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ACEA – (Association des Constructeurs Européens d'Automobiles) Was know as CCMC, it's the European equivalent of API.

ACID NUMBER - (see NEUT NUMBER)

AGMA - American Gear Manufacturers Association, one of whose activities is the establishment and promotion of standards for gear lubricants.

ANTI-FOAM AGENT - (see FOAM INHIBITOR)

ANTI-WEAR AGENT - An additive that minimizes wear caused by metal-to-metal contact during conditions of mild boundary lubrication (e.g. stops and starts, oscillating motion). The additive reacts chemically with, and forms a film on, metal surfaces under normal operating conditions.

ANTI-OXIDANT - (see OXIDATION INHIBITOR)

API - (American Petroleum Institute) - society organized to further the interests of the petroleum industry, in which capacity, it serves to clear information, conduct research, improve marketing conditions, etc. One of the Institute's activities has been the development of the API SERVICE CLASSIFICATIONS for crankcase oils.

ASH CONTENT - non-combustible residue of a lubricating oil (also fuels) determined in accordance with ASTM D582 - also D874 (sulphated ash). Since some detergents are metallic salts or compounds, the percentage of ash has been considered to have a relationship to detergency. Interpretations can be grossly distorted, however, for the following reasons: 1. Detergency depends on the properties of the base oil as well as on the additive. Some combinations of base oil and additive are much more effective than others. 2. Detergents vary considerably in their potency, and some leave more ash than others. Organic detergents have been developed, in fact, that leave no ash at all. 3. Some of the ash may be contributed by additives other than detergents. 4. There appears to be a limit to the effective concentration of detergent. Nothing is gained by exceeding this limit, and a superabundance of detergent may actually reduce cleanliness.

ASLE - (American Society of Lubrication Engineers) - the former name of an organization involved with friction, wear, and lubrication, which is now known as the Society of Tribologists and Lubrication Engineers (STLE).

ing and Materials) - organization devoted to the promotion of knowledge of the materials of engineering, and the standardization of specifications and methods of testing." A preponderance of the data used to describe, identify, or specify petroleum products is determined in accordance with ASTM Test Methods.

AUTO IGNITION TEMPERATURE - See description under FLASH

BASE NUMBER - (see NEUT NUMBER)

BLOCK GREASE - A very firm grease manufactured in block form to be applied to certain large open plain bearings operating at high temperatures and slow speeds.

BOUNDARY LUBRICATION - a state of lubrication characterized by partial contact between two metal surfaces, and partial separation of the surfaces by a fluid film of lubricant. Due to metal-metal contact, severe wear can take place during boundary lubrication. Specific additives in certain lubricants will minimize wear under boundary lubrication conditions. These additives prevent excessive friction and scoring by providing a film on the metal surface. There are varying degrees of boundary lubrication, and they are met with various additive types. For the milder conditions, OILINESS ADDITIVES may be used. These are polar materials that are oil soluble and have an exceptionally high affinity for metal surfaces. Plating out on these surfaces in a thin but durable film, oiliness additives give protection under some conditions that are too severe for a straight mineral oil. In addition, COMPOUNDED OILS which are formulated with polar fatty oils, are sometimes used for this purpose. Another class of boundary lubricants are those which contain ANTI-WEAR ADDITIVES. These additives, typically zinc-phosphorus compounds, reduce the wear of metal surfaces, as distinct from reducing the possibility of scoring. High quality engine oils contain anti-wear additives to protect the heavily loaded parts of modern engines, particularly valve trains. The more severe cases of boundary lubrication are defined as EXTREME PRESSURE (EP) conditions. These conditions are met with lubricants which contain EP additives. Under the less severe EP conditions, as in certain worm gear or shock loaded applications, a mild EP additive such as sulphurized fatty oils may be used. For somewhat more severe EP conditions, as occurs in many industrial gear sets, a moderate EP additive package is used. Under the most severe extreme pressure conditions, as occurs in automotive hypoid gears and in many rolling mill applications, for example, more active EP compounds containing sulphur, chlorine and/or phosphorus may be used. At the very high local temperatures associated with metal contact, these additives

to form a surface film. Not only is it, but it prevents the welding of opposing asperities (high points) and the consequent scoring that is destructive to sliding surfaces.

