

A

**Abrasion**

General wearing of a surface by constant scratching, due to the presence of foreign matter such as metallic particles grit, or dirt in the lubricant. It may also cause a break down of material (such as gears tooth's surfaces). Lack of lubrication may result in abrasion.

**Abrasive wear**

Also known as "Cutting wear". Comes when hard surface asperities or hard particles that have embedded themselves into a soft surface and plough grooves into the opposing harder surface, e.g., journal.

**Absolute filtration rating**

Largest diameter of hard spherical particles that will pass through a filter under specified test conditions. Indicator of largest opening in the filter elements.

**Absolute Viscosity**

Term used interchangeably with viscosity to distinguish it from either commercial or kinematics viscosity. Is the ratio of shear stress to shear rate. It is property of fluid, a fluid's internal resistance to flow. Its common unit is the poise. Absolute viscosity divided by the fluid density equals kinematics viscosity. Occasionally referred to as dynamic viscosity. Absolute viscosity and kinematics viscosity are expressed in fundamental units. Commercial viscosity such as Saybolt viscosity is expressed in arbitrary units of time, usually seconds.

**Absorber Filter**

A filter medium that holds contaminant by mechanical means.

**Absorption**

The assimilation of one material into another; in petroleum refining, the use of an absorptive liquid to selectively remove components from a process stream.

**Accumulator**

A container in which fluid is stored under pressure as a source of fluid power.

**Acid**

In a restricted sense, any substance containing hydrogen in combination with a nonmetal or nonmetallic radical and capable of producing hydrogen ions in solution.

**Acid Sludge**

The residue left after treating petroleum oil with sulfuric acid for the removal of impurities. It is a black, viscous substance containing the spent acid and impurities.

**Acid Treating**

A refining process in which unfinished petroleum products, such as gasoline, kerosene and lubricating oil stocks, are contacted with sulfuric acid to improve their color, odor, and other properties.

**Acidity**

In lubricants, acidity denotes the presence of acid-type constituents whose concentration is usually defined in terms of total acid number. The constituents vary in nature and may or may not markedly influence the behavior of the lubricant.

**Additive**

A compound that enhances some property of, or imparts some new property to, the base fluid. In some hydraulic fluid formulations, the additive volume may constitute as much as 20 percent of the final composition. The more important types of additives include anti-oxidants, anti-wear additives, corrosion inhibitors, viscosity index improvers, and foam suppressants.

**Additive Level**

The total percentage of all additives in an oil.

**Additive stability**

The ability of additives in the fluid to resist changes in their performance during storage or use.

**Adhesion**

The property of a lubricant that causes it to cling or adhere to a solid surface.

**Adhesive wear**

Is often referred to as galling, scuffing, scoring, or seizing. It happens when sliding surfaces contact one another, causing fragments to be pulled from one surface and to adhere to the other.

**Adiabatic compression**

Compression of a gas without extraction of heat, resulting in increased temperature. The temperature developed in compression of a gas is an important factor in lubrication, since oil deteriorates more rapidly at elevated temperatures. Oxidation inhibitors help prevent rapid lubricant breakdown under these conditions.

**Adsorbent filter**

A filter medium primarily intended to hold soluble and insoluble contaminants on its surface by molecular adhesion.

**Adsorption**

Adhesion of the molecules of gases, liquids, or dissolved substances to a solid surface, resulting in relatively high concentration of the molecules at the place of contact; e.g. the plating out of an anti-wear additive on metal surfaces.

**Adsorptive filtration**

The attraction to, and retention of particles in, a filter medium by electrostatic forces, or by molecular attraction between the particles and the medium.

**Aeration**

The state of air being suspended in a liquid such as a lubricant or hydraulic fluid.

**Aftercooling**

The process of cooling compressed gases under constant pressure after the final stage of compression.

**Afterrunning**

Also known as dieseling. When a spark-ignited engine continues to run after the ignition has been turned off. There are two basic causes of afterrunning: surface and compression ignition. In surface ignition, the surfaces of the combustion chamber remain hot enough to provide a source of ignition after the spark ignition is terminated. In compression ignition, the conditions of temperature, pressure, fuel composition, and engine idle speed allow ignition to continue.

**Agglomeration**

The potential of the system for particle attraction and adhesion.

**Air Breather**

A device permitting air movement between the atmosphere and the component in/on which it is installed.

**Air, Compressed**

Air at any pressure greater than atmospheric pressure.

**Air Entrainment**

The incorporation of air in the form of bubbles as a dispersed phase in the bulk liquid. Air may be entrained in a liquid through mechanical means and/or by release of dissolved air due to a sudden change in environment. The presence of entrained air is usually readily apparent from the appearance of the liquid (i.e., bubbly, opaque, etc.) while dissolved air can only be determined by analysts.

**Alkali**

Any substance having basic (as opposed to acidic) properties. In a restricted sense it is applied to the hydroxides of ammonium, lithium, potassium and sodium. Alkaline materials in lubricating oils neutralize acids to prevent acidic and corrosive wear in internal combustion engines.

**Almen EP Lubricant Tester**

A journal bearing machine used for determining the load-carrying capacity or extreme pressure properties of gear lubricants.

**Ambient Temperature**

Temperature of the area or atmosphere around a process (not the operating temperature of the process itself).

**Analytical ferrography**

The magnetic precipitation and subsequent analysis of wear debris from a fluid sample. This approach involves passing a volume of fluid over a chemically treated microscope slide which is supported over a magnetic field. Permanent magnets are arranged in such a way as to create a varying field strength over the length of the substrate. This varying strength causes wear debris to precipitate in a distribution with respect to size and mass over the Ferrogram. Once rinsed and fixed to the substrate, this debris deposit serves as an excellent media for optical analysis of the composite wear particulates.

**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 paraffins. Aniline point is often specified for spray oils, cleaning solvents, and thinners, where effectiveness depends upon aromatic content. In conjunction with API gravity, the aniline point may be used calculate the net heat of combustion for aviation fuels.

**Anti-foam agent**

One of two types of additives used to reduce foaming in petroleum products: silicone oil to break up large surface bubbles, and various kinds of polymers that decrease the amount of small bubbles entrained in the oils.

**Anti-freeze Solution**

A fluid, such as ethylene or propylene glycol, which is added to or used to replace the water in the cooling system of engines in order to prevent freezing.

**Anti-friction bearing**

A rolling contact type bearing in which the rotating or moving member is supported or guided by means of ball or roller elements. Does not mean without friction.

**Antiknock**

Resistance to detonation or pinging in spark-ignition engines.

**Anti-oxidants**

Prolong the induction period of a base oil in the presence of oxidizing conditions and catalyst metals at elevated temperatures. The additive is consumed and degradation products increase not only with increasing and sustained temperature, but also with increases in mechanical agitation or turbulence and contamination - air, water, metallic particles, and dust. Also known as an oxidation inhibitor.

Antistatic (additive)

An additive that increases the conductivity of a hydrocarbon fuel to hasten the dissipation of electrostatic charges during high-speed dispensing, thereby reducing the fire/explosion hazard.

**Antiwear (additives)**

Improve the service life of tribological elements operating in the boundary lubrication regime. Antiwear compounds (for example, ZDDP and TCP) start decomposing at 90°C to 100°C and even at a lower temperature if water (25 to 50 ppm) is present.

#### **API Gravity**

A gravity scale established by the American Petroleum Institute and in general use in the petroleum industry, the unit being called "the A.P.I. degree." This unit is defined in terms of specific gravity as follows:

#### **Apparent Viscosity**

The ratio of shear stress to rate of shear of a non-Newtonian fluid such as lubricating grease, calculated from Poiseuille's equation and measured in poises. The apparent viscosity changes with changing rates of shear and temperature and must therefore, be reported as the value at a given shear rate and temperature (ASTM Method D 1092).

#### **Aromatic**

Derived from or characterized by, the presence of the benzene ring.

#### **Ash**

Inorganic residue of combustion left in oil.

#### **Ash Content**

The percent by weight of residue left after combustion of an oil sample (ASTM Method D 482). Determined by burning the oil and weighing the residue.

#### **Asperities**

Microscopic projections on metal surfaces resulting from normal surface-finishing processes. Interference between opposing asperities in sliding or rolling applications is a source of friction, and can lead to metal welding and scoring. Ideally, the lubricating film between two moving surfaces should be thicker than the combined height of the opposing asperities.

#### **Asphalt**

Black to dark-brown solid or semisolid cementitious material which gradually liquifies when heated and in which the predominating constituents are bitumen's. These occur in the solid or semisolid form in nature; are obtained by refining petroleum; or are combinations with one another or with petroleum or derivatives thereof.

#### **Asphaltic**

Essentially composed of, or similar to, asphalt; frequently used to describe lubricating oils derived from crude oils which contain asphalt.

#### **ASTM Colorimeter**

Apparatus widely used for determining the color of lubricating oils/(ASTM Method D 1500). The color so determined is known as ASTM color.

#### **ASTM Distillation**

A distillation test made on such products as gasoline and kerosene to determine the initial and final boiling points (ASTM Method D 86).

#### **ASTM Gum Test**

An analytical method for determining the amount of existing gum in a gasoline; by evaporating a sample from a glass dish on an elevated-temperature bath (ASTM Method D 381 and ASTM Method D 525).

#### **ASTM Melting Point**

The temperature at which wax first shows a minimum rate of temperature change; also known as the English melting point.

#### **ASTM Viscosity Classification**

A method of specifying viscosity levels for industrial lubricants; does not denote quality.

**Auto Ignition**

The spontaneous ignition, and the resulting very rapid reaction, of a portion or all of the fuel-air mixture in an engine. The flame speed is many times greater than that which follows normal spark ignition. The noise associated with it is called knock.

**Aviation Method**

A method for determining the knock-limited power, under lean-mixture condition, of fuels for use in spark-ignition aircraft engines (ASTM Method D 614).

**Atomic absorption spectroscopy**

Measures the radiation absorbed by chemically unbound atoms by analyzing the transmitted energy relative to the incident energy at each frequency. The procedure consists of diluting the fluid sample with methyl isobutyl ketone (MIBK) and directly aspirating the solution. The actual process of atomization involves reducing the solution to a fine spray, dissolving it, and finally vaporizing it with a flame. The vaporization of the metal particles depends upon their time in the flame, the flame temperature, and the composition of the flame gas. The spectrum occurs because atoms in the vapor state can absorb radiation at certain well-defined characteristic wave lengths. The wave length bands absorbed are very narrow and differ for each element. In addition, the absorption of radiant energy by electronic transitions from ground to excited state is essentially and absolute measure of the number of atoms in the flame and is, therefore, the concentration of the element in a sample.

**Axial-load bearing**

A bearing in which the load acts in the direction of the axis of rotation. Also known as a thrust bearing.

## **B**

### **Babbitt Metal**

A soft, white, non-ferrous alloy bearing material composed principally of copper, antimony, tin and lead.

### **Bactericide**

Additive included in the formulations of water-mixed cutting fluids to inhibit the growth of bacteria promoted by the presence of water, thus preventing odors that can result from bacterial action.

### **Ball bearing**

An antifriction rolling type bearing containing rolling elements in the form of balls or spheres.

### **Barrel**

A unit of liquid volume of petroleum oils equal to 42 U.S. gallons or approximately 35 Imperial gallons.

### **Base**

A material which neutralizes acids. An oil additive containing colloidally dispersed metal carbonate, used to reduce corrosive wear.

### **Base oil credit**

The amount of the base fluid displaced by the additive dosage.

A material which neutralizes acids. An oil additive containing colloidally dispersed metal carbonate, used to reduce corrosive wear.

### **Base stock**

The base fluid, usually a refined petroleum fraction or a selected synthetic material, into which additives are blended to produce finished lubricants.

### **Batch**

Any quantity of material handled or considered as a unit in processing.

