GREASES

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Business Opportunities

Business Opportunities in the Emerging Lubricant Markets of South Asia, The Middle East, and Northern Africa, 2005-2015

- Economic, political, and regulatory forces are reshaping the dynamics of lubricants supply and demand throughout the world, and opportunities to grow this business continue to emerge.

- These markets differ significantly from each other in terms of volumes and performance levels of lubricants consumed, but each of these markets has significant potential to increase consumption and improve quality levels, thereby offering exciting opportunities to lubricant product blenders and marketers.

South Asia, The Middle East, and Northern Africa

- These markets have emerged as a key growth market as well as a source of competitively priced lubricants that could eventually affect mature markets such as the United States and Western Europe. Growth in South Asia is being driven by fast-growing economies as well as increasing levels of disposable income. Growing awareness of vehicle emissions as a source of air pollution is driving environmental regulation, which will force commercial fleets across the region to modernize. This in turn will create a small but growing market for higher-performance engine oils.

Lubricant Market Size 2005

Region	Market Size - Million MT
Middle East GCC & others	1.520
South Asia India, Pakistan, Bangla Desh, Sri Lanka, Nepal & others	1.293
North Africa Egypt, Algeria, Libya, Morocco, Sudan Tunisia	0.802

Organization and Structure

Manufacturers in this industry compete directly with petroleum refiners in many instances. However, the increasing degree of specialization required within the lubricants market gives lubricant manufacturers an edge over general refiners because specialized equipment and multiple blending agents are more difficult to maintain in an integrated refining plant than in a lubricants plant.

GREASES

Total overall global grease consumption for all segments at nearly 1.3 million tons in 2011.

Grease Consumption in 2007

Region	Quantity MT	%
North America	236,000	22.6
Europe	209,000	20
China	279,000	26.7
Japan, India, Middle East, Africa	277,455	26.5
Rest of World	43974	4.2
Total	1,047,000	100

GREASES

- A solid or semisolid lubricant consisting of a thickening agent (soap or other additives) in a fluid lubricant (usually petroleum lubricating oil) is called grease.
- Grease is a lubricant which has been thickened in order that it remains in contact with moving surfaces and not leak out under gravity or centrifugal action.
- ASTM defines lubricating grease as “A solid to semi-solid product consisting of dispersion of a thickening agent in a liquid lubricant.”

GREASES

Grease is a mixture of chemicals and inevitably, chemistry contributes fundamentally to the design and manufacture of the product. However, it is the understanding of tribology, the science of friction and abrasion, coupled with a knowledge of the rheology of grease, the deformation characteristics of the lubricant, which drive innovation forward.

Grease Construction

Greases are used where a mechanism can only be lubricated infrequently and where a lubricating oil would not stay in position. In general greases contain

- 70-95% of base oils,
- 5-20% of thickening agent, and
- 0-10% of additives.

Grease is not simply a highly viscous oil but a complex, physical, multi-phase system. It can demonstrate the properties of a solid or a liquid, depending on the conditions to which it is subjected.

Greases - Rheology

Greases, as a category, fall into a classification of materials called non-Newtonian fluids. All fluids that experience a change in viscosity with change in shear stress are considered non-Newtonian. Mayonnaise, ketchup and hair gel are examples of common household non-Newtonian fluids. Greases that exhibit shear-induced thinning are referred to as thixotropic greases, and those that exhibit shear-induced thickening are referred to as rheopectic greases.

Greases - Rheology

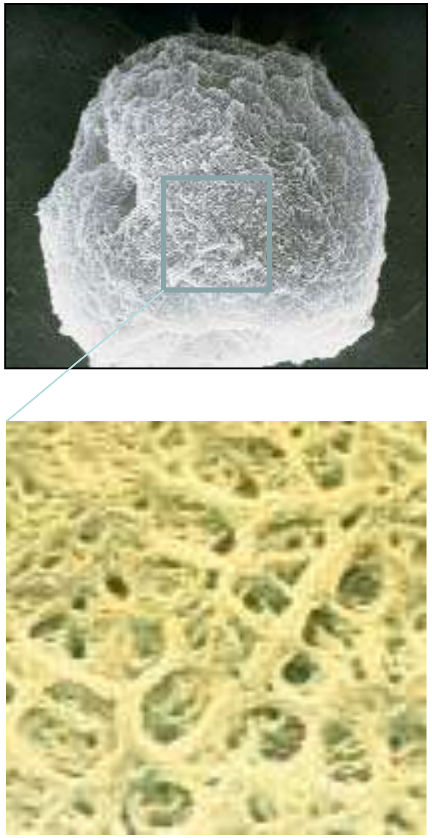
Both thixotropic and rheopectic responses are time dependent, meaning the thinning or thickening effect is more pronounced as the period of shear stress increases. In other words, thixotropic greases tend to liquefy as the elements in the machine squeeze, push and otherwise stress the fluid, and rheopectic greases tend to harden under the same types of mechanical force.

