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Standard Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants[1]

This standard is issued under the fixed designation D4175; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

~~ε[1] NOTE—Terms were transferred and updated editorially in November 2022.~~

1. Scope*

1.1 This terminology standard covers the compilation of terminology developed by Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants, except that it does not include terms/definitions specific only to the standards in which they appear.

1.1.1 The terminology, mostly definitions, is unique to petroleum, petroleum products, lubricants, and certain products from biomass and chemical synthesis. Meanings of the same terms outside of applications to petroleum, petroleum products, and lubricants can be found in other compilations and in dictionaries of general usage.

1.1.2 The terms/definitions exist in two places: *(1)* in the standards in which they appear and *(2)* in this compilation.

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. Terminology

2.1 Alphabetical listing of terms with definitions for each term showing attributions as to source and subcommittee jurisdiction is in bold print following the definition. Those showing no attributes are under the jurisdiction of Subcommittee CS 95. ~~Acronyms, abbreviations, and symbols are listed separately in 2.2, following the defined terms.~~

1,3-butadiene—hydrocarbon product containing more than 99 % 1,3-butadiene. **[D02.D0] D5274**

abrasion, *n*—wear by displacement of material caused by hard particles or hard protuberances. **[D02.96] D7684, D7690**

abrasive wear, *n*—wear due to hard particles or hard protuberances forced against and moving along a solid surface. **[D02.B0] D4998; [D02.L0] D5182**

DISCUSSION—
Also called cutting wear in some instances such as machining swarf. **[D02.96] D7898**

absorbance, *n*—logarithm to the base 10 of the ratio of the reciprocal of the transmittance. **[D02.03] D7740**

[1] This terminology is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.95 on Terminology.

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

absorbance, (A), *n*—the molecular property of a substance that determines its ability to take up radiant energy, expressed by:

$$A = \log_{10}(1/T) = -\log_{10}(T)$$

where T is the transmittance.

DISCUSSION—
Absorbance expresses the excess absorption over that of a specified reference or standard. It is implied that compensation has been affected for reflectance losses, solvent absorption losses, and refractive effects, if present, and that attenuation by scattering is small compared with attenuation by absorption. **[D02.14] D7996**

absorbance, *A*,*n*—the molecular property of a substance that determines its ability to take up radiant power, expressed by:

$$A = \log_{10}\ (1/T) = -\log_{10}T$$

where T is the transmittance.

DISCUSSION—
Absorbance expresses the excess absorption over that of a specified reference or standard. It is implied that compensation has been affected for reflectance losses, solvent absorption losses, and refractive effects, if present, and that attenuation by scattering is small compared with attenuation by absorption. **[D02.04] D2008**

absorbance (A), *n*—the logarithm to the base 10 of the reciprocal of the transmittance, (*T*).

$$A = \log_{10}\ (1/T) = -\log_{10}T$$

DISCUSSION—
Absorbance is a measure of the capacity of a substance to absorb light of a specific wavelength. **[D02.25] D8470**

absorptivity, *a*,*n*—the specific property of a substance to absorb radiant power per unit sample concentration and path length, expressed by:

$$a = Af/bc$$

where:

A = the absorbance,
f = the dilution factor,
b = sample cell path length, and
c = the quantity of absorbing substance contained in a volume of solvent.

[D02.04] D2008

absorptivity, *n*—the absorbance divided by the product of the concentration of the substance and the sample pathlength, a = A/(bc). The units of b and c shall be specified. **[D02.25] D8321**

acceptance limit (*AL*), *n*—a numerical value that defines the point between making the property conformance or non-conformance to a specification decision.

DISCUSSION—
The *AL* is not necessarily the specification limit. It is a value that takes into account the specification limit, the test method precision, and the desired probability of making the conformance to specification decision if the true value (see 3.1.17) of the property is at the specification limit. **[D02.94] D3244**

accepted reference value (ARV), *n*—value that serves as an agreed-upon reference for comparison and that is derived as (*1*) a theoretical or established value, based on scientific principles, (*2*) an assigned value, based on experimental work of some national or international organization, such as the U.S. National Institute of Standards and Technology (NIST), or (*3*) a consensus value, based on collaborative experimental work under the auspices of a scientific or engineering group. **[D02.04] D6596; [D02.25] D8340; [D02.94] D8428**

DISCUSSION—
In the context of this test method, accepted reference value is understood to apply to the ignition delay of specific reference materials determined under reproducibility conditions by collaborative experimental work. **[D02.01] D6890**

DISCUSSION—
In the context of this test method, accepted reference value is understood to apply to the Motor octane number of specific reference materials

determined empirically under reproducibility conditions by the National Exchange Group or another recognized exchange testing organization. **[D02.01] D2700**

DISCUSSION—
In the context of this test method, accepted reference value is understood to apply to the Research octane number of specific reference materials determined empirically under reproducibility conditions by the National Exchange Group or another recognized exchange testing organization. **[D02.01] D2699**

DISCUSSION—
In the context of this test method, accepted reference value is understood to apply to the supercharge and octane number ratings of specific reference materials determined empirically under reproducibility conditions by the National Exchange Group or another recognized exchange testing organization. **[D02.01] D909**

DISCUSSION—
In the context of this test method, accepted reference value is understood to apply to standard fuel or check fuel average research or motor octane numbers determined under reproducibility conditions by a recognized exchange testing organization having a minimum of 16 participants. **[D02.01] D2885**

