# OIL ANALYSIS GLOSSARY

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

**Abrasive wear -- (or cutting wear) comes about 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., a journal.**

**Absolute filtration rating -- the diameter of the largest hard spherical particle that will pass through a filter under specified test conditions. This is an indication of the largest opening in the filter elements.**

**Absolute Viscosity -- a term used interchangeably with viscosity to distinguish it from either kinematic viscosity or commercial viscosity. Absolute viscosity is the ratio of shear stress to shear rate. It is a fluid's internal resistance to flow. The common unit of absolute viscosity is the poise. Absolute viscosity divided by fluid density equals kinematic viscosity. It is occasionally referred to as dynamic viscosity. Absolute viscosity and kinematic viscosity are expressed in fundamental units. Commercial viscosity such as Saybolt viscosity is expressed in arbitrary units of time, usually seconds.**

**Absorbent 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.**

**AC Fine Test Dust (ACFTD)-- A test contaminant used to assess both filters and the contaminant sensitivity of all types of tribological mechanisms.**

**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 number -- The quantity of base, expressed in milligrams of potassium hydroxide, that is required to neutralize the acidic constituents in 1 g of sample.**

**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. (Expressed in % of mass (weight) or % of volume)**

**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.**

**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.**

**A.G.M.A. -- abbreviation for "American Gear Manufacturers Associations," an organization serving the gear industry.**

**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.**

**Agglomeration -- the potential of the system for particle attraction and adhesion.**

**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.**

**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 -- devoid of water.**

**Aniline point -- The minimum temperature for complete miscibility of equal volumes of aniline and the sample under test ASTM Method D611. 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 to 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-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.**

**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.**

**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° to 100°C and even at a lower temperature if water (25 to 50 ppm) is present.**

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

**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: 141.5 - 131.5 >{Specific gravity 60° F/60° F }**

**Apparent viscosity -- The ratio of shear stress to rate of shear of a non-Newtonian fluid such as lubricating grease, or a multi-grade oil, 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 -- a measure of the amount of inorganic material in lubricating oil. Determined by burning the oil and weighing the residue. Results expressed as percent by weight.**

**ASLE -- American Society of Lubrication Engineers. Changed now to Society of Tribologist and Lubrication Engineers (STLE).**

**ASME -- American Society of Mechanical Engineers**

**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.**

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**ASTM -- American Society for Testing Materials**

**A.S.T.M. = American Society for Testing Materials" -- a society for developing standards for materials and test methods.**

**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.**

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

**Background contamination -- The total of the extraneous particles which are introduced in the process of obtaining, storing, moving, transferring and analyzing a fluid sample.**

**Ball bearing -- an antifriction rolling type bearing containing rolling elements in the form of balls.**

**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 number -- The amount of acid, expressed in terms of the equivalent number of milligrams of potassium hydroxide, required to neutralize all basic constituents present in 1 g of sample.**

**Base stock -- the base fluid, usually a refined petroleum fraction or a selected synthetic material, into which additives are blended to produce finished lubricants.**

**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.**

**Bernouilli's theory -- If no work is done on or by a flowing, frictionless liquid, its energy, due to pressure and velocity, remains constant at all points along the streamline.**

**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 (ß-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").**

**Bleeding -- The separation of some of the liquid phase from a grease**

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

**Blowby -- leakage of combustion gases between a piston and the cylinder wall into the crankcase in an automobile**

**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 with pressure**

**Boiling range**
**For a mixture of substances, such as a petroleum fraction, the temperature interval between the initial and final boiling points.**

**Bomb Oxidation**
**A test for the oxidation stability of a product obtained by sealing it in a closed container with oxygen under pressure. The drop in pressure of the oxygen is a measure of the amount of oxidation that has occurred.**

**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.**

**Boyle's law -- The absolute pressure of a fixed mass of gas varies inversely as the volume, provided the temperature remains constant.**

**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.**

**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.**

**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.**

**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.**

**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 small bore (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.**
**Carbon residue -- coked material remaining after an oil has been exposed to high temperatures under controlled conditions.**

**Carbon Type -- The distinction between paraffinic, naphthenic, and aromatic molecules. In relation to lubricant base stocks, the predominant type present.**

**Catalyst -- a substance that initiates or increases the rate of a chemical reaction, without itself being used up in the process.**