### **Bearing**

A support or guide by means of which a moving part such as a shaft or axle is positioned with respect to the other parts of a mechanism.

### **Bentonite**

The mineral montmorillonite, a magnesium-aluminum silicate. Used as a treating agent, also, as a component of drilling mud, and in greases.

### **Benzene**

Colorless liquid hydrocarbon C<sub>6</sub>H<sub>6</sub>, with one ring of carbon atoms. Made from coal tar and by catalytic reforming of naphthyenes, it is used in the manufacture of phenol, styrene, nylon, detergents, aniline, phthalic anhydride, biphenyl, nitrobenzene, chlorbenzene; as a solvent; and as a component of high-octane gasoline.

### **Benzene Insoluble**

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, some matter produced by oxidation and thermal decomposition of the oil, the oil additives, or the fuel. (ASTM Method D 893).

### **Beta Rating**

The method of comparing filter performance based on efficiency. This is done using the Multi-Pass Test which counts the number of particles of a given size before and after fluid passes through a filter.

**Beta-Ratio (fl-Ratio)**

The ratio of the number of particles greater than a given size in the influent fluid to the number of particles greater than the same size in the effluent fluid, under specified test conditions (see "Multi-Pass Test").

**Bitumen**

Also called asphalt or tar, bitumen is the brown or black viscous residue from the vacuum distillation of crude petroleum. It also occurs in nature as asphalt "lakes" and "tar sands." It consists of high molecular weight hydrocarbons and minor amounts of sulfur and nitrogen compounds.

**Black oils**

Lubricants containing asphaltic materials, which impart extra adhesiveness, that are used for open gears and steel cables.

**Blending**

The process of mixing lubricants or components for the purpose of obtaining the desired physical and/or chemical properties (see compounding).

**Bloom**

Fluorescence; the color of an oil by reflected light which could differ from its color by transmitted light.

**Blow-by**

Passage of unburned fuel and combustion gases past the piston rings of internal combustion engines, resulting in fuel dilution and contamination of the crankcase oil.

**Boiling Point**

The temperature at which a substance boils, or is converted into vapor by bubbles forming within the liquid; it varies pressure.

**Bottoms**

The liquid which collects in the bottom of a vessel (tower bottoms, tank bottoms), either during a fractionating process or while in storage.

**Boundary lubrication**

Form of lubrication between two rubbing surfaces without development of a full-fluid lubricating film. Boundary lubrication can be made more effective by including additives in the lubricating oil that provide a stronger oil film, thus preventing excessive friction and possible scoring. There are varying degrees of boundary lubrication, depending on the severity of service. For mild conditions, oiliness agents may be used; by plating out on metal surfaces in a thin but durable film, oiliness agents prevent scoring under some conditions that are too severe for a straight mineral oil. Compounded oils, which are formulated with polar fatty oils, are sometimes used for this purpose. Anti-wear additives are commonly used in more severe boundary lubrication applications. The more severe cases of boundary lubrication are defined as extreme pressure conditions; they are met with lubricants containing EP additives that prevent sliding surfaces from fusing together at high local temperatures and pressures.

**Breakdown maintenance**

Maintenance performed after a machine has failed to return it to an operating state.

**Bridging**

A condition of filter element loading in which contaminant spans the space between adjacent sections of a filter element, thus blocking a portion of the useful filtration.

**Bright stock**

A heavy residual lubricant stock with low pour point, used in finished blends to provide good bearing film strength, prevent scuffing, and reduce oil consumption. Usually identified by its viscosity, SUS at 210°F or cSt at 100°C.

**Brinelling**

Permanent deformation of the bearing surfaces where the rollers (or balls) contact the races. Brinelling results from excessive load or impact on stationary bearings. It is a form of mechanical damage in which metal is displaced or upset without attrition.

**Brookfield viscosity**

Apparent viscosity in cP determined by Brookfield viscometer, which measures the torque required to rotate a spindle at constant speed in oil of a given temperature. Basis for ASTM Method D 2983; used for measuring low temperature viscosity of lubricants.

**Bubble point**

The differential gas pressure at which the first steady stream of gas bubbles is emitted from a wetted filter element under specified test conditions.

**Built-in-dirt**

Material passed into the effluent stream composed of foreign materials incorporated into the filter medium.

**Bulk modulus (of elasticity)**

A ratio of normal stress to a change in volume. A term used in determining the compressibility of a fluid. Data for petroleum products can be found in the International Critical Tables.

**Bunker "C" fuel Oil**

Burst pressure rating the maximum specified inside-out differential pressure that can be applied to a filter element without outward structural or filter-medium failure.

**Bushing**

A short, externally threaded connector with a smaller size internal thread.

**Butane**

Either of two isomeric, flammable, gaseous hydrocarbons, C<sub>4</sub>H<sub>10</sub>, of the paraffin series n-butane or isobutane.

**Bypass Filtration**

A system of filtration in which only a portion of the total flow of a circulating fluid system passes through a filter at any instant or in which a filter having its own circulating pump operates in parallel to the main flow.

**Bypass valve (Relief valve)**

A valve mechanism that assures system fluid flow when a preselected differential pressure across the filter element is exceeded; the valve allows all or part of the flow to bypass the filter element.

## C

### **Calorie**

**1.** The amount of heat required to raise the temperature of 1 gram of water 1°C, at or near the temperature of maximum density. This unit is called a "small calorie", or "gram calorie." **2.** The amount of heat required to raise the temperature of 1 kilogram of water 1°C. This unit is called a "large calorie" or "kilogram-calorie."

### **Cams**

Eccentric shafts used in most internal combustion engines to open and close valves.

### **Capacity**

The amount of contaminants a filter will hold before an excessive pressure drop is caused. Most filters have bypass valves which open when a filter reaches its rated capacity.

### **Capillary Viscometer**

A viscometer in which the oil flows through a capillary tube.

### **Capillarity**

A property of a solid-liquid system manifested by the tendency of the liquid in contact with the solid to rise above or fall below the level of the surrounding liquid; this phenomenon is seen in a smallbore (capillary) tube.

### **Carbon**

A non-metallic element - No. 6 in the periodic table. Diamonds and graphite are pure forms of carbon. Carbon is a constituent of all organic compounds. It also occurs in combined form in many inorganic substances; i.e., carbon dioxide, limestone, etc.

### **Carbonization**

Process where hydrocarbons are reduced, resulting in the formation of carbon residue.

### **Carbon residue**

Coked material remaining after an oil has been exposed to high temperatures under controlled conditions.

### **Carbonyl iron powder**

A contaminant which consists of up to 99.5% pure iron spheres.

### **Case drain filter**

A filter located in a line conducting fluid from a pump or motor housing to reservoir.

### **Carburetor**

An apparatus for supplying an internal combustion engine with an explosive mixture of vaporized fuel and air.

### **Catalyst**

A substance which speeds a chemical action without undergoing a chemical change itself during the process. Now used in catalytic converters to control amount of unburned hydrocarbons and CO in automobile exhaust.

### **Catalytic converter**

An integral part of vehicle emission control systems since 1975. Oxidizing converters remove hydrocarbons and carbon monoxide (CO) from exhaust gases, while reducing converters control nitrogen oxide (NOx) emissions. Both use noble metal (platinum, palladium or rhodium) catalysts that can be "poisoned" by lead compounds in the fuel or lubricant.

### **Catastrophic failure**

Sudden, unexpected failure of a machine resulting in considerable cost and downtime.

### **Cavitation**

Formation of an air or vapor bubble due to lowering of pressure in a liquid, often as a result of a solid body, such as a propeller or piston, moving through the liquid; also, the pitting or wearing away of a solid surface as a result of the collapse of a vapor bubble. Cavitation can occur in a hydraulic system as a result of low fluid levels that draw air into the system, producing tiny bubbles that expand explosively at the pump outlet, causing metal erosion and eventual pump destruction.

**Cavitation erosion**

A material-damaging process which occurs as a result of vaporous cavitation. "Cavitation" refers to the occurrence or formation of gas - or vapor - filled pockets in flowing liquids due to the hydrodynamic generation of low pressure (below atmospheric pressure). This damage results from the hammering action when cavitation bubbles implode in the flow stream. Ultra-high pressures caused by the collapse of the vapor bubbles produce deformation, material failure and, finally, erosion of the surfaces.

**Cellulose Media**

A filter material made from plant fibers. Because cellulose is a natural material, its fibers are rough in texture and vary in size and shape. Compared to synthetic media, these characteristics create a higher restriction to the flow of fluids.

**Centi**

Hundredth

**Centipoise (cp)**

A unit of absolute viscosity. 1 centipoise = 0.01 poise.

**Centistoke (cst)**

A unit of kinematic viscosity. 1 centistoke = 0.01 stoke.

**Centralized lubrication**

A system of lubrication in which a metered amount of lubricant or lubricants for the bearing surfaces of a machine or group of machines are supplied from a central location.

**Centrifugal separator**

A separator that removes immiscible fluid and solid contaminants that have a different specific gravity than the fluid being purified by accelerating the fluid mechanically in a circular path and using the radial acceleration component to isolate these contaminants.

**Cetane Number**

**Calculated:** The cetane number of distillate fuels as estimated from the API gravity and mid-boiling point by using a formula given in Appendix II of 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.

**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.

**Cetane Number Improver**

A substance which, when added to a diesel fuel, has the effect of increasing its cetane number. In this class are nitro alkanes, nitrates, nitro carbonates, and peroxides.

**Cetane Index**

An approximation of cetane number based on API gravity and mid-boiling point of a fuel.

**Channeling**

**1.** 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 is formed through which the part to be lubricated moves without actually coming in full contact with the

lubricant. **2.** A term used in percolation filtration; may be defined as a preponderance of flow through certain portions of the clay bed.

**Chemical stability**

The tendency of a substance or mixture to resist chemical change.

**Chip control (grit control, last-chance) filter**

A filter intended to prevent only large particles from entering a component immediately downstream.

**Chromatography**

A method of separation based on selective adsorption. A solution of the substance is allowed to flow slowly through a column of adsorbent. Different substances will pass with different speeds down the column and will eventually be separated into zones. The column core can then be pushed out and the zones of material cut apart, or the zones can be eluted by passing more solvent down the column and collecting it in small fractions.

☐ Partition chromatography involves the selective solution of the desired material between two solvents. The final solvent, usually water, is used to wet the solid material packed in the column, and the first solvent containing the desired material is poured into the column as described.

☐ Paper chromatography is a micromethod. A drop of the liquid to be investigated is placed near one end of a strip of paper. This end is immersed in solvent which travels down the paper and distributes the materials present in the original drop selectively. Comparison with known substances makes identification possible.

☐ Gas chromatography is an analytical technique for separating mixtures of volatile substances. The procedure consists of introducing the mixture to be examined into the chromatographic column and washing it down (eluting it) with an inert gas. The column is packed with adsorbent material which selectively retard the components of the sample.

**Circulating lubrication**

A system of lubrication in which the lubricant, after having passed through a bearing or group of bearings, is recirculated by means of a pump.

**Clay filtration**

Refining process using fuller's earth (activated clay) or bauxite to absorb minute solids from lubricating oil, as well as remove traces of water, acids, and polar compounds.

**Clean**

100 particles >10 micron per milliliter.

**Cleanable**

A filter element which, when loaded, can be restored by a suitable process, to an acceptable percentage of its original dirt capacity.

**Clean room**

A facility or enclosure in which air content and other conditions (such as temperature, humidity, and pressure) are controlled and maintained at a specific level by special facilities and operating processes and by trained personnel.

**Clearance bearing**

A journal bearing in which the radius of the bearing surface is greater than the radius of the journal surface.

**Cleveland open-cup COC Tester**

Apparatus used for the determination of flash and fire points of petroleum products flashing above 175°F, with the exception of fuel oils (ASTM Method D 92)

**Clogging**

Obstruction of a flow path by means of the build up of debris along the flow path boundaries.