Greases - Rheology

It would be ideal for the grease to “work thin” only at the point of immediate shear stress (motion of the lubricated component) and then instantaneously return to its original state the moment the stress force stops. If this condition existed, the grease would liquefy and function more like an oil at the point of motion and then reform and create an isolating seal when the motion stops. Unfortunately, the thinning and thickening effects tend to be permanent.

Greases-Morphology

Greases perform their lubrication function over time by gradually releasing oil into the working areas of the contacting machine surfaces. This function has been compared to that of a sponge gradually releasing its liquid over a period of time. A more practical image would be of a concentration of millions of microscopic sponges held inside the machine, close to the working machine components, each one gradually releasing oil into the work zone.



Greases-Morphology

The greater the amount of sheer stress that the grease experiences (likened to squeezing the sponge) the faster the grease releases its hold of oil. Of course, once the sponge has released the oil, its usefulness is done. The oil and additive types contained within the sponge, and eventually released into the working areas of the machine, are selected based on the type of frictional conditions expected.

Mineral Oils

- These mineral oils can contain a very wide spectrum of chemical components, depending on the origin and composition of the crude oil as well as the refining processes to which they have been submitted.
- Modern base oils in lubricating greases are therefore often a blend of severely refined paraffinic and naphthenic oils, designed to provide the final product with the appropriate characteristics of mechanical stability, lubricity and dropping point.

Synthetic Fluids

- Synthetic fluids can be tailored to provide properties that might be impossible to achieve using conventional mineral oil products. Typical examples are applications with a wider range of operating temperatures or where chemical resistance is required.
- Environmental considerations, such as biodegradability, are increasingly becoming factors influencing the selection of synthetics.

POLYALPHAOLEFIN (PAO)

Polyalphaolefins are low molecular weight synthetic polymers, which provide advantages in oxidation stability coupled with good viscosity characteristics over a wide range of temperatures. Greases made from PAO exhibit excellent low temperature properties and can offer low friction and optimum energy saving performance.

ESTERS

- Synthetic esters are produced from a variety of long-chain fatty acids, derived from petrochemical or renewable animal or vegetable sources.
- The large range of esters available generally offers good thermal stability, lubricity and, in some cases, excellent biodegradability.
- Ester based greases offer enhanced physical performance at low temperatures, combined with low evaporation losses at high temperatures, and this makes them useful in a wide range of applications and environments.

POLYGLYCOLS

- In grease, a correctly selected polyglycol offers excellent performance opportunities, including a wide temperature range, specific rheological properties, exceptional thermal stability and good compatibility with plastics and rubbers.
- Some polyglycols offer advantages at high temperatures, where their degradation products evaporate completely, leaving no harmful residue.
- Unfortunately, most polyglycol greases are incompatible with mineral oil based products and relubrication with the wrong product can be extremely problematic.

POLYETHERS

- In their chemical structure, polyethers provide a particularly inert polymerised backbone, and this property is further enhanced in the fluorinated polyether derivatives.
- Perfluoropolyethers are inert to almost all types of chemicals, leading to their use in application areas where such exposure is expected. Typical examples are the lubrication of bearings in contact with strong acids and alkalis, with aggressive solvents, or indeed, with oxygen.
- These fluoroethers also have a very low tendency to evaporate and can be used in high vacuum equipment. The fact that they do not react with oxygen is also very beneficial in high temperature applications.