**Catastrophic failure -- sudden, unexpected failure of a machine resulting in considerable cost and downtime.**

**Cavitation -- formation of an air or vapor pocket (or 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.**

**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.**

**Chemical stability -- the tendency of a substance or mixture to resist chemical change.**

**Chromatography -- An analytical technique whereby a complex substance is adsorbed on a solid or liquid substrate and progressively eluted by a flow of a substance (the eluant) in which the components of the substance under investigation are differentially soluble. The eluant can be a liquid or a gas. When the substrate is filter paper and the eluant a liquid, a chromatogram of colored bands can be developed by use of indicators. For gas chromatography, electronic detectors are normally used to indicate passage of the various components from the system.**

**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.**

**Clean -- 100 particles >10 micron per milliliter**

**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.**

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

**Cleanliness level (CL) -- a measure of relative freedom from contaminants.**

**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) -- A flash point test in which the surface of the sample is completely open to the atmosphere, and which is therefore relatively insensitive to small traces of volatile contaminants.**

**Cloud point -- the temperature at which waxy crystals in an oil or fuel form a cloudy appearance.**

**Coalescer -- 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.**

**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.**

**Coking -- The undesirable accumulation of carbon (coke) deposits in the internal combustion engine or in a refinery plant. The process of distilling a petroleum product to dryness.**

**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.**

**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.**

**Compressor -- a device which converts mechanical force and motion into pneumatic fluid power.**

**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.**

**Copper strip corrosion -- a qualitative measure of the tendency of a petroleum product to corrode pure copper.**

**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.**

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

**Cryogenics -- the branch of physics relating to the production and effects of very low temperatures.**

**Degas -- removing air from a liquid, usually by ultrasonic and/or vacuum methods.**

**Degradation -- the progressive failure of a machine or lubricant.**

**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.**

**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.**

**Deplete --The depletion of additives expressed as an approximate percentage.**

**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.**

**Detergent oil -- Is a lubricating oil possessing special sludge-dispersing properties usually conferred on the oil by the incorporation of special additives. Detergent oils hold formed sludge particles in suspension and thus promote cleanliness especially in internal-combustion engines. However detergent oils do not contain ?detergents? such as those used for cleaning of laundry or dishes. Also detergent oils do not clean already ?dirty? engines, but rather keep in suspension the sludge that petroleum oil forms so that the engine remains cleaner for longer period. The formed sludge particles are either filtered out by Oil Filters or drained out when oil is changed.**

**Dewaxing -- Removal of wax from a base oil in order to reduce the pour point.**

**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.)**

**Differential pressure indicator -- an indicator which signals the difference in pressure between any two points of a system or a component.**

**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.**

**Drag -- The resistance to movement caused by oil viscosity.**

**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.**

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

**Dry sump -- An engine design in which oil is not retained in a pan beneath the crankshaft thus permitting splash lubrication. There may be a remote sump from which oil is recirculated, or there may be a total loss system.**

**Duplex filter -- an assembly of two filters with valving for selection of either or both filters.**

**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.**

**Elastomer -- A rubber or rubber-like material, both natural and synthetic, used in making a wide variety of products, such as seals and hoses. In oil seals, an elastomer?s chemical composition is a factor in determining its compatibility with a lubricant.**

**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.**

**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.**

**Environmental contaminant -- all material and energy present in and around an operating system, such as dust, air moisture, chemicals, and thermal energy.**

**EP (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 (EP) 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.**

**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.**

**Face seal -- a device that prevents leakage of fluids along rotating shafts. Sealing is accomplished by a stationary primary seal ring bearing against the face of a mating ring mounted on a shaft. Axial pressure maintains the contact between the seal ring and the mating ring.**

**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.**

**Fatigue chunks -- thick three-dimensional particles exceeding 50 microns indicating severe wear of gear teeth.**

**Fatigue life -- the theoretical number of revolutions (or hours of operation) a bearing will last under a given constant load and speed before the first evidence of fatigue develops on one or more of the components.**

**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.**

**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.**

**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.)**

**Floc Point -- The temperature at which wax or solids separate in an oil**

**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, 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 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 friction -- friction due to the viscosity of fluids.**

**Fluid opacity -- related to the ability of a fluid to pass light.**

**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.**

**Foam inhibitor -- A substance introduced in a very small proportion to a lubricant or a coolant to prevent the formation of foam due to aeration of the liquid, and to accelerate the dissipation of any foam that may form**

**Foaming -- A frothy mixture of air and a petroleum product (e.g., lubricant, fuel oil) that can reduce the effectiveness of the product, and cause sluggish hydraulic operation, air binding of oil pumps, and overflow of tanks or sumps. Foaming can result from excessive agitation, improper fluid levels, air leaks, cavitation, or contamination with water or other foreign materials. Foaming can be inhibited with an antifoam agent. The foaming characteristics of a lubricating oil can be determined by blowing air through a sample at a specified temperature and measuring the volume of foam, as described in test method ASTM D 892.**