DISCUSSION—
In the context of this method, accepted reference value is understood to apply to the ignition delay and the combustion delay of specific reference materials determined under reproducibility conditions by collaborative experimental work. **[D02.01] D7668**

accepted reference value (ARV), *n*—a value that serves as an agreed-upon reference for comparison, and which is derived as: *(1)* a theoretical or established value, based on scientific principles, *(2)* an assigned or certified value, based on experimental work of some national or international organization, or *(3)* a consensus or certified value, based on collaborative experimental work under the auspices of a scientific or engineering group. **[D02.25] D3764**

accommodation cracks, *n*—(also referred to as Mrozowski-like cracks) cracks and voids formed between basal planes and at domain interfaces throughout the graphite microstructure from thermal contraction of the graphite during carbonization/graphitization (sometimes referred to as calcination cracks), from chemical decomposition of the liquid crystal hydrocarbon precursor in graphite manufacture (also referred to as calcination cracks) and following cooling after graphitization (manufacture). In irradiated graphite, they also comprise cracks arising from anisotropic responses to irradiation. **[D02.F0] D8075**

accuracy, *n*—the closeness of agreement between a test result and an accepted reference value. **[D02.91] D8164; [D02.07] D8278**

acid number, *n*—the quantity of a specified base, expressed in milligrams of potassium hydroxide per gram of sample, required to titrate a sample in a specified solvent to a specified endpoint using a specified detection system. **[D02.06] D8045; [D02.09] D943**

DISCUSSION—
In this test method, acids or salts with dissociation constants greater than 10^{-9}, are titrated to a green end point with p-naphtholbenzein indicator. **[D02.06] D3339**

DISCUSSION—
In this test method, the acid number is calculated from the number of drops required to produce a change in solution color from blue-green to orange, compared to the number of drops required to produce an identical color change using a reference standard. Because this is a direct comparison method, the acid number value can be reported in milligrams of potassium hydroxide per gram of sample. **[D02.06] D5770**

DISCUSSION—
In this test method, the indicator is *p*-naphtholbenzein titrated to a green/green-brown end point in a toluene-water-isopropanol solvent. **[D02.06] D974**

DISCUSSION—
In this test method, the solvent is a toluene-water-isopropanol mixture and the end point is determined when a green/green brown color is obtained using the specified *p*-naphtholbenzein indicator solution. **[D02.06] D3242**

DISCUSSION—
This test method expresses the quantity of base as milligrams of potassium hydroxide per gram of sample, that is required to titrate a sample in a mixture of toluene and propan-2-ol to which a small amount of water has been added from its initial meter reading in millivolts to a meter reading in millivolts corresponding to an aqueous basic buffer solution or a well-defined inflection point as specified in the test method. **[D02.06] D664**

DISCUSSION—
This test method provides additional information. The quantity of base, expressed as milligrams of potassium hydroxide per gram of sample, required to titrate a sample in the solvent from its initial meter reading in millivolts to a meter reading in millivolts corresponding to a freshly prepared aqueous acidic buffer solution or a well-defined inflection point as specified in the test method shall be reported as the *strong acid number*. **[D02.06] D664**

DISCUSSION—
The causes and effects of the so-called strong acids and the causes and effects of the other acids can be very significantly different. Therefore, the user of this test method shall differentiate and report the two, when they are found. **[D02.06] D664**

acidity, *n*—the quality, state or degree of being acid.

DISCUSSION—
In this test method, the criterion for acidity is a pink or red color when methyl orange indicator is used. **[D02.06] D1093**

DISCUSSION—
The amount of acid titrated with a base (NaOH or KOH) in a sample of ethanol or ethanol blend with gasoline, calculated as acetic acid in mg/kg (ppm mass). **[D02.06] D7795**

action limit, *n—for multivariate spectroscopic analyzers used in the analysis of liquid petroleum products and fuels*, the limiting value from an instrument performance test, beyond which the analyzer is expected to produce potentially invalid results. **[D02.25] D6122**

action limit, *n—for multivariate spectroscopic analyzers used in the analysis of liquid petroleum products and fuels*, the limiting value from an instrument performance test, beyond which the multivariate spectroscopic analyzer is expected to produce potentially invalid results. **[D02.25] D8470**

activated sludge, *n*—the precipitated solid matter, consisting mainly of bacteria and other aquatic microorganisms, that is produced at a domestic wastewater treatment plant and is used primarily in secondary sewage treatment to microbially oxidize dissolved organic matter in the effluent. **[D02.12] D6731, D6139, D6384**

activation energy (E_a), *n*—measure of temperature effects on the rate of oxidation in the kinetic, or chemical control, regime. Activation energy is calculated from the Arrhenius equation:

$$OR = Z\exp(-E_a/RT)$$

where:

OR = oxidation rate,
R = 8.314 J mole^{-1} K^{-1} is the universal gas constant,
T = absolute temperature (in Kelvin), and
Z = pre-exponential factor.

The activation energy and pre-exponential factor are calculated from linearized form of Arrhenius equation, that is, from the slope and intercept of the linear plot of the logarithm of oxidation rate versus the inverse of absolute temperature (1/T):

$$\log_{10}(OR) = \log_{10} Z - E_a/(2.303\,RT)$$

Activation energy is expressed in units of kJ/mol. Pre-exponential factor is expressed in the same units as the oxidation rates, namely g h^{-1} m^{-2} (for Z_a calculated from area-normalized oxidation rates, OR_a) or g g^{-1} h^{-1} (for Z_w calculated from weight-normalized oxidation rates, OR_w). **[D02.F0] D7542**

active grease-sampling device, *n*—device designed to take an active sample of a lubricating grease from a bearing, gear, or drive shaft located in a grease-lubricated component. **[D02.G0] D7718**

active sampling, *v*—to use a sampling device to actively gather an in-service lubricating grease sample from a grease-lubricated component. **[D02.G0] D7718**

actuate, *v*—to hold the interior cylinder of the active grease-sampling device while pushing the exterior cylinder forward toward the grease-lubricated component that is being sampled allowing lubricating grease to fill the sampling device. **[D02.G0] D7718**

acute ecotoxicity, *n*—the propensity of a material to produce adverse behavioral, biochemical, or physiological effects in non-human organisms or populations in a short period of time, usually not constituting a substantial portion of the life span of the organism. **[D02.N0] D6046; [D02.12] D8324**

