



Designation: D4175 – 18

# Standard Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants<sup>1</sup>

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 ( $\epsilon$ ) 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.*

## 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.

**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

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

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

<sup>1</sup> 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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$$A = \log_{10}(1/T) = -\log_{10}(T) \quad (1)$$

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

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

$$a = A/fbc$$

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

**acceptance limit** ( $AL$ ),  $n$ —a numerical value that defines the point between acceptable and unacceptable quality.

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 product acceptance if the quality 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

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

(NIST), or (3) a consensus value, based on collaborative experimental work under the auspices of a scientific or engineering group. [D02.94] D6792

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 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] D7170

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

**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 an observed value and an accepted reference value. [D02.94] D7372

**accuracy, *n***—the closeness of agreement between a test result and an accepted reference value. [D02.94] D6792

**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.

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—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

**across (or against) grain, *n***—direction in a body with preferred orientation due to forming stresses that has the maximum *c*-axis alignment as measured in an X-ray diffraction test. [D02.F0] C709

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

**activation energy ( $E_a$ )**—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 =  $8.314 \text{ J mole}^{-1} \text{ K}^{-1}$  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  $\text{g h}^{-1} \text{ m}^{-2}$  (for  $Z_a$  calculated from area-normalized oxidation rates,  $OR_a$ ) or  $\text{g g}^{-1} \text{ h}^{-1}$  (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

**acute toxicity test**, *n*—a comparative toxicity 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*—*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

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

[D02.E0] D975

**adenosine monophosphate**, *n*—molecule formed by the removal of two (2) molecules of phosphate (one pyrophosphate molecule) from ATP.

[D02.14] D7463

**adenosine triphosphate**, *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

**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.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] D6006; [D02.N0] D6046; [D02.14] D8070

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

[D02.F0] C709, 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<sub>3</sub>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

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

**aliphatic ether**, *n*—an oxygen-containing, ashless, organic compound in which the oxygen atom is interposed between two carbon atoms (organic groups), has the general formula C<sub>*n*</sub>H<sub>2*n*+2</sub>O with *n* being 5 to 8, and in which the carbon atoms are connected in open chains and not closed rings.

DISCUSSION—Aliphatic compounds can be straight or branched chains and saturated or unsaturated. The term aliphatic ether, as used in this specification, refers only to the saturated compounds.

[D02.A0] D5797

**aliquot**, *n*—portion of sample being tested that is a representative portion of the whole.

[D02.25] D7808

**alternative blendstock**, *n*—*in fuel oils*, a non-hydrocarbon oil substance added to 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, D975

**amine number of reference fuels above 100**, AN—determined in terms of the weight percent of 3-methylphenylamine in reference grade *isooctane* (2,2,4-trimethylpentane). For example, 5 % of 3-methylphenylamine in reference grade *isooctane* 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] D6812

**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 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 of variance (ANOVA)**, *n*—technique that enables the total variance of a method to be broken down into its component factors. (ISO 4259) [D02.94] D6300

**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 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.

**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

**aniline point**, *n*—the minimum equilibrium solution temperature for equal volumes of aniline and sample. [D02.04] D6111

**anisotropic nuclear graphite**, *n*—graphite in which the isotropy ratio based on the value of the coefficient of thermal expansion (25 °C to 500 °C) is greater than 1.15. [D02.F0] C709

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

**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

**API gravity**, *n*—a special function of relative density (specific gravity) 60/60 °F (15.56/15.56 °C), represented by:  
°API = [141.5/relative density 60/60 °F] – 131.5

No statement of reference temperature is required, since 60 °F is included in the definition.

[D02.02] D287, D1298, D6822

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

**apparent viscosity**, *n*—of a lubricating grease, 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*—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<sub>a</sub>)**—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. [D02.F0] D7542

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, OR<sub>a</sub>, are g h<sup>-1</sup> m<sup>-2</sup>. [D02.F0] D7542

**area-normalized standard oxidation rate (SOR<sub>a</sub>)**—value of area normalized oxidation rate corresponding to 1 % weight loss in 24 h. Area-normalized standard oxidation rate, SOR<sub>a</sub>, depends on the initial specimen density. For carbon and graphite samples (density 1.2 – 2.2 g cm<sup>-3</sup>) SOR<sub>a</sub> varies between 2 and 4 g h<sup>-1</sup> m<sup>-2</sup>. [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. [D02.04] D7419

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

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

**ash**, *n*—in carbon and graphite technology, residue remaining after oxidation of a carbon or graphite. [D02.F0] C709

**asphalt**, *n*—a dark brown-to-black cementitious material in which the predominating constituents are bitumens. [D02.G0] D128

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. [D02.G0] D1092

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. [D02.14] D6560

DISCUSSION—In this test method, the aromatic solvent is hot toluene and the paraffinic solvent is heptane. [D02.14] D6560

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-methylnaphthalene, and the paraffinic solvent is n-hexadecane. [D02.14] D7060

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

**assignable cause**, *n*—a factor that contributes to variation and that is feasible to detect and identify. [D02.94] D7372

**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

**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 caused by the application of pressure, heat, or radiation, rather than by an external ignition source, such as a spark, flame, or incandescent surface. [Subcommittee D02.01]

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

**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, D6837, D6894, D7216

**automotive fuel rating**, *n*—the automotive fuel rating required under the amended Octane Certification and Posting Rule (or as amended, the Fuel Rating Rule), 16 CFR, Part 306.