**Force feed lubrication -- a system of lubrication in which the lubricant is supplied to the bearing surface under pressure.**

**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.**

**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.**

**Gage -- 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.**

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

**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.**

**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 exchanger -- a device which transfers heat through a conducting wall from one fluid to another.**

**Heavy Ends -- The portions of a petroleum distillate fraction which are highest boiling, and therefore distill over last if the temperature is raised progressively.**

**Housing -- a ported enclosure which directs the flow of fluid through the filter element.**

**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**
**In refining, the chemical addition of hydrogen to a hydrocarbon in the presence of a catalyst; a severe form of hydrogen treating. Hydrogenation may be either destructive or non-destructive. In the former case, hydrocarbon chains are ruptured (cracked) and hydrogen is added where the breaks have occurred. In the latter, hydrogen is added to a molecule that is unsaturated with respect ot hydrogen. In either case, the resulting products are highly stable. Temperatures and pressures in the hydrogenation process are usually greater than in hydrofining.**

**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**
**Compounds with an affinity for water.**

**Hydrophobic**
**Compounds that repel 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.**

**Hypoid Gears**
**Gears in which the pinion axis intersects the plane of the ring gear at a point below the ring-gear axle and above the outer edge of the ring gear, or above the ring-gear axle and below the outer edge of the ring gear.**

**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 (IR) analysis -- A form o absorption spectroscopy that identifies organic functional groups present in a used oil sample by measuring their light absorption at specific infrared wavelengths; absorbance is proportional to concentration. The test can indicate additive depletion, the presence of water, hydrocarbon contamination of a synthetic lubricant, oxidation, nitration, and glycol contamination from coolant. Fourier Transform Infrared (FTIR) permits the generation of complex curves from digitally represented data.**

**Infrared spectroscopy -- an analytical method using infrared absorption for assessing the properties of used oil and certain contaminants suspended therein. See FTIR.**

**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.**

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

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

**ISO Solid Contaminant Code (ISO 4406) -- a code assigned on the basis of the number of particles per unit volume greater than 5 and 15 micrometers in size. Range numbers identify each increment in the particle population throughout the spectrum of levels.**

**ISO Standard 4021 -- the accepted procedure for extracting samples from dynamic fluid lines.**

**ISO viscosity grade -- a number indicating the nominal viscosity of an industrial fluid lubricant at 40°C (104°F) as defined by ASTM Standard Viscosity System for Industrial Fluid Lubricants D 2422. Essentially identical to ISO Standard 3448.**

**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.**

**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.**

**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**

**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.**

**Lead naphthenate -- a lead soap of naphthenic acids, the latter occurring naturally in petroleum.**

**Light Ends -- Low-boiling volatile materials in a petroleum fraction. They are often unwanted and undesirable, but in gasoline the proportion of light ends deliberately included are used to assist low-temperature starting.**

**Light obscuration -- the degree of light blockage as reflected in the transmitted light impinging on the photodiode.**

**Lip seal -- an elastomeric or metallic seal that prevents leakage in dynamic and static applications by a scraping or wiping action at a controlled interference between itself and the mating surface.**

**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.**

**Lithium Grease -- The most common type of grease today, based on lithium soaps.**

**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.**

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

**Lubrication -- The control of friction and wear by the introduction of a friction-reducing film between moving surfaces in contact. The lubricant used can be a fluid, solid, or plastic substance.**

**Lubricity -- ability of an oil or grease to lubricate; also called film strength.**

**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.**

**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".**

**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.**

**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, colloidally dispersed in some oils and greases.**

**Motor -- a device which converts fluid power into mechanical force and motion. It usually provides rotary mechanical motion.**

**MTBF -- an abbreviation for Mean Time Between Failures.**

**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.**

**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)**

**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.**

**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.**

**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.**

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

**Oiliness -- that property of a lubricant that produces low friction under conditions of boundary lubrication. The lower the friction, the greater the oiliness.**

**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.**

**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.**

**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.**

**Paraffinic -- a type of petroleum fluid derived from paraffinic crude oil and containing a high proportion of straight chain saturated hydrocarbons. 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.**

**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.**

**Permeability -- the relationship of flow per unit area to differential pressure across a filter medium.**

**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.**

**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".**

**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/CM2); 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.**

**Polyglycols -- Polymers of ethylene or propylene oxides used as a synthetic lubricant base. Properties include very good hydrolytic stability, high viscosity index (VI), and low volatility. Used particularly in water emulsion fluids.**