**Cloud point**

The temperature at which waxy crystals in an oil or fuel form a cloudy appearance.

**Coalescor**

A separator that divides a mixture or emulsion of two immiscible liquids using the interfacial tension between the two liquids and the difference in wetting of the two liquids on a particular porous medium.

**Coastal Oil**

Common term for any predominately naphthenic crude derived from the fields in the Texas Gulf Coast area.

**Coefficient of friction**

The number obtained by dividing the friction force resisting motion between two bodies by the normal force pressing the bodies together.

**Cohesion**

That property of a substance that causes it to resist being pulled apart by mechanical means.

**Cold Cranking Simulator**

An intermediate shear rate viscometer that predicts the ability of an oil to produce satisfactory cranking speed in a cold engine.

**Cold-flow improver**

Additive to improve flow of diesel fuel in cold weather. In some instances, a cold-flow improver may improve operability by modifying the size and structure of the wax crystals that precipitate out of the fuels at low temperatures, permitting their passage through the fuel filter. In most cases, the additive depresses the pour point, which delays agglomeration of the wax crystals, but usually has no significant effect on diesel engine performance. Another means of improving cold flow is to blend kerosene with diesel fuel, which lowers the wax appearance point by about 1°C (2°F) for each 10% increment of kerosene added.

**Collapse**

An inward structural failure of a filter element which can occur due to abnormally high pressure drop (differential pressure) or resistance to flow.

**Collapse pressure**

The minimum differential pressure that an element is designed to withstand without permanent deformation.

**Color**

A factor in the identification, rather than in the quality rating of a petroleum product - except where staining or appearance are considerations. See specific types of color under alphabetic listing.

**Complex Grease**

A lubricating grease thickened by a complex soap and a complexing agent.

**Combustion**

Rapid oxidation or burning of a fuel.

**Compound**

**1.** chemically speaking, a distinct substance formed by the combination of two or more elements in definite proportions by weight and possessing physical and chemical properties different from those of the combining elements. **2.** in petroleum processing,

generally connotes fatty oils and similar materials foreign to petroleum added to lubricants to impart special properties.

**Compounded oil**

A petroleum oil to which has been added other chemical substances.

**Compressibility**

The change in volume of a unit volume of a fluid when subjected to a unit change of pressure.

**Compression ratio**

In an internal combustion engine, the ratio of the volume of combustion space at bottom dead center to that at top dead center.

**Compressor**

A device which converts mechanical force and motion into pneumatic fluid power.

**Condensate**

In refining, the liquid produced when hydrocarbon vapors are cooled. In oil and gas production, the term applies to hydrocarbons that exist in gaseous form under reservoir conditions, but condense to a liquid when brought to the surface.

**Consistency**

The degree to which a semisolid material such as grease resists deformation. (See ASTM designation D 217.) Sometimes used qualitatively to denote viscosity of liquids.

**Contaminant**

Any foreign or unwanted substance that can have a negative effect on system operation, life or reliability.

**Contaminant (Dirt, ACFTD) capacity**

The weight of a specified artificial contaminant that must be added to the influent to produce a given differential pressure across a filter at specified conditions. Used as an indication of relative service life.

**Contaminant Failure**

Any loss of performance due to the presence of contamination. Two basic types of contamination failure are Perceptible - gradual loss of efficiency or performance, and Catastrophic - dramatic, unexpected failure.

**Contaminant lock**

A particle or fiber-induced jam caused by solid contaminants.

**Contamination control**

A broad subject which applies to all types of material systems (including both biological and engineering). It is concerned with planning, organizing, managing, and implementing all activities required to determine, achieve and maintain a specified contamination level.

**Coolant**

A fluid used to remove heat. See Cutting fluid.

**Copper strip corrosion**

A qualitative measure of the tendency of a petroleum product to corrode pure copper.

**Copper Dish Gum**

The milligrams of gum found in 100 ml of gasoline when evaporated under controlled conditions in a polished copper dish; indicates the potential gum content of a material.

**Copper Strip Corrosion**

The gradual eating away of copper surfaces as the result of oxidation or other chemical action. It is caused by acids or other corrosive agents.

**Core**

The internal duct and filter media support.

**Corrosion**

The decay and loss of a metal due to a chemical reaction between the metal and its environment. It is a transformation process in which the metal passes from its elemental form to a combined (or compound) form.

**Corrosion inhibitor**

Additive for protecting lubricated metal surfaces against chemical attack by water or other contaminants. There are several types of corrosion inhibitors. Polar compounds wet the metal surface preferentially, protecting it with a film of oil. Other compounds may absorb water by incorporating it in a water-in-oil emulsion so that only the oil touches the metal surface. Another type of corrosion inhibitor combines chemically with the metal to present a non-reactive surface.

**Corrosive wear**

Progressive removal of material from a rubbing surface caused by a combination of chemical attack and mechanical action.

**Coupling, quick disconnect**

A coupling which can quickly join or separate lines.

**Coupling**

A straight connector for fluid lines.

**Cracking**

The process whereby large molecules are broken down by the application of heat and pressure to form smaller molecules.

**Crown**

The top of the piston in an internal combustion engine above the fire ring, exposed to direct flame impingement.

**Cryogenics**

The branch of physics relating to the production and effects of very low temperatures.

**Cutting fluid**

Any fluid applied to a cutting tool to assist in the cutting operation by cooling, lubricating or other means.

**Cycle**

A single complete operation consisting of progressive phases starting and ending at the neutral position.

**Cylinder**

A device which converts fluid power into linear mechanical force and motion. It usually consists of a moveable element such as a piston and piston rod, plunger rod, plunger or ram, operating within a cylindrical bore.

## **D**

### **Deaerator**

A separator that removes air from the system fluid through the application of bubble dynamics.

### **Degas**

Removing air from a liquid, usually by ultrasonic and/or vacuum methods.

### **Degradation**

The progressive failure of a machine or lubricant.

### **Degree Day**

A unit of temperature. Experience has shown that, for buildings requiring an inside temperature of approximately 70°F, the amount of fuel or heat used per day is proportional to the number of degrees the average outside temperature falls below 65°F. The degree-day is based upon this principle. The number of degree-day (65°F base) for a given period is the difference between 65°F and the United States Weather Bureau daily mean temperature, when the latter is less than 65°F, multiplied by the number of days.

### **Degree Engler**

A measure of viscosity. The ratio of the time of flow of 200 ml of the liquid tested, through the viscometer devised by Engler, to time required for the flow of the same volume of water gives the number of degrees Engler.

### **DEO**

Diesel Engine Oil

### **Dehydrator**

A separator that removes water from the system fluid.

### **Delamination wear**

A complex wear process where a machine surface is peeled away or otherwise removed by forces of another surface acting on it in a sliding motion.

### **Demerit rating**

Classification of an engine part condition on an open-ended numerical scale. The scale starts at 0 which represents a new part condition. In this system, the higher the rating number, the worse the part condition. Generally used for diesel engines.

### **Demulsibility**

The ability of a fluid that is insoluble in water to separate from water with which it may be mixed in the form of an emulsion. Demulsibility is an important consideration in lubricant maintenance in many circulating lubrication systems.

### **Density**

The mass of a unit volume of a substance. Its numerical value varies with the units used.

### **Deposits**

Oil-insoluble materials that result from oxidation and decomposition of lube oil and contamination from external sources and engine blow-by. These can settle out on machine or engine parts. Examples are sludge, varnish, lacquer and carbon.

### **Depth filter**

A filter medium that retains contaminants primarily within tortuous passages.

### **Desorption**

Opposite of absorption or adsorption. In filtration, it relates to the downstream release of particles previously retained by the filter.

**Detergent**

In lubrication, either an additive or a compounded lubricant having the property of keeping insoluble matter in suspension thus preventing its deposition where it would be harmful. A detergent may also redisperse deposits already formed.

**Dewaxing**

Removal of paraffin wax from lubricating oils to improve low temperature properties, especially to lower the cloud and pour points.

**Dielectric Strength**

A measure of the ability of an insulating material to withstand electric stress (voltage) without failure. Fluids with high dielectric strength (usually expressed in volts or kilovolts) are good electrical insulators. (ASTM Designation D 877.)

**Diesel Fuel**

Obtained through the partial distillation of crude oil. Diesel fuel is ignited in an internal combustion engine cylinder by the heat of air under high compression--in contrast to motor gasoline, which is ignited by electrical spark. Because of the mode of ignition, a high cetane number is required in a good diesel fuel. Diesel fuel also often contains higher quantities of mineral compounds and sulfur.

**Diesel Index**

An expression for the ignitability of a fuel relative to its aniline point: Diesel index = aniline point (°F) X API gravity 100

**Diester Oil**

A synthetic lubricating fluid made from esters; also called ester oil.

**Differential pressure indicator**

An indicator which signals the difference in pressure between any two points of a system or a component.

**Diluent**

An un-reactive substance used to increase the bulk of some other substance. Petroleum oils and solvents are commonly used as diluents in such products as paints, pesticides, and additives.

**Dirt capacity (dust capacity) (contaminant capacity)**

The weight of a specified artificial contaminant which must be added to the influent to produce a given differential pressure across a filter at specified conditions. Used as an indication of relative service life.

**Dispersant**

In lubrication, a term usually used interchangeably with detergent. An additive, usually nonmetallic ("ashless"), which keeps fine particles of insoluble materials in a homogeneous solution. Hence, particles are not permitted to settle out and accumulate.

**Disposable**

A filter element intended to be discarded and replaced after one service cycle.

**Dissolved gases**

those gases that enter into solution with a fluid and are neither free nor entrained gases.

**Distillate**

Wide range of products produced by distillation.

**Distillation method (ASTM D-95)**

A method involving distilling the fluid sample in the presence of a solvent that is miscible in the sample but immiscible in water. The water distilled from the fluid is condensed and segregated in a specially-designed receiving tube or tray graduated to directly indicate the volume of water distilled.

**Drum**

A container with a capacity of 55 U.S. gallons.

**Dropping Point**

In general, the dropping point is the temperature at which the grease passes from a semisolid to a liquid state. This change in state is typical of greases containing conventional soap thickeners. Greases containing thickeners other than conventional soaps may, without change in state, separate oil.

**Dry-Film Lubricant**

Solid material left between two moving surfaces to prevent metal-to-metal contact, thus reducing friction and wear. Such materials are especially useful in the region of boundary lubrication, and for lubrication under special conditions of extremely high or low temperature where usual lubricants are inadequate. They may be applied in the form of a paste or solid stick, or by spraying, dipping, or brushing in an air-drying carrier which evaporates leaving a dry film. Some examples are graphite, molybdenum disulfide, boron nitride, and certain plastics such as tetrafluorethylene resins.

**Dual Fuel Engine**

A diesel engine which may be operated as an oil diesel, a gas diesel, or a combination of both, as it is equipped with controls or parts to permit operating as one or the other.

**Dumbbell blend**

Mixture of hydrocarbons, usually two components that have different viscosities or other properties.

**Duplex filter**

An assembly of two filters with valving for selection of either or both filters.

**Dynamometer**

Device for measuring the force output of a mechanical device such as the driving torque of a rotating machine.

## E

### **EC & EC II**

Energy Conserving and Energy Conserving II

### **Effluent**

The fluid leaving a component.

### **Elastohydrodynamic lubrication**

In rolling element bearings, the elastic deformation of the bearing (flattening) as it rolls, under load, in the bearing race. This momentary flattening improves the hydrodynamic lubrication properties by converting point or line contact to surface-to-surface contact.

### **Electrostatic separator**

A separator that removes contaminant from dielectric fluids by applying an electrical charge to the contaminant that is then attracted to a collection device of different electrical charge.

### **Element (Cartridge)**

The porous device that performs the actual process of filtration.