DISCUSSION—Under this Rule, sellers of liquid automotive fuels, including alternative fuels, must determine, certify, and post an appropriate automotive fuel rating. The automotive fuel rating for gasoline is the antiknock index (octane rating). The automotive fuel rating for alternative liquid fuels consists of the common name of the fuel along with a disclosure of the amount, expressed as a minimum percentage by volume, of the principal component of the fuel. For alternative liquid automotive fuels, a disclosure of other components, expressed as a minimum percentage by volume, may be included, if desired. This is applicable in the United States. [D02.A0] D7794

**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

**B6 to B20**, *n*—fuel blend consisting of 6 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 *Archaeobacteriota*. 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 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 *isooctane* 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 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**, *n*—term referring to a volume or parcel being transferred.

[D02.25] D7453

**bearing failure**, *n*—the termination of the bearing's ability to perform its design function.

[D02.96] D7973

**bearing failure initiation**, *n*—the moment a bearing starts to perform outside of its design function measured by performance characteristics.

[D02.96] D7973

**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 95 % confidence limit for the difference between two such averages.

[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-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 95 % confidence limit for the difference between two such single and independent results.

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

**bias**, *n*—the difference between the expectation of the test results and an accepted reference value.

DISCUSSION—The term “expectation” is used in the context of statistics terminology, which implies it is a “statistical expectation.” (E177)

[D02.94] D6300, D6792

**bias**, *n*—a systematic error that contributes to the difference between a population mean of the measurements or test results and an accepted reference or true value.

[D02.94] D7372

**binary**, *adj*—characterized by, or consisting of, two components.

[D02.J0] D7719

**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

**binder**, *n*—substance, usually an organic material such as coal tar pitch or petroleum pitch, used to bond the coke or other filler material prior to baking.

[D02.F0] C709

**bioaccumulation**, *n*—the net accumulation of a substance by an organism as a result of uptake from all environmental sources.

[D02.N0] D7044

**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

**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<sub>2</sub> content which undergoes ≥60 % biodegradation as theoretical CO<sub>2</sub> in 28 days and ≥67 % biodegradation as theoretical O<sub>2</sub> uptake in 28 days, or any hydraulic fluid containing ≥10 % wt. O<sub>2</sub> content which undergoes ≥60 % biodegradation as theoretical CO<sub>2</sub> or as theoretical O<sub>2</sub> 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.

DISCUSSION—Biodegradation is only one mechanism by which materials are removed from the environment.

[D02.N0] D6046

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

[D02.12] D5864, D6006, D6139, D7044

**biodeterioration**, *n*—the loss of commercial value or performance characteristics, or both, of a product (fuel) or material (fuel system) through biological processes.

[D02.14] D6469

**biodiesel**, *n*—fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100. [D02.E0] D396, D975, D7467;

[D02.08] D93; [D02.14] D7501; [D02.01] D7170; [D02.04] D7806, D7861

DISCUSSION—*biodiesel*, as defined above, is registered with the U.S. EPA as a fuel and a fuel additive under Section 211(b) of the Clean Air Act 40 CFR Part 79). There is, however, other usage of the term biodiesel in the marketplace. Due to its EPA registration and the widespread commercial use of the term biodiesel in the U.S. marketplace, the term biodiesel will be maintained for this specification.

DISCUSSION—Biodiesel is typically produced by a reaction of a vegetable oil or animal fat with an alcohol such as methanol or ethanol in the presence of a catalyst to yield mono-alkyl esters and glycerin, which is removed. The finished biodiesel derives approximately 10 % of its mass from the reacted alcohol. The alcohol used in the reaction may or may not come from renewable resources.

DISCUSSION—Biodiesel is typically produced by a reaction of vegetable oil or animal fat with an alcohol such as methanol or ethanol in the presence of a catalyst to yield mono-esters and glycerin. The fuel typically may contain up to 14 different types of fatty acids that are chemically transformed into fatty acid methyl esters (FAME).

[D02.07] D5771 [D02.E0] D6751 [D02.E0] D6751

**biodiesel (B-100)**, *n*—fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. [D02.04] D6584

**biodiesel blend**, *n*—a blend of biodiesel fuel with petroleum-based diesel fuel designated BXX, where XX is the volume % of biodiesel. [D02.07] D5771

**biodiesel blend (BXX)**, *n*—blend of biodiesel fuel with diesel fuel oils.

DISCUSSION—In the abbreviation, BXX, the XX represents the volume percentage of biodiesel fuel in the blend.

[D02.01] D7170; [D02.E0] D396, D975, D6751; [D02.04] D7861

**biodiesel blend (BXX)**, *n*—blend of biodiesel fuel with petroleum-based diesel fuel designated BXX, where XX is the volume percentage (as a whole number without the percentage sign) of biodiesel. [D02.07] D7397

**biodiesel blend, BXX**, *n*—a blend of biodiesel fuel with petroleum-based diesel fuel.

DISCUSSION—In the abbreviation BXX, the XX represents the volume percentage of biodiesel fuel in the blend.

[D02.04] D7806

**biodiesel blend, BXX**, *n*—a fuel composed of biodiesel blendstock with hydrocarbon-based diesel fuel.

[D02.14] D7321

**biodiesel blends**, *n*—a blend of biodiesel fuel with petroleum-based diesel fuel. [D02.08] D93

**biodiesel fuel**, *n*—synonym for *biodiesel*. [D02.E0] D6751

**biofilm**, *n*—a film or layer of microorganisms, biopolymers, water, and entrained organic and inorganic debris that forms as a result of microbial growth and proliferation at phase

interfaces (liquid-liquid, liquid-solid, liquid-gas, and so forth). (Synonym—*skinogen*.) [D02.14] D6469

**bio-kinetic model**, *n*—model that can predict the biodegradability of a lubricant. [D02.12] D7373

**bioluminescence**, *n*—production and emission of light by a living organism as the result of a chemical reaction during which chemical energy is converted to light energy. [D02.14] D7463

**biomass**, *n*—biological material including any material other than fossil fuels which is or was a living organism or component or product of a living organism.