Thickeners

- Compared with a fluid base oil, the thickener system within a grease provides viscosity and elasticity benefits, which will result in higher temperature performance and better load carrying capabilities.
- In most grease applications, the thickener acts as an active component at the interface between the equipment surfaces. Protective effects are enhanced by selecting a thickener with the right chemical polarity, resulting in strong attraction to the metal surface of the machine component.
- A multi-phase system comprising of a thickener and a base oil can also improve performance at low temperatures since the thickener system can counteract any tendency of the fluid lubricant to crystallizes as operating temperatures fall.
- **Metal soaps have been dominant in the progress of thickener development.**

Soap & Non Soap Based Thickners

Depending on type of thickening agents different types of greases are classified as follows.

Soap Based

- **Calcium**
- **Lithium**
- **Titanium**
- **Sodium**
- **Aluminium**

Non Soap Based

Clay

Polyurea & Others

Aluminum Greases

- Aluminum and aluminum complex greases are known to have strong high-temperature performance characteristics, including high dropping points and very good oxidationresistance.
- Aluminum-based greases also tend to perform well in high-wash applications, resisting the force of process waters and housekeeping wash hoses. These greases tend to be stringy, and this characteristic increases with rising sustained application temperature.
- These greases have been known to stiffen with extended use.

Calcium Soap Greases

Calcium, calcium complex, calcium sulfonate complex greases are best known for their excellent wash- and water-resistance properties and can be fortified to also provide strong corrosion-resistance properties. The complex and sulfonate complex forms are respected for high load-carrying capabilities and have temperature limits on par with other complex soaps. Calcium (hydrous and anhydrous) are best used in low to moderate temperature applications and have acceptable stability at moderate temperatures.

Lithium Soap Greases

Lithium and lithium complex greases are very widely used. These have strong properties in a variety of categories. These greases have excellent long-term work stability, strong high-temperature characteristics and have acceptable wash- and corrosion- resistance capabilities. With additive enhancement, the wash- and corrosion-resistance can be improved. These also have good low temperature shear performance, making them suitable for extremely low temperature applications. The generally well-rounded performance of these greases has made them the product of choice for general purpose grease relubrication in industrial and manufacturing environments.

Non soap Thickeners Polyurea Greases

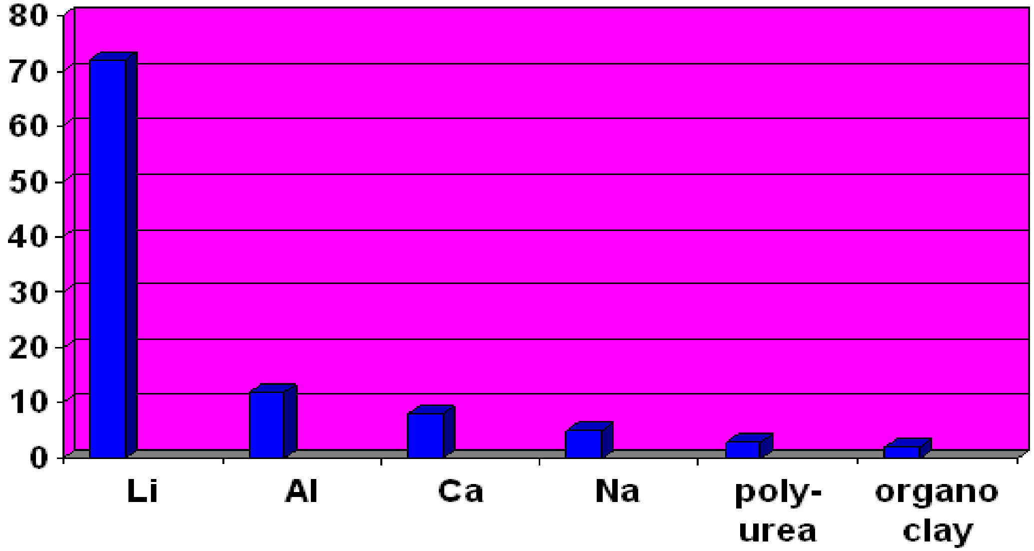
Polyurea greases are preferred for use in ball bearing applications, giving rise to their broad-based acceptance in electric motor applications. Polyurea greases contain little to no heavy metals and have favorable high temperature performance. Together these two traits provide very good oxidation-resistance. Polyureas tend to have fair work stability, wash- and corrosion-resistance. Some polyureas have a low level of compatibility with other soap and non-soap greases,

Clay Based Thickners

Bentonite greases were the original non melting grease. Bentonite is a type of clay. The base oils tend to evaporate before the clay material becomes hot enough to melt. This is both a strength and weakness. When used for extended periods of time at elevated temperatures, bentonite grease residues may cause a filling of the housing that can make long-term relubrication difficult. Bentonite greases are incompatible with most other grease types as well.

