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Standard Terminology Relating to Gaseous Fuels[1]

This standard is issued under the fixed designation D4150; 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 terminology standard covers the compilation of terminology developed by Committee D03 on Gaseous Fuels. It does not include terms, definitions, abbreviations, acronyms, and symbols specific to only a single D03 standard in which they appear. These terms, definitions, abbreviations, acronyms, and symbols are used in:

1.1.1 The sampling of gaseous fuels,

1.1.2 The analysis of gaseous fuels for composition and various other physical properties, and

1.1.3 Other practices related to the processing, transmission, and distribution of gaseous fuels.

1.2 *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:*[2]

D1142 Test Method for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature

D1835 Specification for Liquefied Petroleum (LP) Gases

D3588 Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

2.2 *ISO Standards:*[3]

ISO 7504 Gas Analysis—Vocabulary

ISO 14687 Hydrogen Fuel Quality—Product Specification

2.3 *SAE Standard:*[4]

SAE J2719 Hydrogen Fuel Quality for Fuel Cell Vehicles

2.4 *GPA Standards:*[5]

GPA 2145 Table of Physical Properties for Hydrocarbons and Other Compounds of Interest to the Natural Gas and Natural Gas Liquids Industries

GPA Midstream 2140 Liquefied Petroleum Gas Specifications and Test Methods

3. Terminology

3.1 *Definitions:*

absolute pressure, *n*—the pressure relative to an ideal vacuum.

DISCUSSION—The absolute pressure can be expressed in kPa, mm Hg, bar, psia, etc., as defined by the application.

DISCUSSION—An ideal vacuum is the best vacuum available using the application.

acid gas, *n*—natural gas containing high concentrations of hydrogen sulfide or carbon dioxide, or both, which is acidic when in contact with water or water vapor.

associated gas, *n*—natural gas, also known as gas-cap gas or dome gas, that overlies and is in immediate contact, but not in solution, with crude oil in a reservoir.

at-line instrument, *n*—instrument requiring operator interaction to sample gas directly from the pipeline.

automotive LPG (special duty propane, HD-5 propane), *n*—a product composed chiefly of propane specifically developed for use as fuel in spark-ignition internal combustion engines.

DISCUSSION—Products such as special duty propane from Specification D1835 or HD-5 propane from specification GPA Midstream 2140 were designed for automotive applications.

base conditions, *n*—temperature and pressure conditions at which natural gas volumes are determined for purposes of custody transfer.

DISCUSSION—In natural gas measurements, the properties of interest are temperature, pressure, and composition. Assuming ideal gas

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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 International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[4] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, http://www.sae.org.

[5] Available from Gas Processors Association (GPA), 66 American Plaza, Suite 700, Tulsa, OK 74135, http://www.gpaglobal.org.

properties, for simplicity, tables of pure compounds can be prepared for use in calculating gas properties for any composition at "base conditions." These "base conditions" are chosen near ambient.

biogas, *n*—the gaseous product of the microbial decomposition of organic matter.

DISCUSSION—Common sources of biogas include, but are not limited to, anaerobic digestion of biomass from agricultural waste, landfills, and wastewater treatment plants.

DISCUSSION—Biogas may be processed to purity specifications and thus can be used as a fuel for engines.

DISCUSSION—May be treated to form renewable natural gas (RNG).

British thermal unit (Btu or BTU), *n*—the amount of energy required to raise the temperature of one pound of water one-degree Fahrenheit.

DISCUSSION—One Btu is defined in the International Steam Table (IT) as equal to 1055.056 J. The defining relationships are:

(a) 1 $Btu \cdot lb^{-1} = 2.326\ J \cdot g^{-1}$ (exact)

(b) 1 lb = 453.592 37 g (exact).

By these relationships, 1 Btu = 1055.055 852 62 J (exact). For most purposes, the value rounded to 1 Btu = 1055.056 J is adequate.

calibration gas mixture, *n*—a certified gas mixture of sufficient stability and homogeneity with known composition used for the calibration of a measuring instrument or for the validation of a measurement or gas analytical method.

DISCUSSION—Calibration Gas Mixtures are the analogues of measurement standards in physical metrology (reference ISO 7504 paragraph 4.1).

DISCUSSION—The accuracy of the calibration gas mixture must meet the requirements of the measurement being performed.