[D02.12] D5864; [D02.14] D7463; [D02.J0] D7719

DISCUSSION—In biology and environmental science, biomass is typically expressed as density of biological material per unit sample volume, area, or mass (g biomass/g (or /mL or /cm<sup>2</sup>) sample); when used for products derived from organisms biomass is typically expressed in terms of mass (kg, MT, etc.) or volume (L, m<sup>3</sup>, bbl, etc.).

DISCUSSION—Products of living organisms include those materials produced directly by living organisms as metabolites (for example, ethanol, various carbohydrates and fatty acids), materials manufactured by processing living organisms (for example, pellets manufactured by shredding and pelletizing plant material) and materials produced by processing living organisms, their components or metabolites (for example, transesterified oil; also called biodiesel). [D02.14] D6469; [D02.12] D6384

**biosurfactant**, *n*—a biologically produced molecule that acts as a soap or detergent. [D02.14] D6469

**bituminous material**, *n*—*in petroleum technology*, a black or dark-colored very viscous liquid or semi-solid composed principally of high molecular weight condensed aromatic, or naphthenic compounds, or both. [D02.02] D95

**black oil**, *n*—lubricant containing asphaltic materials. Black oils are used in heavy-duty equipment applications, such as mining and quarrying, where extra adhesiveness is desired. [D02.07] D97

**blank**, *n*—a flask containing the test medium and the inoculum with no additional carbon source added. [D02.12] D5864

**blank**, *n*—*in biodegradability testing*, a test system containing all system components with the exception of the test material. [D02.12] D6384

**blank**, *n*—*in biodegradability testing*, a test system containing all system components with the exception of the test substance. [D02.12] D6006

**blank**, *n*—solution which is similar in composition and contents to the sample solution but does not contain the analyte being measured. [D02.03] D7740

**bleed (bleeding)**, *n*—*of lubricating greases*, the separation of a liquid lubricant from a lubricating grease for any cause. [D02.G0] D6185

**blind reference oil**, *n*—a reference oil, the identity of which is unknown by the test facility. [D02.B0] D7468



DISCUSSION—This is a coded reference oil which is submitted by a source independent from the test facility.

[D02.B0] D6681, D6709, D6750, D7156, D7422, D7484

**blowby**, *n*—*in internal combustion engines*, that portion of the combustion products and unburned air/fuel mixture that leaks past piston rings into the engine crankcase during operation.

[D02.B0] D6593, D6681, D6891, D7156, D7422, D7484, D7589

**boilup rate**, *n*—*in distillation*, the quantity of vapor entering the column per unit of time.

[D02.08] D2892

**bond**, *v*—to connect two parts of a system electrically by means of a conductive wire to eliminate voltage differences.

[D02.14] D6217, D7501; [D02.J0] D5452

**bonded glycerin**, *n*—glycerin portion of the mono-, di-, and triglyceride molecules.

[D02.04] D6584

**boundary lubrication**, *n*—condition in which the friction and wear between two surfaces in relative motion are determined by the properties of the surfaces and the properties of the contacting fluid, other than bulk viscosity.

DISCUSSION—Metal to metal contact occurs and the chemistry of the system is involved. Physically adsorbed or chemically reacted soft films (usually very thin) support contact loads. Consequently, some wear is inevitable.

[D02.96] D7720

**Bourdon spring gauge**, *n*—pressure measuring device that employs a Bourdon tube connected to an indicator.

[D02.08] D323, D4953

**Bourdon tube**, *n*—flattened metal tube bent to a curve that straightens under internal pressure.

[D02.08] D323, D4953

**brake mean effective pressure**, *n*—*for spark-ignition engines*, the measure of engine power at the output shaft as typically measured by an absorption dynamometer or brake.

[D02.01] D909

**break-in**, *v*—*in internal combustion engines*, the running of a new engine under prescribed conditions to help stabilize engine response and help remove initial friction characteristics associated with new engine parts.

[D02.B0] D7589

**break-in**, *n*—*in tribology*, an initial transition process occurring in newly established wearing contacts, often accompanied by transients in coefficient of friction or wear rate, or both, that are uncharacteristic of the given tribological system's long-term behavior.

[D02.G0] D5706, D5707, D7420, D7594 [D02.L0] D6425

**bromine index**, *n*—the number of milligrams of bromine that will react with 100 g of sample under the conditions of the test.

[D02.06] D2710

**BTDC (before top dead center)**, *adj*—used with the degree symbol to indicate the angular position of the crankshaft relative to its position at the point of uppermost travel of the piston in the cylinder.

[D02.B0] D5966, D6837, D6984, D7320

**bubble point**, *n*—the pressure at which the first bubble of vapor forms is the bubble point when the pressure is lowered on a liquid held at a constant temperature.

DISCUSSION—Bubble point pressures are higher at high temperatures.

[D02.02] D4057

**buffer**, *n*—a compound or mixture that, when contained in solution, causes the solution to resist change in pH.

DISCUSSION—Each buffer has a characteristic limited range of pH over which it is effective.

