPWH installed in the space. Exhaust ducts and ducts that transfer air between unconditioned and conditioned spaces are insulated to not less than R-8 and installed with a vapor barrier to prevent the accumulation of condensation on interior and exterior duct surfaces.
		2. The enclosed space containing the water heater is verified to have a total net free opening area to an adjacent heated or conditioned space of no less than ~~300~~ 80 in2per 100 watts of compressor power, using any combination of grilles, louvers, door undercuts, or a louvered door. The net free area is proportional to the number of HPWH installed in the space. The exhaust air is discharged to the same space from which the intake air is supplied.
		3. ~~The Hybrid iHPWH is within an enclosed space that has a volume equal to or greater than 700 ft~~~~3~~.

For all other ~~Hybrid iHPWH~~ air-source HPWH installations, the maximum allowable COP (COPeff) shall be determined by the equation below.

COPeff = (COPcomp - 1.53) \* (1 - ( 1.009 \* exp(-5.492\*(~~RV~~) ) ) ) + 1.53

Where:

 COPcomp = Heat pump compressor COP at the rated UEF

~~RV = Relative Volume = MIN [(Hybrid iHPWH containment volume, ft~~~~3~~~~)/1500 ft~~~~3~~~~), 1.0]~~

1. Modify ‘Service Hot Water Equipment’ section from ‘Table 4.5.2(1).
	1. Existing text: For Hybrid Integrated Heat Pump Water Heaters – containment volume (ft3) and the net free opening area (in2) of the space containing the water heater. If ducted, the space to which the exhaust air is discharged and the space from which the intake air is supplied.
	2. Proposed change:
		1. For ~~Hybrid Integrated~~ air-source Heat Pump Water Heaters
			1. containment volume (ft3) of the space containing the water heater
			2. the net free opening area (in2), the type and location of the natural ventilation openings and whether the exhaust air is discharged to the space from which the intake air is supplied
			3. If ducted, verify that
				1. the diameter of the ducts and the elbows do not restrict the airflow.
				2. exhaust ducts and ducts that transfer air between unconditioned and conditioned spaces need to be insulated to not less than R-8 and installed with a vapor barrier to prevent the accumulation of condensation on interior and exterior duct surfaces.
				3. the exhaust air is discharged to the same space from which the intake air is supplied (really the same pressure zone).
2. Modify ‘Building Element: Service Hot Water (SHW) Equipment’ table within Normative Appendix B
	1. Proposed change: Identify whether the equipment is storage or instantaneous, identify its fuel source and record storage tank capacity in gallons. Also record whether the SHW equipment is ~~a Hybrid Integrated~~ an air-source Heat Pump Water Heater, or supplemented by a desuperheater and/or if it is integrated with the space heating system.