

# A

**absolute viscosity-** The ratio of shear stress to shear rate. It is a fluid's internal resistance to flow. The common unit of absolute viscosity is the poise (see viscosity). Absolute viscosity divided by the fluid's density equals kinematic viscosity

**acid-** A member of an important and fundamental category of chemical substances characterized by having an available reactive hydrogen and requiring an alkali to neutralize them. Acid solutions usually have a sour, biting, and tart taste, like vinegar.

**additive-** A chemical added in small quantities to a petroleum product to impart or improve certain properties.

**alkali-** In chemistry, any substance having basic properties. The term is applied to hydroxides of ammonium, lithium, potassium, and sodium. They are soluble in water; have the power to neutralize acids and form salts. They turn red litmus blue. In a more general sense, the term is also applied to the hydroxides of the earth metals-barium, calcium, strontium, magnesium, beryllium, and radium.

**anhydrous-** Free of water, especially of crystallization.

**aniline point-** The minimum temperature for complete miscibility of equal volumes of aniline and the sample under test ASTM Method D-611. A product of high aniline point will be low in aromatics and naphthenes and, therefore, high in paraffin's.

**antifoam agent-** An additive used to control foam.

**antioxidant-** A chemical added to lubricating oils to resist oxidation.

**antiwear agent-** an additive that minimizes wear caused by metal to metal contact during conditions of mild boundary lubrication( e.g. stops and starts, oscillation motion). The additive reacts chemically with, and forms a film on metal surfaces under normal operating conditions.

**API-** American Petroleum Institute

**API Gravity-** An arbitrary scale expressing the gravity or density of liquid petroleum products. The measuring scale is calibrated in terms of degrees API. It may be calculated in terms of the following formula:

$$\text{Deg API} = \frac{141.5}{\text{Sp. Gravity } 60^{\circ}\text{F}/60^{\circ}\text{F}} - 131.5$$

**API Engine Service Categories-** gasoline and diesel engine oil quality levels established jointly by API, SAE, and ASTM, and sometimes called SAE or API/SAE categories; formerly called API Engine Service Classifications

**Aromatic-** Derived from, or characterized by, there presence of the benzene ring.

**ash content-** non combustible residue of a lubrication oil or fuel, determined in accordance with ASTM D-582 and D-874 (sulfated ash)

**ASLE (American Society of Lubrication Engineers)**- organization intended to advance the knowledge and application of lubrication and related science.

**asphalt**- Black to dark-brown solid or semisolid cementitious/adhesive material that liquefies when heated; predominate constituents are bituminous components. These occur in the solid or semisolid form in nature or by extraction in the petroleum refining process.

**ASTM**- American Society for Testing Materials. Organization devoted to establishing material standardization of specifications and methods of testing.

## B

**barrel**- A unit of liquid measure comprised of 42 U.S. Gallons. Used as a common petroleum unit measure for bulk quantities of crude oil, gasoline/diesel fuel, and other refined stocks.

**base number**- An indication of the alkalinity of an oil in accordance with one of several ASTM Methods- ASTM D 664 - method used to determine acid number; base number portion now commonly performed under ASTM Test Method D 4739 - base number determination by potentiometric titration. ASTM D 974 and D 2896 are also alternative methods for determining base numbers. ASTM D 2896 and D 4739 are generally the selected methods. D 2896 generally results in slightly higher base number value than D 4739.

**base oils**- The base stocks (refined petroleum fraction) used as the chemical inert ingredient in the manufacture of automotive and industrial lubricants.

**base stock**- A primary refined petroleum fraction, usually a lube oil, into which additives and other oils are blended to produce finished products.

**BIA**- Boating Industry Association. Now organized as NMMA, National Marine Manufacturers Association.

**bentonite**- The mineral montmorillonite, a magnesium-aluminum silicate; a component in drilling mud and in greases.

**benzene insoluble**- ASTM Method D 893 - that portion of the normal pentane insoluble in used lubricating oils which is not soluble in benzene, and which may include the insoluble contaminants from external sources or matter produced by oxidation and thermal decomposition of the oil, the oil additives, or the fuel.

**bright stock**- High viscosity oils, with clarity and dewaxed/deasphalted from residual refined stocks, used as a base oil or blending component with lower viscosity oils.

**British Thermal Unit (BTU)**- The quantity of heat required to raise, by 1°F, the temperature of one (1) pound of water at its maximum density 39.2°F .

**Brookfield Viscosity**- The apparent viscosity of an oil, typically, as determined under test method ASTM D 2983. Common metric unit of absolute viscosity is the 'poise'.

**BS&W**- The material which collects in the bottom of storage tanks, usually composed of oil, water, and foreign matter. Referred to as bottoms or "bottom settling and water".

**bulk modulus**- Measure of a fluid's resistance to compressibility. The factor is expressed as the reciprocal of compressibility.