DISCUSSION—A calibration gas mixture is a reference gas mixture connected with a device for routine calibration purposes. **[D03.12]**

calibration standard, *n*—a mixture of known composition prepared and certified with a stated uncertainty used to correlate the response of the measurement system with respect to the concentration or mass of the analyte(s).

DISCUSSION—Certification requirements may be further defined by the specific ASTM D03 standard.

calorimeter, *n*—a device to measure the evolved heat resulting from the combustion of a material.

compressed natural gas (CNG), *n*—natural gas that has been compressed after processing for storage or transportation purposes.

DISCUSSION—CNG is primarily used as a fuel for vehicles, typically compressed up to 24 821 kPa in the gaseous state.

compressibility, *n*—the property of a material that permits it to decrease in volume when subjected to an increase in pressure.

compressibility factor (z), *n*—a factor calculated by taking the ratio of the actual volume of a given mass of gas at a specified temperature and pressure to its volume calculated from the ideal gas law at the same conditions.

constituent, *n*—component, compound, or element found within a mixture.

contaminant, *n*—an impurity that could cause reversible or irreversible damage, harm, or be detrimental to transportation and storage systems, end-use equipment, users, or the environment.

continuing calibration verification (CCV), *n*—a quality control procedure utilizing a known concentration or mass of one or more analytes near the mid-range of a calibration curve to determine that the instrumental drift lies within acceptable limits.

DISCUSSION—Further CCV requirements may be defined by the specific ASTM D03 standard.

continuous fuel monitor, *n*—instrument that samples gas directly from a source and provides an analytical result on a continuous or semi-continuous basis.

detector tube, *n*—see **length-of-stain detector tube**.

detector tube pump, *n*—a hand-operated pump of a piston or bellows type.

DISCUSSION—A detector tube and pump together form a unit and must be used as such. Each manufacturer calibrates detector tubes to match the flow characteristics of their specific pump. Crossing brands of pumps and tubes is not permitted, as considerable loss of system accuracy is likely to occur.

dew point, *n*—the temperature at any given pressure at which liquid initially condenses from a gas or vapor and is specifically applied to the temperature at which water vapor starts to condense from a gas mixture (**water dew point**), or at which hydrocarbons start to condense (**hydrocarbon dew point**).

DISCUSSION—Charts of dewpoints versus pressure and water content are found in Test Method D1142.

direct sampling, *n*—sampling where there is a direct connection between the sample source and the analyzer.

dissolved gas, *n*—natural gas held in solution in reservoir liquids at the prevailing temperature and pressure of the reservoir.

dry gas, *n*—natural gas containing little or no water vapor.

dynamic calibration, *n*—calibration of an analytical system using a gaseous standard generated by dilution of the flow of a known quantity of gaseous analyte with a known quantity of diluent gas.

DISCUSSION—The analyte does not have to be from only a compressed gas source; it may be from a permeation system, liquid source, chemically generated, etc.

DISCUSSION—The diluent gas does not necessarily need to be purified. The minimum purity depends on the critical impurities in the final gas mixture.

fuel, *n*—any material that can be oxidized with the intent to release energy.

fuel cell grade hydrogen, *n*—hydrogen satisfying the specifications in SAE J2719 or ISO 14687, Grade D.

gas, *n*—a state of matter that shows free flow, has neither a definite shape nor a definite volume, and tends to expand

indefinitely to fill any space available, irrespective of its quantity. **[D02.95]** **D4175**

gas quality, *n*—quality of gaseous fuel, which is defined by its composition and its physical properties.

gas sampling chamber, *n*—any container that provides access of the detector tube into a uniform flow of sample gas at atmospheric pressure and isolates the sample from the surrounding atmosphere.

gaseous, *adj*—describing material exhibiting free flow, with neither a definite shape nor a definite volume, and tending to expand indefinitely to fill any space available, irrespective of its quantity. **[D02.95]** **D4175**

gaseous fuel, *n*—any gaseous material that can be oxidized with the intent to release energy.

DISCUSSION—Examples of gaseous fuels include, but are not limited to, natural gas, digester gas, landfill gas, process gas, hydrogen gas, or any gaseous fuel stored or transported as a liquid, such as liquefied petroleum gas or liquefied natural gas.

gauge pressure, *n*—the pressure measured relative to atmospheric pressure.