### **Emission spectrometer**

Works on the basis that atoms of metallic and other particular elements emit light at characteristic wavelengths when they are excited in a flame, arc, or spark. Excited light is directed through an entrance slit in the spectrometer. This light penetrates the slit, falls on a grate, and is dispersed and reflected. The spectrometer is calibrated by a series of standard samples containing known amounts of the elements of interest. By exciting these standard samples, an analytical curve can be established which gives the relationship between the light intensity and its concentration in the fluid.

### **Emulsibility**

The ability of a non-water-soluble fluid to form an emulsion with water.

### **Emulsifier**

Additive that promotes the formation of a stable mixture, or emulsion, of oil and water. Common emulsifiers are: metallic soaps, certain animal and vegetable oils, and various polar compounds.

### **EOLCS**

Engine Oil Licensing and Certification System

### **EP agent**

An extreme pressure additive introduced into a lubricant to improve the load-carrying or anti-weld qualities.

### **Emulsion**

Intimate mixture of oil and water, generally of a milky or cloudy appearance. Emulsions may be of two types: oil-in water (where water is the continuous phase) and water-in-oil (where water is the discontinuous phase).

### **End cap**

A ported or closed cover for the end of a filter element.

### **Engine deposits**

Hard or persistent accumulation of sludge, varnish and carbonaceous residues due to blow-by of unburned and partially burned fuel, or the partial breakdown of the crankcase lubricant. Water from the condensation of combustion products, carbon, residues from fuel or lubricating oil additives, dust and metal particles also contribute.

### **Environmental contaminant**

All material and energy present in and around an operating system, such as dust, air moisture, chemicals, and thermal energy.

**Extreme Pressure (lubricants)**

Lubricants that impart to rubbing surfaces the ability to carry appreciably greater loads than would be possible with ordinary lubricants without excessive wear or damage.

**Erosion**

The progressive removal of a machine surface by cavitation or by particle impingement at high velocities.

**Extreme pressure (additive)**

Lubricant additive that prevents sliding metal surfaces from seizing under conditions of extreme pressure. At the high 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. Reactive compounds of sulfur, chlorine, or phosphorus are used to form these inorganic films.

## **F**

### **Fabrication integrity point**

The differential gas pressure at which the first stream of gas bubbles are emitted from a wetted filter element under standard test conditions.

### **False brinelling**

False brinelling of needle roller bearings is actually a fretting corrosion of the surface since the rollers are the I.D. of the bearing. Although its appearance is similar to that of brinelling, false brinelling is characterized by attrition of the steel, and the load on the bearing is less than that required to produce the resulting impression. It is the result of a combination of mechanical and chemical action that is not completely understood, and occurs when a small relative motion or vibration is accompanied by some loading, in the presence of oxygen.

### **Fat**

An animal or vegetable oil which will combine with an alkali to saponify and form a soap.

### **FFV**

Flexible-Fuel Vehicle

### **Fatigue chunks**

Thick three-dimensional particles exceeding 50 microns indicating severe wear of gear teeth.

### **Fatigue platelets**

Normal particles between 20 and 40 microns found in gear box and rolling element bearing oil samples observed by analytical ferrography. A sudden increase in the size and quantity of these particles indicates excessive wear.

### **Fatigued**

A structural failure of the filter medium due to flexing caused by cyclic differential pressure.

### **Ferrography**

An analytical method of assessing machine health by quantifying and examining ferrous wear particles suspended in the lubricant or hydraulic fluid.

### **Fiber Grease**

A grease with a distinctly fibrous structure, which is noticeable when portions of the grease are pulled apart.

### **Filler (lubricants)**

Any substance, such as talc, mica, or various powders, which may be added to a grease to make it heavier in weight or consistency, but which serves no useful function in making the grease a better lubricant. (Editor's note: Such filler may also be added to certain lubricating oils or other lubricants).

### **Film strength**

Property of a lubricant that acts to prevent scuffing or scoring of metal parts.

### **Filter**

Any device or porous substance used as a strainer for cleaning fluids by removing suspended matter.

### **Filter Efficiency**

Method of expressing a filter's ability to trap and retain contaminants of a given size.

**Filter element**

The porous device which performs the actual process of filtration.

**Filter head**

An end closure for the filter case or bowl that contains one or more ports.

**Filter housing**

A ported enclosure that directs the flow of fluid through the filter element.

**Filter life test**

A type of filter capacity test in which a clogging contaminant is added to the influent of a filter, under specified test conditions, to produce a given rise in pressure drop across the filter or until a specified reduction of flow is reached. Filter life may be expressed as test time required to reach terminal conditions at a specified contaminant addition rate.

**Filter media, depth**

Porous materials which primarily retain contaminants within a tortuous path, performing the actual process of filtration.

**Filter media, surface**

Porous materials which primarily retain contaminants on the influent face, performing the actual process of filtration.

**Filtration (Beta) ratio**

The ratio of the number of particles greater than a given size in the influent fluid to the number of particles greater than the same size in the effluent fluid.

**Filtration**

The physical or mechanical process of separating insoluble particulate matter from a fluid, such as air or liquid, by passing the fluid through a filter medium that will not allow the particulates to pass through it.

**Fire Point Test (COC)**

(See Cleveland open-cup tester)

**Fire point (Cleveland Open Cup)**

The temperature to which a combustible liquid must be heated so that the released vapor will burn continuously when ignited under specified conditions.

**Fire-resistant fluid**

Lubricant used especially in high-temperature or hazardous hydraulic applications. Three common types of fire-resistant fluids are (1) water-petroleum oil emulsions, in which the water prevents burning of the petroleum constituent; (2) water-glycol fluids; and (3) non-aqueous fluids of low volatility, such as phosphate esters, silicones, and halogenated hydrocarbon-type fluids.

**Flash point (Cleveland Open Cup)**

The temperature to which a combustible liquid must be heated to give off sufficient vapor to form momentarily a flammable mixture with air when a small flame is applied under specified conditions. (ASTM Designation D 92.)

**Flash point test (Pensky-Martens closed tester)**

A method of test for the determination of the flash point of liquid fuels flashing below 175°F, with the exception of fuel oils.

**Flash point (Tag closed-cup tester)**

A method of test for the determination of the flash point of liquid fuels flashing below 175°F, with the exception of fuel oils.

**Flock point**

The temperature at which wax or solids separate in an oil.

**Flow, laminar**

A flow situation in which fluid moves in parallel lamina or layers.

**Flow, turbulent**

A flow situation in which the fluid particles move in a random manner.

**Flow fatigue rating**

The ability of a filter element to resist a structural failure of the filter medium due to flexing caused by cyclic differential pressure.

**Flow rate**

The volume, mass, or weight of a fluid passing through any conductor per unit of time.

**Flowmeter**

A device which indicates either flow rate, total flow, or a combination of both.

**Fluid**

A general classification including liquids and gases.

**Fluid, fire resistant**

A fluid difficult to ignite which shows little tendency to propagate flame.

**Fluid compatibility**

The suitability of filtration medium and seal materials for service with the fluid involved.

**Fluid friction**

Friction due to the viscosity of fluids.

**Fluid opacity**

Related to the ability of a fluid to pass light.

**Fluid power**

Energy transmitted and controlled through use of a pressurized fluid.

**Flushing**

A fluid circulation process designed to remove contamination from the wetted surfaces of a fluid system.

**Foam**

An agglomeration of gas bubbles separated from each other by a thin liquid film which is observed as a persistent phenomenon on the surface of a liquid.

**Force feed lubrication**

A system of lubrication in which the lubricant is supplied to the bearing surface under pressure.

**Four Ball Tester**

This name is frequently used to describe either of two similar laboratory machines, the Four-Ball Wear Tester and Four-Ball Tester. These machines are used to evaluate a lubricant's anti-wear qualities, frictional characteristics or load carrying capabilities. It derives its name from the four 1/2 inch steel balls used as test specimens. Three of the balls are held together in a cup filled with lubricant while the fourth ball is rotated against them.

**Fretting**

Wear phenomena taking place between two surfaces having oscillatory relative motion of small amplitude.

**Fretting corrosion**

Can take place when two metals are held in contact and subjected to repeated small sliding, relative motions. Other names for this type of corrosion include wear oxidation, friction oxidation, chafing, and brinelling.

**Friction**

The resisting force encountered at the common boundary between two bodies when, under the action of an external force, one body, moves or tends to move relative to the surface of the other.

**Front-end volatility**

A term applied to the volatility of the lower boiling fractions of gasoline.

**Fuel Economy Oil**

Engine oil specially formulated to increase fuel efficiency. A fuel-efficient oil works by reducing the friction between moving engine parts that contribute to the wastefulness of fuel. There are two known means of accomplishing this goal: (1) by reducing the viscosity of the oil to decrease fluid friction and (2) by using friction-reducing additives in the oil to prevent metal-to-metal contact, or rubbing friction, between surfaces.

**Fuel Injection**

Method of pumping fuel through a small nozzle into the intake system of the cylinders of an engine. Fuel injection is essential to the diesel cycle, and an alternative to conventional carburetion in the gasoline engine. In some designs, each cylinder has a cam-operated injector, which is a plunger pump that delivers precisely metered quantities of fuel at precise intervals. The fuel is injected in a minutely divided spray at high discharge. The amount of the discharge is controlled by the throttle pedal. Fuel injection offers certain advantages over carburetion, including: more balanced fuel distribution in the cylinders for improved combustion, more positive delivery of fuel to the cylinder (hence, easier starting and faster acceleration), and higher power output because of improved volumetric efficiency.

**Fuel Sensitivity**

The response of a motor fuel to the change in engine severity between the operating conditions of the ASTM Research Method (D 908) and ASTM Motor Method (D 357); numerically equal to the difference between the Research and Motor octane numbers.

**FZG Test**

A German gear test for evaluating EP properties.

**Full flow filter**

A filter that, under specified conditions, filters all influent flow.

**Full-flow filtration**

A system of filtration in which the total flow of a circulating fluid system passes through a filter.

**Full-fluid-film lubrication**

Presence of a continuous lubricating film sufficient to completely separate two surfaces, as distinct from boundary lubrication. Full-fluid-film lubrication is normally hydrodynamic lubrication, whereby the oil adheres to the moving part and is drawn into the area between the sliding surfaces, where it forms a pressure - or hydrodynamic - wedge.

## **G**

### **Gauge**

An instrument or device for measuring, indicating or comparing a physical characteristic.

### **Galling**

A form of wear in which seizing or tearing of the gear or bearing surface occurs.

### **Gasohol**

A blend of 10% anhydrous ethanol (ethyl alcohol) and 90% gasoline, by volume. Used as a motor fuel.

### **GATT**

General Agreement on Tariffs and Trade

### **Gear Oil**

For automobiles, a long-life oil of relatively high viscosity for the lubrication of rear axles and some manual transmissions. In industrial applications, a high quality oil with good oxidation stability, rust protection, and resistance to foaming, for service in gear housings and enclosed chain drives.

### **Generated contaminant**

caused by a deterioration of critical wetted surfaces and materials or by a breakdown of the fluid itself.

### **Graphite**

A crystalline form of carbon having a laminar structure, which is used as a lubricant. It may be of natural or synthetic origin.

### **Gravimetric analysis**

A method of analysis whereby the dry weight of contaminant per unit volume of fluid can be measured showing the degree of contamination in terms of milligrams of contaminant per litre of fluid.

### **Gravity**

See Specific Gravity; API Gravity.

### **Grease**

A lubricant composed of an oil or oils thickened with a soap, soaps or other thickener to a semisolid or solid consistency.

## H

### **Hardness**

The resistance of a substance to surface abrasion.

### **Head**

An end closure for the filter case or bowl which contains one or more ports.

### **Heat Transfer Oil**

A medium used for the transfer of heat.

### **Heat exchanger**

A device which transfers heat through a conducting wall from one fluid to another.

### **Heavy End Oil**

Highest boiling portion in a distilled petroleum fraction or finished product.