BROOKFIELD VISCOSITY - viscosity, in centipoises, as determined on the Brookfield viscometer (ASTM D2983). The operating principle for the Brookfield viscometer is the torque resistance on a spindle rotating in the fluid being tested. Although Brookfield viscosities are most frequently associated with low temperature properties of gear oils and transmission fluids, they are in fact determined for many other types of lubricant.

CARBON RESIDUE - percent of coked material remaining after a sample of lubricating oil has been exposed to high temperatures under ASTM Method D189 (Conradson) or D524 (Ramsbottom). While carbon residue may have significance in the evaluation of roll oils and pneumatic-tool lubricants, it should be interpreted with caution. There may be little similarity between conditions of test and conditions of service. As far as the effects of residue on performance go, moreover, many consider that the type of carbon is of greater significance than the quantity.

CENTISTOKE (cSt) - (see VISCOSITY)

CENTIPOISE (cP) - (see VISCOSITY)

CGSB - (Canadian General Standards Board) - a consensus organization composed of people representing producers, users, and general interest groups, which develops standards for products and test methods specifically required in Canada.

CHANNELLING - formation of a "groove" in grease (or in oil too viscous to flow readily under existing conditions). Channels are cut by the motion of a lubricated element, such as a gear or the rolling member of an anti-friction bearing. The amount of channelling can be controlled to a large extent by the consistency or viscosity of the lubricant. While some degree of channelling is desirable to prevent excessive churning of the lubricant, particularly in high speed rolling element bearings, a channel so permanent as to preclude further movement of lubricant to the contacting surfaces might cause equipment failure due to lack of lubricant.

CLOUD POINT - (see POUR POINT)

COMPOUNDED OIL - a blend of petroleum oil with small amounts of fatty or synthetic fatty oils is referred to as COMPOUNDING.

enable the oil to combine physically with the water instead of being displaced by it. Cylinder oils for wet steam applications and for some air compressors are compounded. Because the fatty material imparts a strong affinity for metal surfaces, moreover, compounded oils are frequently used for applications in which lubricity or extra load carrying ability are needed. They are not generally recommended, however, for service that requires high oxidation stability. (See BOUNDARY LUBRICATION).

COPPER STRIP CORROSION - evaluation of a product's tendency to corrode copper or copper alloys, ASTM D130. Test results are based on the matching of corrosion stains. Non corrosiveness is not to be confused with rust inhibiting, which deals with the protection of a surface from some contaminant, such as water, rather than from the oil itself.

CORROSION INHIBITOR - a lubricant additive for protecting surfaces against chemical attack from contaminants in the lubricant. The most common types of corrosion inhibitors generally react chemically with the metal surfaces to be protected, thus forming an inert film in these areas.

DEMULSIBILITY - test time required for a specified oil-water emulsion to break, using ASTM D1401 test method. Highly refined straight mineral oils have inherently good demulsibility. Even after violently shaking an oil/water mixture, the oil separates and rises rapidly to the top of the water. This is true also of other oils formulated for good demulsibility. It is a desirable characteristic of oils such as circulating oils that must separate from water readily. Demulsibility is thus a measure of a lubricating oil's ability to separate from water, an important consideration in the maintenance of many circulating oil systems.

DETERGENT - an additive in crankcase oils generally combined with dispersant additives. A detergent chemically neutralizes acidic contaminants in the oil before they become insoluble and fall out of the oil, forming sludge. Neutral or basic compounds are created which can remain in suspension in the oil. DISPERSANTS operate to break up insoluble contaminant particles already formed. Particles are kept finely divided so that they can remain "dispersed" or colloiddally suspended in the oil.

DISPERSANT - (see DETERGENT)

DROPPING POINT - the temperature at which a grease changes from

purposes.

st conditions. It may be considered
the limitation for application

EMULSION - a mechanical mixture of two mutually insoluble liquids (such as oil and water). Emulsification may or may not be desirable, depending on circumstances. Soluble cutting oils are designed with an emulsifier to maintain a stable emulsion of oil and water for lubricating and cooling machining operations.

