



Standard Test Method for Heating Value of Gases in Natural Gas and Flare Gases Range by Stoichiometric Combustion¹

This standard is issued under the fixed designation D4891; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the heating value of natural gases and similar gaseous mixtures within the range of composition shown in **Table 1**, and **Table 2** that covers flare components but is not intended to limit the components to be measured in flare gases.

1.2 *This standard involves combustible gases. It is not the purpose of this standard to address the safety concerns, if any, associated with their use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

D1826 Test Method for Calorific (Heating) Value of Gases in Natural Gas Range by Continuous Recording Calorimeter
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 EPA Standard:³

EPA-600 /2-85-106 Evaluation of the Efficiency of Industrial Flares: Flare Head Design and Gas Composition

3. Terminology

3.1 All of the terms defined in Test Method **D1826** are included by reference.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *combustion ratio, n* —the ratio of combustion air to gaseous fuel.

3.2.2 *burned gas parameter, n* —a property of the burned gas after combustion which is a function of the combustion ratio.

3.2.3 *critical combustion ratio, n* —for a specific burned gas parameter, the combustion ratio at which a plot of burned gas parameter versus combustion ratio has either maximum value or maximum slope.

3.2.4 *combustion air requirement index (CARI), n* —is the amount of air required for complete combustion of the gas being measured and can be used to index against other measured values such as the Wobbe Index or Heating Value.

3.2.5 *stoichiometric ratio, n* —the combustion ratio when the quantity of combustion air is just sufficient to convert all of the combustibles in the fuel to water and carbon dioxide.

4. Summary of Test Method

4.1 Air is mixed with the gaseous fuel to be tested. The mixture is burned and the air-fuel ratio is adjusted so that essentially a stoichiometric proportion of air is present. More exactly, the adjustment is made so that the air-fuel ratio is in a constant proportion to the stoichiometric ratio that is a relative measure of the heating value. To set this ratio, a characteristic property of the burned gas is measured, such as temperature or oxygen concentration.

5. Significance and Use

5.1 This test method provides an accurate and reliable procedure to measure the total heating value of a fuel gas, on a continuous basis, which is used for regulatory compliance, custody transfer, and process control.

5.2 Some instruments which conform to the requirements set forth in this test method can have response times on the order of 1 min or less and can be used for on-line measurement and control.

5.3 The method is sensitive to the presence of oxygen and nonparaffin fuels. For components not listed and composition ranges that fall outside those in **Table 1** and **Table 2**, modifications in the method and changes to the calibration gas or gases being used may be required to obtain correct results.

6. Apparatus

6.1 A suitable apparatus for carrying out the stoichiometric combustion method will have at least the following four

¹ This test method is under the jurisdiction of ASTM Committee **D03** on Gaseous Fuels and is the direct responsibility of Subcommittee **D03.03** on Determination of Heating Value and Relative Density of Gaseous Fuels.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from United States Environmental Protection Agency (EPA), Ariel Rios Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20004, <http://www.epa.gov>.