### **Herschel Demulsibility Number**

A number which indicates the ability of an oil to separate from water under conditions specified by the Herschel Demulsibility Test.

### **Horsepower**

Unit of power equal to 33,000 foot-pounds per minute, equivalent to 745.7 watts.

### **Housing**

A ported enclosure which directs the flow of fluid through the filter element.

### **Humidity Cabinet Test**

A test used to evaluate the rust-preventing properties of metal preservatives under conditions of high humidity (ASTM Method D 1748).

### **Hydraulic Fluid**

Fluid serving as the power transmission medium in a hydraulic system. The most commonly used fluids are petroleum oils, synthetic lubricants, oil-water emulsions, and water-glycol mixtures. The principal requirements of a premium hydraulic fluid are proper viscosity, high viscosity index, anti-wear protection (if needed), good oxidation stability, adequate pour point, good demulsibility, rust inhibition, resistance to foaming, and compatibility with seal materials. Anti-wear oils are frequently used in compact, high-pressure, and capacity pumps that require extra lubrication protection.

### **Hydraulic Oil**

An oil specially suited for use as either the specific gravity or the API gravity of a liquid.

### **Hydraulics**

Engineering science pertaining to liquid pressure and flow.

### **Hydrocarbons**

Compounds containing only carbon and hydrogen. Petroleum consists chiefly of hydrocarbons.

### **Hydrodynamic lubrication**

A system of lubrication in which the shape and relative motion of the sliding surfaces causes the formation of a fluid film having sufficient pressure to separate the surfaces.

### **Hydrofinishing**

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

### **Hydrogenation**

The chemical addition of hydrogen to a material. In non-destructive hydrogenation, hydrogen is added to a molecule only if, and where, unsaturation with respect to hydrogen exists. In destructive hydrogenation, the operation is carried out under

conditions which result in rupture of some of the hydrocarbon chains (cracking); hydrogen is added where the chain breaks have occurred.

**Hydrolysis**

Breakdown process that occurs in anhydrous hydraulic fluids as a result of heat, water, and metal catalysts (iron, steel, copper, etc.)

**Hydrolytic stability**

ability of additives and certain synthetic lubricants to resist chemical decomposition (hydrolysis) in the presence of water.

**Hydrometer**

An instrument for determining either the specific gravity of a liquid or the API gravity.

**Hydrophilic**

Having an affinity for water.

**Hydrophobic**

Lacking an affinity for water.

**Hydrostatic lubrication**

A system of lubrication in which the lubricant is supplied under sufficient external pressure to separate the opposing surfaces by a fluid film.

**Hypoid gear lubricant**

A gear lubricant having extreme pressure characteristics for use with a hypoid type of gear as in the differential of an automobile.

## I

### **Image analyzer**

A sophisticated microscopic system involving a microscope, a television camera, a dedicated computer, and a viewing monitor similar to a television screen.

### **Immiscible**

Incapable of being mixed without separation of phases. Water and petroleum oil are immiscible under most conditions, although they can be made miscible with the addition of an emulsifier.

### **In-line filter**

A filter assembly in which the inlet, outlet and filter element axes are in a straight line.

### **Indicator**

A device which provides external evidence of sensed phenomena.

### **Indicator, pressure**

An indicator that signals pressure conditions.

### **Indicator, differential pressure**

An indicator which signals the difference in pressure between two points, typically between the upstream and downstream sides of a filter element.

### **Influent**

The fluid entering a component.

### **Infrared spectroscopy**

An analytical method using infrared absorption for assessing the properties of used oil and certain contaminants suspended therein. See FTIR. This method includes measuring the percentage of peaks in the used oil infrared spectrum which match those in the reference oil. A sudden decrease in this value usually means that the oil was mixed with a different type.

### **Infrared spectra**

A graph of infrared energy absorbed at various frequencies in the additive region of the infrared spectrum. The current sample, the reference oil and the previous samples are usually compared.

### **Ingested contaminants**

Environmental contaminant that ingresses due to the action of the system or machine.

### **Ingression level**

Particles added per unit of circulating fluid volume.

### **Inhibitor**

Any substance that slows or prevents such chemical reactions as corrosion or oxidation.

### **Initial Boiling Point**

According to ASTM Method D86, the recorded temperature when the first drop of liquid falls from the end of the condenser.

### **Ink Oil**

Any of the petroleum oils used as carriers for the pigment used in making printing inks.

### **Insoluble**

Material not soluble in pentane or toluene.

### **Insolubles**

Particles of carbon or agglomerates of carbon and other material. Indicates deposition or dispersant drop-out in an engine. Not serious in a compressor or gearbox unless there has been a rapid increase in these particles.

**Insulating Oil**

An oil used in circuit breakers, switches, transformers, and other electrical apparatus for insulating, and/or cooling. In general, such oils are well-refined petroleum distillates of low volatility, with high resistance to oxidation and sludging.

**Intensifier**

A device which converts low pressure fluid power into higher pressure fluid power.

**Intercooling**

Cooling of a gas at a constant pressure between stages in a compressor. It permits reduced work in the compression phase because cooler gas is more easily compressed. Aftercooling is the final cooling following the last compression stage.

**Interfacial Tension**

The energy per unit area present at the boundary of two immiscible liquids. It is usually expressed in dynes/cm (ASTM Designation D 971.)

**Ion**

An atom or group of atoms that carries a positive or negative electric charge as a result of having lost or gained one or more electrons.

**Isomer**

One of two or more compounds, radicals, or ions that contain the same number of atoms of the same elements but differ in structural arrangement and properties.

**Isooctane**

An isomer of octane (C<sub>8</sub>H<sub>18</sub>) having very good anti-knock properties. With a designated octane number of 100, isooctane is used as a standard for determining the octane number of gasolines.

**Isothermal**

Pertaining to the conduct of a substance or process under the conditions of constant temperature.

## **J**

### **Journal**

That part of a shaft or axle that rotates or angularly oscillates in or against a bearing or about which a bearing rotates or angularly oscillates.

### **Journal bearing**

A sliding type of bearing having either rotating or oscillatory motion and in conjunction with which a journal operates. In a full or sleeve type journal bearing, the bearing surface is 360° in extent. In a partial bearing, the bearing surface is less than 360° in extent, i.e., 150°, 120°, etc.

## K

### **Karl Fischer Reagent Method (ASTM D-1744-64)**

The standard laboratory test to measure the water content of mineral base fluids. In this method, water reacts quantitatively with the Karl Fischer reagent. This reagent is a mixture of iodine, sulfur dioxide, pyridine, and methanol. When excess iodine exists, electric current can pass between two platinum electrodes or plates. The water in the sample reacts with the iodine. When the water is no longer free to react with iodine, an excess of iodine depolarizes the electrodes, signaling the end of the test.

### **Kerosene**

a flammable hydrocarbon oil usually obtained by distillation of petroleum and used for a fuel and as a solvent and thinner

### **Kinematic viscosity**

The time required for a fixed amount of an oil to flow through a capillary tube under the force of gravity. The unit of kinematic viscosity is the stoke or centistoke (1/100 of a stoke). Kinematic viscosity may be defined as the quotient of the absolute viscosity in centipoises divided by the specific gravity of a fluid, both at the same temperature:  
*Centipoises / Specific Gravity = Centistokes*

### **Knock**

Premature explosion of a portion of the air-fuel mixture in the cylinder of a spark-ignited internal combustion engine. This happens independent of spark plug ignition, as a result of excessive heat buildup during compression. The high local pressures resulting from the explosion are the source of the objectionable clatter or ping associated with knock. Knock reduces efficiency and can be destructive to engine parts. High-octane gasolines resist knocking. Also called detonation.

## L

### **Lacquer**

A deposit resulting from the oxidation and polymerization of fuels and lubricants when exposed to high temperatures. Similar to, but harder, than varnish.

### **Laminar particles**

Particles generated in rolling element bearings which have been flattened out by a rolling contact.

### **Lard Oil**

An animal oil prepared from the fat of swine. Such oils are compounded with mineral oils to yield lubricants of special wetting properties. These are especially used in cutting oils to improve the finish on the machined parts.

### **Lead Alkali**

Any of several lead compounds used to improve octane number in a gasoline. Use of lead compounds in motor gasoline has been phased out for environmental reasons. Beginning with the 1980-model year, all new U.S. and foreign-made cars sold in the U.S. require unleaded gasoline.

### **Lead naphthenate**

A lead soap of naphthenic acids, the latter occurring naturally in petroleum.

### **Light End Oil**

Lowest boiling portion in a distilled petroleum fraction or finished product.

### **Light obscuration**

The degree of light blockage as reflected in the transmitted light impinging on the photodiode.

### **Liquid**

Any substance that flows readily or changes in response to the smallest influence. More generally, any substance in which the force required to produce a deformation depends on the rate of deformation rather than on the magnitude of the deformation.

### **Liquefield Petroleum Gas (LPG)**

Light hydrocarbon material, gaseous at atmospheric temperature and pressure, held in the liquid state by pressure to facilitate storage, transport, and handling. Commercial liquefied gas consists essentially of propane, butane, or mixtures thereof.

### **Liquefield Natural Gas (LNG)**

Similar to LPG but consisting of lighter hydrocarbons, such as methane and ethane.

### **Liter/Litre**

The primary standard of capacity in the metric system, equal to the volume of one kilogram of pure water at maximum density, at approximately 4°C, and under normal atmospheric pressure.

### **Load-carrying capacity**

Property of a lubricant to form a film on the lubricated surface, which resists rupture under given load conditions. Expressed as maximum load the lubricated system can support without failure or excessive wear.

### **Load Wear Index (LWI)**

See Four Ball Test; a measure of the relative ability of a lubricant to prevent wear under applied loads; calculated 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.

**Lubricant**

Any substance interposed between two surfaces in relative motion for the purpose of reducing the friction and/or the wear between them.

**Lubricity**

Ability of an oil or grease to lubricate and reduce wear and friction, other than just its viscous properties; also called film strength.

**Lubricating Grease**

A solid to semifluid product consisting of dispersion of a thickening agent in a liquid lubricant. Other ingredients for imparting special properties may be included.

## **M**

### **Magnetic**

A separator that uses a magnetic field to attract and hold ferromagnetic particles.

### **Magnetic filter**

A filter element that, in addition to its filter medium, has a magnet or magnets incorporated into its structure to attract and hold ferromagnetic particles.

### **Magnetic plug**

Strategically located in the flow stream to collect a representative sample of wear debris circulating in the system: for example, engine swarf, bearing flakes, and fatigue chunks. The rate of buildup of wear debris reflects degradation of critical surfaces.

### **Manifold**

A filter assembly containing multiple ports and integral relating components which services more than one fluid circuit.

### **Manifold filter**

A filter in which the inlet and outlet port axes are at right angles, and the filter element axis is parallel to either port axis.

### **Mean Hertz Load**

See Load Wear Index.

### **Media migration**

Material passed into the effluent stream composed of the materials making up the filter medium.

### **Medium**

The porous material that performs the actual process of filtration. The plural of this word is "media".

### **Mercaptan**

Any of various compounds that contain a thiol functional group. Mercaptans are found in crude oil and are removed from most petroleum products by refining. However, they may be added to natural gas and liquefied petroleum gas in very low concentrations to give a distinctive warning odor.

### **Metal Deactivator**

A fuel or lubricant additive, which converts into an inactive form, the traces of metal (such as copper in fuels) and metal surfaces (such as copper in fuel lines) which, in the absence of the deactivator would catalyze gum formation and other oxidation.

### **Metal oxides**

Oxidized ferrous particles which are very old or have been recently produced by conditions of inadequate lubrication. Trend is important.

### **Micrometre (µm)**

See Micron.

### **Micron**

A unit of length. One Micron = 39 millionths of an inch (.000039"). Contaminant size is usually described in microns. Relatively speaking, a grain of salt is about 60 microns and the eye can see particles to about 40 microns. Many hydraulic filters are required to be efficient in capturing a substantial percentage of contaminant particles as small as 5 microns. A micron is also known as a micrometre, and exhibited as µm.