**butane**- Flammable, gaseous hydrocarbons C<sub>4</sub>H<sub>10</sub>, of the paraffin series: n-butane or isobutane.

## C

**CAFE**- Corporate Average Fuel Economy. Automobile manufacturer's federal government mandated specified average sales-fleet mileage per calculated gallon of reference fuel.

**calorie**- Thermal unit of energy. The amount of heat required to raise the temperature of one (1) gram of water 1° Celsius, at or near the temperature of maximum density - approximately 4°C .

**carbon**- A non metallic element - Number 6 in the periodic table. Diamonds and graphite are the two pure forms of carbon. Carbon is a constituent of all organic compounds.

**carbon residue**- Percent of coked material remaining after a sample of lubricating oil has been exposed to high temperatures under ASTM Method D 189 (Conradson) or D 524 (Ramsbottom). Results of these tests are reported as a percentage of the weight of the original sample.

**°C Celsius [also "centigrade"]**- Temperature scale calibrated to reference points at 0° = freezing temperature of water; 100° = boiling temperature of water at a pressure of one atmosphere.

**CCMC**- Comite des Constructeurs d'Automobile du Marche Commun. (European Common Market Automobile Manufacturers Association).

**CEC**- Coordinating European Council.

**centipoise (cP)**- 1/100 of a poise; the unit of absolute viscosity most commonly used in lubricant shear measurements.

**centistoke (cSt)**- The international unit of kinematic viscosity. 
$$\text{cSt} = \frac{\text{cP}}{\text{Density, g/cm}^3}$$

**cetane number (calculated)**- The cetane of distillate fuels (i.e. diesel) as estimated from the API gravity and mid- boiling point by using a formula defined in ASTM Method D 975. This estimate is used if a standard test engine is not available, or if the sample is too small for an engine test.

**cetane number (test method)**- The percentage by volume of normal cetane, in a blend with heptamethylnonane (HMN), which matches the ignition quality of the fuel when compared by the procedure specified in ASTM Method D 613. It is a measure of the ignition quality of a diesel fuel. ASTM Cetane No. = (% n-cetane) + (0.15)(%HMN) .

**channeling**- The phenomenon observed among gear lubricants and greases when they thicken, due to cold weather or other causes, to such an extent that a groove-like formation is originated in the path of the part without full surface lubricant contact.

**channel point-** A measure of the lowest temperature at which a gear lubricant may be used safely.

**Cleveland Open Cup (COC)-** ASTM Test Method D 92 for determining the flash point and fire point of all petroleum products except fuel oil and products with flash points below 70°C (175°F). The test is an indication of the volatility and flammability of the fluid being tested.

**cloud point-** Temperature at which a characteristic “cloud or haze” of paraffin wax or other solid substances appears at the bottom of a sample of lubricating oil in a test jar, when cooled under conditions prescribed by test method ASTM D 2500. Separation from the solution, imparting a cloudy appearance to the oil is generally noted.

**CMA-** Chemical Manufacturers Association.

**Cold Cranking Simulator (CCS)-** A high shear viscometric device used to measure viscosity of engine crankcase

oils at low temperature. Current procedure is described in ASTM Method D 5293.

**color-** A non-quality visual identification characteristic of petroleum products. ASTM Method D 1500 incorporates empirical color comparisons by numerical value.

**compatibility-** The capability of petroleum products to form a stable homogeneous mixture that neither separates nor is altered by chemical interaction.

**compounds-** 1. Chemically, any substance formed by a combination of two or more elements. 2. In petroleum processing, compound or compounding traditionally was associated with fatty oils and similar materials foreign to petroleum but added to lubricants to impart special properties to them. Current terminology suggests an identification with general finished lubricants manufacture.

**compounded oil-** special blend of petroleum oil with small amounts of fatty or synthetic fatty oils

**copper strip corrosion-** The gradual surface deterioration of copper as the result of oxidation or other chemical

action. The action is caused by acids or other corrosive agents. ASTM Method D-130

**corrosion-** Gradual deterioration of metallic surfaces as the result of oxidation or other chemical action caused by acids or other corrosive agents.

**corrosion inhibitor-** An additive for protecting lubricated metal surfaces against chemical attack by water or other contaminants.

**cutting fluid-** A fluid, usually of petroleum origin, for cooling and lubricating the cutting tool and the work piece in machining and grinding.

## D

**degree Engler**- A viscometric measure. Viscometer devised by Engler to measure the ratio of the time of flow of 200 ml of a liquid tested through a calibrated system to the time required for the flow of the same volume of water = numerical representation, degrees Engler.

**demulsibility**- Ability of an oil to separate from water, as determined by test method ASTM D 1401 or D 2711.

**density**- The mass of a unit of volume of a substance.

$$\text{Density} = \frac{\text{Unit Weight}}{\text{Unit Volume}} \quad \boxed{\text{@ defined temperature}}$$

**detergent**- An additive in crankcase oils generally combined with dispersant chemical systems. A detergent chemically neutralizes acidic contaminants in the oil before they become insoluble and precipitate out of the oil, forming dense residual matter identified as sludge.