Market of Thickners

Conventional lithium is the most popular grease type in all regions, but leads lithium complex only by one percent in North America. Polyurea production accounted for a higher production percentage in Japan than in other regions. Hydrated calcium grease accounted for the second highest production in China, the Pacific region and in the Caribbean region.



Additives

- Additives can play several roles in lubricating grease. These primarily include enhancing the existing desirable properties, suppressing the existing undesirable properties, and imparting new properties.
- The most common additives are oxidation and rust inhibitors, extreme pressure, antiwear, and friction-reducing agents. In addition to these additives, boundary lubricants such as molybdenum disulfide or graphite may be suspended in the grease to reduce friction and wear without adverse chemical reactions to the metal surfaces during heavy loading and slow speeds

Additives & Functions

FUNCTIONS	TYPE OF ADDITIVES
Antioxidant	Phenols, Amines, Phosphorous Compound, Sulfur Compound
Extreme Pressure & Corrosion Inhibitor	Tricrysylphosphate, Amine Phosphate Triphenylthiphosphate
Rust Inhibitor	Barium & Calcium Sulphonates
Corrosion Inhibitor	Benzotrizoles, Mercapto Bnzothiozoles, Dimercaptothiozoles, Alkyl Benzene Sulphonates
Vi Improvers	Methacrylates.
Antiwear	ZDDP, Antimony Di Alkyl Dithio Phosphate
Water Repelling Agent	Fatty Oils
Tackiness Agent	Polymers
Friction Modifiers	MoS_2, Graphite

AIR – Powering the future

- Many wind turbines are located in places where access is difficult making maintenance such as re-lubrication of bearings, a tough task. A normal re-lubrication interval is somewhere around six months
- By using a non-polar thickener system (polypropylene), almost all additives can easily reach the metal surfaces of the bearing. This, in turn, makes it possible to minimise the amount of additives and improve lubricating performance.

EARTH – Breaking new ground

Yesterday, mining was a tough job for humans. Today, it is mainly a tough job for machines. A loader transports tens of tons of rocks, often in a cold and dusty environment. The heavy loads in combination with slow speeds make lubrication extremely difficult, because there is insufficient momentum to help separate the bearing surfaces and build a lubricating film.

LIFE – Eliminating the risks

- Complex industrial machinery needs lubrication. Even though these lubricants should not come into contact with the food itself, it is difficult to completely avoid incidental contamination.
- Special lubricating greases with medicinal grade white oils and specific soap based grease thickeners are contributing to safe, clean food production.

WATER – Surviving the waves

- Fishing is a tough environment for lubricating greases. In heavy seas when cold, salty waves constantly crash over deck everything takes a beating – hatches, winches, propeller housings. The grease has to stay in place to protect the equipment from wear and maintain its functions. Not an easy task.
- The key components are calcium as the thickener (cold-resilient) and a polymer-based oil (very sticky).

DEVELOPMENT OF TECHNOLOGY

- The driving forces in the search for improved thickeners are many and varied, but in general, the principle motivation is the desire to improve capabilities of grease across an increasingly wide range of operating conditions. Improved performance at high or low temperatures and, in some cases, capability at both extremes, remains an ongoing challenge.
- Water resistance, surface adhesion and tackiness, dropping point and compatibility with other greases are all properties where the selection of the right thickener is important. Increasingly, for centralised lubrication systems, pumpability is becoming an additional prerequisite. And finally as with all other grease components, human toxicology, ecotoxicology and biodegradability of the thickener have become important issues.

Summary …. So far

Grease manufacturing is a highly complex and detailed process. There are many different types of materials that may be used, each of which has some impact on the grease final performance characteristics. The two broad categories of greases in soap-thickened or non-soap thickened greases. While the thickener type does clearly have an influence on the long-term behavior of the grease, the majority of the surface protection work is provided by the oil and the additive choices. The NLGI grease stiffness rating system provides grease manufacturers with a clear mechanism for grading grease stiffness characteristics.

