EO-134 Minority Report

Section C406.2.2 “Minimum Equipment Efficiency”

of the 2018 Washington State Energy Code as it applies to

Gas Fired Hot Water Boilers

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1) Introduction

The draft of the 2018 Washington State Energy code defines minimum efficiency requirements for gas and oil-fired boilers in Table C403.3.2(5). This table is a slight modification of the table used to define minimum Federal efficiency standards for gas and oil-fired hot water and steam boilers.

Section C406 of the 2018 Energy Code defines eight additional efficiency packages and requires buildings to comply with at least two of these packages. One of these packages requires more efficient HVAC equipment as described in C406.2.2. This paragraph refers to the minimum efficiencies listed in C403.3.2(5) discussed above and requires that the equipment exceeds these minimum efficiencies by 15%.

2) Argument against applying this approach to gas-fired hot water boilers

When used in Section C403 of the code, the referenced table is used to regulate the use of non-condensing boilers with efficiencies in the 80-82% range. However, in Section C406 of the code, this same table is used to regulate condensing boilers with efficiencies in the low-to-mid 90%'s. This was not the purpose envisioned when the original Federal table was developed and this mis-application results in counter-productive results.

The minimum boiler efficiency table utilities both Thermal Efficiency as well as Combustion Efficiency ratings depending on the size of the boiler being evaluated. While it might make some sense to utilize combustion efficiency to evaluate non-condensing boilers, it makes no sense when evaluating condensing boilers.

The Thermal Efficiency testing procedure is superior to the Combustion Efficiency testing procedure in that it is completely empirical and measures the actual boiler output (the combustion testing involves calculations and does not measure the output) as well as being more accurate. Please find attached Page 6 of the ANSI/AHRI Standard 1500 where the inlet water temperature used during testing is defined to be 80° F for condensing boilers but is allowed to range from 80° F down as far as 35° F for non-condensing boilers. This wide allowance for non-condensing boilers can alter the Combustion Efficiency rating dramatically depending on what inlet water temperature a manufacturer chooses to use for their settings. This is just one example of the inaccuracies inherent in the Combustion Testing procedure.

Theoretically, thermal efficiency should always be less than combustion efficiency because it measures all losses however, a review of AHRI ratings for a number of condensing boilers reveals that this is often not the case. The reason for this is that the Thermal Efficiency test procedure is simply more accurate than the Combustions Testing procedure.

The Thermal Efficiency testing procedure is more detailed, complete and longer (60 minutes vs 30 minutes) and is the industry accepted method of evaluating condensing boilers. It is the method of measurement used by equipment manufacturers to achieve the most efficient equipment possible and it is the rating that the marketplace uses to judge equipment.

Because the two methods of efficiency testing have little relationship to one another and because Thermal Testing is more accurate, the use of Table C403.2.3(5) to regulate the use of condensing boiler often forces a designer to choose a less efficient boiler for sizes greater that 2,500,000 BTU/h. This is arbitrary and counter productive to the goals of the State Energy Code.

3) Recommendations

In order to avoid the problems resulting from the use of Table C403.3.2(5) for purposes other than what it was designed for, I propose that Section C406 not use this Table for evaluating condensing boilers and instead have a fixed minimum Thermal Efficiency rating for all sizes of gas-fired boilers. My suggested level would be a minimum 95% Thermal Efficiency rating, which is at least 15% better than the values in Table C403.3.2(5) for combustion and thermal efficiency. This is in line with how larger (≥ 1,000 MBH) service water heating systems are evaluated by the code.

This would be an additional requirement to meet C406, above and beyond the minimum Code required efficiencies. Boilers would still be subject to Table C403.3.2(5) and would be compliant with the federal regulations, but by allowing this change to the efficiency requirements in C406.2 it would allow for more energy efficient boilers to be selected when large (>2,500,000 BTU/h) boilers are used. A large boiler with 95% Thermal Efficiency (E_t) will always outperform a similar sized boiler with 95% Combustion Efficiency (E_c).

Proposed Code language:

C406.2 More efficient HVAC equipment and fan performance. Buildings shall comply with Sections C406.2.1 through C406.2.3.

C406.2.1 HVAC system selection. No less than 90% of the total HVAC capacity serving the building shall be provided by equipment that is listed in Tables C403.2.3(1) through C403.2.3(9) or a combination thereof.

Exception: Air-to-water heat pumps or heat recovery chillers are also permitted to be utilized for Option C406.2.

C406.2.2 Minimum equipment efficiency. Equipment shall exceed the minimum efficiency requirement listed in Tables C403.2.3(1) through C403.2.3(9) by 15 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 15 percent.

Exception:

1. Equipment that is larger than the maximum capacity range indicated in Tables C403.2.3(1) through C403.2.3(9) shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table.
2. Hot water boilers with input capacity greater than 2,500,000 BTU/h shall be considered to comply with this section with a minimum thermal efficiency of 95% E per test procedure 10 CFR Part 431.