acute ecotoxicity, *n*—the propensity of a test material to produce adverse behavioral, biochemical, or physiological effects in non-human organisms or populations in a short period, usually not constituting a substantial portion of their life span. **[D02.N0] D8029**

acute ecotoxicity test, *n*—a comparative ecotoxicity test in which a representative subpopulation of organisms is exposed to different treat rates of a test material and is observed for a short period, usually not constituting a substantial portion of their life span. **[D02.N0] D8029**

acute toxicity test, *n*—a comparative test in which a representative subpopulation of organisms is exposed to different treat rates of a test material and is observed for a short period usually not constituting a substantial portion of their life span. **[D02.12] D6081**

additive, *n*—a material added to another, usually in a small amount, to impart or enhance desirable properties or to suppress undesirable properties. **[D02.B0] D6681**

additive, *n—in aviation gasoline*, substance added to a base aviation gasoline in relatively small amounts that either enables that base aviation gasoline to meet the applicable specification properties or does not alter the applicable specification properties of that base aviation gasoline beyond allowable limits. **[D02.J0] D7826**

additive, *n—in fuel oils*, a substance added to fuel oil at a blend level not greater than 1 % by volume of the finished fuel.

DISCUSSION—
Additives are generally included in finished fuel oil to enhance performance properties (for example, stability, pour point, and so forth).

DISCUSSION—
Additives that contain hydrocarbon oil blended with other substances may exclude the hydrocarbon oil portion for determination of the volume percent of the finished fuel.

DISCUSSION—
Triglycerides (for example, vegetable oils, animal fats, greases, and so forth) have been found to cause fouling of fuel oil burning equipment, and triglycerides are therefore not allowed as additives or components of additives. **[D02.E0] D396**

additive, *n—in diesel fuels*, a substance added to diesel fuel at a blend level not greater than 1 % by volume of the finished fuel.

DISCUSSION—
Additives are generally included in finished diesel fuel to enhance performance properties (for example, cetane number, lubricity, cold flow, etc.).

DISCUSSION—
Additives that contain hydrocarbon oil blended with other substances may exclude the hydrocarbon oil portion for determination of the volume percent of the additive in the finished fuel.

DISCUSSION—
Triglycerides (for example, vegetable oils, animal fats, greases, and so forth) have been found to cause fouling of fuel oil burning equipment. Similar fouling is expected in diesel engine applications and triglycerides are therefore not allowed as additives or components of additives. **[D02.E0] D975**

additive, *n—in liquid fuels*, a component used in a finished fuel at 1 % by volume (volume fraction) or less that is included to enhance performance properties of the fuel or to comply with a requirement of the finished fuel.

DISCUSSION—
Dilution of an additive to facilitate handling may be needed. The volume of the diluent is not considered part of the dosage of the additive for the purpose of determining the concentration of the additive. **[Coordinating Subcommittee D02.95]**

additive, *n—in aviation turbine fuel*, a substance added to a base aviation turbine fuel in relatively small amounts that either enables that base aviation turbine fuel to meet the applicable specification properties or does not alter the applicable specification properties of that base aviation turbine fuel beyond allowable limits. **[D02.J0] D4054**

adenosine monophosphate (AMP), *n*—molecule formed by the removal of two molecules of phosphate (one pyrophosphate molecule) from ATP. **[D02.14] D7463, D7687**

adenosine triphosphate (ATP), *n*—molecule comprised of a purine and three phosphate groups, that serves as the primary energy transport molecule in all biological cells.

[D02.14] D7463, D7687

adhesive wear (scuffing), *n*—wear due to localized bonding between contacting solid surfaces leading to material transfer between the two surfaces or loss from either surface. **[D02.B0] D8074; [D02.L0] D5182**

adiabaticity, *n*—the condition in which there is no significant gain or loss of heat throughout the length of the column.

DISCUSSION—

When distilling a mixture of compounds as is the case of crude petroleum, there will be a normal increase in reflux ratio down the column. In the case where heat losses occur in the column, the internal reflux is abnormally greater than the reflux in the head. The opposite is true when the column gains heat, as with an overheated mantle. **[D02.08] D2892**

adjustment, *n*—operation of bringing the portable digital density meter to a state of performance suitable for its use, by setting or adjusting the instrument constants.

[D02.04] D7777

aerobe, *n*—an organism that requires oxygen to remain metabolically active.

DISCUSSION—

Aerobes use oxygen as their terminal electron acceptor in their primary energy-generating metabolic pathways. Aerobes require oxygen for survival, using *aerobic* metabolic processes to generate energy for growth and survival. **[D02.14] D6469**

aerobic, *adj*—(*1*) taking place in the presence of oxygen; (*2*) living or active in the presence of oxygen.

[D02.12] D5864, D6006, D6139, D6731; [D02.N0] D6046; [D02.14] D8070

agglomerate, *n—in manufactured carbon and graphite product technology*, composite particle containing a number of grains. **[D02.F0] D8075**

aggressiveness index (A.I.), *n*—the value computed from the sum of the pH + log alkalinity + log hardness of water sample where both alkalinity and hardness are reported as milligrams $CaCO_3$L.

DISCUSSION—

As A.I. decreases, water becomes more corrosive. At A.I. ≥ 12, water is noncorrosive. At 10 ≤ A.I. < 12, water is moderately corrosive. At A.I. < 10, water is strongly corrosive. **[D02.14] D6469**

air-fuel ratio, *n—in internal combustion engines*, the mass ratio of air-to-fuel in the mixture being induced into the combustion chambers.