**Polymer -- A substance formed by the linkage (polymerization) of two or more simple, molecules, called monomers, to form a single larger molecule having the same elements in the same proportions as the original monomers; i.e. each monomer retains its structural identity. A polymer may be liquid or solid; solid polymers may consist of millions of repeated linked units. A polymer made from two or more similar monomers is called a copolymer; a copolymer composed of three different types of monomers is a terpolymer. Natural rubber and synthetic rubbers are examples of polymers. Polymers are commonly used as viscosity index improvers in multi-grade oils and tackifiers in lubricating greases.**

**Polyolefin -- A polymer derived by polymerization of relatively simple olefins. Polyethylene and polyisoprene are important polyolefins.**

**Polymerization -- the chemical combination of similar-type molecules to form larger molecules.**

**Polyol ester -- A synthetic lubricant base, formed by reacting fatty acids with a polyol (such as a glycol) derived from petroleum. Properties include good oxidation stability at high temperatures and low volatility. Used in formulating lubricants for turbines, compressors, jet engines, and automotive engines.**

**Polyol Esters -- Synthetic lubricants made by reacting fatty acids with polyhydric alcohols.**

**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.**

**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.**

**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.**

**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 maintenance strategy for stabilizing the reliability of machines or equipment. Its central theme involves directing corrective actions aimed at failure root causes, not active failure symptoms, faults, or machine wear conditions. A typical proactive maintenance regiment involves three steps: (1) setting a quantifiable target or standard relating to a root cause of concern (e.g., a target fluid cleanliness level for a lubricant), (2) implementing a maintenance program to control the root cause property to within the target level (e.g., routine exclusion or removal of contaminants), and (3) routine monitoring of the root cause property using a measurement technique (e.g., particle counting) to verify the current level is within the target.**

**PSIA -- pounds per square inch absolute. (PSIG + 14.696)**

**PSID -- pounds per square inch differential.**

**PSIG -- pounds per square inch gauge (PSIA - 14.696)**

**Pump -- a device which converts mechanical force and motion into hydraulic fluid power.**

**Pump, fixed displacement -- a pump in which the displacement per cycle cannot be varied.**

**R & O -- Rust-and-oxidation inhibited. A term applied to highly refined industrial lubricating oils formulated for long service in circulating lubrication systems, compressors, hydraulic systems, bearing housing, gear boxes, etc. The finest R&O oils are often referred to as turbine oils.**

**Rate of shear -- the difference between the velocities along the parallel faces of a fluid element divided by the distance between the faces.**

**Refining -- A series of processes for converting crude oil and its fractions to finished petroleum products. Following distillation, a petroleum fraction may undergo one or more additional steps to purify or modify it. These refining steps include; thermal cracking, catalytic cracking, polymerization, alkylation, reforming, hydrocracking, hydroforming, hydrogenation, hydrogen treating, hydrofining, solvent extraction, dewaxing, deoiling, acid treating, clay filtration, and deasphalting. Refined lubricating oils may be blended with other lube stocks, and additives may be incorporated, to impart special properties.**

**Refraction -- the change of direction or speed of light as it passes from one medium to another.**

**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.**

**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.**

**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.).**

**Reynold's number -- A numerical ratio of the dynamic forces of mass flow to the shear stress due to viscosity. Flow usually changes from laminar to turbulent between Reynold?s Number 2,000 and 4,000.**

**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.**

**Roller bearing -- an antifriction bearing comprising rolling elements in the form of rollers.**

**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.**

**Sample preparation -- fluid factors that can enhance the accuracy of the particulate analysis. Such factors include particle dispersion, particle settling, and sample dilution.**

**Saponification number -- The number of milligrams of potassium hydroxide (KOH) that combine with one gram of oil under conditions specified by test method ASTM D 94. Saponification number is an indication of the amount of fatty saponifiable material in compounded oil. Caution must be used in interpreting test results if certain substances - such as sulfur compounds or halogens - are present in the oil, since these also react with KOH, thereby increasing the apparent Saponification number.**

**Saturation level -- the amount of water that can dissolve in a fluid.**

**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.)**

**Scuffing -- abnormal 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.**

**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.**

**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 µm and less in size.**

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

**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.**

**Solvency -- ability of a fluid to dissolve inorganic materials and polymers, which is a function of aromaticity.**

**Solvent -- A material with a strong capability to dissolve a given substance. The most common petroleum solvents are mineral spirits, xylene, toluene, hexane, heptane, and naphthas. Aromatic-type solvents have the highest solvency for organic chemical materials,**

**followed by naphthenes and paraffins. In most applications, the solvent disappears, usually by evaporation, after it has served its purpose. The evaporation rate of a solvent is very important in manufacture.**