[D02.14] D8070

**bulk density**, *n*—*in carbon and graphite technology*, the mass of a unit volume of material including both permeable and impermeable voids (and boron compounds in the case of boronated carbon or boronated graphite) present in the material at room temperature.

[D02.F0] C559

**bulk density**, *n*—of coke, the ratio of the mass of a collection of particles of a specified size range to the volume occupied.

[D02.05] D8097

**bulk sample**, *n*—a large sample, either from one place or made up of several incremental samples of the same material.

[D02.05] D4296

**bulk sample**—the reduced and divided representative portion of the gross sample as prepared for shipment to and received by a laboratory to be prepared for analysis.

[D02.05] D4930

**Bunsen coefficient**, *n*—the solubility of a gas, expressed as the gas volume reduced to 273 K (32 °F) and 0.10 MPa (1 atm), dissolved by one volume of liquid at the specified temperature and 0.10 MPa.

[D02.L0] D3827

**Bunsen coefficient**, *n*—the solubility of a gas expressed as the volume, reduced to 273 K (32 °F) and 101.3 kPa (1 atm), dissolved by one volume of liquid at the specified temperature and 101.3 kPa.

[D02.L0] D2779

**burn**, *vt*—*in emission spectroscopy*, to vaporize and excite a specimen with sufficient energy to generate spectral radiation.

[D02.03] D6595, D6728

**burner**, *n*—flame device used to atomize the analyte by burning in a high temperature flame mixed of a fuel and an oxidant.

[D02.03] D7740

**burner fuel oil**, *n*—any petroleum liquid suitable for the generation of heat by combustion in a furnace or firebox as a vapor or a spray, or a combination of both.

DISCUSSION—Different grades are characterized primarily by viscosity ranges.

[D02.P0] D6448, D6823

**butanol**, *n*—*for the purposes of this method*, butanol or butyl alcohol refers to one of three structural isomers of butanol—1-butanol, 2-butanol, and 2-methyl-1-propanol. This test method has not been evaluated for use with the butanol isomer 2-methyl-2-propanol.

[D02.04] D7875

**BXX blend**, *n*—fuel blend consisting of up to 20 volume percent biodiesel designated as up to B20 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 test method.

DISCUSSION—The abbreviation BXX represents a specific blend concentration in the range B2 to B20, where XX is the percent volume of biodiesel in the fuel blend. [D02.14] D7501

**calcined petroleum coke**, *n*—petroleum coke that has been thermally treated to drive off the volatile matter and to develop crystalline structure.

[D02.05] D2638, D5003, D5004, D6376, D6791

**calibrate**, *v*—to determine the indication or output of a device (e.g., thermometer, manometer, engine) with respect to that of a standard. [D02.B0] D5966, D5967, D6681, D6794, D6795, D6837, D6984, D7320, D7468, D7589

**calibrated test stand**, *n*—a test stand on which the testing of reference material(s), conducted as specified in the standard, provided acceptable test results.

DISCUSSION—In several automotive lubricant standard test methods, the ASTM Test Monitoring Center provides testing guidance and determines acceptability. [D02.B0] D6681, D6750

**calibration**, *n*—operation that establishes the relationship between the reference density of standards and the corresponding reading of the instrument. [D02.04] D7777

**validation**, *n*—operation of checking the calibration of the portable digital density meter at a single point close to the required operating point. [D02.04] D7777

**calibration**, *n*—process by which the relationship between signal intensity and elemental concentration is determined for a specific element analysis. [D02.03] D7740

**calibration**, *n*—the determination of the values of the significant parameters by comparison with values indicated by a set of reference standards. [D02.03] D6595, D6728

**calibration**, *n*—the determination of the values of the significant parameters by comparison with values indicated by a set of calibration standards. [D02.03] D7171

**calibration curve**, *n*—graphical or mathematical representation of the relationship between known concentrations of an element in a series of standard calibration solutions and the measured response from the measurement system. [D02.F0] C560

**calibration curve**, *n*—plot of signal intensity versus elemental concentration using data obtained by making measurements with standards. [D02.03] D7740

**calibration curve**, *n*—the graphical or mathematical representation of a relationship between the assigned (known) values of standards and the measured responses from the measurement system. [D02.03] D6595, D6728

**calibration curve (or calibration line)**, *n*—the graphical or mathematical representation of a relationship between the assigned (known) values of calibration standards and the measured responses from the measurement system. [D02.03] D7171

**calibration oil**, *n*—an oil that is used to determine the indication or output of a measuring device or a given engine with respect to a standard. [D02.B0] D6837, D7589

**calibration solutions**, *n*—solutions of accurately known concentrations of the chemical element to be determined using the calibration curve method. [D02.F0] C560

**calibration standard**, *n*—a material with a certified value for a relevant property, issued by or traceable to a national organization such as NIST, and whose properties are known with sufficient accuracy to permit its use to evaluate the same property of another sample. [D02.94] D6792; [D02.03] D7740

**calibration standard**, *n*—a standard having an accepted value (reference value) for use in calibrating a measurement instrument or system. [D02.03] D6595, D6728

**calibration standard**, *n*—a standard having an assigned (known) value (reference value) for use in calibrating a measurement instrument or system. This standard is not used to determine the accuracy of the measurement instrument or system (see *check standard*). [D02.03] D7171

**calibration test**, *n*—an engine test conducted on a reference oil under carefully prescribed conditions, the results of which are used to determine the suitability of the engine stand/laboratory for such tests on non-reference oils.

DISCUSSION—A calibration test also includes tests conducted on parts to ensure their suitability for use in reference and non-reference tests.