**detergent-dispersant (DI System)**- Engine oil additive that is a combination of a detergent and a dispersant; important in preventing the formation of sludge and other engine deposits. Reference also to complete chemical systems (DI Packs) utilized in blending base oils and viscosity improves to form a finished lubricant.

**dielectric strength**- Minimum electric potential (voltage) required to produce an electric arc through an oil sample, as measured by test method ASTM D 877. It is an indication of the insulating properties of an oil to be used in transformers, circuit breakers, and other electrical devices. A low dielectric strength may indicate contamination, especially by moisture.

**diester oil**- A synthetic lubricating fluid made from esters used in the manufacture of finished lubricants.

**dispersant**- An oil additive that helps prevent sludge, varnish, and other deposits; especially in engines, by breaking up insoluble contaminant particles formed from the environmental or operating influence of the lubricated mechanical system. The particles are prevented from agglomerating and kept finely divided to remain “dispersed” or colloiddally suspended in the oil.

**distillate**- The resultant fluid produced by collecting the cooled boiled vapors produced by heating a confined mass; i.e. petroleum products from distillation with ranging boiling points.

**dropping point**- In grease terminology, the temperature at which the grease passes from a semisolid to a liquid state under specified test conditions ASTM D 556. The temperature-results are generally used to assess the grease flow stability characteristics within a mechanical system.

**dry-film lubricant**- Solid material left between two moving surfaces to prevent metal-to-metal contact to reduce friction and wear. They may be applied in the form of a paste or solid stick, or by spraying, dipping, or brushing. Graphite, molybdenum disulfide, boron nitride, and certain plastics are materials used to manufacture this type of lubricant.

**drum**- A container with a capacity of 55 U.S. gallons.

# E

**EC & EC II-** Energy Conserving and Energy Conserving II designations under American Petroleum Institute's EOLCS ILSAC criteria "GF-1, GF-2, GF-3, & currently GF-4".

**elastohydrodynamic lubrication-** Lubrication characteristic that considers the elastic properties of the bearing material and viscosity increase of the lubricant under concentrated load.

**EMA-** Engine Manufacturers Association

**emulsibility-** The ability of an oil to emulsify with water. The oil becomes suspended in the water in minute droplets generally under agitation. Inverted emulsions are characterized by the creation of water droplets in an oil mass.

**emulsion-** Intimate mixture of oil and water, generally of a milky or cloudy appearance.

**emulsifier-** A substance used to promote or aid the emulsification of two liquids and to enhance the stability of the emulsion.

**energy conservation-** The reduction in energy to accomplish work under comparative conditions.

**engine deposits-** Hard or persistent accumulations of sludge, varnish, and carbonaceous residues, due to blow-by of unburned and partially burned fuel, or the consequence of defective mechanical engine service or function.

**EOLCS-** American Petroleum Institute's automobile and truck engine oil licensing and certification program.

**EPA-** Environmental Protection Agency, a U.S. government department established in 1970 to abate and control environmental pollution through monitoring, regulation, and enforcement.

**EP ADDITIVE [EP AGENT]-** A lubricant additive that prevents sliding metal surfaces from seizing under conditions of extreme pressure (EP). At elevated local temperatures associated with metal-to-metal contact, an EP additive combines chemically with the metal to form a surface film that prevents the welding of opposing asperities, and the consequent scoring that is destructive to sliding surfaces under high loads.

# F

**°F [Fahrenheit]-** Temperature scale calibrated to reference points at 32° = freezing temperature of water; 212° = boiling temperature of water at a pressure of one atmosphere.

**FDA (Food and Drug Administration)**- Agency administered under the U.S. Department of Health and Human Services to enforce the Federal Food, Drug, and Cosmetic Act to insure that foods are safe, pure, and wholesome, and made under sanitary conditions; drugs and therapeutic devices are safe and effective for their intended uses; cosmetics are safe and prepared from appropriate ingredients; and that all of these products are honestly and informatively labeled and packaged.

**film strength**- The property of an oil under operating conditions that enables it to maintain an unbroken film on lubricated surfaces to prevent surface and bearing scuffing or scoring.

**fire point**- The minimal sample temperature of a petroleum product at which vapor is produced (in a standardized apparatus) at a sufficient rate to sustain persistent combustion for five seconds. The fire point determination is referenced under ASTM D 92 Cleveland Open Cup Test.

**flash point**- Minimum temperature of a petroleum product or other combustible fluid at which vapor is produced at a rate sufficient to yield a combustible mixture that ignites momentarily in the presence of an ignition source (small flame). Standardized test procedures are defined under ASTM methods encompassing "closed cup and open cup criteria". ASTM D-92 open cup/ASTM D-56 & D-93 closed cup.

