



Designation: ~~D6423~~—~~18~~ **D6423** – 19

## Standard Test Method for Determination of pHe of Denatured Fuel Ethanol and Ethanol Fuel Blends<sup>1</sup>

This standard is issued under the fixed designation D6423; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This test method covers a procedure to determine a measure of the acid strength of high ethanol content fuels. These include denatured fuel ethanol and ethanol fuel blends. The test method is applicable to denatured fuel ethanol and ethanol fuel blends containing ethanol at 51 % by volume, or more.

1.2 Acid strength as measured in this test method is defined as pHe. A pHe value for alcohol solutions is not comparable to pH values of water solutions.

1.2.1 The value of pHe measured will depend somewhat on the fuel blend, the stirring rate, and the time the electrode is in the fuel.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3.1 Hydrogen ion activity in water is expressed as pH and hydrogen ion activity in ethanol is expressed as pHe.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[D1193 Specification for Reagent Water](#)

[D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants](#)

[D4806 Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel](#)

[D5798 Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engines](#)

### 3. Terminology

3.1 For general terminology, refer to Terminology [D4175](#).

3.2 *Definitions:*

3.2.1 *denaturants, n*—materials added to ethanol to make it unsuitable for beverage use under a formula approved by a regulatory agency to prevent the imposition of beverage alcohol tax. **D4806**

3.2.1.1 *Discussion*—

Denaturants are only those materials added by the denaturer to comply with the approved formula; any materials absorbed later are not denaturants.

3.2.2 *denatured fuel ethanol, n*—fuel ethanol made unfit for beverage use by the addition of denaturants under formula(s) approved by the applicable regulatory agency to prevent the imposition of beverage alcohol tax. **D4806**

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee [D02](#) on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee [D02.A0.02](#) on Oxygenated Fuels and Components.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard

3.2.3 *ethanol*, *n*—ethyl alcohol, the chemical compound, CH<sub>3</sub>CH<sub>2</sub>OH.

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3.2.4 *ethanol fuel blend*, *n*—a blend of ethanol and hydrocarbons for use in flexible-fuel automotive spark-ignition engines of which the ethanol portion is 51 % to 83 % by volume.

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3.2.5 *flexible-fuel vehicle*, *n*—a vehicle designed to operate on both gasoline or ethanol fuel blends and can operate on any mixture of both.

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#### 3.2.5.1 Discussion—

In the United States, these vehicles have U.S. EPA emissions certifications using gasoline complying with U.S. EPA requirements and ethanol fuel blends that meet the requirements of Specification **D5798**.

#### 3.2.5.2 Discussion—

Flex-fuel vehicle and FFV are commonly used synonyms for flexible-fuel vehicle.

#### 3.2.5.3 Discussion—

The fuels may also contain anti-oxidants, corrosion inhibitors, metal deactivators, and dyes but do not contain lead additives. A jurisdiction may set limits on lead content from all sources.

3.2.6 *fuel ethanol*, *n*—a grade of ethanol with other components common to its production (including water) that do not affect the use of the product as a component for automotive spark-ignition engine fuels.

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#### 3.2.6.1 Discussion—

The common components do not include denaturant.

3.2.7 *hydrocarbon*, *n*—a compound composed solely of hydrogen and carbon.

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3.2.8 *pHe*, *n*—a measure of the acid strength, defined by Test Method D6423, of ethanol-hydrocarbon blends.

#### 3.2.8.1 Discussion—

This measurement is sometimes thought to be analogous to the traditional pH measurement of hydrogen ion activity in aqueous systems, but the measurements done in Test Method D6423 are in a nearly anhydrous environment.

#### 3.3 Definitions of Terms Specific to This Standard:

3.3.1 *pHe*, *n*—~~a measure of the acid strength of ethanol-hydrocarbon blends defined by this apparatus and procedure.~~

## 4. Summary of Test Method

4.1 The sample is analyzed at room temperature using a specified electrode system and a pH meter with an input impedance  $>10^{12} \Omega$  (ohms). Meters designed for use with ion-specific electrodes normally meet this criteria.

4.2 Readings are taken at exactly 30 s because the meter reading will change throughout the analysis due to glass-electrode voltage drift caused by dehydration of the glass-electrode membrane. Because alcohol dehydrates the glass-electrode membrane, time spent soaking in alcohol solution should be minimized.

4.3 The electrode is soaked in water-based pH 7 buffer between readings to prepare it for the next sample. This rehydrates the glass electrode, a necessary step to preserve the electrode's response characteristics.

4.4 The electrodes are cleaned/rehydrated at least every ten samples by alternately soaking several times in 1 mol/L NaOH solution and 1 mol/L H<sub>2</sub>SO<sub>4</sub> (or 1 mol/L HCl) for about 30 s each. New electrodes are treated by this procedure before first use.

## 5. Significance and Use

5.1 The acid strength, as measured by pHe, is a good predictor of the corrosion potential of ethanol fuels. It is preferable to total acidity because total acidity does not measure acid strength; overestimates the contribution of weak acids, such as carbonic acid; and can underestimate the corrosion potential of low concentrations of strong acids, such as sulfuric acid.

## 6. Apparatus

6.1 *pH meter*—As recommended for use with ion-specific electrodes, commercially available pH meters with an input of  $>10^{12} \Omega$  are acceptable for this test method. Temperature compensation and readability to 0.01 pH unit are recommended.