[D02.B0] D6750

**calibration test**, *n*—a test, using a coded oil, conducted as specified in the test method.

DISCUSSION—The test result is used to determine the suitability of the testing facility/laboratory to conduct such tests on non-reference oils.

[D02.B0] D6794, D6795

**calibration test stand**, *n*—a test stand on which the testing of reference material(s), conducted as specified in the standard, provided acceptable results. [D02.03] D7171

DISCUSSION—In several automotive lubricant standard test methods, the ASTM Test Monitoring Center provides testing guidance and determines acceptability. [D02.B0] D6891

**candidate oil**, *n*—an oil which is intended to have the performance characteristics necessary to satisfy a specification and is tested against that specification. [D02.B0] D6750, D6794, D6795, D6894, D7156, D7216, D7422, D7484, D7603

DISCUSSION—These oils are mainly submitted for testing as *candidates* to satisfy a specified performance; hence the designation of the term. [D02.B0] D6681

**candle pitch**, *n*—a dark brown-to-black, tarry or solid, by-product residue from soap and candle stock manufacture, refining of vegetable oils, refining of wool grease, or refining of refuse animal fats. [D02.G0] D128

**capillary**, *n*—For the purpose of this test method, a capillary is any right cylindrical tube having a length to diameter ratio of 40 to 1. [D02.G0] D1092

**capture solution**, *n*—aqueous solution of proprietary composition used to capture and concentrate hydrophilic compounds and particles from liquid fuels. [D02.14] D7463

**carbon**, *n*—element, number 6 of the periodic table of elements, electronic ground state  $1s^2 2s^2 2p^2$ .

[D02.F0] C709

**carbon**, *n*—*in carbon and graphite technology*, artifact consisting predominantly of the element carbon and possessing limited long range order.

DISCUSSION—The presence of limited long range order is usually associated with low electrical and thermal conductivity and difficult machinability when compared with graphite.

[D02.F0] C709

**carbon**, *n*—*in manual transmissions and final drive axles*, a hard, dry, generally black or gray deposit that can be removed by solvents but not by wiping with a cloth.

[D02.B0] D5704

**carbon foam**, *n*—*in carbon and graphite technology*, porous carbon product containing regularly shaped, predominantly concave, homogeneously dispersed cells which interact to form a three-dimensional array throughout a continuum material of carbon, predominantly in the non-graphitic state. The final result is either an open or closed cell product.

DISCUSSION—In most foam, the cell wall thickness is less than half the average cell size.

[D02.F0] C709

**carbon residue**, *n*—the residue formed by evaporation and thermal degradation of a carbon containing material.

DISCUSSION—The residue is not composed entirely of carbon but is a coke that can be further changed by carbon pyrolysis.

[D02.06] D4530

DISCUSSION—The residue is not composed entirely of carbon but is a coke that can be further changed by carbon pyrolysis. The term carbon residue is retained in deference to its wide common usage.

[D02.06] D189, D524

**catalytic thermometric titration**, *n*—a method to determine the end point of a chemical reaction through the use a temperature measuring device and the addition of a chemical to enhance the detection of the endpoint.

[D02.06] D8045

**category**, *n*—*in engine oils*, a designation such as SJ, SL, SM, SN, CH-4, CI-4, CJ-4, CK-4, FA-4, Energy Conserving, and so forth, for a given level of performance in specified engine and bench tests.

[D02.B0] D4485

**cathode block**, *n*—one manufactured unit used as a negative carbon electrode.

[D02.05] D6354

**cause(s) of failure**, *n*—underlying source(s) for each potential failure mode that can be identified and described by analytical testing.

[D02.96] D7874, D7973

**cell (bubble)**, *n*—*in carbon and graphite technology*, single small cavity formed by gaseous displacement in a precursor material in its plastic state, and surrounded completely by its walls when formed. Cells can be open or closed.

DISCUSSION—After processing at high temperatures, the basic structure of the cell will remain even as the material converts from a plastic state to a rigid carbonaceous structure. Hence, the term cell will apply to a carbon product.

[D02.F0] C709

**cell count**, *n*—*in carbon and graphite technology*, *in closed-cell foams*, number of cells aligned in one plane in one linear inch, as determined by stereoscopic image analysis.

[D02.F0] C709

**cell size**, *n*—*in carbon and graphite technology*, average diameter of the cells in the final foam product.

[D02.F0] C709

**cellular adenosine triphosphate (cellular-ATP)**, *n*—ATP present in whole cells, whether they are living or dead.

DISCUSSION—Cellular-ATP is released upon intentional lysis of microbial cells during the sample preparation process. Microbially infected fluids contain both cellular (cell-associated/ cell-bound) and extra-cellular ATP.

[D02.14] D7687

DISCUSSION—Cellular-ATP is released upon intentional lysis (rupturing) of microbial cells during the sample preparation process. Microbially infected fluids contain both cellular (cell-associated/cell-bound) and extra-cellular ATP.

[D02.14] D7463

**center line**, *n*—line on a control chart depicting the average level of the statistic being monitored.

[D02.96] D7720

**certificate of analysis (COA)**, *n*—a document provided by a supplier to a customer giving results from analyses of required parameters to show how the material is in conformance with the product specifications or not.

[D02.94] D7776

**certified reference material**, *n*—reference material one or more of whose property values are certified by a technically valid procedure, accompanied by a traceable certificate or other documentation which is issued by a certifying body.

[D02.03] D7740

**certified reference material, CRM**, *n*—a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by a traceable certificate or other documentation which is issued by a certifying body.