**floc point**- Temperature at which waxy materials in a lubricating oil separate resulting in a cloudy appearance.

**fluid friction**- A liquid internal resistance occurrence due to molecules in motion; expressed as shear stress. Unlike solid friction, fluid friction varies velocity and influenced area.

**fretting**- Wear resulting from small amplitude motion between two surfaces.

**friction**- Resistance to motion of one object over another. Friction is dependent on the relative smoothness of the contacting surfaces and the dependent force with which they are pressed together.

**foaming**- Occurrence of an agglomeration of gas bubbles separated from each other by a thin liquid film that is observed as a persistent phenomenon on the surface of a liquid. In lubricants, foaming can cause sluggish hydraulic operation, air binding of oil pumps, and overflow of tanks or sumps.

**foam inhibitor**- An additive that reduces foaming by promoting the composition of small bubbles into large bubbles which burst more readily.

**Four-Ball Tester**- Either of two similar laboratory machines, the Four-Ball Wear Tester and the Four-Ball EP Tester, to evaluate a lubricant's anti-wear qualities, frictional characteristics, or load carrying capabilities. The test incorporates four 1/2 inch steel balls; three are held together in a standardized cup with lubricant while the fourth ball is rotated against them. Data is generated in form of force application and resultant ball scarring evidence.

**freezing point**- a specific temperature that can be defined in two ways, depending on the ASTM test used.

**fretting corrosion**- An environmentally caused surface scarring initiated by mechanical fretting, then chemical action or "corrosion" results from the exposure of virgin metal surface to the air.

**friction-** resistance to the motion of one surface relative to another. the amount of friction is dependent on the smoothness of the contacting surfaces, as well as the force with which they are pressed together.

**FZG test-** A German industry gear test for evaluating EP properties.

## G

**gallon-** A U.S. standard gallon is a unit of liquid volume equal to 231 cubic inches. An imperial gallon (U.K., Canada, and other countries) is defined as the volume of 10 pounds of water at 68°F; one imperial gallon equals 1.20095 U.S. gallons.

**Gasoline-** A volatile mixture of liquid hydrocarbons, containing small amounts of additives and suitable for use as a fuel in spark-ignited, internal-combustion engines.

**gram-** A metric unit of mass and weight equal to 1/1000 kilogram and equal to the mass (weight) of one (1) cubic centimeter of water at 60°F.

**gravity (Specific Gravity & API)-** In petroleum products, the mass/volume relationship expressed as:

Specific Gravity = Mass per unit volume substance @ 60°F

Mass per unit volume water @ 60°F
-----------------------------------

API Gravity =  $[141.5/\text{Specific gravity of petroleum liquid @ } 60^\circ\text{F}/60^\circ\text{F}] - [131.5]$

**grease-** A mixture of a fluid lubricant (usually petroleum oil) and a thickener (usually a soap) dispersed in the oil. Grease is a semi-solid mass used for extended lubrication requirements and where oil would not be retained.

## H

**heat content-** An expression of combustible heat energy of a unit weight of substance usually expressed in British Thermal Units (BTU)/lb.

**heat transfer oil-** A medium used for the transfer of heat, i.e. heat transfer exchangers used in industry.

**horsepower-** A unit of work over a given period of time; used to describe the power output of all internal combustion engines. One Horsepower = 550 ft-lb/sec = 0.7457 Kilowatts

**hydrocarbon-** A chemical compound containing hydrogen and carbon; also called an organic compound. The simplest hydrocarbons are gases at ordinary temperature; with increasing molecular weight, physical form can be liquid and solid. Hydrocarbon chemistry forms the principal constituents of petroleum.

**HVI**- High viscosity index; greater than 80 VI units and typically ranging above 90 .

**hydrofinishing**- A process for treating raw extracted base oil stocks with hydrogen to saturate them for improved stability.

**hydrodynamic lubrication**- An oil film that provided a pressure equal to the applied load between bearing surfaces. This pressure enables the moving parts to float on a layer of lubricant.

**hydrolytic stability**- The ability of additives and certain synthetic lubricants to resist chemical decomposition (hydrolysis) in the presence of water.

**hypoid gears (automotive)**- Characteristic gear system where the pinion axis intersects the plane of the ring gear at a point below the ring-gear axle and above the outer edge of the ring gear, or above the ring-gear axle and below the outer edge of the ring gear.

I

**ILMA**- Independent Lubricant Manufacturers Association

**ILSAC**- International Lubricants Standardization & Approval Committee. Established by major American automobile manufacturers to promote their lubricant preferences; currently a criteria in American Petroleum Institute's licensing (EOLCS) procedure, i.e. "GF" ratings.

**induction period**- A time period in an oxidation test during which oxidation proceeds at a constant and relatively low rate. Results are noted where the oxidation rate increases sharply.

**inhibitor**- A substance or additive in a petroleum product that improves performance by controlling undesirable chemical reactions.