[D02.B0] D6593, D6709, D6837, D7589, D8111, D8114, D8226, D8350

DISCUSSION—

In this test method, air-fuel ratio (AFR), is controlled by the EEC IV engine control module. **[D02.B0] D6593**

alarm, *n*—means of alerting the operator that a particular condition exists. **[D02.96] D7720**

aliquot, *n*—portion of sample being tested that is a representative portion of the whole. **[D02.25] D7808**

all-levels sample, *n*—a sample obtained by lowering the closed sampling device to the bottom of the outlet suction level, but always above free water, then opening the sampler and raising it at a uniform rate such that it is between 70 % and 85 % full when withdrawn from the product. Alternatively, all-levels samples may be taken with samplers designed for filling as they pass downward through the product.

DISCUSSION—
If required by the test method, the sampler may be greater than 85 % full when withdrawn but in no case shall it be completely full. In these cases, take special handling precautions to consider the hazards associated with product thermal expansion. **[D02.02] D4057**

alloy, *n*—unique composition of two or more metals that has one or more of the metals treated or processed in a special way to confer enhanced performance characteristics on the resulting material. **[D02.96] D8182**

alpha corrections, *n*—influence correction factors that compensate for inter-element X-ray matrix effects; alpha corrections may be determined by best-fit regression, XRF Fundamental Parameters (FP), or XRF theory (called theoretical alphas). **[D02.03] D8252**

alternative blendstock, *n—in diesel fuels and fuel oils*, a non-hydrocarbon oil substance added to diesel fuel or fuel oil at blend levels greater than 1 % by volume of the finished fuel.

DISCUSSION—
An alternative blendstock should normally have an industry consensus standard or an annex in this specification that defines its physical and chemical properties.

DISCUSSION—
See Appendix X3 for guidance regarding new materials for No. 1 and No. 2 grades of fuel oils. **[D02.E0] D396**

alternative blendstock, *n—in diesel fuels and fuel oils*, a non-hydrocarbon oil substance added to diesel fuel and fuel oil at blend levels greater than 1 % by volume of the finished fuel.

DISCUSSION—
An alternative blendstock should normally have an industry consensus standard or an annex in this specification that defines its physical and chemical properties.

DISCUSSION—
See Appendix for guidance regarding new materials for #1-D and #2-D grades of diesel fuels. **[D02.E0] D975**

amine number of reference fuels above 100, AN, *n*—determined in terms of the weight percent of 3-methylphenylamine in reference grade *iso*octane (2,2,4-trimethylpentane). For example, 5 % of 3-methylphenylamine in reference grade *iso*octane has an amine number of 105 (AN 105). No attempt has been made to correlate performance number of leaded reference fuels to the amine number of unleaded reference fuels, and none is implied. **[D02.J0] D6424, D6812**

amplicon, *n*—the product of the qPCR reaction resulting from the amplification of a genetic target using a particular pair of primers. **[D02.14] D8412**

ampule, *n*—a glass vessel for the storage of liquid materials, possessing a long narrow neck for the purpose of providing a flame-sealed closure. **[D02.04] D6596**

anaerobe, *n*—an organism that cannot grow or proliferate in the presence of oxygen.

DISCUSSION—
Anaerobes use molecules other than oxygen in their primary energy-generating metabolic pathways, such as sulfate, nitrate, ketones, and other high-energy organic molecules. Although anaerobes may survive in the presence of oxygen, anaerobic growth typically occurs only in an oxygen depleted environment. **[D02.14] D6469**

anaerobic, *adj*—(*1*) taking place in the absence of oxygen; (*2*) living or active in the absence of oxygen.
[D02.12] D6006; [D02.N0] D6046

analysis, *n*—in the context of this practice, the process of applying the calibration model to a spectrum, preprocessed as required, so as to estimate a component concentration value or property. **[D02.25] D8340**

analysis, *n—in multivariate spectroscopic measurement*, the process of applying the multivariate model to a spectrum, preprocessed as required, to predict a component concentration value or property, the prediction being referred to herein as a Predicted Primary Test Method Result (PPTMR). **[D02.25] D8321**

analysis cycle time, *n*—the period of time required to properly obtain and analyze a representative sample of the process stream material. **[D02.25] D6624**

analysis sample, *n*—the reduced and divided representative portion of the bulk sample, prepared for use in the laboratory. **[D02.05] D4930, D6969**

analyte, *n*—a specific compound to be measured quantitatively in a mixture of compounds. **[D02.04] D7920**

analytical column, *n*—a chromatographic column used to further separate a specific analyte from a mixture of compounds which can coelute in the primary column.

[D02.04] D7920

analytical column, *n*—porous layer open tubular (PLOT) column with a stationary phase selective for oxygenates; it is used to resolve methanol from 1-propanol to provide accurate quantitative results. **[D02.04] D7059**

analytical detector, *n*—a device used to quantify the compounds of interest after they elute from the analytical column. **[D02.04] D7920**

analytical measurement system, *n*—a collection of one or more components or subsystems, such as sample handling and preparation, test equipment, instrumentation, display devices, data handlers, printouts or output transmitters, that are used to determine a quantitative value of a specific property for an unknown sample in accordance with a standard test method. **[D02.94] D7372**

analytical measurement system, *n*—a collection of one or more components or subsystems, such as samplers, test equipment, instrumentation, display devices, data handlers, and printouts or output transmitters, that is used to determine a quantitative value of a specific property for an unknown sample in accordance with a test method.

[Subcommittee D02.94]

DISCUSSION—
ASTM or ISO standard test methods are examples of a test method.

DISCUSSION—
In the context of this test method, the analytical measurement system is comprised of the knock testing unit, automated analyzer system, and any auxiliary equipment required for the safe operation of the engine. **[D02.01] D2885**

analyzer, *n*—all piping, hardware, computer, software, instrumentation and calibration model required to automatically perform the analysis of a process or product stream. **[D02.25] D8340**

analyzer, *n*—see **analyzer system**. **[D02.25] D3764, D6122, D7808, D8321**

analyzer system, *n*—the complete analyzer system inclusive of the sample loop, sample conditioning unit, analyzer unit, readout instrumentation, and excess sample return system (see Fig. 1 from Practice D3764 for example).