[D02.94] D6792; [D02.03] D7578

**cetane number (CN)**, *n*—a measure of the ignition performance of a diesel fuel oil obtained by comparing it to reference fuels in a standardized engine test.

DISCUSSION—In the context of this test method, ignition performance is understood to mean the ignition delay of the fuel as determined in a standard test engine under controlled conditions of fuel flow rate, injection timing and compression ratio.

[D02.01] D613

DISCUSSION—In the context of this test method, cetane number is that defined by Test Method D613/IP 41.

[D02.01] D6890, D7170

**chance cause**, *n*—source of inherent random variation in a process which is predictable within statistical limits; also called *common cause*.

[D02.96] D7720

**char**, *n*—fine carbonaceous powder that is separated from the vapors of biomass during pyrolysis.

DISCUSSION—Pyrolysis liquid biofuel contains uniformly suspended char at varying concentrations.

[D02.06] D7579

**characteristic**, *n*—property of items in a sample or population which, when measured, counted or otherwise observed, helps to distinguish between the items.

[D02.96] D7720

**Check Fuel**, *n*—*for quality control testing*, a spark-ignition engine fuels of selected characteristics having an octane number accepted reference value ( $O.N._{ARV}$ ) determined by round-robin testing under reproducibility conditions.

[D02.01] D2699, D2700

**check fuel**, *n*—for quality control testing, a spark-ignition aviation gasoline having supercharge rating ARV determined by the National Exchange Group. [D02.01] D909

**check standard**, *n*—a material having an assigned (known) value (reference value) used to determine the accuracy of the measurement instrument or system. This standard is not used to calibrate the measurement instrument or system (see *calibration standard*). [D02.03] D7171

**check standard**, *n*—material having an assigned (known) value (reference value) used to determine the accuracy of the measurement system or instrument. This standard is not used to calibrate the measurement instrument or system. [D02.03] D7578

**check standard**, *n*—in *QC testing*, material having an accepted reference value used to determine the accuracy of a measurement system.

DISCUSSION—In the context of this test method, check standard refers to heptane. [D02.01] D6890, D7170

**chronic 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 period of time which constitutes a major portion of their life span. [D02.12] D6384

**chronic toxicity test**, *n*—a comparative toxicity test in which a representative subpopulation of organisms is exposed to different treat rates of a test material and is observed for a period of time that constitutes a major portion of their life span. [D02.12] D6081

**C.L.A.**, *n*—in measuring surface finish, the arithmetic average of the absolute distances of all profile points from the mean line for a given distance. [D02.L0] D6425

**classification**, *n*—in *engine oils*, the systematic arrangement into categories in accordance with different levels of performance in specified engine and bench tests. [D02.B0] D4485

**clear-and-bright**, *n*—condition in which the sample is free of haze or cloudiness. (Also termed *clean-and-bright*.) [D02.05] D156

**clear-and-bright** (also termed *clean-and-bright*), *n*—a condition in which the fuel contains no visible water drops or particulates and is free of haze or cloudiness. [D02.14] D4860

**clogging**, *n*—the restriction of a flow path due to the accumulation of material along the flow path boundaries. [D02.B0] D6984, D7320

**closed cell**, *n*—in *carbon and graphite technology*, cell totally enclosed by its walls and hence not interconnected with other cells. A closed cell foam is a foam consisting predominantly of closed cells. [D02.F0] C709

**closeness sum of squares (CSS)**, *n*—a statistic used to quantify the degree of agreement between the results from two test methods after bias-correction using the methodology of this practice. [D02.94] D6708

**cloud point**, *n*—in *petroleum products and biodiesel fuels*, the temperature of a liquid specimen when the smallest observable cluster of wax crystals first occurs upon cooling under prescribed conditions.

DISCUSSION—The cloud point occurs when the temperature of the specimen is low enough to cause wax crystals to precipitate. In a homogeneous liquid, the cloud is always noted first at the location in the specimen where the specimen temperature is the lowest. The cloud point is the temperature at which the crystals first occur, regardless of their location in the specimen, and not after extensive crystallization has taken place. The wax crystals that precipitate at lower temperatures are typically, but not excluded to, straight chain hydrocarbons and lipids.

[D02.07] D5771, D5772, D5773, D7397, D7683, D7689

DISCUSSION—The purpose of the cloud point method is to detect the presence of the wax crystals in the specimen; however, trace amounts of water and inorganic compounds may be present. The intent of the cloud point method is to capture the temperature at which the liquids in the specimen begin to change from a single liquid phase to a two-phase system containing solid and liquid. It is not the intent of this test method to monitor the phase transition of the trace components, such as water. [D02.07] D5771, D5772, D5773

**coagulate**, *v*—to cause to become viscous or thickened into a coherent mass. [D02.06] D893, D7317

**coagulated pentane insolubles**, *n*—in *used oil analysis*, separated matter that results when a coagulant is added to a solution of used oil in pentane.