**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 spectrographically for the presence of key elements.**

**Spin-on filter -- a throw-away type bowl and element assembly that mates with a permanently installed head.**

**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.**

**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 µm)**

**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/cm2.**

**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.**

**Swarf -- the cuttings, and grinding fines that result from metal working operations.**

**Switch, pressure -- an electric switch operated by fluid pressure.**

**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 hydrocarbon -- oil molecule with superior oxidation quality tailored primarily out of paraffinic materials.**

**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 -- that property of a lubricating grease which is manifested by a softening in consistency as a result of shearing followed by a hardening in consistency starting immediately after the shearing is stopped.**

**Three-body abrasion -- a particulate wear process by which particles are pressed between two sliding surfaces.**

**Thrust Bearing -- an axial-load bearing.**

**Total Acid Number (TAN) -- the quantity of base, expressed in milligrams of potassium hydroxide, that is required to neutralize all acidic constituents present in 1 gram of sample. (ASTM Designation D 974.)**

**Total Base Number (TBN) -- the quantity of acid, expressed in terms of the equivalent number of milligrams of potassium hydroxide that is required to neutralize all basic constituents present in 1 gram of sample. (ASTM Designation D 974.)**

**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.**

**Unloading -- the release of contaminant that was initially captured by the filter medium.**

**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.**

**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, which is defined as the force in dynes required to move a surface one square centimeter in area past a parallel surface at a speed of one centimeter per second, with the surfaces separated by a fluid film one centimeter thick. In addition to**

**kinematic viscosity, there are other methods for determining viscosity, including Saybolt Universal Viscosity (SUV), Saybolt Furol viscosity, Engier viscosity, and Redwood viscosity. Since viscosity varies in 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, 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 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.**

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

**Wicking -- the vertical absorption of a liquid into a porous material by capillary forces.**

**ZDDP -- an antiwear additive found in many types of hydraulic and lubricating fluids. Zinc dialkyldithiophosphate.**

## ABBREVIATIONS, PREFIXES, AND LETTER SYMBOLS

**ASLE -- American Society of Lubrication Engineers. Changed now to Society of Tribologist and Lubrication Engineers (STLE).**
**ASME -- American Society of Mechanical Engineers**
**ASTM -- American Society for Testing Materials**
**ANSI -- American National Standards Institute**
**atm – atmosphere**
**BTU -- British thermal unit**
**C or cent. -- centigrade**
**cc -- cubic centimeter**
**cm -- centimeter**
**cfm -- cubic feet per minute**
**GPM -- gallons per minute**
**hp or HP -- horsepower**
**HVI -- High Viscosity Index, typically from 80 to 110 VI units.**
**Hz -- Hertz (cycles per second)**
**ISO -- International Standards Organization, sets viscosity reference scales.**
**JIC -- Joint Industry Conference**
**kg -- kilograms**
**km -- kilometer**
**kHz -- thousand Hertz (cycles per second)**
**log -- logarithm (common)**
**LVI -- Low Viscosity Index, typically below 40 VI units.**
**MIL -- military**
**M -- meter**
**µm -- micron (micro-meter)**
**NFPA -- National Fluid Power Association**
**NEMA -- National Electrical Manufacturers Association**
**NEC -- National Electrical Code**
**NAS -- National Aerospace Standard**
**NASA -- National Aeronautics and Space Administration**
**psi -- pounds per square inch**
**psia -- pounds per square inch absolute**
**rpm -- revolutions per minute**
**SAE -- Society of Automotive Engineers, an organization serving the automotive industry.**

**SSU -- Saybolt Universal Seconds (or SUS), a unit of measure used to indicate viscosity, e.g., SSU @ 100° F**
**STLE -- Society of Tribologist and Lubrication Engineers, formerly ASLE, American Society of Lubrication Engineers.**
**P -- pressure - psi**
**PPM -- parts per million (1/ppm = 0.000001). Generally by weight. 100 ppm = 0.01%; 10,000 ppm = 1%**
**Q -- flow rate - GPM**
**t -- time in seconds**
**P -- pressure drop psid**
**T -- temperature change, Fahrenheit**
**V -- total volume (gals)**

**PREFIXES - U.S. TERM**

**kilo -- Thousand**
**mega -- Million**
**centi -- Hundredth**
**milli -- Thousandth**
**micro -- Millionth**

**CLEANLINESS DEFINITIONS**

**Clean-- 100 particles >10 micron per milliliter**
**Superclean-- 10 particles >10 micron per milliliter**
**Ultraclean-- 1 particle >10 micron per milliliter**