**ink oil**- Any of the petroleum base oils used as carriers for the pigment used in the manufacture of printing inks.

**insulating oil**- An oil used in electrical equipment, i.e. circuit breakers, switches, transformers, to increase electrical resistance/insulation and/or improve cooling. In general, such oils are well-refined petroleum naphthenic distillates of low volatility, with high resistance to oxidation and sludging.

**inorganic compound**- Chemical compound that does not include hydrocarbons and their derivatives; lube additives include inorganics with elements such as zinc, calcium, sodium, magnesium, sulfur, nitrogen, boron, and others.

**insolubles**- Contaminants found in used oils due to dust, dirt, wear particles or oxidation products. Often measured as pentane or benzene insolubles to reflect insoluble character; test method ASTM D 893.

**ISO**- International Standards Organization. A worldwide organization that sets standards and classifications for lubricants.

**ISO Viscosity Grade System**- A Classification for industrial lubricants based on the mid-point of a kinematic viscosity range in centistokes at 40°C. Eighteen range grades are defined from 2 to 1500 centistokes (cSt).

# J

**JAMA-** Japanese Automobile Manufacturers Association

# K

**ketones-** Organic compounds characterized by a carbonyl group joined to two hydrocarbon radicals. Ketones have very high diluent tolerance and good viscosity reduction power.

**kinematic viscosity-** The absolute viscosity of a fluid divided by its density at the same temperature of measurement. It is the measure of a fluid's resistance to flow under gravity, as determined by test method ASTM D 445 . Metric units of kinematic viscosity are the stoke and centistoke.

$$\text{Kinematic viscosity (stokes)} = \frac{\text{viscosity (poise)}}{\text{density (gram/cm}^3\text{)}}$$

# L

**lacquer-** A deposit resulting from the oxidation and polymerization of fuels and lubricants when exposed to high temperatures. More concentrated and harder than "varnish".

**lard oil-** Animal fat oil prepared from chilled lard or from the fat of swine. Lard oils are compounded with mineral oils to yield lubricants of special wetting properties, such as cutting oils to improve the finish on the machined parts.

**lead-** Commonly used name for tetraethyl or tetramethyl lead, an additive that has been used in gasoline to improve octane ratings. Elemental lead is commonly used in sleeve bearing and bushing alloys.

**lead naphanate-** A lead soap of naphthenic acid. Lead naphthanates were previously used in mineral lubricants to give them high (EP) film strength.

**load wear index-** Measure of the relative ability of a lubricant to prevent wear under applied loads; resultant numerical value is calculated by the Four Ball EP Method from the loads applied and corrected for elastic deformation of the balls under static loading and for the size of the wear scar. Formerly called Mean Hertz Load.

**lubrication-** Control of friction and wear by the introduction of a friction-reducing film between moving surfaces in contact. The lubricant may be a fluid, plastic, or solid substance.

**LVI-** Low viscosity index, typically below 40 VI units.

# M

**melting point-** the temperature at which solid substance melts or becomes liquid. Grease melting point is determined by placing a small amount of the grease on the bulb of a thermometer and heating hot air until the grease begins to run off. also see dropping point.

**metal deactivator-** A fuel or lubricant additive which deactivates catalytic gum formation and oxidation tendencies to traces of metal and metal surfaces.

**middle distillate-** A distillate obtained between kerosene and lubricating oil fractions in the petroleum refining process; includes light fuel oil and diesel fuel.

**mineral oil-** Oils derived from a mineral source, such as petroleum, as contrasted to oil derived from plants and animals.

**miscible-** Capable of being mixed in any concentration without separation of phases.

**MSDS-** Material Safety Data Sheet

**multigrade oil-** Engine or gear oil that meets the requirements of more than one Society of Automotive Engineers viscosity grade classification, and that can be used over a wider temperature range than a single grade oil.

**MVI-** Medium viscosity index, typically ranging between 40 to 80 VI units.

## N

**naphthene (naphthenic)-** Hydrocarbon characterized by saturated carbon atoms in a ring structure, and having the general formula  $C_nH_{2n}$ ; also called cycloparaffin or cycloalkane. Naphthenic lubricating oils have low pour

points owing to the very low wax content, and good solvency properties.

**natural gas-** naturally occurring mixture of gaseous saturated hydrocarbons, consisting of 80-95% methane ( $CH_4$ ), lesser amounts of propane ethane, and butane and small quantities of non-hydrocarbon gases (e.g., nitrogen, helium).

**neutralization number-** Also referred to as base number and acid number; an indication of the acidity or alkalinity of an oil; the number is the weight in milligrams of the amount of HCL-acid (hydrochloric) or KOH-base (potassium hydroxide) required to neutralize one gram of the oil, in accordance with test method ASTM D 664 [potentiometric method] or ASTM D 974 (colorimetric method).

**neutral oil-** Light overhead cuts from vacuum distillation that are the basis of most commonly manufactured automotive/diesel engine and industrial lubricants.