DISCUSSION—The gauge pressure can be expressed in kPag, barg, psig, etc., as defined by the application.

DISCUSSION—Gauge pressure is positive for pressures above atmospheric pressure and negative for pressures below atmospheric pressure. Zero gauge pressure is equal to atmospheric pressure.

gross heating value, *n*—also called **higher heating value**, the amount of energy per volume transferred as heat from the complete, ideal combustion of the gas at standard temperature in which all the water formed by the reaction condenses to liquid.

DISCUSSION—If the gross heating value has a volumetric rather than a mass or molar basis, a base pressure must also be specified.

DISCUSSION—The values for the pure gases appear in GPA Standard 2145. **D3588**

higher heating value, *n*—see **gross heating value**.

hydrate, *n*—a solid, crystalline material composed of water and components of natural gas formed under pressure at temperatures above the freezing point of water.

hydrocarbon dew point, *n*—see **dew point**.

inert components, *n*—those elements or components of natural gas (fuel gas) that do not contribute to the heating value.

in-line instrument, *n*—instrument with an active element installed in the pipeline, measuring pipeline contents or conditions, and measures at pipeline conditions.

interchangeability, *n*—a measure of the degree to which combustion characteristics of one gas are comparable to those of another gas.

DISCUSSION—Two gases are interchangeable when one gas may substitute another directly without interfering with the operation of gas burning appliances or equipment.

internal standard, *n*—a non-analyte element, present in all calibration, blank, and sample solutions, the signal from which is used to correct for interference or improve analytical precision.

lean gas, *n*—natural gas containing little or no hydrocarbons commercially recoverable as liquid products.

DISCUSSION—Water and recoverable hydrocarbons (ethane and heavier hydrocarbons) are customarily removed from natural gas to meet contractual or state statutory requirements.

length-of-stain detector tube, *n*—a sealed glass tube containing a support matrix coated with active chemicals and possessing break-off tips sized to fit the tube holder of the pump.

DISCUSSION—The reagent layer inside the tube is typically a silica gel substance coated with the active chemicals which are specific to the analyte being measured. The reagent layer produces a distinct color change when exposed to a sample of gas containing the specific analyte.

DISCUSSION—Any substances known to interfere must be listed in the instructions accompanying the tubes.

liquefied natural gas (LNG), *n*—natural gas that has been liquefied, after processing, for storage or transportation purposes.

DISCUSSION—Liquefied natural gas is revaporized and introduced into pipelines for transmission and distribution as natural gas and may be used as a fuel for internal combustion engines.

liquefied petroleum gas (LP Gas, LPG), *n*—a narrow boiling range mixture of hydrocarbons consisting of propane, propylene, butanes and butylenes, individually or in specified combinations, with limited amounts of other hydrocarbons (such as ethane) and naturally occurring, petroleum-derived, non-hydrocarbons.

DISCUSSION—LPG is typically maintained in a liquid state by containing it within a closed container or storage tank that can withstand the vapor pressure of the LPG at ambient temperature, or at a low temperature in refrigerated storage.

DISCUSSION—In many jurisdictions, LPG for fuel purposes is required to be odorized with a stenching agent such as ethyl mercaptan. **[D02.H0]** **D1835**

lower heating value, *n*—see **net heating value**.

methane number (MN), *n*—an experimental determination of a gaseous fuel's resistance to knock based on a Cooperative Fuel Research (CFR) Motor Octane Number (MON) test engine and indicated by the volume of methane in a blend with hydrogen.

DISCUSSION—Methane has a value of MN = 100, and hydrogen has a value of MN = 0.

methane number, calculated (MN_c), *n*—calculation of a rating index, indicating the resistance to knock of a gaseous fuel when compared to a reference methane/hydrogen mixture.

DISCUSSION—Multiple methods have been developed in the past for providing this analytical estimate based on gas composition. A MN_c is determined using volumetric fuel composition. Sometimes MN_c is described as "methane index (MI)."

natural gas, *n*—a naturally occurring mixture of hydrocarbon and nonhydrocarbon gases found in porous geological formations (reservoirs) beneath the earth's surface, often in association with petroleum.

