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Sent: Thursday, July 3, 2014 12:03 PM
To: waterheaters@energystar.gov
Cc: Abigail Daken - EPA
Subject: AO Smith comments on ENERGY STAR Residential Water Heater Specification Final Draft V3.0

July 3, 2014

ENERGY STAR® Product Specification for Residential Water Heaters, Final Draft Ver. 3.0 – Comments – AOS

A. O. Smith Corporation is a leading manufacturer of residential and commercial water heating products, and is an ENERGY STAR Partner. We appreciate the opportunity to comment on the ENERGY STAR Product Specification for Residential Water Heaters Eligibility Criteria, Final Draft, Version 3.0.

We very much appreciate EPA's consideration of the comments received in response to Draft 1 of the update to the ENERGY STAR Residential Water Heater Program, and agree with these changes:

- Removing the Connected Criteria from the specification. We do agree that it would be appropriate to revisit the inclusion at some later time.
- Although we do not think that warranty should be part of the water heater specification unless it is a part of all product specifications in ENERGY STAR, if it is to be included, moving to uniform warranty requirements (except for solar) is agreeable. A "level playing field" is always desirable.

We do, however, continue to strongly support a volume-compensated metric for both the EF requirement for large gas storage heaters and the standby loss requirement for "Residential Duty EPACT" (Light Duty EPACT) covered gas heaters, per the following:

> From Chapter 5 (Engineering Analysis) of the Technical Support Document for the 2010 NAECA 3 Rulemaking:
> http://www.regulations.gov/#!documentDetail;D=EERE-2006-STD-0129-0170
>
> From Section 5.3:
>
> "For residential storage-type water heaters, the tank volume significantly affects the energy consumed. That is, it takes more energy to heat a larger volume of water from a given temperature to a higher temperature. Additionally, the tank surface area increases as tank volume increases. Among other factors, the heat transfer rate is a function of surface area. Therefore, increased surface area increases the rate of heat transfer to the ambient air, which increases standby losses. This is reflected in the existing Federal energy conservation standards as the energy factor is a function of the tank storage volume for gas-fired, oil-fired, and electric storage water heaters."
>
> Table 5.3.1 (and accompanying discussion) identifies that the representative gas-fired storage heater selected for the analysis was a 40 gallon capacity model.
>
> Table 5.4.12 identifies that the max-tech level for gas-fired storage was determined for the representative 40 gallon capacity model. (At the time of the TSD this was 0.80 EF, but as has been noted already in the draft specification, was revised to 0.77 EF at the time of the Final Rule.)

The above information clearly shows why EF is volume dependent, and that basing an EF specification for larger NAECA-covered heaters (and thermal efficiency + standby loss "equivalency" to EF for EPACT-covered heaters) on 0.77 EF for all sizes is technically incorrect. On a plot of EF to gallon size, then, the max-tech line should have a downward slope, and not be horizontal at 0.77 EF. The slope of that line can be given by the minimum efficiency equation for greater than 55 gallon heaters contained in the NAECA 3 Final Rule, which is EF=0.8012 – (0.00078*V). Plug in 40 gallons, and you get 0.77 EF.
Similarly, 55 gallons = 0.76 EF, 75 gallons = 0.74 EF, and 100 gallons = 0.72 EF.

Therefore, we strongly believe that the appropriate specification should be volume dependent, and should be based on the max-tech equation in the NAECA 3 Final Rule [EF=0.8012 – (0.00078*V)]. If EPA chooses to set the specification above the NAECA 3 level, we suggest that it be no more than one efficiency point [EF=0.8112 – (0.00078*V)].

Similarly, for standby loss on EPACT-covered heaters:

We strongly believe the TE+SL "equivalence" to EF should be based on a sloped line, as discussed above, and not on 0.77 EF for all gallon capacities, and we encourage EPA to revisit their decision to not consider a volume dependent requirement at this time.

The math behind this approach is:

From the DOE website, the equation to estimate annual operating costs for a gas water heater rated in EF is:
http://energy.gov/energysaver/articles/estimating-costs-and-efficiency-storage-demand-and-heat-pump-water-heaters

365 X 41045/ EF X Fuel Cost (Btu) = estimated annual cost of operation

Therefore, to get to daily energy consumption, you can simplify to: 41045/ EF = daily energy use.

Based on thermal efficiency (TE), the daily energy consumption can be calculated by:

C = (8.29*gallons used*delta T)/TE + standby loss*number of hours in standby

(which is basically "energy used to heat the water used + energy used to replace standby losses")

For the standardized case of 64.3 gallons per day usage, with a 77°F delta T, and evaluated at any given thermal efficiency (TE), this works out to be C = 41045/TE + SL(24 – number of operating hours) Btu

If the input rate is given as P, the number of operating hours is determined by (41045/TE)/P

Therefore, the "volume compensated" EF to TE+SL daily energy consumption equivalence calculation would be:

41045/(0.8012-(0.00078*V)) = 41045/TE + SL(24 – (41045/TE)/P)

For any given unit, knowing the volume, thermal efficiency, and input rate, the "EF equivalent" hourly standby loss in Btu's (SL) readily falls out of the above equation.

The standby loss equation in the Final Draft results in a SL of 321 Btuh for a 90% TE heater and 435 Btuh for a 96% TE heater. If the above "equivalence calculation" for SL is conducted with the "+1 point" equation discussed above in regard to >55 gallon NAECA-covered heaters [EF=0.8112 – (0.00078*V)], it works out that, for 50 gallon units (for example), SL = 323 Btuh for 90% TE @ 76 kBtuh heaters and SL = 441 Btuh for 96% TE @ 100 kBtuh heaters. Those values are very close to the Final Draft (non-volume compensated) values of SL, so use of the "+1 " equation would agree closely with what EPA has proposed at the lower-volume end of the Residential Duty

Commercial (RDC) product offerings, and would provide appropriate volume-compensation for higher volume RDC heaters.
Some examples:

- 60 gallon 90% TE @ 100 kBtuh – SL = 344 Btuh
- 60 gallon 96% TE @ 100 kBtuh – SL = 454 Btuh
- 75 gallon 90% TE @ 100 kBtuh – SL = 379 Btuh
- 75 gallon 96% TE @ 100 kBtuh – SL = 500 Btuh

This provides a volume-compensated SL metric that is tied to the Final Draft metric at the lower end of RDC volumes, and is not unfairly stringent for higher volume heaters.

Previously EPA had expressed concern that any calculations should not be confusing to the non-technical consumer. We firmly believe that the consumers are not going to do any math, anyway – that is part of the value of the ENERGY STAR brand – the math has been done for them!
Therefore, only the manufacturer, any involved Certifying Body, and EPA are the only ones that are going to be using the above calculations, so the "math complexity" issue becomes moot.

Also, since the DOE Final Rule (pre-notice) on the uniform descriptor test method was released on June 27 in which the terminology "Light Duty Commercial" was changed to "Residential Duty Commercial" for EPACT-covered heaters, we suggest that EPA adopt the same terminology in the V3.0 specification.

Thank you for the opportunity to provide comments on the Final Draft, and feel free to contact me if you have any questions or would like additional information.

Regards,

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