**Newtonian flow (fluid)-** A liquid system where the rate of shear is proportional to the shearing force; characterized by straight SAE grade oils which do not contain a polymeric viscosity modifier. When the

rate of shear is not directly proportional to the shearing force, the “non-Newtonian lubricant fluids” are multigrade, containing viscosity modifiers.

**nitration-** The process whereby nitrogen oxides react with petroleum fluids at high temperatures with resulting increases in viscosity and deposit formation.

**NLGI-** National Lubricating Grease Institute, a trade association whose main interest is grease and grease technology.

**NLGI consistency grades-** simplified system established by the National Lubricating Grease Institute (NLGI) for rating the consistency of grease.

**NMMA-** National Marine Manufacturers Association (formerly BIA).

## O

**octane number-** A measure of a fuel’s ability to prevent detonation (knock) in a spark ignition engine. Measurement is done in a standard single-cylinder, variable-compression-ratio engine by comparison with primary reference fuels. Under mild conditions, the engine measures Research Octane Number (RON), ASTM D 2699; under severe conditions Motor Octane Number (MON), ASTM D 2700. Where the law requires posting of octane numbers on dispensing pumps, the Antiknock Index (AKI) is used. This is the arithmetic average of RON and MON,  $(R+M)/2$ . It approximates the Road Octane Number, which is a measure of how an “average” car responds to the fuel.

**OEM-** An acronym for original equipment manufacturer.

**oil-** a greasy unctuous liquid of vegetable, animal, mineral, or synthetic origin.

**oiliness-** A fluid characteristic that is responsible for the reduced degree of friction between two surfaces which cannot be attributed to the basis of viscosity alone. Also, the ability of a lubricating oil to orient itself on bearing surfaces to form new surfaces with a low coefficient of static friction.

**organic compound-** Chemical substance containing carbon and hydrogen; other elements, such as nitrogen or oxygen, may also be present.

**oxidation-** Deterioration of a substance by the action of oxygen. In petroleum products the process is accelerated by heat, light, metal catalysts and the presence of water, acids, or solid contaminants.

**oxidation inhibitor (antioxidant)-** Substance added in small quantities to a petroleum product to increase its oxidation resistance. Lengthened service and storage life are the results of treatment.

**oxidation stability-** Resistance of a petroleum product to oxidation and, therefore, a measure of its potential service or storage life. There are a number of ASTM test methods to determine the oxidation stability of a lubricant or fuel, all intended to simulate service conditions on an accelerated basis.

## P

**pale oil-** A base or process oil refined until its color, by transmitted light, is straw to pale yellow. Also, referenced to straight naphthenic mineral base stock.

**PAO-** Polyalphaolefin base oil. A generic name for synthetic hydrocarbons manufactured by the catalytic oligomerization of high (typically C10 to C14) linear alpha-olefins. Used to formulate “synthetic lubricants”.

**paraffin series-** A homologous chemical series of open-chain saturated hydrocarbons of the general formula  $C_nH_{2n+2}$  of which methane ( $CH_4$ ) is the first member; sometimes referred to as the methane or aliphatic series. Paraffinic derived oils are relatively non-reactive and have excellent oxidation stability in contrast to naphthenic oils.

**paraffin base oil-** A characterization of certain petroleum base oils prepared from paraffinic type crude (crudes containing a high percentage of paraffin series molecules).

**PCMO-** Passenger Car Motor Oil

**pentane insolubles-** The insoluble matter which can be separated from a solution of used lubricating oil in normal pentane or benzene; ASTM Method D 893.

**petrolatum-** A jelly-like product obtained from petroleum and having a microcrystalline structure. Often used in rust prevention.

**poise-** Measurement unit of a fluid's resistance to flow, i.e., viscosity, defined by the shear stress (dynes/cm<sup>2</sup>) required to move one layer of fluid along another over a total layer thickness on one centimeter at a velocity one (1) cm/sec. This viscosity is independent of fluid density, and directly related to flow resistance.

viscosity = shear stress = dynes/cm<sup>2</sup>

**pour point-** The lowest temperature at which oil will pour or flow when it is chilled without disturbance under conditions defined under ASTM Method D 97 .

**pour point depressant-** An additive used to lower the pour point or low-temperature fluidity of a petroleum product.

**power factor-** A measure of the dielectric loss, or ability to perform as an electrical insulating oil.

**ppm-** Parts per million. Measure scale expressed in terms of weight or volume.

**process oil-** A base stock that may receive additional processing to impart a very specific hydrocarbon composition, in addition to viscometrics, used as a component of another material or as a carrier of other products. Process oils are not used as lubricants; they are used as chemical components in the manufacture of rubber, plastics, and other polymeric materials.

**psi-** Unit pressure expression, pounds per square inch.

**pumpability-** The low temperature and low shear stress-shear rate viscosity characteristics of an oil, that permits satisfactory flow to and from the engine oil pump and subsequent lubrication of moving components

## Q

**quenching-** Immersion of a heated manufactured steel part, such as a gear or an axle, in a fluid to achieve rapid and uniform cooling. Petroleum oils are often used for this purpose to provide hardness superior to that of ambient temperature cooling.