### **Microscope method**

A method of particle counting which measures or sizes particles using an optical microscope.

**Mid-Continental crude**

Petroleum oil obtained from the central regions of the United States (principally Oklahoma, Kansas, and North Texas), usually having characteristics between those of Pennsylvania and coastal oils.

**Middle Distillate**

One of the distillates obtained between kerosene and lubricating oil fractions in the refining processes. These include light fuel oils and diesel fuel.

**Mil Spec**

Military specifications; a guide in determining the quality requirements of products used by the military services, published by the United States Department of Defense.

**Mineral oil**

Oil derived from a mineral source, such as petroleum, as opposed to oils derived from plants and animals.

**Miscible**

Capable of being mixed in any concentration without separation of phases; e.g., water and ethyl alcohol are miscible.

**Moly**

Molybdenum disulfide, a solid lubricant and friction reducer, colloiddally dispersed in some oils and greases.

**Motor**

A device which converts fluid power into mechanical force and motion. It usually provides rotary mechanical motion.

**Motor Method- Motor Octane Number (MON)**

A test for determining the knock rating, in terms of ASTM Motor Octane Numbers, of fuels for use in spark-ignition engines. The knocking tendency of the fuel is compared with those for blends of reference fuels of known octane number when run in the ASTM-CFR engine at 900 rpm, under standard operating conditions as prescribed in ASTM Method D 357.

**MSDS**

Material Safety Data Sheet

**Multigrade oil**

An oil meeting the requirements of more than one SAE viscosity grade classification, and may therefore be suitable for use over a wider temperature range than a single-grade oil.

**Multipass or recirculation test**

Filter performance tests in which the contaminated fluid is allowed to recirculate through the filter for the duration of the test. Contaminant is usually added to the test fluid during the test. The test is used to determine the Beta-Ratio (q.v.) of an element.

**Multipurpose Grease**

A lubricating grease suitable to meet the individual requirements for chassis lubricant, bearing lubricant, joint lubricant, water-pump lubricant, and cup grease.

## **N**

### **NAFTA**

North American Free Trade Agreement

### **Naphthenic**

A type of petroleum fluid derived from naphthenic crude oil, containing a high proportion of closed-ring methylene groups.

### **Needle bearing**

A rolling type of bearing containing rolling elements that are relatively long compared to their diameter.

### **Neutralization number**

A measure of the total acidity or basicity of an oil; this includes organic or inorganic acids or bases or a combination thereof (ASTM Designation D974-58T). Also known as an acid number.

### **Neutral Oil**

Light overhead cuts of lubricant stocks. Neutral oils are the basis for most commonly used automotive lubricants.

### **NLGI Number**

One of a series of numbers classifying the consistency range of lubricating greases, based on the ASTM cone penetration number. The National Lubricating Grease Institute (NLGI) grades are in order of increasing consistency (hardness).

### **Newtonian fluid**

A fluid with a constant viscosity at a given temperature regardless of the rate of shear. Single-grade oils are Newtonian fluids. Multigrade oils are NON-Newtonian fluids because viscosity varies with shear rate.

### **Nitration**

Nitration products are formed during the fuel combustion process in internal combustion engines. Most nitration products are formed when an excess of oxygen is present. These products are highly acidic, form deposits in combustion areas and rapidly accelerate oxidation.

### **Nominal filtration rating**

An arbitrary micrometer value indicated by a filter manufacturer. Due to lack of reproducibility this rating is deprecated.

### **Non-Newtonian fluid**

Fluid, such as a grease or a polymer-containing oil (e.g., multi-grade oil), in which shear stress is not proportional to shear rate.

### **Nonwoven medium**

A filter medium composed of a mat of fibers.

## O

### **Obliteration**

A synergistic phenomenon of both particle silting and polar adhesion. When water and silt particles co-exist in a fluid containing long-chain molecules, the tendency for valves to undergo obliteration increases.

### **Octane Number**

A term numerically indicating the relative antiknock value of a gasoline. For octane numbers 100 or below, it is based upon a comparison with the reference fuels isooctane (100 octane number) and n-heptane (0 octane number). The octane number of an unknown fuel is the percent by volume of isooctane with n-heptane which matches the unknown fuel in knocking tendencies under a specified set of conditions. Above 100, the octane number of a fuel is based on the engine rating, in terms of milliliters of tetraethyllead in isooctane which matches that of the unknown fuel.

### **Oil**

A greasy, unctuous liquid of vegetable, animal, mineral or synthetic origin.

### **Oil Groove**

One of the shallow grooves cut into the rubbing faces of a bearing shell to improve the distribution of oil over the shaft and bearings. The grooves are connected with an oil supply hole or cup and act like ducts in conveying the oil to the various parts of the bearings.

### **Oiliness**

That property of a lubricant that produces low friction under conditions of boundary lubrication. The lower the friction, the greater the oiliness. See also lubricity.

### **Oiliness agent**

An additive used to increase the lubricity of a lubricating oil and aid in preventing wear and scoring under conditions of boundary lubrication.

### **Oil mist lubrication**

Type of centralized lubrication that employs compressed air to transform liquid oil into a mist that is then distributed at low pressure to multiple points of application. The oil mist is formed in a "generator", where compressed air is passed across an orifice, creating pressure reduction that causes oil to be drawn from a reservoir into the airstream. The resulting mist is distributed through feed lines to various application points. Here, it is reclassified, or condensed to a liquid, spray, or coarser mist by specialized fittings, depending on the lubrication requirements. Oils for use in a mist lubrication system are formulated with carefully selected base stocks and additives for maximum delivery of oil to the lubrication points and minimal coalescence of oil in the feed lines.

### **OLAP**

Oil Labeling Assessment Program

### **ORI**

Octane Requirements Increase - The tendency of gasoline engines to require higher octane fuels as combustion chamber deposits accumulate.

### **Oil ring**

A loose ring, the inner surface of which rides a shaft or journal and dips into a reservoir of lubricant from which it carries the lubricant to the top of a bearing by its rotation with the shaft.

**Open bubble point (boil point)**

The differential gas pressure at which gas bubbles are profusely emitted from the entire surface of a wetted filter element under specified test conditions.

**Overhead**

The distillation fraction removed as vapor or liquid from the top of a distillation column.

**Oxidation**

Occurs when oxygen attacks petroleum fluids. The process is accelerated by heat, light, metal catalysts and the presence of water, acids, or solid contaminants. It leads to increased viscosity and deposit formation.

**Oxidation inhibitor**

Substance added in small quantities to a petroleum product to increase its oxidation resistance, thereby lengthening its service or storage life; also called anti-oxidant. An oxidation inhibitor may work in one of these ways: (1) by combining with and modifying peroxides (initial oxidation products) to render them harmless, (2) by decomposing the peroxides, or (3) by rendering an oxidation catalyst inert.

**Oxidation stability**

Ability of a lubricant to resist natural degradation upon contact with oxygen.

## **P**

### **Pale Oil**

A base or process oil refined until its color, by transmitted light, is straw to pale yellow.

### **PAN**

Phenyl-Alpha-Naphthylamine, a commonly used antioxidant.

### **PAPTG**

Product Approval Protocol Task Group

### **Paper chromatography**

A method which involves placing a drop of fluid on a permeable piece of paper and noting the development and nature of the halos, or rings, surrounding the drop through time. The roots of this test can be traced to the 1940s, when railroads used the "blotter spot" tests.

### **Paraffin Series**

A homologous 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 series.

### **PCMO**

Passenger Car Motor Oil

### **Paraffinic**

A type of petroleum fluid derived from paraffinic crude oil and containing a high proportion of straight chain saturated hydro-carbons. Often susceptible to cold flow problems.

### **Particle count**

The number of particles present greater than a particular micron size per unit volume of fluid often stated as particles > 10 microns per milliliter.

### **Particle density**

An important parameter in establishing an entrained particle's potential to impinge on control surfaces and cause erosion.

### **Particle erosion**

Occurs when fluid-entrained particles moving at high velocity pass through orifices or impinge on metering surfaces or sharp angle turns.

### **Particle impingement erosion**

A particulate wear process where high velocity, fluid-entrained particles are directed at target surfaces.

### **Particulates**

Atmospheric particles made up of a wide range of natural materials (e.g., pollen, dust, resins), combined with manmade pollutants (e.g., smoke particles, metallic ash); in sufficient concentrations, particulates can be a respiratory irritant.

### **Patch test**

A method by which a specified volume of fluid is filtered through a membrane filter of known pore structure. All particulate matter in excess of an "average size," determined by the membrane characteristics, is retained on its surface. Thus, the membrane is discolored by an amount proportional to the particulate level of the fluid sample. Visually comparing the test filter with standard patches of known contamination levels determines acceptability for a given fluid.

**Penetration**

Consistency, expressed as the distance in millimeters that a standard needle or cone penetrates vertically into a sample of the material under known conditions of loading, time, and temperature.

**Pentane Insolubles**

Usually called normal pentane insolubles; the insoluble matter which can be separated from a solution of used lubricating oil in normal pentane and, in addition to the benzene insolubles, may include resinous bitumens produced from the oxidation of oil and fuel (ASTM Method D 893).

**Permeability**

The relationship of flow per unit area to differential pressure across a filter medium.

**Petrochemical**

Any chemical derived from crude oil, crude products, or natural gas.

**pH**

Measure of alkalinity or acidity in water and water-containing fluids. pH can be used to determine the corrosion-inhibiting characteristic in water-based fluids. Typically, pH > 8.0 is required to inhibit corrosion of iron and ferrous alloys in water-based fluids.

**Pinion**

The smaller of two mating or meshing gears; can be either the driving or the driven gear.

**Piston sweep**

Internal cylinder surface area over which a piston of a reciprocating compressor moves during its stroke.

**Pitting**

A form of extremely localized attack characterized by holes in the metal. Pitting is one of the most destructive and insidious forms of corrosion. Depending on the environment and the material, a pit may take months, or even years, to become visible.

**Pleated filter**

A filter element whose medium consists of a series of uniform folds and has the geometric form of a cylinder, cone, disc, plate, etc. Synonymous with "convoluted" and "corrugated".

**Pneumatics**

Engineering science pertaining to gaseous pressure and flow.

**Poise (absolute viscosity)**

A measure of viscosity numerically equal to the force required to move a plane surface of one square centimeter per second when the surfaces are separated by a layer of fluid one centimeter in thickness. It is the ratio of the shearing stress to the shear rate of a fluid and is expressed in dyne seconds per square centimeter (DYNE SEC/CM<sup>2</sup>); 1 centipoise equals .01 poise.

**Polar compound**

A chemical compound whose molecules exhibit electrically positive characteristics at one extremity and negative characteristics at the other. Polar compounds are used as additives in many petroleum products. Polarity gives certain molecules a strong affinity for solid surfaces; as lubricant additives (oiliness agents), such molecules plate out to form a tenacious, friction-reducing film. Some polar molecules are oil-soluble at one end and water-soluble at the other end; in lubricants, they act as emulsifiers, helping to form stable oil-water emulsions. Such lubricants are said to have good metal-wetting

properties. Polar compounds with a strong attraction for solid contaminants act as detergents in engine oils by keeping contaminants finely dispersed.

**Polishing (bore)**

Excessive smoothing of the surface finish of the cylinder bore or cylinder liner in an engine to a mirror-like appearance, resulting in depreciation of ring sealing and oil consumption performance.

**Polymerization**

The chemical combination of similar-type molecules to form larger molecules.

**Pore**

A small channel or opening in a filter medium which allows passage of fluid.

**Pore size distribution**

The ratio of the number of effective holes of a given size to the total number of effective holes per unit area expressed as a percent and as a function of hole size.

**Porosity**

The ratio of pore volume to total volume of a filter medium expressed as a percent.