Organization and Structure

Manufacturers in this industry compete directly with petroleum refiners in many instances. However, the increasing degree of specialization required within the lubricants market gives lubricant manufacturers an edge over general refiners because specialized equipment and multiple blending agents are more difficult to maintain in an integrated refining plant than in a lubricants plant.

Organization and Structure

- The organization should be lean with research and development, production and sales all of the processes in are perfectly interlinked.
- Customers individual requirements need to be fulfilled in a creative and flexible manner.
- New discoveries and ideas should be rapidly implemented.
- Industrial lubricants must be always aligned with the latest economical and ecological standards.

NLGI Grease Consistency values

NLGI Grades	Consistency Similar to	Worked Penetration 60 Stokes @ 25 oC
000	Thick Cream	445-475
00	Tomato Sauce	400-430
0	Mustard	335- 385
1		310-340
2	Tomato Paste	265-295
3		220-250
4	Soft Cheese	175-205
5	Hard Cheese	130-160
6	Block of Wax	85-115

Cone Penetration Test

Greases for Automobile

- **Wheel Bearing Lubrication**

NLGI No.	Characteristics	Application
2	Lithium soap Excellent mechanical stability	Wheel bearing grease used for high speed and large sized vehicles. Also suitable for general bearings.

- **Break System**

NLGI No.	Characteristics	Application
2	Lithium soap Excellent compatibility with rubber	For where rubber is used, such as automobile shock absorber, door hinges, and shackle pins.
2	Lithium soap Excellent compatibility with rubber	Rubber grease for brakes. Employed by many automobile manufacturers.

Chassis and Joint Application

NLGI No.	Characteristics	Application
0 1 2	Calcium soap Strongly adhesive and water resistant Forms strong oil film	For lubrication of chassis. Also for bearing lubrication of low speed/light load vehicles.
- 00	Calcium soap, , Water resitant Lithium soap, Water resistant	For centralized greasing system of various construction machinery and automatic greasing system for automotive chassis. (Tube package is for auto-greasing use.)
00	Lithium soap Good pumpability	For use in automatic greasing system for automotive chassis.

Construction Machinery

NLGI No.	Characteristics	Application
2	Lithium soap, Excellent water resistance, heat resistance and EP properties	For bearings such as crane of construction machinery and for gears.
2	Lithium soap Excellent water resistance and EP properties, and awesome anti-rust property	For turning gears, pins and bushings of construction machinery, and heavy load use.
-	Lithium soap Excellent water resistance and EP properties, and awesome anti-rust property	For turning gears, pins and bushings of construction machinery, and heavy load use.

Industrial Machinery

NLGI No.	Characteristics	Application
2	Lithium soap Light yellow, Buttery Excellent heat resistance, water resistance and oxidation stability	For high/medium velocity bearings fabricated on small sized electrical motors, precision equipment, electrical fans, etc.
1 2 3	Lithium soap Light Brown, Buttery Excellent heat resistance, water resistance and mechanical stability	For bearings fabricated on general industrial machinery such as wood working machines.
1 2 3 4	Calcium soap, Yellow, Buttery Good water resistance	For bearings operated at ordinary temperatures under low speed/light load conditions.
2	Urea Compound Mineral oil based Light yellowish brown, Buttery	For bearings of hot rolling mill and continuous casting machines in steel plants. For the parts in which heat resistance is required.
2	Urea Compound Brown, Buttery	For various construction machinery, loading facilities, metal working machinery and automobile electrical components.

Frigmaire Plants

Frigmaire Plant

Frigmaire Pilot Plant

Batch Process

There are two different methods by which grease can be manufactured. Batch process and Continuous process. However batch process is more common.

- **Grease kettles are heated with steam or hot oil to as much as 200°C or more.**
- **Kettle capacities generally range from 2 tons to 20 tons.**
- **Kettles usually have counter rotating paddles which force the grease in opposite directions to improve mixing efficiency**
- **Kettles also have recirculation pumps to provide additional (vertical) mixing action and to transport the grease to other processing equipment such as a homogenizer.**

STRATCO Contactor reactor for Grease manufacturing

The STRATCO Contactor reactor consists of a pressure vessel shell, an internal circulation tube and a hydraulic head assembly complete with the mixing impeller and driver. The Contactor reactor by design has a highly turbulent circulation path. All energy input through the mixing impeller is expended within the materials being mixed. The high dispersion mixing in the Contactor reactor is achieved by the proprietary hydraulic head assembly. Frequent and forced changes in velocity and direction of flow occur around the impeller area. This results in a zone of high shear and intense mixing, which ensures intimate mixing of the raw ingredients and results in the most complete chemical reaction.