[D02.25] D8340

analyzer system, *n—for equipment in the analysis of liquid petroleum products and fuels*, all piping, hardware, computer, software, instrument, linear correlation or multivariate model required to analyze a process or product sample; the analyzer may also be referred to as the analyzer system, or the total analyzer system.

DISCUSSION—
Online analyzers that utilize extractive sampling include sample loop, sample conditioning system and excess sample return system (see Fig. 1 in D3764 for example). Online analyzers that utilize insertion probes include fiber optics and sample probes.

DISCUSSION—
At-line, field and laboratory analyzers include the instrument and all associated sample introduction apparatuses.

[D02.25] D3764

analyzer system, *n—for equipment in the analysis of liquid petroleum products and fuels*, all piping, hardware, computer, software, instrument, linear correlation or multivariate model required to analyze a process or product sample; the analyzer system may also be referred to as the analyzer, or the total analyzer system.

Discussion—
Online analyzers that utilize extractive sampling include sample loop, sample conditioning system and excess sample return system (see Fig. 1 in D3764 for example). Online analyzers that utilize insertion probes include fiber optics and sample probes.

Discussion—
At-line, field and laboratory analyzers include the instrument and all associated sample introduction apparatuses.

[D02.25] D6122, D7808, D8321

analyzer unit response time, *n*—time interval between the introduction of a step change in property characteristic at the inlet of the analyzer unit and when the analyzer output indicates a value corresponding to 99.5 % of the subsequent change in analyzer results. **[D02.25] D7453**

Discussion—
For continuous and intermittent analyzers with sufficiently short cycle times, the total analyzer response time is the analyzer dead time plus 5.3 times the analyzer unit time constant. For intermittent analyzers with long cycle times, the analyzer unit response time is effectively equal to the analyzer unit cycle time. For intermittent analyzers with intermediate cycle times, the analyzer unit response time should be defined as the multiple of the analyzer unit cycle time needed to exceed 99.5 % response.

[D02.25] D3764

Anderson-Darling Resolution Sensitive Statistic, ADrs, *n*—a goodness-of-fit statistical tool used to objectively test for normality of proficiency testing data.

Discussion—
ADrs is a modified version of the Anderson-Darling Statistic (see D6299) and was developed specifically for use in assessing normality in proficiency test program data. The ADrs statistic assesses normality regardless of the adequacy of data measurement resolution relative to the overall variation in the dataset.

[D02.94] D7372

aniline point, *n*—the minimum equilibrium solution temperature for equal volumes of aniline and sample. **[D02.04] D611**

annulus—a cut gasket shape consisting of two concentric circles of known geometry. **[D02.B0] F118**

anoxic, *adj*—oxygen free. **[D02.14] D6469**

anti-Stokes line (band), *n*—a Raman line (band) that has a frequency higher than that of the incident monochromatic beam. **[D02.25] D8321**

antibody, *n*—an immunoglobulin, a protein that is produced as a part of the immune response which is capable of specifically combining with the antigen.

Discussion—
In the context of this test method, antibodies created for this purpose are utilized in conjunction with visual indicators to detect presence of microbial antigens. **[D02.14] D8070**

antifreeze, *n*—antifreeze is typically a dilution of ethylene glycol and possibly other glycols, and additives, in water to act as a machine coolant. 1,2-propanediol is found in some antifreeze formulations. **[D02.04] D7922**

antigen, *n*—a substance that stimulates the host to produce an immune response. In the context of this test method, specific antigens are detected as indicators of microbial contamination. **[D02.14] D8070**

antiknock index, *n*—the arithmetic average of the Research octane number (RON) and Motor octane number (MON), that is, (RON + MON)/2. **[D02.A0] D4814**

antimicrobial, *n*—see **biocide**. **[D02.14] D6469**

antinodes, *n*—two or more locations that have local maximum displacements, called antinodes, in an unconstrained slender rod or bar in resonance. For the fundamental flexure resonance, the antinodes are located at the two ends and the center of the specimen. **[D02.F0] C747**

API gravity, *n*—special function of relative density (specific gravity) SG60 °F/60 °F, represented by:

$$°API = 141.5/(SG60\,°F/60\,°F) - 131.5$$

DISCUSSION—
Relative density SG15 °C/15 °C is also applied. **[D02.04] D7777**

apparent density, *n*—the weight per unit volume of a substance, including voids inherent in the material tested. **[D02.05] D5502**

apparent viscosity, *n*—the determined viscosity obtained by use of this test method. **[D02.07] D3829, D4684, D5133, D6821, D6896**

DISCUSSION—
Apparent viscosity may vary with the spindle speed (shear rate) of a rotational viscometer if the fluid is non-Newtonian. See Appendix X1 for a brief explanation. **[D02.07] D2983**

DISCUSSION—
In all cases the term "viscosity" implies that the value is the "apparent viscosity." **[D02.07] D8210**

DISCUSSION—
Apparent viscosity may vary with the spindle speed (shear rate) of a rotational viscometer when the fluid is non-Newtonian. **[D02.07] D8210**

apparent viscosity, *n*—of a lubricating grease is the ratio of shear stress to shear rate calculated from Poiseuille's equation, and is measured in poises. **[D02.G0] D1092**

apparent viscosity, *n*—the viscosity determined by this test method and expressed in milliPascal seconds. Its value may vary with the spindle and rotational speed selected because many hot melts are non-Newtonian. **[D02.10] D3236**

apparent viscosity, *n*—the viscosity obtained by use of this test method. **[D02.07] D7110**

apparent viscosity, *n*—viscosity of a non-Newtonian liquid determined by this test method at a particular shear rate and shear stress. **[D02.07] D4683, D4741, D5481**

area slice, *n*—area under a chromatogram within a specified retention time interval. **[D02.04] D7096**

area slice, *n—in gas chromatography*, the area, resulting from the integration of the chromatographic detector signal, within a specified retention time interval. **[D02.04] D7798**

area-normalized oxidation rate (OR_a), *n*—rate of weight loss due to oxidation of a machined test specimen at a given temperature, divided by the nominal geometric surface area of the specimen.