**Positive crankcase ventilation (PCV)**

System for removing blow-by gases from the crankcase and returning them through the carburetor intake manifold to the combustion chamber where the recirculated hydrocarbons are burned. A PC valve controls the flow of gases from the crankcase to reduce hydrocarbon emissions.

**Pour point**

Lowest temperature at which an oil or distillate fuel is observed to flow, when cooled under conditions prescribed by test method ASTM D 97. The pour point is 3°C (5°F) above the temperature at which the oil in a test vessel shows no movement when the container is held horizontally for five seconds.

**Pour point depressant**

An additive which retards the adverse effects of wax crystallization, and lowers the pour point.

**Pour Stability**

The ability of a pour depressed oil to maintain its original ASTM pour point when subjected to storage at low temperature approximating winter conditions.

**Power unit**

A combination of pump, pump drive, reservoir, controls and conditioning components which may be required for its application.

**Precipitation Number**

The number of milliliters precipitate formed when 10 ml of lubricating oil is mixed with 90 ml of petroleum naphtha and centrifuged under definitely prescribed conditions. The precipitation number should indicate the amount of the asphaltic bodies dissolved in the lubricating oil, although a certain amount of paraffin bodies may separate with the asphaltic bodies (ASTM Method D 91).

**Predictive maintenance**

A type of condition-based maintenance emphasizing early prediction of failure using non-destructive techniques such as vibration analysis, thermography, and wear debris analysis.

**Pre-ignition**

Ignition of a fuel-air mixture in an internal combustion engine (gasoline) before the spark plug fires. It can be caused by a hot spot in the combustion chamber or a very high compression ratio. Pre-ignition reduces power and can damage the engine.

**Pressure**

Force per unit area, usually expressed in pounds per square inch.

**Pressure, absolute**

The sum of atmospheric and gage pressures.

**Pressure, atmospheric**

Pressure exerted by the atmosphere at any specific location. (Sea level pressure is approximately 14.7 pounds per square inch absolute.)

**Pressure, back**

The pressure encountered on the return side of a system.

**Pressure, cracking**

The pressure at which a pressure operated valve begins to pass fluid.

**Pressure, rated**

The qualified operating pressure which is recommended for a component or a system by the manufacturer.

**Pressure, system**

The pressure which overcomes the total resistances in a system. It includes all losses as well as useful work.

**Pressure Drop**

Resistance to flow created by the element (media) in a filter. Defined as the difference in pressure upstream (inlet side of the filter) and downstream (outlet side of the filter).

**Pressure gage**

Pressure differential above or below atmospheric pressure.

**Pressure line filter**

A filter located in a line conducting working fluid to a working device or devices.

**Preventive maintenance**

Maintenance performed according to a fixed schedule involving the routine repair and replacement of machine parts and components.

**Proactive maintenance**

A type of condition-based maintenance emphasizing the routine detection and correction of root cause conditions that would otherwise lead to failure. Such root causes as high lubricant contaminant, alignment and balance are among the most critical.

**Process Oil**

An oil used for lubrication but as a component of another material, or as a carrier of other products.

**Proudness**

Ring protrusions caused by the buildup of carbon or lacquer deposits behind the ring or on the sides of the ring or groove.

**Pump**

A device which converts mechanical force and motion into hydraulic fluid power.

**Pumpability**

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

**Pump, fixed displacement**

A pump in which the displacement per cycle cannot be varied.

**Pump, variable displacement**

A pump in which the displacement per cycle can be varied.

**Q**

**QPL**

Qualified Product List (military listing)

## R

### **(R+M)/2**

Research Octane Number plus Motor Octane Number, divided by 2. Used now as general measure of road octanes of gasoline.

### **R&O**

Rust and oxidation-inhibited

### **Rate of shear**

The difference between the velocities along the parallel faces of a fluid element divided by the distance between the faces.

### **Reclaimed Oil**

A lubricating oil which, after undergoing a period of service is collected, reprocessed, and sold for reuse.

### **Red Oil**

The term is now used to describe any oil of red color, regardless of refining process.

### **Reducer**

A connector having a smaller line size at one end than the other.

### **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).

Instrument is available in two sizes: Redwood No. I and No. II. When the flow time exceeds 2,000 sec, the No. II must be used.

### **Refining**

Series of processes for converting crude oil and its fractions to finished petroleum products.

### **Refraction**

The change of direction or speed of light as it passes from one medium to another.

### **Reid Vapor Pressure**

An important test for gasolines. It is a measure of the vapor pressure of a sample at 100°F, and the test is commonly made in a bomb. The results are reported in pounds (ASTM Method D 323).

### **Rerefining**

A process of reclaiming used lubricant oils and restoring them to a condition similar to that of virgin stocks by filtration, clay adsorption or more elaborate methods.

### **Research Method- Research Octane Number (RON)**

A test for determining the knock rating, in terms of ASTM Research octane numbers, of fuels for use in spark-ignition engines. The knocking tendency of the fuel is compared with those for blends of reference fuels of known octane number when run in the ASTM-CRF engine at 600 rpm under standard operating conditions (ASTM Methods D908 and D 1656).

### **Reservoir**

A container for storage of liquid in a fluid power system.

### **Reservoir (sump) filter**

A filter installed in a reservoir in series with a suction or return line.

### **Residual dirt capacity**

The dirt capacity remaining in a service loaded filter element after use, but before cleaning, measured under the same conditions as the dirt capacity of a new filter element.

**Resins**

Solid or semi-solid materials, light yellow to dark brown, composed of carbon, hydrogen, and oxygen. Resins occur naturally in plants, and are common in pines and firs, often appearing as globules on the bark. Synthetic resins, such as polystyrene, polyesters, and acrylics, are derived primarily from petroleum. Resins are widely used in the manufacture of lacquers, varnishes, plastics, adhesives, and rubber.

**Return line**

A location in a line conducting fluid from working device to reservoir.

**Return Line Filtration**

Filters located upstream of the reservoir but after fluid has passed through the system's output components (cylinders, motors, etc.).

**Rheology**

The study of the deformation and flow of matter in terms of stress, strain, temperature, and time. The rheological properties of a grease are commonly measured by penetration and apparent viscosity.

**Ring lubrication**

A system of lubrication in which the lubricant is supplied to the bearing by an oil ring.

**Rings**

Circular metallic elements that ride in the grooves of a piston and provide compression sealing during combustion. Also used to spread oil for lubrication.

**Ring sticking**

Freezing of a piston ring in its groove in a piston engine or reciprocating compressor due to heavy deposits in the piston ring zone.

**Road Octane Number**

A numerical value based upon the relative anti-knock performance in an automobile of a test gasoline as compared with specified reference fuels. Road octanes are determined by operating a car over a stretch of road or on a chassis dynamometer under conditions simulating those encountered on the highway.

**Roll-off cleanliness**

The fluid system contamination level at the time of release from an assembly or overhaul line. Fluid system life can be shortened significantly by full-load operation under a high fluid contamination condition for just a few hours. Contaminant implanted and generated during the break-in period can devastate critical components unless removed under controlled operating and high performance filtering conditions.

**Roller bearing**

An antifriction bearing comprising rolling elements in the form of rollers.

**RSI**

Registrations Systems Inc.

**Rust prevention test (turbine oils)**

A test for determining the ability of an oil to aid in preventing the rusting of ferrous parts in the presence of water.

## S

### **SAE EP Lubricant Tester**

A machine designed to test the extreme-pressure properties of a lubricant under a combined rolling and sliding action. The revolving members are two bearing cups which rotate at different speeds. This tester is described in Federal Test Method Standard 791, Method 6501.1. Also called a McKee machine.

### **SAE Viscosity Number**

System for classifying crankcase, transmission, and differential lubricants, according to their viscosities, established by the Society of Automotive Engineers. SAE numbers are used in connection with recommendations for crankcase oils to meet various design, service, and temperature requirements affecting viscosity only; they do not denote quality.

### **Sample preparation**

Fluid factors that can enhance the accuracy of the particulate analysis. Such factors include particle dispersion, particle settling, and sample dilution.

### **Saturation level**

The amount of water that can dissolve in a fluid.

### **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 fuel oils. ASTM Method D 88 describes the equipment and procedure.

### **Saybolt Universal Viscosity (SUV) or Saybolt Universal Seconds, (SUS)**

The time in seconds required for 60 cubic centimeters of a fluid to flow through the orifice of the Standard Saybolt Universal Viscometer at a given temperature under specified conditions. (ASTM Designation D 88.)

### **Scaling**

The deposition and growth of insolubles and oxides on cooling system walls.

### **Scoring**

Damage of a rubbing surface that is characterized by a definite surface roughness in line with motion. It is created by the transfer of metal by dragging, which results in progressive deterioration.

### **Scratching**

Damage of a rubbing surface that is characterized by a definite surface roughness in line with motion. The damage, however, is not created by progressive surface deterioration due to debris.

### **Scuffing**

Abnormal engine wear due to localized welding and fracture. It can be prevented through the use of antiwear, extreme-pressure and friction modifier additives.

### **Scuffing particles**

Large twisted and discolored metallic particles resulting from adhesive wear due to complete lubricant film breakdown.

**Seizing**

Sticking together of two surfaces characterized by the presence of small particles of material which have become welded to one or both of the surfaces.

**Semisolid**

Any substance having the attributes of both a solid and a liquid. Similar to semiliquid but being more closely related to a solid than a liquid. More generally, any substance in which the force required to produce a deformation depends both on the magnitude and on the rate of the deformation.

**Separate Test**

A test to determine the tendency of oil to separate from a lubricating grease under conditions prescribed in ASTM Method D 1742. Service SJ, SH, SG, SF, SE, SD, SC, SB, SA, CH-4, CG-4, CF, CF-4, CF-2, CE, CD, CD-II, CC, CB, CA.

**Shear index**

The measure of an oil's percentage viscosity loss.

**Shear rate**

Rate at which adjacent layers of fluid move with respect to each other, usually expressed as reciprocal seconds.

**Shear stress**

Frictional force overcome in sliding one "layer" of fluid along another, as in any fluid flow. The shear stress of a 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 of a Newtonian fluid, the greater the shear stress as a function of rate of shear. In a non-Newtonian fluid - such as a grease or a polymer-containing oil (e.g. multi-grade oil) - shear stress is not proportional to the rate of shear. A non-Newtonian fluid may be said to have an apparent viscosity, a viscosity that holds only for the shear rate (and temperature) at which the viscosity is determined.

**Silt**

Contaminant particles 5  $\mu\text{m}$  and less in size.

**Silting**

A failure generally associated with a valve which movements are restricted due to small particles that have wedged in between critical clearances (e.g., the spool and bore.)

**Single-grade oil**

An engine oil that meets the requirements of a single SAE viscosity grade classification.

**Single-pass test**

Filter performance tests in which contaminant which passes through a test filter is not allowed to recirculate back to the test filter.

**Sintered medium**

A metallic or nonmetallic filter medium processed to cause diffusion bonds at all contacting points.

**Sleeve bearing**

A journal bearing, usually a full journal bearing.

**Sludge**

Coagulated insoluble material formed as a result either of deterioration reactions in an oil or of contamination of an oil, or both.

**Soap**

General term denoting the salt of a fatty acid. The ordinary soaps are those of sodium and potassium. The soaps of lithium, calcium, sodium, and aluminum are the principal thickeners used in grease making.

**Solid**

Any substance having a definite shape which it does not readily relinquish. More generally, any substance in which the force required to produce a deformation depends upon the magnitude of the deformation rather than upon the rate of deformation.

**Soluble oils**

Oils that have the ability to mix with water after emulsifiers and stabilizers have been added. They are used as drilling, cutting and cooling oils in metalworking.

**Solvency**

Ability of a fluid to dissolve inorganic materials and polymers, which is a function of aromaticity.

**Solvent**

A compound that has the ability to dissolve a given substance.