STRATCO Contactor reactor for Grease manufacturing

- Material is pulled down through the center of the circulation tube by the impeller, reversed and then forced up through the annular space between the circulation tube and shell. Because the impeller is located on the bottom, dry materials are kept in suspension until they dissolve or are reacted.
- The heating medium is circulated through the double walled circulation tube inside the Contactor. The outside of the Contactor reactor is also jacketed. An alternate design substituting a large diameter pipe coil for the jacketed circulation tube has been used in the past for high pressure steam as a heating media.
- The Contactor reactor has approximately three times the heat transfer area of an open kettle or other pressure (autoclave) type reactor of the same volume due to the double-walled circulation tube and the outside jacket. Also, the heat transfer rate in the Contactor reactor is enhanced by the high velocity of material flowing over the heat transfer surfaces.

STRATCO Contactor reactor
Pilot plant

Standard STRATCO Contactor reactors are supplied in many sizes from 200 to 7000 L operating volumes. Custom and larger sizes are also available. Small pilot plant Contactor reactors are also available as a 50 L unit. Many grease manufacturers have a grease pilot plant to test and develop formulations.

Production Time
STRATCO Contactor Reactor

- A typical 5.8 m3 Contactor reactor operating with 2.3 m3 of reactants, has 45.5 m2 of heat transfer surface area.
- In an identical size kettle filled with the same volume of reactants, approximately 6.5 m2 of surface area is in contact with the liquid at any one time.
- Savings of 5 hours in production time is typical when manufacturing lithium 12-hydroxystearate grease.

Grease Compatibility

- Mixing different greases, even those with similar thickener types, can sometimes lead to ineffective lubrication resulting in damage of the lubricated components.

- These situations occur due to chemical or structural interaction between the thickener or additive systems of the different greases which would be classified as “incompatible”.

Grease Compatibility

- Symptoms of incompatibility come in various forms. change in consistency relative to that of the individual pure greases. This tendency will be more pronounced as the operating temperature or the rate of shearing of the grease mixture increases.
- Incompatible greases may also exhibit abnormal oil separation or “bleeding” at higher temperatures. If greases that are incompatible are mixed in application it could lead to grease or oil leakage, premature aging, or insufficient oil bleed in the contacting zones.
- Although less probable but not unknown, the greases’ performance additives may act antagonistically, adversely affecting the lubrication performance such as protection against friction, wear, rust or corrosion.

Grease Compatibility
Lab investigations

- Industry Standard ASTM D6185 defines a protocol to evaluate the compatibility of binary mixtures of lubricating greases by comparing their properties or performance relative to those of the neat greases comprising the mixture.
- The principle of the test is to blend and shear under controlled and identical conditions the two greases at various ratios, determining after a short period of rest at room temperature any change in STRUCTURAL stability compared to the fresh greases' stability.
- Three properties are evaluated in a primary testing protocol using standard test methods: (1) dropping point; (2) shear stability by 100 000–stroke worked penetration; and (3) storage stability at elevated temperature via change in 60-stroke penetration after storage.

Grease Compatibility
Generic Chart

The generic chart is common within industry and reflects the compatibility result trends related solely to structural stability of the grease mixture. It should be used with due diligence considering its limitations.

Grease Compatibility
Generic Chart

	Aluminum Complex	Calcium Complex	Calcium Sulfonate	Lithium 12-Hydroxy	Lithium Complex	Polyurea	Clay
Aluminum Complex	C	I	M	I	I	M	I
Calcium Complex	I	C	M	I	M	C	I
Calcium Sulfonate	M	M	C	M	C	I	I
Lithium 12-Hydroxy	I	I	M	C	C	M	I
Lithium Complex	I	M	C	C	C	M	I
Polyurea (shear stable)	M	C	I	M	M	C	M
Clay	I	I	I	I	I	M	C

C: Compatible
M: Moderately Compatible
I: Incompatible

TESTING OF GREASES

Following is the partial list of tests which are normally carried out.

