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ANSI/ASHRAE/AHRI Standard 155-2024
Method of Testing for Rating Commercial Space Heating Boiler Systems

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Preview

NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE website at www.ashrae.org/technology.

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FOREWORD

This standard provides a method of test for rating commercial space heating boiler systems. The ultimate objective is to provide a means to determine the seasonal efficiency of individual, modular, and multiple boiler systems having various means of staging boilers to meet the building load, various boiler outlet (supply) or boiler inlet (return) water control strategies, and various pumping strategies, when applied, to meet the load of a particular building or prototype building in a particular climate. This standard provides test procedures and calculation procedures that allow a full performance map to be created for an individual boiler from the test results.

Development of this standard was initiated in 1993–94 by ASHRAE Technical Committee 6.1, Hydronic and Steam Equipment and Systems. At that time, ASHRAE Standing Standard Project Committee 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, was independently pushing for a more meaningful standard for rating of commercial boilers. Among the needs identified by these committees were procedures that would result in ratings based on thermal efficiency rather than combustion efficiency for all boilers; test boilers at entering and leaving temperatures typical of space heating applications; allow performance to be determined at part-load, idling, and full-load conditions; and include energy used by integral electrical equipment. To date, no other standard available has addressed these needs.

In developing this standard, the project committee gave substantial consideration to the testing burden, because many commercial boiler models are sold in small quantities. The resulting standard requires only steady-state tests and idling tests; no part-load tests under cyclic operation (i.e., while cycling on and off below the lowest steady state meet a load below the lowest steady-state output) are required. At the same time, the project committee sought to avoid the single-load profile and oversizing ratio implicit in the Standard 103 test for residential boilers. To provide a flexible procedure that would allow users to determine energy use for any boiler system configuration, load profile, and oversizing ratio while minimizing the testing burden required the use of numerous computational procedures. Many of the procedures developed to enable generation of a full-performance map from a small number of test results are elucidated in Informative Appendix C. A particular concern was the determination of cyclic performance. Cyclic tests are expensive and require accurate measurement of output under continuously varying conditions, yet are critical to seasonal efficiency. To address this, the project committee designed and oversaw the completion of tests that validated a linear input-output model for this operating regime (also described in Informative Appendix C).

Where the standard allows a datum to be determined through tests or through computations, the guiding principle used was that the calculated datum should be conservative, that is, should result in no lower estimate of energy use than that resulting from an accurate test.

The control volume for this standard is the boiler system. The building distribution loop is external to this control volume, so for complete accounting of energy use, heat losses from the building loop must be included in the building load.

A related ASHRAE Research Project, RP-1196, developed software that automates the application of the results of this test method to specific buildings.

1. PURPOSE

This standard provides procedures for determining the steady-state thermal efficiency, part-load efficiency, and idling energy input rate of space heating boilers.

2. SCOPE

2.1 This standard applies to steam and hot-water boiler systems (individual, modular, or multiple boilers) for use in space heating applications and having individual boilers or modules with gas, oil, electric, or multiple fuel inputs of at least 300,000 Btu/h (87.92 kW) but no more than 12,500,000 Btu/h (3664 kW).

Exception to 2.1: Custom-designed, field-assembled boilers are not covered by this standard.

2.2 This standard provides methods to compare energy consumption measures of various boiler systems. It is not intended to provide an absolute measure of performance in any specific installation configuration.

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2.3 This standard includes

a. test methods for determining full-load and part-load steady-state thermal efficiency, idling energy input rate, and throughflow loss rate of individual boilers;
b. methods for interpolating and extrapolating test data; and
c. rating conditions to be used in executing tests and calculations for a range of classes of space heating applications.

2.4 This standard applies to the space heating performance of boiler systems used for multiple functions, including space heating.

2.5 This standard does not cover methods of testing boiler systems used only in service water heating applications.

3. DEFINITIONS AND NOMENCLATURE

3.1 Definitions

barometric draft regulator: a balanced damper device attached to the vent connector to control draft (negative pressure).

boiler

atmospheric: a low-pressure packaged boiler that incorporates a gas atmospheric burner that operates with a nonpositive vent static pressure.

condensing: a low-pressure packaged boiler that will, during at least one of the thermal efficiency tests in this standard, condense part of the water vapor in the flue gases and is equipped with a means of collecting and draining this condensate from the heat exchange section.

counterflow: a low-pressure packaged boiler in which all of the heat transfer surface contacted by the water as it enters the heat exchanger is within the last 25% of the flue gas flow path.

cross-flow: a low-pressure packaged boiler that is neither a parallel-flow boiler nor a counterflow boiler.

custom-designed, field-assembled: a boiler that is designed for a specific installation and is constructed at the installation site.

low-pressure: a boiler designed to supply low-pressure steam or hot water. A low-pressure steam boiler operates with a steam pressure at or below 15 psig (103.4 kPa); a low-pressure hot-water boiler operates with a water pressure at or below 160 psig (1103. kPa) and temperatures at or below 250°F (121°C), respectively.

modular: a steam or hot-water heating assembly consisting of a grouping of individual low-pressure packaged boilers, commonly referred to as modules, intended to be installed as a unit. Modules may be under one jacket or may be individually jacketed.

modulating: a low-pressure packaged boiler equipped with one of the modulating control arrangements defined herein such that the minimum input rate is equal to or less than 75% of the maximum input rating.

multiple: an assembly consisting of a grouping of individual low-pressure packaged boilers.

noncondensing: a low-pressure packaged boiler that is not a condensing boiler.

outdoor: a low-pressure packaged boiler with integral venting means that is factory assembled, weather-proofed, and wired for use outdoors.

packaged: a boiler that is shipped in one or more assemblies complete with burner and controls authorized by the boiler manufacturer. If the boiler is shipped in more than one assembly, the assemblies may originate from suppliers other than the manufacturer.

parallel-flow: a low-pressure packaged boiler in which all of the heat transfer surface contacted by the water as it enters the heat exchanger is within the first 25% of the flue gas flow path.

steam and hot water: a low-pressure packaged boiler that can be sold as a steam or hot-water boiler simply by changing the controls.

boiler loop: pipes and devices connected to the boiler and through which water flows during conduction of the idling tests, not including attached piping and devices through which water does not flow during the test, such as dead legs and expansion tanks.

burner: a device for the introduction of fuel and air into a firebox at the desired velocities, turbulence, and concentration to establish and maintain proper ignition and combustion of the fuel.

atmospheric: a burner for the final conveyance of a mixture of gas and air at atmospheric pressure to the combustion zone. Air at atmospheric pressure is injected into the burner by a jet of gas.