**Solvent extraction**

Refining process used to separate reactive components from lube distillates in order to improve the oil's oxidation stability, viscosity index, and response to additives.

**Sour crude**

Crude oil containing appreciable quantities of hydrogen sulfide or other sulfur compounds.

**Spalling**

Surface disintegration associated with loss of particles from the surface and associated with adhesion.

**Specific gravity (liquid)**

The ratio of the weight of a given volume of liquid to the weight of an equal volume of water.

**Specific gravity**

The ratio of the weight of a given volume of material to the weight of an equal volume of water.

**Spectrographic analysis**

Determines the concentration of elements represented in the entrained fluid contaminant.

**Spectrographic Oil Analysis Program (SOAP)**

Procedures for extracting fluid samples from operating systems and analyzing them spectro-graphically for the presence of key elements.

**Spin-on filter**

A throw-away type bowl and element assembly that mates with a permanently installed head.

**Spindle oil**

A low viscosity oil used principally for lubricating textile spindles and for light, high-speed machinery.

**Splash lubrication**

A system of lubrication in which parts of a mechanism dip into and splash the lubricant onto themselves and/or other parts of the mechanism.

**Starting Fluid (diesel)**

A fluid, such as diethyl ether, which has a wide flammability range; used to start diesel engines at extremely low temperatures.

**Static friction**

The force just sufficient to initiate relative motion between two bodies under load. The value of the static friction at the instant relative motion begins is termed break-away friction.

**Stoke (St)**

Kinematic measurement of a fluid's resistance to flow defined by the ratio of the fluid's dynamic viscosity to its density.

**Strainer**

A coarse filter element (pore size over approximately 40  $\mu\text{m}$ )

**Suction filter**

A pump intake-line filter in which the fluid is below atmospheric pressure.

**Sulfated ash**

The ash content of fresh, compounded lubricating oil as determined by ASTM Method D 874. Indicates level of metallic particles in the oil.

**Sulfonate**

Hydrocarbon in which a hydrogen atom has been replaced with the highly polar ( $\text{SO}_2\text{Ox}$ ) group, where X is a metallic ion or alkyl radical. Petroleum sulfonates are refinery by-products of the sulfuric acid treatment of white oils. Sulfonates have important applications as emulsifiers and chemical intermediates in petrochemical manufacture. Synthetic sulfonates can be manufactured from special feedstocks rather than from white oil base stocks.

**Sulfurized oil**

Oil to which sulfur or sulfur compounds have been added. The compounds react with a rubbing surface at an elevated temperature to form a protective film.

**Superclean**

10 particles > 10 micron per milliliter

**Supercharger**

A device that pumps intake air into the carburetor of an internal combustion engine at pressures above atmospheric. Supercharging provides a greater air charge to the cylinders at high crankshaft speeds and at high altitudes, thereby boosting engine power without increasing engine size. Some supercharger systems utilize after-cooling to further increase the density of the charge. The blower may be geared to the crankshaft or, in the case of the turbocharger, it may consist of a turbine driven by the exhaust gases to operate the centrifugal blower.

**Surface fatigue wear**

The formation of surface or subsurface cracks and fatigue crack propagation. It results from cyclic loading of a surface.

**Surface filtration**

Filtration which primarily retains contaminant on the influent surface.

**Surface tension**

The contractile surface force of a liquid by which it tends to assume a spherical form and to present the least possible surface. It is expressed in dynes/cm or ergs/cm<sup>2</sup>.

**Surfactant**

Surface-active agent that reduces interfacial tension of a liquid. A surfactant used in a petroleum oil may increase the oil's affinity for metals and other materials.

**Surge**

A momentary rise of pressure in a circuit.

**SUS (SSU)**

Saybolt Universal Seconds. A measure of lubricating oil viscosity used in the oil industry.

**Swarf**

The cuttings, and grinding fines that result from metal working operations.

**Switch, pressure**

An electric switch operated by fluid pressure.

**Synergism**

A situation where a mixture of two or more separate additive materials results in a total effect greater than that of the sum of them.

**Synthetic hydrocarbon**

Oil molecule with superior oxidation quality tailored primarily out of paraffinic materials.

**Synthetic lubricant**

A lubricant produced by chemical synthesis rather than by extraction or refinement of petroleum to produce a compound with planned and predictable properties.

**Synthetic Oils**

Oil produced by synthesis rather than by extraction or refinement.

## T

### **Tacky**

A descriptive term applied to lubricating oils and greases which appear particularly sticky or adhesive.

### **Tag Closed-Cup Tester**

An instrument used to determine the flash point of volatile flammable materials flashing below 200°F, as described in ASTM Method D 56.

### **Thermography**

The use of infrared thermography whereby temperatures of a wide variety of targets can be measured remotely and without contact. This is accomplished by measuring the infrared energy radiating from the surface of the target and converting this measurement to an equivalent surface temperature.

### **Thermal conductivity**

Measure of the ability of a solid or liquid to transfer heat.

### **Thermal stability**

Ability of a fuel or lubricant to resist oxidation under high temperature operating conditions.

### **Thin film lubrication**

A condition of lubrication in which the film thickness of the lubricant is such that the friction between the surfaces is determined by the properties of the surfaces as well as by the viscosity of the lubricant.

### **Thixotropy**

The property of a lubricating grease to revert to its original consistency when the consistency has been decreased as a result of shearing.

### **Three-body abrasion**

A particulate wear process by which particles are pressed between two sliding surfaces.

### **Thrust Bearing**

Also known as an axial-load bearing where the load acts in the direction of the axis of rotation.

### **Timken EP test**

The Timken Extreme Pressure Test is one of many laboratory machines used in determining the load carrying capacities of oils and greases. In this test, 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.

### **Timken OK Load**

The heaviest load that a test lubricant will sustain without scoring the test block in the Timken Test procedures, ASTM Methods D 2509 (greases) and D 2782 (oils).

### **Torque fluid**

Lubricating and power-transfer medium for commercial automotive torque converters and transmissions. It possesses the low viscosity necessary for torque transmission, the lubricating properties required for associated gear assemblies, and compatibility with seal materials.

### **Tribology**

The science and technology of interacting surfaces in relative motion, including the study of lubrication, friction and wear. Tribological wear is wear that occurs as a result of relative motion at the surface.

**Turbidity**

The degree of opacity of a fluid.

**Turbulent flow sampler**

A sampler that contains a flow path in which turbulence is induced in the main stream by abruptly changing the direction of the fluid.

## **U**

### **Ultraclean**

1 particle >10 micron per milliliter.

### **Unleaded Gasoline**

Gasoline that derives its anti-knock properties from high-octane hydrocarbons or from non-lead anti-knock compounds, rather than from a lead additive. See lead alkyl.

### **Unloading**

The release of contaminant that was initially captured by the filter medium.

## V

### **Vacuum separator**

A separator that utilizes subatmospheric pressure to remove certain gases and liquids from another liquid because of their difference in vapor pressure.

### **Valve, by-pass**

A valve whose primary function is to provide an alternate flow path.

### **Valve, directional control**

A valve whose primary function is to direct or prevent flow through selected passages.

### **Valve, directional control, servo**

A directional control valve which modulates flow or pressure as a function of its input signal.

### **Valve, flow control**

A valve whose primary function is to control flow rate.

### **Valve, pressure control, relief**

A pressure control valve whose primary function is to limit system pressure.

### **Valve, relief, differential pressure**

A valve whose primary function is to limit differential pressure.

### **Valve**

A device which controls fluid flow direction, pressure, or flow rate.

### **Valve lifter**

Sometimes called a "cam follower," a component in engine designs that use a linkage system between a cam and the valve it operates. The lifter typically translates the rotational motion of the cam to a reciprocating linear motion in the linkage system.

### **Vapor lock**

Disruption of fuel movement to a gasoline engine carburetor caused by excessive vaporization of gasoline. Vapor lock occurs when the fuel pump, which is designed to pump liquid, loses suction as it tries to pump fuel vapor. The engine will usually stall, but in less severe cases may accelerate sluggishly or knock due to an excessively lean fuel mixture. Automotive engines are more likely to experience vapor lock during acceleration that follows a short shutdown period. Vapor lock problems are most likely to occur in the late spring on unseasonably warm days, before the more volatile winter grades of gasoline have been replaced by the less volatile spring and summer grades (see volatility). Vapor lock can also occur in other types of pumping systems where volatile liquids are being handled.

### **Vapor pressure**

Pressure of a confined vapor in equilibrium with its liquid at specified temperature thus, a measure of a liquid's volatility.

### **Vapor Pressure-Reid (RVP)**

Measure of the pressure of vapor accumulated above a sample of gasoline or other volatile fuel in a standard bomb at 100°F (37.8°C). Used to predict the vapor locking tendencies of the fuel in a vehicle's fuel system. Controlled by law in some areas to limit air pollution from hydrocarbon evaporation while dispensing.

### **Varnish**

When applied to lubrication, a thin, insoluble, nonwipeable film deposit occurring on interior parts, resulting from the oxidation and polymerization of fuels and lubricants.

Can cause sticking and malfunction of close-clearance moving parts. Similar to, but softer, than lacquer.

**Viscometer or Viscosimeter**

An apparatus for determining the viscosity of a fluid.

**Viscosity**

Measurement of a fluid's resistance to flow. The common metric unit of absolute viscosity is the poise. In addition to kinematic viscosity, there are other methods for determining viscosity, including Saybolt Universal Viscosity (SUV), Saybolt FuroI viscosity, Engier viscosity, and Redwood viscosity. Since viscosity varies inversely with temperature, its value is meaningless until the temperature at which it is determined is reported.

**Viscosity, absolute**

The ration of the shearing stress to the shear rate of a fluid. It is usually expressed in centipoise.

**Viscosity, kinematic**

The absolute viscosity divided by the density of the fluid. It is usually expressed in centistokes.

**Viscosity, SUS**

Saybolt Universal Seconds (SUS), which is the time in seconds for 60 milliliters of oil to flow through a standard orifice at a given temperature. (ASTM Designation D88-56.)

**Viscosity grade**

Any of a number of systems which characterize lubricants according to viscosity for particular applications, such as industrial oils, gear oils, automotive engine oils, automotive gear oils, and aircraft piston engine oils.

**Viscosity index (VI)**

A commonly used measure of a fluid's change of viscosity with temperature. The higher the viscosity index, the smaller the relative change in viscosity with temperature.

**Viscosity index improvers**

Additives that increase the viscosity of the fluid throughout its useful temperature range. Such additives are polymers that possess thickening power as a result of their high molecular weight and are necessary for formulation of multi-grade engine oils.

**Viscosity modifier**

Lubricant additive, usually a high molecular weight polymer, that reduces the tendency of an oil's viscosity to change with temperature.

**Viscous**

Possessing viscosity. Frequently used to imply high viscosity.

**Volatility**

This property describes the degree and rate at which a liquid will vaporize under given conditions of temperature and pressure. When liquid stability changes, this property is often reduced in value.

## **W**

### **Wear**

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

### **Weld point**

The lowest applied load in kilograms at which the rotating ball in the Four Ball EP test either seizes and welds to the three stationary balls, or results in extreme scoring of the three balls.

### **White oil**

Highly refined mineral oil, essentially colorless, odorless, and tasteless. White oils have a high degree of chemical stability. White oils have many industrial applications - including textile, chemical, and plastics manufacture - where their good color, non-staining properties, and chemical inertness are highly desirable.

### **Wicking**

The vertical absorption of a liquid into a porous material by capillary forces.

### **Worked Penetration**

The penetration of a sample of lubricating grease immediately after it has been brought to 77°F and then subjected to 60 stokes in a standard grease worker. This procedure and the standard grease worker are described in ASTM Method D 217

## **Z**

### **ZDDP**

An antiwear additive found in many types of hydraulic and lubricating fluids. Zinc dialkyldithiophosphate.