Retrofit Heat Pump Master Specification

Section 1.0 Introduction

Section 2.0 Specification Boundaries

Meet Uniform Plumbing Code requirements

HPWH Size: Small tanks (40 and 30 Gallon)

Space (volume and area space for installing HPWH)

Section 2.1 Performance

PERFORMANCE SPECIFICATION:

The heat pump water heater must have an UEF as measure by the NEEA's Northern Climate Heat Pump Water Heater Testing (Appendix A):

	Space Constraint Exists?	
Power Constraint Exists?	Yes	No
Yes	1. The Minimum Northern Climate UEF, which is potentially less than a 2.6 Northern Climate UEF that allows for designs that meet the space constraints and electrical constraints (i.e., potentially allows for a lower first-hour less than 51).	2. The Minimum Northern Climate UEF that corresponds to a Tier 3 NEEA (2.6 UEF) when simulated at a medium draw pattern allowing for a 140 mean tank temperature.
No	3. The Minimum Northern Climate UEF that corresponds to a that corresponds to a 2.0 UEF with a mean tank temperature of 140 degrees.	4. 2.6 UEF

Set first hour rating of 51 gallons as measured by the DOE test procedure.

Northern Climate UEF of 2.6.

Section 2.2 Refrigerants / Temperature (Air / Water)

Refrigerants

- Environmental
  - Very dynamic time for refrigerant legislation state to state
    - Hinge on CARB dates and appliance classification
    - Need: definite dates from CARB
  - Tier approach?
    - Tier 1 - Current GWP<1500 (current solution)
    - Tier 2 - GWP<750 (Mid level step if needed)
    - Tier 3 - GWP 150 (Long term solution)
  - Safety/Toxicity (Considerations for future policy for type of refrigerant that can be included in a later version of the specification)
    - Should A2L and A3 be allowed if our target installation location is a very tight closet?
    - A3 refrigerants are currently limited to 150 grams, may not be sufficient for current condenser wrap design.
  - Serviceability
    - HFC's and HFO blends
    - Transicritcal CO_2 will drive up unit cost necessitating repairable design, but there is currently severe lack technicians that can service these units.
- Operating envelope
  - Air
    - Heat pump operation
      - Ambient temperature
        - $T_{AMBIENT}$ 40°F to 120°F
        - Backup Resistance element allowed for operation above or below (Electric only mode not a selectable)
  - Water
    - Inlet
      - Inlet water minimum of 50°F per NEEA specification
    - Tank Setpoint
      - Must be capable of achieving 140°F set point

Commented [EM1]: Need to have discussion on temperature. Should 37 degrees be considered? Need to research to look at percent of construction that is located in climates that are 37 degrees.

Section 2.3 Electrical

Electric Component of Retrofit-Ready HPWH Spec

- Spec
  - 110-120 V
  - Plug and play without a dedicated circuit or panel upgrade: 5-12 A
    - NEC - continuous heating loads can take up to 80% of capacity of shared circuit
    - 5A is a worst case – 1/3 of 15 A circuit; 12 A is "best case" - 80% of 15A circuit

- Feasibility check
  - Load up to 140 F with mixing valve
    - Based on Ecotope study, this is the sweet spot between thermal capacity, standby losses, and loss of efficiency
  - With 110V, 140F, 40 gal tank, can achieve 49 gal first hour rating with compressor
    - Required by UPC for up to 2 bed, 2.5 baths or 3 bed, 1.5 baths
  - In backup resistive mode, even at 40F inlet water temperature you get a 6 gal/hr recovery rate - can recharge whole tank in 8 hours
    - Overnight for morning draws
    - During the day for evening draws - low carbon electricity from solar
- Research questions
  - Double check NEC requirement for continuous load on a shared circuit – is it 80%?
  - Double check that you can start first hour rating test with the tank at 140 F.
  - What would be required to achieve UPC first hour rating for 62 gal? (Larger homes)
  - Research: How many showers in the real world do you get from a 49 and 62 gallon first hour rating tank?
  - NEC – fixed appliances require dedicated circuit. Need to verify. Can NEC be amended at state or local level?
  - Reference NEC 210.21(B)(1) and 210.23(A)(1) Look at GFI requirements

Section 2.4 Space

How water storage vessel must to fit through a 22" opening for installation, and must fit within a space of 24"X26"X84" (inclusive of drain pan and all plumbing connections and venting connections).
Add language for recommended serviceability

NOTE: This space requirement is based on limited data set and anecdotal experience. We recommend gathering more field data before solidifying these numbers. We recommend crowd sourcing the info by just putting the question out to the Building Decarb Working Group Listserve.

Section 2.5 Communications / Controls

- Open Protocol at device or at cloud – non-proprietary API
- Secure API – Security is important
- Open Cloud based API -
- Integration with home controls ecobee, nest, etc.
- Wireless WIFI signals that are open for communication recommended that OEM manage the relationship with customer experience
- Enable management of ToU energy cost for consumers through a trusted energy advisor
- Don't force the all the hardware and software on the water heater
  - Minimum capability at the standard water heater for onboard controls are:
    - Tank Temperature upper & lower
    - Setpoint temperature with capability to program setbacks or time of use interaction
    - Programmable on physical unit or remote

        - on/off controls
        - Change operating mode
        -
        - Connection through USB, BLE or wifi direct connect for provisioning and commissioning
- Add on “Dongle” or enhanced hardware “connect in” option for commissioning or updates
    - One option is CTA 2045 software protocol
        - Robust set of commands
        - Communication protocols
        - Consensus based ANSI standard
        - Standardized communication plugs

Commented [EM2]: ANSI Specification

Draft language to describe the intent of the controls – communication enabled

Consider minimum set of data parameters for stakeholder needs

Third party tested

Utility Integration

- Opt out/ setback 72 hrs to efficiency/demand response mode
- Price signal capable, solar response to negative price signals
- Training for installers and setup for controls
- Thermal storage capable for first hour requirement and management

Section 2.6 Warrantees

5.3 Warranty and Service. The unit shall carry a warranty of a minimum of 10 years for all system parts. The unit shall carry a warranty of a minimum of 1 year for labor from date of installation with a reasonably priced, manufacturer provided extended labor warranty.

Commented [EM3]: Negotiable

Commented [EM4]: Needs further discussion

Should delete 5 years of labor warranty based on business models

Can 1.5 years (18 month) year warranty for labor be considered?