PETRONAS
GREASE

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Grease Technology

What is Grease?

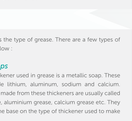
Grease is typically known as semisolid lubricant. As defined by the American Society for Testing and Materials (ASTM), grease is known as "A solid to semifluid product of dispersion of a thickening agent in liquid lubricant. Other ingredients imparting special properties may be included" (ASTM D 288, Standard Definitions of Terms Relating to Petroleum).

Meanwhile, the Japanese Industrial Standard (JIS) has define grease as "A solid or semi-solid product of dispersion of a thickening agent in lubricating oil. Other ingredients imparting special properties may be included."

As stated above, there is not much difference on the definitions of grease from the above definitions by two different standardization bodies. In a simple definition, grease is another type of lubricant, which is semisolid in nature. The base oil is mixed with a thickener, to form a solid or semisolid and, hence forming grease.

Grease Properties

As mentioned above, lubricating oil mixed with thickener (soap) will from grease. To enhance the performance of grease, additives are being added too. A typical modern-day grease is consist of base oil mixed with thickener and additives.



Generally, greases are made of both mineral and synthetic base oil. For general applications, mineral-oil base grease provides satisfactory performance in industrial applications. Nonetheless, for certain applications, such as applications under extreme low or high temperatures, synthetic-oil base grease may provide better stability and performance.

Base Oil

The thickener defines the type of grease. There are a few types of thickener as listed below:

Thickener (Soap)

Simple soaps

The main thickener used in grease is a metallic soap. These metals include lithium, aluminium, sodium and calcium. Thus, greases made from these thickeners are usually called lithium grease, aluminium grease, calcium grease etc. They are being name base on the type of thickener used to make the grease.

Complex soaps

Greases with complex soap thickeners are becoming more popular because of higher operating temperature and superior load-carrying abilities. Complex greases are made by combining the metallic soap with a complexing agent. The most widely used complex grease is lithium based, made with a conventional lithium soap and low-molecular-weight organic acid as the complexing agent. Lithium complex grease, aluminium complex grease and calcium complex grease are the example of complex greases commonly used in industries.

Nonsoap

Greases made of nonsoap thickeners are usually used for special applications such as high-temperature environments. Bentonite and silica aerogel are two examples of thickeners that do not melt at high temperatures.

Additives

Just as lubricating oils require various performance additives in keeping with their intended uses, so do lubricating greases contain additives selected to ensure the grease long life span and effective protection of metal parts from friction and corrosion. Lubricating grease typically contains about 50%-95% base oil stock, combined with 3%-45% thickener and 2%-8% additives.

Additives in grease can be divided into two groups: *Physical and chemical*

Physical

Physical additives undergo no chemical reactions but affect the physical properties of the grease.

Chemical

The first type reacts at the contacting surfaces of metal parts, working to inhibit corrosion, impart extreme pressure tolerance or provide anti-wear properties.

The second type reacts within the grease and serves as antioxidants or structure modifiers.

Multipurpose EP Grease: Typical Additive Package	
	%wt
Extreme pressure	2.00
Antiwear agent	1.00
Rust inhibitor	0.60
Oxidation inhibitor	0.25
Metal deactivator	0.15
Total	**4.00**

Typical Additives Source: www.stle.org

Other commons additives in grease are such as oxidation inhibitors, rust and corrosion inhibitors, and anti-wear additives.

Applications

The NLGI consistency number, which also known as NLGI grade, is a measure of the relative hardness of a grease used for lubrication, as specified by the Standard Classification of Lubricating Grease established by the National Lubricating Grease Institute (NLGI). The following table shows the NLGI classification and consistency.

NLGI Consistency Numbers			
NLGI Grade	ASTM worked (60 strokes) penetration at 25 °C	Appearance	Consistency similar to (at room temp)
000	445-475	fluid	ketchup
00	400-430	semi-fluid	yogurt
0	355-385	very soft	brown mustard
1	310-340	soft	tomato paste
2	265-295	"normal" grease	peanut butter
3	220-250	firm	Margarine spread
4	175-205	very firm	hard ice cream
5	130-160	hard	fudge
6	85-115	very hard	cheddar cheese

NLGI Grade	Application
6	Slow-moving journal bearings
5	Low-speed journal bearings
4	Very high speed and low load
3	High speed rolling element bearings. Typically ball bearings
2	Most common grade for all rolling element bearing types
1	Centralized lubrication systems and low temperatures
0	Centralized lubrication systems
00	Enclosed gears
000	Enclosed gears

