BSR/ASHRAE/IES Addendum BC
to ANSI/ASHRAE/IES Standard 90.1-2016

Public Review Draft

Proposed Addendum BC to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings

Second Public Review (February 2019)
(Draft Shows Proposed Independent Substantive Changes to Previous Public Review Draft)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

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FOREWORD

This is a second comment review. Comments from the first public review have been incorporated into these changes. The requirement for a minimum 40 degree delta T between the leaving and entering boiler water has been removed. Boilers less than 300,000 Btu/h are no longer included in the proposal. Additionally the flow requirements have been simplified.

Boilers represent 40% of the heating in commercial buildings and are especially prevalent in cold climates. In table 6.8.1-6 efficiency improvement were implemented in 2010 and some further improvements are scheduled for 2020 for gas fired natural draft but all these levels are defined to not achieve condensing boiler level efficiency. A challenge for condensing boilers for hot water heating is that they require system design changes and the use of higher delta entering and leaving temperature to maintain condensing operation to ensure they operate efficiently.

The addendum proposes implementation of condensing boilers for new construction to achieve condensing-level efficiency (i.e., 90% E_t) for large boiler systems (i.e., between 1 million and 10 million Btuh), where the proper design considerations are included so that the condensing boilers will operate properly. To ensure condensing occurs, requirements are added to ensure boiler entering water temperature is designed to be low and able to be maintained low by minimizing recirculation of hot water supply into the return.

First cost was determined from the *2012 GSA Condensing Boiler Study*[1], which estimates $38.50/MBtu for non-condensing and $42.60/MBtu for condensing boilers. In addition, the study estimates an additional average annual maintenance cost of $400 for condensing boilers. Energy savings were found using energy modeling simulations run using DOE's EnergyPlus. Three prototype buildings were used, large office, hospital, and secondary school, in varied US climate zones. A blended cost of $0.10/kWh was assumed.

Using the 90.1 scalar ratio, the economic analysis shows an average scalar ratio of 4.2. The maximum scalar ratio of 17.2 for boilers with a life expectancy of 25 years. Models and estimates show that all prototypes fall within the maximum scalar ratio and are cost-effective.

[Note to Reviewers: This public review draft makes proposed independent substantive changes to the previous public review draft. These changes are indicated in the text by <u>underlining</u> (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the previous draft are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed substantive changes.]

[1] https://www.gsa.gov/cdnstatic/Condensing_Boilers-findings_FINAL_4-15-13_508.pdf

Addendum BC to 90.1-2016 ISC

Modify the standard as follows (IP and SI Units) by adding a new section 6.5.4.8 to section 6.5.4 (Hydronic System Design and Control) in section 6.5 (Prescriptive Path).

6.5.4.8 Buildings with High Capacity Space Heating Gas Boiler Systems

New buildings with gas hot water *boiler systems* for space heating with a total *system* input of at least 1,000,000 Btu/h (290 kW) but not more than 10,000,000 Btu/h (2900 kW) shall comply with 6.5.4.8.1 and 6.5.4.8.2.

6.5.4.8.1 Boiler Efficiency

Gas hot water *boilers* shall have a minimum thermal *efficiency* (E_t) of 90% when rated in accordance with the test procedures in Table 6.8.1-6. Systems with multiple boilers are allowed to meet this requirement if the space-heating input provided by equipment with thermal *efficiency* (E_t) above and below 90% provides an input capacity-weighted average thermal *efficiency* of at least 90%. For boilers rated only for combustion *efficiency* ~~or *AFUE*~~, the calculation for the input capacity-weighted average thermal *efficiency* shall use the combustion *efficiency* value ~~or the *AFUE*, respectively~~.

6.5.4.8.2 Hot Water Distribution System Design

The hot water distribution system shall be designed to meet all of the following:

a. Coils and other heat exchangers shall be selected so that at design conditions~~:~~

~~i.~~ the hot water return temperature entering the *boilers* is 120°F (49°C) or less~~., and~~

~~ii. the temperature difference between the hot water supply temperature leaving the boiler and the hot water return temperature entering the *boilers* is 40°F (22°C) or higher.~~

b. Under all operating conditions, the water temperature entering the boiler is 120°F (49°C) or less or the flow rate of supply hot water that recirculates directly into the return system, such as by 3-way valves or minimum flow bypass controls, shall be no greater than~~:~~

~~i.~~ 20% of the design flow of the operating boilers. ~~*boiler system* hot water flow rate at design conditions and;~~

~~ii. 5% above the sum of the minimum flow rates of operating *boilers*, as required by the *boiler equipment manufacturer.*~~

Exception to 6.5.4.8

1. Where 25% of the annual space heating requirement is provided by ~~*site-solar energy*~~ on-site renewable energy, *site-recovered energy*, or heat recovery chillers.
2. *Space heating boilers* installed in individual dwelling units.
3. Where 50% or more of the design heating load is served using perimeter convective heating, radiant ceiling panels or both.
4. Individual gas boilers with input capacity less than 300,000 Btu/h (87 kW) shall not be included in the calculations of the total system input or total system efficiency.