**QPL-** Qualified Product List; a U.S. Military listing of those products qualified for purchase prior to bidding.

## R

**R&O-** An acronym - "rust and oxidation inhibited" - applied to highly refined or inhibited (additives) industrial lubricating oils formulated for long service in circulating systems, compressors, hydraulic systems, bearing housing, gear cases, etc. The highest quality R & O oils are turbine oils.

**refining-** Series of processes to convert petroleum crude oil and its fractions into finished products, including distillation, thermal cracking, catalytic cracking, polymerization, alkylation, reforming, hydrocracking, hydroforming, hydrogenation, hydrogen treating, hydrofining, solvent extraction, dewaxing, de-oiling, acid treating, clay filtration, and deasphalting.

**rerefining-** A process of reclaiming used lubricant oils and restoring them to a condition similar to that of virgin neutral base stocks by a combination of various refining methods.

**Redwood Viscometer-** Standard British viscometer. The number of seconds required for 50 ml of an oil to flow out of a standard Redwood viscometer at a definite temperature (IP Method 70). The measuring instrument is available in two definable sizes: Redwood No. 1 (Redwood seconds <2000) and No. 2 (Redwood seconds >2000).

**rheology-** Study of the deformation and flow of matter in response to mechanical stress and strain, temperature, and time.

**rings-** Circular metallic elements that ride in the grooves of a piston and provide compression sealing (upper ring) during combustion. Also used to spread oil (lower ring) for lubrication.

**ring sticking-** Binding of a piston ring in its groove in a piston engine or reciprocating compressor due to heavy deposits in the piston ring zone.

**roller bearing-** An antifriction bearing comprising rolling elements in the form of rollers. **rust-** see compounds and additives, corrosion inhibitors.

**rust inhibitor**- A lubricant additive for protecting ferrous (iron and steel) components from rusting caused by water contamination or other harmful materials from oil degradation.

## S

**SAE (Society of Automotive Engineers)**- Organization responsible for the establishment of many U.S. automotive and aviation standards, including the viscosity classification of engine and gear oils.

**SAE engine viscosity grades**- Engine oil classification system developed by the Society of Automotive Engineers, based on the measured viscosity/temperature data described in SAE J 300. The classification system defines the limits for a classification of engine lubricating oils in rheological terms only. Other oil characteristics are not considered or included.

**Saybolt color**- A color standard for petroleum products. The procedure for determining Saybolt color and description of the Saybolt chronometer are given in ASTM Method D 156 .

**Saybolt Furol viscosity**- The time in seconds for 60 ml of fluid to flow through a capillary tube in a Saybolt Furol viscometer at specified temperatures between 70°F and 210°F. This method is appropriate for high-viscosity oils such as transmission, gear, and heavy industrial fuel oils. ASTM Method D 88 describes the equipment and procedure.

**Saybolt Universal Viscosity (SUS)**- The time in seconds for 60 ml of fluid to flow through a capillary tube in a Saybolt Universal viscometer at a given temperature [units are Saybolt Universal Seconds (SUS)] as described in ASTM Method D 88 .

**scuffing**- Abnormal engine wear due to localized welding and fracture. Prevention can be accomplished through the formulation of lubricants incorporating antiwear, extreme-pressure, and friction modifier additives.

**sds**- Safety Data Sheets

**shear**- Deformation which occurs when parallel planes of a body are displaced relative to each other in a direction parallel to themselves.

**shear stress**- The force per unit area acting tangent to the surface of an element of a fluid or a solid resulting in a perpendicular vector deformation. It is the exceeded internal frictional force in sliding one "layer" of fluid along another; typical of any fluid flow. The shear stress of petroleum oil or other Newtonian fluid at a given temperature varies directly with shear rate (velocity). The ratio between shear stress and shear rate is constant; this ratio is termed viscosity.

**sludge**- A thick, dark residue, normally of mayonnaise consistency, that accumulates on non-moving engine interior surfaces. Its formation is associated with an insolubles overload of the lubricant caused by deterioration reactions and/or contamination of an oil.

**solvent extraction**- Refining process used to separate reactive components (unsaturated hydrocarbons) from lubricant distillates in order to improve the oil's oxidation stability, viscosity index, and additive response.

**solvent refining-** A process for extracting lubricant base stocks from stripped heavy gas oil or other heavy, stripped crude stream using selective solvents such as furfural or phenol.

**soluble cutting oil-** A mineral oil containing an emulsifier which allows it to be mixed easily with water to form a cutting or cooling fluid.

**soap-** General term denoting the salt of a fatty acid derived from animal or vegetable matter. Metallic soaps of lithium, calcium, sodium, and aluminum are the principal thickeners used in grease making.