DISCUSSION—
The rate of weight loss is determined by a linear fit of the weight loss plotted against time in the range from 5 % to 10 % loss of original specimen weight. The units of area-normalized oxidation rate, ORa, are g h^{-1} m^{-2}. **[D02.F0] D7542**

area-normalized standard oxidation rate (SOR_a), *n*—value of area normalized oxidation rate corresponding to 1 % weight loss in 24 h. Area-normalized standard oxidation rate, $SORa$, depends on the initial specimen density. For carbon and graphite samples (density 1.2 – 2.2 g cm^{-3}) $SORa$ varies between 2 and 4 g h^{-1} m^{-2}. **[D02.F0] D7542**

aromatics, *n—in high performance liquid chromatography*, aromatic hydrocarbon components, minus polar material, that has a longer retention time than saturates on the specified polar columns, but can be removed as a single peak by backflushing the columns with heptane.

DISCUSSION—

Generally, aromatic hydrocarbons contain 1 to 4 rings. **[D02.04] D7419**

aromatics fraction, *n*—portion of the sample desorbed with the polar eluants. The aromatics fraction is divided into nonpolar and polar based. They may contain aromatics, condensed naphthenic-aromatics, aromatic olefins, and compounds containing sulfur, nitrogen, and oxygen atoms. **[D02.12] D7373**

as-calcined particles, *n—of coke*, those particles that have not been subject to laboratory crushing. **[D02.05] D7454**

aseptic, *adj*—sterile, free from viable microbiological contamination. **[D02.14] D6974, D7463, D7464, D7687**

ash, *n—in carbon and graphite technology*, residue remaining after oxidation of a carbon or graphite. **[D02.F0] C561**

asphalt, *n*—a dark brown-to-black cementitious material in which the predominating constituents are bitumens.

DISCUSSION—

Asphalt can be a natural product or a material obtained from petroleum processing. **[D02.G0] D128**

asphalt, *n—in North American usage*, (1) the heavy, black, viscous hydrocarbon-based material used for roofing and paving *or* (2) mixtures of that material with aggregate *or* (3) finished paving.

DISCUSSION—

Asphalt free of aggregate is of three types: (1) natural asphalt, (2) asphalt from the processing of crude oils, and (3) asphalt that has been modified by blowing with air or other means. Natural asphalt is obtained from tar pits or tar lakes, such as those in Trinidad. In the refinery, asphalt is usually the residual portion of asphaltic crude oil obtained as bottoms from vacuum distillation or by propane deasphalting. Either of these types of asphalt can be air blown for further removal of lighter fractions and for mild oxidation, to modify the properties of the final product.

[Coordinating Subcommittee D02.95]

asphaltenes, *n*—(rarely used in the singular)—*in petroleum technology*, represent an oil fraction that is soluble in a specified aromatic solvent but separates upon addition of an excess of a specified paraffinic solvent.

DISCUSSION—

In this test method, the aromatic solvent is hot toluene and the paraffinic solvent is heptane.

DISCUSSION—

Historically, benzene was the aromatic solvent, but benzene is not typically used now for health reasons. The precision of this test method when using toluene has been found to be the same as when using benzene. **[D02.14] D6560**

DISCUSSION—

In this test method, the aromatic solvent is toluene and the paraffinic solvent is heptane. **[D02.14] D7061, D7827, D7996**

DISCUSSION—

In this test method, the aromatic solvent is toluene and the paraffinic solvent is n-heptane. **[D02.14] D7157**

DISCUSSION—

In this test method, the aromatic solvent is xylene and the paraffinic solvent is n-heptane. **[D02.14] D7112**

DISCUSSION—

In this test method, the aromatic solvent is 1-methylnapthalene, and the paraffinic solvent is n-hexadecane. **[D02.14] D7060**

DISCUSSION—

Asphaltenes are found largely in crude oils and in heavy fuel oils containing residual fractions. They are insoluble in alkanes such as heptane and pentane, but soluble in aromatic solvents such as benzene or toluene. **[D02.14] D8253**

assay, *n*—the procedure to determine the presence, absence, or quantity of one or more components. **[D02.02] D4057**

assignable cause, *n*—factor that contributes to variation in a process or product output that is feasible to detect and identify; also called *special cause*. **[D02.96] D7720**

assigned test value (ATV), *n*—the average of all results obtained in the several laboratories which are considered acceptable based on the reproducibility of the test method. **[D02.94] D3244**

ASTM color, *n*—the name of an empirical scale of expressing the color of a petroleum liquid darker than Saybolt color based on a scale of 0.5 (lightest) to 8 Dil (darkest) and determined by Test Method D1500. **[D02.05] D6045, D6756**

attenuated total reflection (ATR), *n*—reflection that occurs when an absorbing coupling mechanism acts in the process of total internal reflection to make the reflectance less than unity.