DISCUSSION—The principal constituent of natural gas is methane.

natural gas, processed, *n*—a methane-rich commercial gaseous product derived from naturally occurring gas mixtures by processing (also referred to as merchantable natural gas).

net heating value, *n*—also called **lower heating value**, the amount of energy per volume transferred as heat from the complete, ideal combustion of the gas at standard temperature in which all the water formed by the reaction remains in the vapor state.

DISCUSSION—Condensation of any "spectator" water does not contribute to the net heating value.

DISCUSSION—If the net heating value has a volumetric rather than a mass or molar basis, a base pressure must also be specified.

nonassociated gas, *n*—natural gas not in contact with, nor dissolved in, reservoir liquids.

odorant, *n*—an intensively smelling organic chemical or combination of chemicals (for example, sulfur compounds), added to gaseous fuels to impart a characteristic and distinctive (usually disagreeable) warning odor so gas leaks can be detected.

DISCUSSION—For the purpose of certain test methods, odorants may be compounds that are present at the wellhead or commercial mixtures that are added to the gas stream, or both.

on-line instrument, *n*—automated instrument that samples gas directly from the pipeline, but is installed externally.

organosilicon compound, *n*—an organic compound containing one or more carbon-silicon bonds.

poisoning, *v*—refers to the partial or total deactivation of a catalyst by a chemical compound.

DISCUSSION—For fuel cells and internal combustion engine aftertreatment systems, substances such as hydrogen sulfide or other sulfur compounds can bind to a component in the catalyst (such as a noble metal like platinum) and render the catalyst less effective.

qualitative accuracy, *n*—the ability of an analytical system to correctly identify compounds without necessarily providing a precise concentration.

quantitative accuracy, *n*—the ability of an analytical system to measure the concentration of an identified compound to a specified degree of accuracy.

reference gas mixture, *n*—a gaseous mixture with known measurable properties, sufficiently homogeneous, and stable with respect to those properties, which has been established to be fit for its intended use in a measurement process.

relative density, *n*—also called **specific gravity**, ratio of the density of the gaseous fuel, under specified conditions of temperature and pressure, to the density of normal dry air,[6] at the same temperature and pressure.

relative humidity, *n*—ratio of actual pressure of existing water vapor to maximum possible pressure of water vapor in the atmosphere at the same temperature, expressed as a percentage.

renewable natural gas (RNG), *n*—a pipeline-quality gas that is all or in part from renewable sources and is fully interchangeable with geological (fossil fuel) natural gas.

DISCUSSION—RNG can be produced from biogas or other renewable sources that have been processed to purity standards and thus can be used as a fuel for internal combustion engines.

DISCUSSION—Like geological (fossil fuel) natural gas, RNG can be used for transportation purposes in the form of compressed natural gas (CNG) or liquefied natural gas (LNG).

reporting limit (RL), *n*—the lowest level of an analyte that an individual laboratory can confidently report for a matrix.

rich gas, *n*—natural gas containing commercially recoverable amounts of condensable hydrocarbons.

siloxane, *n*—an organosilicon compound containing repeated (-Si-O-Si-) linkage.

sour gas, *n*—natural gas containing concentrations of sulfur compounds which make it impractical to use without purification because of toxicity or corrosive effects, or both, on piping and equipment.

specific gravity, *n*—see **relative density**.

standard condition for temperature and pressure (STP), *n*—standard set of conditions established to allow the comparison of different sets of data.

standard pressure, *n*—a reference pressure of any gas at a standard temperature.

DISCUSSION—The pressure of 101.325 kPa should be used, unless stated by the application.

DISCUSSION—The standard pressure can be expressed in kPa, bar, psi, etc., as defined by the application.

standard temperature, *n*—a reference temperature of any gas at a standard pressure.

DISCUSSION—The temperature of 288.7 K (15.55 °C) should be used, unless stated by the application.

DISCUSSION—The standard temperature can be expressed in K, °C, °F, etc., as defined by the application.

standard volume of gas, *n*—the quantity of any gas that at a standard temperature and under a standard pressure will fill a space of a defined volume.

DISCUSSION—Standard temperature and standard pressure are to be defined by the application.

DISCUSSION—The standard volume of gas can be expressed in cubic feet, cubic meters, liters, etc., as defined by the application.

[6] *Journal of Research*, National Institute of Standards and Technology, Vol 83, 1978, pp. 419.