EP AGENT - an additive to improve the extreme pressure properties of a lubricant. (see BOUNDARY LUBRICATION)

FIRE POINT - (see FLASH POINT)

FLASH POINT - minimum temperature of a petroleum product or other combustible fluid at which vapour is produced at a rate sufficient to yield a combustible mixture. Specifically, it is the lowest sample temperature at which the air vapour mixture will "flash" in the presence of a small flame. Flash point may be determined by the following ASTM Methods: CLOSED CUP (covered sample container): D93 "Flash Point by Pensky-Martens Closed Test" for fuel oils - also for cutback asphalts and other viscous materials and suspensions of solids: OPEN CUP (uncovered sample container): D92 "Flash and Fire Points by Cleveland Open Cup: for lubricating oils. As indicated, this last method provides also for the determination of a FIRE POINT. Fire point is the minimum sample temperature at which vapour is produced at a sufficient rate to sustain combustion. Specifically, it is the lowest sample temperature at which the ignited vapour persists in burning for at least 5 seconds. Since the fire points of commercial petroleum oils ordinarily run about 30°C above the corresponding flash point, they are often omitted from petroleum product data. Flash and fire points have obvious safety connotations - the higher the test temperature the less the hazard of fire or explosion. Of comparable significance, however, is their value in providing a simple indication of volatility, where a lower flash point denotes a more volatile material. The dilution of a crankcase oil with fuel, for example, lowers the flash point. Flash and fire points should not be confused with AUTO-IGNITION TEMPERATURE, the temperature at which combustion occurs spontaneously (without an external source of ignition). FOAM INHIBITOR - an additive which causes foam to dissipate more rapidly. It promotes the combination of small bubbles into large bubbles which burst more easily.

FOUR BALL TESTS - two test procedures based on the same principle - the Four-Ball EP Test (ASTM D2596) and Four-Ball Wear Test (ASTM D2266). The three lower balls are clamped together to form a cradle upon which the fourth ball rotates in a vertical axis. The balls

investigation. The FOUR BALL test is a relative wear preventing test. The test is carried out at a specified speed, temperature, and load. At the end of a specified period, the average diameter of the wear scar on the three lower balls is reported. The FOUR-BALL EP TEST is designed to evaluate performance under much higher unit loads. In this test the top ball is rotated at a specified speed (1700 ± 60 rpm), but temperature is not controlled. The loading is increased at specified intervals until the rotating ball seizes and welds to the other balls. At the end of each interval the average scar diameter is recorded. Two values are generally reported - LOAD WEAR INDEX (formerly mean Hertz load) and WELD POINT.

HYDROCRACKING - is a process, which is used by a few manufacturers of superior quality lubricant basestock. In the process, a petroleum feedstock is reacted with hydrogen, in the presence of a catalyst, at very high temperatures ($400-425^{\circ}\text{C}$) and pressures (3000 plus psi). Under these severe conditions, virtually all the aromatic hydrocarbons present are cracked and saturated to yield a basestock containing 96% to 99.5+% saturated hydrocarbons. The process also eliminates all traces of sulphur, nitrogen and oxygen containing impurities. Hydrocracking produces very high quality, synthetic-like, basestocks, which when blended with carefully selected additives, give extremely stable lubricants, which perform similarly to synthetic products.

HYDROFINISHING - (see HYDROTREATING)

HYDROTREATING - a generic name for a refinery process for treating fuels and lubricant feedstocks, at elevated temperatures, in the presence of hydrogen and a catalyst. This relatively mild process, is sometimes called "Hydrofinishing" and is used to improve the colour and odour of fuels and lubricant basestocks.

HYDRODYNAMIC LUBRICATION - a lubrication regime characterized by a full fluid film between two moving surfaces. The most common example is the type of lubrication which occurs in oil lubricated journal bearings. The movement of one surface (the shaft or journal) "pulls" lubricating oil into the space between the journal and the bearing. This action develops a high pressure in the fluid which completely separates the two surfaces. By contrast, in boundary lubrication there is only a partial fluid film separating the two surfaces and some surface-to-surface contact occurs.

INHIBITOR - additive for the control of an undesirable phenomenon in grease, oils, or fuels, etc., for example: oxidation inhibitors, rust

ISO - (International Organization for Standardization) - an organization which establishes internationally recognized standards for products and test methods. One example is the ISO Viscosity Grade system for industrial oils.