DISCUSSION—

In this process, if an absorbing sample is placed in contact with the reflecting surface, the reflectance for total internal reflection will be attenuated to some value between zero and unity ($O < R < 1$) in regions of the spectrum where absorption of the radiant power can take place. **[D02.25] D8321**

atomic absorption spectrometry, *n*—analytical technique for measuring metal content of solutions, based on a combination of flame source, hollow cathode lamp, photomultiplier, and a readout device. **[D02.03] D7740**

atomizer, *n*—usually a flame source used to decompose the chemical constituents in a solution to its elemental components. **[D02.03] D7740**

audit, *n*—a systematic examination of the laboratory's quality management system documentation and related activities by an internal or external team to determine conformance to the applicable quality management system standard, such as described in this practice. **[D02.94] D6792**

autoignition, *n*—the ignition of a material commonly in the air as the result of a heat liberation due to the exothermic oxidation reaction in the absensce of an external ignition source, such as a spark or flame. **[Subcommittee D02.01]; [D02.N0] D2155**

autoignition temperature, *n*—the minimum temperature at which autoignition occurs under the specified conditions of the test. **[D02.N0] D2155**

automatic sample collector, *n*—device used to repetitively extract a grab and collect a representative sample of a batch or process stream. **[D02.25] D7453**

automatic sampler, *n*—a device used to extract a representative sample from the liquid flowing in a pipe; the automatic sampler generally consists of a probe, a sample extractor, an associated controller, a flow measuring device, and a sample receiver. **[D02.02] D4057**

automatic sampling system, *n*—system consisting of a sample probe, sample fast cycle loop, sample supply line stream conditioning, an automatic sampler and an associated controller, a flow measuring device, and sample holding, mixing and handling capabilities. **[D02.25] D7453**

automotive, *adj*—descriptive of equipment associated with self-propelled machinery, usually vehicles driven by internal combustion engines. **[D02.B0] D4485, D6709, D7216, D8111, D8114, D8226, D8350**

automotive wheel bearing grease, *n*—a lubricating grease specifically formulated to lubricate automotive wheel bearings at relatively high grease temperatures and bearing speeds. **[D02.G0] D4693**

aviation gasoline, *n*—fuel derived from petroleum or non-petroleum materials possessing specific properties suitable for operating aircraft powered by spark-ignition piston engines.

DISCUSSION—

Principal properties include combustion, fluidity, volatility corrosion, stability, water shedding, and detonation-free performance in the engine (or engines) for which it is intended. In the context of this guide, the terms fuel and gasoline are interchangeable. **[D02.J0] D7826**

aviation gasoline, *n*—gasoline possessing specific properties suitable for fueling aircraft powered by reciprocating spark ignition engines.

DISCUSSION—
Principal properties include volatility limits, stability, detonation-free performance in the engine for which it is intended and suitability for low temperature performance.

[D02.J0] D910, D6227

aviation turbine fuel, *n*—refined petroleum distillate, generally used as a fuel for aviation gas turbines.

DISCUSSION—
Different grades are characterized by volatility ranges, freeze point, and by flash point. **[D02.J0] D1322**

B6 to B20, *n*—fuel blend consisting of 6 volume percent to 20 volume percent biodiesel conforming to the requirements of Specification D6751 with the remainder being a light middle or middle distillate grade diesel fuel and meeting the requirements of this specification.

DISCUSSION—
The abbreviation BXX represents a specific blend concentration in the range B6 to B20, where XX is the percent volume of biodiesel in the fuel blend.

[D02.E0] D7467

backflush, *v*—elution of the HPLC mobile phase in the backward or reverse direction from the silica gel column towards the cyano column.

DISCUSSION—
In this test method, it is used to elute the total aromatics plus polars as one sharp component. **[D02.04] D7419**

background RLU, *n*—quantity of relative light units resulting from running the test method without incorporation of the sample. **[D02.14] D7687**

bacterium (pl. bacteria), *n*—a single cell microorganism characterized by the absence of defined intracellular membranes that define all higher life forms.

DISCUSSION—
All bacteria are members of the biological diverse kingdoms *Prokaryota* and *Archaebacteriota*. Individual taxa within these kingdoms are able to thrive in environments ranging from sub-zero temperatures, such as in frozen foods and polar ice, to superheated waters in deep-sea thermal vents, and over the pH range <2.0 to >13.0. Potential food sources range from single carbon molecules (carbon dioxide and methane) to complex polymers, including plastics. Oxygen requirements range from obligate anaerobes, which die on contact with oxygen, to obligate aerobes, which die if oxygen pressure falls below a species specific threshold.

[D02.14] D6469

base fuel, *n—in automotive spark-ignition engine fuels*, a material composed primarily of hydrocarbons that may also contain oxygenates, anti-oxidants, corrosion inhibitors, metal deactivators, and dyes but does not contain deposit control or lead additives.

DISCUSSION—
A jurisdiction may set limits on lead content from all sources. **[D02.A0] D5500, D6201**

base number, *n*—the quantity of a specified acid, expressed in terms of the equivalent number of milligrams of potassium hydroxide per gram of sample, required to titrate a sample in a specified solvent to a specified endpoint using a specified detection system. **[D02.06] D2896, D8126**

DISCUSSION—
In this test method, the indicator is *p*-naphtholbenzein titrated to an orange end point in a toluene-water-isopropanol solvent. **[D02.06] D974**

DISCUSSION—
This test method uses fixed amounts of *iso*octane and alcoholic hydrochloric acid as the sample solvent and the endpoint is defined as the amount of titrant required to reach a yellow endpoint with a methyl red indicator solution. **[D02.06] D5984**

DISCUSSION—
In this test method, the sample is titrated to a meter reading corresponding to aqueous acidic buffer solution or appropriate inflection point. **[D02.06] D4739**

base oil, *n*—a base stock or a blend of two or more base stocks used to produce finished lubricants, usually in combination with additives. **[D02.P0] D6074**

base peak of a compound, *n*—the peak used as 100 % in computing the cracking pattern coefficient. **[D02.04] D2650**

base stock, *n*—a hydrocarbon lubricant component, other than an additive, that is produced by a single manufacturer to the same specifications (independent of feed source or manufacturer's location), and that is identified by a unique formula number or product identification number, or both.

[D02.P0] D6074

basicity, *n*—the quality, state or degree of being basic.