- **Cone Penetration**
- **Dropping Point**
- **Mechanical Stability**
- **Rolling stability**
- **Oxidation Stability**
- **Anti Wear**
- **Extreme Pressure**
- **Water Washout**
- **Oil Separation**
- **Evaporation Loss**
- **Corrosion**
- **Rust**

Test Methods

- **Evaporation Loss of Lubricating Greases and Oils**
  ASTM D972, D2878; IP 183; FTM 791-351
- **Evaporation Loss of Lubricating Grease Over Wide Temperature**
  ASTM D2595, D2878
- **Dropping Point of Lubricating Greases**
- D566, D4950; IP 132; ISO 2176; DIN 51801; FTM 791-1421
- **Dropping Point of Lubricating Grease Over Wide Temperature Range**
- ASTM D2265, D4950
- **Oxidation Stability of Lubricating Grease by the Oxygen Bomb Method**
- ASTM D942; IP 142; DIN 51808; FTM 791-3453

Test Methods

- **Corrosion Preventive Properties of Lubricating Greases**
  ASTM D1743
- **Copper Corrosion From Lubricating Grease**
  ASTM D4048; FTM 791-5309
- **Roll Stability of Lubricating Grease**
  ASTM D1831; MIL-G-10924SA
- **Apparent Viscosity of Lubricating Greases**
  ASTM D1092
- **Grease Mobility**
  U.S. Steel Method; ASTM Draft Method
- **Low Temperature Torque of Ball Bearing Grease**
  ASTM D1478, D4693, D4950; FTM 791-334

Test Methods

- **Low Temperature Torque of Grease-Lubricated Wheel Bearings**

  ASTM D1478, D4693, D4950; FTM 791-334

- **Leakage Tendencies of Automotive Wheel Bearing Greases**

  ASTM D1263; FTM 791-3454
- **Life Performance of Automotive Wheel Bearing Greases**

  ASTM D3527, D4950
- **Leakage Tendencies of Automotive Wheel Bearing Grease Under Accelerated Conditions**

  ASTM D4290, D4950
- **Water Washout Characteristics of Lubricating Greases**

  ASTM D1264, D4950; IP 215; FTM 791-3252

Test Methods

- **Resistance of Lubricating Grease to Water Spray**
  ASTM D4049
- **Oil Separation From Lubricating Grease**
  ASTM D6184; FTM 791-321
- **Oil Separation On Storage of Grease**
  IP 121
- **Oil Separation From Lubricating Grease During Storage**
  ASTM D1742; FTM 791-322
- **Estimation of Deleterious Particles in Lubricating Greases**
  ASTM D1404
- **Oil and Grease in Water and Wastewater by Infrared (IR)**
  ASTM D7066; EPA Methods 413.2 and 418.1
- **Lincoln Vent meter**

Dropping Point of Lubricating Grease

Test Method

Dropping point determinations are used for identification and quality control purposes, and can be an indication of the highest temperature of utility for some applications. The sample
is heated at a prescribed rate in a precision machined cup whose sides slope toward an opening at its center. The temperature at which a liquid drop
F irst falls from the cup is the
dropping point of the sample.
Dropping Point Apparatus

Evaporation Loss of Lubricating Greases and Oils

Test Method

Evaluates the potential for evaporation loss of lubricant components in high temperature service. A controlled flow of heated air is passed over the sample for a specified period. Evaporation loss is measured by the change in sample weight during the test.

Oxidation Stability of Lubricating Greases by the Oxygen Bomb Method

Test Method

The sample is oxidized in a bomb initially charged with oxygen at 110psi (758kPa) and maintained at elevated temperature for a specified aging period. The pressure drop inside the bomb is measured by means of a gauge or transducer.

Corrosion Preventive Properties of Lubricating Greases

Corrosion Preventive Properties of Lubricating Greases in Presence of Dilute Synthetic Sea Water Environments

Test Method

Determines the corrosion preventive properties of greases when distributed in a tapered roller bearing stored under wet conditions.

Conforms to ASTM D1743 and D4950 specifications

Roll Stability of Lubricating Grease

Test Method

Provides an indication of shear stability of lubricating greases by testing the change in worked penetrations after two hours in the roll stability tester.

Conforms to ASTM D1831
and related specifications

Oil Separation From Lubricating Grease

Test Method
Determines the tendency of oil and lubricating grease to separate at elevated temperature.

Conforms to ASTM D6184 and FTM 791-321 specifications

Thank You