DISCUSSION—The addition of a coagulant will aid in separating finely divided materials that may have been held in suspension because of the dispersant characteristics of the oil. [D02.06] D893

DISCUSSION—This test method uses a 1 % coagulant solution. Test Method D893 uses a 5 % coagulant solution. [D02.06] D7317

**coagulated toluene insolubles**, *n*—in *used oil analysis*, coagulated and separated matter not soluble in pentane or toluene. [D02.06] D893

**coefficient of friction**, ( $\mu$ )—the ratio of the tangential force that is needed to start or to maintain uniform relative motion between two contacting surfaces to the perpendicular force holding them in contact. [D02.L0] D5183

**coefficient of friction**,  $\mu$  or *f*, *n*—in *tribology*, the dimensionless ratio of the friction force (*F*) between two bodies to the normal force (*N*) pressing these two bodies together.

$$\mu \text{ or } f = (F / N) \quad (2)$$

DISCUSSION—A distinction is often made between static coefficient of friction and kinetic coefficient of friction. [D02.L0] D2714, D3702

**coke**, *n*—carbonaceous solid produced from coal, petroleum, or other materials by thermal decomposition with passage through a plastic state. [D02.F0] C709

**cold sticking**, *n*—of *piston rings*, a condition in which the ring is free in its groove while the engine is running but stuck when the piston is cold, normally indicated by the absence of varnish or other deposits on the outer face of the ring and of signs of blowby on the piston skirt. [D02.B0] D4857

**cold-stuck piston ring**, *n*—*in internal combustion engines*, a piston ring that is stuck when the piston and ring are at room temperature, but inspection shows that it was free during engine operation.

DISCUSSION—A cold-stuck piston ring cannot be moved with moderate finger pressure. It is characterized by a polished face over its entire circumference, indicating essentially no blowby passed over the ring face during operation. [D02.B0] D6593, D6984, D7320

**colony**, *n*—a discreet visible aggregate of microorganisms that develops when a viable microorganism, or particle containing viable microorganisms, is introduced into a gelbased nutritive culture medium and reproduces there.

[D02.14] D8070

DISCUSSION—A period of incubation is necessary to allow sufficient reproduction. This test method utilizes a reactive compound that shortens the time for colonies to become visible and stains them so that they appear as red or purple spots.

DISCUSSION—Typically, bacterial colonies become visible to the naked eye only after the colony contains  $\geq 10^9$  individual cells. Consequently, the time required for a colony to become visible is dependent on the organism's generation (doubling), which can range from <30 min to >1 week. [D02.14] D7978

**colony forming unit (CFU)**, *n*—a viable microorganism or aggregate of viable microorganisms, which proliferate(s) in a culture medium to produce a viable colony.

[D02.14] D8070

**colorimetric analysis**, *n*—photometric analysis method of using absorption of monochromatic light in the visible spectrum.

[D02.F0] C560

**combustion**, *n*—chemical reaction by which graphite is combined in a controlled manner with pure oxygen in a high temperature furnace for analytical purposes. [D02.F0] C816

**combustion chamber**, *n*—*in reciprocating internal combustion engines*, the volume bounded by the piston crown and any portion of the cylinder walls extending above the piston crown when in the top dead center position, and the inner surface of the cylinder head including any spark plugs and other inserted components. [D02.B0] D4857, D4858, D4863

**combustion ion chromatography (CIC)**, *n*—an analytical system consisting of oxidative pyrohydrolytic combustion followed by ion chromatographic detection.

[D02.H0] D7994

**commercial butane**—a hydrocarbon product for use where low volatility is required.

[D02.H0] D1835

**commercial PB mixtures**—mixtures of propane and butane for use where intermediate volatility is required.

[D02.H0] D1835

**commercial propane**—a hydrocarbon product for use where high volatility is required. Commercial propane is suitable for certain low severity internal combustion engine applications.

[D02.H0] D1835

**compatibility**, *n*—*of crude oils or of heavy fuel oils*, the ability of two or more crude oils or fuel oils to blend together within

certain concentration ranges without evidence of separation, such as the formation of multiple phases.

DISCUSSION—Incompatible heavy fuel oils or crude oils, when mixed or blended, result in the flocculation or precipitation of asphaltenes. Some oils may be compatible within certain concentration ranges in specific mixtures, but incompatible outside those ranges.

[D02.14] D7060, D7061, D7827

**compatibility**, *n*—*of crude oils and of heavy fuel oils*, the ability of two or more crude oils or fuel oils to be blended together within specified ratios without evidence of separation, such as flocculation or separation of asphaltenes.

[D02.14] D7112

**compensation line**, *n*—a line of plot on log-log paper where the coordinates are scar diameter in millimetres and applied load in kilograms-force (or newtons) obtained under dynamic conditions.

[D02.G0] D2596

**compensation scar diameter**, *n*—the average diameter, in millimetres, of the wear scar on the stationary balls caused by the rotating ball under an applied load in the presence of a lubricant, but without causing either seizure or welding.

[D02.G0] D2596; [D02.L0] D2783

**component**, *n*—of a hydraulic system, an individual unit, excluding piping, comprising one or more parts designed to be a functional part of a fluid power system, for example, cylinder, motor, valve, or filter.

[D02.N0] D7721

**component incipient failure**, *n*—moment a component begins to deteriorate or undergo changes that will eventually lead to the loss of its design function.

DISCUSSION—This moment may not be easily detectable because of sensitivity limitations of monitoring instrumentation or a lack of measurable change in performance characteristics or both.

[D02.96] D7874

**composite sample**, *n*—a sample, representative of an entire consignment of calcined petroleum coke, generated by mixing portions of gross samples from different lots together in mass fractions proportioned to the consignment.

[D02.05] D6969

**composite sample**—a thoroughly mixed gross sample.

[D02.05] D4296

**compression ratio (CR)**, *n*—the ratio of the volume of the combustion chamber including the precombustion chamber with the piston at bottom dead center to the comparable volume with the piston at top dead center. [D02.01] D613

**compressive strength**, *n*—property of solid material that indicates its ability to withstand a uniaxial compressive load.