NEUT NUMBER - or **NEUTRALIZATION NUMBER**: the specific quantity of reagent required to "neutralize" the acidity or alkalinity of a lube oil sample. Either of these characteristics - acidity or alkalinity - may be exhibited by an unused oil, depending on its composition. In addition, certain additives impart acidity, while alkalinity may be derived from the presence of detergents or of basic material added to control oxidation. In service, the oil will, in time, show increasing acidity as the result of oxidation and, in some cases, additive depletion. Though acidity is not, of itself, necessarily harmful, an increase in acidity may be indicative of oil deterioration, and neut number is widely used to evaluate the condition of an oil in service. The most common measurement is **ACID NUMBER**, the specific quantity of KOH (potassium hydroxide) required to counterbalance the acid characteristics. How high an acid number can be tolerated depends on the oil and the service conditions; and only broad experience with the individual situation can determine such a value. Neut number is determined in accordance with the ASTM Method D664 or D974. The former is a potentiometric method, the latter, colorimetric. Values for **TOTAL ACID**, **STRONG ACID**, **TOTAL BASE**, and **STRONG BASE** can, where they exist, be obtained. Strong acid numbers are considered to be related to inorganic acids, such as those derived from sulfur, while the difference between the total and strong acid numbers is attributed to weak (organic) acids - possibly the products of oxidation. A total acid number (**TAN**) and a total base number (**TBN**) - can exist simultaneously, both representing components too weak to completely neutralize the other. When results are reported simply as "neut number" or "acid number", a **TOTAL ACID NUMBER (TAN)** is implied.

OXIDATION - A form of chemical deterioration to which petroleum products - like most other organic materials - are subject. The resistance of many petroleum products to oxidation, however, is very high. Oxidation usually involves the addition of oxygen atoms, and the result is nearly always one of degradation. It is accelerated by higher temperatures, the reaction becoming significant at temperatures above 70°C. For every 10°C rise, the rate of oxidation doubles. Oxidation is also promoted by the presence of catalytic metals, copper being particularly active in this latter respect. What is more, the peroxides that are the initial products of oxidation are themselves oxidizing agents. So the oxidation of petroleum products is a chain reaction; the farther it progresses, the more rapid it becomes. With fuels and lube

minishes, gums, and acids, all of which, many oils, such as turbine oils, give years of service without need for replacement. Petroleum products that require a long service or storage life can be formulated to meet requirements by: 1. proper selection of crude type. Paraffinic oils are noted for natural resistance to oxidation: 2. thorough refining, which removes oxidation-susceptible materials and allows greater response to inhibitor; 3. addition of oxidation inhibitors. Long service is also promoted by good maintenance practices - filtration, centrifuging, or other means of controlling contamination; limiting duration or intensity of high temperatures; eliminating the presence of air and of catalytic metals. For information on determining the degree of deterioration sustained by a used oil and hence, its suitability for further service, (see NEUT NUMBER.)

OXIDATION INHIBITOR - chemical added in small quantities to a petroleum product to increase its oxidation resistance and, hence, to lengthen its service or storage life. An oxidation inhibitor may combine with the peroxides formed initially by oxidation, thereby modifying them in such a way as to arrest their oxidizing influence. Or the inhibitor (a passivator) may react with a catalyst either to "poison" it or to coat it with an inert film.

POISE - CGS unit of absolute viscosity: shear stress (in dynes per square centimeter) required to move one layer of fluid along another over a total layer thickness of one centimeter at a shear rate of one centimeter per second. Dimensions are dyne-sec/cm². The CENTIPOISE (cP) is 1/100 of a poise and is the unit of absolute viscosity most commonly used. Whereas ordinary viscosity measurements depend on the force of gravity on the fluid to supply the shear stress and are thus subject to distortion by differences in fluid density, ABSOLUTE VISCOSITY measurements are independent of density and are directly related to resistance to flow. (See also VISCOSITY.)

POUR POINT - is a widely used low temperature flow indicator and is 3°C above the temperature to which a normally liquid petroleum product maintains fluidity. It is a significant factor in cold weather start-up, but must be considered along with pumpability, the ease with which an oil pumps at low temperatures. Paraffinic oils contain wax which forms a honeycomb of crystals at low temperatures near the pour point. However, agitation by a pump breaks down this wax structure and allows paraffinic oil to be pumped at temperatures well below their pour point. Naphthenic oils, on the other hand, contain little or no wax and reach their pour point through increase in viscosity: they cannot be pumped readily near the pour point. ASTM D97 is used to determine pour point. ASTM D97 also provides for the determination of CLOUD

which the sample becomes clouded. Clouding is a characteristic only of paraffinic oils. It is a consideration in the evaluation of fuels whose filtration might be impaired by the plugging effect of wax crystals.