Guidelines for Selection of NLGI Grade Grease (source: www.efficientplantmag.com)

Thickener Type	Application
Lithium	Versatile and less expensive than the Li Complex. Should not be used over 135°C.
Lithium Complex	Most versatile thickener for wide variety of industrial and automotive applications. Used up to 180°C.
Aluminum Complex	Good high-temperature and water-resistant properties. Used in steel and paper mills. Most common food grade thickener with H1 approval. Used up to 180°C.
Polyurea	Excellent oxidative resistance because of non-metallic thickener. Grease of choice for electric motors and sealed-for-life applications. Use up to 180°C .
Organophilic clay	Non-melt resulting in good high-temperature properties along with H1 approval for food grade. Used in oven conveyers. Used up to 180°C.
Calcium Complex	Good water resistance and H1 approval. Used in steel and paper mills. Also used in food plants. Used up to 180°C.
Calcium Sulfonate	Very good inherent corrosion resistance and high EP along with H1 approval, but expensive because of high thickener content. Used in food grade, corrosive and high-load environments. Used up to 180°C.
Sodium	Inexpensive and used where good adhesion and corrosion protection required. Cannot be used in presence of water and limited to 120°C.

Major Grease Type and the Common Uses (source: www.efficientplantmag.com)

PETRONAS Greases and Applications

PETRONAS Grease	Thickener Type	NLGI Grade	Applications
Gris Li	Lithium	2,3	Anti-friction bearing including the outer race and vertical shaft configuration. Plain bearings up to 3,600 rpm, machine tools and variety of marine applications. Electric motor bearings. -12°C to +130°C.
Gris Li EP	Lithium	00,0,1,2,3	Multi-purpose applications. Lubrication of both plain and anti-friction bearings even where severe and shock loads are experienced. Pins and bushes, geared couplings at normal speed. Vibrating shafts and sliding mechanism under normal operating condition. -12°C to +130°C
Gris EP/LC	Lithium Complex	2	Automotive and industrial applications where high temperature is required. Industrial ball and roller bearing. Roller element bearing applications in moist applications. High and shock load applications. -15°C to 180°C.
Tutela WB	Lithium Complex	2,5	Rolling element bearings, especially in wheel bearings where high cyclic stresses and shock loads are encountered. Boat trailer wheel bearings in salt and fresh water environment. General automotive applications such as steering and chassis fittings, grease cups and water pump bearings. NLGI Spec: GC-LB GC (Wheel bearing): Severe duty, high temperature, frequent stop and go service. -35°C to +160°C.

Reader Advice
For further assistance on PETRONAS product specifications and correct applications, please refer to the product technical data sheets

Grease Advantages

Generally, most lubrication uses lubricating oil rather than grease. Nevertheless, grease is preferred when it counts both for economical and operational reasons.

According to Society of Tribologists and Lubrication Engineers (STLE), oil lubrication requires the use of efficient and often expensive sealing arrangements to prevent leakage and the possible contamination of the finished product to prevent the ingress of contaminants such as water and airborne dust, which could result in premature machinery failure. For rolling bearings, the use of lubricating oil may necessitate the use of expensive lubrication systems.


A typical NLGI 2 Grease


Greased inner ring of tapered roller bearing unit. (source: www.skf.com)

1. Greases are better for leakage control and provide better seals against contaminants. Grease can remain in equipment longer and tolerate a variety of conditions. It is also easier to apply in most industrial settings. The best greases should tolerate some contamination, resist leakage, and change in consistency and be compatible with all seals.

2. STLE also listed useful characteristics of greases in specialize applications can include:
   - Water-resistant and/or resistant to wash- off by water.
   - Extreme pressure properties.
   - Tackiness.
   - Antiqueak.
   - Low noise.
   - Electrically conducting

3. In addition, grease tend to have longer operating life span when properly selected for a given application. Example in some electric motors, they are lubricated for lifetime grease applications, with some lasted or exceeded ten years of service

4. Furthermore, many grease lubricated machines can run for years without the need to repack the bearings. As compared to bearings lubricated by oil, they sometimes require constant drains and refills.

Another advantage of using grease is that according Noria Corporation, 90 percent of bearings and components lubricated with grease are noncritical and do not require routine sampling and analysis as we usually do with lubricating oil.