DISCUSSION—

In this test method, the criterion for basicity is a pink or red color when phenolphthalein indicator is used. **[D02.06] D1093**

basis weight of paper, *n*—basis weight is expressed in grams per square metre. In countries where the metric system is not universal, basis weight is also expressed in pounds per ream. **[D02.10] D2423**

batch—all the O-rings molded from the same lot of material and presented for inspection at one time. **[D02.N0] D6546**

batch, *n*—discrete shipment of commodity defined by a specified quantity, a time interval, or quality. **[D02.25] D7453**

bearing failure, *n*—the termination of the bearing's ability to perform its design function. **[D02.96] D7973, D8128**

bearing failure initiation, *n*—the moment a bearing starts to perform outside of its design function measured by performance characteristics. **[D02.96] D7973, D8128**

between ILCP method-averages reproducibility ($R_{ILCP\_X, ILCP\_Y}$), *n*—a quantitative expression of the random error associated with the difference between the bias-corrected ILCP average of method X versus the ILCP average of method Y from a Proficiency Testing program, when the method X has been assessed versus method Y, and an appropriate bias-correction has been applied to all method X results in accordance with this practice; it is defined as the numerical limit for the difference between two such averages that would be exceeded in about 5 % of the time (one case in 20 in the long run). **[D02.94] D6708**

between-method bias, *n*—a quantitative expression for the mathematical correction that can statistically improve the degree of agreement between the expected values of two test methods which purport to measure the same property. **[D02.94] D6708**

between-method reproducibililty (R_{XY}), *n*—a quantitative expression of the random error associated with the difference between two results obtained by different operators using different apparatus and applying the two methods *X* and *Y*, respectively, each obtaining a single result on an identical test sample, when the methods have been assessed and an appropriate bias-correction has been applied in accordance with this practice; it is defined as the 95 % confidence limit for the difference between two such single and independent results. **[D02.25] D6122**

DISCUSSION—

Within the context of this practice, R_{XY} is interpreted to be the 95 % confidence limit for the prediction deviation between any single Primary Test Method Result (PTMR) and the Predicted Primary Test Method Result (PPTMR) produced by the analyzer system that is deemed acceptable on the assumption that both the analyzer system and primary test method are in statistical control, and that the correlation relationship applied to the analyzer results to produce the PPTMR is fit-for-purpose.

[D02.25] D3764

between-methods reproducibility (R_{XY}), *n*—a quantitative expression of the random error associated with the difference between two results obtained by different operators using different apparatus and applying the two methods *X* and *Y*, respectively, each obtaining a single result on an identical test sample, when the methods have been assessed and an appropriate bias-correction has been applied in accordance with this practice; it is defined as the numerical limit for the difference between

two such single and independent results that would be exceeded about 5 % of the time (one case in 20 in the long run) in the normal and correct operation of both test methods.

DISCUSSION—
A statement of between methods reproducibility must include a description of any bias correction used in accordance with this practice.

DISCUSSION—
Between methods reproducibility is a meaningful concept only if there are no statistically observable sample-specific relative biases between the two methods, or if such biases vary from one sample to another in such a way that they may be considered random effects. **[D02.94] D6708**

binary, *adj*—characterized by, or consisting of, two components. **[D02.J0] D7719**

binder—a component of certain gasket materials, which solidifies the structure, imparts uniform adhesion to surfaces, and has an impact on the pore structure and resiliency. **[D02.B0] F118**

binder, *n*—substance such as coal tar pitch or petroleum pitch, used to bond the coke or other filler material prior to baking. **[D02.F0] D8075**

bioaccumulation, *n*—the net accumulation of a substance by an organism as a result of uptake from all environmental sources. **[D02.N0] D7044, D8029**

bioburden, *n*—the level of microbial contamination (*biomass*) in a system.

DISCUSSION—
Typically, bioburden is defined in terms of either biomass or numbers of cells per unit volume or mass or surface area material tested (g biomass/mL; g biomass/g; cells/mL sample, and so forth). The specific parameter used to define bioburden depends on critical properties of the system evaluated and the investigator's preferences. **[D02.14] D6469**

biochemical oxygen demand (BOD), *n*—the mass concentration of dissolved oxygen consumed under specified conditions by the biological oxidation of organic or inorganic matter, or both.

DISCUSSION—
BOD determination is performed using empirical tests employing standardized laboratory procedures. These tests measure oxygen utilization during a specified incubation period for the biochemical degradation of organic material (carbonaceous demand) in water. **[D02.12] D6731**

biocide, *n*—a poisonous substance that can kill living organisms.

DISCUSSION—
Biocides are further classified as bactericides (kill bacteria), fungicides (kill fungi), and microbiocides (kill both bacteria and fungi). They are also referred to as *antimicrobials*.

[D02.14] D6469

biodegradability, *n*—ability of a substance to be broken down into simpler substances by bacteria. **[D02.12] D7373**

biodegradable, *adj*—any substance containing <10 % wt. O_2 content which undergoes ≥60 % biodegradation as theoretical CO_2 in 28 days and ≥67 % biodegradation as theoretical O_2 uptake in 28 days, or any hydraulic fluid containing ≥10 % wt. O_2 content which undergoes ≥60 % biodegradation as theoretical CO_2 or as theoretical O_2 uptake in 28 days. **[D02.N0] D7044**

biodegradation, *n*—the process of chemical breakdown or transformation of a material caused by organisms or their enzymes. **[D02.12] D6006, D6139, D7044, D8324; [D02.N0] D6046**

DISCUSSION—
Biodegradation is only one mechanism by which materials are transformed in the environment.

[D02.12] D5864; [D02.N0] D8029

biodegradation, *n*—the process of chemical breakdown or transformation of a material caused by microorganisms or their enzymes.

DISCUSSION—
Biodegradation is only one mechanism by which materials are removed, transformed, or both, in the environment. **[D02.12] D6731**