**spalling-** Severe damage characterized by large pits, cavities and related cracks; related to overload and fatigue of a mechanical part.

**specific gravity-** For petroleum product, the ratio of the mass of a given volume of product and the mass of an equal volume of water, at the same temperature. The standard reference temperature is 15.6°C (60°F). Specific gravity is determined by test method ASTM D 1298. Water is referenced numerically at 1.000 .

**STLE-** Society of Tribologists and Lubrication Engineers

**stoke-** Kinematic measurement of a fluid's resistance to flow defined by the ratio of the fluid's dynamic viscosity to it's density.

**straight mineral oil-** petroleum oil containing no additives.

**sulfated ash-** The ash content of fresh, compounded lubricating oil, as determined by ASTM Method D 874, indicating metallic additives in the oil. It is the ash content which remains after a sample of additive formulated lubricating oil has been incinerated and the residue subsequently heated with sulfuric acid until constant weight is observed.

**surface tension-** The molecular film attraction exhibited at the free surface of liquids, measured in force per unit length.

**syncrude-** Unconventional crude (other than petroleum drilled-well originated) such as those derived by tar sands, oil shale and coal liquefaction.

**synthetic hydrocarbon-** Oil molecule prepared by by the reaction-result of paraffinic materials.

**synthetic lubricant-** Lubricating fluid produced by chemically reacting materials of a specific chemical composition, by chemical synthesis of refining processes, to form a compound with planned and predictable properties.

## T

**tacky, tackiness agent-** A descriptive term applied to lubricating oils and greases which appear particularly sticky or adhesive; tackiness characteristic is imparted by additive technology to increase the adhesive properties of a lubricant to improve retention, and prevent dripping and splattering.

**temperature scales-** Arbitrary thermometric calibrations that serve as convenient references for temperature determination. There are two thermometric scales based on the freezing and boiling point of water at a pressure of one atmosphere: The Fahrenheit (F) scale (32 degrees = freezing, 212 degrees = boiling) and the Celsius (C), or Centigrade, scale (0 degrees = freezing, 100 degrees = boiling).

**thermal conductivity-** Measure of the ability of a solid or liquid to transfer heat.

**thermal stability-** Ability to resist physical and chemical degradation at high temperature.

**Timken EP Test-** The test measures the load carrying capacities of oils and greases. In the procedure, a Timken bearing cup is rotated against a steel block; the highest load under which a lubricant prevents scoring of the steel block by the rotating cup is the reported value.

**TOST-** Turbine Oil Oxidation Stability Test; results by ASTM Method D 943. Test method is intended to determine the resistance of an oil to oxidation, indicating a measure of its potential service.

**Total Acid Number (TAN)-** The quantity of base, expressed in milligrams of potassium hydroxide (KOH), that is required to titrate all acidic constituents present in 1 gram of sample.

**Total Base Number (TBN)-** The quantity of acid, expressed in terms of the equivalent number of milligrams of potassium hydroxide, that is required to titrate the strong base constituents present in 1 gram of sample. See Base Number.

**tribolgy-** Science of the interactions between surfaces moving relative to each other. Such interactions usually involve the interplay of two primary factors: the load, or force, perpendicular to the surfaces, and the frictional force that impedes movement.

## U

**USDA-** United States Department of Agriculture

**USP (United States Pharmacopoeia)-** compendium of drugs, drug formulas, quality standards and test published by the United States Pharmacopoeial Convention, Inc., which also publishes the NF (National Formulary).

**UTTO-** Universal Tractor Transmission Oil.

## V

**varnish-** When applied to lubrication, a thin, insoluble, non-wipeable film, resulting from the oxidation and polymerization of fuels and lubricants appearing on interior engine parts; softer than lacquer.

**VGO-** Vacuum Gas Oil.

**viscosity-** That property of a fluid or semi-solid substance characterized by resistance to flow and defined as the ratio of the shear stress to the rate of shear of a fluid element.

**viscosity index (VI)**- An empirical number that indicates the effect of change of temperature on the viscosity of an oil. Tables are found in ASTM Method D 2270 . The higher the viscosity index, the smaller change in viscosity with temperature.

**viscosity index improver (viscosity modifier)**- Lubricant additive, usually a high molecular weight polymer, that reduces the tendency of an oil's viscosity to change with temperature.

**volatility**- An expression of evaporation tendency. The more volatile a petroleum liquid, the lower its boiling point and flash point, and greater its flammability.

## W

**wear**- The attrition or rubbing away of the surface of a material as a result of mechanical action.

**white oil**- Highly refined mineral oil, essentially colorless, odorless, and tasteless. White oils have a high degree of chemical stability and are employed in medicinal and pharmaceutical preparations; and as a base for creams, salves, and ointments. They are also used as lubricants.

## Z

**ZDP** (zinc dithiophosphate, zinc diaryl dithiophosphate)- Widely used in motor oils and industrial lubricants to impart antiwear and oxidation inhibition to formulated oils.