[D02.F0] C709, C695

**condition monitoring**, *n*—a field of technical activity in which selected physical parameters associated with an operating machine are periodically or continuously sensed, measured, and recorded for the interim purpose of reducing, analyzing, comparing, and displaying the data and information so obtained, and for the ultimate purpose of using interim result to support decisions related to the operation and maintenance of the machine.

[D02.96] D7917

**congealing point**, *n*—of petroleum wax, that temperature at which molten petroleum wax, when allowed to cool under prescribed conditions, ceases to flow. [D02.10] D938

**consistency**, *n*—of lubricating grease, the degree of resistance to movement under stress.

DISCUSSION—The term consistency is used somewhat synonymously with penetration. Generally, consistency refers to worked penetration of a grease. [D02.G0] D217, D1403, D7342

**consortium (pl. consortia)**, *n*—microbial community comprised of more than one, species that exhibits properties not shown by individual community members.

DISCUSSION—Consortia often mediate biodeterioration processes that individual taxa cannot. [D02.14] D6469

**contamination**, *n*—any process which introduces contaminants into the fuel. [D02.E0] D2880

**continuous analyzer unit cycle time**—the time interval required to replace the volume of the analyzer measurement cell. [D02.25] D7278

**control limits**, *n*—limits on a control chart that are used as criteria for signaling the need for action or judging whether a set of data does or does not indicate a state of statistical control based on a prescribed degree of risk.

DISCUSSION—For example, typical three-sigma limits carry a risk of 0.135 % of being out of control (on one side of the center line) when the process is actually in control and the statistic has a normal distribution. [D02.96] D7720

**conventional-fuel vehicle**, *n*—a vehicle designed to operate on spark-ignition engine fuel that complies with Specification D4814. [D02.A0] D7794

**conventional hydrocarbons**, *n*—hydrocarbons derived from the following conventional sources: crude oil, natural gas liquid condensates, heavy oil, shale oil, and oil sands. [D02.J0] D7566

**cool-on-column injector**, *n*—an injection port that allows controlled injection of the sample at a temperature close to or lower than the boiling point of the solvent into the gas chromatographic column or a liner within the injection port connected to the column.

DISCUSSION—After the injection, the injection port is heated at a fixed rate to a temperature sufficiently high enough to allow the transfer of sample components of interest from the injection port to the part of the column located in the gas chromatograph (GC) oven. [D02.04] D7059

**copper corrosion**, *n*—effect of a chemical attack on copper metal by a lubricant causing various levels of tarnishing and change in appearance.

DISCUSSION—Acidic and other aggressive species, often sulfur-based, in a lubricant can attack copper or copper alloys present in bearings or other lubricated surfaces. The presence of this antagonistic interaction is often apparent in a well-defined series of color changes. [D02.G0] D4048

**core sample**—the portion of graphite obtained from an electrode by use of a sampling device. [D02.F0] C783

**corrected area slice**, *n*—in gas chromatography, an area slice corrected for baseline offset, by subtraction of the corresponding area slice in a previously recorded blank (non-sample) analysis. [D02.04] D7798

**corrected load**, *n*—the load in kilograms-force (or Newtons) for each run obtained by multiplying the applied load by the ratio of the Hertz scar diameter to the measured scar diameter at that load. [D02.L0] D2783

**corrected load**, *n*—the load in kilograms-force (or Newtons) obtained by multiplying the applied load by the ratio of the Hertz scar diameter to the measured scar diameter at that load.

DISCUSSION—In this test method, the corrected load is calculated for each run. [D02.G0] D2596

**correction factor**, *n*—a mathematical adjustment to a test result to compensate for industry wide shifts in severity. [D02.B0] D6984, D7320

**corrosion**, *n*—the chemical or electrochemical reaction between a material, usually a metal surface, and its environment that can produce a deterioration of the material and its properties. [D02.B0] D6557, D6594, D6984, D7320

**crack extension resistance**,  $K_R$ [FL<sup>-3/2</sup>],  $G_R$ [FL<sup>-1</sup>], or  $J_R$ [FL<sup>-1</sup>], *n*—measure of the resistance of a material to crack extension expressed in terms of the stress-intensity factor, *K*, strain energy release rate, *G*, or values of *J* derived using the J-integral concept. [D02.F0] D7779

**cracked gases**, *n*—hydrocarbon gases that contain unsaturates. [D02.04] D2650

**critical parts**, *n*—those components used in the test that are known to affect test severity. [D02.B0] D6709; [D02.N0] D7721

**critical pressure**, *n*—that pressure needed to condense a gas at the critical temperature. [D02.04] D7347

**critical temperature**, *n*—highest temperature at which a gaseous fluid can be converted to a liquid by means of compression. [D02.04] D7347

**criticality number**, *C*, *n*—product of the severity (*S*) and occurrence (*O*) numbers for a given failure mode's causes and effects. [D02.96] D7874

**crosshead**, *n*—an overhead component, located between the rocker arm and each intake-valve and exhaust-valve pair, that transfers rocker arm travel to the opening and closing of each valve pair.

DISCUSSION—Each cylinder has two crossheads, one for each pair of intake valves and exhaust valves. [D02.B0] D7484

**crude oil**, *n*—a naturally occurring hydrocarbon mixture, generally in a liquid state, which may also include compounds of sulfur, nitrogen, oxygen, metals, and other elements. (Synonym—*crude petroleum*, *crude*.) [D02.14] D7996

**crystallite**, *n*—in manufactured carbon and graphite product technology, a region of regular crystalline structure having parallel basal planes. [D02.F0] D8075