RUST INHIBITOR - a lubricant additive for protecting ferrous (iron and steel) components from rusting caused by water contamination or other harmful materials from oil degradation. Some rust inhibitors operate similarly to corrosion inhibitors by reacting chemically to form an inert film on metal surfaces. Other rust inhibitors absorb water by incorporating it into water-in-oil emulsion so that only the oil touches the metal surfaces.

SCUFFING - engine wear resulting from the localized welding and fracture of rubbing surfaces.

SOLVENT EXTRACTION - a traditional refinery process that is used to upgrade chemical and physical properties in the manufacture of lube oil base stocks. The process relies on the solubility of impurities (especially aromatic components that may also contain sulphur and nitrogen) in an extractive solvent usually furfural or phenol. The byproduct of this process is highly aromatic EXTRACT, used to make EXTENDER oils, and as feed for other refinery processes.

STLE - (Society of Tribologists and Lubrication Engineers) - formerly known as ASLE.

SULPHATED ASH - (see ASH)

SYNTHETIC LUBRICANTS - lube oils possessing a base oil that has been manufactured from chemical constituents or by polymerization of hydrocarbons (olefins) rather than by conventional refining of petroleum. The three most common types of synthetic base oil are: i) Polyalphaolefins ii) Organic esters iii) Polyglycols.

Synthetic lubricants have several advantages over conventional mineral oils:

- excellent low temperature fluidity
- low pour point
- high natural viscosity index
- excellent oxidation stability
- high flash, fire, and auto-ignition points
- low volatility
- non-corrosive and non-toxic

Synthetic lubricants have been in use for some time in applications such as jet engine lubrication, Arctic lubricants, and fire resistant hydraulic fluids. These applications tolerate the extremely high cost of synthetics because they are the only products which can do the job. Synthetic

replace conventional petroleum lubricants. Despite their much higher purchase price, synthetics may offer operating advantages that can make them more economical in the long run. (For example, reduced oil consumption, longer oil life, improved fuel economy, and easier starting at low temperatures).

TIMKEN OK LOAD - measure of the extreme pressure properties of a lubricant. Lubricated by the product under investigation, a standard steel roller rotates against a block. Timken OK load is the heaviest load that can be carried without scoring.

TOTAL BASE NUMBER - (see NEUT NUMBER)

VISCOSITY - measure of a fluid's resistance to flow. It is ordinarily expressed in terms of the time required for a standard quantity of the fluid at a certain temperature to flow through a standard orifice. The higher the value, the more viscous the fluid. Since viscosity varies inversely with temperature, its value is meaningless unless accompanied by the temperature at which it is determined. With petroleum oils, viscosity is now commonly reported in CENTISTOKES (cSt), measured at either 40°C or 100°C (ASTM Method D445 - Kinematic Viscosity). An earlier method for reporting viscosity in North America was in Saybolt Seconds Universal - SSU or SUS - or, for very viscous oils, in Saybolt Seconds Furol - SSF (ASTM Method D88). Other less common viscosity units are the ENGLER and REDWOOD scales, principally used in Europe. (See also BROOKFIELD VISCOSITY, POISE.)

VISCOSITY INDEX (V.I.) - the measure of the rate of change of viscosity with temperature. This change is common to all fluids - some more, some less. Heating tends to make them thinner, - cooling, thicker. The higher the V.I., the less the tendency for the viscosity to change. V.I. is determined by formula from the viscosities at 40°C and 100°C in accordance with the ASTM Test Method D567 or D2270. The latter test is required for V.I.'s above 100. High V.I. oils are often preferred for service in which a relatively constant viscosity is desired under conditions of varying temperature. Some hydraulic systems require this property. Paraffinic oils are inherently high in V.I., and the V.I. of any petroleum oil can be increased by the addition of a V.I. improver. Naphthenic oils are inherently low in V.I. and aromatic oils are still lower - often having negative numbers.

VOLATILITY - that property of a liquid that defines its evaporation characteristics. Of two liquids, the more volatile will boil at a lower temperature, and it will evaporate faster when both liquids are at the same temperature. The volatility of petroleum products can be



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